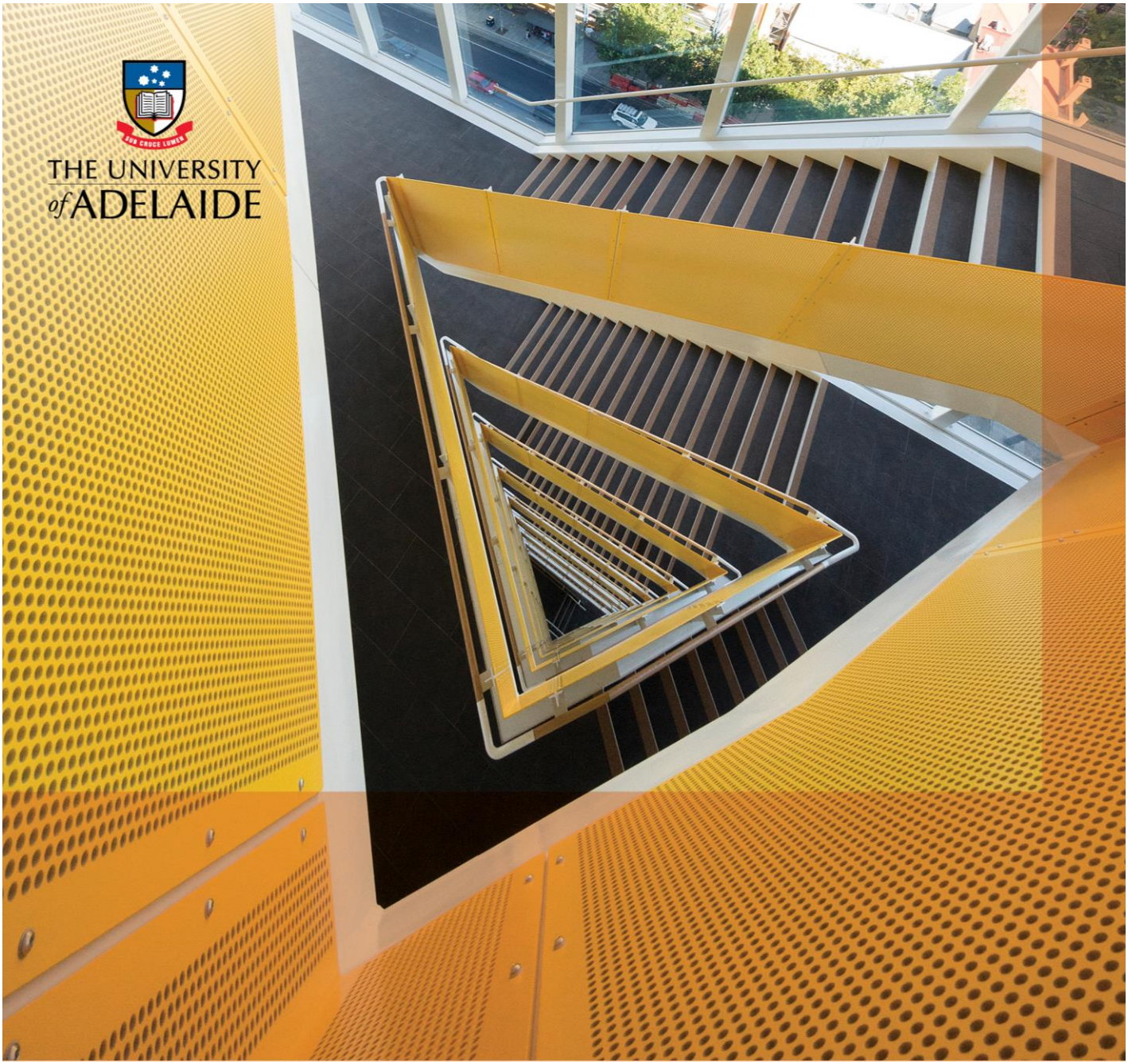

DESIGN STANDARD

F. Hydraulic Services

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Contents

Revision log

Current issue

F. Hydraulic Services - UoA Design Standards. FINAL Version 4. August 2018.

Previous issues

Version	Authors	Description	Revision	Date
1.0	John Edge, UoA Service Delivery, UoA	F. Hydraulic Services - UoA Design Standards	DRAFT Version 1	December 2017
2.0	John Edge, UoA Service Delivery, UoA/ GHD	F. Hydraulic Services - UoA Design Standards	DRAFT Version 2	December 2017
3.0	GHD	F. Hydraulic Services - UoA Design Standards	DRAFT Version 3	March 2018
4.0	Vicki Jacobs, Capital Project Delivery, UoA/ GHD	F. Hydraulic Services - UoA Design Standards	FINAL Version 4	August 2018

List of revised items

Version	Authors	Revised items	Date

Revision management

It is envisaged that revisions to this document will be undertaken at intervals of not more than two (2) years.

Endorsement body

Director of Infrastructure

Owner

Capital Projects Delivery

Contact person

Associate Director, Capital Project Delivery

Authors and acknowledgements

The standards have been developed by Capital Projects with the assistance of UoA staff, external consultants, contractors, and colleagues from other education institutions. The University conveys its thanks.

Abbreviations

AGA	Australian Gas Association
AS/NZS	Australia or Australian/New Zealand Standards
ASME	American Society of Mechanical Engineers
BCA	Building Code of Australia
BIC	British Instantaneous Couplings
BMCS	Building Management and Control Systems
CPD	University of Adelaide- Capital Projects Delivery
DDA	Disability Discrimination Act

Abbreviations continued

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
NCC	National Construction Code
OPSO	Over pressure shut off
OSH	Occupational Safety and Health
PLB	Plumbers Licensing Board
PVC	Polyvinyl chloride
RO	Reverse osmosis
RPZD	Reduced pressure zone devices
SEPP	State Environmental Planning Legislation
SiD	Safety in Design
TMV	Thermostatic mixing valves
UOA	the University of Adelaide
UoA	University of Adelaide
UV	Ultraviolet
WC	Water Corporation
WELS	Water Efficiency Labelling and Standards
WHS	Work, Health and Safety

1. Introduction

This section outlines the purpose, structure, related documents, and definitions for the University of Adelaide (UoA) Design Standards.

