hepworth acoustics

THE OLIVE SCHOOL, MANCHESTER

ACOUSTIC DESIGN STRATEGY
BB93 DESIGN REVIEW

On behalf of:

Conlon Construction

Report No: P22-461-R01v4
May 2023

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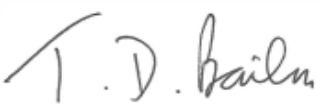
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1.0 INTRODUCTION

1.1 Hepworth Acoustics Ltd was commissioned by Conlon Construction to provide acoustic consultancy services in connection with the design of a new school building at The Olive School in Manchester.

1.2 The location of the site of the proposed new building is indicated in Figure 1.

1.3 This report has been prepared in respect of the following aspects of the development at Stage 3:

- Control of noise transmission between teaching and learning spaces;
- Control of ambient noise within rooms from ingress of external noise and from any mechanical services;
- Control of reverberation of sound in teaching spaces and corridors; and,
- Control of noise from externally located plant.

1.4 For schools, Requirement E4 of the Building Regulations is normally satisfied by achieving the relevant performance standards that are set out in Building Bulletin 93, *'Acoustic Design of Schools'* (Referred to as BB93:2015) for sound insulation, reverberation time and internal ambient noise in teaching and learning spaces.

1.5 The various noise units and indices referred to in this report are described in Appendix I.

1.6 All noise levels mentioned in the text have been rounded to the nearest decibel, as fractions of decibels are imperceptible.

1.7 All recommendations in this report are provided with respect to acoustic performance only and compliance with other requirements (e.g. fire, structural & ventilation) should be checked by others.

2.0 BB93:2015 DESIGN GUIDANCE

2.1 BB93:2015 describes acoustic performance criteria for different types of rooms and are determined by the room usage as defined in Table 1 of BB93:2015.

2.2 For the purposes of this assessment, the rooms have been classified as shown in Tables 1, 2 and 3 of this report.

2.3 Acoustic conditions in administration and ancillary spaces that are not used for teaching and learning are not critical, except where they affect conditions in neighbouring teaching and learning spaces.

Room Use Designations, Indoor Ambient Noise Level and Reverberation Time

2.4 The adopted BB93 room types for each space along with the upper limit of Indoor Ambient Noise Level (IANL) and reverberation time (RT) criteria are shown in Tables 1 & 2 (overleaf). It should be noted that the values in Tables 1 & 2 have been taken from the standard tables in BB93 which relates to mechanically ventilated spaces. For teaching spaces that will have natural ventilation, or a hybrid ventilation system, the values in Tables 1 and 2 can be relaxed.

Table 1: Adopted Acoustic Performance Standards for Teaching Spaces (IANL, RT)

Internal Space	BB93 Table 1 Room Type	Activity noise (Source room)	Noise tolerance (Receiving room)	Upper limit for the internal ambient noise level $L_{Aeq,30mins}$ dB	Upper limit for Reverberation Time T_{mf}
Teaching Spaces					
Reception Classrooms (1&2)	Primary Classroom	Average	Medium	35	0.6
Infant Classrooms (1-4)	Primary Classroom	Average	Medium	35	0.6
Junior Classrooms (1-8)	Primary Classroom	Average	Medium	35	0.6
MT Sen (402)	SEN calming room	High	Low	35	0.6
Main Hall	Multi-purpose hall	High	Low	35	1.2
MMR Food / Science / DT (201)	Design and technology: food	Average	Medium	40	0.8
Small Group Rooms	Small Group Room (<30m^2)	Average	Medium	35	0.6
Library	Library (Quiet Study Area)	Low	Medium	40	1.0
Studio (301)	Performance/recital room1	Very high	Low	35	1.0-1.5

Table 2: Adopted Acoustic Performance Standards for Ancillary Spaces (IANL, RT)

