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**WESTERN
AUSTRALIA**

The University of Western Australia

Design and Construction Standards

HYDRAULIC SERVICES

E

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1 Introduction

1.1 PURPOSE

The *UWA Design and Construction Standards* (the *Standards*) outline UWA's expectations for its built forms in order to achieve consistency in the quality of the design and construction of those built forms. They are aligned with the *UWA's Campus Plan 2010* planning principles and UWA's requisites for aesthetic appeal, maintainability and environmental sustainability, while ensuring that there is sufficient scope for innovation and technological advancements to be explored within each project.

The Standards are intended for use by any parties who may be involved in the planning, design and construction of UWA facilities. This includes external consultants and contractors, UWA planners, designers and project managers as well as faculty and office staff who may be involved in the planning, design, maintenance or refurbishment of facilities. These Standards also provide facility managers, maintenance contractors and other service providers with an understanding of UWA services in order to assist in the maintenance and operation of facilities.

1.2 SERVICES

The *UWA Design and Construction Standards for **Hydraulic Services*** (this document) are a part of *UWA Design and Construction Standards* set of documents (the Standards). The Standards are divided into the following service documents for ease of use, but must be considered in its entirety, regardless of specific discipline or responsibilities:

- A Building and Architecture
- B Mechanical Services
- C Electrical Services
- D Communication Services
- E Hydraulic Services (this document)**
- F Security Services
- G Fire Services and Fire Safety Engineering
- H Structural Works
- I Civil Works
- J Irrigation Services
- K Sustainability
- L Vertical Transport

1.3 RELATED DOCUMENTS

1.3.1 University Documents

The Standards are to be read in conjunction with the following relevant University documents:

- UWA General Preliminaries Document
- UWA Specification for As-Constructed Documentation
- Relevant UWA planning and policy documents such as the *UWA Campus Plan*, *Commercial Masterplan*, *Landscape Vision* and *Integrated Infrastructure Strategy*, *University Policy on Alterations to University Buildings*, etc.
- Relevant UWA operational and maintenance documents such as preferred vendors lists, room data sheets, operational and maintenance manuals, etc.
- Other documents as referenced within the *UWA Design and Construction Standards*.

1.3.2 Relevant Legislation

The planning, design and construction of each UWA facility must fully comply with current relevant legislation, including but not limited to:

- Relevant Australian or Australian / New Zealand Standards (AS/NZS),
- National Construction Code (NCC),
- Occupational Safety and Health (OSH) legislation,
- Disability Discrimination Act (DDA),
- Accessibility Aspiration Design Factors, and
- Local council and authority requirements.

1.3.3 Manufacturer Specifications and Data Sheets

All installation must be carried out in accordance with manufacturer specifications and data sheets to ensure product performance over its intended life and so as not to invalidate any warranties.

1.3.4 Project Specific Documentation

Requirements specific to a particular project, campus or other variable, will be covered by project specific documentation, such as client briefs, specifications and drawings. These Standards will supplement any such project specific documentation.

The Standards do not take precedence over any contract document, although they will typically be cross-referenced in such documentation.

Extracts from the Standards may be incorporated in specifications, however it must remain the consultant's and contractor's responsibility to fully investigate the needs of the University and produce designs and documents

that are entirely 'fit for purpose' and which meet the 'intent' of the project brief.

1.4 DISCREPANCIES

The Standards outline the University's generic requirements above and beyond the above mentioned legislation. Where the Standards outline a higher standard than within the relevant legislation, the Standards will take precedence.

If any discrepancies are found between any relevant legislation, the Standards and project specific documentation, these discrepancies should be highlighted in writing to the Associate Director Capital Works, Campus Management.

1.5 DEPARTURES

The intent of the Standards is to achieve consistency in the quality of the design and construction of the University's built forms. However, consultants and contractors are expected to propose 'best practice / state of the art' construction techniques, and introduce technological changes that support pragmatic, innovative design.

In recognition of this, any departures from relevant legislation, or the Standards, if allowed, must be confirmed in writing by the Associate Director Capital Works, Campus Management.

Any departures made without such written confirmation shall be rectified at no cost to UWA.

1.6 PROFESSIONAL SERVICES

For all works, it is expected that suitably qualified and experienced professionals are engaged to interpret and apply these Standards to UWA projects. Works cannot be carried out by unqualified and unlicensed consultants or contractors.

1.7 STRUCTURE OF DOCUMENT

This document is structured into 4 parts:

- Part 1** Introduction (this Section)
- Part 2** General Requirements – outlines the general requirements or design philosophies adopted at UWA
- Part 3** Checklist for project team (if applicable) – checklist of items for consideration at various stages of a project
- Part 4** Specifications (if applicable) – materials specifications and/or preferred lists for materials, processes or equipment used by UWA.

1.8 DEFINITIONS

For the purpose of this document, the following definitions apply:

- Can:** Implies a capability of possibility and refers to the ability of the user of the document, or to a possibility that is available or might occur.
- May:** Indicates the existence of an option.
- Shall:** Indicates that a statement is mandatory.
- Should:** Indicates a recommendation.

2 General Requirements

2.1 REGULATORY REQUIREMENTS

All hydraulics work including but not limited to sanitary plumbing, industrial waste systems, property sewers, water supply and fire services and stormwater drainage shall be carried out in accordance with the *Water Corporation Plumbing By-laws*, *National Construction Code (NCC)*, Department of Fire and Emergency Services (DFES) requirements and local authority by-laws.

All natural gas services work shall be carried out by an authorised installer possessing a current certificate of competency issued by Energy Safety and suitably endorsed in the relevant classes of work.

All plumbing work, fire services and rainwater pipes and stormwater drainage shall be carried out by registered plumber with a full and current license with the Water Corporation.

Applications and permits must be submitted to the relevant authorities before commencement of work.

Trade waste application and plans must be submitted to the Water Corporation (including Radiological Council where applicable). Approvals must be received prior to commencement of any works.

