Report

Building Services SSD-6674

UNIVERSITY OF NSW - BIOLOGICAL SCIENCES PROJECT

Report

CONFIDENTIAL

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Norman Disney & Young

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1 GLOSSARY OF TERMS

The following provides a glossary of terms for the list of the abbreviations used throughout this report:

Abbreviation	Meaning
ACH	Air Changes Per Hour
A/C	Air Conditioning
AS	Australian Standard
AHU	Air Handling Unit
BMCS	Building Monitoring and Control System
BSC	Biological Safety Cabinet
CBACS	Campus Building Automation and Control System
CHW	Chilled Water
CW	Condenser Water
ESD	Ecologically Sustainable Development
FCU	Fan Coil Unit
FRNSW	Fire & Rescue New South Wales
HHW	Heating Hot Water
HEPA	High Efficiency Particulate Arrestance
HV	High Voltage
HVAC	Heating, Ventilation & Air Conditioning
IPLV	Integrated Part Load Value
MSB	Main Switchboard
MSSB	Mechanical Services Switchboard
MSR	Main Switchroom
NDY	Norman Disney & Young

Abbreviation	Meaning
OH&S	Occupational Health & Safety
RDS	Room Data Sheets
TBC	To Be Confirmed
UNSW	University of New South Wales
UNSW FM	University of New South Wales Facilities Management
UPS	Uninterruptible Power Supply
VAV	Variable Air Volume
VSD	Variable Speed Drive

2 INTRODUCTION

2.1 Purpose

This report is a Concept Design report outlining the proposed Mechanical, Laboratory Gases and Vertical Transportation services concepts for the University of New South Wales Biological Sciences Project for the State Significant Development – SSD 6674.

The purpose of this report is to define the mechanical and vertical transportations services system concepts proposed for the development and detail how the services are integrated into the design of the development.

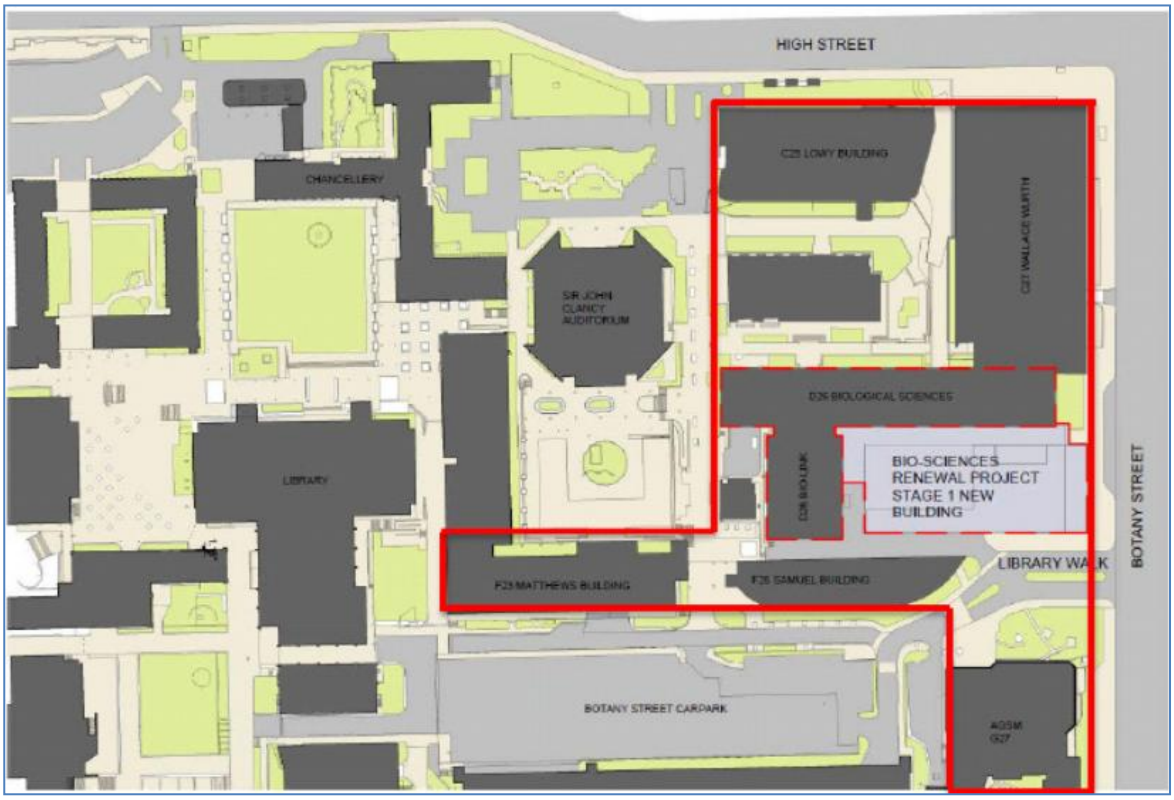
2.2 Authority

The authority to undertake this report was provided by Brookfield Multiplex Construction.

2.3 Project Site

The project site is located at the UNSW's Kensington Campus within the Biomedical Precinct.

Figure 1 – UNSW Biomedical Precinct



2.4 Information Sources

Norman Disney and Young have compiles this report based on the following information sources:

- "*Biological Sciences Project University of New South Wales Design Brief*", Capital Insight, February 2014

- *"UNSW Design and Construction Requirements Rev 4.2 – E.2 Mechanical Services"*, UNSW
- *"Project Definition Plan and Business Case Stage Report",* ARUP Issue 2, 29th August 2013
- *"Volume 3.9 – Room Data Sheets of the Contract Documentation for the Biological Sciences Project at the University of New South Wales"*
- *"Volume 3.10 – FF&E Schedule of the Contract Documentation for the Biological Sciences Project at the University of New South Wales"*

2.5 Revision History

	Date Issued	Comment
1.0	October 2014	SSD 6674 Application
2.0	November 2014	Information
A	22 January 2015	

3 MECHANICAL SERVICES

3.1 Design Criteria

Design Criteria

Item	Design Criteria
External Ambient Conditions	***For comfort and non-critical installations:*** Summer: 32.8°C Dry Bulb/22.6°C Wet Bulb Winter: 7.0°C Dry Bulb and 80% Relative Humidity ***For critical installations:*** Summer: 34.5°C Dry Bulb/23.5°C Wet Bulb Winter: 4.5°C Dry Bulb and 80% Relative Humidity ***For Vertebrate facilities:*** Summer: 40.0°C Dry Bulb/25.0°C Wet Bulb Winter: 4.5°C Dry Bulb and 80% Relative Humidity ***Heat rejection equipment:*** Summer: 40.0°C Dry Bulb/25.0°C Wet Bulb Winter: 4.5°C Dry Bulb and 80% Relative Humidity
Internal Conditions	***Air Conditioned Areas - Generally:*** Room Temperature: 22.5±1.5°C Room Humidity: No direct humidity control (Refer to notes below) ***Laboratory Areas - Generally:*** Room Temperature: 22.5±1.5°C Room Humidity: 60% Relative Humidity maximum achieved via dehumidification cycle for air conditioning units. ***Ventilated Areas - Generally:*** Room Temperature: Uncontrolled Room Humidity: Uncontrolled Notes: 1. All nominated set points and tolerances are applicable at the point of control. 2. Where no direct humidity control is nominated for air conditioned areas, an element of dehumidification will be provided as part of the normal cooling process.
Internal Heat gains	***Occupant Heat Gains:*** Activity Level: Moderately Active Office Work Sensible Gain: 75 Watts/person Latent Gain: 55 Watts/person ***Equipment Heat Gains - Generally:***

Item	Design Criteria
	Heat Gain Rate: 15 Watts/m^2 (Refer to notes below) ***Equipment Heat Gains – Laboratory Areas Generally:*** Heat Gain Rate: 50 Watts/m^2 (Refer to notes below) ***Lighting Heat Gains - Generally:*** Heat Gain Rate: 15 Watts/m^2 (Refer to notes below) Notes: 1. The nominal laboratory heat gain rate will be applied to laboratory areas where detailed equipment lists are not available.
Occupant Density	***Occupancy Rate - Generally:*** Occupancy Rate: 10m^2 per person (Refer to notes below) Notes:
Ventilation Rates	***Outside Air Supply for Occupants:*** General Supply Air: 11.25 L/s per person ***Exhaust Ventilation:*** Toilets: Greater of 150% of AS1668.2 rates or 10 ACH/hr Cleaner's Cupboards: 5.0 L/s/m^2 Garbage Room: 5.0 L/s/m^2, 100 L/s minimum Plant or Storage Room: 5.0 L/s/m^2, 100 L/s minimum Laboratories: To meet specific requirements Notes:
Supplementary Heat Rejection Systems	***General Office Areas Chilled Water Allowance:*** Chilled Water Allowance: 20 W/m^2 Temperature Split: ΔT = 7.0°C (6.0°C flow and 13°C return) ***Laboratory Areas Chilled Water Allowance:*** Chilled Water Allowances: As per briefing documents Temperature Split: ΔT = 7.0°C (6.0°C flow and 13°C return) ***Laboratory Condenser Water Allowance:*** Condenser Water Allowances: As per briefing documents Temperature Split: ΔT = 5.5°C (29.5°C flow and 35°C return) Notes: 1. Individual floor branches shall be sized for 250% of nominal capacity.
Supplementary Outside Air System	***Supplementary Outside air Allowance:*** General Office Areas: 0.3 L/s per m^2 Tempered outside air range: 20-25°C
General Exhaust System	***Supplementary Outside air Allowance:*** General Office Areas: 0.1 L/s per m^2
Central Thermal Plant Chilled and Heating Hot	CHW Temperature Split: ΔT = 7.0°C (6.0°C flow and 13°C return) HHW Temperature Split: ΔT = 20.0°C (80.0°C flow and 60.0°C return)