1.1 Purpose of the document

The UoA Design Standards (the Standards) respond to the strategic vision for the University, outlined in Beacon of Enlightenment 2016-2035, and the guiding planning principles contained in the UoA Masterplan 2016-2035. Prepared in recognition of the University's unique historical context, the Standards are guided by the aims of supporting physical, social and cultural connectivity, embracing diversity, equity and accessibility, and promoting sustainability and academic excellence.

The Standards specify the minimum, mandatory requirements for the design, construction and management of all University of Adelaide infrastructure projects. Requirements are specific to the University's needs, and are over and above minimum mandatory Authority requirements. They include:

- Methodological requirements for project delivery; and
- Technical requirements for the finished product.

The objective is to support the consistent delivery of a high quality product, while allowing sufficient scope for innovation, creativity and technological advancements.

The Standards must be used by any parties involved in the planning, design, construction, occupation management, maintenance and operation of UoA facilities. This includes external consultants and contractors, UoA planners, designers and project managers as well as professional and faculty staff, facility managers, maintenance contractors and other service providers – all of whom must be aware of the Standards as they apply to their project and scope of work.

1.2 Structure of UoA Design Standards

F. Hydraulic Services Design Standard (this document) is a part of the UoA Design Standards suite of documents (the Standards).

The Standards are divided into the following volumes for ease of use:

- A. Project Process Checklist
- B. Building and Architecture
- C. Mechanical Services
- D. Electrical Services
- E. Communication Services
- F. Hydraulic Services (this document)
- G. Fire Services
- H. Security Services
- I. Vertical Transport
- J. External Works
- K. Documentation
- L. Metering and Monitoring
- M. Audio Visual
- N. Signage and Wayfinding

The Standards must be considered in their entirety, regardless of the project's size, specific disciplines or responsibilities.

In particular, UoA staff and consultants using this volume must ensure familiarity with the mandatory project procurement obligations, detailed in A. Project Process Checklist.

Each volume within the Standards is structured into four parts:

- Part 1 – Introduction
- Part 2 – General requirements
- Part 3 – Technical requirements
- Part 4 – Schedules

1.3 Related documents and legislation

1.3.1 Documents

During the earliest strategic feasibility and planning stages of the project, review and analysis of the latest edition of the following UoA strategic planning documents must be carried out and outcomes of that review reflected in the Project Brief (refer to clause 1.4 – Definitions of this volume).

These documents should also be read in conjunction with the UoA Design Standards.

- UoA Masterplan 2016-2035
- UoA Strategic Plan - Beacon of Enlightenment, 2013-2035
- Disability Action Plan 2013-2019
- Campus/ Building-specific Disability Action Plans
- Dormwell Framework
- UoA Reconciliation Statements
- Campus/ Precinct/ Building-specific Masterplans (e.g. Waite Masterplan, Union House Masterplan)
- Campus/ Building-specific Conservation Management Plans
- Faculty Masterplans
- Technical discipline/ space-specific Masterplans, including:
  - ITS Strategy Masterplan
  - Mechanical Services Masterplan

- SAMP
- Teaching Spaces Masterplan
- Labs Standards and Masterplan
- Library of the Future Masterplan
- Space Standards Guidelines
- Deferred Maintenance Schedule
- Bushfire Prevention Plans
- Campus Water Management Plan

- Campus Sustainability Plan 2017 and associated documents, including:
  - The Carbon Neutral Adelaide Action Plan 2016-2021
  - Innovation Hub/ Smart Cities
  - Building Performance Rating System

1.3.2 Relevant legislation

The planning, design and construction of each UoA facility must fully comply with current legislation. Legislation includes but is not limited to:

- Australia or Australian/ New Zealand Standards (AS/NZS)
- National Construction Code (NCC)
- Building Code of Australia (BCA)
- Occupational Safety and Health (OSH) legislation
- Disability Discrimination Act (DDA)
- Accessibility Aspiration Design Factors
- State Environmental Planning Legislation (SEPP)
- Commonwealth and State Legislation
- Local Council and Authority requirements
- Relevant Heritage Acts (for both Places and Natural Resources)

1.4 Definitions

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

Must	Indicates that a statement is mandatory
Should/ shall	Indicates a recommendation
May/ can	Indicates the existence of an option
The Standard/s	The University of Adelaide Design Standards
Project Manager	University of Adelaide staff member responsible for delivering the building project
Strategic Project Brief	The strategic project brief developed by the University, during the project feasibility phase. Used to develop the consultants scope of works. Refer to clause 2.1 of this document for further discussion.
Return Brief/ Project Brief	The detailed brief prepared by the consultant/ design team at the end of the detailed briefing phase, and signed off by the Project Stakeholder/s, prior to commencement of Concept Design, against which mandatory milestone certification checkpoints are measured. Refer to clause 2.1 of this document for further discussion.

2. General requirements

This section outlines:

- General administrative requirements related to the use of the B. Building and Architecture, and the process for project delivery for all projects, including: project specific documentation; discrepancies; departures; certification of compliance; project procurement process; value management; safety in design; WHS; environmental management; independent building commissioning; manufacturer's specifications; and professional services requirements; and

- General design requirements related to the B. Building and Architecture, including the University policy on sustainable design as well as durability, economy and flexibility.

2.1 Project specific information

Project-specific information will be contained in project- specific documentation, such as Project Brief. The Standards will supplement any project-specific documentation. Refer below clause 2.2- Discrepancies for clarification of precedence, should a discrepancy between Project Specific Documentation and The Standard arise.

