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Northern Rivers Schools Cluster

Acoustic Concept Design Report

Broadwater Public School

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2	23/10/2023	20230554.5/2310A/R2/PF	PF		PF	Update Project Description

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A LONG PROJECT DESCRIPTION

The existing buildings at Broadwater Public School, 9 Byrnes Street, Broadwater (Lot 4 & 5, Deposited Plan (DP) 1043232 and Lot 501 DP 755624) were significantly inundated during the February 2022 floods and most of the structures are no longer habitable due to the damages caused by the flood waters. As a result, the NSW Department of Education is proposing to demolish the existing school buildings and construct a new elevated school building to replace it. The floor level of the new building will be located above the design flood level to increase flood resistance and create useable undercroft spaces.

A development application will be submitted to Richmond Valley Council for these works.

Works will comprise the following:

- Site preparation including site establishment works, earthworks and relocation of heritage bell.
- Demolition of existing school buildings.
- Construction of a new elevated school building, with at-grade (undercroft) amenities and storage, including:
    - Ground Level:
        - Open undercroft space for covered outdoor learning and play.
        - Male and female amenities and accessible toilet / change room facility.
        - Cleaners' store.
        - Sports store.
        - Equipment and general store.
    - Elevated Level:
        - New administration comprising interview room, clerical spaces, Principal's office, staff room, sick bay, store and male, female and accessible amenities.
        - School library with computer room, store, main communications room and library office.
        - Three (s) General Learning Spaces (GLS) with learning commons and multi-purpose space.
        - Canteen with open servery space.
        - Store.
        - Male, female and accessible amenities.
        - Mechanical plant.
- New and hard soft landscaping including replacement play field, playground, half games court and vegetable garden and new yarning circle.

It is not proposed to increase staff or student numbers as a result of these works.

B APPLICATION OF THIS SPECIFICATION

This specification presents recommended design standards for the proposed new Broadwater Public school, as part of the Northern Rivers Schools Cluster, at 9 Baynes Street, Broadwater, NSW, 2472.

B.1 SCOPE AND PERFORMANCE REQUIREMENTS

The specification addresses the following acoustic performance requirements:

- Acoustic privacy/separation of spaces
- Review of reverberant noise objectives and treatments
- Treatments to mitigate rain noise
- Noise and vibration from services
- Noise emissions to surrounding properties and to the site

The design standards are based on the following documents:

- The Educational Facilities Standards and Guidelines Design Guide by the NSW Department of Education and Communities (the EFSG Design Guide), Version 2.0, dated November 2022.
- DGN003 – Sliding Glazed Doors and Wall Specifications (16/12/2022)
- Green Star – Design & As Built v1.3, and
- Australian Standard AS2107:2016 for internal noise levels and reverberant noise performance criteria.

B.2 COMPLIANCE WITH NON-ACOUSTIC REQUIREMENTS

The requirements or standards contained within this acoustic specification are in addition to any other non-acoustic requirements such as structural integrity, fire rating, material compatibility, etc.

The acoustic requirements or standards contained in this specification where they exceed those stated in another specification or drawing override the other requirement. Where multiple performance requirements are stated (including non-acoustic related requirements), comply with all requirements. The requirement to comply with this specification does not remove the requirement to comply with other specifications having non-acoustic related requirements.

Install all systems in accordance with the manufacturer's requirements and recommendations unless this specification requires a higher standard.

B.3 PRECEDENCE

Where there are conflicts in requirements, the greater requirement shall be used. For any conflicts that are identified, the Contractor shall not proceed until receiving approval.

B.4 ABBREVIATIONS

dB	Decibels - unit for the measurement of sound
dB(A)	A-weighted decibels. Unit for measurement for broadband sound with the A-frequency weighting applied to approximate human loudness perception to sounds of different pitch.
L_{eq}	Energy averaged sound level
L_{max}	Maximum sound pressure level
R_w	Frequency weighted sound reduction index.
D_{ntw}	Weighted, normalised sound reduction between two rooms
C_{tr}	Traffic spectrum adaptation term for partitions
L'_{nTw}	Field measured normalised, weighted impact sound level determined using standard test method
RT	The time it takes for sound in a room to decay by 60 dB
Sound rated partition **Sound rated element**	A building partition or element (wall, floor, glazing, door, etc) separating two spaces that is required to meet a minimum acoustic performance
Sound rated door	A door that is required to meet a minimum acoustic performance
Discontinuous wall	A wall with 2 leaves that do not have any connections between them and are separated by a minimum of 20mm. The wall leaves should not be bridged by piping or other rigid or resilient connection (except at the periphery of the wall).
NRC	Average absorption co-efficient for the octave bands with centre frequencies of 250Hz to 2 kHz inclusive.

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C ACOUSTIC PERFORMANCE CRITERIA

C.1 NORMAL OPERATION NOISE AND REVERBERATION CRITERIA

C.1.1 Internal Criteria

The following criteria has been summarised based on ESFG and Green star Design & As Built v1.3 requirement.

Table C-1 – Internal Spaces Criteria

Space	Also Applies to	Space Ambient Noise Level dB(A) Leq	Maximum RT (s)*	Rain Noise Level dB(A) Leq**
Corridors and lobbies		45	Minimise	NR
Dining rooms	Canteen	45	1	50-55
Duplicating rooms/stores	Store, Entry Vestibule	50	NR	NR
Interview/counselling rooms	Sick Bay	35	0.6	40-45
Libraries - General areas		40	0.6	45-50
Office areas	Library Office	40	0.7	45-50
Open plan teaching areas	Learning Commons	40	0.8	45-50
Professional and Administrative offices	Principal's office	35	0.8	40-45
Staff common rooms	Staff Room, Clerical, Library Main Comms	40	0.6	45-50
Study Rooms	Multipurpose Space	35	0.6	40-45
Teaching spaces – Primary schools	GLS	40	0.5	45-50
Toilet/change/showers		50	NR	NR

*Note 1 in AS 2107 applies where indicated. Average of 500Hz and 1000Hz Octave Bands.

**AL note that for an intermittent event such as rain noise, a tolerance of 5-10dB(A) above the target ambient noise levels (based on internal noise levels given in Table 01 of the EFSG 0001c Design Checklist – Acoustic) is reasonable. Rain noise will be assessed based on the one year annual recurrence, one-hour event for the school.

Areas not listed in the table below shall be designed to comply with the relevant recommended design sound level as detailed in Australian/New Zealand Standard AS/NZS 2107:2016 *"Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors"*.

C.1.2 External Noise Level Criteria

Noise emissions to surrounding properties to comply with EPA NPI 2017. Noise emission objectives for the proposed school have been summarised with applicable noise limits which are bolded in the tables below.

Table C-2 – Maximum Noise Emissions to Surrounding Properties (from Mechanical Plant)*

School	Type of receiver	Time Period	Assessment Background Noise Level dB(A)L_{90}	Project Amenity Criteria dB(A) L_{eq}	Intrusiveness Criteria $L_{eq(15min)}$
Broadwater Public School	Residential	Day (7 am – 6 pm)	50	**48**	55
		Evening (6 pm – 10 pm)	46	**43**	51

* Noise emissions measured in accordance with EPA guidelines, including any penalties for annoying characteristics.

C.2 VIBRATION

Vibration generated by plant and equipment not to exceed the levels recommended in Australian Standard AS 2670.2-1990 *"Evaluation of Human Exposure to Whole-Body Vibration - Continuous and Shock-Induced Vibration in Buildings (1 to 80 Hz)"*.and NSW EPA "Assessing Vibration: A Technical Guideline" for the relevant occupancy. The minimum level of any range nominated in the guideline applies.

C.3 ARCHITECTURAL ELEMENTS

C.3.1 Internal Walls and Partitions

C.3.1.1 Green Star Requirements

One (1) point is awarded where the project addresses noise transmission in enclosed spaces within the nominated area. Enclosed space is defined as meeting rooms, private offices, classrooms, residential apartments (bounding apartment construction), and any other similar space where it is expected that noise should not carry over from one space to the next. For this specific criterion, where the delivery method of the project is core and shell, then the criteria may be considered 'Not Applicable'. There are three methods for demonstrating compliance with this criterion.

10.3 ACOUSTIC SEPARATION

10.3A SOUND REDUCTION

Noise transmission between enclosed spaces has been addressed by the installation of partitions that achieve a weighted sound reduction index (R_w) of:

At least 45; for all partitions fixed without a door, and/or are glazed partitions without a door; or

At least 35; for all partition types that contain a door.

10.3B SOUND INSULATION

Noise transmission between enclosed spaces has been addressed by the installation of partitions that comply with

$$D_w + LA_{eq}T > 75.$$

Where: D_w = weighted sound level difference measured between two spaces; and

$LA_{eq}T$ = Indoor ambient noise level in the space adjacent to the enclosed space

C.3.1.2 EFSG Requirements

The EFSG provides guidelines for the acoustic separation of spaces. Between teaching spaces (and teaching spaces to other spaces generally) the EFSG requires a partition rating of R_w 45. It is noted that the EFSG also states:

- *The extent to which room to room noise control will have to be considered and the required acoustic rating of constructions between adjacent rooms will depend upon whether the construction between adjacent rooms includes an operable wall, a door, a glazed section or other potentially 'acoustically weak' construction.*

Where doors complying with the EFSG are located in partitions the overall noise reduction provided by the partition will be limited by the door rather than the wall. Accordingly, the wall rating will be selected so that there is no perceptible increase in sound transmission contribution from the wall over and above what occurs through the door.

In respect of glazing within, or in partitions adjacent to doors the following guidance is provided in the EFSG:

- *Internal glazed sections in walls and vision panels in or adjacent to internal doors: minimum 10.38mm laminated glass. In some situations, acoustic windows may be needed for satisfactory noise separation.*

Select and install systems to comply with the minimum performance nominated in Section ***Appendix B – Wall/Door /Floor***/Ceiling Performance Markups**.**

C.3.2 Floors

The proposed school development is elevated single storey building with undercroft underneath. All floors are to be minimum R_w 45. Any penetrations shall be acoustically sealed and treated.

Carry out the installation of floors in a manner that will not reduce the performance below the tabled acoustic requirements. This includes but not limited to the proper filling of joints, back filling with non-shrink grout any chasing.

C.3.3 Doors

C.3.3.1 Green Star Requirements

Green Star initially requires a rating of R_w 35 for partition contains a door. See also in Section ***Green Star Requirements.***

Notwithstanding the above, it has been approved for SINSW school projects that glazed sliding doors to have an R_w of 30 instead of 35. See details in TQ (R-14412), dated 11 Feb 2021.

C.3.3.2 EFSG Requirements

ESFG stated the following regarding rating of doors:

- *Entry doors to occupied teaching, music, drama and sports spaces: Solid core, minimum 35 mm thick with acoustic weather (where external) seals on all rebated closing faces. Gap at floor to be minimized.*

For sliding glazed doors and wall, the following criteria is recommended in the EFSG design guide note **DGN003 – *Sliding Glazed Doors and Wall Specifications* (16/12/2022)**:

- *Glazed sliding doors between Teaching Spaces or Learning Commons are to achieve: A tested 32R_w min acoustic rating (subject to holistic acoustic review of the spaces by an acoustic consultant).*

Select and install systems to comply with the minimum performance nominated in Section ***Doors***. Refer also Section ***Appendix B – Wall/Door /Floor***/Ceiling Performance Markups.

C.3.4 Room Finishes

Select and install systems to comply with the reverberation times performance in Section ***Acoustic Performance Criteria***.

C.3.5 Rain Noise

ESFG stated the following regarding rain noise assessment:

- *Rain noise is to be assessed only for general learning areas, music, drama, movement studios and halls or as otherwise directed. Rain is to be assessed using the one-year annual recurrence, one-hour event for the region as reported by the Bureau of Meteorology. A recognized rain noise calculation procedure (such as Dubout, 1969 or Griffin, Ballagh, 2012) shall be used.*

According to Bureau of Meteorology, the design rainfall depth applied to the project site is 32.6mm based on a one year annual recurrence, one hour event.

Select and install roof/ceiling systems to comply with the rain noise levels in Section ***Acoustic Performance Criteria***.

C.3.6 Building Envelope

Select and install external wall, window, door, roof/ceiling systems, etc to comply internal noise criteria in Section ***Internal Criteria,*** and to prevent noise emissions from plant and internal activities exceeding the noise levels in Section ***External Noise Level Criteria.***

D ARCHITECTURAL ELEMENTS INSTALLATION – MINIMUM REQUIREMENTS

Notwithstanding the required minimum acoustic performance requirements in Section ***Acoustic Performance Criteria***, comply with the following minimum installation standards and requirements.

D.1 SOUND RATED PARTITIONS/ELEMENTS

D.1.1 Generally

Install all systems in a manner that will not reduce their performance below the performance requirements. This includes, but not limited to:

- The filling of joints and junctions between systems, materials and surfaces.
- Caulked joints are to have correct joint geometry, backing rods and bond breakers so that joint movement capability is not impaired.
- Backfilling chasing in walls
- Sealing and treatment of penetrations.
- Treatment of flanking paths including ceiling and wall cavities where sound rated partition meets other building elements.
- Do not install untreated grilles and openings in sound rated partitions.
- Prevent voids in poured concrete partitions.

D.1.2 Sealants

Carry out sealing of joints in acoustic rated partitions using Selleys Proseries Fireblock or CSR Fireseal. An equivalent, alternative sealant must not be used unless approval is first gained from the acoustic consultant.

Unless otherwise detailed in this Acoustic Specification, with the exception of set plasterboard-to-plasterboard sheet joints, acoustically seal all vertical and horizontal wall junctions using a 10-15mm high joint caulked joint with minimum 10mm sealant bead depth, plus foam backing rod where the joint to be filled exceeds 13mm depth).

D.1.3 Manufacturer's Recommendations

Install all systems in accordance with the manufacturer's requirements and recommendations unless this specification requires a higher standard.

D.1.4 Contact with Services

Prevent contact between any part of the walls or the ceiling supports framing with water, waste, stormwater or air conditioning piping/ductwork. Maintain a minimum 15mm gap clearance.

D.1.5 Partition Junctions

D.1.5.1 Partition Wall Junctions

Where a high acoustically rated wall (R_w 45 or higher) butts into a lower rated wall, such as a corridor wall, the higher rated wall is to have sheets taken into the lower rated wall, example as shown below:

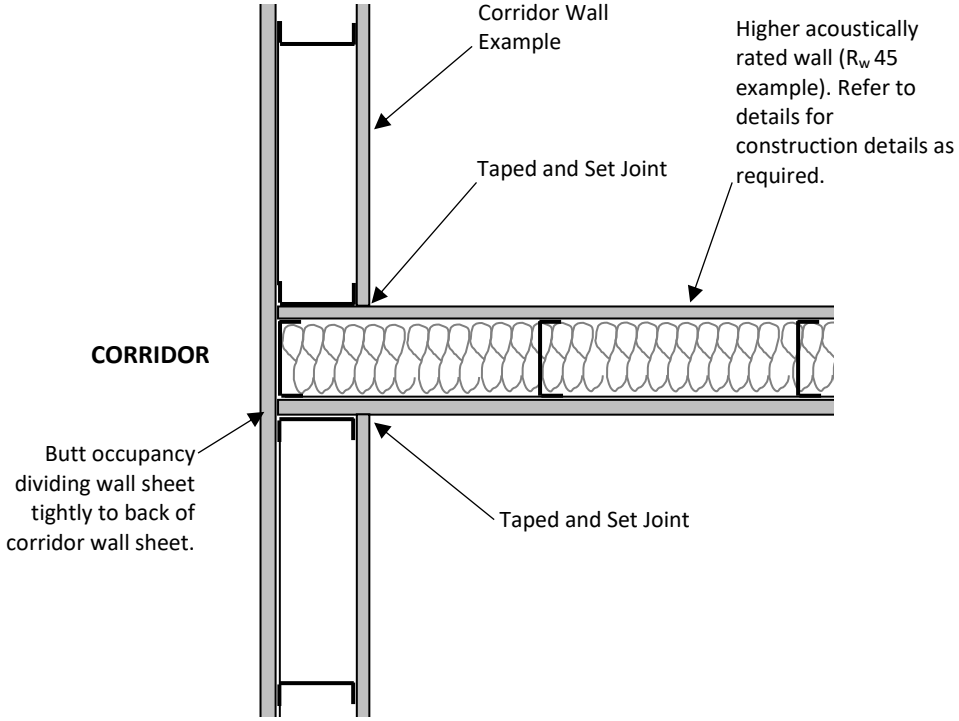


Figure D-1 –Acoustically Rated Wall Junction Construction Example

D.1.5.2 Core Walls

Where partitions required to have a sound rating butt into the core walls (or other perpendicular masonry walls), they should be taken to within 10-15mm of the concrete/masonry core wall and caulked.

D.1.5.3 Partition/Façade Junctions

- Where required pack any cavities behind external wall linings, etc. to prevent excessive flanking via the wall cavity (horizontally and vertically).
- Seal the junction between sound rated partitions where they butt into façades.
- Where R_w45 or higher rated partitions butt into the façade, the partition wall should be taken through to the external skin and the junction sealed appropriately.
- Where partition walls butt to the external facade seal the partition to the façade (including cavities behind sill panels and other façade linings).
- Where partition walls R_w 40 or higher butt into the façade it should be either at an opaque panel or mullion – they cannot butt into glass.

D.1.6 Partition to Roof Junctions

Seal sound rated partition to metal roofs to maintain element acoustic rating. As a minimum extend the partition lining hard to the underside of the roof, compressing the roof insulation. Seal any remaining gaps with infills of plasterboard with any smaller gaps and infills sealed as per Section ***Sealants***.

D.1.7 Doors

The following table nominates minimum door construction requirement for doors.

Table D-1 – Door Constructions to Meet Ratings

SPACE	Door R_w	MINIMUM DOOR CONSTRUCTION
Toilet, Store	20	Minimum 35mm thick solid core doors set into door frames. Minimise gaps with maximum 5mm gap to threshold.
Doors to Staff Room, Sick Bay, Interview, Private Offices and Library	25	Minimum 35mm thick solid core doors set into door frames. Seals to be installed on top and sides and gaps minimised at the base. Top and side seals equal to Lorient Batwing and IS 8010Si drop seal rebated into the door bottom. Glazed panel in door minimum 10.38mm glass.
Solid Door Plant Room	32	Minimum 44mm thick solid core doors having a surface density not less than 33 kg/m^2 in rebated timber frame. Install seals equal to Kilargo IS 1212 and IS 7090 seals around the perimeter, IS 8090Si drop seal and IS 7061 seals on meeting stiles of double doors.
Sliding Glazed Separating Teaching Spaces	32	Proprietary system. Minimum 10.38mm glass. See Section ***Glazed Sliding Doors***

Install sound rated doors, frames and seals in a manner that will not reduce the performance of the doors including:

- Install doors without warps.
- Hang doors with even gaps.
- Install doors with minimum gaps. Gap at door bottom complying with seal manufacturer's requirement (3-5mm). Threshold under door seal is to be level and flat. Install aluminium threshold plate under door seals where door seals close onto carpet.
- Install seals without gaps at joints/junctions.
- Adjusting seals so that they are acoustically effective around the full perimeter without excessive effort required to close the doors.
- Selecting and positioning door hardware to prevent the seals being fouled (especially at meeting stiles of double doors) so that seals form a continuous seal around the door perimeter, or allow sound to leak through key holes, etc.
- Do not install door grilles in sound rated doors.
- For proprietary systems provide evidence of laboratory test for approval prior to ordering.

D.1.7.1 Glazed Sliding Doors

For single track glazed sliding door system (face mounted), Lotus single sliding door with 10.38mm Laminated glass is proposed that will be able to achieve R_w 32. The system is designed to have:

a) Glazing-single glazed 10.38mm laminated glass

b) Slider system: Lotus single 10.38mm laminated glass glazed acoustic slider framing, in-line acoustic jamb and fixed glazed side panel framing- of proprietary aluminium extrusions

c) Track system: Lotus 100-1 track and track covers - of proprietary aluminium extrusions

d) Slider mechanical components

e) Installed acoustic seals: premanufactured acoustic sweep seals fitted into corresponding slots and grooves in the extrusions- sweep seals installed on glazed acoustic slider to both sides of the top and bottom rails; vertical bulb seals installed on both sides of slider cavity nib wall

For double slider glazed sliding door system with cavity, products that will be able to achieve R_w 32 or equivalent can be used. A sample product is Glyde double sliding door with 10.38mm laminated glazing. The system is to have:

f) Gglazed cavity sliding door with 10.38mm laminated glass, in proprietary extruded aluminium framing

g) Cavity wall: a 155mm cavity to accommodate the 130mm wide slider was enclosed with a composite plasterboard and steel clad, timber framed construction both sides of the cavity, void in cavity walls filled with 50mm rockwool @80kg/m3. All joins caulked, installed dims (w*h):340*2460 mm

h) Head/track enclosure: 2 layers of 13mm soundcheck plasterboard fixed to KD hardwood H section; track fixed to underside of H section; top of H section void filled with 50mm rockwool @80kg/m3; All joins caulked, installed dims (w*h):1460*240 mm

i) Receiving jamb: 2 layers of 13mm soundcheck plasterboard fixed to KD hardwood; installed dims (w*h):90*2220mm

j) Sealing: a range of components was used to seal the slider system. Including 2 acoustic sweep seals on the bottom and acoustic bulb seals on the trailing jambs

In the event of equivalent systems are proposed, this is subject to be reviewed by the acoustic consultant before installation.

D.1.8 Floors

D.1.8.1 Floor/Façade Junctions

Treat floor façade/junctions so that the required minimum performance is achieved. Refer to ***Appendix A – Acoustic Details.***

D.1.9 Ceilings

Provide sound rated ceiling according to the following minimum requirement schedule.