Internal Space	BB93 Table 1 Room Type	Activity noise (Source room)	Noise tolerance (Receiving room)	Upper limit for the internal ambient noise level $L_{Aeq,30mins}$ dB	Upper limit for Reverberation Time T_{mf}
Administration and Ancillary Spaces					
Kitchen	Kitchen	High	High	50	1.5
WC, AWC, Staff WC, Hygiene, Ablutions	Toilet	Average	High	50	1.5
Confid Meeting/Interview Rooms	Meeting room	Low	Medium	40	1.0
Staff Work Rooms	Office	Low	Medium	40	1.0
Heads Office	Office	Low	Medium	40	1.0
Entrance/Reception	Office	Low	Medium	40	1.0
Office/Reception/Repro	Office	Low	Medium	40	1.0
Gen Office/SBM Office	Office	Low	Medium	40	1.0
Lobby, Shared Lobby, Circulation Areas/Stairways	Corridor	Average	High	45	ADE Methodology
Lift	N/A	High	High	N/A	N/A
General Office	Office	Low	Medium	40	1.0
Plant Room	N/A	High	High	N/A	N/A
Staff Room	Office	Low	Medium	40	1.0
Server Room	N/A	High	High	N/A	N/A

2.5 In order to protect students from regular discrete noise events, e.g. aircraft or trains, IANLs should not exceed 60 dB $L_{A1,30mins}$ in Teaching Spaces.

2.6 Where rooms are proposed that do not have appropriate BB93 designations we have adopted reasonable activity noise and noise tolerance values.

2.7 The IANL criteria exclude noise contribution from rain noise. However, BB93:2015 states that IANL during heavy rain (as defined in BS EN ISO 140-18) should be no more than 25 dB above the IANL criteria of Table 1.

2.8 There is no statutory requirement to achieve the IANL or RT criteria in administration and ancillary spaces.

2.9 We understand that the new spaces are to be mechanically ventilated the standard IANL criteria (that are shown in Tables 1 & 2) is applicable. The corresponding IANL tolerances for mechanical ventilated spaces are shown in Table 3 below.

Table 3: Summary of IANL Tolerance/Limits for Natural Ventilation (or Hybrid Ventilation System)

Condition	Ventilation System	IANL Limit
Normal – Ventilation for normal teaching and learning activities	Mechanical	Table 1 [4]
Summertime – ventilation under local control of teacher to prevent overheating	Mechanical	Table 1 +5 dB [4]
Intermittent Boost - ventilation under local control of teacher to provide dilution of fumes	Mechanical	Table 1 +5 dB [4]

*** The +5 dB does not apply to teaching and learning spaces where the Table 1 IANL is greater than or equal to 45 dB..**

Control of Reverberation in Circulation Spaces

2.12 Control of reverberation of sound in circulation spaces (i.e. corridors and stairs) is dealt with separately in BB93 because acoustic measurements of reverberation in spaces with this type of shape can be unpredictable. The control of reverberation of sound in corridors and circulation areas is achieved via installation of prescribed amounts of acoustic absorption materials rather than by achieving any specific reverberation time criteria.

2.13 Method A of the Building Regulations Approved Document E requires that:

- for corridors, an area equal to or greater than the floor area should be covered with a Class C absorber or better. This is generally achieved with a suitable Class C (rated in accordance with international standard EN ISO 11654) ceiling tile.
- for stairwells (or stair enclosures) calculate the combined area of the stair treads, the upper surface of landings and intermediate landings, and the ceiling area of the top floor. Either cover an area equal to this calculated area with a Class D Absorber or cover an area equal to at least 50% of this calculated area with a Class C absorber or better.

2.14 The purpose of this is to control reverberation of sound so that it does not interfere with teaching and study activities in adjacent rooms.

Sound Insulation of Walls and Floors Separating Teaching Spaces and Other Spaces

2.15 BB93:2015 provides the required airborne sound insulation performance standards of walls and floors separating rooms, based on the activity noise level in the source room and the noise tolerance in the receiving room. We have used the room types adopted in Tables 1 & 2 to determine the sound insulation requirements of separating partitions.