<table>
<tr><th>Item</th><th>Design Criteria</th></tr>
<tr><td>Water Systems</td><td></td></tr>
<tr><td>Filtration</td><td>General Filtration Levels:
<table>
<tr><th>Space Type</th><th>Pre Filter</th><th>Final Filter</th></tr>
<tr><td>Wet Laboratories:</td><td>G4</td><td>F7</td></tr>
<tr><td>Dry Laboratories:</td><td>-</td><td>F5</td></tr>
<tr><td>Admin Write-up:</td><td>-</td><td>F5</td></tr>
<tr><td>Specialist Labs:</td><td>G4(TBC)</td><td>F7(TBC)</td></tr>
<tr><td>Misc. Support Spaces:</td><td>-</td><td>G4</td></tr>
</table>
HEPA Filtration Requirements:
No specific requirement for provision of HEPA filtration has been nominated within the project briefing documentation.</td></tr>
<tr><td>Thermal Zoning - Generic Workplace Areas</td><td>VAV System maximum zone sizes:
Internal Zones: 120m²
Perimeter Zones: 85m²
Perimeter zones are to be 4.0m in depth from internal façade envelope.
After hours operation minimum zone sizes:
The minimum after hours zone size will be dictated by minimum turn down on the AHU supply air fan providing air conditioning to the occupied area. The nominal minimum after hours zone size will be equivalent to the area served by 30% of the AHU design capacity.
Areas within Generic Workplace areas requiring continuous air conditioning such as floor comms rooms will be provided with dedicated ceiling mounted air conditioning units.</td></tr>
<tr><td>Building Envelope Thermal Performance</td><td>Glazing Performance:
Solar Gain Allowance: <80 W/m²
Vision Panel U-Value: 2.8 W/m².K
External Wall Performance:
Opaque Wall U-Value: 0.35 W/m².K
Roof Performance:
Roof U-Value: 0.25 W/m².K
Exposed Soffit Performance:
Exposed Soffit U-Value: TBC W/m².K
Infiltration:
Façade Infiltration Rate: 0.5ACH/hr applied to a four meter deep perimeter zone
Notes:
1. Building envelope thermal performance is subject to NCC Section J analysis and validation during the concept and schematic design phases.</td></tr>
<tr><td>Ductwork Sizing</td><td>Variable Volume Systems:
Risers and Plantrooms: 7.5 m/s</td></tr>
</table>

Item	Design Criteria	
	In-Ceiling Secondary Distribution:	5.5 m/s
	In-Ceiling Tertiary Distribution:	3.5 m/s & 1.0 Pa/m friction rate max.
	Constant Volume Systems:	
	Risers and Plantrooms:	5.5 m/s
	In-Ceiling Secondary Distribution:	5.5 m/s
	Branch Ducts to Terminal Devices:	3.5 m/s & 1.0 Pa/m friction rate max.
	Flexible Ductwork:	
	Diameter <= 200mm	3.0 m/s
	Diameter >= 200mm	4.0 m/s
Pipework Sizing	Risers:	1.0-1.8 m/s
	Main Distribution:	1.0-1.8 m/s
	Headers:	0.9-1.5 m/s
	Maximum Pressure Drop:	200 Pa/m

3.2 Design Codes and Standards

The design of the mechanical services systems will comply with the following relevant Codes and Standards:

- UNSW Design and Construction Guidelines.
- National Construction Code (NCC).
- AS 1668.1:1998 – The Use of Ventilation and Air Conditioning in Buildings, Part 1: Fire and Smoke Control in Multi-Compartment Buildings.
- AS 1668.2:2012 – The Use of Ventilation and Air Conditioning in Buildings, Part 2: Mechanical Ventilation in Buildings.
- AS/NZS 2243 – Safety in Laboratories.
- AS/NZS 2982 – Laboratory Design and Construction.
- AS/NZS ISO 14644 – Cleanrooms and Associated Controlled Environments.
- Australian Therapeutic Goods Administration (TGA) – Guidelines for Sterility Testing of Therapeutic Goods.
- Australian Office of the Gene Technology Regulator (OGTR) – Guidelines for Certification of a Physical Containment Level 2 Laboratory.
- Australian Office of the Gene Technology Regulator (OGTR) – Guidelines for Certification of a Physical Containment Level 2 Animal Facility.
- The Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH) Handbook.
- The American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Handbook – Applications (2007).
- The American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Handbook – Fundamentals (2009).

- The American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Laboratory Design Guide (2002).
- US Department of Energy – Labs for the 21st Century (Labs21).
- Department of Agriculture - Quarantine Approved Premise Criteria – 5.2 Quarantine containment Level 2.

3.3 General

The following list outlined the main components of the mechanical services systems proposed for the project:

- Chilled Water Plant
- Heating Water Plant
- Process Cooling Water Plant
- Steam Plant
- Air Handling Plant
- Humidification Plant
- General Ventilation Systems
- Fume Cupboard Systems
- Specialist Laboratory Ventilation Systems
- Smoke Control Systems
- Cool Room and Freezer Room Systems
- BMCS System.

3.4 Chilled Water Plant

The new building is to be provided with a new, stand-alone central chilled water plant.

The central chilled water plant is to be comprised of water-cooled chilled water refrigeration machines, cooling towers, chilled water pumps and condenser water pumps.

The central chilled water plant is to be located on the lower ground floor enclosed plantroom consisting of chillers and associated pumps. The cooling towers are to be located externally at roof level at a location adjacent to the pipework riser. If required, the cooling towers will be screened with acoustic louvres and the discharge attenuated to meet noise requirements within and external to the University.

3.4.1 Chillers

The calculated preliminary chilled water cooling load estimate for the building is 3,800 kW.

The chillers are to be high efficiency, variable speed, water cooled machines with either screw or centrifugal compressors. The type of compressors will be selected to maximise efficiency of the chilled water plant and ensure stability of operation.

Each chiller and its associated chilled water pumps will be provided with a dedicated MSSB and a dedicated BMCS control panel in order to ensure continuity of service of the remaining chillers in the event of MSSB or BMCS downtime.

The low load chiller MSSB will be provided with essential power.

The chillers will operate under their own integral control systems to maintain the specified chilled water leaving chilled water temperature at all times throughout the full range of operational loading conditions.

The chiller operating parameters will be monitored by the UNSW CBACS system.

3.4.2 Cooling Towers

The calculated preliminary condenser water heat rejection load estimate for the building chilled water plant is 4,560kW.

The calculated preliminary condenser water heat rejection load estimate for the supplementary and process cooling system is 125kW.

The cooling towers are to be specified with variable speed fan motors for efficient operation.

Cooling towers will be located with appropriate separation distance from adjacent exhaust discharge points and building ventilation openings and also take into consideration site specific acoustic constraints and the requirement for acoustic treatments.

Cooling tower discharge air will be directed vertically and intake air will be via louvered screens which may be acoustically rated as required to address acoustic constraints.

The condenser water system for the building chilled water plant will be an open circuit system.

The condenser water system for the supplementary process cooling system will be a closed circuit system. Two plate heat exchangers in a duty/standby configuration will be utilised to isolate the closed circuit system from the open cooling tower condenser water circuit.

Side stream filtration and dirt separation will be incorporated into the design of the condenser water systems.

The installation of three cooling towers is proposed with each to be sized for 33% of the total calculated condenser water heat rejection load for the building.

Condenser water distribution to the building chilled water plant will be via a variable primary pumping configuration comprised of four condenser water pumps in an N+1 arrangement with each pump sized for 33% of the calculated condenser water flow rate. The condenser water pumps will be provided with VSDs.

One cooling tower and one condenser water pump will be provided with a dedicated MSSB provided with essential power. The remaining two cooling towers will each be provided with a dedicated non essential MSSB. One of these MSSBs will supply power to two condenser water pumps while the other will supply power to the remaining condenser water pump.

The cooling tower fan operation will be monitored by the UNSW CBACS system.

3.5 Heating Water Plant

The new building is to be provided with a new, stand-alone central heating hot water plant.

The central heating hot water plant is to be comprised of conventional gas-fired, modulating, hot water generators and heating hot water pumps.

The central heating water plant is to be located within the roof top plant area. The hot water generators and associated heating water pumps are to be located in a dedicated, enclosed plant room with two hour fire rated construction.

Flues from each hot water generator are to be run from the boiler room vertically to a suitably located discharge point above the roof of the building.

The calculated preliminary heating water load estimate for the building is 1,600kW.

