E.1 HYDRAULIC SERVICES – TABLE OF CONTENTS

UNSW DESIGN & CONSTRUCTION REQUIREMENTS – WEB ENTRY PAGE

SECTION A – INTRODUCTION

SECTION B – DEVELOPMENT & PLANNING

SECTION C – ARCHITECTURAL REQUIREMENTS

SECTION D – EXTERNAL WORKS

E.1 HYDRAULIC SERVICES – SCHEDULE OF CHANGES – REV 4

As a guide only, attention is drawn to changes that have been made in the following clauses since the last revision

Clause	Date
General revision	
General revision	September 2004
General Revision	February 2007

E.1. HYDRAULIC SERVICES

E.1.1. Checklist for Hydraulic Consultants

The check list shall be completed by the actual designer to verify to UNSW that the specific and general requirements of the UNSW DESIGN & CONSTRUCTION REQUIREMENTS manual have been incorporated into the design and documentation. In initialling the box, the designer declares that he/she has read, understood and complied with that part of the manual by incorporating its intent into the hydraulic contract works. Note: The whole of the manual is required to be read and complied with.

Refer to Diagram E.1.1 Checklist for Hydraulic Consultants at the end of Section E.1.

E.1.2. General

This document sets out additional design and construction technical requirements to those contained in the mandatory New South Wales Codes of Practice produced by the Committee on Uniformity of Plumbing and Drainage Regulations in New South Wales and the Gas Installation Codes published by the Australian Gas Association, and other relevant Australian Standards.
In addition to the mandatory requirements of the above documents, these technical requirements shall be adopted in the execution of all UNSW projects, unless specifically altered in writing by the UNSW Engineering Services Manager.
Where 'similar to' or 'equal to' is used in association with trade names, alternative products may be offered on the basis that they perform either as well as or better than those specified and their adoption must be approved in writing by the UNSW Engineering Services Manager before inclusion.

The Hydraulic Consultant is required to refer to and examine the UNSW Design and Construction Requirements document for guidance on special UNSW requirements, which may be in addition to the regulatory New South Wales Codes of Practice for Water Supply and Sydney Water requirements.

UNSW Design and Construction Requirements document shall not be referred to or appended to any project documents, but project-specific clauses shall be written into the project specification to ensure construction is carried out to meet those Requirements.

Three reviews of designs are required at concept stage, 30% and 90% complete. At 90% stage, the designer must supply a check-list of all UNSW briefed requirements, with each one separately signed off as incorporated into the design, unless otherwise instructed in writing. Upon completion of Tender, you are also required to issue UNSW with a Letter of Compliance with statutory Codes.

UNSW have produced Drawing Standards and Design Requirements, which shall be followed by the Consultant.

To assist interpretation of some aspects of this document, sketches have been prepared and are located at the back of Section E.1.

E.1.2.1. OHS 2001 Interpretation

A recent interpretation of the word "Plant" as used in OHS Act 2000 and OHS Regulation 2001 by WorkCover determined that all building services are classified as "plant". Therefore designers of services, internal and external to buildings, must meet their responsibilities under this Act and Regulation.

Attention is drawn to Chapter 4 for controllers of premises to identify risks and Chapter 5 for designers to identify hazards and assess risks of the final design. UNSW require all designers to carry out such identification and risk assessment with a statement of how associated OHS issues are to be addressed. This information shall be provided to UNSW prior to documents being "Issued for Construction".

E.1.2.2. Design Requirements

Prior to documentation of refurbishment works, and in conjunction with UNSW Project Manager, survey all proposed user groups for each building to determine requirement for services.

E.1.2.3. Contract Drawings

Each hydraulic services drawing shall have the following note displayed in a prominent location:
'Only licensed persons, or those under the direct supervision of a licensed person, shall install works covered by the New South Wales Codes of Practice Plumbing and Drainage, and Gas Installation Codes. Works required under these Codes are not detailed, as the licensee is expected to have full knowledge of these Codes. These drawings show the pipework layout in the positions required by UNSW and the fittings shown may be additional to Code requirements, but shall not prevent the work from being carried out in accordance with these Codes. Certificates of Compliance shall be furnished to UNSW for all works within 7 days of Authority inspection'

An abbreviated 'UNSW Project Specific Requirements' list shall be provided on the legend sheet. The consultant shall identify in point form the major departures from 'industry standard plumbing materials and workmanship' brought about by the special requirements of the University or identified as problem areas of quality control.

For each hydraulic service, present on the first sheet of the series a statement on the Basis of Design of that service. It shall provide all information required to size all components of the building infrastructure.

E.1.2.4. Authorities

For all plumbing and drainage works, an application shall be lodged with the water Authority (such as Sydney Water) as required by the Sydney Water Regulation 2000 Section 7 under the Sydney Water Act 1994. Upon completion, the plumber carrying out the work shall submit to the Project Manager the signed original Owner's Copy of the Certificate of Compliance.

For natural gas installations, all works upon completion shall be inspected by AGL Limited and those installations incorporating Type B appliances shall be approved and Certified by AGL.

E.1.2.5. Operating and Maintenance Manual

Refer also to 'Appendix 4 – Document Requirements - Operating and Maintenance Manuals'
Documents are to reflect the need for the hydraulic consultant to prepare Work as Executed Drawings and the Operating and Maintenance Manual. Included in the manual shall be the following documents: pump test curve where applicable, pressure test certificates with actual pressures achieved and Certificate of Compliance with Sydney Water requirements. All certificates to be signed by the plumber performing the work.

E.1.2.6. Asset Registration List

In conjunction with the preparation of the Operating and Maintenance Manual, the Consultant shall list all plant and equipment either removed or installed as new on the attached schedule and incorporate the completed list with the Manual.

Such items could include Thermostatic mixing valve, tempering valve, gas shut off valve, water filter, pumpset, trade waste pit, safety shower, safety eye wash, hot water unit, automatic toilet flushing device, landing valve, hosereel, water cooler, boiling water unit, dish washer (Not equipment supplied by School), backflow prevention device, hygiene station, water meter, gas meter, gas regulator, flow switch

The list shall be identical in all respects with the Excel spreadsheet. *Refer to Diagram E.1.3 Asset Registration Form at the end of this Section E.1.*

E.1.2.7. Water Supply for Construction

During site establishment, arrange with UNSW Engineering Operations for access to the site bore water system. Construct a temporary or other bore water service to the site. Use bore water for such purposes as: washing down, street cleaning, trench compaction, pipeline cleaning and testing, etc. Special bore water tap with reverse thread nut and tail will be supplied by UNSW. An adaptor hose from left hand to normal right hand thread to be supplied by the contractor.

E.1.2.8. Pipe Levels & Control Valves

Pipe work shall be located as high as possible unless otherwise noted. Control and isolating valves located facilitate access and allow operation without the use of portable steps. Maximum height above floor 1500mm.

E.1.2.9. Core Holes

Core holes shall be cast in situ. Liner shall be removed prior to pipework installation. Incorrect positioning requires new core holes to be approved by the structural engineer. Chopping out to extend core holes shall not be permitted.

E.1.2.10. Chases

Chases shall be saw cut in approved locations. Insulate all pipes with 3mm thick foamed PVC and fix with brass/copper clips.

E.1.2.11. Brick Cavities

Piping shall not be installed in brick cavities.

E.1.2.12. Vibration and Noise

Pipe work shall be constructed and installed to prevent vibration and noise. Make approved alterations to correct any faulty condition.

In particular, where pipework is installed in noise-sensitive areas such as lecture theatres, libraries, study areas and public halls and rooms, provide sound insulation to all pipelines, with special attention given to gravity waste and stormwater lines.

E.1.2.13. Soil and Water Management

Soil and water management shall adhere to best practice at all times across all campuses. Kensington Campus is a catchment area for aquifer recharge, as most rainwater and stormwater is captured and recycled for site and building non-potable water requirements via the University's bore field.

Civil / hydraulic / landscape Consultants are therefore required to prepare a detailed site-specific Soil and Water Management Plan with Specification for each project, complying with the detailed requirements of Randwick City Council which are available on: http://www.randwick.nsw.gov.au/default.php?id=41. There are 16 information sheets all dealing with soil and water management. The Plan shall include those information sheets applicable to the specific project and shall treat Campus roadways as though they are Council public roads for the purpose of managing soil and water.

Prevention of stormwater pollution due to oil and chemical spills shall be included in the Soil & Water Management Plan. Gross chemical pollutants entering the aquifer must be prevented at all costs.

E.1.2.14. Excavation

Excavate in straight lines and grades to facilitate future location of buried services. Where in pavement, saw cut bitumen and concrete prior to excavating. Where over excavation occurs, backfill with selected excavated or imported material to required levels in 150mm layers compacted to 95% modified dry density. Remove all spoil from the UNSW site as the work proceeds using skips or trucks as the work requires. Provide timbering and shoring as required to protect workers and adjacent structures and remove prior to completion where possible.

E.1.2.15. Bedding

All services except sewer and subsoil shall be bedded on 50mm thick compacted sand. Sewer & subsoil bedding to suit site conditions.

E.1.2.16. Backfilling

Where required, all services except sewer and subsoil, shall be backfilled and over laid to 75mm above pipe socket with approved granular fill. Complete backfilling with approved excavated material. Charge or pressurise all hydraulic services during backfilling operations. Compact side support and backfilling in 225mm thick layers using mechanical compaction equipment. Maintain moisture content to achieve optimum compaction.

E.1.2.17. Backfilling under Pavements and Floors

The following procedures shall be adopted in all instances:
Backfill with approved granular material in 225mm thick layers and compact using vibrating mechanical compaction equipment to 95% maximum modified dry density or to match surrounding ground.
Specified compaction must be verified by compaction tests performed by a NATA registered testing agent and at the contractor's expense.
Should compaction fail any test, backfill shall be removed down to within 225mm of the top of the surface and compaction and backfilling recommenced with tests taken at frequent intervals. The number and frequency of tests shall be determined in conjunction with Engineering Services and shall be dependent on size of excavation, quality of existing pavement and future pavement upgrading works.

E.1.2.18. Testing

All services shall be tested in the presence and to the approval of the Superintendent.
Pressure Systems: As for cold water supply (Refer: Pipework & Materials)
Gravity Pipelines: As for sanitary drainage

Underground services shall be tested before backfilling, but after the installation of thrust support blocks.

Internal pipe work shall be tested before finishing trades commence, before ceilings are installed and insulation of pipe work. On site the contractor shall maintain records of all tests.

E.1.2.19. Damage to Services

Contractor shall replace at his own expense any service damaged during construction.

E.1.2.20. Materials and Workmanship

New materials and first class Tradesmen and workmanship shall be used in all instances.

E.1.2.21. Restoration

Restore all surfaces to their original condition, using materials matching materials as found.
Bitumen, concrete and brick paved surfaces shall be restored by a UNSW approved contractor experienced in the relevant pavement restoration. This work shall be included in the contract documents.

E.1.2.22. Work in Lawns and Gardens

At least 7 days prior to commencement of works, arrange with the UNSW Grounds Curator (Telephone: 9385 4993) for all affected plants to be removed for storage, to be transplanted back to their original position upon completion of the works. Damage to planting not removed by UNSW shall be rectified by the Contractor to UNSW direction and approval at contractor's cost. All costs of works incurred by UNSW shall be attributed to the project cost.

E.1.2.23. Services Across Pavements

Wherever economical or where specifically directed by UNSW Project Manager, bore under roads and pathways for hydraulic services

E.1.2.24. Alarms

All equipment fault and level alarms to be relayed back to security. This would normally be done via the Cardex system.

E.1.2.25. Underground Piping

Provide service identification tape in appropriate colour and incorporating detector wire placed 200mm above the pipeline.