2.2 DESIGN CONSIDERATIONS

The following shall be given special design considerations:

- Location of machinery and plant – not permitted on roofs without UWA approval
- Access to plant, plant rooms, valves, cleanouts and equipment – confined spaces shall be avoided at all times
- Water quality
- Water and energy efficiency
- Fire hydrant / fire hose reel coverage
- Alternative firefighting solutions
- Stormwater treatment
- Industrial waste pre-treatment
- Design for industrial waste – consult with relevant UWA Faculty or School for chemical discharge data
- Health and safety of building users and operators
- Environmental sustainability
- Whole of life consideration
- Material selection – availability, recyclability, maintainability, disposal.

2.3 CO-ORDINATION OF SERVICES

Ensure co-ordination of the design and installation of hydraulic services with other services to ensure adequate provisions are allowed for and to minimise conflict with other services (e.g., location of access hatches, ceiling

space allowances, etc.). This includes:

- Electrical power supply to pump switchboards, hot water units, boiling water units, ice machines, dishwashers, chilled water units, autoclaves, process water pumps, de-ionised water pumps and Fire Drencher Flow switch.
- Connection of hydraulic services points (meters, solenoids, etc.) to BMCS
- Relaying Fire Drencher flow switched Fire Pump functions and alarms to Fire Indicator Panel
- Connection from gas service solenoid valve in laboratories to emergency stop button
- Provision of hydraulic services for fume cupboards, cool rooms, etc.
- Provision of ceiling access and access panels where required

2.4 MAINS WATER

Mains water cannot be used for irrigation purposes.

Fixtures are to have a minimum 4 star WELS rating unless otherwise approved by UWA

Water filtering and water conditioning are to be provided to all buildings.

Each building and major user of water is to be metered for monitoring of water use. The meters are to be connected to the Building Management and Control System (BMCS).

Cold water only shall be supplied to student, staff and universally accessible toilets.

Time flow taps shall be used for hand basins in student toilets.

Taps in general shall be provided with flow restrictors.

Any process water systems supplied from mains water shall be designed as a closed loop system. Where possible, process water should be supplied from alternate water sources such as stormwater or waste water from deionised water plants.

Incorporate leak detection via the BMCS within systems where considerable water losses may be likely.

Above sink boiling water units are preferred. Where under sink boiling water units are installed, supply of chilled water is to be approved by UWA.

2.4.1 Hot Water

Consult UWA prior to design of hot water system.

Hot water is not normally provided in student, staff or universally accessible toilets except in cases where it is specifically required. Where hot water is supplied in universally accessible toilets, there shall be thermostatic control.

Generally, electric point-of-use hot water units are preferred.

Natural gas shall be used for storage hot water units where practical.

Solar hot water systems shall be considered and assessed for its feasibility in all projects.

The following hot water units are preferred.

Fixture	Type	Make
Cleaners sink	Instantaneous 60 degrees	Stiebel Eltron DHB-E13
Tea sink	Instantaneous 60 degrees	Stiebel Etron SNU10 with MES Tapware
Laboratory sink	Instantaneous 60 Degrees	Stiebel Eltron DHB-E13
Hand basin	Instantaneous 45 Degrees	Stiebel Eltron DEL
Electric hot water units	Storage	Rheem
Gas hot water units	Instantaneous	Rinnai Infinity
Gas hot water units	Storage	Rinnai Infinity package
Solar	Storage	Rinnai

Pressure and temperature reliefs are to be discharged to a safe and easily accessible location.

Thermostatic mixing valves (TMV) are to be Reliance (high performance) or Horne (with integral isolator).

Valves shall be chrome plated where exposed.

Circulating pumps shall be Grundfos UPS with bronze housing. An identical pump shall be supplied at project handover.

Insulation shall be of closed-cell insulation 25mm wall. Insulation requiring painting shall be painted with Aerocoat or approved equivalent.

2.4.2 Cold Water

Material for cold water pipes shall be:

In ground external

- 25 to 63 diameter inclusive to be poly-ethylene
- Pipes 100 diameters and over to be ACUTEC PE PN16
- Copper pipe in ground to be Type B to AS 1432.
- Valves 25 – 50 inclusive to be stainless steel ball, stem and handle.
- Valves 100mm or larger to be Norcast Rislan "nylon 11" coating as standard, with key head. Left hand closing.

Above ground external

- Copper tube to be minimum Type B to AS 1432, 15% silver brazing alloy painted.

Internal pipe

- Copper tubing Type B to AS 1432, 15% silver brazing alloy
- Cross linked poly-ethylene, to be clipped rigid and shall be from straight lengths not coils. Pipe to be installed with service colours as available. 25mm and larger to be electrofusion jointing.
- Chrome plated copper when exposed within tea sinks, toilets, etc.
- Isolation valves 15 to 65mm inclusive shall be of stainless steel ball, stem and handle.

Water Filters

Install Turbu-flow water treatment (softener) to all buildings in line with 25-micron stainless steel filters.

Provide flow and by-pass adequately sized for maximum required flow.

Install stainless steel Cuno-pacific (taste and odour) water filter equipment to all boiling water units and cold water drinking units. Specialised equipment shall be filtered individually as per manufacturer's recommendations.

Backflow

Reduced pressure zone devices (RPZD) have been installed downstream of the two (2) incoming Water Corporation water supplies into the Crawley site. These devices prevent contamination of the Water Corporation's main water supply.

Throughout the campus, RPZDs in duplicate are to be installed on all non-potable water supplies to each building. Additional backflow devices shall be installed as required.

All internal laboratory faucet outlets (including eye washers) shall have mini dual check valves fitted.

Laboratories shall have a universal non-potable sticker on all doors (200mm x 200mm) and a smaller sticker (80mm x 80mm) on all taps.

All new or modified mains water systems are to have backflow prevention devices installed in duplicate. FEBCO 825 YA series is the preferred option or FEBCO P25 series with light pattern unions (Yankee couplings) between test cocks and the RPZD.

Testing is an integral part of the installation, servicing and maintenance procedure for backflow prevention valves. Backflow valves are to be tested prior to commissioning, immediately after servicing and at the end of defects liability period.

2.4.3 De-Ionised Water / Reverse Osmosis

Plant and equipment shall be provided from a non-potable metered supply with high and low level alarms, connected to BMCS.