The installation of two hot water generators is proposed with each to be sized for 65% of the total calculated heating water load for the building.

Heating water distribution to the building will be via a variable primary pumping configuration comprised of three heating water pumps in an N+1 arrangement with each pump sized for 50% of the calculated heating water flow rate. The heating water pumps will be provided with VSDs.

Both hot water generators and one hot water pump will be provided with a dedicated MSSB provided with essential power. The remaining hot water pumps will be provided with a dedicated non essential MSSB.

3.6 Process Cooling Water Plant

Both chilled and condenser water supplementary heat rejection provisions are nominated for the laboratory areas.

3.7 Steam Plant

3.7.1 Steam Requirements

The provision of steam to the new building is anticipated for the following:

- Vertebrate House humidification systems
- Laboratory humidification systems.

The calculated preliminary steam load estimate for the building based on the above usages is 262kg/hr. This load estimate is based on the following assumptions:

3.7.2 Existing Steam Plant

There is an existing steam plant located within the D26 Building which is to be relocated as part of the enabling works to accommodate the new substation.

It is intended that the supply of steam for the new building be provided by extension from the relocated existing steam plant.

3.8 Humidification Plant

Humidification systems are required for the following areas:

- Vertebrate Holding humidification
- Laboratory humidification to specialist areas where tight band humidity control has been nominated.

Should the provision of steam not be required for the wash equipment, several options exist for the provision of the humidification systems.

The following humidification system options for the new building have been considered:

- Gas Boiler Steam Humidification
- Electric Boiler Steam Humidification
- Evaporative Humidifier (Adiabatic)
- Water Spray/Atomising Systems.

Gas boiler steam humidification is the recommended option as it offers close band humidity control and energy efficiency. Evaporative and water spray humidifiers are limited in their ability to provide close band humidity control and electric boiler steam humidifiers have relatively more intensive maintenance regimes and energy consumption.

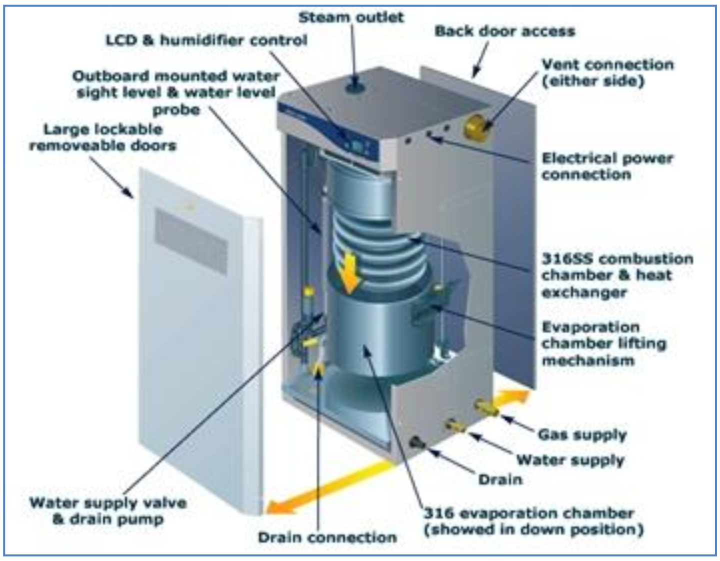
3.8.1 Gas Boiler Steam Humidification Overview

A gas humidifier works by boiling the water within a combustion chamber in a similar manner to a traditional gas boiler. The steam take off from the boiler is supplied to a steam lance located within the ductwork downstream of the AHU.

This type of unit can work for a large range of humidification requirements. The steam generation doesn't always have to be local. It can be generated centrally and distributed to various humidifiers throughout the building via steam pipes.

These systems are usually installed where gas is available and there is a priority on reducing carbon emissions as well as running costs, particular for large system volumes.

Figure 2 – Gas Humidifier (Picture courtesy of JS Humidification)



The following table highlights the advantages and disadvantages of a gas fired humidifier:

Advantages	Disadvantages
Low power consumption	Regular maintenance requirements
Low energy costs	Gas infrastructure required
Allows close steam control	Flues required to outside
Self flushing maintenance schedule	

3.9 Air Handling Plant

Central air handling plant is proposed for the development mounted in enclosed roof plantrooms. The air handling units shall be ducted type with attenuation as required to meet internal and external noise requirements. Refer to specific space concepts stated further in this report.

3.10 General Ventilation Systems

The following general ventilation systems are proposed for the new building:

- Toilet Exhaust
- General Exhaust
- Supplementary Outside Air
- Loading Dock Exhaust
- Garbage Room Exhaust
- Storage Room Ventilation

- Miscellaneous Minor Ventilation Systems.

3.10.1 Toilet Exhaust System

A centralised toilet exhaust system comprising a roof plant level exhaust fan with attenuation as required and an overhead ductwork distribution system connected to ceiling mounted exhaust grilles will be provided which will ventilate the following areas:

- Toilets
- Showers
- Change rooms
- Parenting rooms
- Cleaner’s cupboards.

3.10.2 General Exhaust System

A centralised general exhaust system comprising a roof plant level exhaust fan with attenuation as required and an overhead ductwork distribution system connected to ceiling mounted exhaust grilles will be provided which will ventilate the following areas:

- Photocopier areas
- Kitchenettes
- Tea points.

3.10.3 Supplementary Outside Air System

A centralised tempered supplementary outside air system will be provided comprising a roof plant level AHU with attenuation as required and an overhead ductwork distribution system connected to blanked ductwork connection points on each floor within the General Workplace area. Outside air ductwork will be extended from these blanked connection points to supplementary ceiling mounted air conditioning units serving areas with localised increased ventilation rates such as meeting rooms.

3.10.4 Loading Dock Exhaust System

The lower ground floor load dock will be mechanically ventilated due to the depth of the load zone. An extract system including fan, ductwork and attenuation as required will be provided on the lower ground level and discharge located at high level on the southern side of the development.

3.10.5 Garbage Room Exhaust System

The lower ground floor general waste room will be mechanically ventilated. An extract system including fan, ductwork and attenuation as required will be provided on the lower ground level and discharge located at high level on the southern side of the development.

3.10.6 Storage Room Ventilation System

The lower ground floor storage rooms will be mechanically ventilated. An extract system including fan, ductwork and attenuation as required will be provided on the lower ground level and discharge located at high level on the southern side of the development.

3.10.7 Miscellaneous Minor Ventilation Systems

Miscellaneous minor ventilation systems will be provided as required to code requirements.

3.11 Fume Cupboard Systems

3.11.1 Summary of Fume Cabinets

The following table outlines the extent of fume cabinets:

Level	Room Number	Room Name	Cabinet Description	Qty
Lower Ground	NB.E26.CSH.LG.01	Petrological Prep_Laboratory	1500w Open support frame	1
	NB.E26.CSH.LG.07	Paleontological Prep_Sample Sorting / Prep	1800w Acid + Flammable Cabinet under	1
			Floor Total	**2**
Ground	NB.E26.TAL.LG.02	Wet Teaching_Prep 01	1500w Open support frame	1
			Floor Total	**1**
Level 1	NB.E26.TAL.GL.04	Wet Teaching Prep 02	1500w Open support frame	1
			Floor Total	**1**
Level 2	NB.E26.CCA.L1.01	Preparation Lab - Specimen Prep	1500w Open support frame (FUTURE)	
	NB.E26.CGE.L1.01	Prep_Pre Amplification	1800w Acid + Flammable Cabinet under	1
	NB.E26.CGE.L1.02	Prep_Post Amplification	1800w Acid + Flammable Cabinet under	1
	NB.E26.CPT.L1.01	Preparation + Biophysical Analysis Laboratory	1500w Open support frame	1
	NB.E26.CGE.L1.03	Quality Assurance Lab		1
			Floor Total	**4**
Level 3	NB.E26.RSS.L3.01	Equipment Room_clean / instruments 01	1500w Open support frame	1
	NB.E26.RSS.L3.03	Equipment Room_dirty / noisy	1800w Acid + Flammable Cabinet under	1
	NB.E26.RSS.L2.03	Equipment Room_dirty /	1800w Acid +	1