E.1.3. Building Automation & Control System (BACS)

The Hydraulics Services Contractor shall allow for the following BACS associated items where applicable:

1. Fire Hydrant pump – run and fault alarms;
2. Fire sprinkler pump – run and fault alarms;
3. Sump pump – run and fault alarms;
4. Water meter analogue output with graphed flow rate in litres per second, recording daily usage in kilolitres, and collection of historical data;
5. Water pump – run and fault alarms;

6. Bore water meter analogue output with graphed flow rate in litres per second, recording daily usage in kilolitres, and collection of historical data;
7. Bore water pump – run and fault alarms;
8. Fire services tank – high and low water level alarms;
9. Natural gas meter analogue output with graphed flow rate in litres per second, recording daily usage in kilolitres, and collection of historical data;
10. Natural gas system 3 valve closed status;

E.1.4. Pipework and Materials

E.1.4.1. General

Pipe work shall comply with N.S.W. Codes of Practice and relevant part of AS. 3500, except that pipework flanges shall be rated higher for fire sprinkler and hydrant installations.

E.1.4.2. Pipe work Design Velocities:

In-ground water service 1.0 to 2.1 m/sec
Building services pressure pipe < 2.2m/sec
Water pump rising mains 1.0 to 2.7m/sec
Gravity flow pipes from upper storage (top 2 floors) 0.1 to 0.4m/sec
Gravity sewer pipes – self-cleansing for average daily flows
Sewer rising mains - > 1.0m/sec

E.1.4.3. Copper Pipe

For all pipe sizes use Type B pipe. Jointing shall be either 5% silver soldered joints, rolled groove Victaulic bolted joints or flanges as required. Brazed tees formed by mechanical forming tools only on pipe sizes greater than 25mm and installed only above ground. Joints to be 20mm long (minimum). Provide samples to Superintendent prior to installation to demonstrate minimum quality of joint to be used.

Where laid below ground, provide polyethylene sleeving taped to all pipe work.

E.1.4.4. Copper Pipe Fittings

Proprietary fittings only shall be used for pipes less than 25mm.

E.1.4.5. Black Steel Pipe

Black Steel pipes shall not be used.

E.1.4.6. Fire Light Galvanised Pipe

Shall not be used

E.1.4.7. Dissimilar metals

Connections between dissimilar metals shall be avoided.

E.1.4.8. Rolled Groove Joint

Install rolled groove joints on exposed internal pipe work only and similar to 'Northguard' or 'Victaulic' joints.

E.1.4.9. Pipe Access

Cleaning eyes (inspection openings) for pipeline maintenance and inspection shall be provided at every section of pipe for all gravity pipelines.
Locate inspection openings every 30m, at the base of every vertical dropper, at each fixture outlet and at each junction and change in direction.
Provide clearouts to permit internal cleaning and clearing of blockages to the whole of the reticulation system. Extend risers up to the finished surface, terminating under a heavy-duty inspection box. Inspection boxes to be screw fixed, brass where located internally and cast iron externally.

Engrave brass clearout covers with the following letters: S – sewer, S/W – stormwater, T/W – trade waste.

E.1.4.10. Dismantling

Unions and dismantling joints shall be provided at all plant connections to facilitate installation and dismantling. Provide isolation valves adjacent to union to allow removal of plant without shutting down service.

E.1.4.11. Exposed Threads

Where pipe work is exposed to Public view, keep external threads to minimum required to make the joint.

E.1.4.12. Mitred Joints

Not permitted unless noted otherwise.

E.1.4.13. Exposed Pipe work

In toilets and other public rooms, pipe work shall be chrome plated and fitted with wall plates.

E.1.4.14. Flexible Braided Connections

Braided connections (Plumb-easy or similar) shall not be used in laboratories, hot water unit installations, service ducts or plant rooms. They may be used in ablution areas where 100mm floor wastes are provided and, if they fail, no real damage is caused. Where they are used, they shall be of the correct type to prevent straining, kinking or twisting or stresses on the connections. They shall be the correct length to match the installation requirements.

Braided vibration dampers on fire pumps shall be capable of working pressures of 2,200kPa.

E.1.4.15. Underground Pipeline Markers

Mark surface to indicate service below. Bury warning tapes in the trench 200mm above the pipeline to identify the service below. Where the service is non-metallic, provide a tape incorporating locating wire.

E.1.4.16. Equipment and Valve Labelling

All equipment shall be labelled and all valves numbered. These shall be incorporated in the operation and maintenance manuals and drawings. Labels to be manufactured from aluminium sheet and engraved one one side with valve number . On the back of the label, identify the plant isolated by the valve.

Obtain valve numbering from the Superintendent

E.1.4.17. Valve Numbering and Schedule

Where numbering does not exist for a building, the following system shall be adopted.

Valves shall be identified by numbering in consecutive order as follows:
As an example, a main potable water service valve installed on Level 2 of Biological Sciences Building shall be numbered: D26 – 2 – PW – 1, where

D26 = Building Number
2 = Level 2
PW = Potable Water
1 = Consecutive Number

Service Abbreviations
DW - Cold Drinking Water
HW - Hot Drinking Water
WW - Warm Water
BW - Bore Water
LCW - Laboratory Cold Water
LHW - Laboratory Hot Water
CCW - Circulated Cooling Water
CW - Chilled Water
TW - Trade Waste
SP - Sanitary Plumbing
RO - Reverse Osmosis Purified Water
NG - Natural gas
CA - Compressed Air
N - Nitrogen
A - Argon
HE - Helium
V - Vacuum

Schedule

Valve ID	Service	Type & Size of Valve	Location	Area or equipment affected upon valve operation
D26-2-PW-1	Potable Water	50mm ball	In service riser next to Rm 221	Level 2 , west side from Rm245

E.1.4.18. Painting and Identification

All pipe work which is not chromed but is exposed to view inside rooms, shall be painted. Colour coding to requirements of AS 3500 and NSW Plumbing Codes of Practice. Affix pipeline labels showing name of service and direction of flow. Gas services shall also have the pressure shown. Markers similar to '3M Safetyman'.
Refer also: Section E.2 - MECHANICAL SERVICES – Method of Identification.

E.1.4.19. Pipe Capping

Pipe work shall be capped off as work proceeds to prevent ingress of dirt, concrete etc. Use proprietary caps/plugs.Crimping or flattening of pipework is not acceptable.

E.1.4.20. Fire Stop Collars

Fire Stop collars shall be provided on all PVC pipe penetrations through fire rated reinforced concrete slabs. To be equal to 'Fire Research Pty Ltd MKIII' to provide 4 hour fire rating by expanding under 100 deg C heat to collapse the pipe

E.1.4.21. Pipe Supports

Ref: AS. 3500. Use Stauff pipe supports in exposed public areas. Provide 1.2mm thick extruded PVC insulation between supports and all piping. (Note that the purpose of the insulation is: stop slipping, allow clamps to be tightened, provide sound insulation, and where necessary to separate different metals) Tape or coated brackets are not acceptable, except that Abey Acoustic Clips may be used for pipe sizes up to and including 25mm.
Steel supports to be galvanised after fabrication and similar to 'Unistrut' or 'Racestrut', complete with proprietary fittings and pipe clamps. Pipes over 25mm shall be fully supported with Unistrut angle brackets to ensure that pipe cannot drop even if clip becomes loose with vibration
All fixings to be similar to 'Hilti'. Horizontal wall mounted pipes to be fully supported by cantilevered bracket. End-fill brackets with proprietary plastic caps. Use only one brand throughout the project. For RC slabs and beams, locate fixings as recommended by the structural engineer.

E.1.4.22. Fixing Through Steel Wall Framing

Where pipework is inserted through holes in steel wall framing, provide proprietary rubber grommets to isolate pipe from steel to prevent vibration noise and corrosion

E.1.4.23. Redundant Services Disconnection and Removal

Disconnect and remove all redundant services. Disconnection shall occur at the last live tee and the redundant branch line capped within 150mm of the main line with

proprietary cap or plug. Do not remove main building infrastructure pipework unless agreed in writing by Manager FM Engineering.

E.1.4.24. Electrical Hazard Zones

The Consultant shall be responsible for bringing to the Project Manager's notice the existence of electrical fixtures that could be affected by the installation of hydraulic works.

The documents shall require plumbers ensure they are not installing hydraulic works in electrical hazard zones. The following shall be included in the tender and contract documents. 'Should an electrical fixture be present which puts it within a restricted zone by the actions of the plumber, then it shall be the Contractor's responsibility and cost to have this fixture either relocated away from the zone or to be replaced by a fixture appropriate to the zone.'

The following standards are representative of those applicable to UNSW but it shall be the Consultant's responsibility to ascertain all applicable standards and clauses.

AS/NZ 3000 – Wiring Rules
Clause 7.1 Locations containing baths, showers or other fixed water containers
Clause 7.2 Swimming pools, paddling pools and spa pools or tubs
Clause 7.3 Locations containing sauna heaters
Clause 7.4 Refrigeration rooms
Clause 7.5 Locations where general hosing down operations are required
Clause 7.6 Fountain and water features
Clause 7.7 Extra-low voltage electrical installations
Clause 7.9 Hazardous areas

AS/NZ 2430 - Classification of hazardous areas
AS/NZ 2430.3.1 – Examples of area classification – General
AS/NZ 2430.3.3 – Examples of area classification – Flammable liquids
AS/NZ 2430.3.4 – Examples of area classification – Flammable gases
AS/NZ 2430.3.6 – Examples of area classification – Laboratories including fume cupboards and flammable medical agents
AS/NZ 2430.3.9 – Examples of area classification – Miscellaneous

E.1.4.25. Insulation

Kemlag is not acceptable for insulation other than for pipework chased into masonry.

Insulation shall be installed only after pipe testing. Provide polyethylene foam incorporating aluminium wrap with built in overlap similar to 'Thermotec 4-Zero'. Provide approved proprietary wood blocks in two halves and 25mm wide of equal diameter to the insulation at all fixing points. Valves, flanges and unions are not to be insulated.

In noise-sensitive areas all piping shall be insulated with 'Thermotec Acoustic 4-Zero'.

E.1.4.26. Covers, grates and frames

All grated pit covers shall be bicycle and wheelchair proof. This requires the slots to be no wider than 10mm and no longer than 250mm Pit gratings shall be equal to ICON ductile iron Bicycle Safe Class B or D as required. Provide heavy-duty hinged GMS gratings and frames on all grated surface water entry pits.
Trench gratings shall be ACO type S100 or S200 Heelguard as required with maximum opening size of 8mm x 35mm.
Refer also: Section D - EXTERNAL WORKS – Hard Landscaping

E.1.4.27. Garden beds

Concrete covers and frames.
Refer also: Section D - EXTERNAL WORKS – Hard Landscaping

E.1.4.28. External bitumen or concrete paved areas:

Cast iron gas-tight covers and frames equal to Mascot Engineering Gastight Manhole Covers, concrete filled, with reinforced concrete frame surround. Provide 10mm thick expansion joint between surround and adjacent paving.

Pits requiring regular maintenance, but not in trafficable areas, should be fitted with heavy duty aluminium checker plate lid and surrounds, incorporating flush mounded lifting handle and locking device

E.1.4.29. Tile, block or brick paved areas

Cast iron gas-tight covers and frame equal to Mascot Engineering Gastight Manhole Covers, with 3mm thick 316 grade stainless steel riser strips bolted to frame and covers. Riser height to suit paving thickness. Fix pavers with appropriate bonding and bedding compounds.

Where covers are likely to be too heavy to meet OH&S requirements, colour-stencilled or coloured concrete infill may need to be adopted rather than inserting pavers into covers.

Key openings to suit Gatic SR150 lifters. Provide two sets of universal type lifting keys, lengthened to suit final cover thickness. Provide and fit covers to all keyholes.
'Gatic SR150'
All covers, grates and frames for the entire project to be from one manufacturer.
Where isolating valves are housed beneath the cover, provide inserted inspection covers to suit.