Ibis Technology water purification systems are preferred.

Pipe work fittings and valves shall be HDPE electrofusion. Pipework to be supplied in straight lengths, installed and clipped as per manufacturer's specifications. Isolation valves to be Philmac HDPE blue handle.

Laboratory outlets shall be Galvin Engineering TLDIMPLE-EC lab set 1-way distilled / deionised water unit with 15mm Philmac blue handle isolation. Identification and labelling of pipe and valves (including direction arrows) shall be provided.

On completion of any new installation or modification, system shall be thoroughly flushed.

2.5 NATURAL GAS

The UWA Crawley campus has a ringed main gas service reticulated at 15kPa. Generally, branch lines extend into each building at 15kPa. Branch pipes are to be sized to maintain this design pressure up to the pressure regulating valve in the building plant room.

Filters, meters, pressure reduction valves and OPSO valves are to be provided for each building.

Each building and major user of natural gas within buildings shall be metered for monitoring of gas use. Meters shall record gas usage in m³/h and have pulse heads connected to the BMCS. The preferred meter is "Elster" Turbine.

A single isolation valve shall be installed adjacent to each building. Valves are to be housed within a cast iron valve box with an embossed cast iron cover. Valves are to be identified with a brass label on the cover. Refer *Section 4.1* of this document. Where the valve is below ground-level, a PVC sleeve, supported on masonry blocks, shall be placed over the valve and extend into the valve box. The PVC sleeve shall have free movement within the valve box. As constructed drawings showing the locations of any valves shall be provided to Campus Management. Isolation valves shall be easily accessible.

For natural gas services in-ground, external to buildings, all pipes and fittings are to be HDPE.

All valves are to be AGA approved. Valves up to 50mm shall be full flow ball valves with stainless steel handle secured to the spindle with a stainless steel nut. Valves greater than 50mm shall be AGA-approved butterfly valves with key handle.

All internal gas pipes and fittings exposed to public view shall be seamless copper tube Type B to AS 1432.

All internal pipes concealed within ceiling spaces and risers shall be labelled. All internal pipes within plant rooms shall be painted to UWA's requirements.

2.6 SEWER

2.6.1 External

Every new below-ground property sewer, or section of an existing below-ground property sewer that has been replaced shall be tested using either a water test or an air test.

External clean outs shall be extended to ground level and be located within 100mm high cast iron box with embossed cover.

Overflow relief gullies shall be intended to minimise the likelihood of any sewer overflow from entering buildings. Ensure that they are correctly installed.

At least one overflow relief gully shall be installed for each building and/or out building connected. These shall be located adjacent to buildings and not in pedestrian paths or in areas likely to be covered by garden refuse and mulch. Reflux valves are to be avoided.

Floor wastes shall be discharged into sumps of brick construction with a minimum effective depth of 3 bricks laid on its side. Sumps are to be finished at ground level with 250 x 250mm concrete floor waste box and cast iron grate.

Acid drains and waste under concrete slabs and in inaccessible locations shall be of HDPE, installed to manufacturer's specifications.

2.6.2 Internal Wet Areas

Rooms with floor wastes, gullies, floor channels and bucket traps shall have a graded floor with a minimum of 25mm to the gratings. All floors shall be designed to avoid the risk of pooling.

All internal grates shall be stainless steel non-slip with vinyl clamp rings and puddle flanges where applicable.

Puddle flanges to be installed for all floor areas, including balconies, except on ground level.

Clean outs / inspection openings shall be provided for access into all parts of waste and drainage systems. In floor and with concrete pathways shall be stainless steel non-slip bolt down type.

Exposed under bench pipes shall be of DWV PVC pipe or HDPE.

Pipes in ceilings and ducts shall be "Rehau Raupiano" or HDPE.

2.6.3 Plant Rooms

All plant room floor waste outlets shall be a minimum of 150mm diameter. All plant room drains to have a minimum of 100mm waste and grate and shall discharge to sewer.

Plant room traps shall be charged via a solenoid and be connected to BMCS and have a trap seal depth to suit mechanical services requirements (i.e. may require deep seal).

Plant room floors shall grade to waste and grate to avoid pooling.

2.6.4 Mechanical Waste

Mechanical waste shall be discharged into tundishes /floor wastes located adjacent to mechanical plant and connected to industrial waste outlets. Waste run across floors shall be avoided where practical.

Traps and gullies shall be automatically charged from non-potable supply.

Charge pipes shall be installed with pulse head meter connected to the BMCS for detection of faulty solenoid valves.

Normally closed solenoids shall be controlled from BMCS 24V AC.

Charge pipes to be operated from solenoids connected to BMCS.

Break tanks and expansion tanks shall be installed to Australian Standards. A water meter shall be installed and connected to BMCS.

2.6.5 Industrial Waste

Trade waste, or industrial waste, is any wastewater discharged from facilities, other than office facilities or staff / student amenities.

Pre-treatment installations may include, but not be restricted to, the following:

- Passive / aggressive grease arrestor
- Petrol / oil separator
- Bucket traps and filters
- Dilution / neutraliser pits
- Cooling pits

Trade waste permits applications shall be completed by the owner / user and submitted to Water Corporation by the builder / plumbing contractor. To avoid creating a hazard, industrial waste sampling points shall not be located within pedestrian paths.

Pre-treatment installations shall be located to allow for general cleaning and maintenance. Non-potable hose cock and an external switch socket outlet shall be provided nearby.

2.7 STORMWATER

Stormwater is to be retained on site and be directed back into the aquifer.

Stormwater is restricted from entering the river or any natural water body. An exception may be granted with the installation of light liquid and solid arrestors. Refer local council regulations and *Design and Construction Standards – Civil Works*.

Stormwater reuse shall be considered and assessed for its feasibility in all projects.