2.16 The sound insulation requirements are calculated in both directions between adjacent rooms, and where a teaching space is adjacent to an administration and ancillary space, BB93:2015 details the sound insulation requirement of the separating wall. As noted, there is no formal requirement to achieve any given sound insulation performance between administration and ancillary spaces, or from teaching spaces to ancillary spaces, but sound transmission from ancillary spaces to teaching spaces must be controlled. Stores and cleaner cupboards are not noise sensitive, and although noise levels within them would not be expected to be significant the sound insulation of walls of these rooms has been considered and appropriate recommendations made.

2.17 The sound insulation performance standards adopted for separating walls that do not contain a door are detailed in Table 4.

Table 4: Adopted Sound Insulation Performance Standards for Separating Walls

Internal Spaces Separated by a Wall (with no door)		Airborne Sound Insulation Performance dB $D_{nT,w}$
Ground Floor		
Assembly Hall (301)	Studio 1 (302)	Folding Partition not less than 40 dB [1]
Studio 1 (302)	Plant (6101)	60[2]
Infant 1 (103)	Stairs (6301)	45
Infant 2 (104)	Group Room (405)	55
Infant 2 (104)	W/C (810a)	45
Infant 2 (104)	Infant 3 (105)	45
MT SEN (402)	Stair 2 (6302)	45
Reception 2 (102)	MT SEN (402)	50
Reception 2 (102)	Hygiene (813)	45
Reception 1 (101)	Server (6201)	50
Server (6201)	Interview (508)	50
Staff Workroom 1 (502)	Head (503)	40
Staff Workroom 1 (502)	Sickbay (509)	40
Staff Workroom 1 (502)	Plant (6101)	60[2]
Head (503)	Office / MTG (504)	40
Studio 1 (302)	W/C (815b)	50
Food Prep (801)	Assembly Hall (301)	*Serving Hatch of not less than 18 dB R_w
First Floor		
Junior 8 (114)	Staff Workroom 2 (501)	45
Junior 8 (114)	Junior 7 (113)	45
Junior 7 (113)	Junior 6 (112)	45
Junior 6 (112)	W/C (810a)	45
Junior 5(111)	W/C (810a)	45
Junior 5(111)	Stairs (6303)	45
Group (406)	MMR Food/Science/DT (201)	45
Group (406)	W/C (817)	45
MMR Food/Science/DT (201)	Junior 1 (107)	45

First Floor		
Junior 1 (107)	Junior 2 (108)	45
Junior 2 (108)	Junior 3 (109)	45
Junior 3 (109)	Library (401)	50
Junior 4 (110)	Library (401)	50
Junior 4 (110)	W/C (811)	45

[1] Where there is an operable wall or folding partition between a teaching area and a hall, the $D_{nT,w}$ between the spaces should be at least 40 dB. It is important to note that the sound insulation performance of the wall **may not** be suitable for simultaneous use of the spaces on either side.

[2] This is indicative and is dependent on the noise level of the equipment proposed for the plant room/Lift

Sound Insulation of Walls Separating Teaching Spaces and Circulation Spaces

2.18 BB93:2015 Table 4a gives the required performance standard for sound insulation between circulation spaces and teaching spaces used by students that are separated by a door and/or wall containing any glazing and is reproduced in Table 5.

Table 5: Performance Standards for Airborne Sound Insulation Between Circulation Spaces & Teaching Spaces

Room Classification	Minimum Required R_w (dB)	
	Composite R_w of Wall and Glazing	Doorset
	New Build	
Main Hall & Studio 1	45	35
Rooms used for teaching or learning	40	30

Sound Insulation of Walls, Doors, and Floors Separating Administration & Ancillary Spaces

2.19 There are no formal requirements to meet any sound insulation performance standards for walls or floors that separate administration and ancillary spaces. Therefore, these spaces have not been considered further in this report.