Table D-2 – Minimum Sound Rated Ceiling Installation Requirements

Space	External Lining	Insulation	Ceiling	Other
GLS/Library	0.5mm Metal Sheet Roof +sarking +50mm thick 11kg/m^3 glasswool insulation	50mm thick 32 kg/m^3 insulation with Bradford ulterphon facing	Perforated ceiling with minimum NRC6.0*	Butt insulation to walls, and treat light fittings so there are no gaps in the insulation.
Staff room/Clerical Space				
Other admin spaces		50mm thick 32 kg/m^3 insulation	Plasterboard ceiling	

*Detailed percentage of perforated ceiling opening for each spaces refer to Section ***Finishes***.

D.1.10 Glazing

Glazed partitions are to be installed such that the acoustic rating of the sound rated partition remains compliant with the acoustic requirements outlined in Section ***Architectural Elements*** of this specification.

Partitions not containing a door - select rating of glazed infill panels according to the following table.

Table D.3 – Maximum Percentage of Glazed Area to Maintain Wall Rating – Partitions Not Containing a Door

GLAZING R_w*	Partition Required R_w		
	45	**40**	**35**
45	100%	100%	100%
40	12%	100%	100%
38	7%	45%	100%
35	3%	12%	100%
31	0%	3%	20%

* For example – for a required R_w 45 partition having a glazed area of between 3% and 7% of the partition the glazing would need a minimum rating of R_w 38.

Partitions containing a door (following provides guidance for standard doors of approximately 1.8m^2 area)

Table D.4 – Maximum Percentage of Glazed Area to Maintain Wall/Door Rating – Partitions Containing an R_w 20 Door

GLAZING R_w	Partition Required R_w		
	45	**40**	**35**
45	100%	100%	100%
40	100%	100%	100%
38	100%	100%	100%
35	90%	100%	100%

31	28%	30%	50%

Table D.5 – Maximum Percentage of Glazed Area to Maintain Wall/Door Rating – Partitions Containing an R_w 30 Door

GLAZING R_w	**Partition Required R_w**		
	45	**40**	**35**
45	100%	100%	100%
40	50%	100%	100%
38	25%	85%	100%
35	12%	25%	100%
31	3%	5%	15%

Table D.6 – Maximum Percentage of Glazed Area to Maintain Wall/Door Rating – Partitions Containing an R_w 32 Door

GLAZING R_w	**Partition Required R_w**		
	45	**40**	**35**
45	100%	100%	100%
40	30%	100%	100%
38	16%	62%	100%
35	7%	17%	100%
31	2%	4%	13%

The minimum glazing for each R_w rating is nominated in the following table. Glazing systems (glass and framing combined) to achieve both the minimum thickness/construction as well as the R_w rating specified below.

Table D.7 – Minimum Glazed Partition Construction Requirements

R_w OF INSTALLED WINDOW	**MINIMUM GLAZING ASSEMBLY**	**ACOUSTIC SEALS**
30	6.38mm laminated glass	Yes
35	10.38mm laminated glass	Yes

Acoustically seal the perimeter of glazing system required to achieve an acoustic rating into the window/door opening so there is no leakage of noise between the window frame and the building opening. The sealing method selected shall take into account and allow for any movement of the window frame relative to the building opening and so that the acoustic performance is maintained.

D.1.11 Roof Acoustic Treatment

For rain noise control, the following roof construction is recommended:

0.5mm metal deck roof + roof sarking + 50mm thick 11kg/m^3 insulation + 13mm standard plasterboard

The above construction applied to external walkways. For internal spaces, additional insulation should be installed following details presented in Section ***Ceilings***.

D.1.12 Finishes

Finishes are to achieve the minimum performance required in Section ***Acoustic Performance Criteria***.

D.1.12.1 Reverberation Tim Control

Reverberation time for each internal space is calculated and compared with the reverberation time criteria presented in Section ***Acoustic Performance Criteria***. The following ceiling and pin board products are proposed to be used for the school:

Table 8 – Sound Absorption Coefficients for Perforated Ceiling

Product Name	500Hz	1kHz
Gyprock Rigitone Galaxy (10% free area) with Bradford supertel RM1.5 50mm 32kg/m^3 with Bradford ultraphon facing	0.7	0.75

Table 9 – Sound Absorption Coefficients for Pinboards

Product Name	500Hz	1kHz
13.5 mm Ecoustic Panel (NRC 0.5)	0.38	0.7
24 mm Pixel Panel (NRC 0.6)	0.41	0.58

Detailed treatment for each internal space is to be conducted during CC stage.

D.1.12.2 Access Panels

Access panels are to be selected and installed to maintain the acoustic integrity of the wall/ceiling system in which there are installed.

D.2 INSTALLED SYSTEM VERIFICATION TESTING

Testing of installed partitions is to be conducted by an approved, experienced specialist acoustic consultant and generally in accordance with the relevant Australian standard current at the date of the issue of the specification.

Field tested performance (DnTw + Ctr, D_{nTw} or D_w) of partitions must be not less that 5 rating point below the design R_w + Ctr or R_w acoustic performance.

Tests according to the following schedule:

Airborne Sound

- Minimum of 10% of sound rated partitions. Representative selection of partitions to be tested.

Impact Sound

- Minimum of 10% of sound rated floors. Representative selection of floors to be tested.

Reverberation

- Minimum of 10% of spaces where maximum reverberation times are nominated in this specification. Representative selection of spaces to be tested.

Provide test plan a minimum of 5 work days prior to testing for approval that includes the test method and the locations to be tested.

With 5 business days of testing provide summary test report including:

- The test method used and a description of the testing carried out including condition of the spaces, equipment used, etc.
- A table of measured performance compared to the minimum required performance.
- Comment on non-compliances identified.
- Conclusion

E MECHANICAL SERVICES

E.1 PROJECT NOISE AND VIBRATION CRITERIA

E.1.1 Internal and External Noise Levels

Noise and vibration generated by mechanical services not to exceed the levels indicated in Section ***Acoustic Performance Criteria*** notwithstanding the equipment noise ratings or the acoustic treatments indicated in the mechanical services specification or drawings. For the plant selected, assess noise levels and provide treatment needed to comply with the noise criteria.

Unless stated otherwise, the noise level criteria shall not be exceeded with the plant operating under normal operating conditions, and at start-up for intermittently operating plant items.

E.1.2 Plant Noise Levels

Adjust and balance all systems so that excessive noise is not created, and the scheduled internal and external noise levels are complied with. Select plant noise rating to not exceed any nominated plant noise levels (sound power or sound pressure).

E.2 NOISE GENERATED BY THE AIR DISTRIBUTION SYSTEM

Noise from the air distribution system shall be minimised by:

1. Selecting grilles, diffusers, dampers and accessories and duct velocities to meet the specified noise levels.

2. Balancing the system using dampers on duct branches, with dampers at grilles being used for minor adjustment of air volumes. Where excessive noise levels are due to noise generated at dampers near grilles, the branch dampers shall be readjusted to eliminate excessive dampering and noise at the grilles.

3. Installing ductwork with a minimum number of bends, offsets, etc. Flexible ducts should not be kinked or have excessive bends, particularly near grilles, etc. Ensure there are no protrusions inside the duct that could generate noise. Unless indicated otherwise, install turning vanes in tee's and bends or use long radius bends to minimise turbulence. Spigots plenum boxes should maintain the full internal cross section of the duct connecting into the plenum box.

4. Seal duct joints adequately so there is no noise resulting from air leakage.

E.3 STRUCTURE BORNE NOISE AND VIBRATION

Minimise the transmission of vibration to the building structure to ensure the noise and vibration criteria are achieved by:

1. Statically and dynamically balancing rotating plant and equipment. Where specified, provide balancing test certificates.

2. Providing isolation mounts or hangers for vibrating plant and equipment.

3. Providing inertia blocks to limit the vibration amplitude.

4. Isolating piping, electrical conduit, etc. subject to vibration from the building structure.

5. Providing flexible connections where ducts and piping is connected to vibrating plant and machinery.

6. Proper installation.

Submit a schedule of isolation mounts for approval by the acoustic consultant indicating make, model, rated load and static deflection, actual load and static deflection, unloaded height and fully loaded height.

The vibration isolation systems shall be selected to achieve seismic and noise/vibration requirements.

E.3.1 Anti-Vibration Mounts and Isolators

E.3.1.1 Selection of Equipment Isolation Mounts

As a minimum, select isolation mount type and static deflection according to the following table (refer below for isolator types).

Table E.1 –Minimum Isolator Schedule

Plant	Isolator Type	Minimum Static Deflection
In-line Centrifugal Fans and Small Axial Fans <450mm diameter)	M3/H1	10 mm
Air conditioning fan/coil units	M3/H1/HE1	10 mm
Air conditioning condensing units	M3/H1	5mm

E.3.1.2 Isolation Mount Types

Type M1 - Waffle Pad Mounts

Waffle pad mounts shall be: minimum 17mm thick neoprene rubber (nitrile rubber where oil contamination is possible); cross ribbed with alternately raised ribs on both faces of the pad; loaded within the load range of the isolator with a minimum static deflection of 1.5mm.

Type M2 - Multiple Layer Waffle Pad Mounts

Multiple layer waffle pad mounts incorporating; specified number of layers of Type M1 Waffle Pad Mount; 1.5mm thick metal shim plate between the pad layers; minimum 1.5mm static deflection per layer.

Type M3 - Neoprene Mounts

Neoprene mounts should be selected to give the static deflections under load nominated for the item of plant and incorporate: separate steel top and base plates completely embedded in elastomer; elastomer colour coded for identification of load rating; non-skid mounting surfaces; bolt holes for bolting down plant.

Type M4 - Spring/Neoprene Mounts

Spring/neoprene mounts should be selected to give the static deflections under load nominated for the item of plant and: be laterally stable without any housing or other lateral support; be capable of an additional travel to solid of at least 50% of the rated static deflection; incorporate a levelling facility; a spring diameter not less than 0.8 of the loaded height; incorporate a 6mm thick neoprene base pad to isolate acoustical frequencies. Isolators exposed to weather should have zinc plated springs and housings coated with a flexible epoxy to prevent corrosion.

E.3.1.3 Isolation Hanger Types

Type HE1 - Neoprene Hanger Elements

Neoprene hanger elements should be selected to give the static deflections under load nominated for the item of plant and incorporate: separate steel top and base plates completely embedded in elastomer which should interlock in the event of fire or mechanical failure; elastomer colour coded for identification of load rating; hole for locating hanger and a lip to locate the element within in the mounting hole.

Type H1 - Neoprene Hangers

Neoprene hanger elements should be selected to give the static deflections under load nominated for the item of plant and incorporate: Type HE1 - Neoprene Hanger Element located within a galvanised steel cage with provision for threaded hanger rods to screw into the hanger element; provide sufficient clearance around the threaded hanger rod to ensure it cannot touch the hanger cage.

Type H2 - Spring/Neoprene Hangers

Spring/neoprene hangers should be selected to give the static deflections under load nominated for the item of plant and: be laterally stable without any housing or other lateral support; be housed in a galvanised steel cage; be capable of an additional travel to solid of at least 50% of the rated static deflection; incorporate a levelling facility; a spring diameter not less than 0.8 of the loaded height; incorporate a neoprene base pad to isolate acoustical frequencies. Isolators exposed to weather should have zinc plated springs and housings coated with a flexible epoxy to prevent corrosion, and self-draining cups.

E.3.2 Piping

Vibration isolate all small diameter refrigerant piping (FCU piping) using min. 12mm thick foam sleeve equal to Thermotec E-Flex fitted between the pipe and the clamp. The clamp should oversized so that tightening the clamp is sufficient to hold the pipe, but not compress the foam more than 50%. Any chased-in piping should be completely wrapped in foam.

E.3.3 Equipment Bases and Plinths

Mount equipment on rigid bases. The bases shall be sufficiently rigid not to deform under the weight of the machinery or during operation and reduce the effectiveness of the isolation mounts.

Where required, concrete inertia bases shall be installed. The mass of the base shall be at least 1.5 times the mass of the equipment being supported including pipe fittings, etc. Bases shall minimize the height of the centre of gravity of the machine/base.

E.3.4 Installation of Vibration Isolation Mounts

Install mounts in accordance with manufacturer's recommendations.

Level the mounts once the equipment is fully loaded in its operating condition with a minimum clearance between the machine and the structure of 20mm, and adjusted to ensure that the isolators are loaded correctly.

Ensure that the isolators are not bridged by mounting bolts or contact between any part of the machine or an unisolated part of the isolation mounts and the structure including seismic restraining bolts.

Select the number and spacing of the mountings to minimise machine rocking. Consider static and dynamic forces during operation and start-up when selecting the mounts. Where there is a possibility of significant lateral loads occurring use hold down bolts, lateral restraints, or housed mounts to locate equipment.

E.4 PENETRATIONS

E.4.1 General

Duct, pipe and electrical penetrations through walls, floors, etc. shall not:

- Decrease the required sound rating isolation rating of the wall, floor, ceiling, etc (refer Section ***Architectural Elements***).
- Allow the transmission of vibration from pipes and ducts to the wall, floor, etc.

Do not penetrate full height walls with flexible ducts. Where ducts pass through above ceiling barriers, below access floor barriers or full height walls, the main sheet metal duct should be taken through the penetration to over the room served by the flexible duct, and the flexible duct run out to the grille connected. Alternatively provide acoustically treated transfer duct where the flexible duct passes through the partition.

E.4.2 Pipe Penetrations

Seal pipes penetrating sound rated elements as follows:

Table E.2 – Pipe Seal Type

Pipe Location	Seal Type
Within 15m of condensing unit	Type PB seal (Refer ***Appendix A – Acoustic Details***)
Other pipes	Type PA or PB seal (refer ***Appendix A – Acoustic Details***)

Where the building element penetrated consists of one or more leaves then all leaves shall be acoustically sealed.

Route condensate and refrigerant piping so that there are no penetrations in any walls having a required R_w >50.

E.4.3 Duct Penetrations

Seal ducts penetrating sound rated elements as follows:

Table E.3 – Duct Seal Type

Wall/Floor Construction	Seal Type
Masonry or Plasterboard	Type DA or DB seal (refer ***Appendix A – Acoustic Details***)

Where the building element penetrated consists of one or more leaves then all leaves shall be acoustically sealed.

E.4.4 Electrical Wiring

Seal individual electrical cables with a flexible sealant equal to Selleys Proseries Fireblock. Bunches of cables shall be spread along the head of the wall before sealing or alternatively drawn through a 5mm thick, 600mm long PVC conduit packed with glass wool or Rockwool insulation. Seal around the conduit by caulking as indicated in Pipe Seal detail Type PA.

Where possible locate cable penetrations at the head of the walls, at the slab soffit.

E.4.5 Co-Ordination with Other Sub-Contractors/Trades

Where the installation of ducting limits access to other trades that would prevent them from installing acoustic treatment (for example, caulking of partitions) coordinate with these trades so that their works can be completed before access is prevented.

E.5 INTERNALLY LINED DUCTING - GENERAL

E.5.1 Lined Ducting

Internal duct insulation should be of resin bonded mineral wool insulation in a batt or board form having a minimum density of 32kg/m^3. Lining acoustic absorption shall exceed the following performance when measured in accordance with AS 1045-1988:

Table E.4 – Minimum Absorption Coefficient

Insulation Thickness	Minimum Absorption Coefficient					
	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
25mm	0.08	0.30	0.64	0.90	0.90	0.90
50mm	0.35	0.72	0.95	0.95	0.95	0.95
75mm	0.45	0.8	0.95	0.95	0.95	0.95
100mm	0.5	0.9	0.95	0.95	0.95	0.95

Insulation to be either factory faced with perforated aluminium foil similar to Sisilation 450 or faced with 30% open area perforated zinc anneal steel sheet. Perforated steel sheet shall be used whenever airflow velocities in the duct exceed 10m/s, or where specified elsewhere.

Internal lining for ducts exposed to weather (or where nominated) provide 25µm thickness Melinex/Mylar lining behind minimum 30% open area perforated zinc anneal steel sheet and insulation.

Internally line all grille cushion heads/plenums with min. 25mm thick black or perforated foil faced glasswool or polyester fibre insulation equal to Martini Absorb HD.

E.5.2 Flexible Ducting

Flexible ducting for air-conditioning to be 4 zero fire rated acoustic flexible duct equal to Bradford Acoustiflex with perforated inner core and minimum 25mm thick insulation and minimum 1.5m length.

E.6 ATTENUATORS

E.6.1 Performance

Install attenuators with not less than the nominated minimum silencer performance requirements for insertion loss, airflow pressure drop and regenerated noise where nominated, or as required to meet the space noise levels with the selected plant.

E.6.2 Construction

Acoustic attenuators shall be manufactured by a specialist manufacturer approved by the acoustic consultant and shall comprise:

1. A minimum 1.6mm thick galvanised outer casing stiffened as required to ensure that deformation of the silencer does not occur during installation and operation.

2. Acoustically absorbent internal splitters constructed of perforated zinc anneal steel sheet with acoustically absorbent, high-density mineral fibre infill. The ends of the splitters shall be shaped to minimise airflow resistance and regenerated noise.

3. Heavy gauge flanges where the silencer is to be connected to ducting. Flanges shall be corrosion protected with an approved finish.

Allow for duct transition sections before and after the attenuator, if required.

Where attenuators are installed in risers, behind louvres, etc. seal around the perimeter of the attenuator to the building opening with minimum 1.6mm thick sheet metal, fixed and caulked in a similar to that indicated in the "PB" duct penetration detail.

Manufacture attenuators exposed to water or are subject to corrosive or other special conditions using materials compatible with those conditions and the requirements of the mechanical specification.

E.7 EXTERNAL LAGGING AND BULKHEADS/ENCLOSURES

Where external lagging of plant or ducting is required minimum external pipe wrapping to be 5kg/m^2 foam backed loaded vinyl (equal to Vibralag from Acoustic Supplies). Overlap all joints by minimum of 50mm and tape airtight with aluminium tape.

Where enclosure of plant or ducting is required the enclosure or any framing should not contact the plant/ducting. Line internally with minimum 50mm thick Martini Absorb HD insulation. Seal any gaps and junctions airtight using an approved caulking (refer Section ***Sealants***) to pevent leakage of sound. Access panels to have equivalent construction to the enclosure and have full perimeter seals to prevent any sound leakage.

Where fans or fan/coil units are required to be externally lagged or enclosed:

- Provide for removable sections to allow access to removable panels required for regular servicing.
- Treatment to include and extend to just past any flexible duct connections.

E.8 ELECTRICAL

E.8.1 Belt Driven Plant

Fit belt driven intermittently operating plant having motors rated at greater than 2.5kW with motor-starters that limit the build-up in motor speed at start-up.

E.8.2 Contactors/Starters/Controllers

Noise from contactors, starters and controllers shall be inaudible inside rooms having a noise of 45dB(A) or lower, on adjacent properties. Provide enclosures around these items and/or vibration isolate the items from building elements where they may give rise to the transmission of structure-borne noise.

E.9 PROJECT SPECIFIC TREATMENT

The following minimum levels of treatment are to be provided to each system based on the mechanical drawings prepared by JHA Consulting drawings (Job No. 230185, dated Jun 2023).

If there are any changes to the layouts, plant selections, etc determine and install whatever additional treatment is needed to comply with all performance outcomes and minimum requirements of this specification.

Following list the additional minimum treatment required to be installed.

E.9.1 TEF-BRO-3

- No additional acoustic treatment is required.

E.9.2 TEF-BRO-4

- No additional acoustic treatment is required.

E.9.3 GEF-BRO-4

- No additional acoustic treatment is required.

E.9.4 TEF-BRO-2

- No additional acoustic treatment is required.

E.9.5 GEF-BRO-3

- No additional acoustic treatment is required.

E.9.6 GEF-BRO-2

- Intake: install minimum 1 m long internally lined duct with 25mm thick insulation before any grille.

E.9.7 GEF-BRO-1

- No additional acoustic treatment is required.

E.9.8 TEF-BRO-1

- No additional acoustic treatment is required.

E.9.9 Typical GLS OA fan

- Intake: install 1m internally lined duct with minimum 25mm thick insulation before the fan.
- Discharge: install 1m internally lined duct with minimum 25mm thick insulation after the fan.
- Fan casing: wrap the fan with 1 layer of minimum 5kg/m2 foam backed mass loaded vinyl (Acoustic Supplies Vibralag or equivalent). This includes flexible connections to each duct.

E.9.10 Multipurpose OA fan

- No additional acoustic treatment is required.

E.9.11 OAF-BRO-2

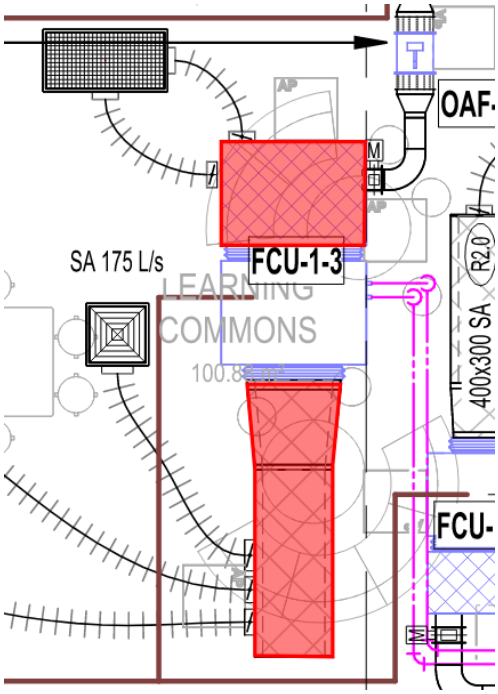
- Fan casing: wrap the fan with 1 layer of minimum 5kg/m2 foam backed mass loaded vinyl (Acoustic Supplies Vibralag or equivalent). This includes flexible connections to each duct.

E.9.12 GLS FCU 1-1 & 1-2 &1-5– FXMQ250PV1A

- Assume designed speed is M
- Wavebar is to be installed in the ceiling cavity within 2.5m of any FCUs to provide sufficient acoustic attenuation.
- Ensure proposed insulation for both supply duct and return duct is minimum 50mm thick.

