Kensington Community High School - Electrification

KCHS - Electrification

Kensington Community High School - Electrification

Submission date: 18-Mar-24

Document Control

Client Contact

Abdur Rahman (Hafeel)

Senior Project Coordinator

City Property | Property Infrastructure and Design

City of Melbourne

Bridgeford Group Contact

Nick Tassigiannakis

Managing Director

Bridgeford Group

+61 447 249 459

nick.tassi@bridgefordgroup.com.au

Document Version

Title	Kensington Community High School - Electrification
Date Created	15-Feb-24
Date of Change	18-Mar-24
Author	Sajeewi Baddage/Richard O'Sullivan/Ben Wilsmore
Review and Approval	Lynette Williams
Approval Date	18-Mar-24
Version	V1.0

Table 1: Document Version Control

Contents

1 Executive Summary

1.1 Context – Kensington Community High School

The City of Melbourne has engaged the Bridgeford Group to perform an engineering analysis and options study for providing air conditioning and ventilation systems to classrooms and various office spaces in the Kensington Community High School. The building has a heritage overlay which limits the extent of the works that can be done.

The existing systems on site are as follows:

- Wall-hung split Air conditioning units providing cooling and heating to the Kitchen/canteen, staff room, and copy room.
- Wall-mounted gas-fired heaters for space heating to most spaces
- . Pedestal/floor-standing AC units have been installed for high-occupancy spaces; however, it was evident during the site visit that these are not provided sufficient cooling.
- Openable windows and doors for ventilation for high-occupancy spaces such as classrooms.

This option report provides an overview of possible design options for air conditioning systems, discusses proposed options and their buildability issues, and provides recommendations.

1.2 Financial overview and option of costs

Item	Option 1- Multi Head AC / Split AC units (recommended)	Option 2- VRF systems / Split AC units
Capital costs including 20% continency	$ 283,577	$ 472,163
Energy Consumption p.a.	36,605 kWh	34,832 kWh
Running Cost $ p.a.	$ 7,321	$ 6,966
Energy Source	Electricity	Electricity
Comments		
Electrification	Yes	Yes
Cooling/Heating	Yes	Yes
Removal of existing gas fired heaters	Yes	Yes
Additional plant space	Yes	Yes
Builders work	Additional allowance required for builder's works: • wall penetrations for refrigerant pipes and condensate drain installation including sealing, • wall/roof make good works once the gas fired heaters are removed. • equipment lifting/cranage. • Minor ceiling works for pipework installation. • Patch and paint	Additional allowance required for builder's works: • wall penetrations for refrigerant pipes and condensate drain installation including sealing, • wall/roof make good works once the gas fired heaters are removed. • Ceiling works for Branch boxes • Patch and paint. • Equipment lifting/cranage.

Table 2: Financial summary

These costings don't include craneage, builders-work-in-association, consultant fees and similar.

1.3 Key project Issues

The following key issues have been noted –

- Natural ventilation only for the high occupancy spaces such as classrooms
- Existing AC units do not provide sufficient cooling.
- The building was initially constructed in 1850s and has a heritage overlay. So, the modification to the existing building is limited for any proposing Air conditioning system.
- Given the age of the building and the construction, this building has many open gaps causing air leakages and/or infiltration of outside air.
- Existing drawings provided for review do not match with the observed room arrangement on site nor to room labels match current room usage.
- Electrical works include the demolition and replacement of the existing Main Switchboard and potential supply upgrade to site.

1.4 Ventilation and MHRVs

Most of the spaces are not airtight, given the age of the building and spaces have many gaps causing air leaks, hence providing an MHRVs for ventilation would not be cost effective. However, spaces are provided with openable windows for natural ventilation.

1.5 Recommended Option Justification

Bridgeford Group's recommendation is **Option 1 – Provision of Multi head AC units and split AC units for spaces heating/cooling due to the following reasons**:

- Lowest total cost.
- The use of small-sized individual systems allows to turn off any unoccupied spaces.
- Smaller footprints for outdoor units' installation compared to VRF outdoor units.
- The combination of multi-head AC systems and split AC units reduces the use of bulky outdoor units, like those in the VRF system.
- Outdoor units can be wall-hung or floor-mounted like the existing AC units installed at the site.
- Multi-head AC units do not require Branch boxes connections (these boxes must install inside ceiling voids usually) like in VRF systems. Less damage to the building.
- Comparable energy consumption per annum and running cost per annum.

The recommended option requires additional wall penetration for refrigerant pipes, drains, and electrical cabling installations. It also requires identifying suitable outdoor unit installation locations around the building.

1.6 Next steps

The following works are required prior to progressing to tender documentation -

- A detailed site survey is required to confirm the room sizing, current lighting and equipment needs and occupancy. (Outside BG scope)
- Site review of proposed condensing unit locations
- Consultation with Heritage over proposal to confirm that permission would be granted to alter the building.
- Confirmation of electrical supply to the site and ability to increase supply to site (BG action once loadings are confirmed)

1.7 Additional recommendations

1. Perform a building survey by a heritage architect to identify any remedies to improve the spaces airtightness.
2. Conduct a due diligence check on the existing AC units at the site.

2 Options Comparison Summary

The table below presents the key concept options and recommendation.

Item	Option 1- Multi head / Split ACs	Option 2- VRF systems
System Description	Combination of reverse cycle Multi head AC units and Reverse cycle Split AC units for space cooling and heating.	VRF heat pump systems and Split AC units (for smaller rooms) for space cooling and heating.
Plant		
Electrification	Yes	Yes
Space Cooling/heating	Yes	Yes
Additional plant space	Yes	Yes
Space temperature control flexibility	Limited	Yes
COP		
Cooling	3.9	4.24
Heating	4.3	4.24
Spatial Review		
Indoor units	Wall hung type	Wall hung type. Additional in ceiling spaces required for Branch box installation.
Outdoor units	-Wall hung/floor mounted adjacent to the building. -Similar to the existing AC units	-Only floor mounted on plinths -Bulky outdoor units -Larger footprints are needed slightly away from the building (due to noise).
Refrigerant pipe reticulation	- The refrigerant pipe can run on the external side of the walls and penetrate the building where the indoor units are located. -Any refrigerant pipe that cannot run on the external side of the wall shall be installed on the internal side of the walls (with a protective casing), similar to the installation of the existing AC unit.	-External (exposed to sun) refrigerant pipes connecting the building and outdoor units (installed slightly away from the building) -Refrigerant pipes can run on the external walls of the building. However, the VRF systems' related branch connection boxes shall be installed inside ceiling voids, and more refrigerant pipe congestion/coordination will be required near the branch box.
In ceiling installation	No required	Required for VRF systems' Branch connection box installation
Energy		
Energy Sources for cooling/heating	Electricity	Electricity
Electricity Consumption kWh p.a.	36,605 kWh	34,832 kWh
Items included in consumption	Selected AC systems	Selected AC systems
Life span and costing		
Energy and Maintenance Cost p.a.	$ 16,205	$ 18,325
Capital Cost including contingency 20%	$ 283,577	$ 472,163
Economic life of systems	15 years	15 years

Table 3: Financial summary

3 Existing System Overview

3.1 Building Description

The Kensington Community High School is a single-story building constructed using redbrick masonry. The roof structure is assumed to be cut timber trusses with timber battens that support the slate-tiled roof with several skylights for classrooms and offices. (reference: KPMG—DRAFT Condition Assessment & CAPEX—Kensington Community High School). Construction was completed in the late 1850s. The KCHS has historical significance and a heritage overlay that needs to be considered while selecting/proposing air conditioning systems.