Folding Partitions

2.20 Folding partitions are typically hung from a frame built at the ceiling line and move along a track or rail on the structural floor.

2.21 A proper seal can generally be achieved with the rail, depending on the proprietary manufacturer system, however, this leaves a flanking path via the ceiling above.

2.22 We would recommend installing a baffle along the folding partition rail above the ceiling line to block flanking sound transmission via this path.

2.23 Proprietary solutions are available, however if standard construction materials are to be used, we recommend a baffle formed of 2 x 12.5 mm layers of gypsum board with staggered joints and sealed with high density non-setting acoustic mastic at the perimeter, the exact detailing of the partition should be reviewed at Stage 4.

Impact Sound Insulation of Floors Separating Teaching Spaces and Other Spaces

2.24 BB93:2015 states the required impact sound insulation performance standards of floors for receiving rooms of different types and uses. We have taken the room types at the new school building to be as stated in Table 1 to determine the sound insulation requirements of separating floors. The design assessment of $L'_{nT,w}$ is considered into the room via the floor/ceiling above. The sound insulation performance standards adopted for separating floors in this development are detailed in Table 6.

Table 6: Adopted Impact Sound Insulation Performance Standards for Separating Floors

Ground Floor Internal Space	Maximum Impact Sound Pressure Levels $L'_{nT,w}$
MT SEN (402)	60
Reception (101,102)	60
Infant (103,104,105,106)	60
Group (404a/b, 406)	60
Head (503) Office (504, 505, 506,507,508)	65
Staff Work (502)	65
Cloaks, WC and Stores	65

3.0 CONTROL OF INTERNAL AMBIENT NOISE LEVELS (IANL)

3.1 The IANL within a space is taken as being the noise level in the completed and unoccupied space due to the break-in of external noise and any noise from building services. Noise from teaching activities or teaching equipment are excluded.

3.2 An environmental noise survey was carried out on the site in March 2022 by others, the results of which are detailed in Report FS0766-AEC-XX-XX-T-J-0001-001Acoustic_Survey-S5-P01 and appended as Appendix I to this report. **(will be merged to PDF after checking** Noise levels were measured at a number of locations close to roads near the proposed site, the results of which are relevant for the elevation of the proposed building that would be most exposed to road traffic noise. The typical maximum noise levels were below 61 dB $L_{A01,15mins}$ at all locations.

3.3 It is widely accepted that the attenuation loss provided by an external wall with a partially open window is 10-15 dB. Therefore, a reduction of 13 dB has been applied to the relevant noise survey measurements to provide an indication of the likely internal noise levels for each elevation of the proposed building. The predicted internal noise levels are summarised below in Table 7.

Table 7: Predicated Internal Noise Level with Open Window

Elevation	Predicted Internal Noise Level ($L_{Aeq\ 30min}$)	Ventilation Approach
East (12m from Heywood Road)	41	Standard glazing configuration (i.e., 4-12-4) and trickle ventilation will be required or alternative means of ventilation for sensitive spaces
West (Tammerton Road)	34	Openable window for normal teaching spaces and resource areas, potentially requiring attenuated natural ventilation for sensitive spaces
North (Brentfield Avenue	37	Standard glazing configuration (i.e., 4-12-4) and trickle ventilation will be required or alternative means of ventilation for sensitive spaces
South	40	Standard glazing configuration (i.e., 4-12-4) and trickle ventilation will be required or alternative means of ventilation for sensitive spaces

3.4 In order to adequately control noise break-in, we recommend the following:

- Glazed areas should have a minimum sound insulation of 25 dB $R_w + C_{tr}$, which could be provided by well fitted standard thermal double glazing of minimum 4 mm glass – 12-20 mm nominal cavity – 4 mm glass;
- In order to maintain the sound insulation of the building envelope, we recommend that any non-glazed elements should be designed such that they provide a minimum sound insulation of at least 40 dB R_w.