Areas	Cover Weights
Pedestrian only	Class A
Pits requiring regular access	Class B maximum
Pits requiring regular access in	Class B

Vehicle access areas	
Pits requiring regular access in Grassed areas	Class B
Pits not requiring regular access in Roads and vehicle access	Class C

E.1.4.30. Vent Terminations

Terminate sewer and trade waste vents to AS/NZS 3500.2.2:1996 Clause 6.7.4. Generally vents shall be terminated at least 6m and preferably 8m laterally from air conditioning intakes and at least 3m from wall openings. Where required, vents should be diverted away from air conditioning units and cooling towers by increasing the vent size and providing guy wire supports. Under such circumstances, it is likely that stainless steel pipework would be required to meet aesthetic approval.

E.1.4.31. Pressure Gauges

100mm dia Bourdon tube type shall be used, securely mounted and provided with shut-off tap & union. Where pressure gauges are mounted on pump lines, provide glycerine filled gauges for protection against extreme pressures. Full scale reading to be 150% of expected maximum pressure. Graduations to be in KILOPASCALS.

E.1.4.32. Water Tanks

Materials for water tanks installed in or on buildings shall be, either copper, cast iron, stainless steel or polyethylene. Standard galvanised mild steel shall not be used. However purpose-built sectional tanks may be approved, subject to full engineering details on jointing of sections, corrosion protection, tank support, pipe penetrations, roof etc being approved by UNSW.

Only polyethylene tanks shall be used for holding non-potable water due to the potential corrosive nature of bore water. These tanks shall be fitted with a dual supply, the primary from bore water and backup drinking water. Refer to sketch.

All water storage tanks shall have overflow alarms fitted and connected to the campus wide BMS system.

Refer to Diagram E.1.4 Non-Potable Tank Standard Details at the end of Section E.1.

E.1.5. Drinking (Potable) Water

E.1.5.1. Basis of Design

On the first drawing in the set, provide details on which the design was based. Such information shall include: How flow rate and system pressures were determined, flow rate and pressure determination for pumps, design pressure head at top floor fittings, actual head and flow curve for pump as designed showing duty points, criteria for sizing water storage

E.1.5.2. Pipe Materials

The following pipe materials shall be used for potable water.

1. Type B copper with silver-soldered joints shall be used internal and external to buildings, both above and below ground. Where pipework is concrete encased below ground, wrap the pipe in 3mm thick Denso Tape to prevent concrete contacting the pipe.
2. Where underground pipework is larger than 80mm diameter, use blue stripe PN16 medium or high density Polyethylene with electrofusion welded joints. (Refer below to Water Mains)

No other materials shall be used unless with written authority from Manager FM Engineering for specific project technical reasons. Do not assume this authorisation shall be forthcoming. In particular “Rehau” composite pipe shall not be used.

E.1.5.3. Water Meter

Water meter(s) shall be provided to measure all water consumption at each building. Meter type Davies Shepherd (Elster Metering Pty Ltd) with pulse attachment for connection to UNSW remote monitoring system. Mandatory Requirement, Davies Shepherd.

Sub-meters shall be installed on all water consuming plant and equipment which is likely to use more than 20% of the total building Average Day Demand. Such users may include: cooling towers, laboratory non-potable water, toilet flushing tanks and pure water treatment plants. Note that it is likely these consumers will be supplied by bore or rainwater where available.

E.1.5.4. Water Filter

Provide 100 micron static in-lineY-strainer immediately before the main building meter

E.1.5.5. Water Mains

Site water mains are combined fire and domestic and are metered at the site boundary. Pipeline material shall be medium or high density polyethylene PN 16 with electrofusion

joints. Minimum pipeline size shall be 110mm outside diameter, sized for fire flows concurrent with distributed site domestic / industrial flow rates. Sizes of any extension or diversion of existing mains system shall be engineered by FM Engineering. Provide all expected design flow rates for new conditions to FM Engineering.

Where electrofusion jointed mains join onto existing pipelines or where spigot and socket fittings are used, mass concrete thrust blocks shall be placed against bends, tees, ends etc as required. A guide to thrust block sizing is provided.

Refer to Diagram E.1.5 Thrust Blocks for Water Supply at the end of Section E.1

Connect to existing main with an RMC Sureseal or equal tapping band and bonnet ferule cock. Provide ball valve for isolating service. Where tapping is into 'live' mains, perform all tappings under pressure and as directed by UNSW FM Engineering Hydraulic Works Supervisor. Make arrangements with FM Engineering at least 7 days prior to required shut-down to ensure service interruption is convenient to the University's operations.

E.1.5.6. Valves - Service Isolation

A main isolating valve shall be provided to each building in a readily accessible location as approved by "SUPERINTENDENT". Isolate each building service line from the external water main and each branch line from the service lines.
For pipe sizes up to 65mm use 'Johns J360' or equal ball valves with screwed BSP and union connection.
For pipe sizes over 65mm use flanged epoxy-coated cast iron resilient seated valves similar to RMC Tefglide or equal with Table E flanges. Make provision for dismantling pipework and valve replacement.
All valves are to close in a clockwise direction.
Label each above ground valve with a circular plate of traffolyte material engraved with their respective function and mounted in an approved manner on top of valve spindles with a brass ring.

E.1.5.7. Valves in Service Risers and Ducts

Where branches are cut into service risers or services in corridors, valves shall be located on the new pipe parallel to the main service and not on the right-angle take-off. This is required to minimise intrusion into working space.

E.1.5.8. Valves – Laboratory or Room Isolation

Where a number of fixtures are served with hot or cold water from outside the area, such as teaching laboratory, toilet areas, plant rooms, etc., provide isolating valves on the wall adjacent to the main entry door and inside a stainless steel wall box mounted no higher than 1500mm above the floor.

Refer to Diagram E.1.6 - Laboratory Service Valve Compartment at the end of this Section E.1.

E.1.5.9. Valves - Fitting Isolation

Isolating valve on supply to each cistern, sink and basin on hot and cold water supplies shall be provided to permit individual fitting servicing. Valves to be chromed and located on service as it penetrates wall under fixture. They shall be installed in conjunction with in-line water savers where these are required.
Provide all valves with unions or flanges to permit replacement without cutting pipework.

E.1.5.10. Valves – Non-Return

All non-return valves shall be Tyco double check valves. Pumps shall be designed for the associated pressure losses. Swing check and spring-loaded wafer type (e.g. Duo Check) are not acceptable.

Mandatory Requirement: Tyco

E.1.5.11. Hose taps

External drinking water hose taps shall only be installed where required for water supply to relocatable drink preparation units such as coffee carts, barbeques, hot dog stands etc. In these cases only hose tap risers shall be 20mm copper pipe, fixed to masonry with copper brackets and masonry anchors or, if free-standing, to a 75x50 hardwood or treated pine post buried 500mm into 300 x 300 compacted gravel road base. Tap connection to be 650mm above finished ground level.
Provide isolating ball valve on riser. Hose tap shall be Lock-shield type fitted with a permanently installed dual check valve.

E.1.5.12. Water Pumps

Provide stainless steel, vertical spindle, multistage Grundfos pump.. Include suction and discharge pressure gauges. Provide pressure tank similar to Davey 'Supercell' with capacity to suit duty, butyl liner, modified non-return valve for slow filling and air valve. Provide complete pump unit on stainless steel base. Isolate pump suction and discharge from fixed pipework with flexible high-pressure connectors.
Motors to be energy rated ‘high efficiency’.
Control pumps with variable speed controllers where applicable and size pumps to prevent water hammer shock and associated pipe noise. Connect pump failure alarm to campuswide BMS system. Provide hours run meter to each pump. Note: Do not oversize pumps. Installation shall be designed to provide minimum sustained flow rates in addition to the design maximum. Provide multiple smaller units rather than a single large unit.

Non-return Valves. Place non-return valve on discharge before stop valve.
Power & Electrical Controls. Fit with non-overloading, 415v, 2,900 rpm electric motor where applicable. For small units provide plug-in 240v units with timer. Set timer to run pump between the hours of 7.00am and 8.00pm Refer to Section E.3.2 - Electrical Services.

E.1.5.13. Fitting Flow Rates

Flow rates shall meet the following mandatory WELS star ratings:

- Basins: 5 star (4L/min) generally, 4 star (6L/min) when supplied by flow-through gas boiler such as Rinnai Infinity without return loop. (Note: Basins in public ablutions shall be fitted with a single cold water time flow tap)
- Ablutions showers: 2 to 3 star (10L/min max)
- Dishwasher: 3 star or higher
- Clothes washer: 3 star or higher

E.1.5.14. Drinking (Potable) Water Backflow Prevention

Backflow Prevention Policy

UNSW has a Policy on "Back-flow Prevention of Potable Water Supplies". To comply with the Policy, the following must be met:

The back-flow provisions of AS 3500.2 shall be rigidly adhered to, except where the supply Authority over-rules these requirements. This Policy has been established to provide rigid rules for the provision of back-flow prevention devices at each of UNSW campuses to overcome the various individual interpretations of the requirements of AS 3500. The Kensington campus has significant contamination potential and this site has specifically been targeted.

Whilst clarification of this Policy can be obtained from the Superintendent, it is unlikely that any deviation from this Policy will be accepted.

Potential causes of pollution from within UNSW are many, due to the various biological, chemical, industrial and irrigation uses of potable and non-potable water on the campuses.

a) *Containment at Site Boundary*

Containment at the site boundary to protect the municipal water supply shall be handled solely by UNSW, Engineering Services.
Contractors or Engineering Consultants are not to address this work unless specifically instructed and briefed to do so in writing by UNSW Engineering Services.

b) *Levels of Protection*

Within the UNSW, three levels of protection shall be provided as appropriate to the proposed work:
Building containment may be required to protect UNSW general site reticulation. Devices shall be installed to suit the greatest hazard within the building.

Zone protection within the building, areas or parts thereof - to contain contamination within a specific and separable part of the site. Within this zone and downstream of the device, water must not be supplied for any potable uses.

Individual protection of each outlet - to prevent back-siphonage of contaminated substances into the water delivery system.

Zoning areas of potential contamination should not generally be done if a single device can be used at the water use point. Zoning large areas or whole floors of buildings can cause major issues with respect to defining water potability. Where Zoning is warranted, UNSW Engineering Services must approve it in writing.
In all situations, air gaps and registered air gaps are the preferred option. Mechanical devices shall only be used where it is not economically feasible to provide an air gap. Where any activities in the building or on the site could cause potential back-flow of contaminated water to the University's water reticulation, containment is required.

Refer: Section F - SPECIFIC AREA REQUIREMENTS

c) *Bore Water in Buildings*

Where bore water is supplied to a building and connected to the potable water supply as a second source, the potable water shall be fitted with a reduced pressure zone device at its connection with the bore water. An additional RPZD shall also be fitted at the incoming supply meter to comply with AS 3500 backflow protection where non-potable water supplies are provided.
Mandatory Requirement: Tyco RPZD Complete with strainers and isolators. Provide drain from atmospheric zone to building drainage.

The bore water installation shall be fitted with a double check valve device.
Mandatory Requirement: Tyco DCVA Complete with strainers and isolators

d) *Connections for Fire Services*

Where fire hosereels, hydrants or sprinklers are pressurised by a fixed pump after the potable water connection, a device shall be fitted.
Install a double detector check valve with resilient seated valves at the connection with the potable water.

e) *Kensington Campus Specific Requirements*

The following are specific requirements for the Kensington Campus:
Bore Water System The bore water system is a non potable water supply. However it shall be deemed to be a protected water supply. Air gaps and double check valves shall be used for significant risks of contamination.
Note that bore water should be connected to all new user points where significant quantities of non-potable water are expected to be used. Refer to Project Officer for direction on such uses as cooling water, laboratory non-potable, washing and flushing.
Irrigation is generally supplied from the bore water system. Backflow prevention devices are not required for irrigation.
Where irrigation is connected to the potable supply, a testable device shall be installed.
Mechanical Equipment and Cooling Towers - Connect the bore water supply wherever practicable via an air gap.
Where connecting mechanical equipment and cooling towers to potable water, provide an air gap. Where this is not economically feasible, considering the long term maintenance commitment to mechanical devices, a testable mechanical device could be used.

f) *Types of Devices*

Backflow prevention devices to be Tyco..