Level	Room Number	Room Name	Cabinet Description	Qty
		noisy	Flammable Cabinet under	
	NB.E26.RSS.L2.11	Negative Pressure_Ionising Radiation	1800w Acid + Flammable Cabinet under	1
	NB.E26.ROL.L2.01	Open Laboratory - Molecular / Cell Biology 01_40P	1500w (FUTURE)	
	NB.E26.ROL.L2.02	Open Laboratory - Molecular / Cell Biology 02_40P	1500w (FUTURE)	
			Floor Total	**4**
Level 4	NB.E26.RSS.L5.01	Equipment Room_clean/ instruments - Large	1500w Open support frame	1
	NB.E26.RSS.L5.02	Equipment Room_clean/ instruments - Small	1500w Open support frame	1
	NB.E26.RSS.L5.05	Negative Pressure_Chemistry 01	1800w Acid + Flammable Cabinet under	1
	NB.E26.RSS.L5.06	Negative Pressure_Chemistry 02	1800w Acid + Flammable Cabinet under	1
	NB.E26.ROL.L3.01	Open Laboratory - Molecular / Cell Biology 03_40P	1500w (FUTURE)	
	NB.E26.ROL.L3.02	Open Laboratory - Molecular / Cell Biology 04_40P	1500w (FUTURE)	
	NB.E26.ROL.L4.01	Open Laboratory - Ecology / Earth Sciences 01_40P	1500w (FUTURE)	
	NB.E26.ROL.L4.02	Open Laboratory - Ecology / Earth Sciences 02_40P	1500w (FUTURE)	
			Floor Total	**4**
Level 5	NB.E26.RSS.L4.01	Equipment Room_clean/ instruments 01	1500w Open support frame	1
	NB.E26.RSS.L4.07	Negative Pressure_Ionising Radiation	1800w Acid + Flammable Cabinet under	1
	NB.E26.RSS.L4.08	Negative Pressure_Chemistry 01	1800w Acid + Flammable Cabinet under	1
	NB.E26.RSS.L4.09	Negative Pressure_Chemistry 02	1800w Acid + Flammable Cabinet under	1
	NB.E26.ROL.L5.01	Open Laboratory - Ecology	1500w (FUTURE)	

Level	Room Number	Room Name	Cabinet Description	Qty
		/ Earth Sciences 03_40P		
	NB.E26.ROL.L5.02	Open Laboratory - Ecology / Earth Sciences 04_40P	1500w (FUTURE)	
			Floor Total	**4**
			Building Total	**20**

3.11.2 Fume Cabinet Systems

Fume cupboards will be serviced using dedicated PVC exhaust riser ducts and on floor run out ducts. Each exhaust will include a centrifugal exhaust fan located at the upper level of the roof plant room. Each system will include an automatic dilution damper which modulates to ensure maximum efflux velocity at the system discharge point.

Each fume cupboard exhaust fan will be fitted with a VSD to control the fan speed and the air velocity through the cupboard sash opening based on sash position to maintain the minimum inward velocity through the opening.

The discharge height of a fume cupboard exhaust system is critical for proper dilution of the fumes and their dispersal. It is necessary to discharge the exhaust outside the building environment envelope. This is to ensure that fumes are not entrained into the building's fresh air intakes or through operable windows and doors. The discharge height above roof level is nominally 6 meters however this will need to be proven by a plume study assessment. This plume study assessment will be carried out once the plant room equipment layouts are further developed.

In addition to the discharge height the exhaust exit velocity needs to be maintained at between 10 and 15 m/s to ensure that the proper dispersal is maintained in climatic down wash conditions.

3.12 Biological Safety Systems

The following table outlines the extent of biological safety cabinets:

Level	Room Number	Room Name	Cabinet Description	Qty
Level 2	NB.E26.CCA.L1.03	Cell Analysers and Prep	Class 2, 1400 x 850 x 2300	1
	NB.E26.CCA.L1.03	Cell Analysers and Prep	Class 2, 1500 x1700 x2350	1
	NB.E26.CCA.L1.04	Cell Sorters_Environmental	Class 2, 1650 x 1350 x 2320	1
	NB.E26.CCA.L1.05	Cell Sorters_Biological	Class 2	1
	NB.E26.CCA.L1.05	Cell Sorters_Biological	Class 2, 1200 x 1250 x 2200	1
	NB.E26.CPT.L1.01	Preparation + Biophysical Analysis Laboratory	Class 1	1
	NB.E26.RSS.L3.10	SSBA Room	Class 2, 1500 wide	1
			Floor Total	**7**
Level 3	NB.E26.RSS.L2.07	Tissue Culture 01 (Positive Pressure)	Class 2, 1200 wide	3
	NB.E26.RSS.L2.08	Tissue Culture 02 (Positive Pressure)	Class 2, 1200 wide	3
	NB.E26.RSS.L2.09	Tissue Culture 03 (Positive Pressure)	Class 2, 1200 wide	3
	NB.E26.RSS.L2.10	Tissue Culture 04 (Positive Pressure)	Class 2, 1200 wide	3
	NB.E26.RSS.L3.07	Tissue Culture 01 (Positive Pressure)	Class 2, 1200 wide	3
			Floor Total	**15**

Level	Room Number	Room Name	Cabinet Description	Qty
Level 4	NB.E26.RSS.L3.08	Tissue Culture 01 (Positive Pressure)	Class 2, 1200 wide	3
	NB.E26.RSS.L3.09	Negative Pressure_ QC2	Class 2, 1500 wide	1
			Floor Total	**4**
			Building Total	**26**

It is anticipated. that all BSCs will be recirculating type cabinets with integral HEPA filtration systems which will discharge air directly back into the room in which they are located.

A local ceiling mounted exhaust point is proposed to be located directly above each biological safety cabinet. These exhaust points are intended to be used to evacuate the biological safety cabinet following fumigation of the cabinets.

Each exhaust point will consist of a 50mm diameter ball type isolation valve connected to a 50mm diameter PVC ductwork spigot. These ductwork spigots will be connected to a common PVC ductwork header reticulated within the ceiling space. This ductwork will be connected to a central exhaust system with a roof mounted discharge fan.

The proposed exhaust point arrangement is outlined in the photograph below.

Figure 3 - Proposed BSC fumigation exhaust point arrangement

3.13 Specialist Laboratory Ventilation Systems

Based on examination of the laboratory equipment briefed to date in the RDS and FF&E schedules, the following general lab extracts appear appropriate for the new Biological Sciences Building.

1) Chemical and Vacuum Pump General Extract
2) Nederman Arm Extract
3) Warm Air Extract (from heat producing equipment)
4) Combustion Extract

The above extract system's capacities vary dependant on the laboratories use and complexity. The intent of the design is to allow users to connect these services via takeoffs below the ceiling as new equipment is expected to be provided within the laboratories over the operational life of the building. Hence the extracts above are somewhat general but require distinct systems due to the nature of the associated laboratory processes (i.e. Nederman arm extract has a higher system pressure drop requirement from other systems and combustion extract should not be combined with chemical extract etc.).

3.14 Smoke Control Systems

The smoke control system concepts comprise of the following:

- Central smoke exhaust via Return/Relief/Smoke spill shaft and fan located at plant level for General Workplace areas with make-up air via the supply air systems. Motorised dampers are intended to be used as an alternate solution to sub ducts within Return/Relief/Smoke spill shaft.
- Smoke exhaust via purge systems with make-up air via laboratory AHUs for the following areas:
  - Open Laboratories
  - Support Laboratories
  - Teaching Laboratories.

Further development of the smoke control concepts are subject to the approval of the project Fire Engineer.

3.15 Cool Room and Freezer Room Systems

The following table outlines the extent of walk in Cool Rooms and dedicated Fridge and Freezer rooms:

Level	Room Number	Room Name	Description
Lower Ground	NB.E26.CSH.LG.08	Sample Store +4 deg C walk in Cold Room	Sample Store +4 deg C walk in Cold Room
	NB.E26.TAL.GL.06	Store 4 deg C Cold Room	Store 4 deg C Cold Room
Level 2	NB.E26.CGE.L1.06	Store Fridges	Store for fridges
	NB.E26.RSS.L2.05	Equipment Room freezers 01	Store for fridges
	NB.E26.RSS.L2.06	Equipment Room freezers 02	Store for fridges
Level 3	NB.E26.RSS.L3.05	Equipment Room freezers 01	Store for fridges
	NB.E26.RSS.L3.06	Equipment Room freezers 02	Store for fridges
Level 4	NB.E26.RSS.L4.05	Equipment Room freezers/ fridges 01	Store for freezers
	NB.E26.RSS.L4.06	Equipment Room freezers/ fridges 02	Store for freezers
Level 5	NB.E26.RSS.L5.03	Equipment Room freezers/ fridges 01	Store for freezers
	NB.E26.RSS.L5.04	Equipment Room freezers/ fridges 02	Store for freezers

3.15.1 Walk-In Cold Rooms

Walk in cold rooms will be factory assembled if feasible and will include compressors, condensers, forced draft evaporators and interconnecting refrigeration piping as required to form a complete system.

The condensers are intended to be located at high level within the loading dock area if feasible to reduce the required refrigerant pipework lengths.

3.15.2 Refrigerator and Freezer Storage Rooms

Refrigerator and Freezer Rooms will be air conditioned via dedicated ceiling mounted air conditioning units. Air conditioning units will be provided in an N+1 configuration. Outside air will be provided to each room via the AHU serving the adjacent laboratory areas to satisfy the requirements of AS1668.

3.16 BMCS

A Building Monitoring and Control System (BMCS) will be provided for the new building in accordance with the following documents:

- UNSW Design and Construction Requirements Rev 4.2 Appendix 1 – Campus Building Automation and Control System
- UNSW Design and Construction Requirements Rev 4.2 Appendix 7 – Energy Management – Electricity, Gas and Water Metering
- UNSW Biological Sciences Project Building Management and Control Systems Performance Brief Rev 2, ARUP

The BMCS will be specified in accordance with the following document:

- UNSW Design and Construction Requirements Rev 4.1 Appendix 3 – UNSW Control System Standards HVAC

The details of the BMCS will be developed in further detail during the Schematic and Design Development phases of the project in consultation with UNSW FM.