3.5 In line with the above sensitive rooms on the Eastern elevation i.e. MT SEN (402) will require alternative means of ventilation (i.e. other than by opening windows) which could be provided in a number of ways depending on the overarching ventilation scheme for the building.

4.0 SOUND INSULATION BETWEEN SPACES

Airborne Sound Insulation of Separating Walls

4.1 It should be noted that the airborne sound insulation specification (in terms of R_w) is always higher than the in-situ airborne sound insulation actually achieved on site. For the avoidance of doubt, a 45 dB R_w wall will not provide an in-situ airborne sound insulation performance of 45 dB $D_{nT,w}$ on site, as the former is an acoustic laboratory test value whereas on-site conditions will reduce the actual airborne sound insulation in situ. Typically, on-site sound insulation ($D_{nT,w}$) will be around 7 dB below that of the laboratory test value (R_w), but the difference can be higher depending on flanking sound transmission conditions. Therefore, the sound insulation performance recommended for new walls separating teaching and ancillary spaces should be taken as a minimum required performance.

4.2 The minimum required laboratory sound insulation performance values for walls separating teaching spaces and other spaces in this development are shown in Figures 2 and 3 of this report. Walls which provide these sound insulation performance values in R_w as a minimum will be necessary to achieve the BB93 sound insulation performance criteria in $D_{n,T,w}$.

4.3 Classroom corridor doorsets will generally need to have a minimum sound insulation performance of 30 dB R_w but a minimum sound insulation performance of 35 dB R_w where noted on Figures 2 & 3.

4.4 Where any corridor doorsets to the teaching spaces will have glazed side lights/side vision panels, the composite sound insulation performance will need to be considered. The composite sound insulation of the corridor walls and glazed areas (including any glazed side panels) will need to achieve at least 40 dB R_w.

4.5 For adjoining teaching and learning spaces with an interconnecting door, the wall containing the door should have a minimum laboratory sound insulation performance of 45 dB R_w and the doorset should have a minimum laboratory sound insulation performance of 35 dB R_w.

4.6 At this stage we have not been provided with details of the floor/ceiling construction for the ground and first floors. Therefore, we are unable to provide detailed sound insulation advice at this time.

4.7 Nevertheless, the following should be taken into account when designing and constructing the separating elements.

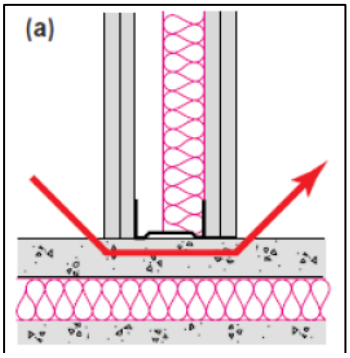
Walls

4.8 Any blockwork walls should be built off the structural concrete slab in order that the floor screed is not common to adjacent rooms.

4.9 All walls should be built from the floor to the structural soffit in order to maximise airborne sound insulation between spaces that they separate.

4.10 Where separating walls are to have a laboratory sound insulation performance of 50 dB R_w or more, depending on the mass of the floor, flanking sound transmission via continuous sub-floors or soffits could significantly reduce the overall sound insulation performance between the spaces. This is shown in Sketch 1 for a plasterboard partition wall. Depending on the mass of the proposed floor, flanking transmission via the floor may need to be controlled via additional measures.

Sketch 1: Flanking sound transmission via floor

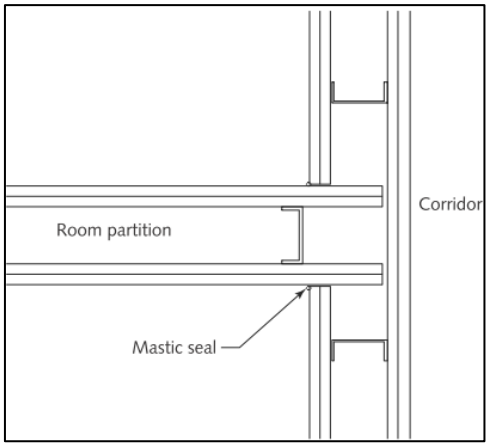


4.11 Where the separating walls abut a profiled soffit (including the underside of the roof), suitable deflection head details must also be fully in line with the manufacturer's instructions and capable of maintaining the sound insulation of the wall.