2.7.1 Stormwater Drainage

The following are to be incorporated within stormwater drainage systems:

- Stormwater manholes shall be “Humes” precast with built-in ladder rungs if they are deeper than 1200mm. Covers shall be finished at ground level with grate.
- Stormwater soakwells shall be “Humes” precast concrete, wrapped in geo-fabric cloth. Soakwells shall be supported on 150mm thick concrete ring beam and finish at ground level with grate.
- Grates shall be heavy duty cast iron safety grates.
- Minimum 600mm diameter bicycle safe, raised 100mm, cast in concrete.
- Grated channel drains shall be at least 150mm wide with grating at right angles to direction of fall towards drain. Bar spacing shall 19mm apart. Permeable paving to be assessed as an alternative.

2.7.2 Gutters and Downpipes

Box gutter overflow shall have an equivalent area to downpipes. Refer Australian Standards.

Box gutters shall be designed and installed for 1 in 100 year rainfall intensity (200mm/hr) and shall penetrate the wall (full cross section) and project over into an external rainhead with a relief overflow installed below the base of the box gutter.

Downpipes shall be sized to be twice the cross sectional area of connected gutter. Downpipes shall be supported with standoff clips of stainless steel or of the same material as the downpipes. Discharge shall be over grated gullies, 240 x 240 x 150mm deep. Outlets shall be twice the cross sectional area of downpipes.

2.8 WASTE WATER

Waste water reuse shall be considered and assessed for its feasibility in all projects. Possible sources of waste water include discharge from reverse osmosis or deionised water plants.

2.9 FIRE SERVICE

The fire service shall comply with *AS 2419.1* and *AS 2441* and tested to the requirements of DFES.

2.9.1 Fire Hydrants

Within the Crawley site, UWA utilises irrigation water for the hydrant water supply. This system is in place for hydrants for the Reid Library, Business School, Barry J Marshall Library and the Indian Ocean Marine Research Centre. Any new development on the Crawley site requiring a hydrant service shall connect to the irrigation network where practical. This removes the requirement for firefighting tanks. Fire booster pumps will still be required.

External fire hydrants shall be supplied from campus mains water ring main unless required to be integrated to a building boosted system.

The builder / plumbing contractor shall be responsible for contacting DFES and UWA to organise a booster test and to coordinate the integration into the existing fire / irrigation systems.

External Hydrants

External fire hydrants shall be Galvin Engineering 65mm Sydney pattern type with top BIC coupling, red plastic protection cap and brass securing chain. Provide galvanised chain with heavy duty Lockwood type padlocks to hydrant wheels to prevent opening of hydrants by unauthorised persons.

Hydrants shall be dual type mounted on a single 100mm diameter steel riser and fixed to a GWI purpose made hydrant support frame concreted in-ground. Bollards shall be provided as required.

Internal Hydrants.

Signage shall be provided indicating water pressure (kPa) at each hydrant.

Internal fire hydrants shall be Galvin Engineering 65mm Sydney pattern type with top BIC coupling.

2.9.2 Fire Hose Reels

Fire hose reels shall be Galvin Engineering 36m swing fire hose reels with fixed water ways and swing guide arm.

Fire hose reels located within cupboards shall be Galvin Engineering 36m swing fire hose reels with flexible water ways mounted on galvanised bolted down mounting post. GE-507040 wall mounted swing arm shall be provided.

Fire hose located on walls other than masonry walls shall be reinforced so as to withstand a force of 1kN and in accordance with *AS/NZS 1221*.

On completion, fire hose reels are to be tagged as per *AS 1851*. Fire hose reels shall be inspected and serviced at 6 month intervals in accordance with *AS 1851*. Records of such shall be provided to UWA.

2.9.3 Pipework and Valves

In ground fire service pipe work and valves shall be as follows:

- 25 to 63mm diameter inclusive - PE Auspex
- 100mm diameters or larger - ACUTEC PE PN16
- Valves 25 – 50mm inclusive to be stainless steel ball, stem and handle.
- Valves 100mm or larger - Norcast Rilsan Nylon 11 coating as standard, with key head.

All valves shall be located in 250mm x 250mm cast iron valve box painted white with “Fire” embossed on the cover.

2.10 PLUMBING FIXTURES / TAP WARE

Generally, all vitreous enamel fixtures are to be white. PVC fittings are to be a natural colour. Fixtures are to be installed only after tiling has been completed and using appropriate sealant.

Refer *Section 4.2* of this document for fixtures / tapware schedule.

Pans and cisterns shall be Caroma shrouded trap pans or back to wall with standard seats. Caroma induct cisterns are preferred. Exposed cisterns shall have vandal proof covers and be connected with R/A Arco stop with hard drawn chrome plated copper connection.

Urinals shall be electronic activated urinal suite using less than 1L per flush. Waterless urinals shall not be installed unless approved by UWA. Electronic flushing devices shall be located within ceiling spaces or adjacent service ducts for ease of servicing and maintenance. Electrical requirements shall be provided as required.

Hand basins shall be Caroma, with chrome plated standard brass plug and washer. Exposed water connections shall be chrome plate hard drawn copper. Student basins shall have Time Flow Pillar Taps. Basins in student and universally accessible facilities shall have cold water only unless otherwise approved.

Cleaners sink shall be stainless steel of size 515mm x 405mm with strainer waste. 50mm diameter fixture traps are required. Wall taps shall have jumper valve type spindles, chrome plated brass handles, conversion flanges and chrome plated brass 110mm swivel aerated outlet. Hot water shall be provided at 60 degrees. Hot water units shall be mounted above cleaners sink at high level where practical.

Drinking fountains shall provide water at ambient temperature unless otherwise approved. Drink fountains shall be stainless steel wall-mounted or free-standing units with filters, to be approved by UWA. Arcus Oasis STW 34BJ is preferred. Consult UWA with regards to DDA provisions.

Boiling water units shall be ZIP auto-boil, sized to cater for the needs of the occupants. Other makes and models shall be approved by UWA. Water boiling units are to be installed with Aqua-pure water filters AP115 stainless steel housing with AP117 filter cartridge. Under bench models to be approved by UWA. Where under sink units are approved, energy savings timer shall be set up at commissioning to suit users. Ambient cold water supply only unless otherwise approved by UWA.