The school building comprises different-sized classrooms, office spaces, a kitchen/canteen, and student and staff toilets..

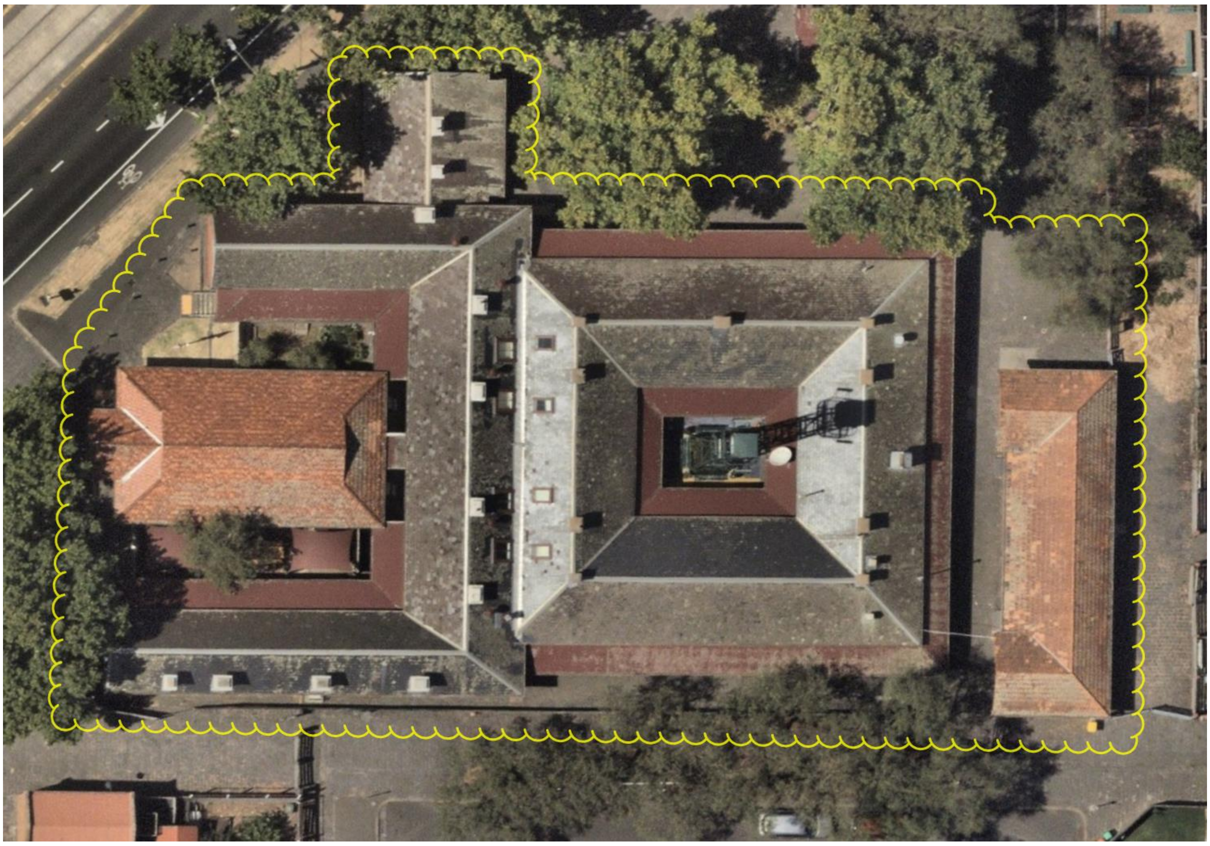

Figure 1: Aeriel view of the KCHS.

3.2 Mechanical

There are a few mechanical systems installed in the building for cooling and heating. However, the following observations have been made during the site walkthrough.

- Wall-hung split Air conditioning units for few spaces (shown/indicated in the below figure)
- Pedestal/floor-standing AC units.
- Ceiling mounted exhaust fans inside classrooms/offices
- Wall-mounted gas-fired heaters for space heating
- Ceiling fans in some of the spaces.

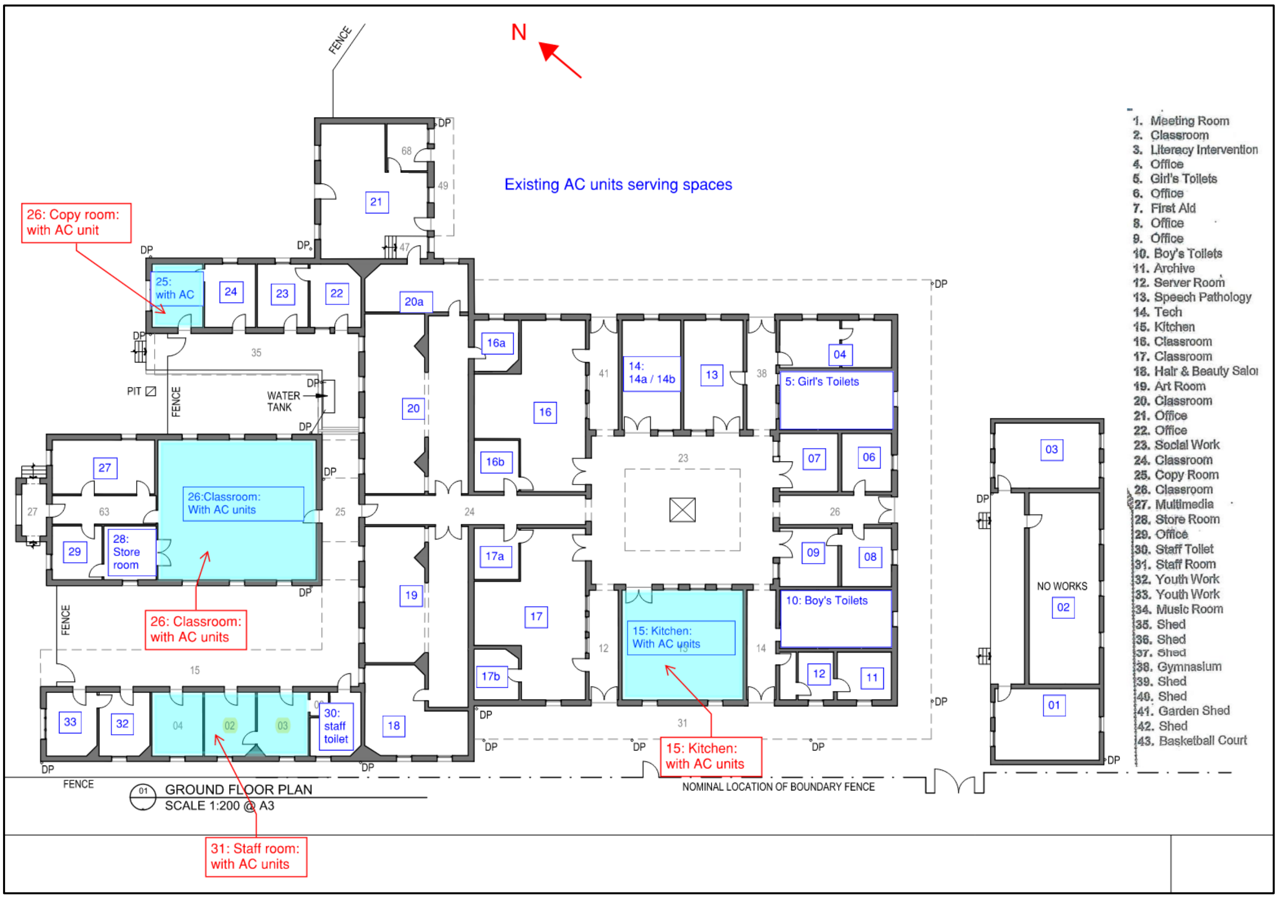

Figure 2: Existing AC units serving spaces/rooms.