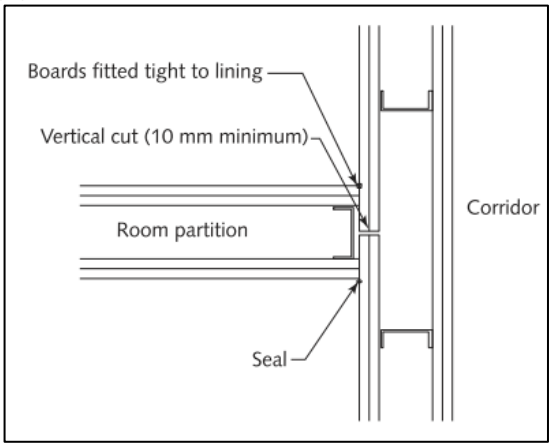
4.12 Wall linings should not be common to adjacent spaces, and should be broken at the junction with external walls, corridor walls and flanking walls, as indicated in Sketch 2 (a) and (b).

Sketch 2 Detail at junction of separating walls and corridor walls

(a) preferred



(b) alternative



4.13 Vertical cuts between the inner lining of flanking walls (Sketch 2(b) above) should be minimal in number, and no less than 10mm.

4.14 The ceiling of adjacent spaces should be broken by the new wall - i.e. new ceilings must be installed after any new walls and be broken by internal walls and the inner leaf of external walls such that the new suspended ceiling is not common to any adjacent spaces.

4.15 Plasterboard linings should have staggered joints and be well sealed at the perimeter with acoustic sealant.

4.16 Any resilient bars should be installed according to the manufacturers' instructions as the acoustic performance of these can be compromised easily.

4.17 The cavity of external walls must be closed along the line of junctions with separating walls with an appropriate flexible closer, or fully filled with mineral wool.

4.18 Electrical and other sockets in any separating walls should ideally be surface mounted. If not practicable, back boxes/pattresses should be done fully in line with manufacturers recommendations for the partition specification to ensure that the sound insulation of the wall is not affected.

4.19 Where possible penetrations in separating walls should be avoided as this will reduce the overall sound insulation performance of the wall. However, where holes made for cabling or pipework are unavoidable, they should be carefully cut/drilled to minimise gaps around the pipes. Alternatively, oversized holes can be closed off with surface-mounted plasterboard pieces following installation of

the ducts/pipes etc. Any remaining gaps, including any piping sleeves should then be sealed with a suitable intumescent/flexible sealant.

4.20 Soil pipes must be wrapped in mineral wool and encased with two layers of 15mm Gyproc SoundBloc and mounted on an independent frame.

Doors/Internal Glazing

4.21 Doors should be fitted in accordance with the manufacturer's installation instructions to ensure a good seal is achieved around the full perimeter of the door. The doors will only meet the required sound insulation performance if the door sets are installed with the appropriate edge seals as specified by the manufacturer.

4.22 All internal glazing should be well fitted such that an effective seal is achieved around the perimeter of any window frame and any openings.