E.9.13 FCU 1-3 & FCU 2-1

- Assume designed speed is M
- Wavebar is to be installed in the ceiling cavity within 2.5m of any FCUs to provide sufficient acoustic attenuation.
- Ensure proposed insulation for both supply duct and return duct is minimum 50mm thick. see mark up below:



E.9.14 FCU 3-2, 3-5 & FCU 3-6

- Under ceiling type cassete unit cannot be acoustically treated

E.9.15 Plant room

Condenser units CU-1, CU-2, CU-3 and CU-4 (assumed to be same noise level as CU-3) are assessed.

- All condenser units are to be installed with minimum 10mm static deflection isolation mounts
- No additional acoustic treatment is required.

F HYDRAULIC SERVICES

F.1 PROJECT NOISE AND VIBRATION CRITERIA

F.1.1 Internal and External Noise Levels

Vibration generated by plant not to exceed the levels nominated in Section ***Acoustic Performance Criteria***. Noise generated by hydraulic services not to exceed the levels indicated in Section ***Acoustic Performance Criteria*** minus 5 dB(A) notwithstanding the equipment noise ratings or the acoustic treatments indicated in the hydraulics services specification or drawings. For the plant selected, assess noise levels and provide treatment needed to comply with the specified maximum noise levels.

Unless stated otherwise, the noise level criteria shall not be exceeded with the plant operating under normal operating conditions, and at start-up for intermittently operating plant items.

F.1.2 Emergency Operation Noise Levels

Comply with space noise levels stipulated in the relevant version of AS 1668 when fire emergency operation or testing of emergency systems.

F.1.3 Plant Noise Levels

Adjust and balance all systems so that excessive noise is not created, and the scheduled internal and external noise levels are complied with.

F.2 STRUCTURE BORNE NOISE AND VIBRATION

Minimise the transmission of vibration to the building structure to ensure the noise and vibration criteria are achieved by:

1. Statically and dynamically balancing rotating plant and equipment. Where specified, provide balancing test certificates.
2. Providing isolation mounts or hangers for vibrating plant and equipment.
3. Providing inertia blocks to limit the vibration amplitude.
4. Isolating piping, electrical conduit, etc. subject to vibration from the building structure.
5. Providing flexible connections where ducts and piping is connected to vibrating plant and machinery.
6. Proper installation.
7. Do not bridge across discontinuous wall or other constructions with piping, noggings, brackets, etc.

Submit a schedule of isolation mounts for approval by the acoustic consultant indicating make, model, rated load and static deflection, actual load and static deflection, unloaded height and fully loaded height.

The vibration isolation systems shall be selected to achieve seismic and noise/vibration requirements.

F.2.1 Anti-Vibration Mounts and Isolators

F.2.1.1 Selection of Equipment Isolation Mounts

As a minimum, select isolation mount type and static deflection according to the following table (refer below for isolator types).

Table F.1 –Isolator Schedule

Plant	Isolator Type	Minimum Static Deflection
Pumps ≤ 1.5kW motor power	M3/H1	10 mm
Pumps >1.5kW motor power	M4/H2	25mm

F.2.1.2 Isolation Mount Types

Type M1 - Waffle Pad Mounts

Waffle pad mounts shall be: minimum 17mm thick neoprene rubber (nitrile rubber where oil contamination is possible); cross ribbed with alternately raised ribs on both faces of the pad; loaded within the load range of the isolator with a minimum static deflection of 1.5mm.

Type M2 - Multiple Layer Waffle Pad Mounts

Multiple layer waffle pad mounts incorporating; specified number of layers of Type M1 Waffle Pad Mount; 1.5mm thick metal shim plate between the pad layers; minimum 1.5mm static deflection per layer.

Type M3 - Neoprene Mounts

Neoprene mounts should be selected to give the static deflections under load nominated for the item of plant and incorporate: separate steel top and base plates completely embedded in elastomer; elastomer colour coded for identification of load rating; non-skid mounting surfaces; bolt holes for bolting down plant.

Type M4 - Spring/Neoprene Mounts

Spring/neoprene mounts should be selected to give the static deflections under load nominated for the item of plant and: be laterally stable without any housing or other lateral support; be capable of an additional travel to solid of at least 50% of the rated static deflection; incorporate a levelling facility; a spring diameter not less than 0.8 of the loaded height; incorporate a 6mm thick neoprene base pad to isolate acoustical frequencies. Isolators exposed to weather should have zinc plated springs and housings coated with a flexible epoxy to prevent corrosion.

F.2.1.3 Isolation Hanger Types

Type HE1 - Neoprene Hanger Elements

Neoprene hanger elements should be selected to give the static deflections under load nominated for the item of plant and incorporate: separate steel top and base plates completely embedded in elastomer which should interlock in the event of fire or mechanical failure; elastomer colour coded for identification of load rating; hole for locating hanger and a lip to locate the element within in the mounting hole.

Type H1 - Neoprene Hangers

Neoprene hanger elements should be selected to give the static deflections under load nominated for the item of plant and incorporate: Type HE1 - Neoprene Hanger Element located within a galvanised steel cage with provision for threaded hanger rods to screw into the hanger element; provide sufficient clearance around the threaded hanger rod to ensure it cannot touch the hanger cage.

Type H2 - Spring/Neoprene Hangers

Spring/neoprene hangers should be selected to give the static deflections under load nominated for the item of plant and: be laterally stable without any housing or other lateral support; be housed in a galvanised steel cage; be capable of an additional travel to solid of at least 50% of the rated static deflection; incorporate a

levelling facility; a spring diameter not less than 0.8 of the loaded height; incorporate a neoprene base pad to isolate acoustical frequencies. Isolators exposed to weather should have zinc plated springs and housings coated with a flexible epoxy to prevent corrosion, and self-draining cups.

F.2.2 Equipment Bases and Plinths

Mount equipment on rigid bases. The bases shall be sufficiently rigid not to deform under the weight of the machinery or during operation and reduce the effectiveness of the isolation mounts.

Where required, concrete inertia bases shall be installed. The mass of the base shall be at least 1.5 times the mass of the equipment being supported including pipe fittings, etc. Bases shall minimize the height of the centre of gravity of the machine/base.

F.2.3 Installation of Vibration Isolation Mounts

Install mounts in accordance with manufacturer's recommendations.

Level the mounts once the equipment is fully loaded in its operating condition with a minimum clearance between the machine and the structure of 20mm, and adjusted to ensure that the isolators are loaded correctly.

Ensure that the isolators are not bridged by mounting bolts or contact between any part of the machine or an unisolated part of the isolation mounts and the structure including seismic restraining bolts.

Select the number and spacing of the mountings to minimise machine rocking. Consider static and dynamic forces during operation and start-up when selecting the mounts. Where there is a possibility of significant lateral loads occurring use hold down bolts, lateral restraints, or housed mounts to locate equipment.

F.3 PENETRATIONS

F.3.1 General

Pipe and electrical penetrations through walls, floors, etc. shall not:

- Decrease the required sound rating isolation rating of the wall, floor, ceiling, etc.
- Allow the transmission of vibration from pipes and ducts to the wall, floor, etc.

F.3.2 Pipe Penetrations

Seal pipes penetrating sound rated elements as follows:

Table F.2 – Pipe Seal Type

Pipe Location	Seal Type
Within 15m of pump	Type PB seal (refer ***Appendix A – Acoustic Details***)
Other pipes	Type PA or PB seal (refer ***Appendix A – Acoustic Details***)

Where the building element penetrated consists of one or more leaves then all leaves shall be acoustically sealed.

F.3.3 Electrical Wiring

Seal individual electrical cables with a flexible sealant equal to Selleys Proseries Fireblock. Bunches of cables shall be spread along the head of the wall before sealing or alternatively drawn through a 5mm thick, 600mm long PVC conduit packed with glass wool or Rockwool insulation. Seal around the conduit by caulking as indicated in Pipe Seal detail Type PA.

Where possible locate cable penetrations at the head of the walls, at the slab soffit.

F.3.4 Co-Ordination with Other Sub-Contractors/Trades

Where the installation of piping limits access to other trades that would prevent them from installing acoustic treatment (for example, caulking of partitions) coordinate with these trades so that their works can be completed before access is prevented.

F.4 WASTE, STORMWATER AND SUPPLY PIPING ACOUSTIC LAGGING

As a minimum, treat piping in ceiling spaces according to the following.

Table F.3 – Pipe Treatment Ceiling Spaces

Space/Location	System	Ceiling	Minimum Treatment
Any Occupied Space	Supply Pipes	Perforated plasterboard, timber, metal or other open ceiling	Double wrap piping

External pipe wrapping to be 5kg/m^2 foam backed loaded vinyl (equal to Vibralag from Acoustic Supplies). Overlap all joints by minimum of 50mm and tape airtight with aluminium tape. In addition, all pipes which are required to be lagged which penetrate slab soffits, walls, risers or like shall have the pipe lagging flanged (minimum 50mm lap) to the meeting surface or sealed with a flexible sealant.

All waste pipes shall be kept a minimum of 20mm clear of any part of the structure including walls, ceilings, ceiling hangers, etc. Waste pipe penetrations shall be sealed as recommended above for pipe penetrations. Mortar or render should be kept clear of the penetrations so as to prevent any bridging between the pipe and the wall.

Where waste pipes or in-wall cisterns are located within walls backing onto normally occupied spaces with a required hydraulic services plant noise level requirement of 40 dB(A) or less) the piping should be located in a discontinuous services wall (dummy wall) with the piping attached only to the wall leaf on the wet area side.

G ELECTRICAL SERVICES

Penetrations in sound rated ceilings or walls or floors or risers should maintain the acoustic performance of the sound rated element. Refer Section ***Acoustic Performance Criteria***. Where required provide acoustic boxes or other treatment.

Where penetrations are made in sound rated walls >R_w 35 for either GPO's or light switches, these should be backed using the HPM 430 Fire/Acoustic wall box. The boxes may be used in a back to back arrangement. Boxes are not required:

- On plasterboard walls with a rating of R_w 40 or less provided back to back GPO/switches are offset a minimum of 300mm.
- On masonry walls where the depth of the wall material removed is less than 30% of the total depth of masonry thickness.
- On masonry walls provided back to back GPO/switches are offset a minimum of 150mm.

Seal individual electrical cable penetrations with Selleys Fireblock sealant. Seal bunches of cables using one of following methods:

- Drawn through a 5mm thick, 600mm long PVC conduit tightly packed with polyester fibre, glass wool or Rockwool insulation. Seal around the conduit by filling with a non-shrinking grout or caulking.
- Spread apart so there is a clear gap between cables and caulked as described for individual cables.

Wherever possible, where pipes and cables running through ceiling voids enter or pass through an acoustically rated wall (or pass into a wall cavity forming part of an acoustically rated wall) the pipe/cable shall be located as close as possible to the head of the wall with the cables spread to facilitate sealing.

H FACADE

Select and install façade (glazing, infills, spandrels, etc) so that noise transmission through these elements does not result in internal noise levels exceeding the levels in Section ***Acoustic Performance Criteria***.

H.1 EXTERNAL GLAZING

Notwithstanding any other requirement, glazing systems (glass and framing combined) to achieve both the minimum thickness/construction as well as the R_w rating specified below.

All external windows and doors listed are required to be fitted with Q-lon type acoustic seals or equal. (**Mohair Seals are unacceptable**).

Table H.1 – Minimum Glazing Requirements

FAÇADE	SPATIAL USE	GLAZING REQUIREMENTS	ACOUSTIC SEALS
All	Teaching, Learning, Library, Offices	6.38mm Laminated glass	Yes
All	Stores, Bathrooms	4mm Float	Yes

In addition to complying with the minimum scheduled glazing thickness, the R_w rating of the glazing fitted into openable or fixed frames, installed into the building opening should not be lower than the values listed in the table below. This will require the use of acoustic seals around the full perimeter of openable frames and the frame will need to be sealed into the building opening using a flexible sealant. Note that mohair seals in windows and doors are not acceptable where acoustic seals are required.

Table H.2 – Minimum R_w Requirements of Glazing Construction

GLAZING CONSTRUCTION	SYSTEM MINIMUM R_w RATING
4mm glass	27
6.38mm laminated glass	31
10.38mm laminated glass	35

H.1.1 Acoustic Sealing of Window Frames

Acoustically seal the perimeter of glazing system required to achieve an acoustic rating into the window/door opening so there is no leakage of noise between the window frame and the building opening. The sealing method selected shall take into account and allow for any movement of the window frame relative to the building opening and so that the acoustic performance is maintained.

H.2 EXTERNAL WALLS

External walls are proposed to be constructed from lightweight elements and the complying construction is presented below:

Table H-3 – External Wall Construction

INTERNAL LINING	WALL Cavity	EXTERNAL LINING
1×13 mm plasterboard	92mm steel stud with 75mm thick 11kg/m3 glasswool insulation in cavity	9mm FC sheet

In the event penetrations are required through any part of a wall, it should be sealed airtight with an acoustic grade sealant.

H.3 NON- VISION ELEMENTS

Select and install non-vision façade elements (infills, spandrels, etc) so that noise transmission through these elements does not result in internal noise levels exceeding the specified levels. Unless nominated otherwise, do not rely on any internal linings not installed by the façade sub-contractor.

H.4 MANUFACTURER'S RECOMMENDATIONS

Install all systems in accordance with the manufacturer's requirements and recommendations unless this specification requires a higher standard.

I OPERATIONAL NOISE ASSESSMENT

I.1 OPERATING HOURS AND CAPACITY

Noise emission from the operation of the school is assessed based on the following operational condition of the school:

- Broadwater School has a total number of 54 Students, and
- Hours of operation is between 8:30am to 3:30pm during school terms (Daytime).

Operational noise generally includes the following scenarios:

Scenario 1: All students using indoor classrooms with all windows & doors open, 1 of 2 students are speaking and

Scenario 2: All students using outdoor play area.

I.2 SOUND POWER LEVELS

Noise emissions from student activities were predicted using the mid-point level of Sound Power Level data recommended by AAAC Guideline for Child Care Centre Acoustic Assessment (2020) which has been detailed in the table below. Note that following SWL is normally used for outdoor activity hence is considered conservative for indoor activity assessment.

Table 4 – AAAC Sound Power Levels

Number of Children	Sound Power Levels (dB) at Octave Band Centre Frequencies (Hz)								
	dB(A)	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
10 Children	**87**	64	70	75	81	83	80	76	72

Notes:

1. *If applicable, an adjustment to the above sound power levels of -6 dB could be applied in each age group for children involved in passive play.*
2. *For simplicity, based upon a review of World Health Organization (WHO) data, a single recommended source height of 1 metre is suggested as the source heights.*

To calculate the effective sound power level for a specific number of children, the following formula shall be used:

Effective Sound Power Level for 'n' children = Effective Sound Power Level for 10 children + 10 log (n/10)

Notes:

1 The noise level of boys and girls are assumed to be very similar and therefore are not differentiated in this guideline.

2 For every doubling of the number of children, 3 dB is added.

I.3 SUMMARISED PREDICTED OPERATIONAL NOISE DISCUSSION

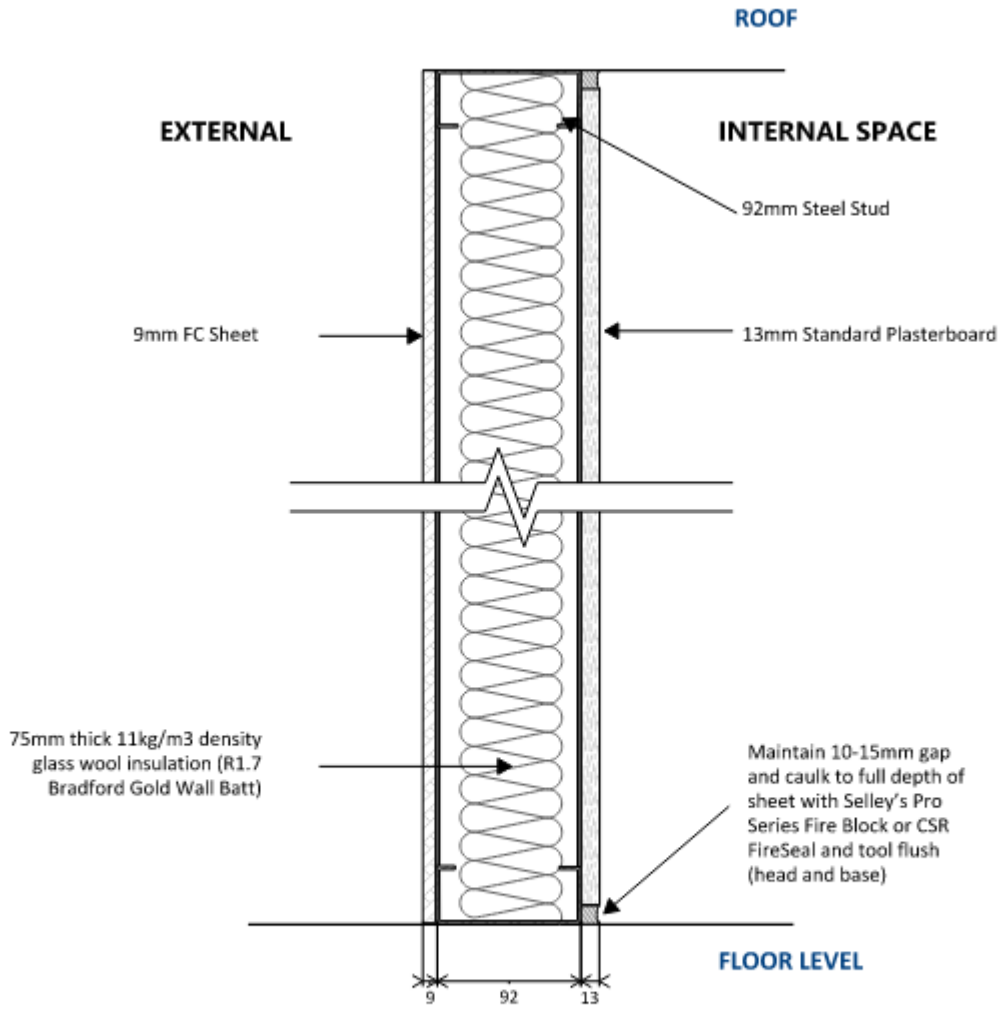
The table below presents the maximum external noise level due to operational noise from the proposed school at the nearest sensitive receivers.

Table 6-2 – Predicted Operational Noise Levels at Sensitive Receivers

Assessment Location	Predicted Worst Case Noise Level dB(A)L_{eq}	Operational Activity	Criteria - Day* (7am-6pm)	Compliance?
R1 - Residential receivers	51	All students using indoor classroom with all windows open, 1 of 2 talking	**55** dB(A) $L_{eq\ (15min)}$- (BG+5)	**Yes**
R2 - Residential receivers	42			**Yes**
R1 - Residential receivers	58	All students using outdoor play area	**60** dB(A) $L_{eq\ (15min)}$- (BG+10)	**Yes**
R2 - Residential receivers	48			**Yes**

*Criteria were adopted from AAAC Guideline for Child Care Centre Acoustic Assessment (2020) for Other Noise Emission (including use of indoor classroom: BG+5) and use of outdoor playing area (BG+10).

APPENDIX A – ACOUSTIC DETAILS



SECTION ELEVATION

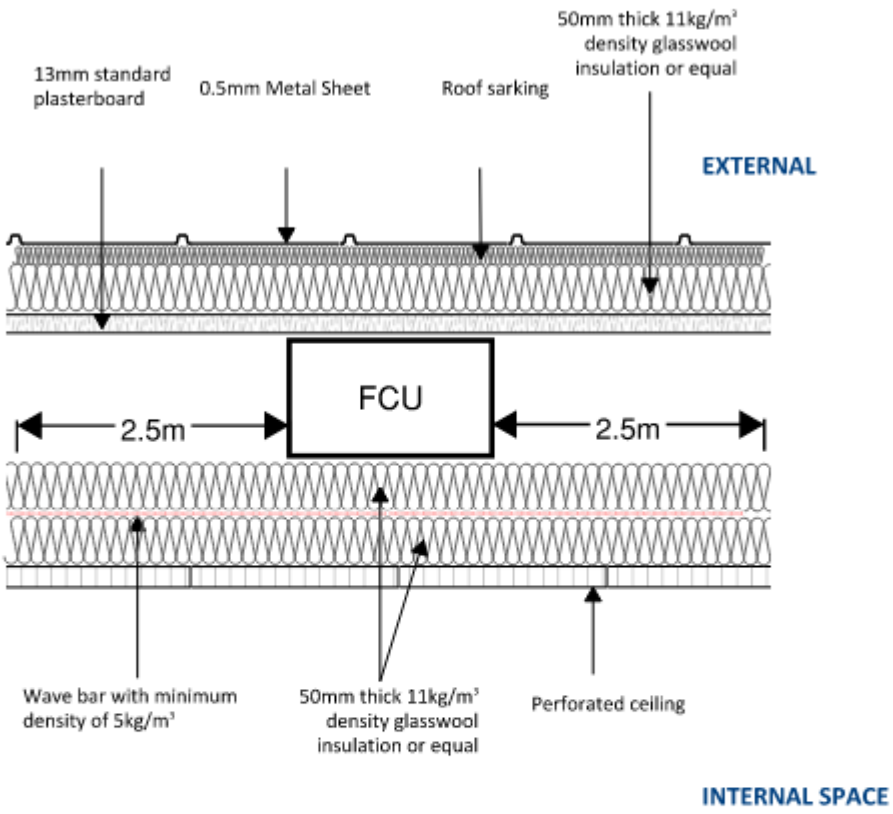
NOTE:
- ALL WALL PENETRATIONS TO BE ACOUSTICALLY SEALED.