Laboratory sink units shall be custom designed and built to suit project requirements. PVC, polypropylene, poly-ethylene, or 316 stainless steel sinks may be used. 50mm fixture trap are required. Shop drawings of all sinks shall be submitted to UWA prior to construction.

Laboratory taps to be colour-coded epoxy Galvin Engineering (preferred) laboratory units or chrome plated consolidated brass tapware made to UWA approval. All laboratory taps outlets to be supplied with a female 15mm BSP thread with a mini-dual check valve with a 15mm BSP removable tube nozzle and a 15mm BSP adaptor and aerator. Additional nozzles to be handed to UWA. All wash up basins to have aerated faucets. Laboratory taps shall be of jumper valve type or needle valve where flow regulation is required.

Laboratory taps to be finished in white epoxy powder-coat with the nominated service colour identification handles. Finishes shall be durable for maximum resistance against corrosion, discolouration and other surface

damage. Colour coding of handles shall be as per DIN EN 13792 identification standards.

Stainless steel sinks shall be 316 marine grade with a minimum thickness of 1.2mm with fully seamless #4 satin finish. All fixture surfaces shall be smooth and evenly finished. Surfaces shall be free of die marks, blemishes, and wrinkles and roping. Where possible, fixtures shall be one-piece construction. Welds shall be ground and polished to a continuous smooth, even surface. Sink compartments, drain boards, benches etc., shall be coated with an effective sound inhibiting material. All fixtures, including legs and splash backs, shall be fully enclosed, with no openings, crevices or unwelded joints. Wooden or other foreign material shall not be used unless specified. Supporting legs and frames to have adjustable feet and shall be constructed from 32mm square tubing. All fixtures shall be provided with 50mm poly-ethylene plug and washer.

Taps shall have brass jumper-valves with replaceable washers. Under no circumstances are any valves or taps to be fitted with plastic jumper washers or ceramic discs.

Shower rose must be of fixed water saving types where possible. Wall taps shall have jumper valve type spindles, chrome plated brass handles and conversion flanges. 100mm stainless steel non-slip floor waste shall be provided as a minimum.

Safety dump shower / eyewash stations to be ceiling-mounted with pull handles. Safety showers and eye washers shall be approved by UWA. 150 x 100mm floor waste shall be installed under showers where practical. Duress flow alarms shall be considered for each installation.

2.11 IDENTIFICATION OF SERVICES

Identification of hydraulic services shall be by:

- Painting of pipework
- Labelling of pipework
- Tagging and labelling of valves and equipment
- Indicator tile tag on ceilings indicating concealed cleaning points on waste systems and valves.

2.11.1 Pipework

Provide permanent identification to all hydraulic services in accordance with AS 1345. Labels are to be a durable proprietary type.

Labels shall be 6m apart on exposed soffits and 3m apart in plant rooms, ducts, ceiling and roof space and on pipes immediately upon entry through doors and hatches.

Labels shall state the type of service and indicate directional flow arrows.

All exposed services are to be painted. Refer *Section 4.1* of this document. If in doubt, consult UWA.

2.11.2 Valves

All valves, meters and devices, below or above ground, shall be identified by using 'BRADY', or approved equivalent, round custom brass valve tags (50mm diameter) secured to valve stem with 'BRADY', or approved equivalent, brass chain. Engraving shall identify purpose and extend of control and shall correspond with as constructed information and schedules.

On ceiling tiles / hatches provide ceiling indicator tag identifying system waste cleaning point or valve.

2.12 BUILDING WORKS

2.12.1 Access

All cabinets, plant room doors, etc. with locks are to be keyed to the UWA EMA key system.

Plant rooms and equipment shall be easy to access for maintenance and replacement.

All pipework, plant, equipment, fixtures, valves, instruments etc., shall be protected against the entry of foreign matter and damage at all times.

Pipework on columns, in storerooms, loading areas and plant rooms, shall be protected with a purpose made heavy duty galvanised steel cover panel, securely fixed to the building structure. Height of cover panel shall be 2100mm. Access openings in the panel shall suit components requiring service access.

Concealed valves, flushing units etc., in ceiling spaces shall have minimum 600mm x 600mm access panels with identification stickers.

Services in laboratories which are exposed or under benches shall be supported with a minimum 25mm gap from walls or other surfaces where practical.

2.12.2 Fire Stopping of Service Penetrations

Install fire-stopping products around all service pipe penetrations through fire barrier elements, such as masonry floors, walls, ceilings and ducts. Products used shall be of approved manufacture, compatible with materials used in the installation.

Fire stopping shall conform to the *NCC* and local council requirements. On request, provide certification for all products and installation.

For PVC / HDPE pipes, use fire stop collars of water resistant and fire barrier gauging

For metallic service pipes, use water-resistant fire barrier caulking.

2.12.3 Acoustic Attenuation

Generally, consult with the environmental or acoustic consultant (If appointed) for extent of acoustic attenuation works. This may include:

- Sanitary pipework located in ceiling space above meeting rooms, offices and lecture theatres, or as directed.
- Rainwater pipes located in ceiling space of all areas. - rainwater pipes in ducts need not be insulated if duct cladding is sufficient.
- Flushing cisterns valves – silent fill valves to be used. Acoustic fixings for cisterns located between the cistern and the wall are required.
- Pipework above or within offices, meeting rooms, lecture theatres or as directed - acoustic insulation shall be provided. This comprises 50mm thick acoustic insulation with a minimum 5kg/m² loaded vinyl outer wrapping.

Bracket Fixing shall have Binder or equal approved 6mm thick BE150 noise attenuation pad between bracket and fixing.

Manufacturer's installation specification shall be adhered to.

2.13 METERING

Metering is required for all hydraulic services at each building with sub-metering of the following services:

- Potable cold water
- Non-potable cold water
- Reverse osmosis system
- Natural gas
- Mechanical plant
- Trap charging
- Wash down
- Industrial waste

Meters shall be correctly calibrated and connected to the BMCS. Detectors and alarms shall be tested prior to handover.

Meters shall be provided with 24V AC pulse head.

Metres shall not to be installed in ground and shall be readily accessible for reading and maintenance.