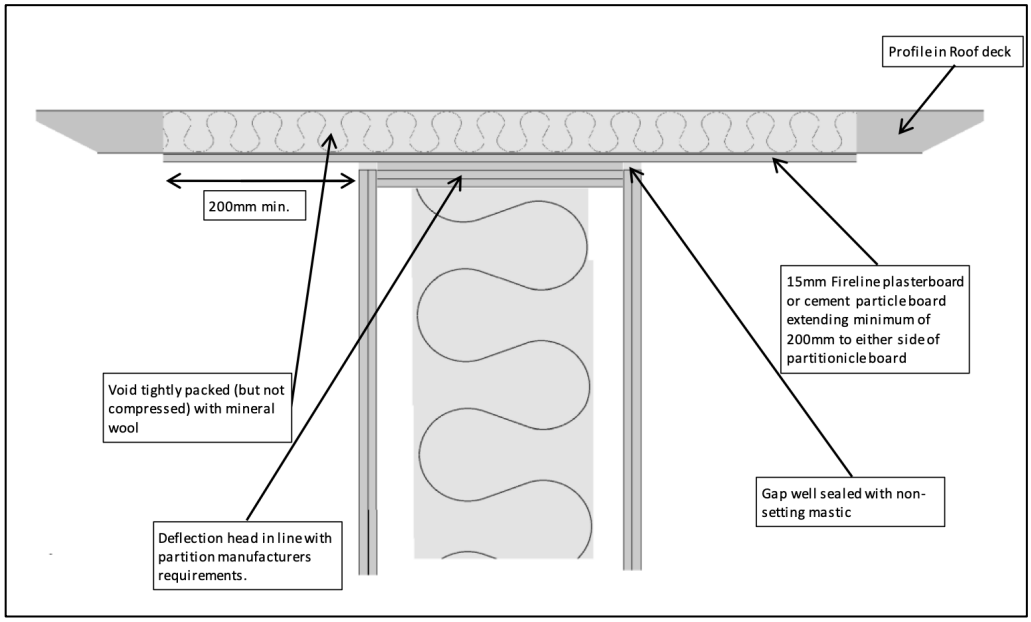
Flanking Noise transmission via Light-weight Roof

4.23 We understand that the proposals are for a lightweight roof construction which could introduce a significant flanking sound transmission path between separated spaces.

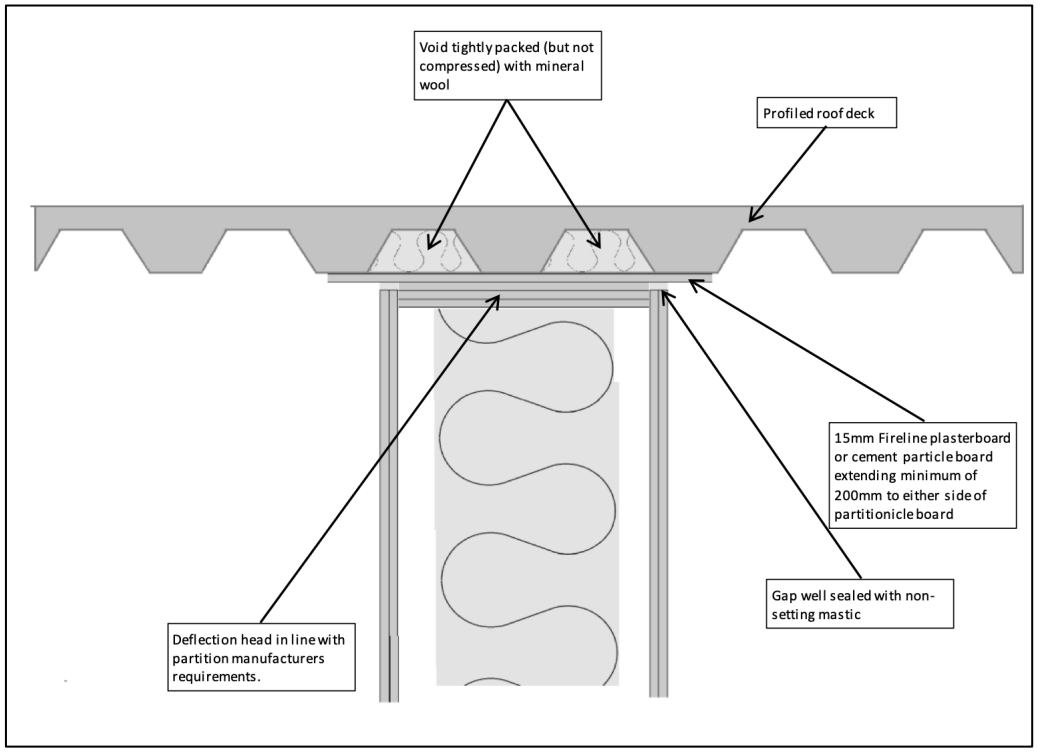
4.24 The sound insulation performance between spaces on the first-floor level will depend heavily on the junction details between the separating walls and the roof soffit, along with the sound insulation performance of the ceiling.