3.17 General Workplace Concepts

Each General Workplace area will be air conditioned via a number of dedicated variable volume AHUs located within the roof level plant area. These AHU's supply air will be utilised to:

- Satisfy the ventilation requirement based on the room occupancies.
- Provide the required air conditioning capacity to offset space heat gains and losses and maintain the nominated temperature set point within the space.

Each AHU will be capable of delivering 100% outside air and providing economy cycle mode.

Each AHU supply air fan will be sized to deliver the calculated air flow rate required to offset space heat gains and losses and maintain the nominated temperature set point within the space.

The cooling and heating capacities of each AHU will be specified to maintain the nominated temperature set points and tolerance bands within the under normal operating conditions on a design day.

Primary thermal zoning within the General Workplace areas will be provided by provision of dedicated AHUs for each distinct thermal zone. Dedicated AHUs will be provided for North, East and West perimeter zones and a dedicated AHU for the Internal Zone.

Supply air will be distributed throughout the General Workplace areas via overhead ductwork located within the ceiling space and introduced to the room via ceiling mounted supply air diffusers.

Secondary thermal zoning within the General Workplace areas will be provided via Variable Air Volume (VAV) terminal boxes.

Return/Relief air will be removed from the General Workplace areas via common overhead ductwork located within the ceiling space. This ductwork system is also intended to be utilised for smoke spill operation.

A common Return/Relief/Smoke Spill fan dedicated to the General Workplace areas will be provided at the plant room level. Individual ductwork branches from this fan will be connected to each AHU serving the General Workplace areas and to relief/smoke spill discharge louvres.

Modulating, tight shutoff, motorised dampers will be provided to the system outside air, return air, and relief/smoke spill air ductwork branches at the plant room level. The operation of these dampers will be controlled in unison to maintain the required flow rates in each ductwork branch.

Supplementary chilled water will be provided to the General Workplace areas as nominated.

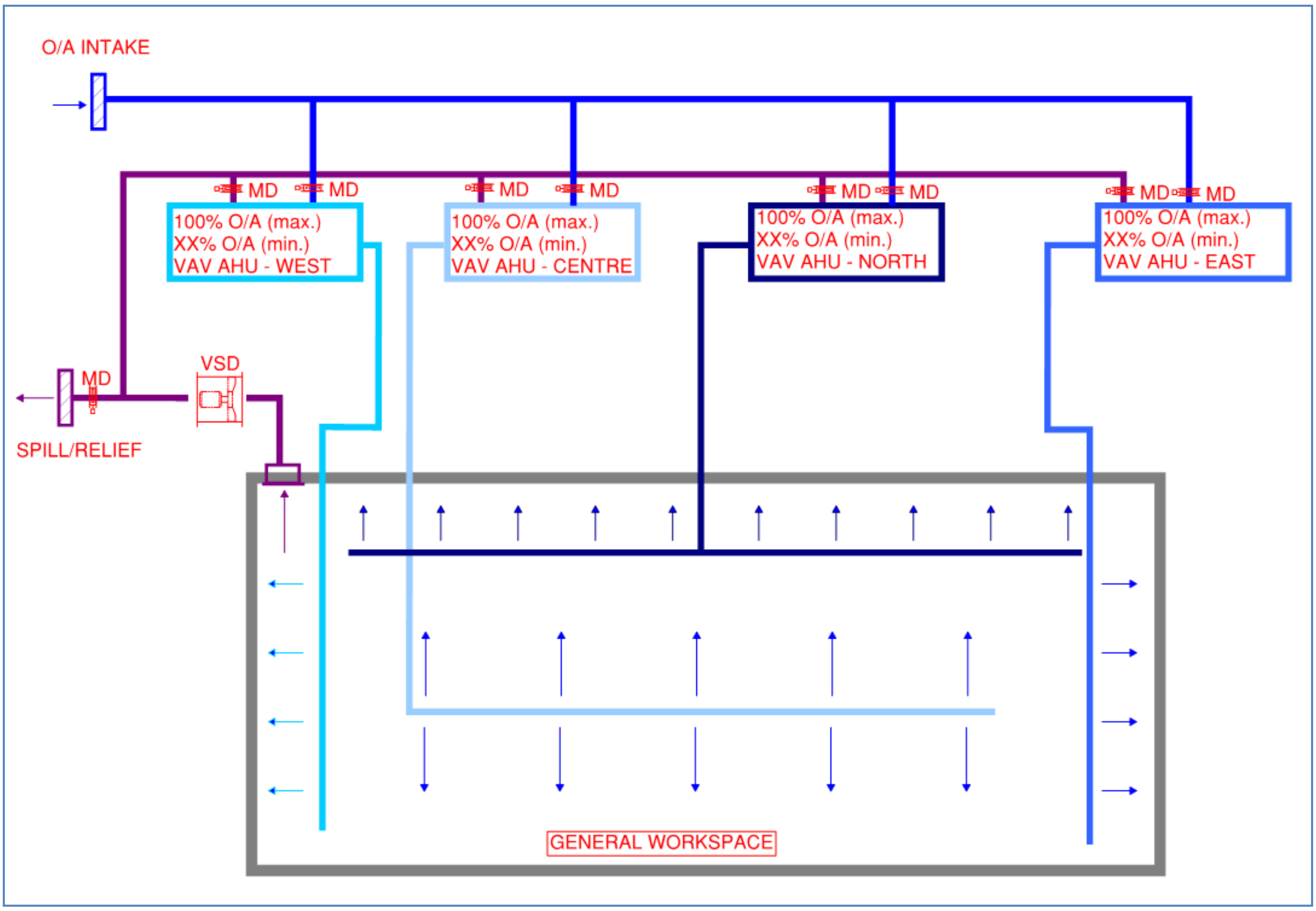
Supplementary ceiling mounted air conditioning units will be provided to the following areas within the General Workplace where required to satisfy increased ventilation and/or heat rejection resulting from higher occupant density and/or equipment heat generation rates:

- Meeting rooms with more than 6 occupants
- Seminar rooms
- Comms rooms.

General exhaust and supplementary outside air will be provided to areas within the General Workplace.

The figure below outlines schematically the concept the General Workplace areas.

Figure 4 – General Workplace Area Concept Schematic



3.18 Open Laboratory Concepts

Each open plan laboratory will be air conditioned via a dedicated variable volume AHU located within the roof level plant area. This AHU supply air will be utilised to:

- Provide a maximum Air Change (ACH) rate of 6 ACH/hr of outside air during normal operation.
- Deliver a maximum Air Change (ACH) rate of 10 ACH/hr of outside air during purge mode.
- Satisfy the ventilation requirement based on the room occupancies.
- Provide the required air conditioning capacity to offset space heat gains and maintain the nominated temperature set point within the space.

Each AHU will be capable of delivering 100% outside air and providing economy cycle mode.

Each AHU supply air fan will be sized to deliver a maximum Air Change (ACH) rate of 10 ACH/hr of outside air during purge mode.

Under normal operating conditions a maximum ACH rate of 6 ACH/hr of outside air is to be maintained.

High level control of relative humidity will be provided via inclusion of a dehumidification cycle on each AHU which is to operate when space relative humidly exceeds the nominated maximum value.

An air quality sensor system may be provided to monitor Total Volatile Organic Compounds (TVOC) levels and reduce volume of outside air delivered to the laboratory under normal operating conditions if this approach is recommended by a ventilation study.

The cooling and heating capacities of each AHU will be specified to maintain the nominated temperature set points and tolerance bands within the laboratory under normal operating conditions on a design day.

Supply air will be distributed to each laboratory via overhead ductwork located within the ceiling space and introduced to the room via ceiling mounted supply air diffusers.