External Façade Wall Construction
R_w 45

ACOUSTIC LOGIC

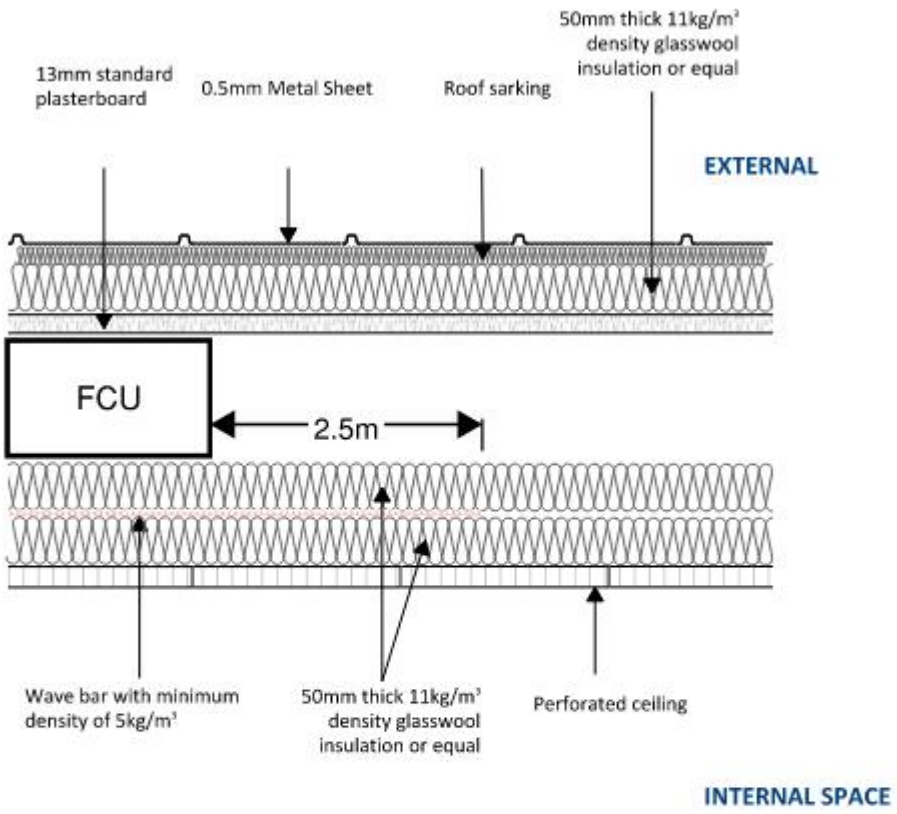
Northern Rivers Schools Cluster

Date:	Drawn:	Checked:	Project Number:	Drawing Number:
25/07/2023	PF		20230554.5	AC001
Issue:	**Scale:**	**Approved:**		
	NTS	PF		



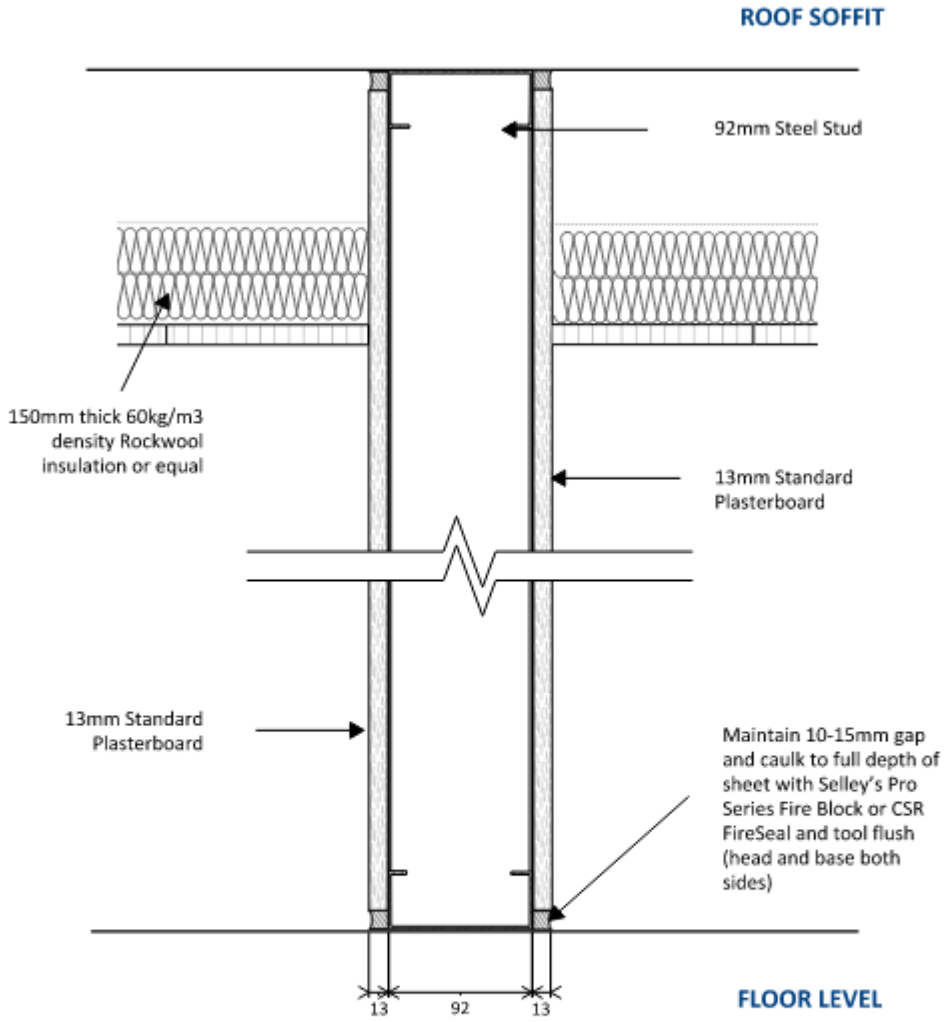
SECTION ELEVATION

Roof and Ceiling Construction (2.5m within FCU)			ACOUSTIC LOGIC Northern Rivers Schools Cluster	
Date:	**Drawn:**	**Checked:**	**Project Number:**	**Drawing Number:**
25/07/2023	PF		20230554.5	AC002
Issue:	**Scale:**	**Approved:**		
	NTS	PF		



SECTION ELEVATION

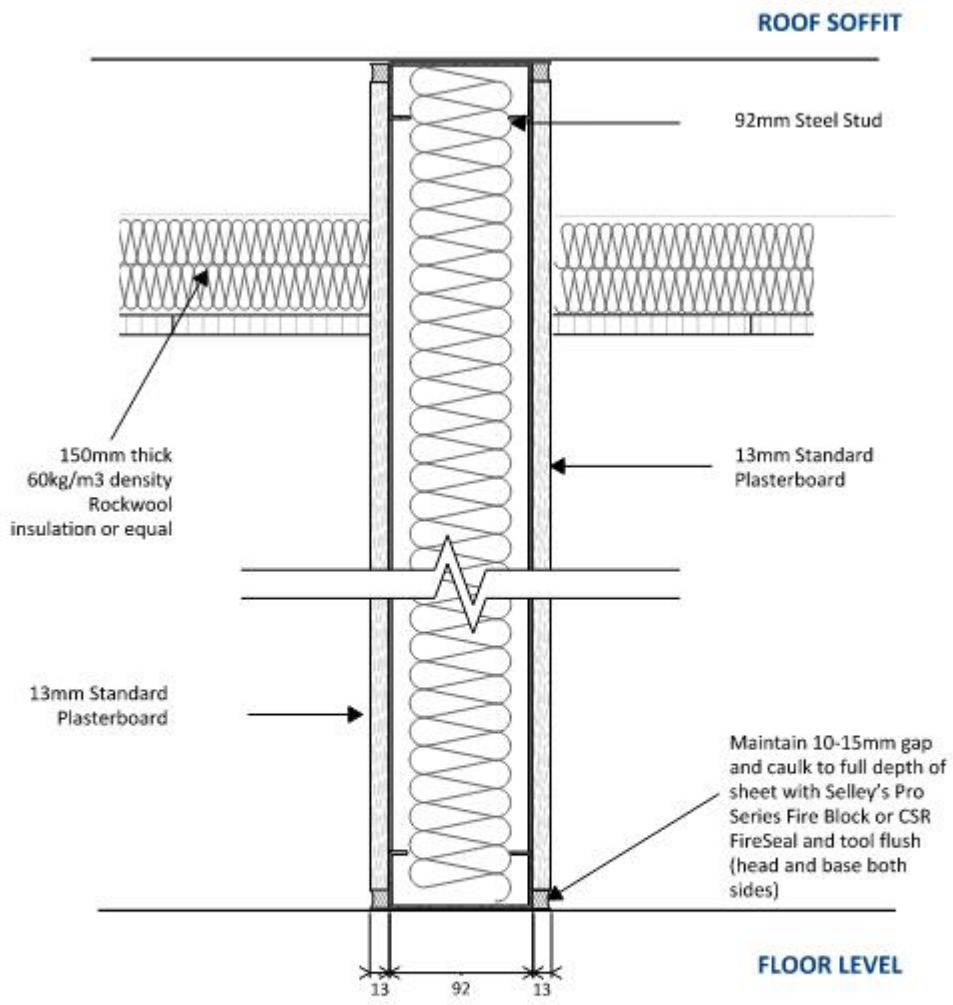
Roof and Ceiling Construction (2.5m away from any FCU)			ACOUSTIC LOGIC Northern Rivers Schools Cluster	
Date:	**Drawn:**	**Checked:**	**Project Number:**	**Drawing Number:**
25/07/2023	PF		20230554.5	AC002
Issue:	**Scale:**	**Approved:**		
	NTS	PF		



SECTION ELEVATION

NOTE:
- ALL WALL PENETRATIONS TO BE ACOUSTICALLY SEALED.

R_w 35 Wall System Section Elevation			ACOUSTIC LOGIC	
			Northern Rivers Schools Cluster	
Date:	**Drawn:**	**Checked:**	**Project Number:**	**Drawing Number:**
25/07/2023	PF		20230554.5	AC003
Issue:	**Scale:**	**Approved:**		
	NTS	PF		



SECTION ELEVATION

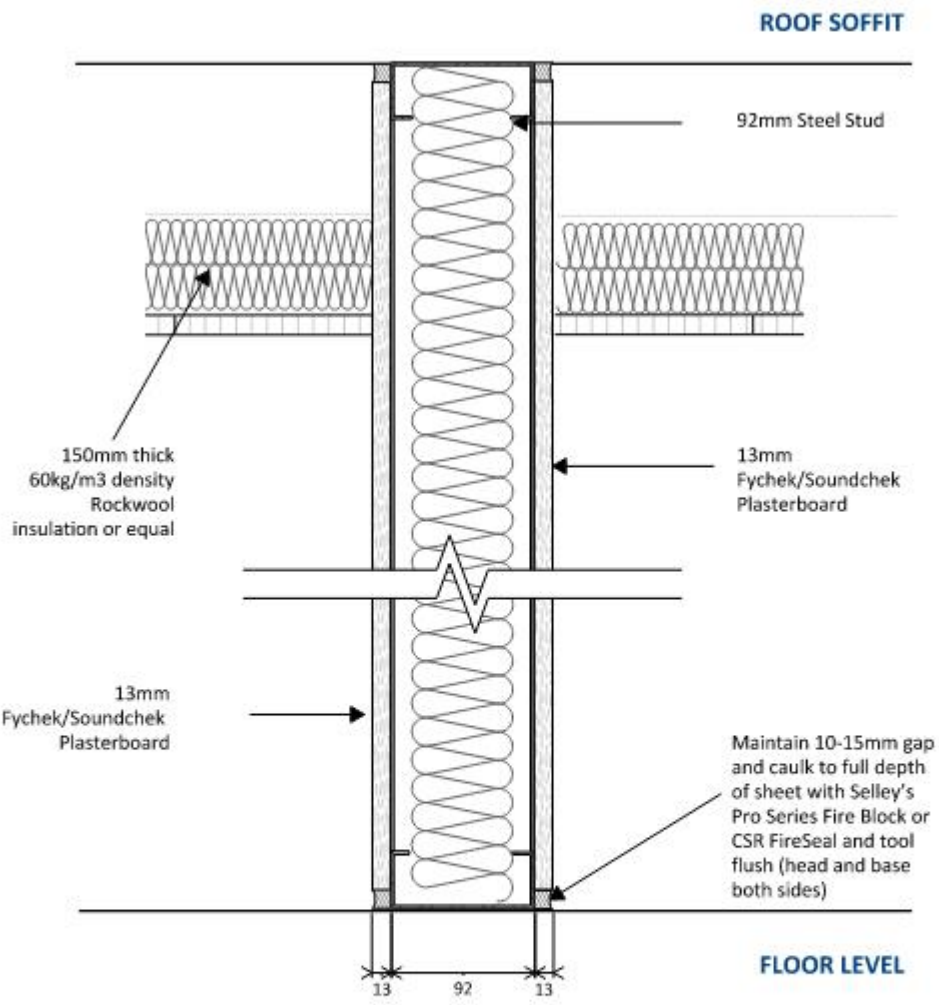
NOTE:
- ALL WALL PENETRATIONS TO BE ACOUSTICALLY SEALED.

R_w 40 Wall System
Section Elevation

ACOUSTIC LOGIC

Northern Rivers Schools Cluster

Date:	Drawn:	Checked:	Project Number:	Drawing Number:
25/07/2023	PF		20230554.5	AC004
Issue:	**Scale:**	**Approved:**		
	NTS	PF		



SECTION ELEVATION

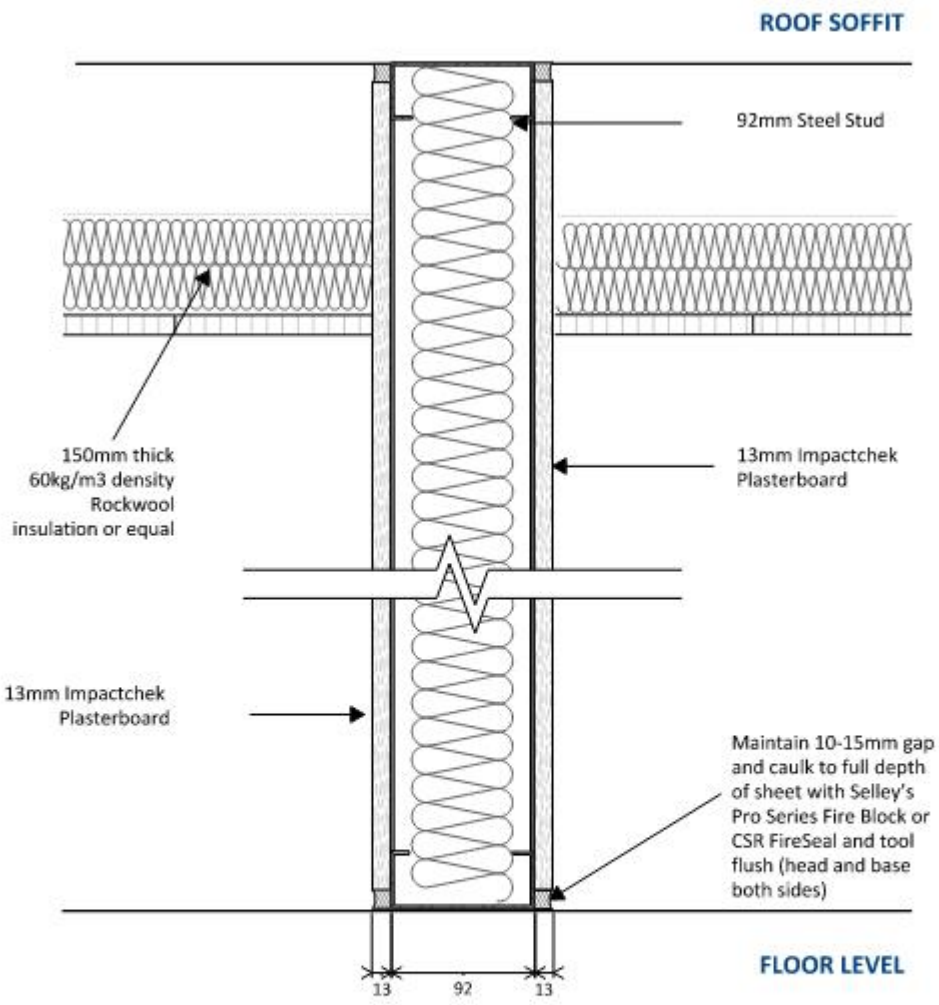
NOTE:
- ALL WALL PENETRATIONS TO BE ACOUSTICALLY SEALED.

R_w 45 Wall System
Section Elevation

ACOUSTIC LOGIC

Northern Rivers Schools Cluster

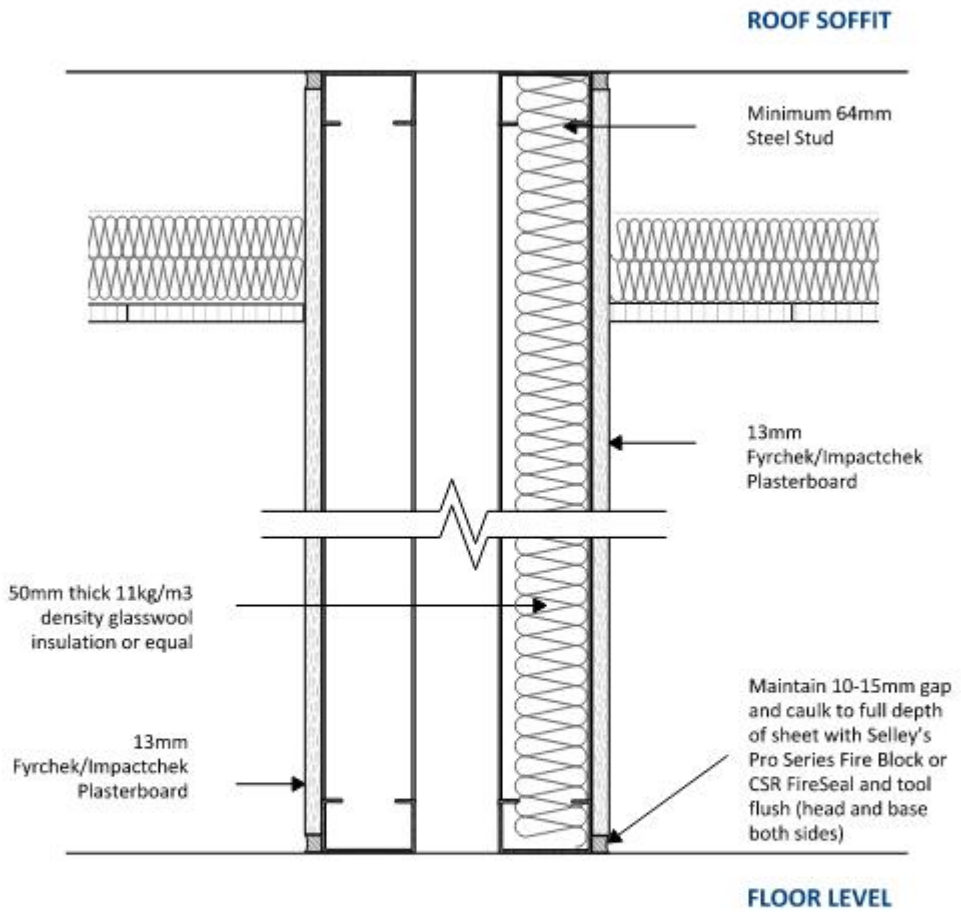
Date:	Drawn:	Checked:	Project Number:	Drawing Number:
25/07/2023	PF		20230554.5	AC005
Issue:	**Scale:**	**Approved:**		
	NTS	PF		



SECTION ELEVATION

NOTE:
- ALL WALL PENETRATIONS TO BE ACOUSTICALLY SEALED.