Figure 3: From left, High wall AC units, Pedestal type AC units, ceiling fan.

Figure 4: From left, Outdoor installation for the existing split ACs, and condensate drainpipe termination to a floor gully.

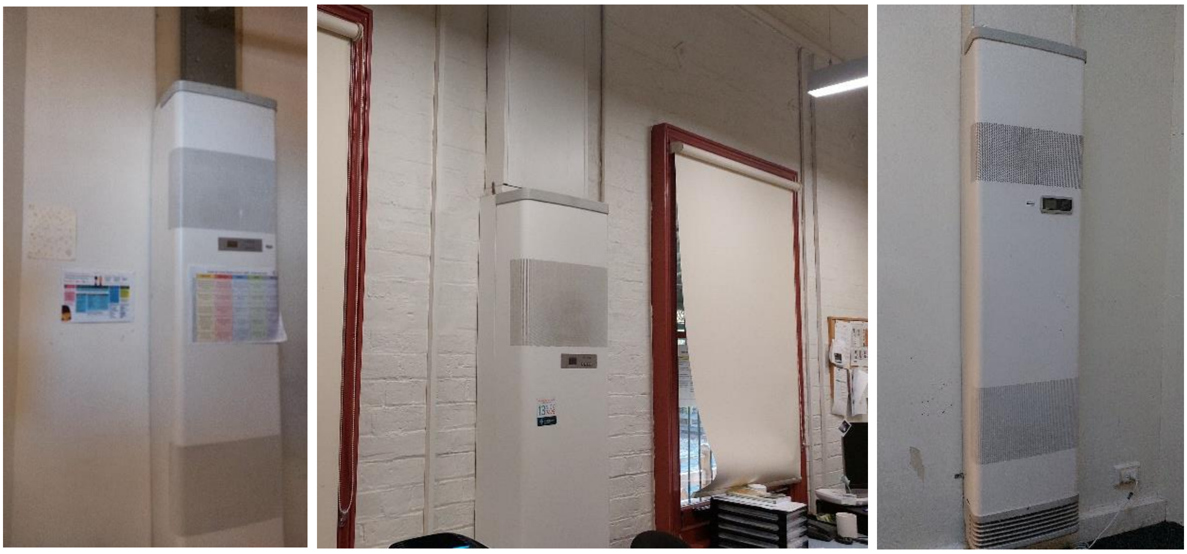

Figure 5: Existing wall-mounted gas-fired heaters for space heating.

Figure 6: Ceiling mounted exhaust fans, and skylights with manually operable shades.

3.3 Existing Electrical Power Supply Review

3.3.1 Site Supply

The site is supplied from a 500kVA supply authority transformer located inside the school grounds. Power is reticulated from the transformer via underground conduit to the main switchboard (MSB).

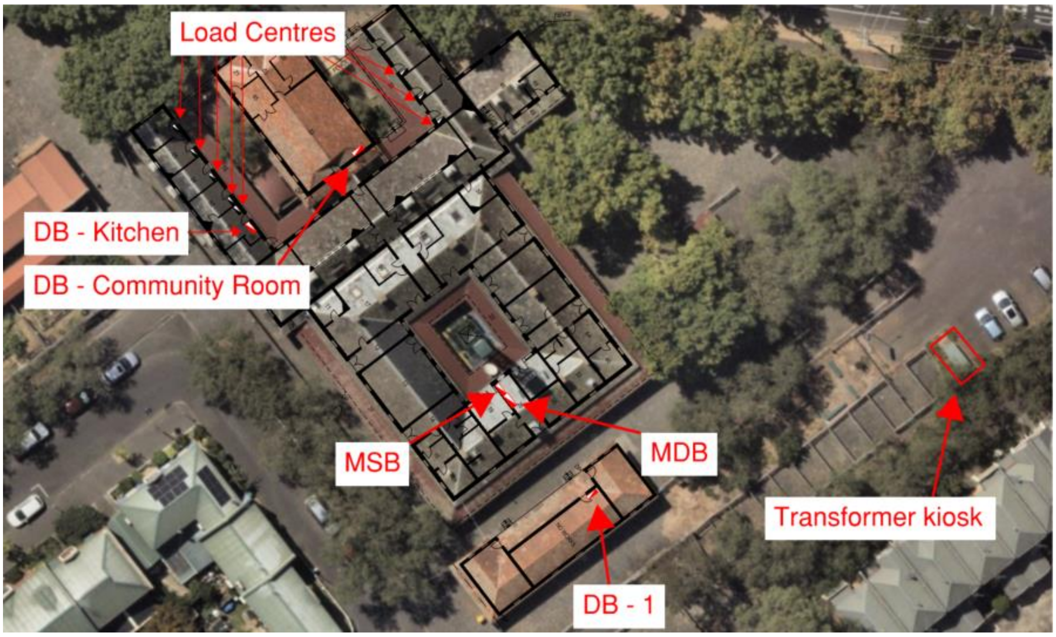

Figure 7: Electrical site plan.

3.3.2 Main Switch Board

The existing MSB contains two fuse switches which feed power through to the main distribution board and kitchen switchboard. The existing supply is limited to 200A by the fuse installed between the transformer and MSB. This board has three spare poles remaining for distribution. The Metering of the site occurs at entry of this board with a CT metering configuration.

Figure 8: Main Switch Board

Figure 9: CT Metering Enclosure

3.3.3 Main Distribution Board

The existing main distribution board (MDB) has capacity for up 250A, however the supply to this board is limited to 100A by the fuse switch in the MSB. This board delivers power to distribution boards located in the gym, building B, along with smaller load centers distributed around the school site as well as lighting circuits.

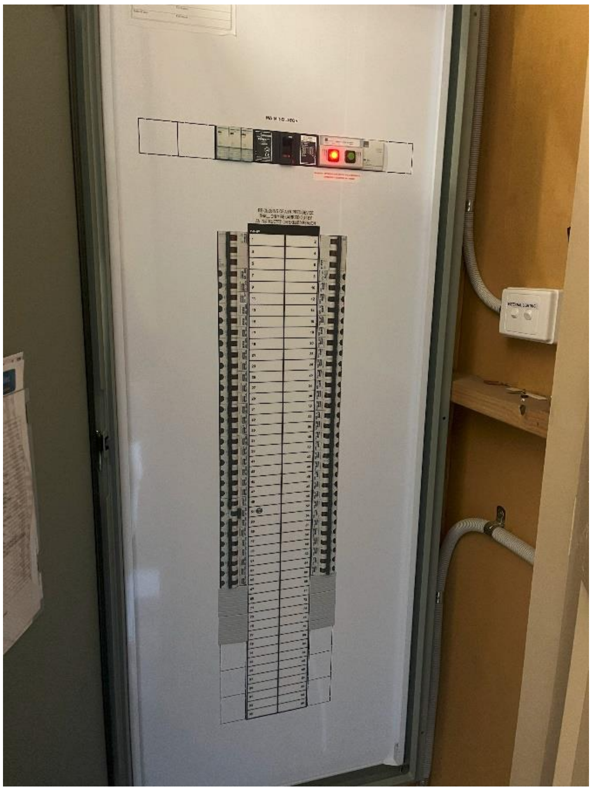
Figure 10: Existing MDB

3.3.4 Community Room Distribution Board

The existing community center distribution board has a capacity of 250A, however is currently limited by the circuit breaker supplying the board, which is rated to 40A. This board feeds power to the load centers located in the east and west offices.