Extracts from the Standards may be incorporated in contract documentation specifications. However, the consultant and the contractor must fully investigate the needs of the University and produce designs and documents that are entirely fit for purpose, which meet the intent of the Project Brief.

2.1.1 The project brief

In accordance with A. Project Process Checklist and clause 2.4 Certification of Compliance, the Project Brief must be developed and signed-off in the following manner, and utilised as a measure, against which periodic certification must be carried out.

1. The Pre-feasibility Statement and preliminary project brief contained therein, communicates proposed project objectives and scope, preliminary budget and any project- specific strategic targets (if known).
2. The Strategic Project Brief is typically developed by the University during the feasibility phase of the project. This brief reflects outcomes of the strategic project investigations. The Strategic Project Brief must be interrogated and verified by the Project Delivery Unit, Project Manager and key strategic stakeholders, prior to proceeding to the next Detailed Briefing Phase of the project delivery process. It is from this verified Strategic Brief, that the consultants brief will be developed.

The Strategic Project Brief must:

- Identify project- specific sustainability targets, over and above the Standards, and associated reporting obligations;
- identify proposed project budget and funding source. This must include:
    i. Capital Budget (separated into construction and university costs), and
    ii. Operating Budget (reflecting project- specific sustainability targets);
- identify other strategic targets associated with the project;
- identify list of known Stakeholders with a preliminary engagement plan developed. This includes identification of key stakeholders with whom sign-off approvals obligations will sit. Refer below Clause 2.4 Certification of Compliance with the Standard;
- identify general spatial and operational requirements of the end users;
- identify decanting and relocations proposals associated with works;
- identify a list of further investigations that are required (e.g. Heritage, DDA etc.);
- identify an indicative project program for the delivery of works;
- identify strategic risks associated with the project (Refer Clause 2.7 Risk Register);
- communicate any safety in design risks identified to date (Refer Clause 2.8 Safety in Design);
- The Return Brief (also referred to as Project Brief) is typically prepared by the Consultant at the end of the detailed briefing phase, during which intensive stakeholder consultation has occurred. The Project Brief must be signed-off by key stakeholders prior to proceeding to the next Concept Design Phase of the project delivery process. It is against the signed- off Return Brief (also typically referred to as Project Brief), that the mandatory, milestone, compliance certifications will be measured. (Refer to clause 2.4 Certification of compliance, in this document). For very simple projects, compliance may be measured against the Strategic Project Brief, or equivalent, provided it meets all mandatory due diligence obligations, related to the development of a brief, listed in A – Project Process Checklist.

The Return Brief must:

- Meet the obligations of the Strategic Project Brief (including, but not limited to budget and sustainability targets);
- identify detailed operational and spatial requirements of the end users;
- include room data sheets for complex projects (refer to A. Project Process Checklist for clarification).

2.2 Discrepancies

The Standards outline the University's general requirements above and beyond mandatory authority requirements and legislation.

Where the Standards outline a standard higher than the relevant legislation, the Standards will take precedence.

If any discrepancies are found between any relevant legislation, the Standards, or project-specific documentation, these discrepancies must be highlighted in writing to the Associate Director, Capital Projects Delivery.

2.3 Departures

The intent of the Standards is to achieve consistency in the quality of the design and construction of the University's built forms.

In addition, University staff, consultants and contractors are expected to apply industry best-practice and strive for improvement and innovation in design and construction techniques wherever possible. In recognition of this expectation, application to depart from the Standards, must be made in writing to the Associate Director, Capital Projects Delivery via the UoA Project Manager, using the Alternative Design Solution Application Form. The application must include:

- Reference to the Standard clause under consideration
- Details of the departure and alternative proposal
- Impact of that departure on:
  - Compliance with the Project/ Return Brief
  - Project capital budget
  - Operating budget

Where a departure from the Standards is sought, dual-approval to proceed must be issued in writing by both the Associate Director, Capital Projects Delivery and the Director of Infrastructure. Until this approval is granted, the consultant is not authorised to proceed to the next project phase. Any departures made without written confirmation must be rectified at no cost to UoA.

At the completion of the project, all authorised Alternative Design Solution Application Forms must be submitted to the Associate Director, Capital Projects Delivery by the UoA Project Manager. Alternative Design solutions shall be monitored over time for success and may be considered for inclusion in subsequent versions of the Standards.

2.4 Certification of compliance

At regular intervals the consultant team must certify in writing that both the Standards, and the Project Brief, have been met.

This can be done using the templates provided in A- Project Process Checklist, or an equivalent, approved reporting tool.

Discrepancies and departures must be declared, with justification, at this time, in accordance with clauses 2.2 Discrepancies and 2.3 Departures of this document.

Approval must be granted prior to proceeding to the next project phase in accordance with the process outlined in A- Project Process Checklist.

It should be noted that The Standards, as they relate to this clause, refer to all Volumes of the Standard, including A- Project Process Checklist.

2.4.1 Frequency of certification

Frequency of certification is based on the size and complexity of the project. Refer to A. Project Process Checklist for frequency of certification requirements based on the complexity of the project.

For new all new building projects, (multi-disciplinary) projects, or projects with a value greater than $500,000, Certification must occur at the end of each of the following project phases:

- Concept Design Phase
- Design Development Phase
- 50% Complete Contract Documentation Phase
- 100% Complete Contract Documentation Phase
- Project Hand-Over Phase

For very small or simple (single discipline) projects, Building Standard Certification must occur at the following times:

- At an agreed point, prior to the end of the 50% Complete Documentation Phase
- At an agreed point prior to the end of the 100% Complete Contract Documentation Phase

2.4.2 Additional certification requirements

In addition to the above mandatory certification check-points, certification of compliance with the Design Standards and The Project Brief, must also occur as part of any Value Management Session, in accordance with clause 2.6. Value management of this document.