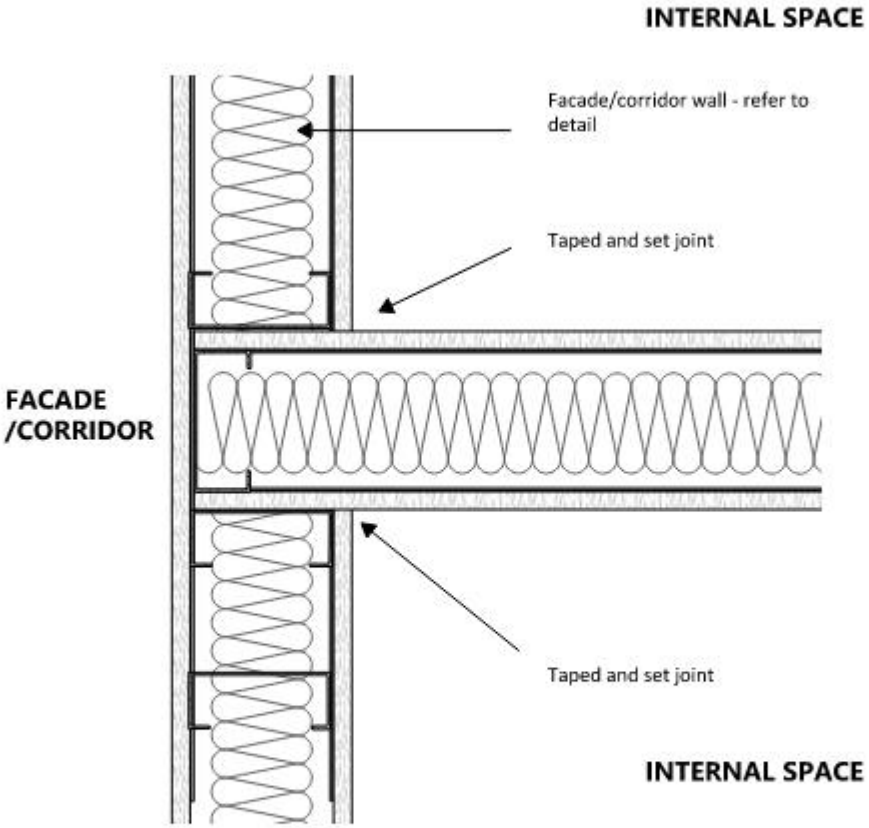
R_w 45 Wall System (Impact Rated) Section Elevation			ACOUSTIC LOGIC	
			Northern Rivers Schools Cluster	
Date:	**Drawn:**	**Checked:**	**Project Number:**	**Drawing Number:**
25/07/2023	PF		20230554.5	AC006
Issue:	**Scale:**	**Approved:**		
	NTS	PF		



SECTION ELEVATION

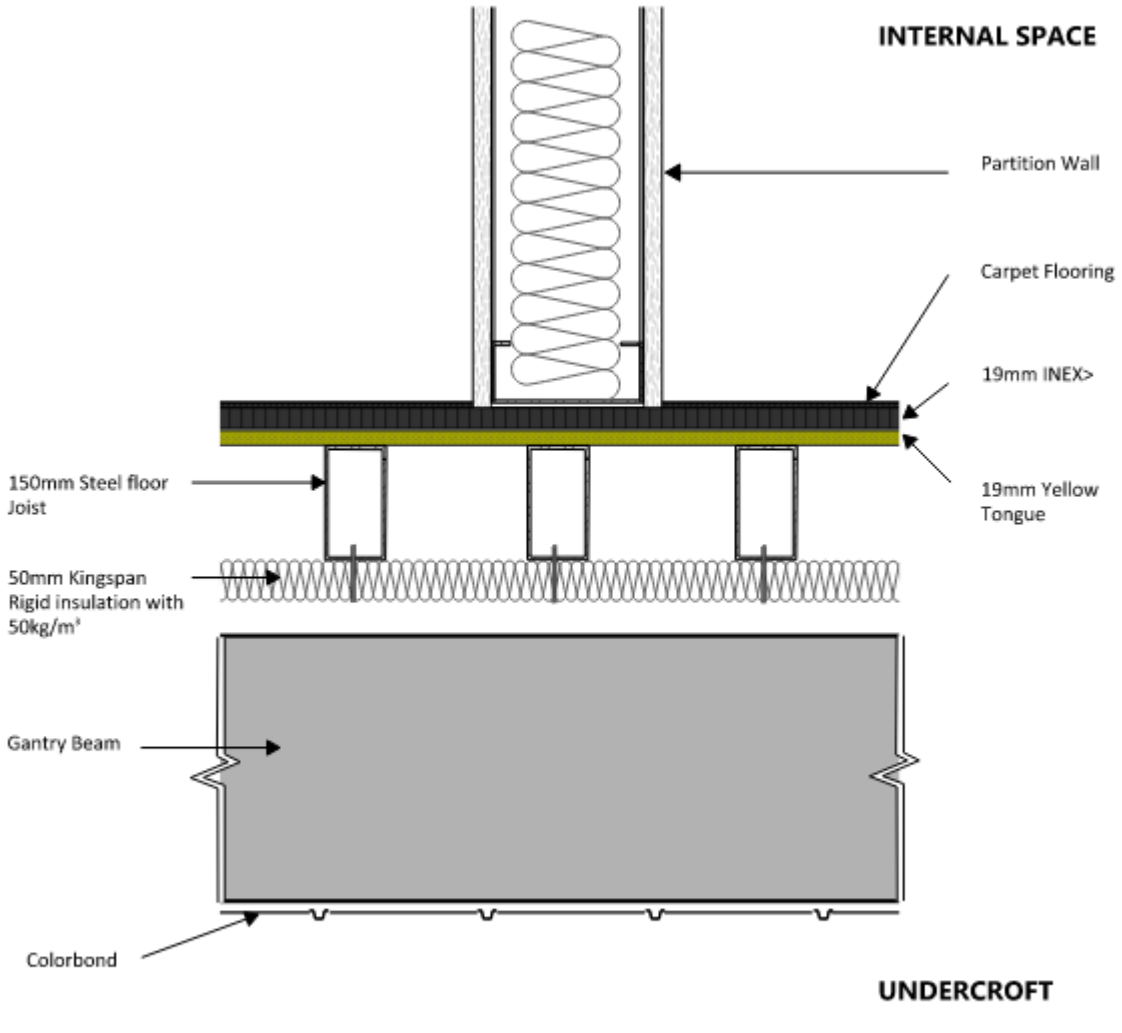
NOTE:
- ALL WALL PENETRATIONS TO BE ACOUSTICALLY SEALED.

R_w 45 Wall System (Cavity Sliding Door) Section Elevation			ACOUSTIC LOGIC	
			Northern Rivers Schools Cluster	
Date:	**Drawn:**	**Checked:**	**Project Number:**	**Drawing Number:**
25/07/2023	PF		20230554.5	AC007
Issue:	**Scale:**	**Approved:**		
	NTS	PF		



PLAN SECTION

Façade/ Corridor Wall Junction Plan Section			ACOUSTIC LOGIC	
			Northern Rivers Schools Cluster	
Date:	**Drawn:**	**Checked:**	**Project Number:**	**Drawing Number:**
25/07/2023	PF		20230554.5	AC008
Issue:	**Scale:**	**Approved:**		
	NTS	PF		



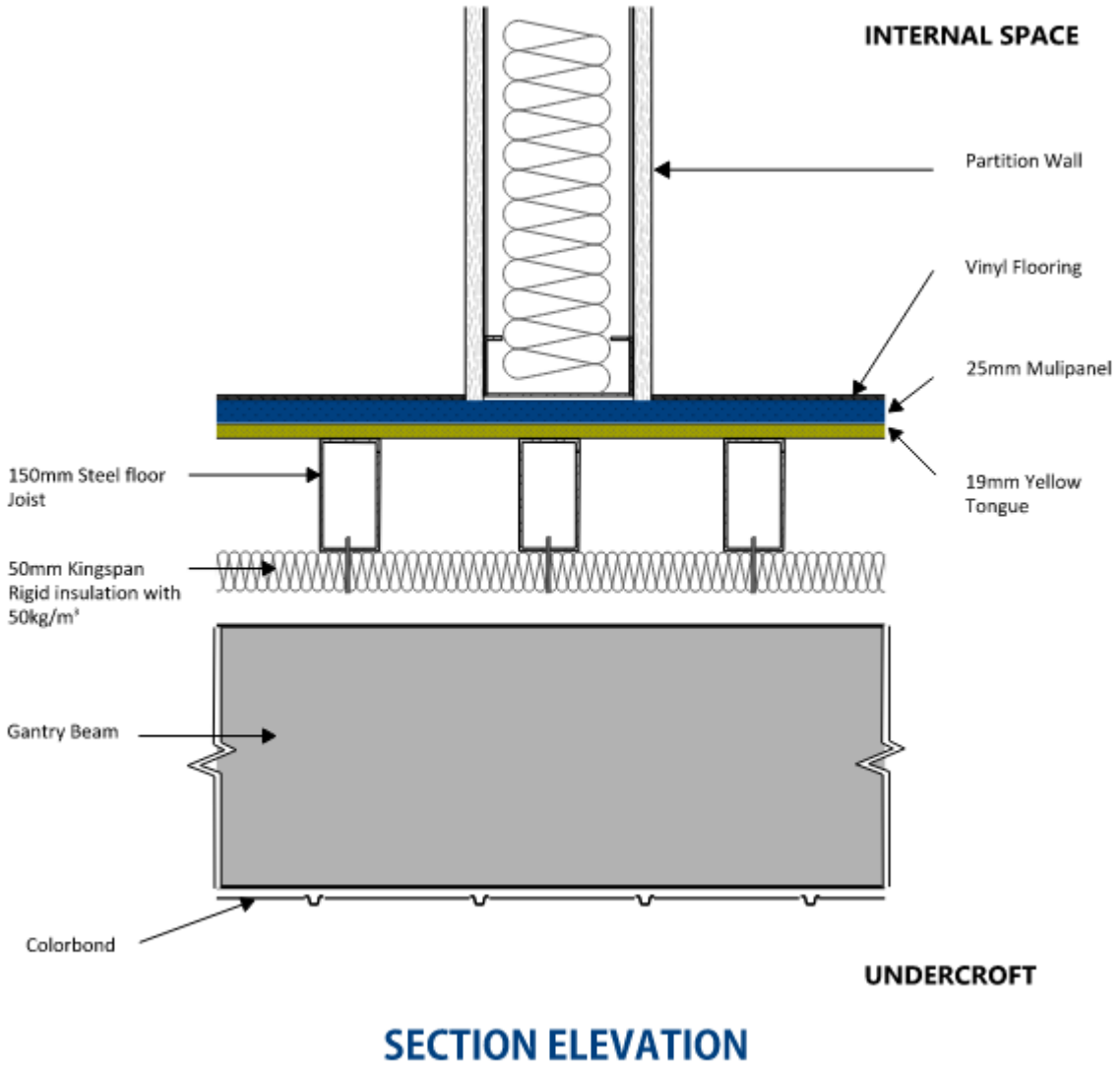
SECTION ELEVATION

Floor System
Option 1
Section Elevation

ACOUSTIC LOGIC

Northern Rivers Schools Cluster

Date:	Drawn:	Checked:	Project Number:	Drawing Number:
25/07/2023	PF		20230554.5	AC009a
Issue:	**Scale:**	**Approved:**		
	NTS	PF		



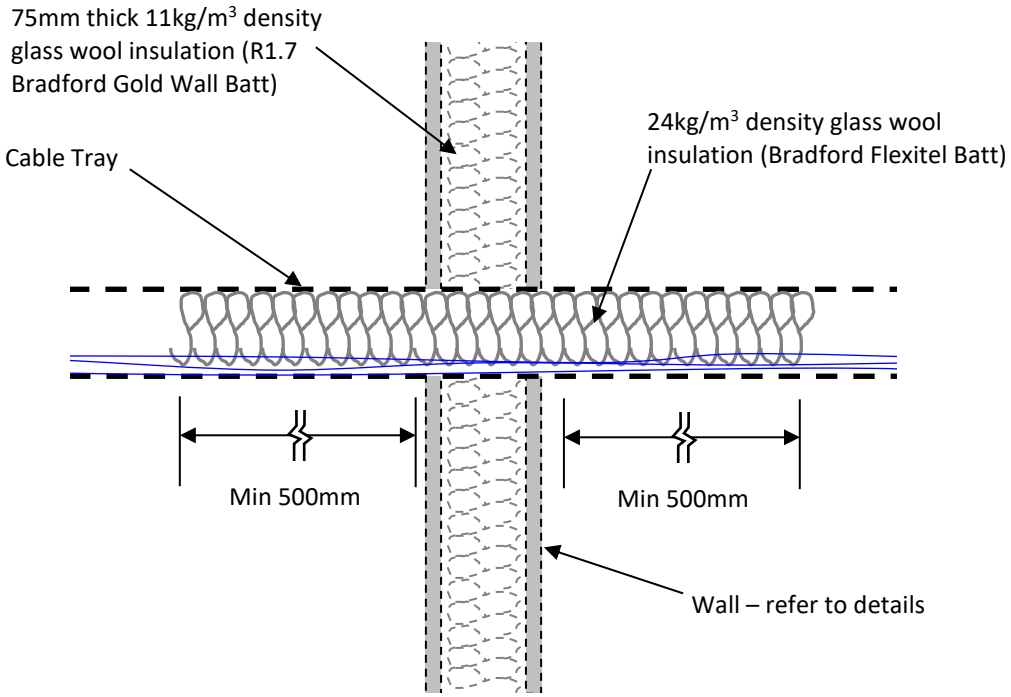
SECTION ELEVATION

Floor System
Option 2 (Wet Area)
Section Elevation

ACOUSTIC LOGIC

Northern Rivers Schools Cluster

Date:	Drawn:	Checked:	Project Number:	Drawing Number:
25/07/2023	PF		20230554.5	AC009b
Issue:	**Scale:**	**Approved:**		
	NTS	PF		

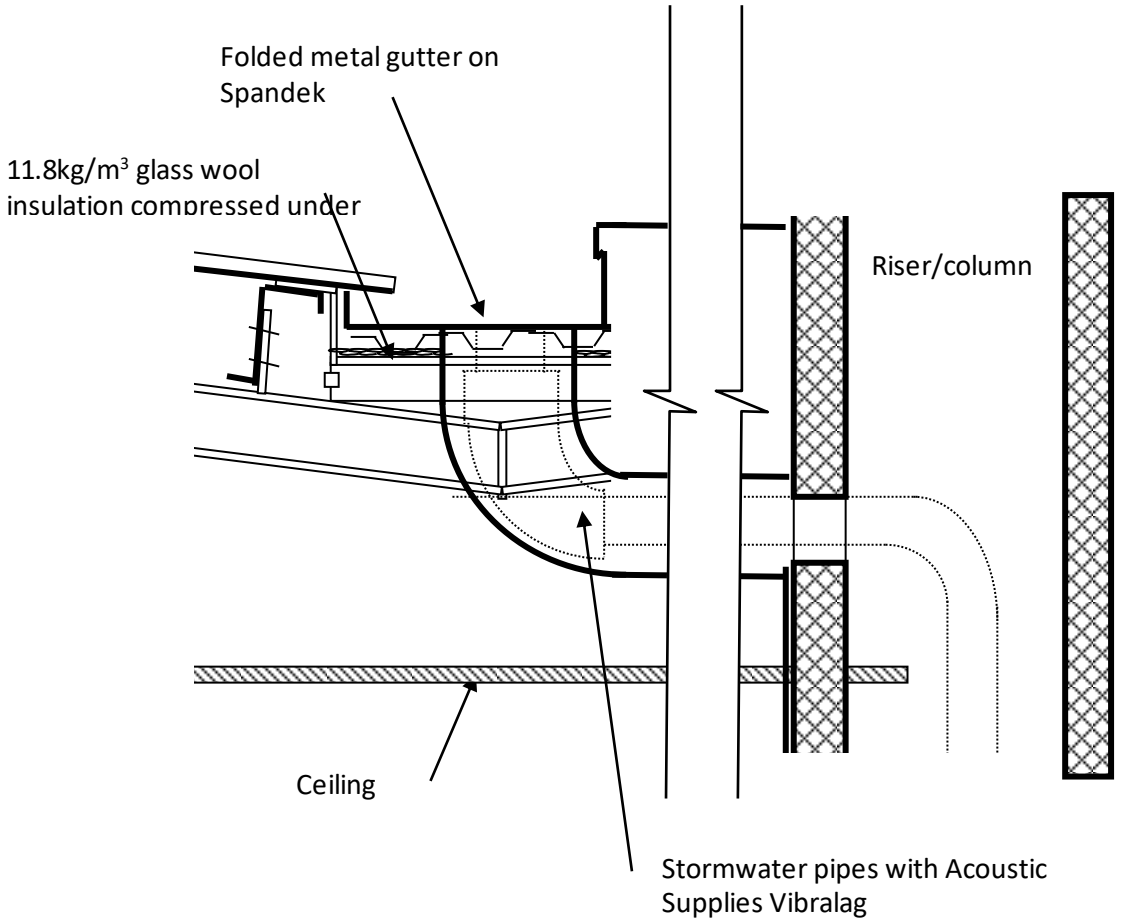


SECTION ELEVATION

NOTE: THE CABLE TRAY SHOULD BE TIGHTLY PACKED WITH BRADFORD FLEXITEL 24KG/M^3 GLASS WOOL INSULATION. PACKING WITHIN THE TRAY TO EXTEND BY 500MM EITHER SIDE OF THE WALL.

PLASTERBOARD IS TO BE CUT NEATLY TO TIGHTLY FIT THE CABLE TRAY

Cable Tray Penetration Treatment ***R_w 45* Wall System** **Section Elevation**			ACOUSTIC LOGIC Northern Rivers Schools Cluster	
Date:	**Drawn:**	**Checked:**	**Project Number:**	**Drawing Number:**
25/07/2023	PF		20230554.5	AC010
Issue:	**Scale:**	**Approved:**		
	NTS	PF		



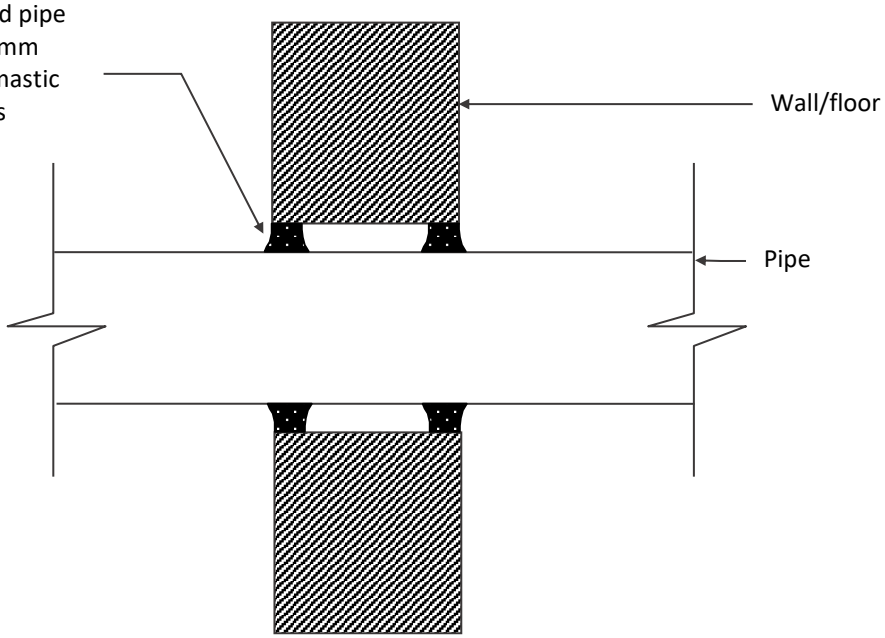
Typical Detail at Internal Gutters

ACOUSTIC LOGIC

Northern Rivers Schools Cluster

Date:	Drawn:	Checked:	Project Number:	Drawing Number:
25/07/2023	PF		20230554.5	AC011
Issue:	**Scale:**	**Approved:**		
	NTS	PF		

10-15mm clear gap around pipe filled for min. depth of 12mm with non-setting flexible mastic similar to Selleys Proseries Fireblock.

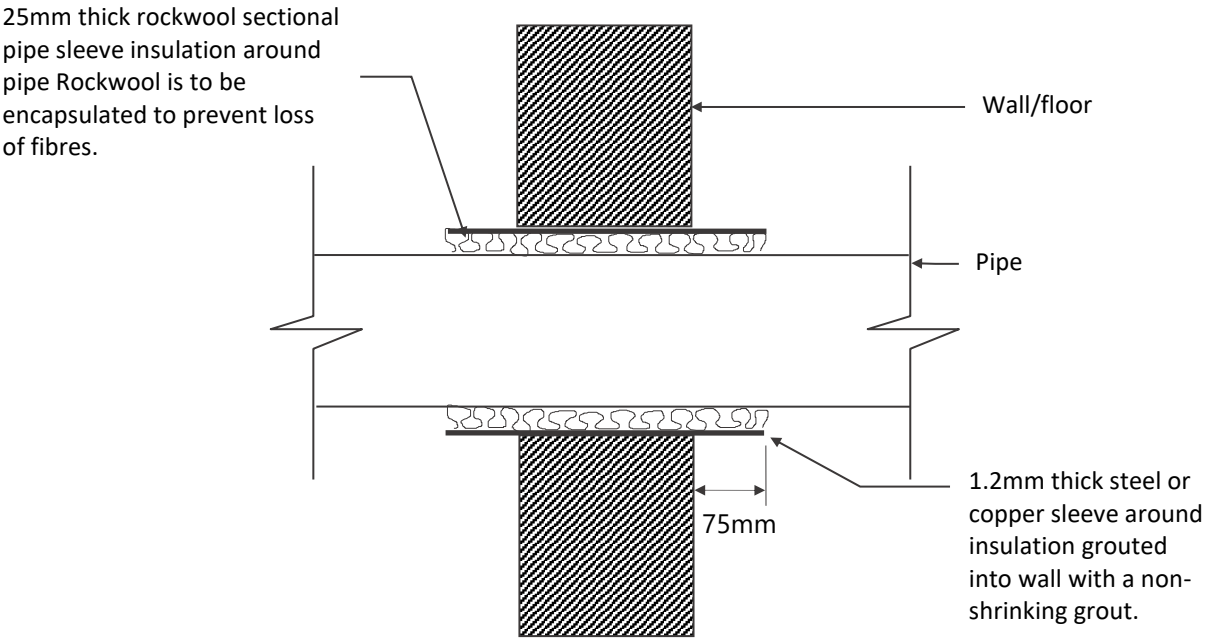


TYPE PA PIPE PENETRATIONS

ACOUSTIC LOGIC

Northern Rivers Schools Cluster

Date:	Drawn:	Checked:	Project Number:	Drawing Number:
25/07/2023	PF		20230554.5	AC012a
Issue:	**Scale:**	**Approved:**		
	NTS	PF		