Preferred meters are:

- Water - RMC
- Natural Gas - "Elster" Turbine

2.14 EXTERNAL SITE REQUIREMENTS

UWA reserves the right to carry out site inspections at its discretion with the presence of the plumbing supervisor on site.

UWA shall be invited to witness all tests and all work prior to backfilling or concealment. A minimum 48 hours notice shall be given.

The plumbing supervisor shall have the relevant experience with major campus installations and shall remain responsible for the works at all stages of the project.

2.14.1 Approvals

The contractor shall provide evidence from relevant authorities of:

- Sections of property sewer, sanitary plumbing and industrial waste systems and storm water down pipes tested by the WC.
- Sections of potable and non-potable hot and cold water systems and fire hydrant services tested by WC prior to concealment
- Sections of the rainwater pipe system tested and approved by the Superintendent prior to concealment
- Sections of the natural gas services installation tested by the installer prior to concealment
- Fire stopping of penetrations approved by the manufacturer and DFES prior to concealment

Installations shall include all necessary works to complete the project including and not restricted to paying all associate fees, levies, taxes and headwork charges. Headwork charges may be reimbursed by UWA.

As constructed marked up drawings are to be kept on site and made readily available at all times. Drawings are to be forwarded upon request at nominated stages throughout the project.

2.14.2 In Ground Services

Service mains infrastructure to be laid at equal depth with required horizontal spacings at a depth 900mm minimum cover.

Services are to be located within hard landscape where practical.

All in-ground hydraulic services shall be a 'BRADY' or approved equivalent with B-721 detectable "Identoline" underground line warning tape positioned 300mm below finished ground level. The tape is to be looped through valve boxes and pits.

Indicator wrapping shall be a minimum of 80mm wide.

"Denso" petroleum primer and tape shall be provided to all metal services, valves and components.

2.14.3 Covers and Grates

Covers and grates shall be medium trafficable cast iron construction supported on minimum 150mm concrete raised 100mm to suit paving surround.

Finish levels shall be flush with surrounding hard landscape and raised 100mm within garden beds.

Manholes and soak well covers to be installed with minimum medium traffic duty covers with EJ (Havestock) cast iron lite lift lids and/or grates.

Ball valve and sewer inspection / cleaning access within paved areas to be provided with cast iron flushing point cover positioned at FGL with 100mm clearance from support. Riser shall have minimum 50mm clearance from underside of cover.

Sluice valves within paved areas shall be provided with conical cast iron path covers positioned at FGL with 100mm concrete support. Riser shall have minimum 50mm clearance from underside of cover.

2.14.4 Excavation and Backfill

Prior to any excavation, consult with UWA / Superintendent on excavation methods and seek permission to use any excavators or machinery. Excavations within vegetated landscape areas shall be carried out by hand so as to avoid damage to existing trees and plants including root systems.

Determine the location of existing in-ground services prior to excavation. Refer UWA in-ground services drawings where available.

Trenches shall be excavated so that piping will be supported on a solid bed of undisturbed earth and/or earth compacted to eight blows per 300 on a penetrometer. Allow additional excavation under joints for proper installation.

All backfilling, except as noted, shall be carried out with selected excavated sand, without large stones, to a depth of 300mm above the crown of pipes and with unselected sand for the remaining depth. Backfilling shall be done in 300mm layers, thoroughly watered and compacted to eight blows per 300 on a penetrometer. The first 600mm of all backfill over drains shall be hand compacted. Large boulders, rubbish, etc., shall not be used for backfilling and shall be removed from the site. Backfilling around manholes and catch basins shall be done with the same materials to the same depth as connecting piping.

All existing fencing, roads, footpaths, turf, vegetation and all other surfaces which have been disturbed by the operations shall be reinstated to a standard of at least equal to the standard they were in when the works commenced and to the satisfaction of the Superintendent and UWA.

2.14.5 Redundant Services

All services made redundant (internal/external) shall be removed and made good.

Cut and seal off services at the source of supply.

Existing branch valves shall be removed and made good.

Existing redundant services exposed during excavation shall be highlighted to UWA and removed where appropriate.

2.15 SAMPLES

Samples shall be provided for items such as fixtures, equipment and materials prior to purchase.

Samples to be supplied shall include the following. Samples of other items may also be requested by UWA where required.

- Taps and valves and meters
- Pipe material
- Floor grates
- Sanitary fixtures
- Valve boxes
- Pipe, valves and equipment identification labels and tags
- Insulation material
- Sound attenuation products

Approval of samples shall be sought prior to placement of orders. Samples are to be retained as a benchmark of the standard of equipment workmanship or material to be supplied.

Apart from the samples, the following are required to be submitted for approval prior to installation.

- Pumping systems and wiring diagrams
- Equipment, plant and pumps data sheets and technical manuals
- Shop Drawings for purpose made fixtures and fittings

2.16 TESTING AND CERTIFICATION

Prior to practical completion, compliance certificates of satisfactory completion shall be required for:

- Property sewer, sanitary plumbing, industrial waste system, the potable and non-potable hot and cold water system, fire hydrant services and stormwater drainage – from Water Corporation
- Natural gas service installation – from ATCO Gas
- Fire hydrant, hose reel system and fire stopping of penetrations – from DFES
- Stormwater drainage system – from local council
- Installation compliance of fire stopping products – from supplier / manufacturer
- Apparatus used in radiation laboratories – from Radiological Council
- Contractors Contract Certifications

For as-constructed documentation requirements, refer UWA Campus Management *Specification for As Constructed Documentation*.

Operating and Maintenance Manuals for hydraulic services are to include:

- Contractor contract certificate
- Equipment supplier names and contact details
- Equipment operating and maintenance instructions
- Equipment warranties
- Maintenance contractor names and contact details
- Preventative maintenance schedules
- PLB Certificate of Compliance
- Energy Safety WA Notice of Completion
- Fire Stopping Compliance
- Notice of Compliance for Natural Gas
- Water Corporation Certificates of Completion and Compliance
- Calibrations certificates
- As Constructed Drawings.

Contractor to provide letter testifying the installation has been installed as per documentation and applicable standards.