2.5 Project procurement process

All project team members must follow the project process outlined in A. Project Process Checklist. The checklist is a planning and tracking tool to be used by the project manager, consultants and contractors, to ensure adherence to the approved UoA process for project delivery and to ensure the Standards are achieved as a minimum on all projects.

A. Project Process Checklist Design Standard caters for different project complexity types. For clarification of the project complexity type, refer to Manager, Capital Projects Delivery.

A. Project Process Checklist Design Standard does not alleviate any responsibility to ensure familiarity and compliance with all aspects of the Design Standards. The checklist (or an approved, project specific version) must be maintained as an active document throughout the project, and must be submitted to the Manager, Capital Projects Delivery, via the UoA Project Manager at project completion.

A. Project Process Checklist Design Standard is divided into project delivery phases. While the order of actions listed can be varied to suit a project, all actions listed must be completed, and certified as complete, prior to proceeding to the next phase. Project-specific variations of the checklist involving alteration to the number of mandatory milestone certification checkpoints, or elimination of any action, must be treated as a departure from the Standards and submitted for approval to the Associate Director, Capital Project Delivery at the commencement of the project start-up phase.

Project managers, consultants and contractors must ensure that adequate time and resources are allocated to meet the requirements of A. Project Process Checklist Design Standard and, in particular:

- Mandatory milestone certification checkpoints and associated approvals processes (refer to clause 2.4 Certification of compliance)
- Engagement and consultation obligations with stakeholders
- DDA, Safety in Design, and Risk Management workshops
- UoA peer reviews
- Two-step value management process, refer to 2.6 Value- management

2.6 Value management

3. A mandatory two-step value management (VM) session must be carried out when the project has reached the 50% Complete Contract Documentation Phase (or at a time deemed appropriate by the UoA Project Manager). Additional value management sessions may be required and must follow the same process. Consultants and Project Managers must make appropriate allowance for resources and time to meet the requirements of this clause.

Any value management sessions must take the following two-step process:

- Value management (VM) session; followed by
- Written certification (in accordance with disclosure and approvals obligations set out in clause 2.4 Certification of compliance in this volume), that the proposed value managed solution:

4. Meets the requirements of the Design Standard
5. Meets the requirements of the Brief. This includes (but is not limited to) confirmation of the following:

— Estimated order of cost for capital and operating budget; and

— Project-specific sustainability objectives

2.7 Risk Register

The Risk Register records details of all the risks identified at the beginning and during the life of the project, their grading in terms of likelihood of occurring and seriousness of impact on the project, initial plans for mitigating each high-level risk, the costs and responsibilities of the prescribed mitigation strategies and subsequent results.

This Risk Register must be maintained for all projects, throughout the life of the project. Initial risk assessment must form part of the Project Feasibility Phase for the project. If strategic risks are identified, they must be recorded and managed separately to those that are related to workplace health and safety. The preliminary register (or list of issues) must be communicated in the Strategic Project Brief.

The register must continue to be developed and maintained by the UoA Project Manager for all projects. Later the register will be maintained by the Managing Contractor, Service Delivery maintenance staff, and potentially end-users. The register will be updated regularly as existing risks are re-graded in the light of the effectiveness of the mitigation strategy, and new risks are identified. For larger projects a Risk Management Plan may be required also. In smaller projects, the Risk Register can be used as the Risk Management Plan.

Refer to clause 2.8 for further discussion about Safety in Design and the mandatory Safety in Design Risk Assessment Workshop.

Refer to A. Project Process Checklist for the Project Risk Register Template.

Refer to clause 2.8 Safety in Design/ workplace health and safety for discussion on cultural safety.

2.8 Safety in Design/ workplace health and safety

Safety in Design (SiD) aims to prevent injuries and disease by considering hazards as early as possible in the planning and design process. A safe design approach considers the safety of those who construct, operate, clean repair and demolish an asset (the building, structure, plant or equipment) as well as those who work in or with it. Designers are in a unique position to reduce the risks that arise during the life cycle of the asset during the design phase.

In accordance with Safety in Design/ WHS Legislation, at each phase of the design process, risk identification must take place with the view to eliminating the risk, or where this is not possible, reducing risk as low as reasonably practicable, through the implementation of control measures. Safety in Design Risk Assessments must be carried out throughout the job and reported on at regular team meetings, keeping the status of control measures and the residual risks at a current level. Refer to clause 2.7 Risk Register for further information about reporting obligations.

For all new building projects, complex refurbishment projects, or high-risk projects a mandatory Safety in Design Risk Assessment Workshop must be carried out no later than the 50% Documentation Phase. This should be led by a member of the consultant team and in addition to the contractor, the consultant team and relevant other parties such as fabricators/ operators specific to the project, the workshop must be attended by a UoA WHS Representative and the UoA End-User Representative.

The assessment should involve hazard identification, assessment of risk of harm for each hazard, and strategy for eliminating or controlling the risk. One outcome of the assessment may be that Safe Operating Procedures (SOP) need to be developed. The SOPs identified in the Safety in Design Risk Assessment Workshop must be incorporated into the End-User Building User Guide and Safety Induction.

As part of the Safety in Design Risk Assessment, confirm with the Associate Director Capital Projects Delivery, as to whether consultation with the Gender Equity and Diversity Committee (or delegate) is required, to establish risks associated with cultural and gender safety associated with the project.

2.9 Independent building commissioning

For all new buildings, or where the Project Brief requires it, an independent commissioning agent not involved with the design or construction of the project must be engaged.

Detailed testing and commissioning requirements must be specified for each project by the UoA-appointed consultant/designer.

Project hand over inspection and testing plans (ITPs) must be developed by the consultant/contractor to allow the system to be handed over to the University. Detailed testing and commissioning records must be provided for each system and each component, taking into account the requirements of the Standards. All such records must be witnessed and verified by the UoA-appointed project consultant/ designer.