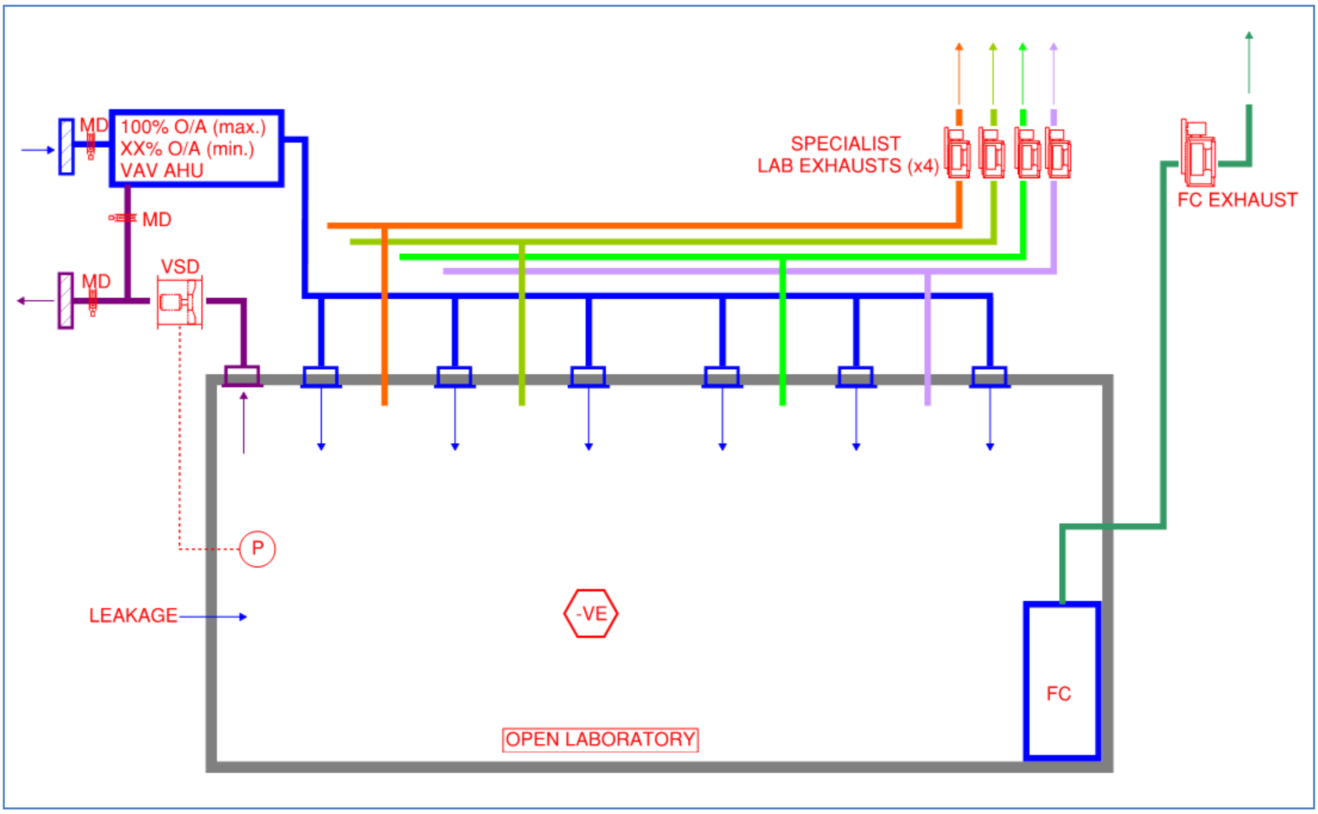
Return/Relief/Purge air will be removed from each laboratory via common overhead ductwork located within the ceiling space connected to ceiling mounted exhaust air grilles.

A dedicated variable volume Return/Relief/Purge air fan will be provided for each AHU which will operate in response to a pressure sensor located within each laboratory. This fan will be sized to deliver a maximum Air Change (ACH) rate of 10 ACH/hr during purge mode. The fan speed will vary dynamically in order to maintain the predetermined negative pressure set point within the laboratory relative to the surrounding areas and in response to the operation of fume cabinets and any point exhausts located within the laboratory.

Modulating, tight shutoff, motorised dampers will be provided to the system outside air, return air, and purge/relief air ductwork branches at the plant room level. The operation of these dampers will be controlled in unison to maintain the required flow rates in each ductwork branch. Flow grids will be installed in each ductwork branch connection to the AHU to monitor the air flow rates and inform the position of the modulating dampers.

The figure below outlines schematically the concept for a generic open plan laboratory.

Figure 5 - Open Laboratory Concept Schematic



3.19 Support Laboratory Concepts

Each support laboratory area will be provided with tempered outside air via a common variable volume AHU located within the roof level plant area. This tempered outside air supply will be utilised to:

- Provide a maximum Air Change (ACH) rate of 6 ACH/hr of outside air during normal operation.
- Deliver a maximum Air Change (ACH) rate of 10 ACH/hr of outside air during purge mode.
- Provide positive pressurisation to support labs where nominated.
- Satisfy the ventilation requirement based on the room occupancies.

Each tempered outside air AHU will be capable of delivering 100% outside air and providing economy cycle mode.

Each AHU supply air fan will be sized to deliver a maximum Air Change (ACH) rate of 10 ACH/hr of outside air during purge mode.

Under normal operating conditions a maximum ACH rate of 6 ACH/hr of outside air is to be maintained.

High level control of relative humidity will be provided via inclusion of a dehumidification cycle on each AHU which is to operate when space relative humidly exceeds the nominated maximum value.

An air quality sensor system may be provided to monitor Total Volatile Organic Compounds (TVOC) levels and reduce volume of outside air delivered to the laboratory under normal operating conditions if this approach is recommended by a ventilation study.

The cooling and heating capacities of each AHU will be specified to deliver tempered outside air at the nominated temperature set points and tolerance bands within the laboratory under normal operating conditions on a design day.

Tempered outside air will be distributed to each laboratory via overhead ductwork located within the ceiling space and introduced to the room via ceiling mounted supply air diffusers.

Relief/Purge air will be removed from each individual support laboratory via common overhead ductwork located within the ceiling space. A dedicated ductwork connected to ceiling mounted exhaust air grilles. A dedicated ductwork branch provided with a variable volume device will be provided to each individual support lab room.

A common variable volume Relief/Purge air fan will be provided for each support laboratory area which will operate to maintain a constant negative pressure within the common Relief/Purge ductwork. The variable volume devices located within each dedicated ductwork branch will modulate the Relief/Purge air quantity in response to a pressure sensor located within each laboratory to maintain either a positive or negative pressure differential within each individual support lab room relative to the surrounding areas.

This Relief/Purge fan will be sized to deliver a maximum Air Change (ACH) rate of 10 ACH/hr of outside air during purge mode for any one room served by the common system while maintaining an a maximum ACH rate of 6 ACH/hr of outside air for the remaining rooms served by the system.

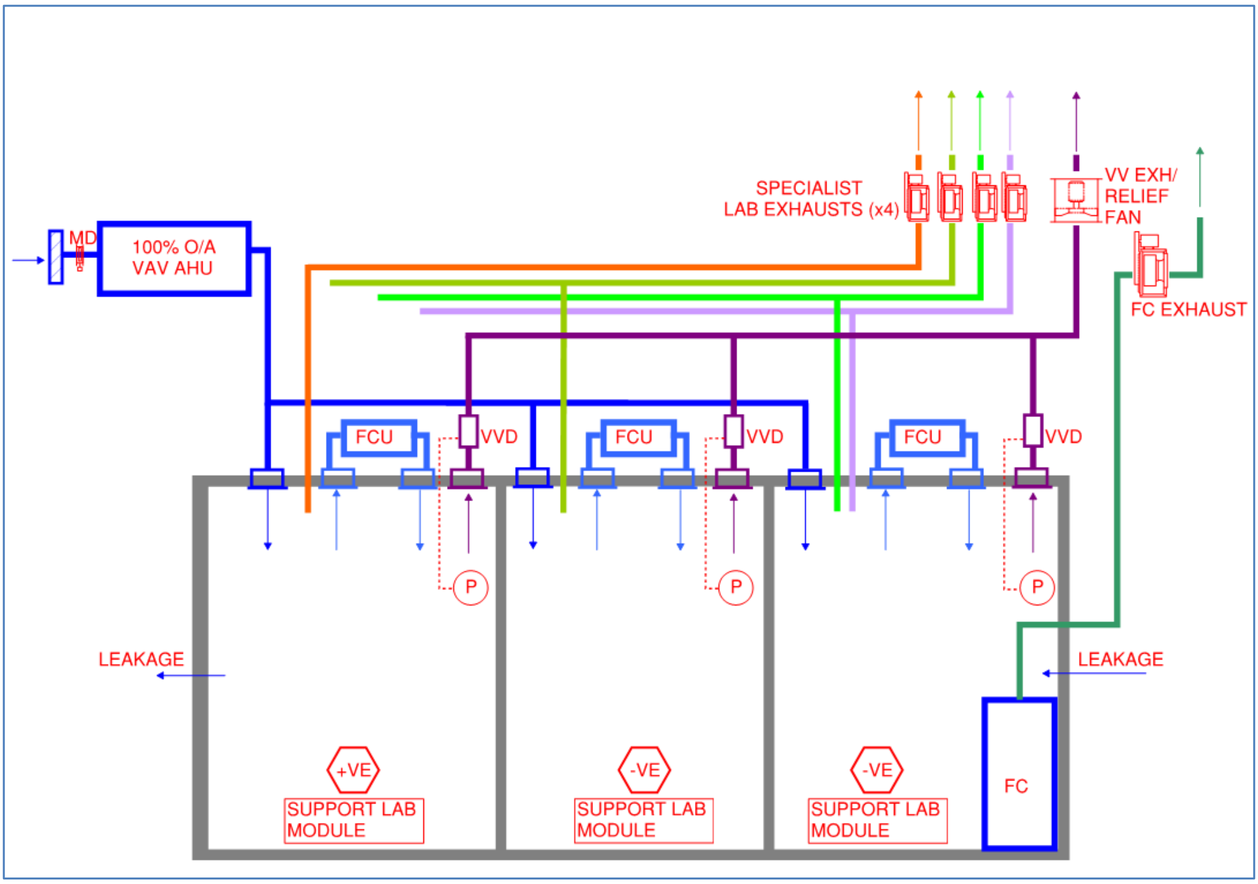
The fan speed will vary dynamically in order to maintain the predetermined negative pressure set point within each individual support lab room and in response to the operation of fume cabinets and any point exhausts located within each room.