Refer to Diagram E.1.7 – Site Backflow Device Schematic at the end of this Section E.1
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E.1.6. Non Potable Water Systems

E.1.6.1. General

Non-potable water (NPW) applies to a dedicated water system supplying directly to potential sources of contamination such as: scrub up sinks, laboratory sinks, x-ray processing, etc. and is separated from drinking water by appropriate backflow prevention devices including break tanks. Note: A building drinking water service supplying toilet cisterns and other non-drinking uses is not a “Non-Potable Water System” for the purposes of this Clause.

E.1.6.2. Basis of Design

On the first drawing in the set, provide details on which the design was based. Such information shall include: How flow rate and system pressures were determined, flow rate and pressure determination for pumps, design pressure head at top floor fittings, actual head and flow curve for pump as designed showing duty points, criteria for sizing water storage

E.1.6.3. Pipework

Pipework shall be either:
Type B copper with silver soldered joints and painted before installation, or

Lilac-coloured Rehau pipe, Pressure Rating to suit 1500kPa test pressure.

E.1.6.4. Colour Coating of Pipework

Prior to installation of copper pipework, coat pipes with enamel paint coloured purple to distinguish it from potable pipework. Scrape back paint at joints to allow soldering.

E.1.6.5. Break Tank

Materials shall be selected to suit the water stored. e.g. do not use copper for de-ionised water or bore water.

E.1.6.6. Backflow Prevention

Generally in addition to a registered break tank, other devices required include at least a dual check valve at or near the fitting outlet. For PC2 laboratories, a double check valve shall be installed in the Service Valve Compartment prior to the service entering the containment area.

E.1.6.7. Non-Potable Signage

Provide a sign “Caution not for Drinking” similar to ‘Safetyman’ over each non-potable outlet fixture

E.1.7. Hot Water

E.1.7.1. Ecological Sustainable Design (ESD)

Provide a circulated centralised system only where sufficient outlets would achieve an energy-efficient system. In commerce buildings likely to require hot water only for tea sinks, accessible toilet basins and cleaners’ sinks, provide small capacity stand-alone instantaneous electric units.

Where a new hot water system is to be provided, it shall be be supplied from gas-boosted solar units. Solar units to be so designed to ensure maximum capture and retention of solar gain. This is most likely achieved by pre-heating make-up cold water prior to final natural gas heating. Pre-heating to be automatically controlled to ensure heat is not lost to solar units during times of negative solar gain.

E.1.7.2. Basis of Design

On the first drawing in the set, provide details on which the design was based. Such information shall include: How flow rate and system pressures were determined, flow rate and pressure determination for pumps, design pressure head at top floor fittings, actual head and flow curve for pump as designed showing duty points, temperature control, statement on Legionella control.

E.1.7.3. Piping

All piping to be copper. Refer also to – HYDRAULIC SERVICES -Pipework & Materials.

E.1.7.4. Insulation

Only pipework chased into masonry shall be pre-lagged with Kemlag

All other hot water piping concealed in ducts and ceiling spaces shall be insulated with Thermotech 4-Zero fire retardant polyethylene foam having a density of 50kg/m^3 . Where condensation on the outside of cold water pipes is liable to occur, insulate pipework as above. Refer also HYDRAULIC SERVICES -Pipework & Materials for insulation.

E.1.7.5. Hot Water System

Wherever practicable provide gas fired units. These may be of the Rinnai Infinity 'instantaneous' type. Systems shall be designed to ensure potable water use is minimised by installing short dead legs or a circulated system.

Where undersink hot water units are required, consideration shall be given to the use of 240volt push through (non-storage) units (such as Steibel Eltron) to avoid installation of safe trays and drainage.

Tea rooms shall be provided with hot and cold water at the sink. Under no circumstances will boiling water be used as a substitute for hot water at the sink.
Boiling Water Units shall be sized to suit duty and be similar to ZIP Hydro Tap under-sink Boiling / Chilled water unit.

. Provide signage indicating 'Caution – boiling water outlet' adjacent to outlet.

E.1.7.6. Circulating Pump

Provide 'Grundfos' or equal stainless steel variable speed 240V in-line pump. Where economically justified, provide variable speed units where variable hot water flows are expected. Provide time clocks and thermostats to automatically operate the pump. Set thermostat to start pump at 65 deg.C and stop at 75 deg C. Set timer so that pump only operates during the regular hours of building use.

(Systems circulating water at less than 60 deg C shall not be installed unless fitted with a reliable system of continuous disinfection due to risk of Legionella bacteria build-up. This requirement shall be confirmed with UNSW Engineering Services)

E.1.7.7. Warm Water Policy

In all new installations and refurbishments, only timed flow taps will be installed in public ablutions areas (Does not include Student Housing). Access toilets shall be fitted with a suitable “Access” lever-type mixer tap.

Where taps in public toilets and public washrooms are replaced, they will be replaced only with timed flow taps.

No warm water will be supplied to public toilet areas except for Access toilets to save water and energy.

Timed flow taps will have a flow rate of not greater than 5 litres per minute and must be adjustable to enable operation for between 5 and 15 seconds. Installed default time flow is to be set at 7 seconds.

Push button taps should be specified for areas that are likely to suffer vandalism.

For Access toilets, where a common or circulated warm water supply is required for other purposes within 10 metres of the toilet area, it shall be used as the supply for that area. In all other areas, unless otherwise specified by the University’s Energy Manger, a low-delivery electric instantaneous water heater unit (Steibel Eltron or approved equal) shall be installed with a thermostatic mixing valve. The delivery temperature of this system shall be adjustable to operate between 35 and 50 degrees C. with the default delivery temperature being 40 degrees C.

E.1.7.8. Thermostatic Mixing Valves

Provide temperature-controlled water to all domestic hot water systems to reduce pipe delivery temperature, except for kitchen and cleaners’ sinks and laundry fittings. Point of use devices are not acceptable. To be approved by NSW Department of Health for use in health care buildings and installed to Hosplan standards.
Provide Enware 'Aquablend 1500' thermostatic mixing valves complete with all associated valves. Binder / Pease points to be provided for testing the warm water outlet, sized to suit the duty requirements. Test certificates to be provided to Superintendent.

Locate mixing valves between 1500 and 1800mm above floor level, either in lockable hinged stainless steel wall boxes or built-in and framed wall cupboards within the room to facilitate servicing. Keys shall be to UNSW standard.

Tempering Valves shall not be used.

E.1.8. Bore water

E.1.8.1. Basis of Design

Shall be used for all non-potable uses (except for marine studies). Where necessary use pH adjusted borewater for laboratory uses. Where used for cooling tower make-up, water treatment within the tower is all that is required. This must be advised to the chemical treatment contractor at the time of commissioning and shall be included in the project specification.

Bore water demand flow rates need to be managed to ensure bores are not sucked dry at times of campus peak instantaneous demands. The best way to manage this is on a building by building basis by designing the system with an averaging tank (and pump where required). Where the project provides for rainwater harvesting, the make-up to the storage tank shall be by borewater. The borewater supply meter to the building should be 20mm to restrict the tank make-up flow rate and the tank inflow rate should be restricted to 1L/sec by use of a standard "Universal" float valve. Where the non-potable requirements of the building cannot be met by a 20mm meter, a larger meter must be approved in writing by Manager FM Engineering.

Irrigation flow rates shall be designed on the basis of planting need. Typically lawn area shall be provided with 27mm per week precipitation and garden areas 23mm per week, scheduled to operate within the allotted night-time period which will be provided by FM Engineering once the irrigated areas are known. Maximum station flow rate shall be 1.5L/sec with only one station operating at any one time. Stations will be designed to operate for 1 or more 20 minute periods to achieve the required precipitation rate.

On the drawing, provide details on which the design was based. Such information shall include: How flow rate and system pressures were determined, flow rate and pressure determination for pumps, design pressure head at top floor fittings, actual head and flow curve for pump as designed showing duty points.

E.1.8.2. Pipe Material

Copper pipework shall not be used due to the low pH and possible long term corrosive effects of the bore water. However existing toilet flushing systems being altered to bore water flushing shall remain as copper.

In-ground piping over 80mm nominal diameter shall be purple PVC Class 16 and pipework 80mm and less shall be purple PVC Class 18. Refer to PIPEWORK & MATERIALS for Pipe Installation.

Where new pipework is to be installed within buildings, pipelines shall be either:
Grade 316 x 1.6mm thick stainless steel seamless tube in accordance with DIN 1988, with crimped joints as supplied by Blucher Australia. Joints to be Mapress press fittings with NBR Nitrile rubber seals, or
Rehau pipe pressure rated to 1500kPa.

E.1.8.3. Pipe Installation Below Ground

Non-potable water service shall be laid 300mm clear of parallel potable water service – this includes irrigation pipework.

All non-potable buried pipes shall be lilac.

Identification tape (lilac) at least 75mm wide stating NON POTABLE or RECLAIMED WATER shall be laid along and in contact with the pipe and fixed at 3m intervals - including irrigation pipework.

Bore water hose tap outlets above ground shall have removable handles and a different type of connection to standard. (UNSW supply all hose taps for bore water applications and there are special UNSW-standard methods of providing these. Refer to sketch)

E.1.8.4. Connections

Main connections to each building, irrigation system or facility shall be at the site ring main. Each connection shall include an isolating valve and a pulse-type water meter as directed by SUPERINTENDENT.

E.1.8.5. Backflow Prevention

The bore water system is a non-potable water supply and as such does not require devices to be fitted, with the exception of the following:
Direct supply to laboratory outlets via an RPZD.
Direct connection to potable supply for dual supplies via DCV
Direct feed to chemicals (Not permitted)
It should be protected from contamination wherever possible.

E.1.8.6. Isolation Valves

Refer to: HYDRAULIC SERVICES - Potable Water, Service Isolation Valves and Fitting Isolation Valves.

E.1.8.7. Water Meter

Provide a single 20mm main building meter and a single 32mm irrigation meter. Both meters shall be Elster PSM meters provided with a pulse output cable connected to the high pulse rate side of the meter ready for connection to the UNSW site EMACS metering system. Where the non-potable requirements of the building cannot be met by a 20mm meter, a larger meter must be approved in writing by Manager FM Engineering.

Sub-meters shall be installed on all water consuming plant and equipment which is likely to use more than 20% of the total building Average Day Demand. Such users may include: cooling towers, laboratory non-potable water, irrigation, toilet flushing tanks and pure water treatment plants.

Refer also to: HYDRAULIC SERVICES - Potable Water, Water Meter

E.1.9. Irrigation Water Service

E.1.9.1. General

For all works of irrigation downstream of the water service

Refer to: LANDSCAPING – Irrigation.

Requirements below relate to provision of water to the irrigation system.

E.1.9.2. Water Supply

All irrigation shall be supplied from the site bore water non-potable system. In exceptional circumstances, connection to potable water may be permitted where approved in writing by Manager Engineering Services. Provide ball-type service valve at the connection and install water meter as directed by SUPERINTENDENT.

E.1.9.3. Pipework

Supply from Borewater main to Control Valve: For pipework up to 80mm, use black Polyethylene Class PN12 or greater with lilac stripe or Lilac Class 16 PVC.

Where potable water is supplied, use Copper Type B.