2.10 Post-occupancy Building Services Performance Report

After one seasonal cycle of operation, an independent building services performance review must be carried out and report prepared. Refer to the Manager, Sustainability for details. This may be carried out internally, or by an external consultant. Requirements of the Post-Occupancy Building Services Performance Report will be established by the Manager of Sustainability.

2.11 Manufacturer specifications

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.

2.12 Sustainable design

The adoption of environmentally sustainable building philosophies must be considered a primary objective of all projects, regardless of size. Opportunity to implement responsible design and construction solutions must be considered as a matter of course during every phase of the project. Project specific sustainability initiatives and targets must be identified in the Project Brief along with associated reporting obligations relating to both:

a. the requirement for the designer to certify/ rate/ measure the proposed design solution prior to construction; and

b. the requirement for the designer to include physical equipment and processes for measuring the performance of the building throughout its life- cycle (refer Vol Metering and monitoring).

In the absence of the identification of project- specific sustainability targets, and in addition to sustainability considerations covered in the relevant Volumes, the following must be incorporated in all architectural and engineering services designs.

2.12.1 Energy demand and thermal comfort

To minimise energy demand and improve thermal comfort in buildings, the following must be considered:

a. Use of basements and underground parking areas and labyrinths to pre-cool intake fresh air in mechanical systems if viable and where excessive dehumidification is not required.

b. High levels of thermal insulation to roof, floors and walls.

c. Reflectance of external building materials.

d. Thermal and solar performance of glazing.

e. External shading of north, east and west facing windows and walls.

f. Building orientation and massing.

g. Design glazing to achieve optimal day lighting and solar heat gain and to minimise the need for mechanical heating or cooling.

h. Appropriate design for temperature, air velocity, fresh air ventilation rates, relative humidity for different functional spaces as required by C. Mechanical Services Design Standard.

i. Use of natural daylight

j. Design façades and windows to maximise natural daylight in usable floor areas and incorporate use of sky lights, light wells and internal atriums or courtyards where appropriate.

k. Avoid overshadowing and visual intrusion onto adjoining sites.

l. Design buildings to avoid undesirable glare impacts on pedestrians, motorists, people using open spaces and those in other buildings.

m. Minimise the impact of night lighting on adjacent sites and buildings.

2.12.2 Indoor environmental quality

a. Provide appropriate lighting to suit the use of the space in accordance with E. Electrical Design Standard. Record the as-designed lighting levels and controls per functional space within the post-construction As-built documentation package.

b. Use materials, fittings and furnishings with low-VOC content i.e. paints, adhesives, sealants, carpets, timber products and furniture to avoid and minimise off-gassing impacts on building occupants' health.

c. Design to minimise unacceptable noise.

d. Utilise natural cross ventilation of habitable rooms and corridors to minimize the requirement for mechanical air conditioning.

2.12.3 Energy efficiency

a. Electrical appliances with the highest Australian Government Energy Star Ratings must be used for the relevant capacity ranges of appliances. These appliances include but are not limited to refrigerators, freezers, clothes dryers, dishwashers, electric hot water boilers, televisions, computer monitors and air-conditioning units.

b. Preference must be given to locally manufactured products where multiple products have the highest energy rating.

c. Electrical equipment, including specialised laboratory equipment not covered by Energy Star Rating Scheme must include energy efficiency as part of the selection criteria and have controls to prevent unnecessary energy consumption.

d. All buildings must provide utility meters to monitor, electricity, gas and water in accordance with C. Mechanical Services Design Standard, D. Electrical Services Design Standard, F. Hydraulic Services Design Standard, and L. Metering and Monitoring Design Standard:

— Energy efficient lighting and lighting controls must be provided to meet minimum illumination requirements in accordance with the D. Electrical Services Design Standard.

— Buildings must incorporate technology to reduce peak power demand, i.e. use of thermal storage for cooling and heating, power factor correction devices, etc.

— Roof design must maximise orientation to the northwest to northeast to optimise potential for installing roof top solar energy systems.

2.12.4 Water use

a. Water sub-metering must be provided to monitor large water consuming processes in accordance with F. Hydraulic Services Design Standard and L. Metering and Monitoring Design Standard.

b. All sanitary fixtures and tap ware must achieve WELS ratings specified in F. Hydraulic Services Design Standard.

c. Rainwater harvesting and reuse (toilets, cooling towers, fire test water and landscape irrigation) must be considered for all projects and applied where feasible. Ensure system design allows for future upgrade and expansion. Opportunities to integrate 'demonstrator' education must be explored. Refer also to F. Hydraulic Services Design Standard.

2.12.5 Water sensitive urban design

University campuses must implement water sensitive urban design principles by:

a. Reducing potable water demand through water efficient appliances, hydraulic standard.

b. Capturing rainwater for beneficial reuse including irrigation, cooling water and toilet flushing.

c. Minimising wastewater generation and treatment of wastewater to a standard suitable for effluent re-use and or release to receiving waters.

d. Passively treating urban stormwater using bio-filtration and wetlands systems to meet water quality objectives for reuse and or discharge to surface waters.

e. Using stormwater in the urban landscape to maximise the visual and recreation amenity of developments.

f. Grey water must not be reused where expensive wastewater treatment involving significant inputs of energy, chemicals and high maintenance is required.

2.12.6 Materials

a. Materials must be selected to meet sustainability requirements specified in Section 12 of B. Architecture and Building Design Standard (this document).

b. Selection of construction materials must consider 'cradle-to-grave' environmental impacts which look at impacts associated with raw materials extraction, manufacture, use and re-use potential and disposal.

c. Preference must be given to construction materials with recycled content and reused materials where practical.

d. Life cycle costing principles must be considered in selection of materials and systems. This includes capital, operations and maintenance, and disposal costs.

e. Use recycled and recyclable content in building materials, where fit-for-purpose from a durability and performance perspective.

f. Use suitable demolition materials for on-site fill.

g. Rainforest timber and timber from Australian high conservation forests must not be used.

h. Consider appropriate design detailing for engineered products to avoid any off-gassing potential from volatile compounds used in manufacture.