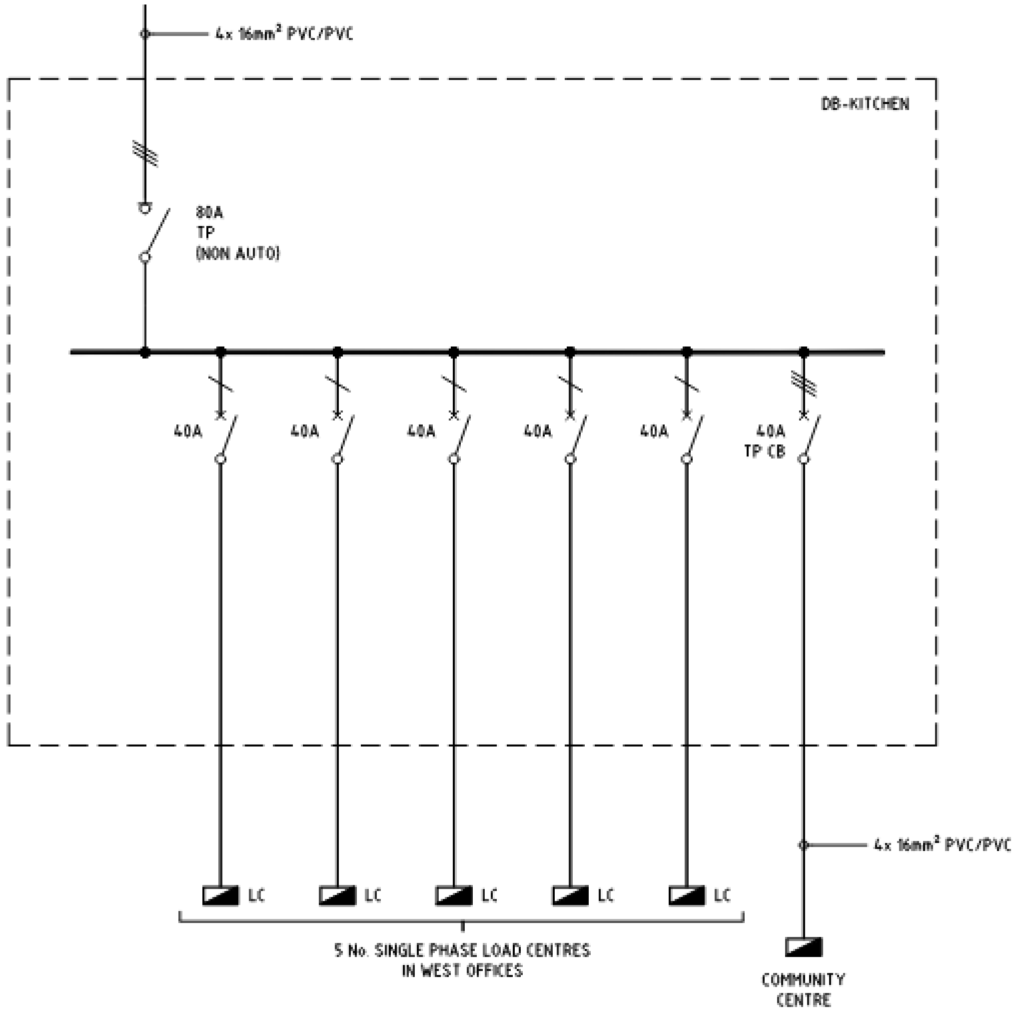

Figure 11: Existing DB Kitchen - Single Line Diagram

3.3.5 Building B Distribution board

The distribution board located in building B is rated 160 A, the supply to this board however is restricted to 40A by the circuit breaker feeding the board in the MSB.

3.3.6 Submains Cabling sizing.

As per the single line diagram provided, the submains from the MSB to the Kitchen DB are 4 x 16mm^2 PVC/PVC cables, these have a current carrying capacity of 62A depending on the method of installation and are undersized for any future proposed works and will require upgrade. Further investigations will be required to confirm cable size/installation method.

3.4 Controls

There is no overall control system within the building, each split AC unit and gas fired heater has their own individual controls.

3.5 Constraints

As the building was constructed in late 1850s and due to the heritage overlay, following constrains are identified-

- Heritage constraints limits
  - Use of roof area for external plant installation.
  - Modifications to the walls including penetrations and exposed plant and conduits.
  - Locations for ground mounted/wall hung plant which cannot be visible from the street.
- The ceiling spaces are not large enough nor available for concealed HVAC equipment installation (MHRVs, ceiling cassettes etc.).
- The observed spaces' numbering, naming, and internal wall/partitioning are slightly different from the available old drawings. i.e. some of the spaces have been divided by partitioned to make stores/offices etc. – A detailed site survey is required to confirm the room sizing, current lighting and equipment needs and occupancy.
- Given the age of the building, the air tightness of the building would have deteriorated so outside air supplies are unlikely to be able to pressurize the spaces, hence the provision of MHRVs for ventilation with ventilation reclaim would not be effective and efficient and.

4 System load confirmation

4.1 High level review of system loads

The spaces' cooling and heating loads were calculated using the Carrier HAP program, and the assumptions and results are shown in the table below on a room-by-room basis.

The calculations allowed for fluorescent lighting loading at 15W/m^2 and an infiltration rate of 0.5AC/hr.

The calculated total loads (cooling/heating) are below 150kW and economical for split AC or VRF systems.

Note: The space names/numbers were obtained from available drawings, and any deviation from the building's current layout shall be verified and updated if necessary.

SN	Room no.	Room Name	Total floor area (m2)	No of people assumed	Equipment load allowance (W/m2)	Total Cooling load (kW)	Cooling sensible load (kW)	Heating load (kW)
1	01	Meeting room	30	5	7	4.2	4.2	3.8
2	02	Classroom	54	25	4	9.4	9.2	10.3
3	03	Literacy Intervention	30	5	7	4.5	4.5	3.8
4	04	Office	21	4	10	3.7	3.6	3.4
6	06	Office	11.5	2	15	1.6	1.6	1.4
7	07	First Aid	13.4	3	15	2.1	2	1.7
8	08	Office	11.5	3	15	1.8	1.8	1.6
9	09	Office	13.4	3	15	2.1	2	1.7
11	11	Archive	10	2	20	1.8	1.7	1.6
12	12	Server room	10	1	1000	11.5	11.5	1.4
13	13	Speech Pathology	25.6	10	8	4.6	4.6	4.9
14	14	Tech	25.6	6	8	3.7	3.7	3.7
16	16	Classroom	55.5	25	4	9.5	9.5	10.4
16	16a	Office	8.6	2	20	1.5	1.4	1
16	16b	Office	9	2	20	1.3	1.3	0.9
17	17	Classroom	55.5	25	4	9.3	9.3	10.2
17	17a	Office	9.1	2	20	1.5	1.5	1.2
17	17b	Office	8.7	2	20	1.1	1	0.9
18	18	Hair & Beauty salon	29	10	15	5.4	5.4	4.7
19	19	Art room	62.6	25	5	10.8	10.8	10.5
20	20	Classrooms	73	25	5	12.3	12.1	11.1
20	20a	Classrooms	19	4	5	2.3	2.3	1.9
21	21	Office	57	6	4	6.6	6.6	5.8
22	22	Office	12	2	4	1.7	1.6	1.2
23	23	Social work	12	2	15	1.7	1.6	1.4
24	24	Office	12	2	15	1.7	1.6	1.4
27	27	Multimedia	22	6	22	4.3	4.2	3.7
29	29	Office	10.3	2	20	1.8	1.8	1.5
32	32	Youth work	12.5	2	15	1.8	1.7	1.4
33	33	Youth work	12.5	2	15	1.8	1.7	1.4
		Total loads (kW)				127.4		108.5

Table 4: Summary of Cooling and heating load required spaces and total loads.