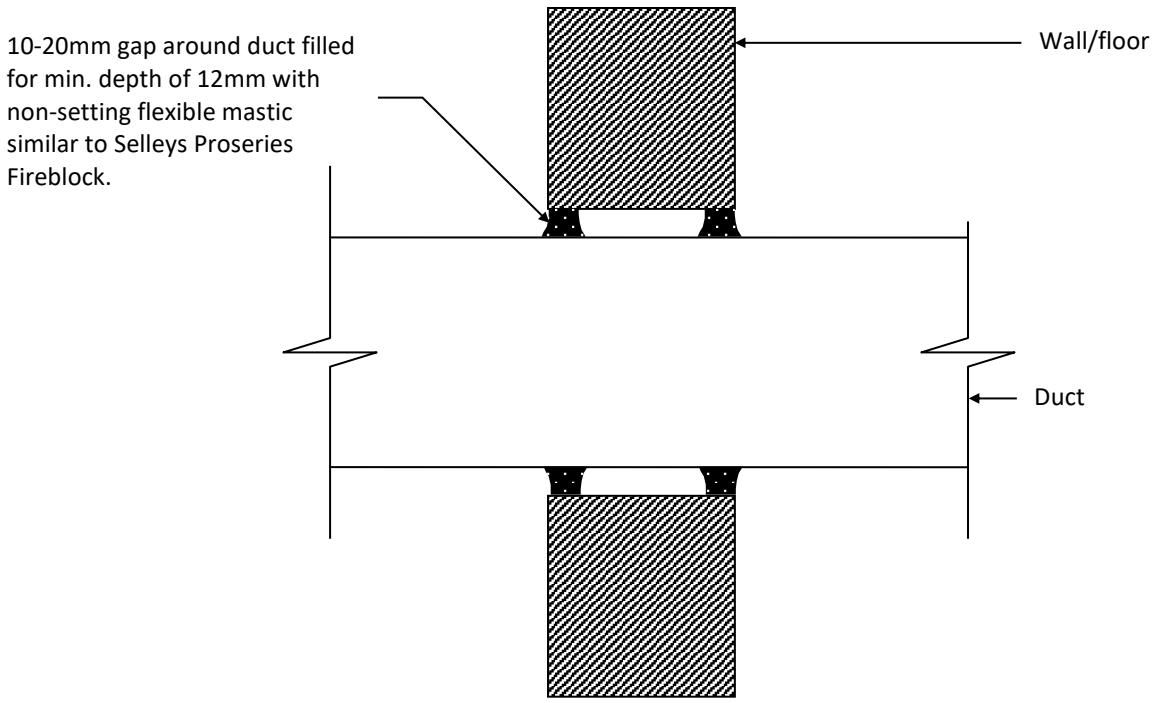


TYPE PB PIPE PENETRATIONS

ACOUSTIC LOGIC

Northern Rivers Schools Cluster

Date:	Drawn:	Checked:	Project Number:	Drawing Number:
25/07/2023	PF		20230554.5	AC012b
Issue:	**Scale:**	**Approved:**		
	NTS	PF		



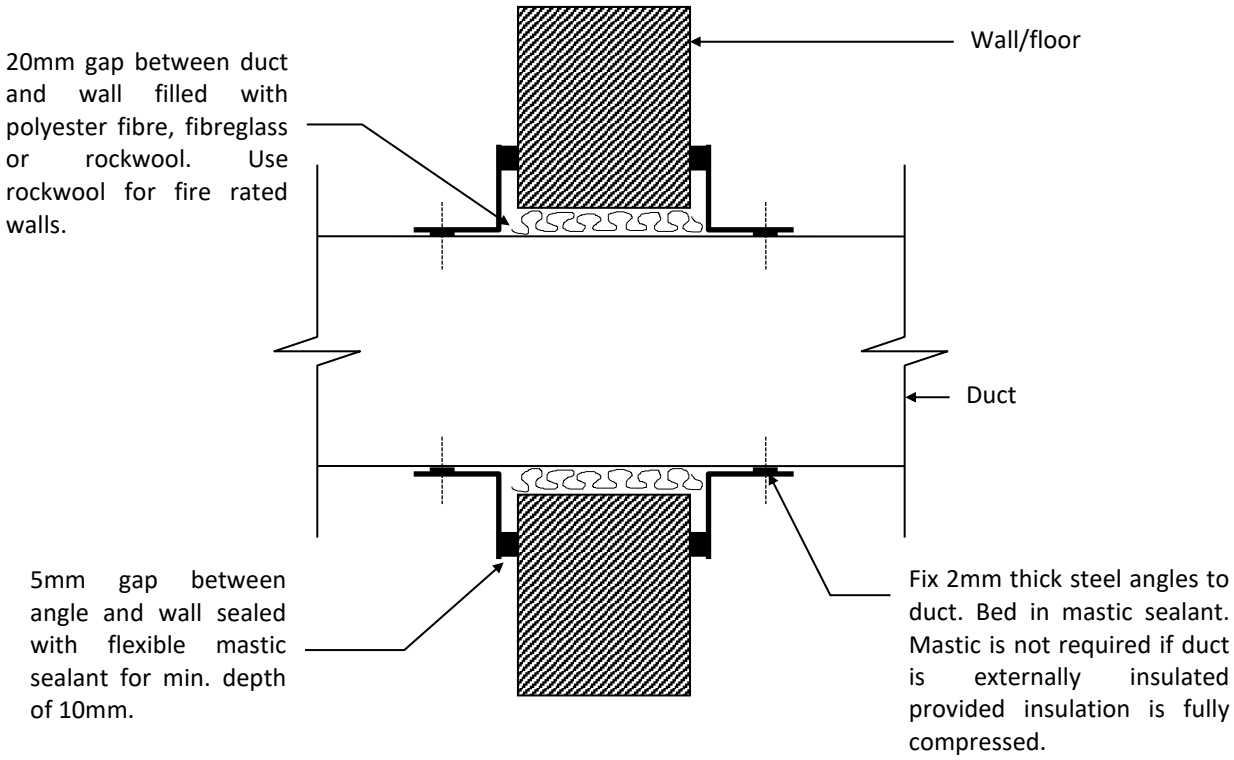
(Note: Typical fire damper detail is also adequate provided any gaps are sealed with Selleys Proseries Fireblock)

TYPE DA PIPE PENETRATIONS

ACOUSTIC LOGIC

Northern Rivers Schools Cluster

Date:	Drawn:	Checked:	Project Number:	Drawing Number:
25/07/2023	PF		20230554.5	AC013a
Issue:	**Scale:**	**Approved:**		
	NTS	PF		



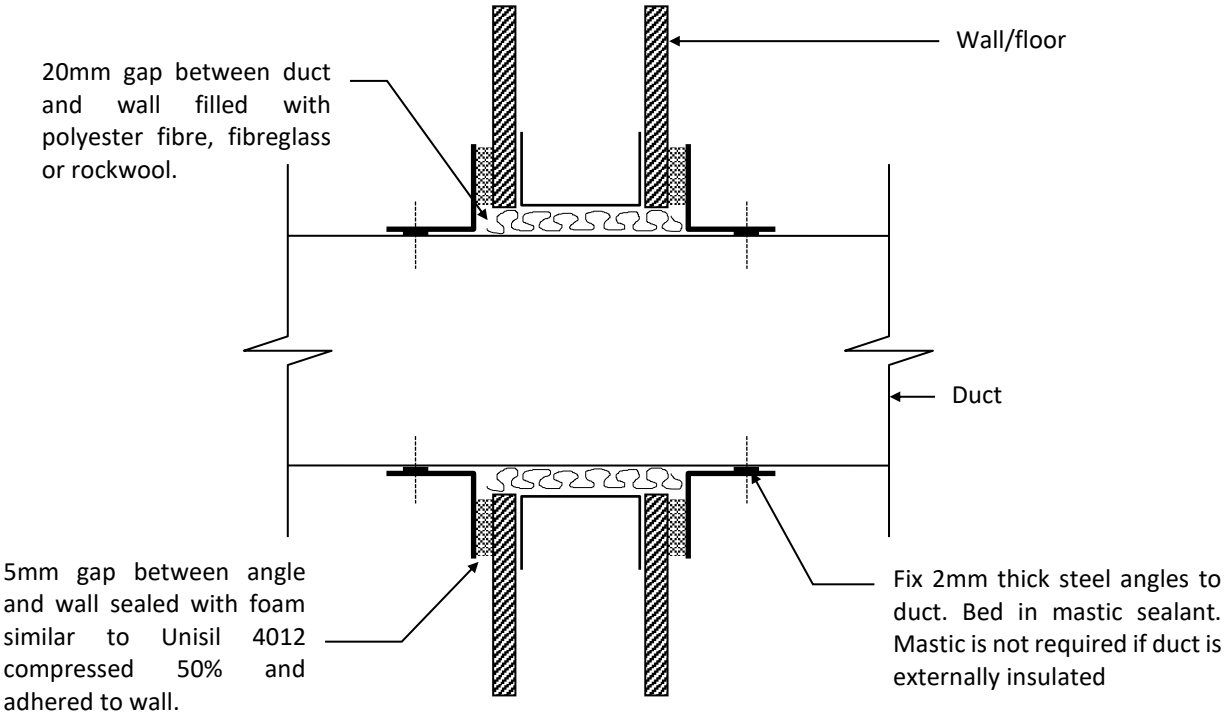
(Note: Typical fire damper detail is also adequate provided flange is sealed to wall with Selleys Proseries Fireblock)

TYPE DB PIPE PENETRATIONS

ACOUSTIC LOGIC

Northern Rivers Schools Cluster

Date:	Drawn:	Checked:	Project Number:	Drawing Number:
25/07/2023	PF		20230554.5	AC013b
Issue:	**Scale:**	**Approved:**		
	NTS	PF		



(Note: Typical fire damper detail is also adequate for fire rated walls provided flange is sealed to wall with Selleys Proseries Fireblock)

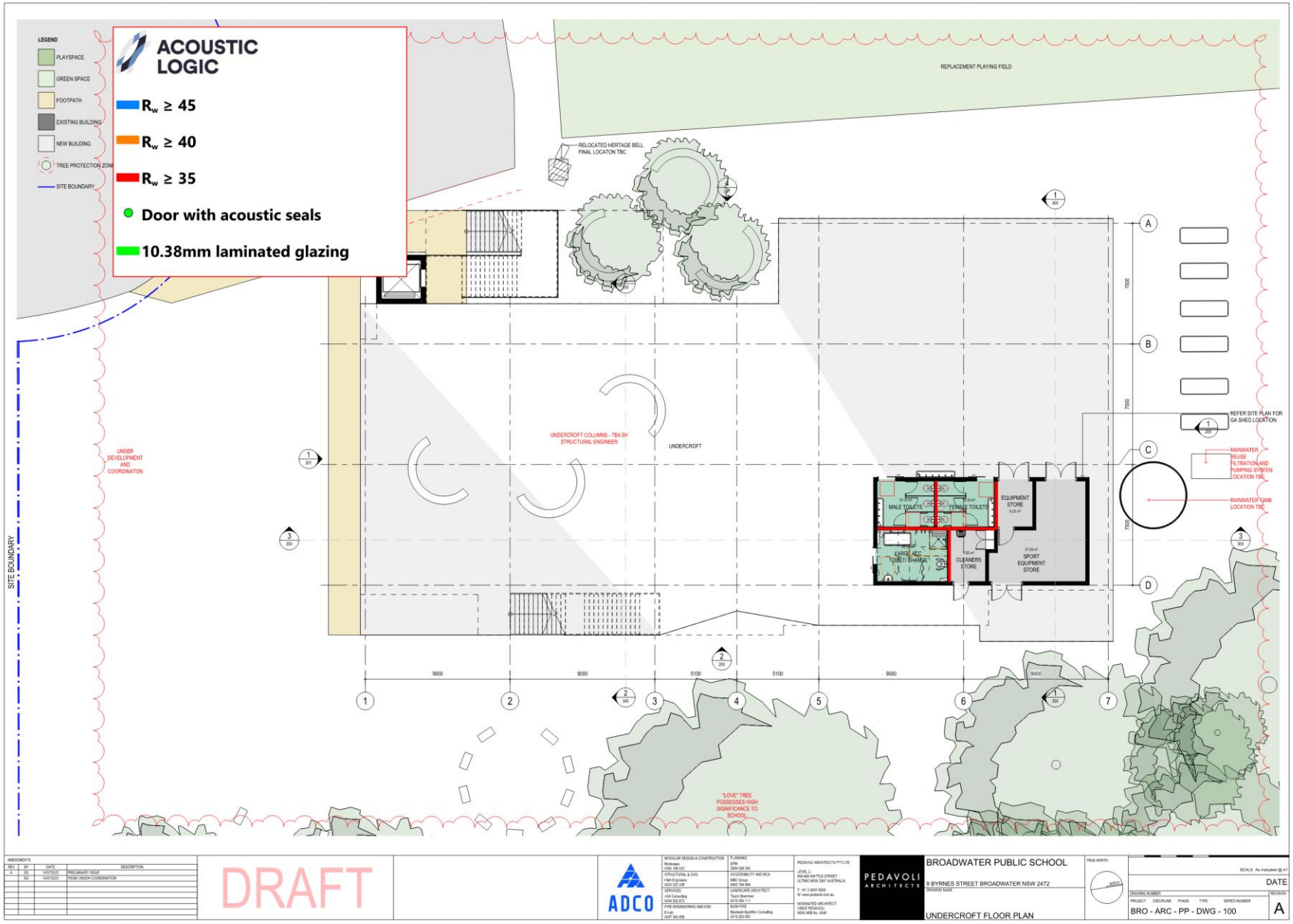
TYPE DC PIPE PENETRATIONS

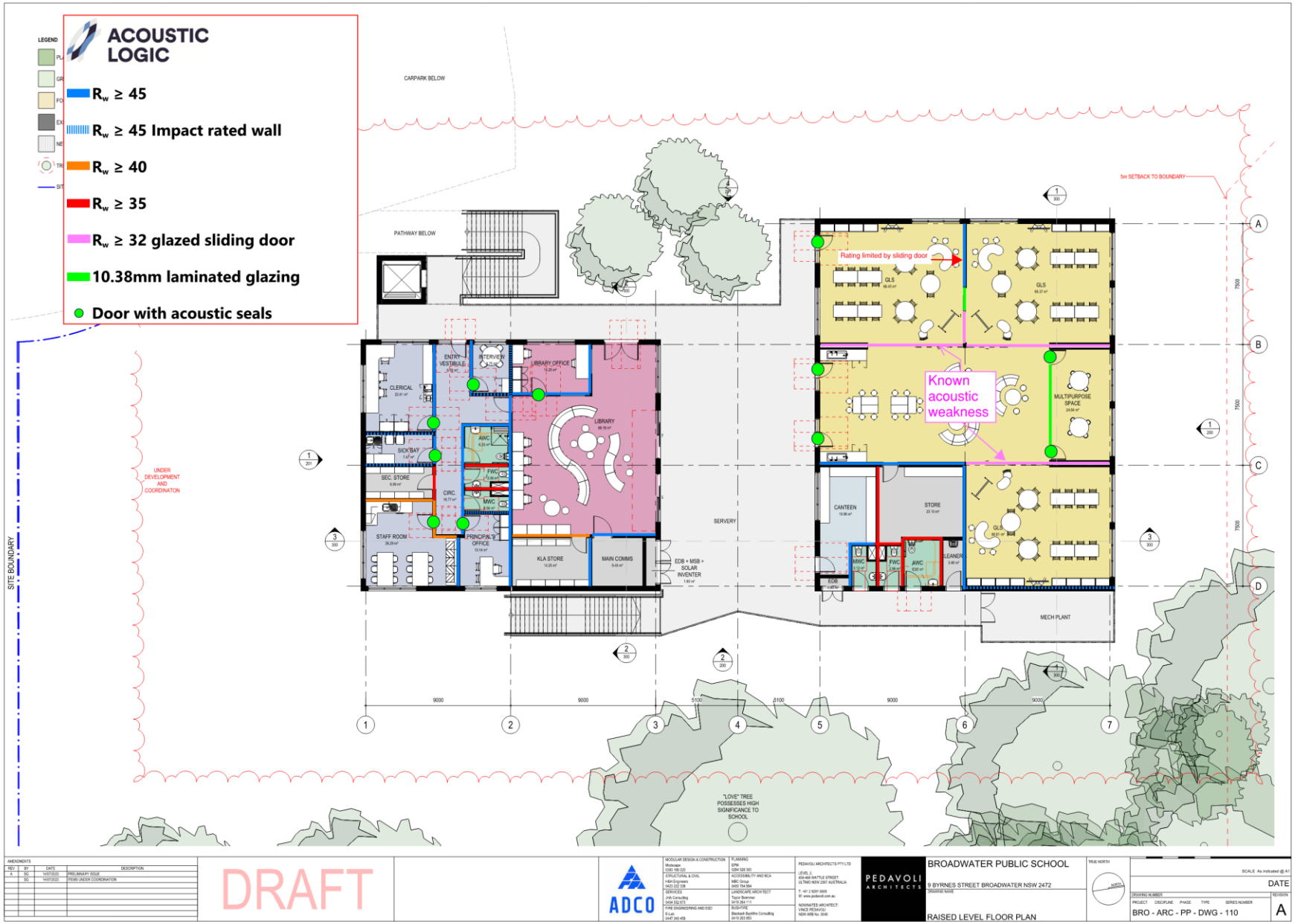
ACOUSTIC LOGIC

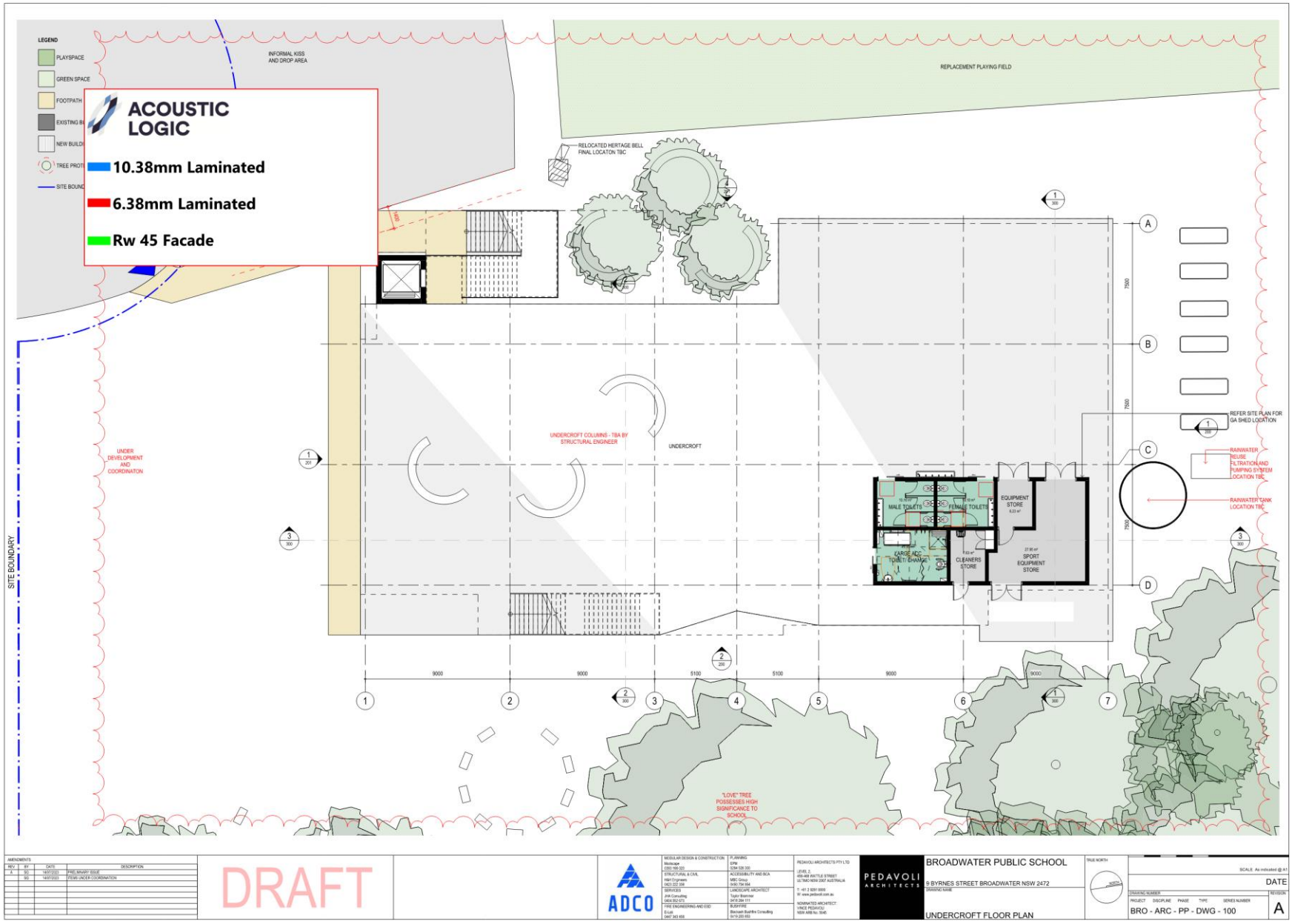
Northern Rivers Schools Cluster

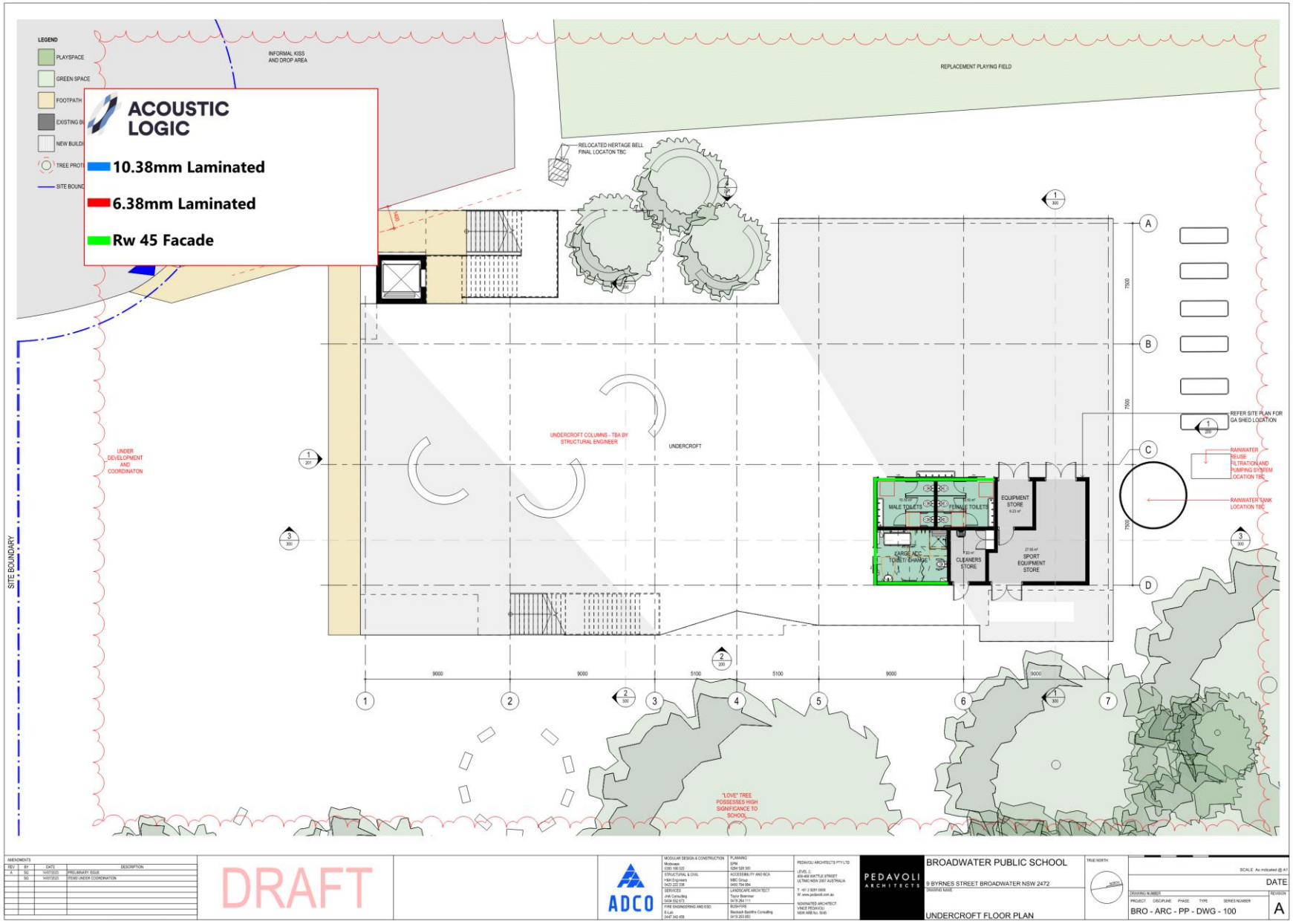
Date:	Drawn:	Checked:	Project Number:	Drawing Number:
25/07/2023	PF		20230554.5	AC013c
Issue:	**Scale:**	**Approved:**		
	NTS			