2.12.7 Noise mitigation

a. During the planning process isolate noise generating activities to avoid impact on sensitive receptors and quiet activities.

b. Protect all occupied spaces from noise pollution from external and internal sources.

c. Plant and equipment located on roofs must have acoustic treatment if they generate excessive noise.

d. Plant locations and noisy equipment must be designed and situated to avoid noise impacts on sensitive receptors and local residents.

e. Minimise noise emitted from external equipment such as fans, air-conditioners, compressors, and from other noise generating sources.

f. Minimise noise transmission within multiple occupancy buildings.

2.12.8 Construction and demolition waste

Building contractors and designers must provide infrastructure for recovery of building, construction and demolition materials to minimise waste disposal to landfill. They must:

a. Prepare and implement a materials recycling and waste management plan in the construction phase for all construction and demolition waste as part of the project environmental management plan.

b. Identify the range of materials that will be collected for recycling and describe procedures, management practices and reporting.

c. Formally apply dimensional co-ordination where it will practically assist the efficiency of material use, preference for modular components and materials supplied in set sizes or dimensions.

d. Consider ease of disassembly and recycling of construction materials and components at the time of refurbishment or completion of a facility's life.

e. Ensure project planning, specification and programming for the recovery, storage and transfer of reusable materials from demolition works including their transport from site to recycling and re-use facilities.

f. Implement procedures for disposal or recycling of hazardous materials at properly licensed facilities.

2.13 Durability, economy and flexibility

The University's goal is to achieve the optimal balance between capital and operating costs, whilst providing occupants a high level of environmental quality and service throughout the lifetime of each building. A whole-of-life asset value-for-money solution must be sought.

The University's building elements, services and external spaces must be:

- Cost-effective to operate and maintain.
- Designed with consideration of capital as well as operating expenditure in mind.
- Robust and durable.
- Easily and safely cleaned and maintained.
- Standardised to minimise individual specialisation and customisation.

- Flexible in the design to allow for expansion or adaption to new uses.
- Designed with built-in flexibility of space, plant and equipment to reasonably accommodate future uses.

2.14 Building compartmentation and sealing

Building fire compartments (existing and proposed) must be clearly identified within the contract documentation package and within the post-construction package. All penetrations through the barrier must be fire treated. Provide motorized dampers connected to the fire alarm system for any fixed open louvers such as at elevator shafts. Provide damper and controls to all air intakes/ exhausts.

Building envelopes must be designed and constructed with a continuous air barrier to control air leakage into, or out of, the conditioned space. Clearly identify all air barrier components on construction documents and detail the joints, and penetrations of the air barrier. The air barrier must be durable to last the anticipated service life of the assembly. Do not install lighting fixtures with ventilation holes through the air barrier.

3. Technical requirements

This section outlines the specific technical requirements for F. Hydraulic Services UoA Design Standards.

3.1 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.

3.2 Design considerations

The following shall be given special design considerations:

- Location of machinery and plant – not permitted on roofs without UoA 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 (internal and external) / fire hose reel coverage (Refer to G. Fire Services Design Standards)
- Alternative firefighting solutions
- Stormwater treatment
- Industrial waste pre-treatment
- Design for industrial waste – consult with relevant UoA 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.

3.3 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. Refer to D. Electrical Services.
- 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

3.4 Mains Water

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) and shall enable costs for the service to be charged to the tenant (I.e., All meters must be rated for revenue billing in commercial applications) Consideration must be given to alternate water sources on a project by project basis.

All meters and sub meters assemblies must be smart water meter types with pulsed output.

Domestic Cold water shall be supplied to student, staff and DDA complaint toilets.

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

Taps in general shall be provided with flow restrictors.

Consideration must be given to incorporate leak detection via the BMCS within systems where considerable water losses may be likely.

Where under sink boiling / chilled water units are installed, drip trays, interruption sensors and adequate ventilation is required.

3.4.1 Hot water

Consult UoA prior to design of hot water system. It is the designer's responsibility to make themselves aware of project specific requirements.

Hot water is not normally provided in student, staff, ambulant or DDA compliant toilets except in cases where it is specifically required. Where hot water is supplied in toilets, there shall be thermostatic control to supply tempered water in accordance with the Standards.

Pressure and temperature reliefs are to be discharged to a trapped drain point, the point shall be safe and be in an easily accessible location.

Thermostatic mixing valves (TMV) must comply with the Australian standards in terms of temperature control. Generally, TMVs shall be located in a stainless steel lockable cabinet, shall be wall mounted or recessed and within the area being served.

Valves shall be chrome plated where exposed.

Re-circulation pumps shall have anti corrosion coating and shall be centrifugal type.

All pumps used for circulation shall have BMS output capability. The purpose of this BMS output is to signal an alarm on BMS upon pump failure. Localised pump failure alarm shall be installed along with wall mounted high level strobe to notify of pump failure (red or yellow strobe) and Pump normal operation (green light) along with the required identification signage.

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

Where under sink hot water units are installed, drip trays, interruption sensors and adequate ventilation is required.

3.4.2 Cold water

The designer shall use the best suited material for its application to the project. Consideration must be given to impact to existing system where applicable, where suitability of connection of new material to existing system shall be confirmed.

The domestic cold and hot water shall be designed to a maximum velocity of 1.3 m/s in branches and 1.5 m/s in main runs, pressure to the hydraulically most remote fixture shall not be less than the lowest pressure nominated by the standard plus 50 kPa. The maximum pressure in the system may not exceed to that has been nominated by the standards. Allowances must be made for pressure reducing valves for branch supplies greater than 400 kPa and pressure reducing stations for main runs greater than 500 kPa .