At practical completion, the contractor is to handover all required information and familiarise UWA with operation and maintenance requirements, including:

- Dates of Practical Completion and Defects Liability termination
- Names and contact details of emergency contact persons in event of warranty attendance during defects liability period
- Warranties for each item of equipment installed
- Emergency shutdown and resetting procedures.

4 Checklist for Project Team

The following activities should be considered by the project team during the planning of the project.

Activity	Responsibility	Stakeholder(s)	Timeframe
Available hydraulic infrastructure for connection.	Services Consultant	CM (Engineering Services)	Gate 2 Feasibility
Waste water / stormwater re-use / recycling	Services Consultant	CM (Engineering Services)	Gate 2 Feasibility
Approval for location of machinery and plant (not permitted on roofs)	Services Consultant / contractor	CM (Planning and Design / Engineering Services)	Gate 3 Planning Detail Design
Access to plant, plant rooms, valves, cleanouts and equipment – confined spaces shall be avoided at all times.	Services Consultant	CM (Engineering Services)	Gate 3 Planning Detail Design
Hydraulic requirements for plantrooms and equipment (e.g., evaporative coolers, fume hoods, mechanical plant rooms, etc.)	Services Consultant / contractor	CM (Engineering Services)	Gate 3 Planning Detail Design
Check location of existing in-ground services	Services Consultant / contractor	CM (Engineering Services)	Gate 3 Planning Detail Design
Design for industrial waste and pre-treatment – consult with relevant UWA Faculty or School for chemical discharge data.	Services Consultant	CM (Engineering Services), UWA Safety Health and Wellness, UWA Faculties / Schools	Gate 3 Planning Detail Design
Finish floor levels for sewer relief and stormwater risk of flooding and/or water damage.	Services Consultant	CM (Engineering Services)	Gate 3 Planning Detail Design
Approvals of all samples and shop drawings.	Services Consultant	CM (Engineering Services)	Gate 3 Planning Detail Design
Fire hydrant/fire hose reel coverage	Services Consultant	CM (Engineering Services)	Gate 3 Planning Detail Design
Alternative firefighting solutions (e.g., use of irrigation network)	Services Consultant	CM (Engineering Services)	Gate 3 Planning Detail Design
Provision of BMCS to all meters, detectors, etc.	Services Consultant	CM (Building Operations)	Gate 3 Planning Detail Design
Water quality treatment	Services Consultant / Contractor	CM (Engineering Services)	Gate 3 Planning Detail Design
Building Works (penetration sealing / acoustic attenuation)	Services Consultant / Contractor	CM (Building Services / Engineering Services)	Gate 3 Planning Detail Design
Grades of floor in plant rooms and wet areas to floor grates and points of relief.	Services Consultant / Contractor	CM (Engineering Services)	Gate 5 Construction

Activity	Responsibility	Stakeholder(s)	Timeframe
In-ground services and concealed services inspections (including excavation, compaction and backfilling)	Contractor	CM (Building Services / Engineering Services)	Gate 5 Construction
Water pipework pressure testing and witnessing	Services Consultant / Contractor	CM (Building Operations)	Gate 5 Construction
Natural gas heating water system compliance with the Gas Code	Services Consultant / Contractor	ATCO Gas	Gate 5 Construction
Medical gas pipework commissioning	Services Consultant / Contractor	ATCO Gas	Gate 5 Construction

5 Specifications

5.1 IDENTIFICATION COLOURS

Service	Pipe Colour	Lettering	Lettering Colour
Non-Potable Cold	Green/Jade	'Cold Non Potable'	White
Non-Potable Hot	Green/Jade	'Hot Non Potable'	White
Potable Cold	Blue/Atlantic	'Cold Potable Water'	White
Potable Hot	Green/Jade	'Hot Potable Water'	White
Deionised / Reverse Osmosis	Green/Jade	'Deionised'	White
Drains	Black	'Drain'	White
Vent	Black	'Vent'	White
Natural Gas	Yellow Ochre	'Natural Gas'	Black
Fire	Red / Signal Red	As applicable	White

5.2 SANITARY PLUMBING FIXTURES / TAPWARE

All fixtures shall be as per schedule below or of an equivalent product approved by UWA. Locally sourced Australian made products and manufacturer warranties shall be considered a priority in selection.

The fixtures shall be the best quality available and shall include all trim, traps, wastes, water connections and fixings required to make them complete and usable for the purposes required.

All sanitary fixtures shall have "Arco" mini stop with stainless steel raised wall plate. All other fixtures shall have Galvin Engineering stainless steel 3-piece ball valves.

Flexible connectors shall not be used. Hard drawn chrome plated connectors shall be used unless flexible connectors are part of the tapware selected.

Fixtures shall be fully sealed into bench tops or on walls with an anti-fungal silicone base sealant, wiped clean and smooth with no excessive coverage.

Toilet pans shall be mounted on a 4:1 cement sand base secured with stainless steel screws. Gaps under pan to be filled with grout matching surrounding tiles.

Refer to manufacturers details for specific fixing locations and heights of fixtures and for all fixture dimensions.

All exposed parts, such as clips and brackets shall be stainless steel and fixing mediums shall be a non-ferrous metal. Brackets and supports for fixtures shall be capable of supporting 115kg downward force without deflection.

Plug and washers to sanitary fixtures shall be chrome plated brass.

Plug and washers to laboratory fixtures shall be poly-ethylene chemical resistant.