Backflow prevention devices are required as follows:

Where supply is from bore water and fertilizer injection is installed, a testable RMC Watts Double Check Valve Assembly shall be installed.

Where supply is from potable water supply, a testable RMC Watts Reduced Pressure Zone Device Assembly shall be installed

E.1.9.4. Isolation valves

Provide isolation ball valves on each branch at tee and upstream of each solenoid valve. Valves to be Philmac (Black base with blue handle)

E.1.9.5. Valve Boxes

Valve boxes to be buried with lid approx. 10-20mm bleow turf level (for lawn areas) and 10-20mm above soil level (for garden areas). Use large boxes to house isolating ball and solenoid valve installations. Where necessary, use two boxes for ease of access.

E.1.9.6. Wiring

Underground wiring to be multi-core multi-strand type, taped to the underside of the irrigation pipe where possible. Aboveground wiring to be installed inside electrical conduit. Contractor to size control wiring to minimise voltage drop hence ensuring that solenoid valves operate satisfactorily.

E.1.9.7. Borewater Hose taps

Hose taps under surface boxes shall be special upturned reverse-threaded, ball valve tap and Lock-shield key to be supplied by UNSW. Irrigation boxes shall be supplied by UNSW and have purple lid to identify it as bore water. Support box on 80 thick concrete pad. Provide Unistrut support with clamp under pipe just behind special valve and fix Unistrut to concrete slab to prevent tap from being pulled out of box and supply pipe fracture.

Hose tap risers shall be 25mm copper pipe, fixed to 75x50 hardwood or treated pine post buried 500mm into 300 x 300 compacted gravel road base. Tap connection to be 650mm above finished ground level.
Special reverse-threaded, ball valve tap and Lock-shield key to be supplied by UNSW.
Schedule of bore water taps and irrigation boxes to be provided to UNSW Campus Services Hydraulics staff by designer
Provide sign 140 X 170 approx. on aluminium backing, brass screw-fixed to post or rivet to lid, with the standard pictogram and the following wording:

DO NOT
DRINK

Refer to Diagram E.1.8 Borewater Tap Standard Detail at the end of this Section E.1

E.1.10. Sanitary Drainage

E.1.10.1. Basis of Design

On the first drawing in the set, provide details on which the design was based. Such information shall include: Fixture units on each stack, total discharge flow rate, flow rate and pressure determination for sewage pumps, actual head and flow curve for pump as designed showing duty points, criteria for sizing pump station storage.

E.1.10.2. Pipe Material

Vertical stacks – cast iron, except that PVC may be used up to 2 storey and only where noise minimisation is not a design requirement.
Horizontal drainage – PVC

E.1.10.3. Expansion Joints

Provide as follows:
On vertical stacks, between each floor
On each branch line exceeding 2.3m in length.
On each branch line with fixed points more than 1.2m apart.
On straight runs at 3.0m apart.

E.1.10.4. Floor Wastes

Provide 100mm chrome plated brass bayonet grate. Make watertight around waste with epoxy concrete.

In commercial kitchens nd food preparation areas, provide appreoved dry basket arrester or bucket trap with internal strainer under basket cage.

E.1.10.5. Traps

Provide traps to fixtures not provided with integral traps. All traps except WC's to be white in colour, 'universal' in construction and have 75mm water seal. Provide screwed adaptors where traps join waste piping and / or drains and provide chrome plated cover plates where traps and waste piping joins floor and wall.

Where air conditioning condensate is the only method of charging a trap, provide a ‘waterless’ trap equal to “Hep$_v$O Plumbing Hygienic Self Sealing Waste Valves”

E.1.10.6. Tundishes

Drain air conditioning condensation and other intermittent drainage into tundishes which drain through a Hepworth waterless trap. Wherever possible the tundish shall be mounted within a wall and shall meet all the design features of the Stainless Metal Craft Model TU RE 2 Recessed Tundish with Perspex viewing window. Locate the tundish low down for viewing and to facilitate servicing should it be required. Ensure the inlet pipe is cut with a taper to ensure all drips discharge towards the rear of the unit and prevent splashing discharging from the air gap below the window.

Refer to Diagram E.1.9 Recessed Tundish at the end of this Section E.1

E.1.11. Fixtures, Faucets and Taps

E.1.11.1. General

All to be first quality and of one manufacturer. Written warranties on workmanship and materials of at least 1 year required for each unit. All units shall be subject to inspection by the Superintendent. All to be vandal-proof.
Flow rates for domestic and laboratory sinks and basins not to exceed 6 L/min for hot water and 6 L/min for cold water. (Cleaners' sinks excluded)
Flow rates for showers not to exceed 8 L/min for hot water and 8 L/min for cold water with the combined flow not exceeding 9 L/min. Shower roses shall be AAA rated.

E.1.11.2. Drinking Fountain

Free standing Zip or equal refrigerated drinking fountain.

E.1.11.3. Toilet Pans, Cisterns and Flush Valves

New multi-storey buildings shall be provided with either a gravity flusherette tank system using flush valves or ‘Water Wafer’ cisterns, or bore water mains-supplied ‘Water Wafer’ cisterns. Operation of flush valves shall be by FlushSaver or approved equal dual flush touch pad, control module and solenoid. Note that water supply shall be from tank fed by dual potable and bore water. (Refer to Section: Potable Water Backflow Prevention). Refer also to Section: Water Tanks.

Do not convert existing flusherette systems to cisterns without written approval from UNSW Facilities Management.

Where treated bore water is available, it shall be used for toilet flushing with manual drinking water standby supply. stand-alone installations do not have access to a flusherette system, provide cisterns, supplied with either treated bore water or drinking water.

WC suites shall be similar to Fowler 'Florida' code 10160005 vitreous china with 'Premier' code 0690 seat.

Cisterns to be Caroma ‘Water Wafer’ or equal, fitted to discharge pipe with 'Keeseal' type concealed flush pipe connection. Include internal overflow. Cistern installation shall be detailed to ensure stop tap will not interfere with servicing any component.
Base to have 100mm outlet. Set onto floor with 2:1 cement mortar with maximum exposed bed thickness of 10mm. Pan connector to be copper with rubber seal.
Seat to be double flap, closed front type, suitable for top fixing.
Disabled suites: Caroma ‘Leda’ vitreous china 6 litre full flush washdown type with proprietary disabled person pushbutton option. Seat to be single flap with institutional hinge. Pans to be specially manufactured and stamped for use by disabled persons and installed 800mm (min) distance from the front of the pan to finished wall surface and seat height to comply with the Code.

E.1.11.4. Basins

Generally without overflow. Install with front edge 825mm above finished floor.
Vitreous china wall basin with heavy duty concealed bracket as supplied with basin.

For general ablutions provide one only cold water Enware or approved equal Time Flow press button pillar tap factory set to 7 seconds.

For disabled persons' use in access toilets:

a) Use lever action with maximum mixed flow rate of 6L/min.

b) Install with front edge height above finished floor to comply with the Code. Basin to have CP brass plug and washer and supply with warm water using a thermostatic mixing valve.

c) Maximum temperature 43.5 deg C.

E.1.11.5. Urinals

Install only Uridan water-free wall-mounted fibreglass urinals. Trough urinals and flushing urinals shall not be installed.

E.1.11.6. Cleaner's Sink

To be either white vitreous china similar to Fowler or stainless steel 304 similar to Clark with 600mm upstand.

E.1.11.7. Showers

Provide separate floor waste and recess taps to each shower recess. Shower rose to be WELS 3-Star Rated (as specified in Fitting Flow Rates) finished in CP brass or as specified, set 1750mm above finished floor.

E.1.11.8. Sinks

To be stainless steel grade 304 with satin finish and fitted with stainless steel plugs and washers. Similar to Clark.

E.1.11.9. Hose Taps

Refer to Potable Water and Bore Water for detailed requirements

All hose taps are to be key-operated.
Hand keys over to the Superintendent before practical completion.

Schedule of bore water taps to be provided to UNSW Campus Services Hydraulics staff by designer.

E.1.12. Laboratories

Refer also: Section F - SPECIFIC AREA REQUIREMENTS

E.1.12.1. Laboratory Codes

All designs shall comply with the requirements of:
AS/NSZ 2243 – Safety in Laboratories
AS/NZS 2982 – Laboratory Design and Construction
Office of the Gene Technology Regulator –
Guidelines for Certification of PC2 Facilities
Physical Containment 2 Requirements

Should there be a requirement for Physical Containment 3 or 4, then these shall be applicable.

E.1.12.2. Testing for Cross-Connections

All specifications shall include a requirement as follows:
Upon completion of any works of water supply within a building housing laboratories, testing of the potable supply for illegal connections to laboratories via other water supplies or laboratory equipment shall be undertaken by the plumbing contractor performing the works. Any risk of contamination shall be immediately brought to the

attention of the UNSW Project Manager. Where the contractor has an obligation to rectify the problem, rectification shall commence immediately the risk is apparent.

E.1.12.3. Main Service Isolating Valves

Each major laboratory and each Physical Containment (PC2 and above) laboratory must include main shut off valves for all services outside and adjacent to the entrance doorway in a Laboratory Service Valve Compartment. This includes laboratory hot and cold water, natural gas and other reticulated gases.

Refer to Diagram E.1.6 Laboratory Service Valve Compartment at the end of this Section E.1.

E.1.12.4. Non-Potable Water Fixture Labels

At all laboratory sinks and other non-potable water outlets, including laboratory hot and cold water outlets, reverse osmosis and cooling water outlets, supply and fix permanent labels with the words 'NOT FOR DRINKING' with the appropriate pictogram.

E.1.12.5. Backflow Prevention

Potable water supply to a building containing wet laboratories shall be fitted with a Reduced Pressure Zone Device at the point of entry to the building. (Level 2)

GENERAL TEACHING LABORATORIES

Non-Potable Supplies
Generally laboratory buildings shall be provided with non-potable laboratory water from a Registered Break Tank service, preferably located on the building upper floors. Pump boosting may be required. (Level 3)

In addition to the break tank, to prevent backflow between laboratories and building levels, install a testable double check valve at the supply point to each laboratory. Filters are not to be fitted at this installation.
Apply the identical procedure to Reverse Osmosis supplies. (Level 4)

Drinking (Potable) Supply
Supply potable water only to wash basin Hydropathic Hygiene Station, safety showers and fixed eye wash units without mechanical device protection. It is not possible to make illegal connections to these points as the Hydropathic Station has no spout for connection point, and safety shower and eye wash units are required to be tested weekly under the Laboratory Code. (Level 4)

Hand-held eye wash guns fitted to flexible hoses should already be fitted with Dual Check Valves by the manufacturer. This should be checked by the Consultant at design stage. If not, fit a Double Check Valve Assembly at the supply point.

PHYSICAL CONTAINMENT LABORATORIES (PC2)
PC2 laboratories are defined in the Laboratory Code AS/NSZ 2982.1 Appendix B as having a 'moderate' severity to human health. On this premise, the risk has been taken as 'medium' with respect to AS/NSZ 3500.1.2 Tables E1 and E2.

Non-Potable Supplies
As per General Teaching Laboratories with the following additional measures:

To prevent cross-contamination backflow between laboratories, install a testable Double Check Valve Assembly at the point of service entry and outside the Containment Area. Only one penetration into the PC2 space shall be made for each type of service. (Level 4)

Potable Supply
Hand-held eye wash guns fitted to flexible hoses shall be fitted with a Double Check Valve Assembly at the supply point of service entry and outside the Containment Area.

Drainage
Where the user advises that there is a risk to human or the environment by escape of contaminants via the sewer / trade waste system, all wastewater shall be either pre-treated prior to discharge to render it safe, or contained in sealed, covered and bunded drums for disposal as arranged by UNSW Risk Management Unit.