Consideration must be given to reduce water hammer.

Consideration for flow and pressure must be given to project specific fixture outlets, such as laboratory equipment.

Material for cold water pipes shall be:

3.4.3 In ground external

- Copper tubing Type B in accordance with AS 1432, AS 3688 Fittings for pipes below DN100.
- PE Pressure pipe (minimum PN16), PE100, in accordance with AS 4130 for pipe greater than DN100

Underground pipe warning tape and trace wire must be installed 150mm above underground service. Line marking identification plates must be installed at change of directions and 50m intervals. Identification plates shall indicate service type, direction off flow, diameter and depth. The identification plates shall be brass, epoxy resin screw flushed with the surrounding surface.

3.4.4 Above ground external

- Copper tube to be minimum Type B to AS 1432, AS 3688 Fittings

- Stainless steel 316 min 2mm in accordance with ASTM A269-02a
- High density cross-linked polyethylene (PEX) pipe on branch pipework to bathroom and kitchen fixtures

3.4.5 Internal pipe

- Copper tubing Type B to AS 1432
- Cross linked poly-ethylene, to be clipped rigid. Pipe to be installed with service colours as available.
- 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.

3.4.6 Potable Water Filtration

Domestic cold water service is not required to be filtered. Specialised equipment shall be filtered individually as per manufacturer's recommendations.

3.4.7 Plant Water Filtration

Specialised equipment shall be filtered individually as per manufacturer's recommendations. Consideration must be given to the requirements of specialised equipment filtration, where activated carbon, pressurized sand, water softening and/or UV filtration maybe required.

3.4.8 Non- Potable Water

Consideration must be given to use of TSE network or Rainwater reuse

Consideration must be given to WC water supply as non-potable source (TSE or Rainwater reuse)

3.4.9 Backflow

As per code requirements

All documents associated with approvals inclusive of CoCs (certificate of compliance) to the OTR (office of the technical regulator) or AHJ (Authority having jurisdiction) must be provided at project handover as part of contract documentation.

3.4.10 De-ionised water / reverse osmosis

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

3.5 Natural gas

As per code requirements

Gas meters must be diaphragm type meters. Connection to site wide BMS monitoring is to be provided. Service isolation points must be provided which enable isolation to each building, each plant room and/or laboratory spaces.

All meters must be rated for revenue billing in commercial applications. Additionally, they shall be suitable for monitoring of gas supply network.

Sub-metering must be provided to the following systems (refer to project specific requirements for any additional systems): centralised hot potable water system, hot water boilers for primary loops, hot water boilers for mechanical equipment, steam boilers, laboratory supplies, commercial kitchens and all spaces proposed for tenancy leasing agreements.

Meters must be installed in fully accessible position to allow for ease of access, serving and meter reading. Individual isolation must be provided for each gas meter and sub-meter assembly.

3.5.1 In ground

- Copper tubing Type B in accordance with AS 1432, AS 3688 Fittings
- Nylon tube in accordance with AS2944.1, class 400

Underground pipe warning tape and trace wire must be installed 150mm above underground service. Line marking identification plates must be installed at change of directions and 50m intervals. Identification plates shall indicate service type, nominal pressure in kPa, direction off flow, diameter and depth. The identification plates shall be brass, epoxy resin screw flushed with the surrounding surface.

3.5.2 Above ground external

- Copper tube to be minimum Type B to AS 1432, AS 3688 Fittings

3.6 Private Sewer

The designer must allow to investigate and obtain all available details of the existing sewer, trade waste infrastructure applicable to the project, including the location survey of underground services, pits, silt arrestors, etc. as required.

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

3.6.1 External

All connections as per code requirements. Inspection openings must be provided at change of directions and at intervals not exceeding 30m. Underground pipe warning tape and trace wire must be installed 150mm above underground service. Line marking identification plates must be installed at change of directions and 50m intervals. Identification plates shall indicate service type, nominal pressure in kPa, direction off flow, diameter and depth. The identification plates shall be brass, epoxy resin screw flushed with the surrounding surface.

3.6.2 Internal wet areas

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

Pipes in ceilings and ducts shall be DWV PVC or HDPE.

3.6.3 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.

Consideration must be given to trap primers in areas of low discharge and where depth of seal maybe compromised through evaporation.

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

Plant rooms floors will be water proof, consideration must be given to making good of penetrations.

3.6.4 Mechanical waste

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

Mechanical plant that produces waste must be plumbed on an separate pipework to sanitary drainage, with continuous fall to termination and having a diameter of no less than DN25. All drainage termination must be to a gully, a trapped tundishes or above the water seal of a waste trap having a diameter of no less than DN50.

3.6.5 Trade waste

Trade waste, shall meet or exceed SA Water, AHJ requirements.

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

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.

3.7 Stormwater

Stormwater reuse shall be considered and assessed for its feasibility in all projects. Refer Civil Works standard for further information.

3.7.1 Stormwater drainage

Refer Civil Works standard for further information.

3.7.2 Gutters and downpipes

Refer Architectural Design Standard for further information.

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 (Refer Australian Standards for rainfall intensities for geographical locations) and shall penetrate the wall (full cross section) and project over into an external rain head 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.

Consideration must be given in building stormwater hydraulic design to allow for a fail safe system, with the intend to divert rainwater away from buildings during an event of stormwater blockage.

3.8 Waste water

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

3.9 Plumbing fixtures / tap ware

Safety dump shower / eyewash Safety showers and eye washers shall be approved by UOA. 150 x 100mm floor waste shall be installed under showers where practical. Duress flow alarms must be considered for each installation. Bunding must be provided in hazardous areas to contain hazardous mixture of water deluge. Where impractical, the floor drain shall be drained to a holding pit.

For all above fixture titles listed refer to Architectural Design standards.