Location	Preferred Fixture / Tapware	Colour / Finish
Universal Accessible Toilets	<p>Basin</p> <ul style="list-style-type: none"> Caroma Opal 720 single shelf wall basin with single tap hole with 40mm chrome plug and waste 40mm chrome plated trap and waste with double union trap Dyson sink mounted tap AB-09 hand dryer airblade faucet. <p>Toilet</p> <ul style="list-style-type: none"> Caroma Care 800 Cleanflush wall faced suite with backrest and Pedigree 11 Care single flap seat and vandal proof cistern. <p>Shower</p> <ul style="list-style-type: none"> Caroma Skandic bath / shower mixer Caroma Virtu Plus Starsafe 11 shower set. 	<p>White vitreous china</p> <p>White vitreous china</p> <p>Chrome Plated</p>
Male and Female Toilets	<p>Basin</p> <ul style="list-style-type: none"> Caroma 'Concord 500 Care' white wall or semi recess basin with single tap hole with 40mm chrome plug and waste 40mm chrome plated trap and waste with double union trap Dyson sink mounted tap AB-09 hand dryer airblade faucet "Arco" Mini-stop controllers mounted under basin. <p>Toilet</p> <ul style="list-style-type: none"> Caroma Urbane Cleanflush Easy Height wall faced toilet suite with double flap seat and anti-vandal cistern Caroma Urbane Cleanflush Invisi Series 11 wall faced suite (In-duct/In-wall) with double flap seat, round dual flush plated and raised care buttons. Stainless steel buttons and panel kits to be inclusive for remote buttons as required. <p>Urinal</p> <ul style="list-style-type: none"> Caroma Cube 0.8 litre electronic activation urinal suite. <p>Shower</p> <ul style="list-style-type: none"> Caroma Skandic bath / shower mixer Pheonix anti vandal shower #AV750. 	<p>White vitreous china Chrome plated tapware</p> <p>White vitreous China White seat</p> <p>Chrome plated tapware</p>
Tea Rooms	<p>Sink</p> <ul style="list-style-type: none"> Clark Advance stainless steel (size TBA) Specialized tapware as provided with "Stiebel, Eltron" hot water unit or Caroma Opus mixer tap 	<p>White enamel</p>

Location	Preferred Fixture / Tapware	Colour / Finish
	<p>Boiling Hot Water Units (above sink)</p> <ul style="list-style-type: none"> • “ZIP” Boiling hot water unit- BF/150 (SD 097) • Vented Chrome plated copper drain to discharge over #99017 Zip Wall Mounted Tundish or #99018 Zip Sink Mounted Tundish. <p>Boiling Hot Water Units (below sink)</p> <ul style="list-style-type: none"> • “Zip” Hydro-tap 	
Cleaners Room	<p>Sink</p> <ul style="list-style-type: none"> • Clark or equal standard pattern Cleaners Sinks with bonded rear splashback 150mm high with front supporting legs. Nominal size 610x457x180mm deep. • Unit complete with stainless steel hinged grate and 50mm stainless steel plug and waste outlet • GE vandal resistant wall top assembly jumper valve • GE swivel wall spout cast 225mm long (WELS 5) 	<p>304 grade, satin finish stainless steel</p> <p>Chrome</p>
Laboratories	<p>Tapware for Gas Turrets / Reverse Osmosis / Deionised water / Hot and Cold Laboratory Mixing Taps</p> <ul style="list-style-type: none"> • Galvin Engineering, supplied with tube nozzle and aerated outlets) <p>Dump Shower and Eye Wash</p> <ul style="list-style-type: none"> • Caroma Concorde 500 wall basin • Galvin Engineering # TP08045 - Chrome Plated Knee Operated Valve 15mm with Regulator - Timeflow # 33540 - CP Fixed Basin Outlet Aerator Comp (Gooseneck) (WELS 5 Star, 6L/min). • Galvin Engineering # WS-SE927UWA - Dual Aerated Eyewash Spray Head SE927 (UWA Version). # WS-SEDECKFL - CP Deck Flange to suit. Galvin Engineering lever tap with # 46805 - Chrome Plated Lever Action Handle and Button 100mm. • Ashley ASE 700 safety deluge shower complete with bracket 	<p>Epoxy Coated for laboratories. Chrome Plated for other locations</p> <p>White ceramic</p>
Drinking Fountains	<ul style="list-style-type: none"> • Arcus Oasis STW 34BJ 	
Hose Cock	<ul style="list-style-type: none"> • Galvin Engineering chrome plated vandal proof handle 	Chrome

Location	Preferred Fixture / Tapware	Colour / Finish
(Internal)	<ul style="list-style-type: none"> • #49975 and chrome plated flanged bib extension 	
Floor Grates and Cleanouts	<ul style="list-style-type: none"> • Floor grates to be Galvin Engineering stainless steel, slip in 150mm top for all plant rooms and 100mm top in all other locations. • Clean outs to be Galvin Engineering stainless steel non-slip, sized appropriately. • Provide for vinyl floor type as required 	Stainless Steel

Abbreviations

AGA	Australian Gas Association
ASME	American Society of Mechanical Engineers
BIC	British Instantaneous Couplings
BMCS	Building Management and Control Systems
DDA	Disability Discrimination Act
DFES	Department of Fire and Emergency Services
DWV	Drain, waste and vent
FGL	Finish Ground Level
GE	General Electric
GWI	Galvanised wrought iron
HDPE	High density poly ethylene
NCC	National Construction Code
OPSO	Over pressure shut off
PLB	Plumbers Licensing Board
PVC	Polyvinyl chloride
RO	Reverse osmosis
RPZD	Reduced pressure zone devices
TMV	Thermostatic mixing valves
UV	Ultraviolet
UWA	the University of Western Australia
WC	Water Corporation
WELS	Water Efficiency Labelling and Standards

References

- AS/NZS 1221 Fire hose reels
- AS 1345 Identification of the contents of pipes, conduits and ducts
- AS/NZS 1428 Design for access and mobility
- AS 1432 Copper tubes for plumbing, gasfitting and drainage applications
- AS 1851 Routine service of fire protection systems and equipment
- AS/NZS 2243 Safety in laboratories
- AS 2419 Fire hydrant installations
- AS 2441 Installation of fire hose reels
- AS/NZS 2845 Water supply- backflow prevention devices
- AS/NZS 2982 Laboratory design and construction
- AS/NZS 3500 Plumbing and drainage
- AS 3814 Industrial and commercial gas-fired appliances (supersedes AG 501)
- AS 4775 Emergency eyewash and shower equipment
- AS 5601 Gas installations (supersedes AG 601)
- Australian Guidelines for Certification of Physical Containment
- Australian Quarantine and Inspection Services
- Department of Fire and Emergency Services
- National Construction Code
- Radiological Council
- Water Corporation Plumbing By-laws



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