PHYSICAL CONTAINMENT LABORATORIES (PC3 & PC4)
PC3 & 4 laboratories are defined in the Laboratory Code AS/NSZ 2982.1 Appendix B as having a 'serious and life threatening' severity to human health. On this premise, the risk has been taken as 'high' with respect to AS/NSZ 3500.1.2 Tables E1 and E2.

Each service shall be provided via a Registered Break Tank and pump set for each individual laboratory. Hot water shall be generated within the Containment Area where required. The Consultant shall contact UNSW Engineering Operations Manager to formulate satisfactory design.

Refer to Diagram E.1.7 Site Backflow Prevention Schematic at the end of this Section E.1.

E.1.12.6. Hand Wash Basin

Where laboratories require installation of a hand wash basin adjacent to the exit, this basin shall be supplied with potable warm water and hands-free operation. To achieve this, provide hot and cold water supplies to Aquablend 1500 TMV with an Enware Knee

Operated Hands Fee Basin Kit over a compatible vitreous china basin. As an alternative to the knee operation, provide sensor operation where directed by Project Manager.

E.1.12.7. Safety Shower / Eye / Face Wash

Provide Enware free standing hand operated safety shower / eye / face wash unit to each definable laboratory to ANSI Z358.1/1998 and AS 2982.1:1997.
Model 'EC240'. with stainless steel finish. Provide 25 - 32mm POTABLE cold water supply to suit available water supply capacity, with all isolation valves key-locked open (Key to UNSW requirements). Drain the eye / face wash only to the most convenient building waste drainage system to facilitate weekly testing.
Mandatory Requirement **'EC240'**

Where rigid drainage is not possible, provide flexible drain-pipe to dedicated receptacle to allow testing

E.1.12.8. Eye Wash

Provide Enware eye wash unit Model 'EE180' with drainage.
Provide 20mm (minimum) POTABLE cold water supply to suit unit requirements. Eye wash shall be drained to the most convenient building waste drainage system.
Mandatory Requirement **'EE180'**

Should Client requirements dictate installation of an Eye / Face Wash, then Model ‘EF360’ shall be substituted.

Where rigid drainage is not possible, provide flexible drain pipe to dedicated recepticle to allow testing

E.1.12.9. Eye Wash / Body Spray

In addition to the above eye wash and only where directed to do so by the Client, provide Enware bench mounted eye wash / body spray unit Model 'EL450' with chrome finish.
Provide 20mm (minimum) POTABLE cold water supply to suit unit requirements. Unit shall be located adjacent to a basin where available. It should be noted that it may be difficult to comply with the exclusion zones for electrical fittings.

E.1.12.10. Laboratory Sink Tapware

Faucets and taps for all fixtures and appliances shall be Enware commercial laboratory tapware including Mini Stop service valves. Finish as specified in project documents. Allow for submitting indicator button and colouring code schedule for approval prior to procurement. Cold water tap indicator shall be marked “NPCW” and hot water marked “NPHW”
Mandatory Requirement **'Enware'**

E.1.12.11. Laboratory Gases

Install gas cylinders with proprietary locking devices such as those supplied by Matheson
Secure small diameter gas lines with STAUFF pipe clamps
Provide flash-back arresters on all combustible gas outlets

E.1.12.12. Floor Wastes

Where new floor wastes are to be installed in existing buildings, floors shall be re-graded to drain to the wastes. Unless this can be achieved, consideration should be given to deleting the floor wastes.

Refer: HYDRAULIC SERVICES - Trade Waste

E.1.12.13. Laboratory Equipment Cooling Systems

Provide a flow and return cooling system to meet the cooling demands of the equipment likely to be installed. Liaise closely with the user representative for the project to ensure they provide all hydraulic information necessary to design the system. Provide supply and return connections to all wet fume cupboards, furnaces, electron microscopes, and laboratory benches likely to require chemical reaction cooling or condensing of gases. Tundishes shall only be provided for return water where it is not pressurized and therefore will not flow through a tube connection to a return tap. The top of the tundish shall be raised above the bench to prevent it being used as a sink to deposit waste water and chemicals.

The system shall be pumped from a gravity collection tank at building basement level and the return upsized and vented to ensure gravity flow thus reducing return pressures to atmospheric. This allows for an infinite range of head loss characteristics across equipment and prevents backpressure in the equipment discharge reducing or stopping cooling water flow rates. The pump duty flow pipeline shall be sized for the maximum likely combined cooling flow rates and required equipment inlet pressures. Where equipment is sensitive to high inlet pressures, provide a pressure reducing valve in the equipment supply pipe. At each branch line feeding groups of like equipment, provide a balancing valve with binder points to allow final system balancing during commissioning. Such groups of equipment shall be limited to flow rates no greater than 0.5L/sec. to prevent starvation of cooling water supply.

Method of cooling is dependent upon temperatures required. For general cooling of glassware, furnaces and distilling apparatus cooling towers and immersion coils are satisfactory, producing cooling water of about 25 to 35 degrees depending on weather conditions. For cooling of sensitive equipment such as laser beam generators, electron microscopes, neutron magnetic resonance generators etc, mechanically cooled water from chillers is required to achieve the 18 degrees (max) temperature requirement. This is most reliably achieved by a dedicated chiller, co-located in the basement with the receiving tank and pump.

Refer to Diagram E.1.10 Laboratory Equipment Cooling System at the end of this Section E.1

E.1.12.14. Laboratory Centralised Reverse Osmosis Systems

Where buildings are specifically designed to house wet laboratories, a centralised pure water system shall be designed and installed as follows:

Raw water supply: shall be obtained from the site borewater system if the building is located on the Kensington Campus. Where available treated bore water shall be used, otherwise use raw bore water. Provide backflow prevention as required, borewater sub-meter, sand/carbon filtration, UV disinfection and cartridge micro-filtration prior to the RO process.

Water efficiency: Overall water efficiency of the treatment process shall be at least 80%, obtained by the use of a series of reverse osmosis (RO) processes to concentrate the reject impurities.

Plant production rate: RO plant shall be sized to produce one day's Average Day Demand supply of pure water in 8 hours. Average Day Demand shall be determined from the users. Where this is not possible, assess requirements based on like installations within UNSW and with the assistance of the users.

Product Specifications: RO water product shall be a Type 2 (analytical grade) to ISO3696 (Water for Analytical Laboratory Use), requiring de-ionising using ion exchange prior to product storage.

Point of Use Treatment: Where Type 1 (Ultrapure grade) is required for specific users, this shall be provided as a "point of use" treatment. These units shall be strictly limited in numbers due to the cost of maintaining such equipment. It is suggested that one unit per building level would be sufficient, with all operation and maintenance requirements provided by the user to ensure quality water to the users' satisfaction.

Product storage: Pure water produced by the RO plant shall be stored in a single translucent polypropylene tank with capacity for a minimum of 8 hours' use.

Circulation: To maintain quality product, the main distribution system shall be a "flow and return" system with UV disinfection controlled by the duty and standby circulation pumps. Pumps shall be sized to circulate total storage every 4 hours. Duty and standby functions shall alternate each 24 hours.

Branch lines: Off-takes from the ring (flow & return) main shall be made at one only point for each laboratory, with a supply emergency isolation valve located within the laboratory service valve compartment.

Refer to Diagram E.1.11 Laboratory RO System Arrangement at the end of this Section E.1.

E.1.13. Student Housing Special Requirements

E.1.13.1. Bore Water Use

Bore water shall be used for all irrigation, toilet flushing and external hose taps. All bore water shall be metered with separate sub-meters for internal building use and irrigation. Water meter sizes shall be as follows to limit peak demand flow rates.
Building uses: 20mm connected to campus wide BMS
Irrigation: 32mm connected to campus wide BMS

E.1.13.2. Toilet Flushing

Flushing shall be by either dual flush cisterns or dual flush flush-valves. Cisterns shall be fed from roof-mounted flush tanks or direct from borewater main. Flush valves shall be fed only from roof-mounted flush tanks. Flush tanks shall hold at least 50% of Average Day Demand for toilet flushing, with filling rate of 0.5L/sec (max).

E.1.13.3. Hand Basins and Showers

Provide all domestic ablutions with hand basins supplied with warm and cold water regulated by tapware with WELS rating of 5. Maximum run for warm water pipelines to be 10m to prevent excessive water loss. Showers shall be WELS rating of 3 (10L/min).

E.1.14. Fire Hydrants and Hose Reels

E.1.14.1. Basis of Design

Indicate on drawings basis of design of system, including: Design Code, flow rates, head loss in pipelines, residual pressure of mains at design flows, pump duties if applicable, height of highest hydrant above ground, available flow rates in main

E.1.14.2. Pipework

Pipework shall be galvanised mild steel where above ground inside and outside buildings (Not “Fire Light”). In-ground pipework shall be either ductile iron or copper. Flanges shall be a minimum Table E pressure rated for pipework over 80mm diameter.

All pipelines shall be capable of withstanding working pressures of up to:

- 1500kPa for non-boosted pipelines
- 2200kPa for boosted pipelines

External dedicated fire mains pipework shall be kept as short as possible and preferably no longer than 50m to ensure fire mains are not used for domestic purposes or cross-connected to the campus combined fire / domestic town system.

E.1.14.3. Existing Hosereels

Where hosereels are to be retained by UNSW, the Contractor shall be responsible for their removal and return to the UNSW store in undamaged condition. Where hosereels are to be reused, the Contractor shall maintain their condition as at the time of contract. The Contractor shall repair or replace hosereels damaged during his contract.

E.1.14.4. Hosereel Isolation Valve

For the purposes of supplying hosereels, the UNSW Kensington Campus water supply is a fully metered supply (Building meters shall be disregarded for the purposes of hosereel isolation). Therefore hosereel supplies may be taken off the hydrant service. Isolation valves must be ball valves, clearly marked in accordance with the Standards and UNSW requirements. They must be located in a prominent and readily accessible position.

In other locations, hosereel supplies shall be supplied by a separate service within the building fed from the discharge side of the water meter immediately after the meter and before the domestic supply stop valve. Provide locked ball isolating valve on hosereel supply.

E.1.14.5. Hosereels

Provide all hosereels with 36m hoses. Provide instruction panel, setting out operation instructions, fixed permanently to front of each fire hosereel.

E.1.14.6. Fire Hosereel Pump

Provide pressure system discharging 1.26L/sec with residual pressure at the hosereel of 250kPa., construction similar to Prime Pumps 'FHR4/60' centrifugal pump with close coupled TEFC, non-overloading, 415v, 2,900 rpm electric motor. Include suction and discharge pressure gauges. Provide pressure tank similar to Davey 'Supercell 8' with 8L nominal capacity, butyl liner, modified non-return valve for slow filling and air valve. Provide complete unit on GMS base.

E.1.14.7. Hydrant Systems

Systems shall be complete with connection to water main, booster valve and booster pump installation.

E.1.14.8. Hydrant Check Valves

Provide Watts/RMC 07F detector check valves or equal to detect illegal use or leakage.

E.1.14.9. Hydrants

External hydrants: (Pillar Hydrants) Double brass 63mm landing valves on 100mm GMS or copper standpipe and brass cap. Turn down landing valve. Provide isolating valve on branch line to permit landing valve servicing. Wrap pipe with Denso tape to isolate from concrete and install concrete anchor block at tee and bend and provide 100 thick x 450 square concrete pad around standpipe. Top surface to be level with finished ground level. Internal hydrants: Right angled type single brass 63mm landing valve with integral Storz coupling and cap. Provide a hydrant at roof level in an accessible and convenient location for periodic flow testing of the hydrant system (Up to 20L/sec flow rates).

E.1.14.10. Hydrant Booster Valve

Arrange hydrant booster valve to be in parallel and not in series with the fixed hydrant booster pump to prevent boost pressures being experienced by the pump and associated flexible connections. This will also prevent the pump being destroyed during boosting.