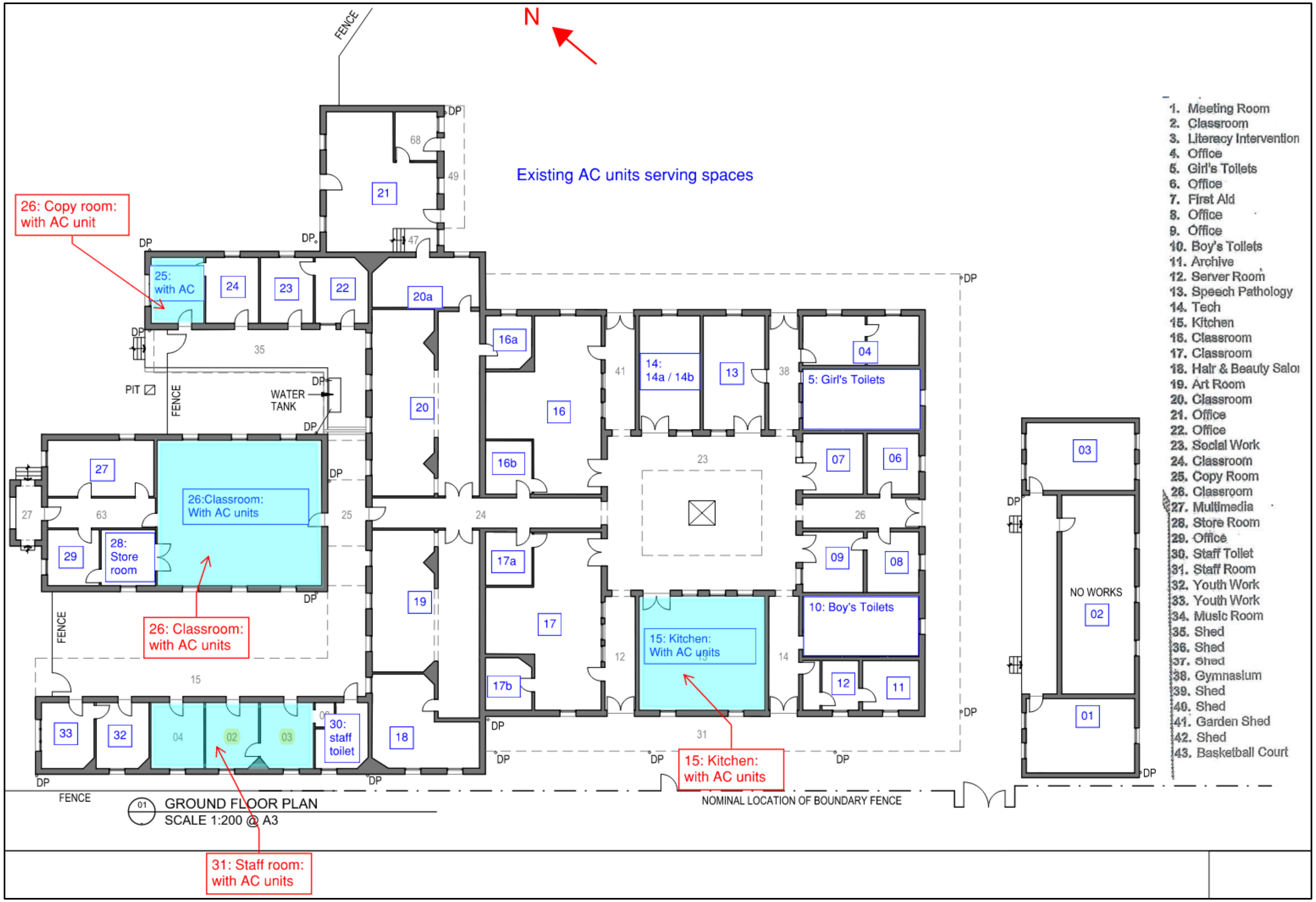

Figure 12: Load summary table associated space numbers and space names.

4.2 Future capacity requirements

The spaces with existing AC units (15-Ktichen, 25-Copy Room, 26-Classroom, and 31-StaRoomoom) are potentially future capacity addition spaces. Though the existing AC units are working fine, they need to be replaced sooner or later.

5 Proposed Concept

5.1 Design Consideration

The proposed concept design conforms to the following key criteria:

Criteria	Requirement	Description
Heritage compliance	Meet the heritage architectural requirements	There shall be no work on the roof or demolition work on the wall/façade. However, wall penetrations would be needed for each space for the refrigerant pipes' connections between indoor and outdoor units and for the condensate drainpipe from the indoor unit to the nearest drains. Hence, heritage architectural approval shall be obtained.
Possible increase in comfort conditions	Performance and occupancy comfort	To propose design and additional recommendations to increase human comfort by adding AC systems
Fit for Purpose & compliance	Efficient in terms of cost, operation, and compliance	The proposed design fulfils the heating and cooling demands. The physical dimensions of indoor/outdoor units fit inside rooms and the available outdoor locations. VRF system: Allowable refrigerant volume requirements to meet the latest codes/standards.
Maintainability	Ease of maintenance	The AC system shall have easy maintenance access. The reverse cycle AC systems for cooling/heating will have lesser maintenance to the existing wall mounted gas-fired heaters.
Environmental Benefits	Low emissions	Electrification of the existing gas-fired heater with reverse cycle AC system and reduction of onsite emissions.
Energy Efficient, Removal of gas	Support Net Zero goals	Energy Efficient design supporting Net Zero goals. Removal or disconnection of the existing gas pipe network.
Efficiency	Efficient Equipment	Above 3.5 peak load COP.
Buildability	Installation with minimum interruption	Due to the nature of the building, the proposed AC system would consist of a set of decentralized AC systems. Therefore, installation can be staged (system by system).

Table 5: Key design criteria

5.2 Other considered options

The following HVAC systems were considered and determined to be inappropriate for this building -

- Centralized HHW/CHW systems would require a central plant space within or external to the building, there is no available roof or ground mounted area suitable for this plant. Pipe reticulation around the building would also be obtrusive.
- The option of one-to-one Dx split AC units has not been considered due to the limited availability of outdoor units' installation locations around the heritage building.
- Variable air volume Air handling unit – Requires large AHU and ductwork distribution across the floor which would not fit within the limited ceiling space.
- Central tempered outside air and local fan coil units – require ductwork and pipework distribution.