- Pans and cisterns
- Urinals
- Hand basins
- Cleaners sink
- Drinking fountains
- Boiling / Chilled water units
- Laboratory sink units
- Laboratory taps
- Stainless steel sinks
- Taps
- Shower rose.

3.10 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 (tags may not be installed on ceiling tiles to avoid change of locations of tagged service)
- Type of service
- Direction of flow

3.10.1 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 though 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 UoA.

3.10.2 Valves

All valves, meters and devices, below or above ground, shall be identified, round custom brass valve tags (50mm diameter) secured to valve stem. 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.

3.11 Building works

3.11.1 Access

All cabinets, plant room doors, etc. with locks are to be keyed to the UoA 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.

3.11.2 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.

Bracket fixings must be considered.

3.12 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
- Wash down

Meters shall be suitable for tenant on charging, fit for purpose for commercial revenue collection. They shall be 'smart water meter' type with pulsed output.

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

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

3.12.1 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
- All approvals in accordance with AHJ (Authority having jurisdiction)

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 UoA.

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.

3.12.2 In ground services

Service mains infrastructure to be laid at equal depth with required horizontal spacings at a depth 750mm minimum cover.

Services are to be located within hard landscape where practical.

3.12.3 Covers and grates

Consideration must be given to location of covers and grates where preference is given to accessibility, i.e, take care to avoid high traffic areas.

Covers and grates shall be trafficable cast iron construction supported on minimum 150mm concrete raised 100mmm to suit paving surround. The specification for the class of trafficable cover must be assessed on project by project basis.

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

3.12.4 Excavation and backfill

See J. External Works.

3.12.5 Redundant services

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

Cut and seal off services at the source of supply.

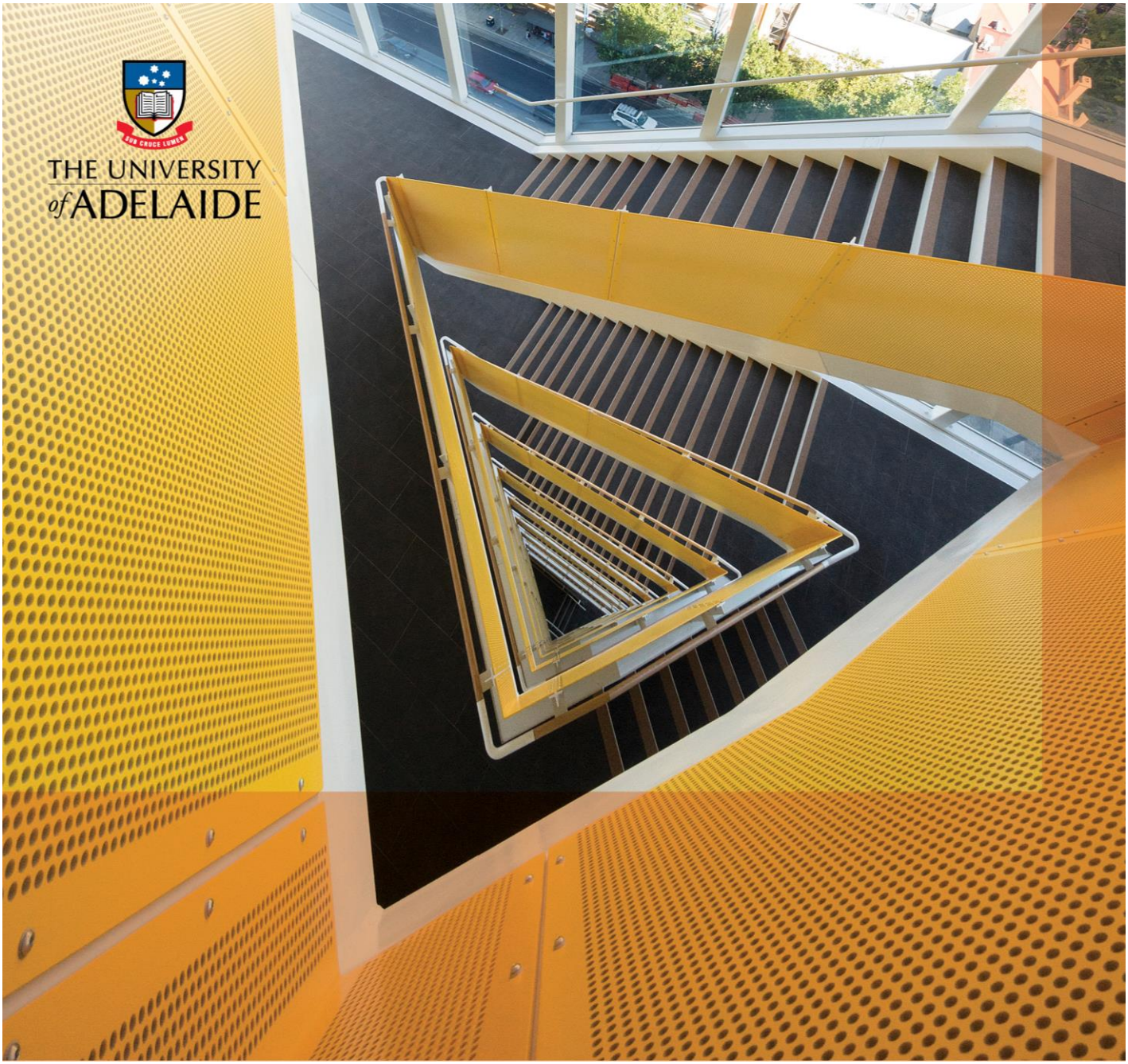
3.13 Samples

Refer to B. Building and Architecture.

3.14 Testing and certification

Prior to practical completion, compliance certificates of satisfactory completion shall be provided in accordance with the standard and AHJ.

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



SCHEDULES

F. Hydraulic Services

4. Specifications

4.1.1 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

4.2 Sanitary plumbing fixtures / tapware

Refer to B. Building and Architecture.