Fabricate booster similar to Northgard and fitted with 100mm glycerine-filled pressure gauge, drain tap, Storz couplings and caps. Drain tap to be capped ball valve to prevent accidental depressurization. Provide RMC / Watts Series 774 Double Check Valve instead of the single check valve usually provided.

Provide and mount a block plan separately to the booster to the exact details of the UNSW standard Hydrant Block Plan. Refer to Facilities Management Signage Officer for advice.

Refer to Diagram E.1.12. Fire Hydrant Booster Requirements at the end of this Section E.1

E.1.14.11. Hydrant Pumps

In all new buildings, locate the hydrant pump so that it is arranged in parallel with, and not pressurized by, the hydrant booster valve. Refer to AS 2419 Fig. 7.5.

Refer to Diagram E.1.13. Fire Hydrant Booster Requirements at the end of this Section E.1

Provide complete unit on GMS frame inertia block, including main pump, jacking pump, pressure vessel, diesel motor, fuel tank, controls, circulation pipework and valves, and all other required appurtenances. Isolate pump suction and discharge from fixed pipework with high-pressure flexible connectors. Where pump is arranged in series with the fire hydrant booster valve in existing buildings, connectors shall sustain a test pressure of 2,200kPa.

Main Pump: 20.0L/sec @ 27m (typical duty - to be assessed for each project) delivered head at the most disadvantaged hydrant. Similar in construction to Prime Pumps 'F-80x65-16-PW2' with diesel drive selected to suit location.

Fire hydrant ‘run’ signal shall be connected to the Fire Monitoring System to ensure the hydrant pump is turned off in the event of a false actuation.
Jacking Pump: Similar to fire hosereel pump but with duty of 0.3L/sec.

E.1.15. Fire Sprinklers

Systems shall comply with AS 2118 and components shall comply with AS 4118. They shall be complete with booster pump installation where required, connection to water main and fire brigade booster valve. Make allowance for draining test water to stormwater system. Provide block plan.
Jacking Pump: Electric automatic.

E.1.15.1. Basis of Design

Indicate on drawings basis of design of system, including: Design Code, flow rates, head loss in pipelines, residual pressure of mains at design flows, pump duties if applicable, height of highest sprinkler above ground, available flow rates in water supply main.

E.1.15.2. Water Main Connection

Water supply shall be from the site combined fire / domestic water mains located adjacent to the building. Refer to Fire Hydrants and Hosereels part of this document.

E.1.15.3. Sprinkler Booster Valve

Modified proprietary type similar to Northgard and fitted with pressure gauge, drain tap, Storz couplings and caps. Drain tap to be capped ball valve to prevent accidental depressurization. Provide RMC / Watts Series 774 Double Check Valve instead of the single check valve usually provided.

E.1.16. Stormwater Drainage

E.1.16.1. Council Conditions of Development Approval

Kensington Campus

Kensington Campus has a campus wide Stormwater Strategy agreement with Randwick City Council which details engineering design methodology. Stormwater shall be designed to parameters shown on the Stormwater Catchment Management Plan and Stormwater Diversion Structures Plan available from the University's Facilities Management Information Services group. These drawings identify overland flow paths, drainage structures forming boundaries of overland paths, detention basins, method of calculating detention volumes and run-off from sub-catchment areas etc. Overland flow paths shall not be disrupted or violated by construction or removal of kerbs, or removal of kerb inlet pits. Where diversion occurs due to development, full hydraulic computer modelling using the DRAINS model shall be carried out and submitted to Randwick Council for their approval. Existing detention basins and percolation chambers shall be retained. Where alterations due to development are proposed, identical footprint areas for percolation, identical volumes for detention and weir crest levels shall be maintained. Piped drainage capacities shall not be increased in areas draining to catchments outside the Village Green Detention Basin due to potential flooding in Anzac Parade and surrounding streets.

The Village Green Detention Basin has been designed to accept flows from its existing catchment area. There is no additional detention storage available to accept additional catchment. Randwick Council will not permit stormwater to be diverted from other catchments to the Village Green Detention Basin.

Dedicated rainwater tanks shall not be installed. It should be noted that borewater is extracted from the Botany Sands Aquifer which is recharged with campus stormwater run-off via the aquifer recharge percolation chamber at the Village Green. This forms the major part of the University's water management strategy.

The Development Application should show that the proposed development drainage satisfies the requirements as set down in the Stormwater Strategy which is part of the Campus 2020 Master Plan, the basis of all project DA assessments by Council.

Refer to Appendix 6 - UNSW Kensington Campus Stormwater Strategy

Refer to Diagrams E.1.13 Stormwater Catchment Management Plan and E.1.14 Stormwater Diversion Structures Plan at the end of this Section E.1

Randwick Campus

Randwick Campus has building-specific detention Any alterations to building works or stormwater drainage will require special treatment, as Randwick Council have placed the highest of constraints on stormwater detention and discharge rates for this site.

Detention basins are identified on the UNSW Randwick Stormwater Master Plan drawing.

E.1.16.2. Basis of Design

Show Basis of Design on the drawings, including: Design storm, design flow rates and pipe capacities, storm intensity, time of concentration and calculations of volumes for detention basins and percolation pits. Such basins and pits shall be formally designed and documented with the project.

E.1.16.3. Pipework

In-ground - Reinforced concrete (RC), fibre reinforced cement (FRC) or polyvinyl chloride (PVC). RC and FRC to be spigot and socket jointed. PVC to be solvent welded.
Where appropriate, siphonic drainage systems may be used.
Minimum pipe size for downpipe drainage 100mm.
Where buried PVC pipework is greater than 2.5m below finished surface, side support and overlay shall be inspected and approved by the Superintendent before backfilling.

E.1.16.4. Downpipes

Buildings up to 2 storey: 1.2mm thick copper for internal. Zincalume or PVC for external.
Buildings over 2 storey: cast iron.
Terminate cast iron pipes with watertight socket or mechanical joint at roof gutter spigots. Provide inspection openings at the bottom of all downpipes and enter in-ground pipe with 2 x 45 deg. bends or long radius bends.

E.1.16.5. Roof Drainage

Sumps: Proprietary nickel-bronze hinged grate and sump similar to Gatic TJ12.
Capacity: Allow hydraulic capacity in gutters, rain heads and downpipes for hydrant flow testing up to 20L/sec where building is equipped with internal fire hydrants.

E.1.16.6. Kerb Outlets

Where possible, direct all roofwater and stormwater flows to the underground piped system.
Where necessary, provide preformed aluminium or galvanised mild steel kerb outlets. Encase steel sections in 50 thick (min) 3:1 sand / cement mortar.

E.1.16.7. Pits

Precast reinforced concrete with 150mm deep silt trap and knockouts for pipe entries. Internal sizes to match cover and surround dimensions, make good pipe connections with

watertight 100mm (min) thick epoxy concrete collar. Adjust wall heights to final levels and make connection with cover surround watertight using epoxy concrete or grout.

E.1.16.8. Pits – Redundant

If inlet gully pits are redundant in the new landscape design, the following treatment of pits needs to be carried out:

Pits on line without other pipes entering can be converted into inaccessible chambers by removing the top of the pits and constructing or installing a sealed prefabricated reinforced concrete slab. The chamber can then be buried.
Where more than one pipe enters the pit, or a severe change of direction occurs on a single entry pit, it needs to be accessible and hence fitted with a removable Gatic cover.

Where it is unlikely that entry will be required due to pipeline configuration and sizes, the removable cover could be buried if in grassed area. However these instances would only be with consent of Engineering Services Hydraulics staff.

E.1.16.9. Gratings

Refer HYDRAULIC SERVICES - Pipe work and Materials

E.1.16.10. Drainage Pumps

Submersible pumps and close coupled submersible motors similar to Flygt, with stainless steel or epoxy coated cast iron casings and bronze impellers with in-built suction strainers and stainless steel shaft. Motors to be 415v. Install with galvanised mild steel lifting chains to enable pump to be lifted 1,5m clear of pit for maintenance. Non-return valves to be spring loaded resilient seated (Not Duo Check or similar butterfly pattern).
Control panel to be wall mounted, steel galvanised after fabrication, powder coated enamel finished orange colour. Provide key-lockable door master keyed to building requirements.
Mount the following equipment on the cabinet door:
Lights to indicate:

Power on
Pump running
Pump failure
High level alarm
Pump duty selector
Controls inside cabinet::
Main power supply circuit breaker
circuit breaker for each pump
on/off/auto switch for each pump

audible alarm
alarm mute

Operation:

i) Provide one duty and one standby pump with alternating start
ii) Only one pump to operate at any one time.
iii) Discharge flow rate > 3.0L/sec
iv) Standby pump to start if duty pump fails to discharge or maintain flow.
v) Automatic activation of alarms
vi) Float switches to be mercury type similar to 'Flygt'

E.1.17. Trade Waste

E.1.17.1. Basis of Design

Show on the drawings the basis of design of trade waste pre-treatment pits and chemicals known to be discharged at the time of design. Purpose of pre-treatment to be identified.

E.1.17.2. Pipework

In ground pipework to be as for sanitary drainage, except that rubber rings to be acid resistant.

All other pipework shall be polyethylene (Vulcathene or approved equal).

E.1.17.3. Silt Arrester

Install silt arrester to trap sand, silt and clays.

Supply and install 60L effective capacity 3 compartment PVC silt arrester with fixed baffle and weir and fitted PVC cover. Plumb with PVC Class DWV pipe and fittings. Drain sink directly to high level inlet without trap, but install trap in discharge.

Where mounted on floor, provide galvanised mild steel frame with castors to assist with removal of arrester for cleaning purposes.

E.1.17.4. Plaster Arrester

Install plaster arresters only where gypsum is to be trapped. Do not use for sand, silt or clays.

Supply 40L Grade 304 stainless steel plaster arrester with removable SS baffles and bolted down SS cover equal to Clark Model 76652. Provide SS frame 50mm x 50mm on casters to assist with removal of arrester for cleaning purposes.

E.1.17.5. Basket Arrester

Provide a fine stainless steel basket arrester to the inlet of all trade waste pits serving laboratories to catch broken glassware, syringes and other foreign objects likely to enter the wastewater. The arrester shall be fitted into its own pit with top access for basket removal. Basket shall be manufactured as follows:
Supply and install on the inlet side of the pit, a stainless steel basket as manufactured by Mascot Engineering to catch all debris larger than 3mm diameter entering the pit via the inlet pipe. It is to be easily removed from above the pit for cleaning without the screenings entering the pit accidentally. The weight of the empty basket is to be no more than 5Kg. The unit is to be complete with stainless steel cradle and basket with extended lifting handle. The cradle shall be fixed to the pit wall by 2 x 6mm stainless steel masonry anchors so that the lip of the basket is immediately under the inlet pipe. Extend handle up to within 20mm of underside of pit cover frame. Approx. size of basket: 460long x 200wide x 100deep front lip x 210deep back.

Refer to Diagrams E.1.15 Trade Waste Basket Arrester at the end of this Section E.1

E.1.17.6. Silver Recovery Unit

As per user requirements and UNSW approval.

E.1.17.7. Grease Arrester

Provide 1000L minimum precast concrete arrester similar to C.I.&D. with heavy duty concrete lid with Gatic covers and frames . Coat all internal surfaces with acid and alkaline resistant epoxy. Brace internally during backfilling operations.
Provide ground vent and educt vent to Sydney Water Corporation requirements. Take care to extend the educt vent up to a height to release gases away from habitable areas and prevent offensive odours entering buildings.

E.1.17.8. pH Correction

Automatic using pH probes and chemical dosing. Maintain pH between 6.5 and 7.5.

E.1.17.9. Trade Waste Storage

Materials to be compatible with stored liquid. Where reinforced concrete tanks are used, line or coat internal surfaces with acid and alkali resistant epoxy. Provide basket arrester before each trade waste pit.