Each individual Support Laboratory room is to be air conditioned via a dedicated ceiling mounted Fan Coil Unit (FCU). This will be a constant volume unit which recirculates air within each individual Support Laboratory. The unit will be sized to provide the required cooling to offset space heat gains and maintain the nominated temperature set point within the space.

FCU supply air will be distributed to each laboratory via overhead ductwork located within the ceiling space and introduced to the room via ceiling mounted supply air diffusers. FCU return air will be removed from each laboratory via overhead ductwork located within the ceiling space connected to ceiling mounted exhaust air grilles.

The figure below outlines schematically the concept for a generic Support Laboratory area.

Figure 6 - Support Laboratory Concept Schematic



3.20 Teaching Laboratory Concepts

Each teaching laboratory area will be provided with tempered outside air via a common variable volume AHU located within the roof level plant area. This tempered outside air supply will be utilised to:

- Provide a maximum Air Change (ACH) rate of 6 ACH/hr of outside air during normal operation.
- Deliver a maximum Air Change (ACH) rate of 10 ACH/hr of outside air during purge mode for the Wet Teaching Prep area only.
- Satisfy the ventilation requirement based on the room occupancies.

Each tempered outside air AHU will be capable of delivering 100% outside air and providing economy cycle mode.

Each AHU supply air fan will be sized to deliver simultaneously a maximum Air Change (ACH) rate of 6 ACH/hr of outside air during normal operating conditions to the teaching laboratory areas and an ACH rate of 10 ACH/hr of outside air for purge mode of the Teaching Prep area only.

High level control of relative humidity will be provided via inclusion of a dehumidification cycle on each AHU which is to operate when space relative humidly exceeds the nominated maximum value.

An air quality sensor system may be provided to monitor Total Volatile Organic Compounds (TVOC) levels and reduce volume of outside air delivered to the laboratory under normal operating conditions if this approach is recommended by a ventilation study.

The cooling and heating capacities of each AHU will be specified to deliver tempered outside air at the nominated temperature set points and tolerance bands within the laboratory under normal operating conditions on a design day.

Tempered outside air will be distributed to each laboratory via overhead ductwork located within the ceiling space and introduced to the room via ceiling mounted supply air diffusers. A dedicated ductwork branch provided with a variable volume device will be provided to each individual teaching lab room.

Relief/Purge air will be removed from each individual teaching laboratory via common overhead ductwork located within the ceiling space. A dedicated ductwork branch provided with a variable volume device will be provided to each individual teaching lab room.

A common variable volume Relief/Purge air fan will be provided for each teaching laboratory area which will operate to maintain a constant negative pressure within the common Relief/Purge ductwork. The variable volume devices located within each dedicated ductwork branch will modulate the Relief/Purge air quantity in response to a pressure sensor located within each laboratory to maintain either a positive or negative pressure differential within each individual teaching lab room relative to the surrounding areas.

This Relief/Purge fan will be sized to deliver a maximum Air Change (ACH) rate of 10 ACH/hr of outside air during purge mode of the Wet Teaching Prep area only while maintaining an a maximum ACH rate of 6 ACH/hr of outside air for the remaining rooms served by the system.

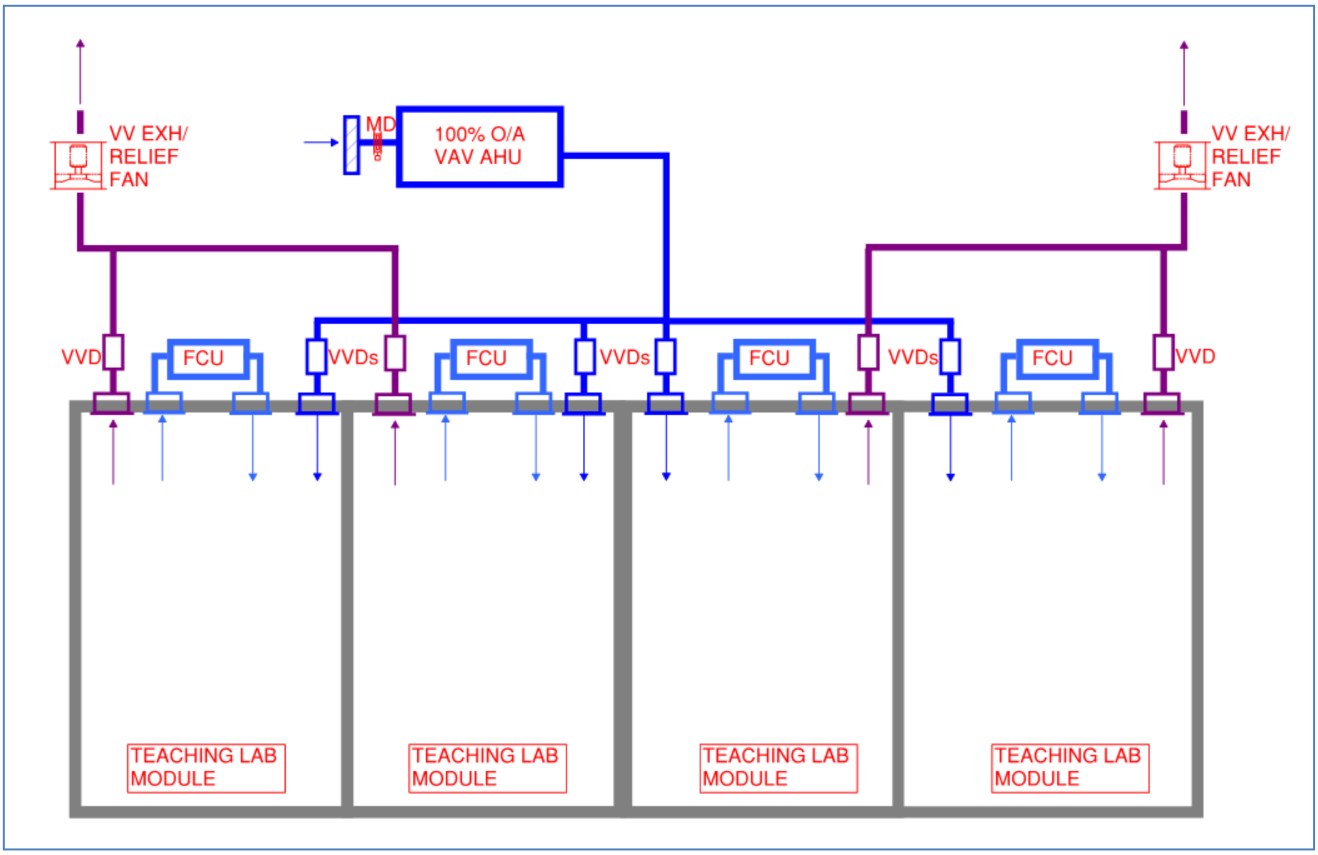
The fan speed will vary dynamically in order to maintain the predetermined negative pressure set point within each individual teaching lab room and in response to the operation of fume cabinets and any point exhausts located within each room.

Each individual Teaching Laboratory room is to be air conditioned via a dedicated ceiling mounted Fan Coil Unit (FCU). This will be a constant volume unit which recirculates air within each individual Teaching Laboratory. The unit will be sized to provide the required cooling to offset space heat gains and maintain the nominated temperature set point within the space.

FCU supply air will be distributed to each laboratory via overhead ductwork located within the ceiling space and introduced to the room via ceiling mounted supply air diffusers. FCU return air will be removed from each laboratory via overhead ductwork located within the ceiling space connected to ceiling mounted exhaust air grilles.

The figure below outlines schematically the concept for a generic Teaching Laboratory area.