APPENDIX B – WALL/DOOR /FLOOR/CEILING PERFORMANCE MARKUPS



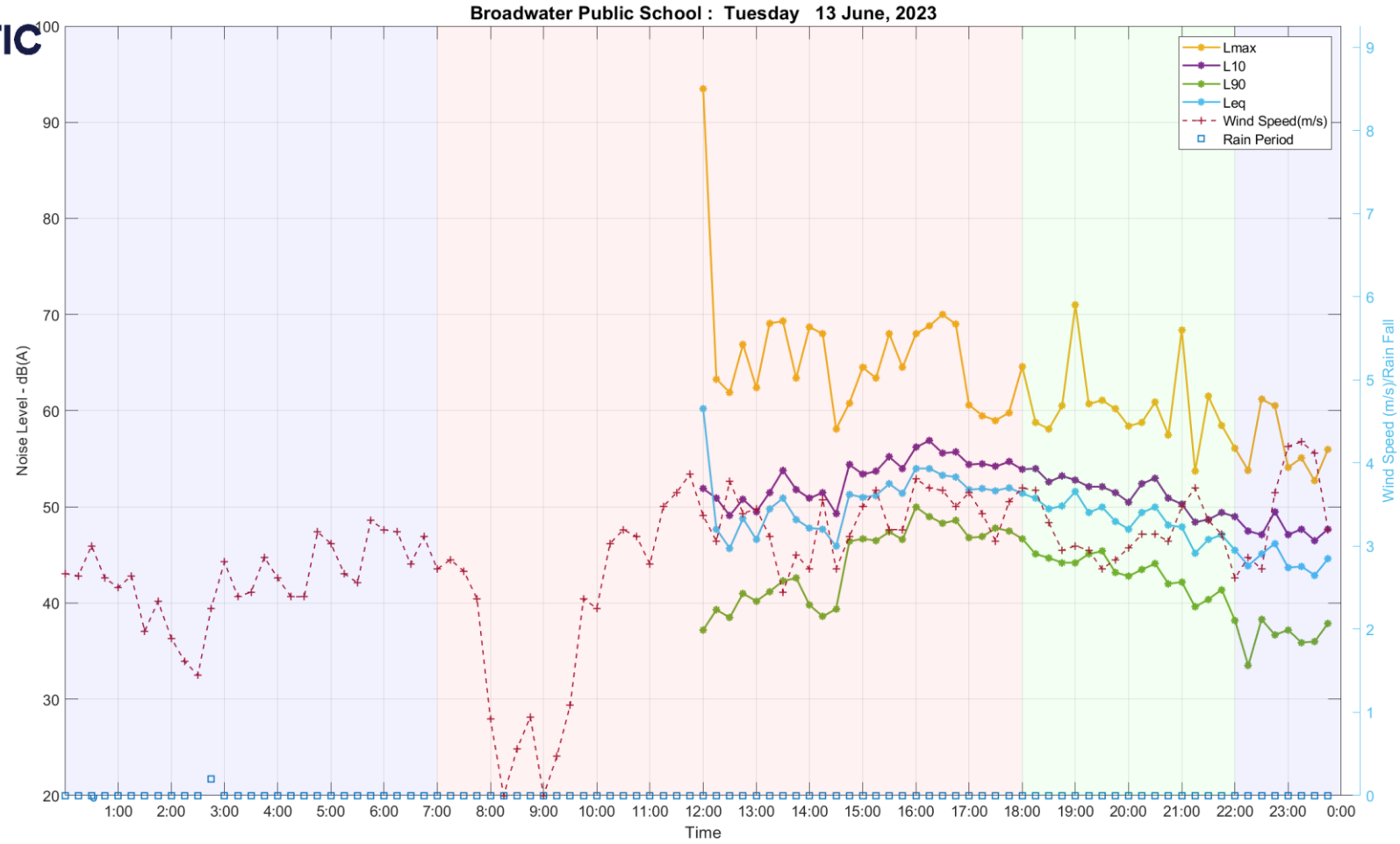


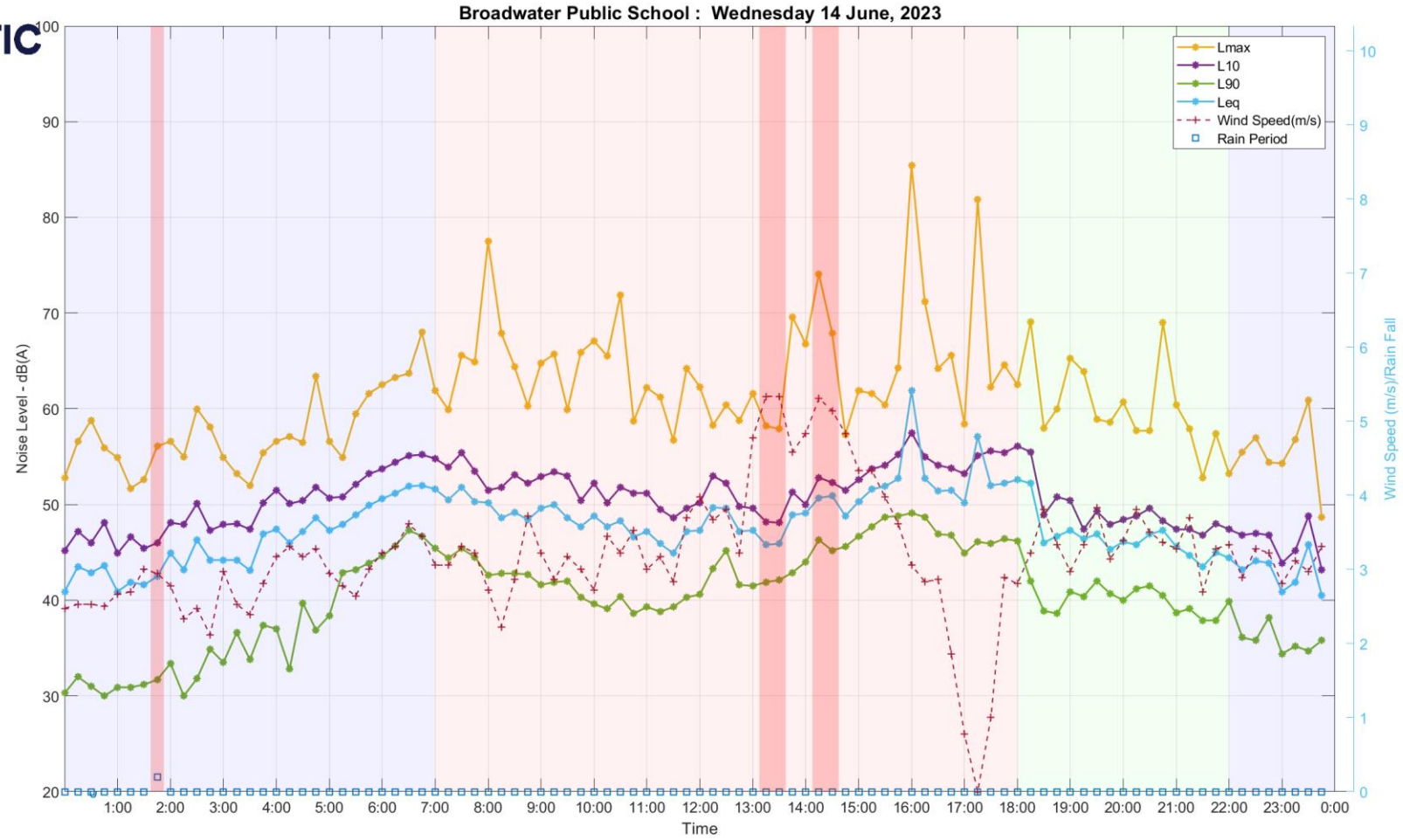


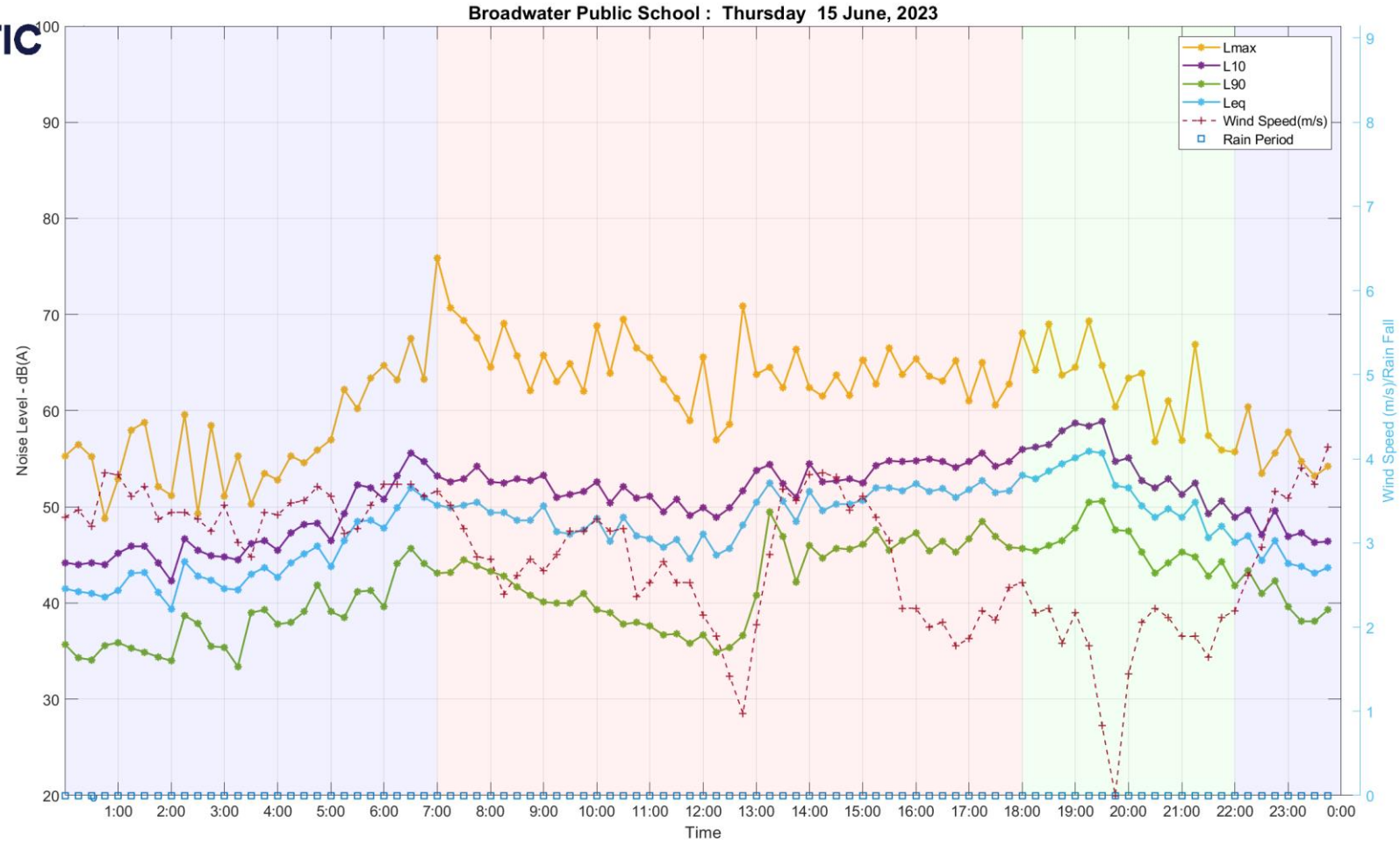


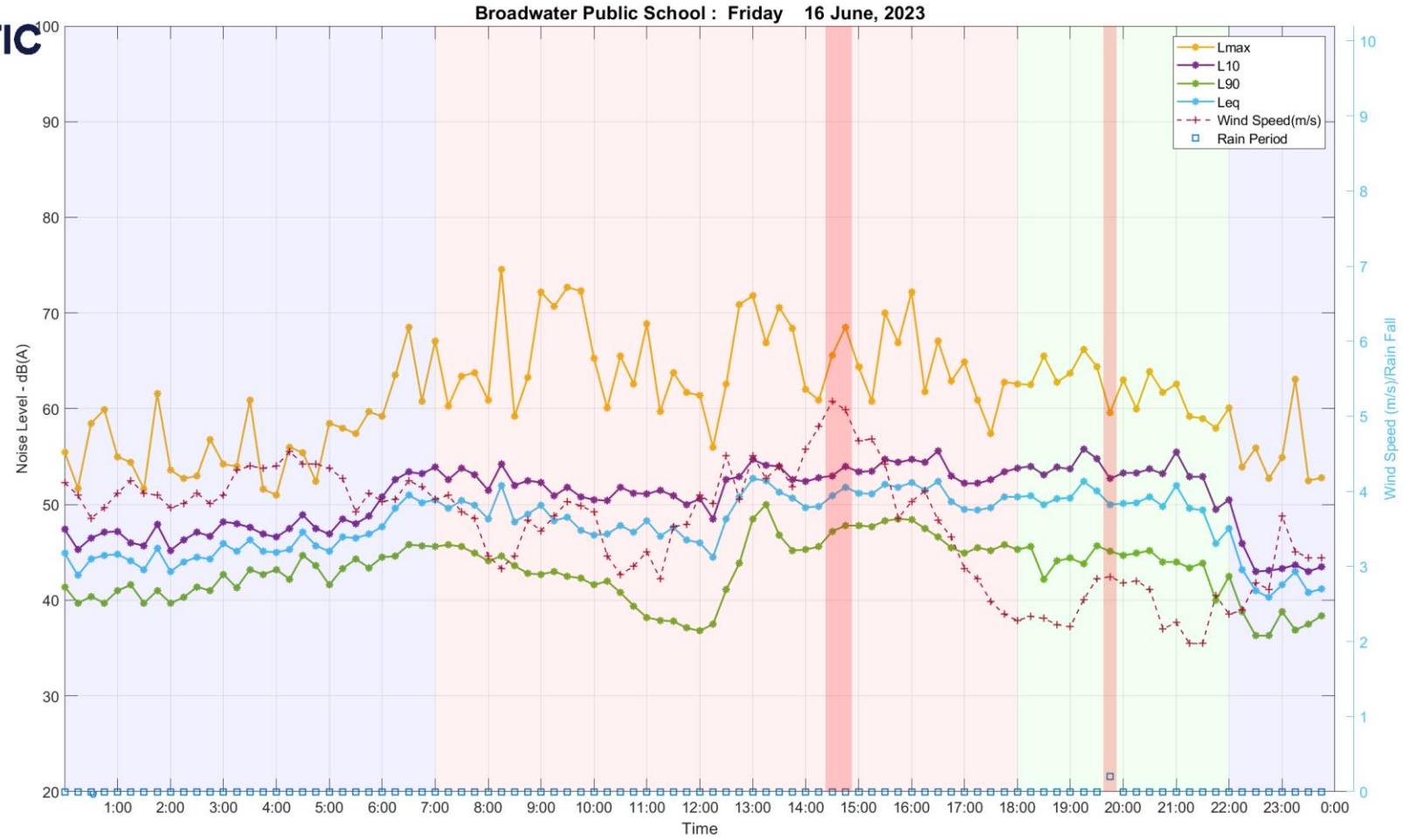
APPENDIX C – SITE SURVEY MAP

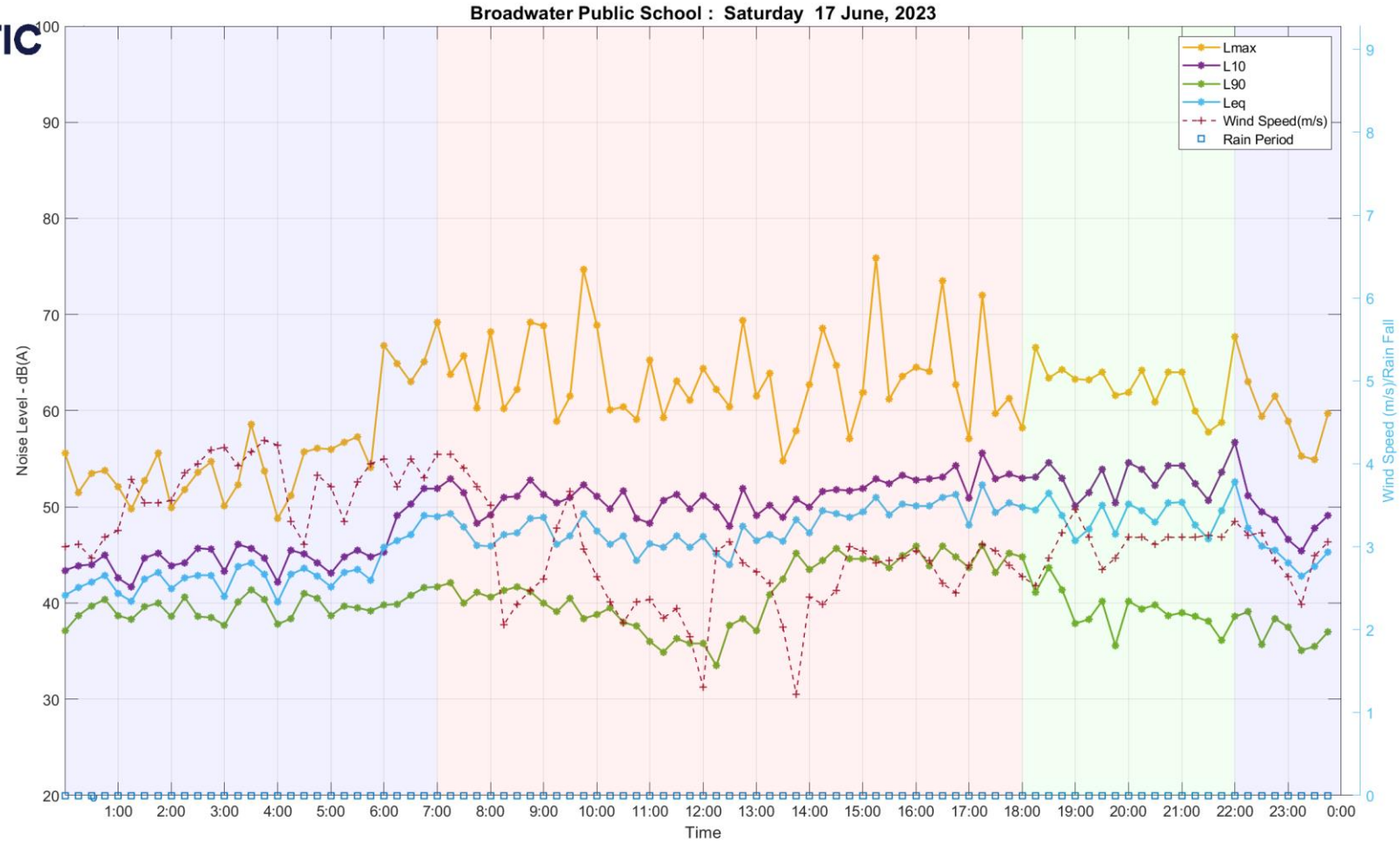
APPENDIX D – NOISE MONITORING DATA