E.1.18. Natural Gas

E.1.18.1. Basis of Design

On the drawing, provide details on which the design was based. Such information shall include: Gas demand calculation, pressure loss in pipework, pressure at building.

E.1.18.2. Authority Inspection

All natural gas installations shall be inspected and certified by the gas authority (e.g. AGL) prior to being put into service.

E.1.18.3. Pipework

To suit test pressures of 500kPa.

Buried outside buildings: Nylon, polyethylene or copper. Denso or polyethylene sleeve copper pipes.

Buried inside buildings: Not permitted.

Above ground: Copper tube Types A and B to suit natural gas.

E.1.18.4. Laboratory Gas Outlets

Provide each bench top gas outlet with flash-back arresters.

E.1.18.5. Isolation

ROOMS

Where uncontrolled gas outlets such as Bunsen burners or kitchen appliances are installed, provide a press button emergency gas shut off system with key controlled start-up switch similar to Gas Guard by System Control Engineering Model GG1. The emergency press button shall be near to the main entrance and provided with appropriate signage.

Install the solenoid valve assembly as close as possible to the main manual shut-off valve prior to any take offs.
Provide main manual shut-off valve outside the room in a box common to the other services as described in Section - Laboratories

BUILDINGS

Manual
Point of entry to each building: Provide wall-mounted manual shut-off valve at the point of entry to each building. The valve is to be accessible and external to each building. A durable and permanent sign is to be provided in a prominent position adjacent to the valve. The sign with black lettering 25mm high on yellow background is to include the following wording: “GAS VALVE”.

Boilers: Emergency valves for all steam and hot water boilers shall be provided. Locate in an accessible position remote to the boiler and clearly identify by the appropriate sign.

Laboratories & kitchens: Provide “Gas Guard” or “Kromschroeder
LSV” safety system with ball isolating valve at assembly inlet and outlet (as supplied by System Control Engineering). Provide black lettering on yellow sign with instructions for emergency shut-off and resetting.

Automatic
Where a building is provided with a fire detection or suppression system, and is supplied with gas, provide a “System 3” automatic gas shut-off valve assembly (as supplied by System Control Engineering Pty Ltd) with ball isolating valve at assembly inlet. System 3 shall activate upon fire sprinkler flow detection. (Note that water flow is to be used rather than alarm activation to prevent false fire alarms shutting down the gas). Locate in an unobstructed location at the main person entry.

All valves to be not greater than 1500mm above floor level. Where the valve is mounted inside a cabinet, the cabinet shall not be lockable.

Connect a signal from the System 3 to UNSW Security Cardax alarm system to ensure that resetting of the valve occurs promptly.

Provide the following black on yellow signs:
At building fire indicator panel sign to have the words “GAS SHUTS OFF (insert location such as kitchen or to building) ON FIRE TRIP OR POWER FAILURE - AUTOMATIC SHUT OFF VALVE LOCATED IN (ROOM LOCATION) - TO RESET, FOLLOW INSTRUCTIONS ABOVE SYSTEM 3 VALVE”.
Above System 3 valve, affix to the wall operating and resetting instructions for System 3.
On the door(s) leading to the System 3, sign to have the words “GAS VALVE INSIDE”.

Mandatory Requirement**, 'System 3'**

E.1.18.6. Markers

Provide surface markers at each change of direction or pipeline end. Markers to be directional arrows engraved on a brass plate, mounted on a concrete block or in concrete pavement and installed flush with the finished surface.

E.1.18.7. Testing

Test all works to AG601 Appendix E. Seal the gas system after removing all items of plant or equipment liable to damage at the test pressure. Remedy defects found and retest as required.

E.1.18.8. Control & Isolating Valves

Valves to be quarter turn ball type (AGA approved). Valves up to 50mm to be screwed; 65mm and larger to be flanged.
Below ground valves to be similar to 'Richards Spherical Ball Valves' and installed under a cast iron surface box.

E.1.18.9. Gas Regulators

Low and medium pressure regulators shall be diaphragm type similar to 'Jeavons' as supplied by Systems Control Engineering. On major supply systems, provide two full capacity regulator installations in parallel so that supply to the building will be maintained during servicing. No by-passes to the regulators are permitted. Where supply is to continuous flow water heaters or Bunsen burners, provide additional step down regulator to 1.75kPa.
Provide 'Binder' type test point on the inlet and outlet.
Mandatory Requirement, '**Binder**'

E.1.18.10. Venting

Care should be taken to control gas vented from OPSO valves at regulators. Gas odours are a source of nuisance and if there is any indication that gas will be released in an inhabited area it should be vented via pipeline to above the roof line and away from air inlet vents and building openings.

E.1.18.11. Gas Meters

Provide pulse type gas meter to each building. Meter to provide pulse for connection to and be compatible with UNSW central monitoring system. Sub-meters shall be installed

on all major gas consuming plant and equipment which is likely to use more than 20% of the total building Average Day Demand, and where inefficiencies and losses are potentially significant.

Diaphragm meters shall be used for all purposes across campuses due to their accuracy, minimal maintenance and turndown ratios up to 600:1. Size meters for the minimum probable demand rather than maximum possible to ensure small losses are identified. Where medium pressure supply (100kPa) is to be metered, such meters shall be sized by the meter supplier, as special meters area available for this purpose and the meter will be correctly sized for that pressure.

Meters shall be fitted with Remote Volume Pulser (RVP) and output wiring ready for connection to the site EMACS metering system. Meters shall also be fitted with automatic temperature and pressure correction equipment.

Provide the assembly with upstream filter and regulator to stabilise inlet pressure and downstream regulator with discharge pressure to suit equipment connected.

Turbine meters shall not be used due to their small turndown ratio and Rotary meters shall not be used due to their on-going maintenance requirements. House meter within weatherproof enclosure where installed outside buildings.

As a guide, meter sizes and their ranges are:
Model 750 – up to 7.5m^3 / hour
AL 425 – up to 12m^3 / hour
AL 800 – 0.1 to 22m^3 / hour
AL 1000 – 0.1 to 28m^3 / hour
AL 1400 – 0.1 to 40m^3 / hour

Refer to Diagrams E.1.16 Meter Sizing & Selection at the end of this Section E.1

E.1.18.12. Water Heaters

Continuous flow Rinnai hot water heaters shall be installed where there is a requirement for an external gas hot water unit. Where bulk hot water is required, an assessment shall be made on need for hot water storage. Binder-type test points shall be provided to allow safe testing of inlet and outlet temperatures and gas pressures. Provide labelling and insulation of pipework to conform to other parts of this document. For multiple system installations electronic controllers should be used to provide the “lead – lag & alternating start” principle.
For larger project, refer to Engineering Operations and discuss.

E.1.18.13. Tailpipes

Where located in ground, provide 450mm square x 450 deep tailpipe pit similar in construction to stormwater pits.

Where condensation or dust is likely to occur in pipework, particularly at the base of risers in buildings, provide a drain or cleaning point consisting of two ball valves with a short vertical length of pipe, equal in size to main pipe, between the valves. This allows the gas supply to be isolated and the liquid drained by the lower drain valve.

E.1.19. Main Services Tunnel

E.1.19.1. General

The main services tunnel runs generally east-west from Valentine Annex to Science Rd. It is a restricted access space, which has specific requirements for placement and types of services and methods of installation. The following conditions must be met by any works or service connections to the tunnel.

E.1.19.2. Access

Special conditions apply for entry and work permits, which shall be determined from UNSW Engineering Operations Manager. Give notice when applying for access into Services Tunnel

E.1.19.3. Pipe Locations

Refer to the cross sections for details of installation and cross-over locations. No pipes shall penetrate the tunnel roof. All wall penetrations shall be mechanically sealed with bolted weep flanges where below the water table. All other penetrations shall be watertight.

Where conduits are connected to the tunnel, they shall be graded away from the tunnel wall to a self-draining scour point to prevent entry of seepage via the conduits.

Refer to Diagram E.1.17 Tunnel Cross Section at the end of this Section E.1

E.1.19.4. Additional Services

No additional services or extension of existing services shall be introduced without explicit permission of UNSW Engineering Operations Manager and an accompanying risk assessment.

Existing nitrogen pipeline dedicated to the Photovoltaic Laboratory shall not be interfered with for any reason. Other nitrogen and oxygen pipelines shall be continuous welded without any valves within the tunnel.

Natural gas joints shall be brazed wherever possible. Screwed joints shall be kept to a minimum. No regulators or venting shall be installed within the tunnel. No joints are to be within 300mm of oxygen pipeline on vertical risers and no longitudinal natural gas services shall be located within 300mm of the oxygen pipeline.

E.1.19.5. Electrical Hazard Zones

All drainage sumps up to floor level are Class 1 Zone 2 (AS3000) rated, requiring explosion rated cabling and sump pump motors up to and including the local pump isolation switch.

Steel shielding is installed on tunnel roof and wall near grid H14. This must remain intact to protect electromagnet interference with adjacent electron microscope.

E.1.19.6. Structural Issues

Where services tunnel walls are sprayed concrete, pipelines or fittings are to be fixed to those walls by bracing from the roof and the floor. Bracing shall not be fixed to the walls. All framing and bracing members are to be kept clear of the wall and floor surfaces using synthetic spacers.
Where galvanised steel vertical supports are located within side drains, they shall be raised with 25mm high stainless steel spacers. All floor fixings shall be stainless steel.

E.1.19.7. Drainage

Additional drainage pumps installed in tunnel extensions shall be connected to the central drainage pump control cubicle in the Webster entrance for power supply, pump control and alarm monitoring. Pumps shall be identical to existing Nossiter submersible Model NP750T with 0.75kW and 415volt motor. Discharge shall be at least 50mm pressure pipe with non-return valve both at the pump and at the discharge pit located outside the tunnel to prevent drainage of stormwater back into the tunnel. Direct flow towards outlet of receiving pit.

E.1.20. SECTION E.1 SUPPORTING DIAGRAMS

E.1.20.1. Checklist for Hydraulic Consultants (Refer Section E.1.1 Checklist for Hydraulic Consultants)

E.1.20.2. – UNSW Hydraulic Asset Registration Form (Refer Section E.1.2 General)

E.1.20.3. - Non-Potable Tank Standard Details (Refer Section E.1.4 – Pipework and Materials)

E.1.20.4. - Thrust Blocks for Water Supply (Refer Section E.1.5 – Water Mains)

E.1.20.5. - Laboratory Service Valve Compartment (Refer Sections E.1.5 - Drinking Water, and E.1.12 – Laboratories)

E.1.20.6. - Site Backflow Device Schematic (Refer to Section E.1.5 - Drinking Water).

E.1.20.7. – Bore Water Hose Taps (Refer to Section E.1.9 Irrigation Water Service)

E.1.20.8. – Recessed Tundish (Refer to Section E.1.10 Sanitary Drainage)

E.1.20.9. - Laboratory Equipment Cooling System (Refer to Section E.1.12 Laboratories)

E.1.20.10. – Laboratory RO System Arrangement (Refer to Section E.1.12 Laboratories)

E.1.20.11. – Fire Hydrant Booster Requirements (Refer to Section E.1.14 Fire Hydrants and Hose Reels)

E.1.20.12. - Stormwater Catchment Management Plan (Refer to Section 1.16 Stormwater Drainage. Obtain AO size drawing from UNSW Project Manager)

E.1.20.13. - Stormwater Diversion Structures Plan (Refer to Section 1.16 Stormwater Drainage. Obtain AO size drawing from UNSW Project Manager)

E.1.20.14. – Trade Waste Basket Arrester (Refer to Section 1.17 Trade Waste)

E.1.20.15. - Meter Sizing and Selection (Refer to Section 1.18 Natural Gas)

E.1.20.16. - Tunnel Cross Section (Refer to Section 1.19 Main Services Tunnel)