5.3 Component

The following components of the system are proposed –

Recommended option is a combination of Multi head AC systems and split Acs for space cooling and heating.

- Multi head AC systems for cooling and heating
- Split AC units (for smaller spaces)
- Proprietary control systems come with each AC system.

5.4 High level markup

5.4.1 Option 1 (recommended)

The table below shows the system Option 1 related zones, the proposed type of AC system with a number of indoor units and estimated cooling/heating loads. The locations of the indoor units and the outdoor units are tentatively marked on the markup drawings and are not drawn to the scale. However, the final installation locations shall be verified at the site. Note that the outdoor units can be wall hung, and the typical installation shall be to the existing installation shown in Figure 4 (either floor or wall).

Room no.	Room Name	Indoor units qty	Zone no. for AC system	Proposed system	Total Cooling load (kW)	Cooling sensible load (kW)	Heating load (kW)
01	Meeting room	1	1	Split AC unit	4.2	4.2	3.8
02	Classroom	2	2	Split AC unit	9.4	9.2	10.3
03	Literacy Intervention	1	3	Split AC unit	4.5	4.5	3.8
04	Office	1	4	Multi head split AC	3.7	3.6	3.4
06	Office	1			1.6	1.6	1.4
07	First Aid	1			2.1	2	1.7
08	Office	1	5	Multi head split AC	1.8	1.8	1.6
09	Office	1			2.1	2	1.7
11	Archive	1			1.8	1.7	1.6
12	Server room	1	6	Split AC unit	11.5	11.5	NA
13	Speech Pathology	1	7	Multi head split AC	4.6	4.6	4.9
14	Tech	1			3.7	3.7	3.7
16	Classroom	2	8	Multi head split AC	9.5	9.5	10.4
16a	Office	1			1.5	1.4	1
16b	Office	1			1.3	1.3	0.9
17	Classroom	2	9	Multi head split AC	9.3	9.3	10.2
17a	Office	1			1.5	1.5	1.2
17b	Office	1			1.1	1	0.9
18	Hair & Beauty salon	1	10	Split AC unit	5.4	5.4	4.7
19	Art room	2	11	Split AC unit	10.8	10.8	10.5
20	Classrooms	2	12	Multi head split AC	12.3	12.1	11.1
20a	Classrooms	1			2.3	2.3	1.9
21	Office	2	13	Multi head split AC	6.6	6.6	5.8
22	Office	1			1.7	1.6	1.2
23	Social work	1	14	Multi head split AC	1.7	1.6	1.4
24	Office	1			1.7	1.6	1.4
27	Multimedia	1	15	Multi head split AC	4.3	4.2	3.7
29	Office	1			1.8	1.8	1.5
32	Youth work	1	16	Multi head split AC	1.8	1.7	1.4
33	Youth work	1			1.8	1.7	1.4
	Total loads (kW)				127.4		108.5

Table 6: Option 1 - Zones considered for Multi head and Split AC systems

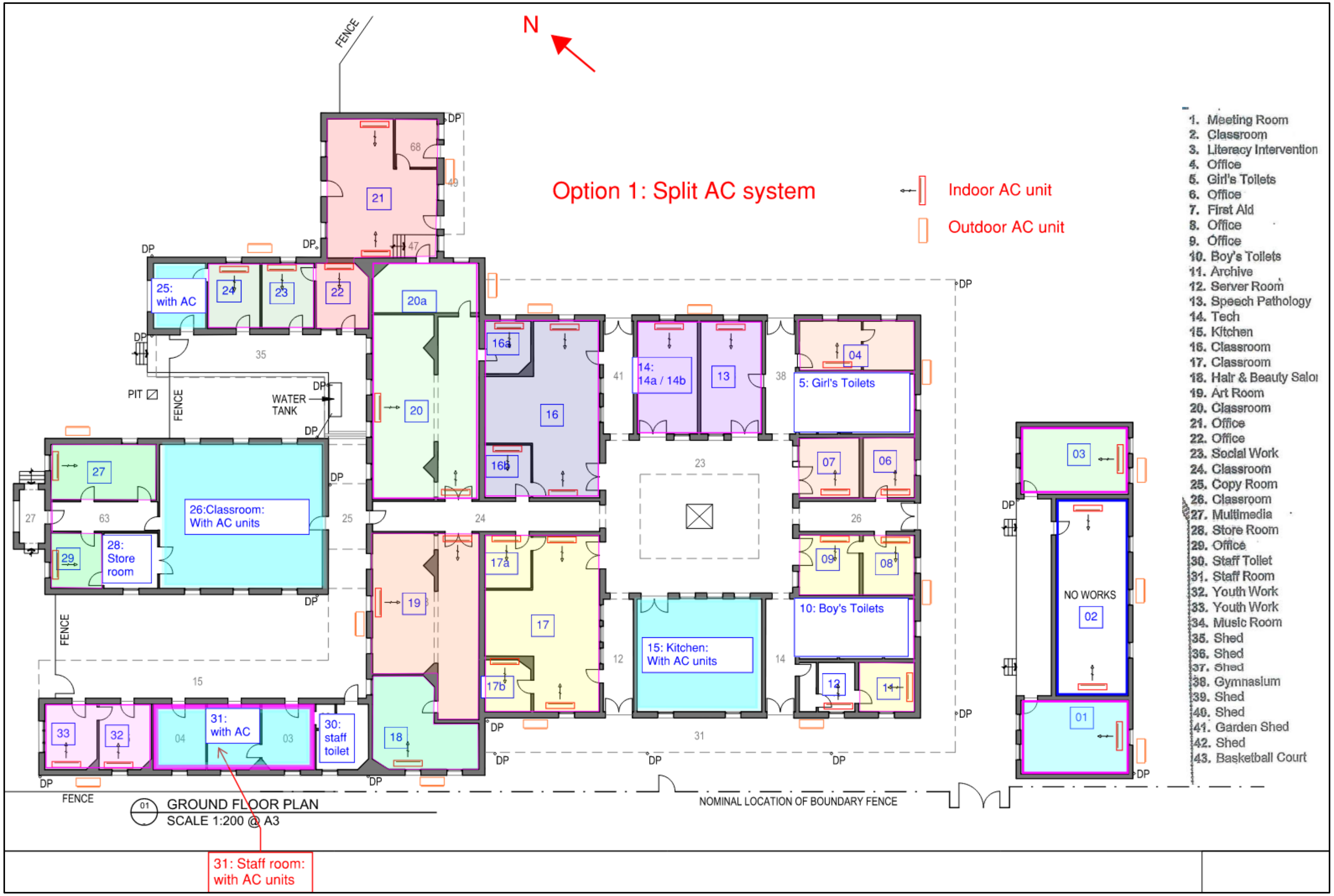

Figure 13: Option 1 - Indoor and outdoor units' tentative installation locations.

5.4.2 Option 2

The table below shows the system Option 2 related zones, proposed type of AC system with number of indoor units and estimated cooling/heating loads. The locations of the indoor units and the outdoor units are tentatively marked on the markup drawings and are not drawn to the scale. Note that the outdoor units serving VRF system are floor mounted types and shall be installed on plinths.