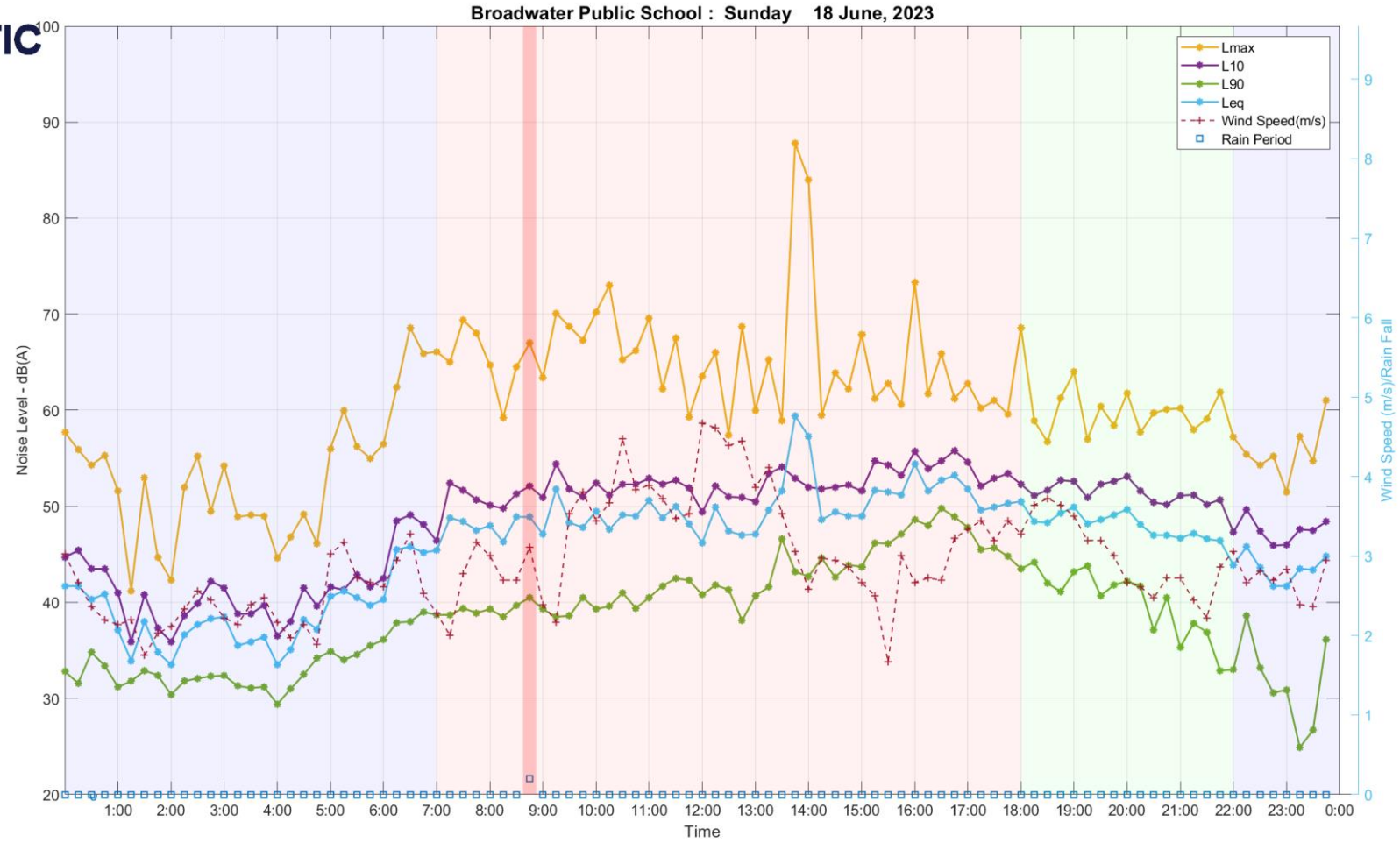


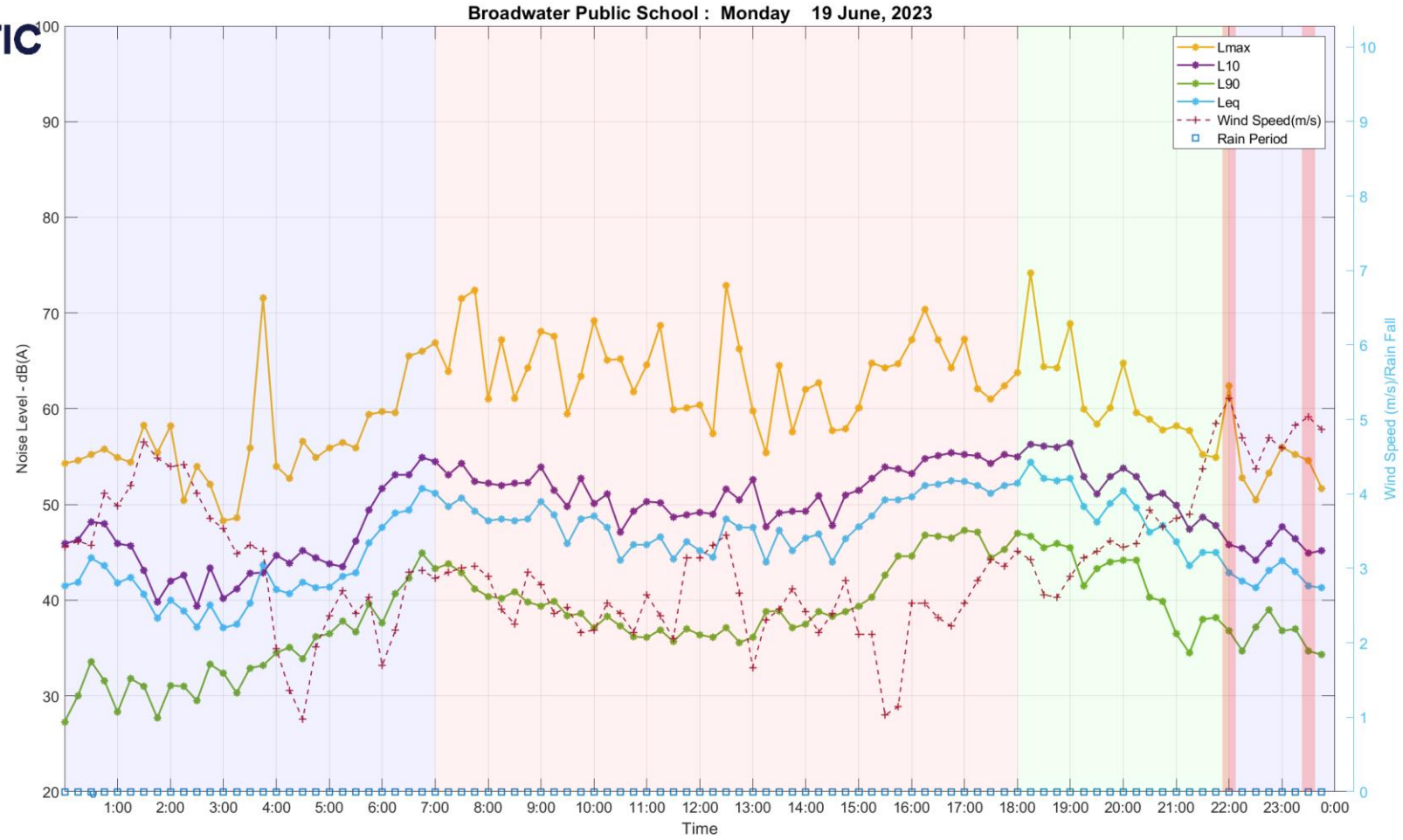


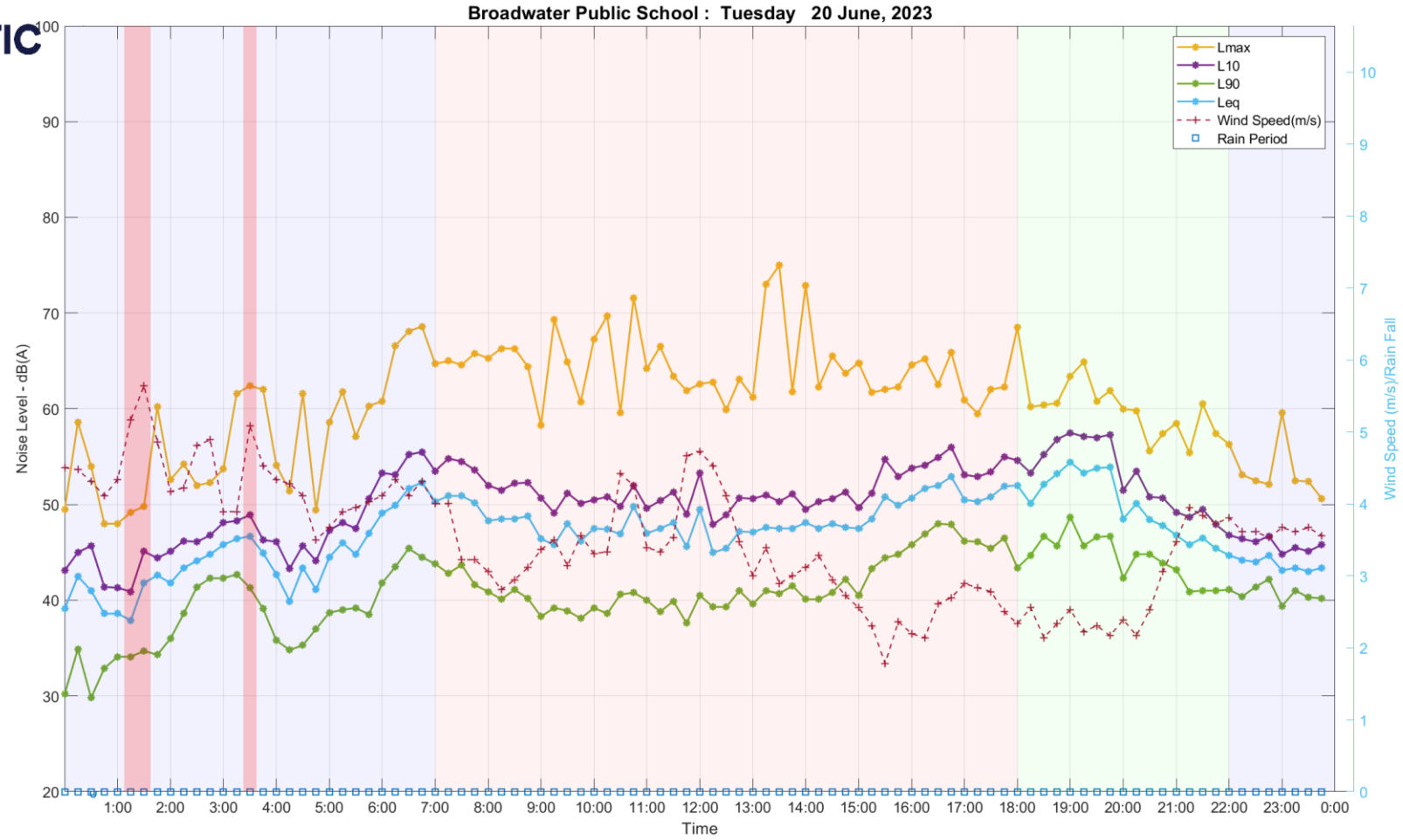


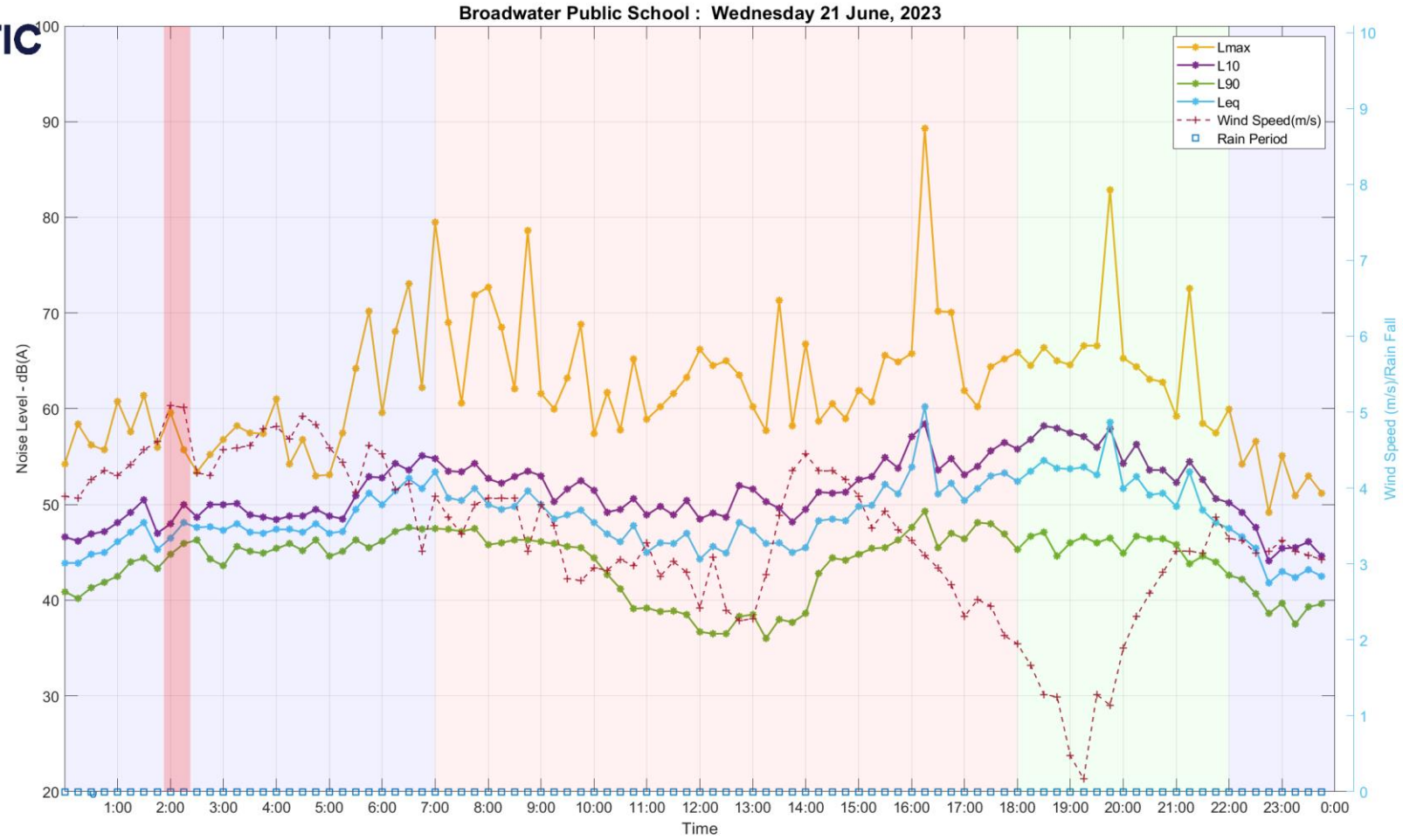


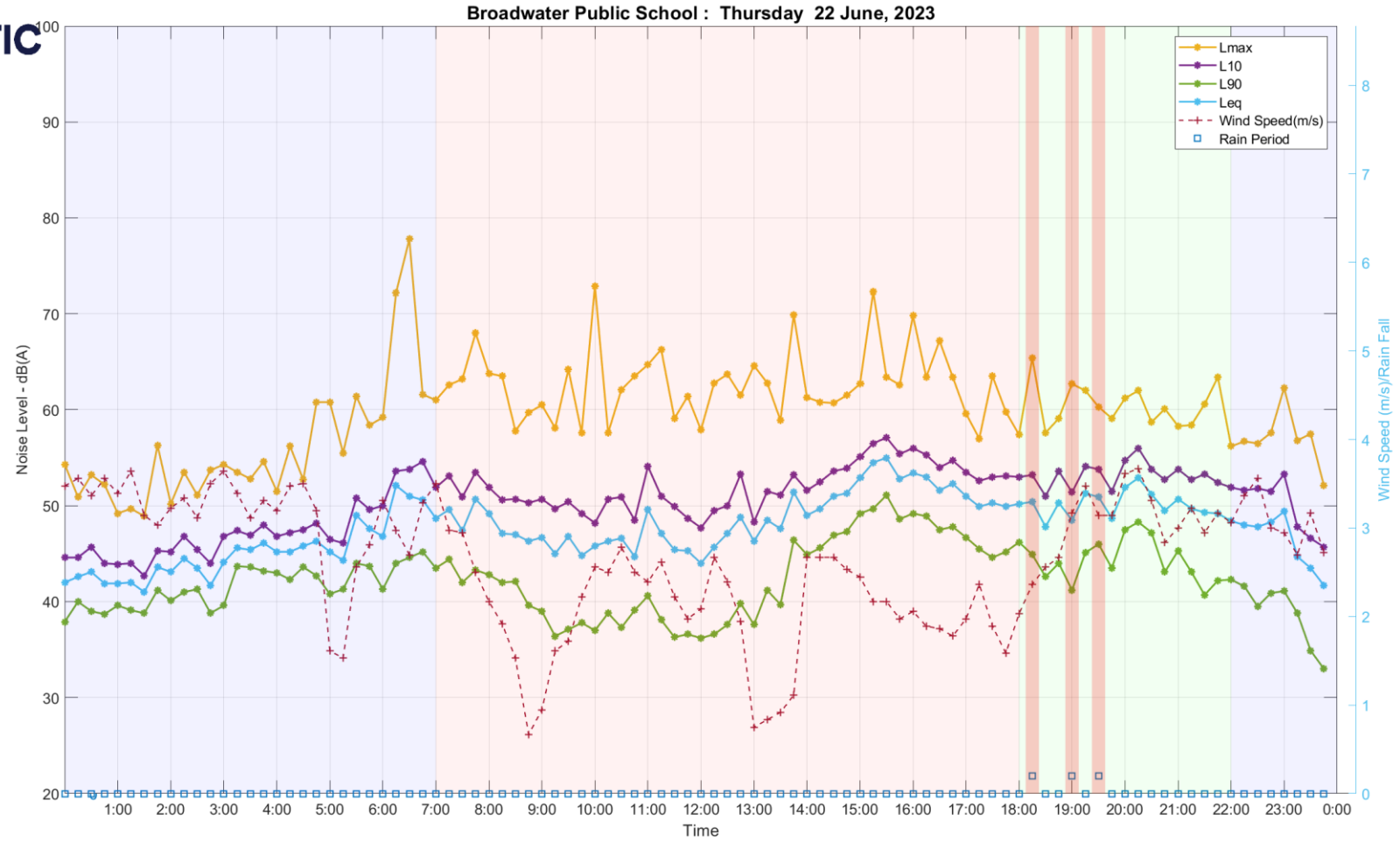


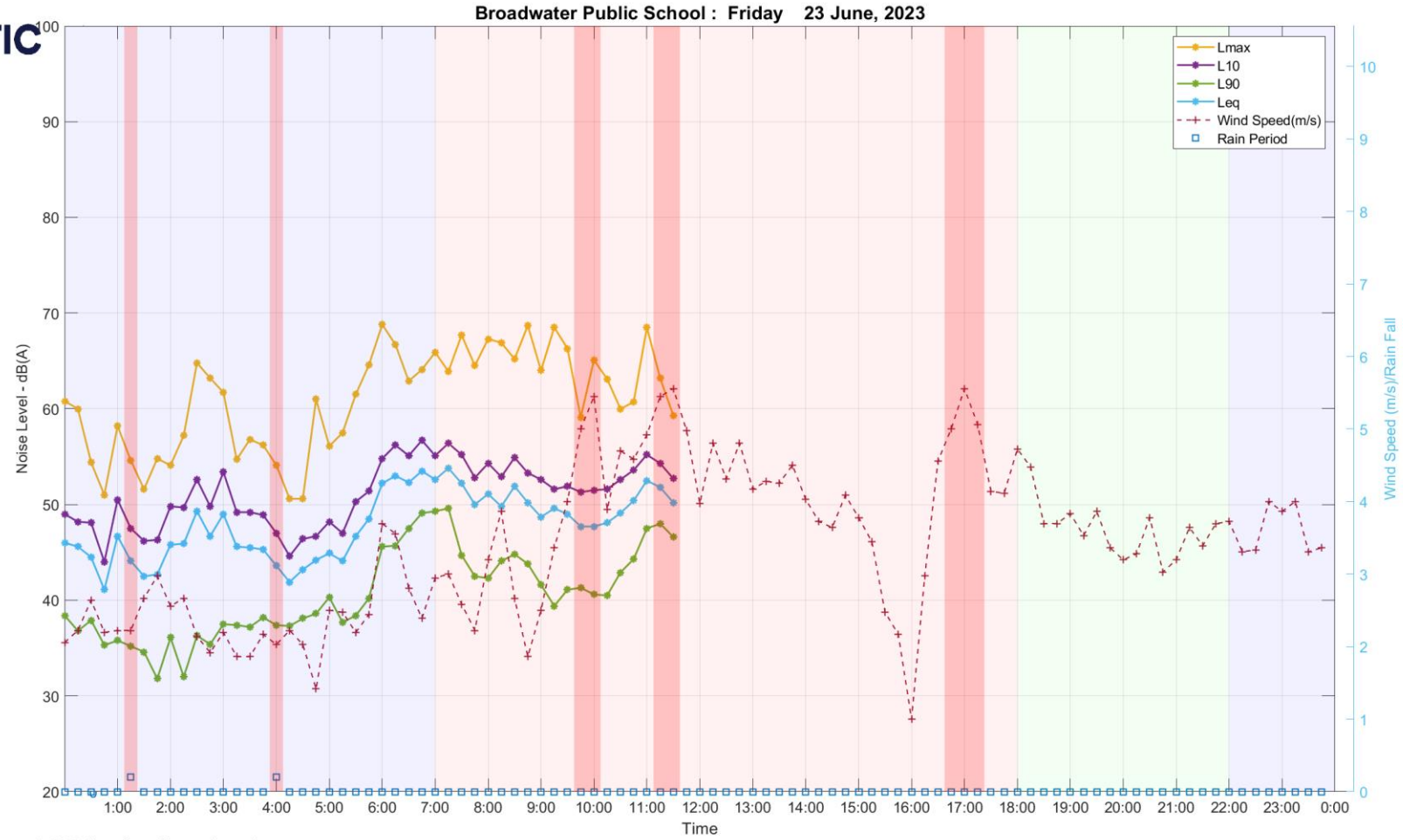












Wind Speed is corrected using factor 1.0000 based on logger location