Figure 7 - Teaching Laboratory Concepts Schematic

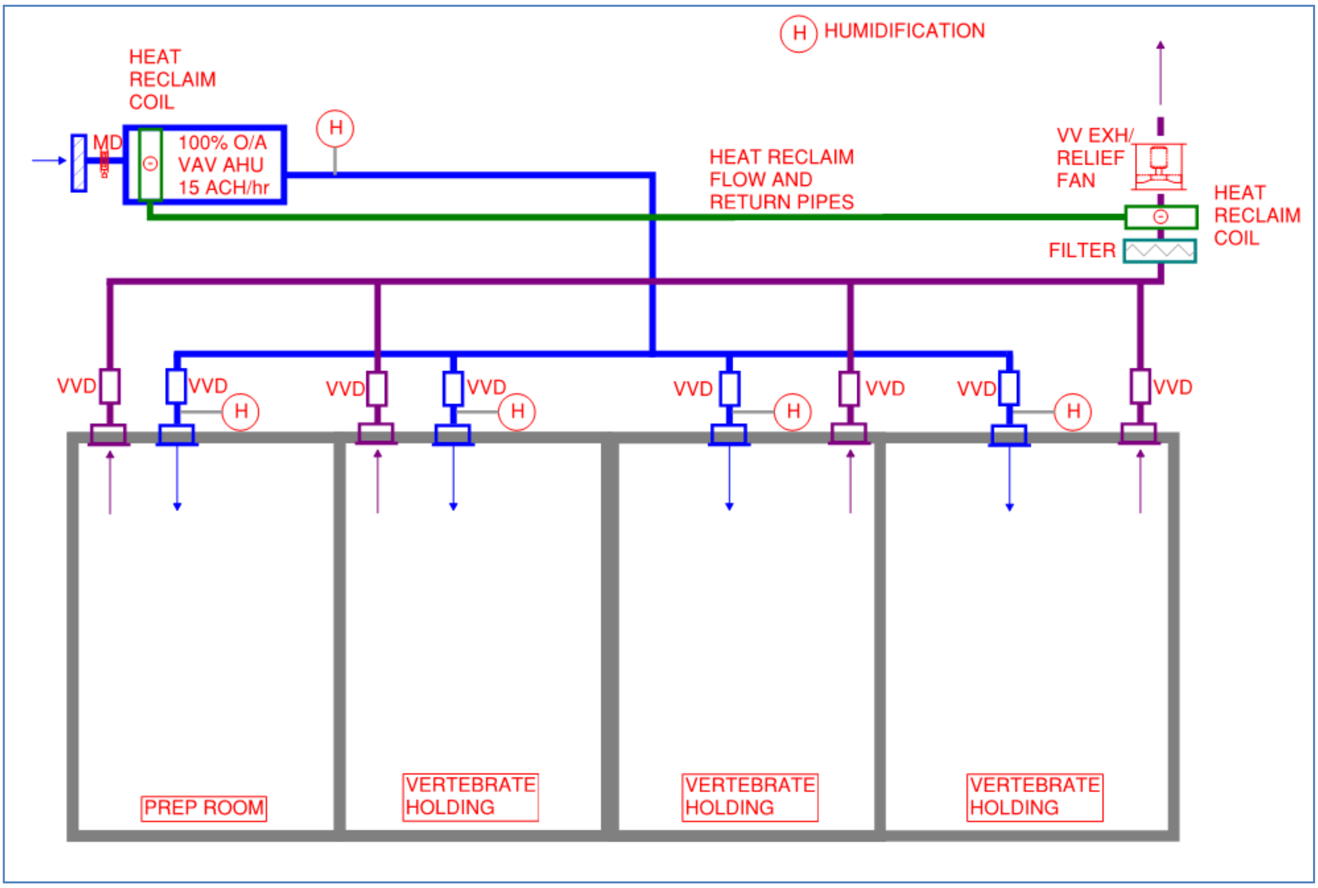


3.21 Vertebrate Holding Concepts

Each individual Vertebrate Holding enclosure will be provided with tempered outside air via a common variable volume AHU located within the roof level plant area. This tempered outside air supply will be utilised to:

- Provide a minimum Air Change (ACH) rate of 6 ACH/hr of outside air during normal operation.
- Deliver a maximum Air Change (ACH) rate of 15 ACH/hr of outside air during normal operation.

Figure 8 – Vertebrate Holding Areas Concept Schematic



4 LABORATORY GASES SERVICES

4.1 General

The following laboratory gases outlets are nominated in the briefing documents:

- Carbon Dioxide
- Nitrogen:
  - Standard
  - High Purity 99% (for mass spectrometers and microscopes)
- Compressed Air:
  - Standard
  - Medical Grade/High Purity Oil Free (for robotics and microscopes)
- Argon (for mass spectrometers and cell sorters)
- Oxygen - Medical Grade (for mass spectrometers)
- Helium:
  - High Purity (for mass spectrometers)
  - Helium Nitrogen Mix (HeN_2) (for mass spectrometers)
- Vacuum
- Spare Gas Provisions.

4.2 Design Criteria, Diversification Allowances and Pipe Materials

The laboratory gases systems and pipework reticulation will be design in accordance with the following schedule:

Gas Service	Design Pressure	Diversity	Pipe Material
Carbon Dioxide	400kPa		Type B Copper (Medical Grade)
Nitrogen - Standard	400kPa		Type B Copper (Medical Grade)
Nitrogen – High Purity	400kPa		Stainless Steel
Compressed Air - Standard	400kPa		Type B Copper (Medical Grade)
Compressed Air – Medical Grade	400kPa		Type B Copper (Medical Grade)
Argon	400kPa		Type B Copper (Medical Grade)
Oxygen – Medical Grade	400kPa		Type B Copper (Medical Grade)
Helium - High Purity	400kPa		Stainless Steel
Helium – Helium Nitrogen Mix	400kPa		Type B Copper (Medical Grade)
Vacuum	-70kPa		Type B Copper (Medical Grade)

4.3 Design Codes and Standards

- AS 2896 Medical gas systems—Installation and testing of non-flammable medical gas pipeline systems

- AS 4332 The storage and handling of gases in cylinders
- AS 1894 The storage and handling of non-flammable cryogenic and refrigerated liquids.

4.4 Carbon Dioxide System

The laboratory nitrogen will be provided via the centralised liquid carbon dioxide bulk vessel located on the lower ground floor providing liquid and gas boil off carbon dioxide. The bulk liquid tank is proposed to be provided on the southern side of the development for the tanker truck to be able to park along side to fill the tanks. It is proposed silencers will be installed to limit the noise when off gassing occurs.

4.5 Laboratory Vacuum System

The laboratory vacuum service will be provided by dedicated plant located within the roof plant room area and reticulated via a single vertical riser to all floors of the facility.

The vacuum plant will be provided with N+1 redundancy.

Interconnectivity will be provided to allow for connection to the adjacent buildings in the event of plant failure.

4.6 Compressed Air System

The laboratory compressed air service will be provided by extending the existing compressed air system that serves D26. This plant was inspected and it is considered that adequate capacity exists to extend the system to serve Stage 1 based on the estimated usage. Compressed air will be reticulated via a single vertical riser to all floors of the facility.

4.7 Argon System

The laboratory argon service will be provided by local cylinders and manifold areas on each generic lab floor that will allow reticulation for gases to be supplied per floor. Duty/standby cylinder packs complete with an auto-change over manifold will be provided.

4.8 Nitrogen System

The laboratory nitrogen will be provided via the centralised liquid nitrogen bulk vessel located on the lower ground floor providing liquid and gas boil off nitrogen. The bulk liquid nitrogen tanks are proposed to be provided on the southern side of the development for the tanker truck to be able to park along side to fill the tanks. It is proposed silencers will be installed to limit the noise when off gassing occurs.

A separate manifolded cylinder system may be required with the proposed nitrogen quantity provided in Room Data Sheets and the Hassell Room Equipment for high use and high purity areas consisting of microscopes and mass specs.

4.9 Helium System

The laboratory helium and helium nitrogen mix services will be provided by local cylinders and manifold areas on each generic lab floor that will allow reticulation for gases to be supplied per floor. Duty/standby cylinder packs complete with an auto-change over manifold will be provided.

4.10 Oxygen System

The laboratory helium service will be provided by local cylinders and manifold areas on each generic lab floor that will allow reticulation for gases to be supplied per floor. Duty/standby cylinder packs complete with an auto-change over manifold will be provided.

5 VERTICAL TRANSPORTATION SERVICES

5.1 General

We confirm the proposed design meet UNSW Design Guidelines and incorporate lift maintenance activities to be carried out in an area not accessible to users and staff as the following options includes lifts serving plant levels for the option of MRL.

5.2 Design Criteria and Standards

The proposed lift design has been based on the following criteria and standards:

- UNSW Biological Science Project Engineering Design principles and Guidelines
- UNSW Lift Standards and Guidelines Volume 4.12
    - Handing Capacity of 12.5%
    - Waiting Interval of <35 seconds
- Woods Bagot Populations Assessment– Static Population
- NDY site assessment 2nd October 2014
- Lift Services good practice to limit the horizontal distance travelled from anywhere on the floor plate to the lifts to a maximum of 50 meters

5.3 Passenger Lifts

Recommended Passenger Lift Scheme is 3 x 1.75m/s, 1350kg (18 pass) Machine Roomless (MRL) lifts with conventional control

- Result using the recommended passenger lift scheme is:
    - Handing Capacity of 12.5%
    - Up-Peak Waiting Interval of 30.7 seconds

Car size of 1550mm wide x 2000mm deep x 2500mm high

Door entrance of 1100mm wide x 2100mm high

Liftwell Plan Dimensions would be 2500mm x 2500mm per lift (plus 150mm trimmer beam)

Liftwell overrun would be 4600mm (from FFL top level served to underside liftwell slab)

Pit depth of 1800mm

5.4 Goods Lifts

Recommended Scheme is 1 x 1.0m/s, 3000kg (43 pass) Machine Roomless (MRL) lift with conventional control

Car size of 2000mm wide x 2700mm deep x 2500mm high

Car with front and rear entrances

Door entrance of 1500mm wide x 2500mm high

Liftwell Plan Dimensions would be 2800mm wide x 3400mm deep

Liftwell overrun would be 4900mm (from FFL top level served to underside liftwell slab)

Pit depth of 2200mm

Goods lift shall be arranged as a passenger/goods lift provided with Hazardous Goods service in accordance UNSW Design Guidelines

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