Room no.	Room Name	Number of indoor units	Zone no. for AC system	Proposed system	Total Cooling load (kW)	Cooling sensible load (kW)	Heating load (kW)
1	Meeting room	1	1	VRF system	4.2	4.2	3.8
2	Classroom	2			9.4	9.2	10.3
3	Literacy Intervention	1			4.5	4.5	3.8
4	Office	1	2	VRF system	3.7	3.6	3.4
6	Office	1			1.6	1.6	1.4
7	First Aid	1			2.1	2	1.7
13	Speech Pathology	1			4.6	4.6	4.9
14	Tech	1			3.7	3.7	3.7
16	Classroom	2			9.5	9.5	10.4
16a	Office	1			1.5	1.4	1
16b	Office	1			1.3	1.3	0.9
8	Office	1	3	VRF system	1.8	1.8	1.6
9	Office	1			2.1	2	1.7
11	Archive	1			1.8	1.7	1.6
17	office	2			9.3	9.3	10.2
17a	Classroom & offices	1			1.5	1.5	1.2
17b	Classroom & offices	1			1.1	1	0.9
18	Hair & Beauty salon	1	4	VRF system	5.4	5.4	4.7
19	Art room	2			10.8	10.8	10.5
32	Youth work	1			1.8	1.7	1.4
33	Youth work	1			1.8	1.7	1.4
20	Classrooms	2	5	VRF system	12.3	12.1	11.1
20a	Classrooms	1			2.3	2.3	1.9
21	Office	2			6.6	6.6	5.8
22	Office	1			1.7	1.6	1.2
23	Social work	1			1.7	1.6	1.4
24	Office	1			1.7	1.6	1.4
27	Multimedia	1	6	Split AC unit	4.3	4.2	3.7
29	Office	1	7	Split AC unit	1.8	1.8	1.5
12	Server room	1	8	Split AC unit	11.5	11.5	N/A
			Total loads (kW)		127.4		108.5

Table 7: Option 2 - Zones considered for VRF systems and Split AC systems.

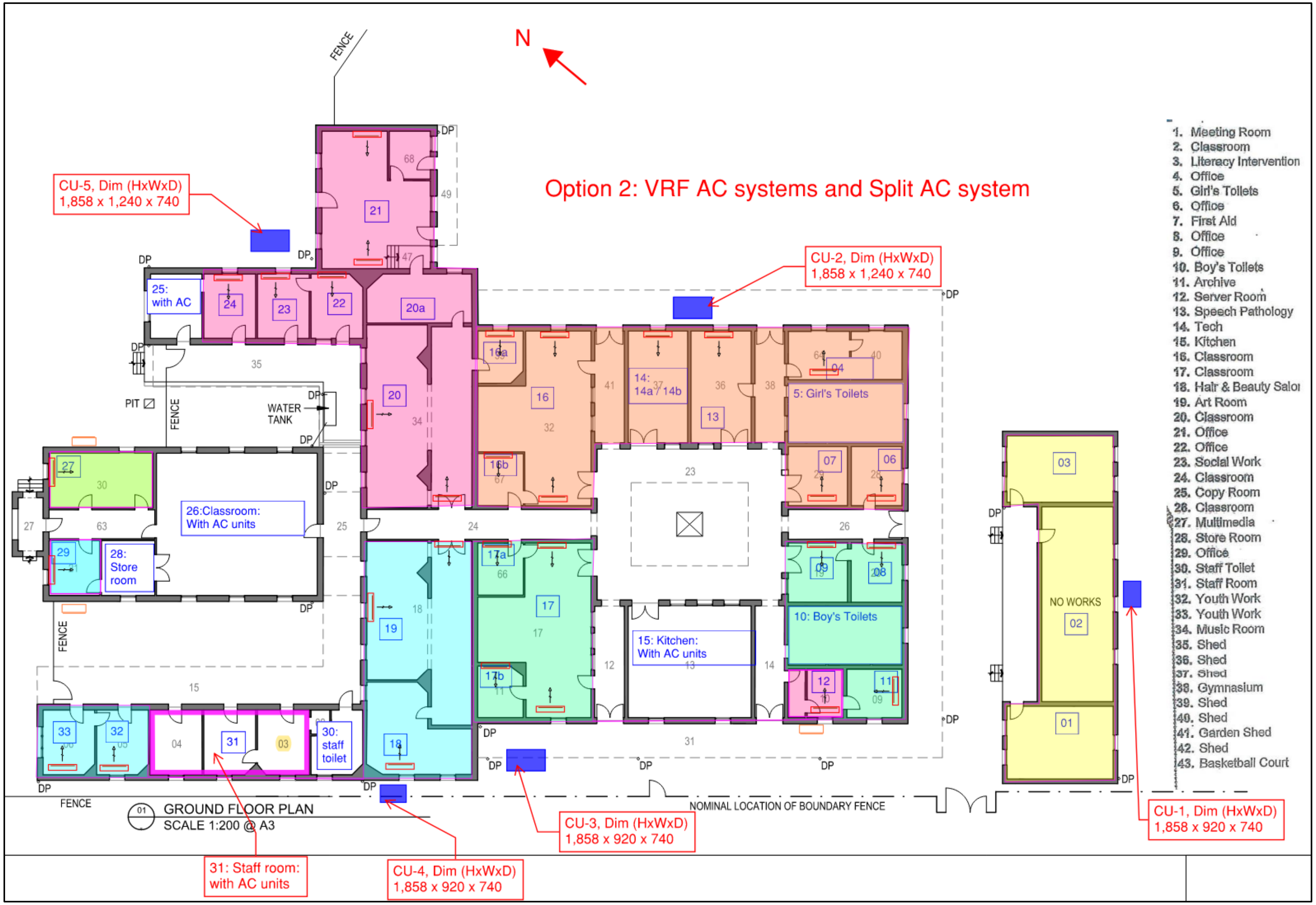

Figure 14: Option 2 - Indoor and outdoor units' tentative installation locations

5.5 Electrical

5.5.1 Proposed Maximum Demand

Based off the below maximum demand calculation, the proposed equipment requires an additional 160A including AS3000 diversity. In reality, the equipment loads during normal operation will be lower due to the capacity of classrooms, number of students at school per day and usage of the spaces.

Equipment	AS3000 DIVERSITY (%)	(A)	R (A)	W (A)	B (A)
CU-8	100.0%	18.7	18.7	18.7	18.7
CU-9	75.0%	18.7	18.7	18.7	18.7
CU-12	75.0%	18.7	18.7	18.7	18.7
CU-13	75.0%	18.7	18.7	18.7	18.7
CU-6	75.0%	18.1	18.1	18.1	18.1
CU-11	75.0%	18.1	18.1	18.1	18.1
CU-14	75.0%	15.0		15.0	
CU-16	75.0%	15.0			15.0
CU-2	75.0%	14.7	14.7	14.7	14.7
CU-4	75.0%	14.7	14.7	14.7	14.7
CU-7	75.0%	14.7	14.7	14.7	14.7
CU-10	75.0%	11.3	11.3	11.3	11.3
CU-5	75.0%	10.5	10.5	10.5	10.5
CU-15	75.0%	10.5	10.5	10.5	10.5
CU-1	75.0%	7.4	7.4		
CU-3	75.0%	7.4	7.4		
Sum of Indoor Units	75.0%	9.8	3.3	3.3	3.3
Maximum Demand Total per phase (A)			205.3	205.5	205.5
Maximum Demand Total per phase including AS3000 Diversity (A)			158.7	158.8	158.8

Table 8: Proposed HVAC Maximum Demand

5.5.2 Main Switchboard

The existing main switchboard requires a replacement to be able to maximize the existing capacity of the site.

The following works will be required:

- Disconnect and remove existing MSB.
- Install new 400A, Form 2, IP65, 25kA for 1 sec MSB into position of existing MSB.
- MSB to contain new Light & Power metering as per NCC J7
- Modify, rationalize and extend all existing circuits into new MSB.

Further to the upgrade of the MSB, the supply authority should be contacted to confirm the current negotiated supply amount to the site. If required, this may need to be increased to suit the new MSB.

5.5.3 Downstream Distribution boards

The proposed AC units will be fed directly from the closest distribution board. From the recent site inspection, the existing distribution boards have been recently upgraded and should remain.

As the site is heritage listed and has limitations/restrictions on how cabling and equipment can be installed, the most suitable distribution board feeding each unit will be determined on site with consideration of cost and buildability.

Based off the provided as-built drawings, the existing submains cabling from the MSB to the downstream distribution boards are undersized and possibly require an upgrade to maximize the capacity of the existing switchboards however this would require further investigation on site. If the submains are in fact undersized, Bridgeford recommends increasing the cabling to all impacted downstream distribution boards.

5.6 Proposed staging and implementation.

The following staging and implementation have been proposed -

Stage 1:

- Modification of electrical infrastructure
- Site preparation for installation of AC units – plinths, hangers and similar.

Stage 2:

- Installation of AC units (indoor & outdoor) with associated refrigerant pipes & condensate drainpipes.
- Any required builder works such as wall, roof etc. repair works.

Stage 3:

- Demolition and removal of existing gas-fired heaters with associated gas pipes, flues and etc.
- Coordinate with gas supply authorities, disconnection of the gas supply, and capped the gas main.

Note that works could be scheduled to be completed over school holiday periods when the building is likely to be unoccupied.

6 Financial Summary

The following financials are provided as a budget estimate only for the equipment supply and installation for the options.

6.1 Total Project Budget

The total project budget is presented below.

Please note that for all items other than equipment supply, this pricing is budget only.

Item	Option 1	Option 2
Equipment cost	$ 98,472	$ 130,239
Proposed AC systems Installation costs including electrical connections	$ 109,042	$ 234,430
Main Switchboard Upgrade	$40,000	$40,000
Electrical Submains Upgrades	$25,000	$25,000
Demolition of gas heaters	$ 28,800	$ 28,800
Contingency	$ 47,263	$ 78,694
Total	**$ 348,577**	**$ 567,163**

Table 9: Total project budget pricing (±20%)

6.2 Lifecycle Cost

The table below provides an overview of the lifecycle cost for the three options:

Item	Option 1	Option 2
Maintenance Cost $, p.a.	$ 8,884	$ 11,358
Elec consumption, kWh p.a.	36,605 kWh	34,832 kWh
Elec, $ p.a.	$ 7,321	$ 6,966
Total Operating Cost $ p.a.	**$ 16,205**	**$ 18,325**

Table 10: Concept option lifecycle cost. Note: 0 tCO_2 p.a. for Option 2 as electricity assumed to be from renewable sources.

7 Project buildability and high-level project risks

7.1 Project Risks

The following key project risks are identified below with a rating based on the likelihood and severity. A post-mitigation rating has been provided.

7.1.1 Identified Project Risks

Risk	Description	Pre-install mitigation			Space Heating & cooling equipment	
		Likelihood	Severity	Rating	Description	Rating
Design risks	Changes in internal occupancy from plans, resulting in higher or lower load than planned.	Possible	Moderate	3	Bottom-up load assessment during detailed design to account for known changes and current load. Latest floor plan/arrangement occupancy details to reverify against the available drawings	-
Planning/co-ordination of the upgrade works	The implementation of this upgrade must be carefully planned and staged to ensure minimal downtime/closure in the facilities.	Probable	Moderate	5	Recommend Staging of the HVAC system upgrade and demolition works. Work to commence during School holidays or spring/autumn times when cooling and heating demands are lower.	2
Electrical capacity issues	Capacity issues.	Probable	High	8	Electrical review has been undertaken.	2
Spatial & weight	Potential spatial constraints during installation	Possible	Moderate	3	Detailed review of available spaces for indoor and outdoor units' installation.	2
Load matching	Ability for units to match varying loads.	Possible	Low	2	AC systems allows for moderate load variability.	2
Shutdown during installation	Requirement for shutdown of spaces during installation	Possible	High	5	Space shutdowns are required. This needs to be coordinated with user groups during installation.	3
Maintainability	Increased potential for maintenance of new equipment.	Unlikely	Moderate	2	The AC system will have comparable maintenance to the existing gas fired heater for heating	1
Acoustic issues	Noise levels from indoor units and outdoor units shall considered	Possible	High	5	Overall noise level inside classrooms/offices shall not exceed NC 34.	2

Table 11: Identified Project Risks.

7.1.2 Risk reference table.

This table below provides a reference for use for the above identified project risks.

		Severity			
Likelihood		Low	Moderate	High	Critical
>75%	Likely	4	6	9	10
50%-75%	Probable	3	5	8	9
25-50%	Possible	2	3	5	7
<25%	Unlikely	1	2	4	5

Table 12: Risk rating table.

8 Appendix

8.1 Assumptions

The following assumptions were used:

- Pricing for equipment based on quotations received from suppliers for similar equipment in the last 6 months.
- All quoted figures are excluding GST.
- Other pricing is based on general industry standard allowances.

- Operating hours
  - School opening schedule 6.30am to 4.00pm for weekdays: total 9.5 hrs. per day, number of school opening days based on Victoria school calendar (2024/25)
- Blended energy rates (assumed)
  - Electricity: $ 0.20 /kWh based on Jan-Dec 23 billing rates

- Maintenance costs based on industry standards including CIBSE and AIRAH
- Financial Calculations
  - Escalation of 2.5% p.a.
  - Discount rate of 5% p.a.
  - NPV term of 15 years
  - No tax, depreciation or other items considered in modelling.
- Emissions factors:
  - Electricity carbon emissions: 0 kg CO_2 per kWh (assumed all electricity from renewable sources)

8.2 References documentation and data

The following documentation and data were used during this concept design:

Description	Description
Site walkthrough	13 Feb 2024
Drawings	Ground floor plan: Floor plan, Floor Plan- KCHS Electrical drawings: R072A ES-01 & ES-02
Reports, utility data	• KPMG- DRAFT Condition Assessment & CAPEX- Kensington Community High School • red energy electricity bill data
Description	Document or Information Source

Table 13: Referenced documentation and data

General Disclaimer

This document has been prepared with assumptions, reference documentation, data and information provided by the Client.

All calculations, figures (financial, engineering or otherwise) or statements within this document are made in good faith and Bridgeford Group believe they are accurate and reliable but are estimates only. Actual costs and figures may vary due to conditions or factors outside of Bridgeford Group PTY LTD control, and as such should only be used as a guide only. Bridgeford Group PTY LTD does not give any warranty as to the accuracy, reliability or completeness of information that is contained in this report, except in so far as any liability under statute cannot be excluded.

Confidentiality

This document has been produced for the Client and Client Recipient/Client Contact only, and may be bound be external confidentiality agreements. In addition, this document contains intellectual property and information that may be considered confidential in nature, and as such all reasonable precautions and measures should be taken to maintain confidentiality and to prevent the disclosure of the material contained in this document to unauthorized parties.

Copyright

Bridgeford Group
energy · engineering · efficiency

ABN: 19635109527

10-12 Commercial Drive Lynbrook VIC 3975

Web: www.bridgefordgroup.com