4.25 We have provided the following indicative sketches for wall/roof soffit junction details in Sketches 3 and 4.

Sketch 3 Indicative Wall/Roof Soffit Junction Detail Perpendicular



Sketch 4: Indicative Wall/Roof Soffit Junction Detail Parallel



4.26 Lightweight roofs, when combined with a lightweight suspended ceiling consisting of ceiling tiles can provide sufficient control of flanking noise to achieve a sound insulation performance of 45 dB $D_{nT,w}$ between classrooms, but is not generally enough to achieve 50 dB $D_{nT,w}$. To achieve a sound insulation performance of 50 dB $D_{nT,w}$ the ceiling will also need to incorporate a plasterboard element.

4.27 The junction details between separating walls and a profiled soffit will have to be carefully reviewed with the proposed ceiling tiles to ensure that flanking is suitably controlled.

Fixed Plant Noise

4.28 Any building service plant and equipment must be appropriately isolated from the building structure to ensure that residual vibration and re-radiated noise is adequately controlled.

4.29 Necessary measures may include any Air Handling Units (AHUs) located on anti-vibration pads with flexible connectors either side of the unit (including roof top AHUs), isolation pads to boilers, open spring, or rubber mounts for pump sets with flexible connectors either side of the units.

4.30 The sound insulation specifications for the partitions which separate plant rooms from other parts of the building will have to be determined once equipment noise output levels are available for the rooms.

5.0 CONTROL OF REVERBERATION

5.1 Guidance on reverberation time criteria/targets are detailed in Table 1.

5.2 We understand that a mix of carpet and vinyl floor finishes as well as plasterboard ceilings are proposed in both circulation spaces and teaching areas.

5.3 At this stage, the exact specifications of these finishes are not available. Nevertheless, it is likely that without the introduction of acoustically absorptive material, the reverberation targets detailed in Table 1 may not be achieved. The requirements will need to be reviewed once the proposed final finishes are determined.

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6.0 ENVIRONMENTAL NOISE LIMITS FOR FIXED PLANT & EQUIPMENT

6.1 We understand that there will be some new building services equipment installed to the northern elevation as part of the development, however, there are no details of the noise emissions from this equipment at this stage.

6.2 As such, we have derived appropriate noise design limits which will need to be considered in the selection and installation of the equipment.

6.3 British Standard 4142:2014, *'Methods for rating and assessing industrial and commercial sound'* is appropriate guidance for assessing the potential noise impact from commercial plant noise sources.

6.4 Based on the analysis of the background noise survey carried out by others the representative background noise levels have been determined at the nearest dwelling. The exact proposals for externally mounted plant are not known at this stage therefore cumulative plant noise rating limits are shown in Table 8 as BS 4142 rating levels ($L_{Ar,Tr}$) for the representative periods.

Table 8: Plant Noise Limits at Dwellings (dB)

School Day (08:00-17:00) $L_{Ar,Tr}$	Evening (19:00-23:00) $L_{Ar,Tr}$
46	46

6.5 It is also very important to note that the externally mounted plant may also need to be controlled to within lower noise levels to ensure that there is no adverse effect on the spaces within the building itself.

6.6 Typical measures that can be taken to adequately control noise from new fixed plant and equipment include:

- Specifying low noise equipment;
- Careful siting of equipment away from dwellings;
- Installation of acoustic enclosures around the fixed plant and machinery where necessary;
- Installation of noise attenuators, acoustic louvres, etc; and
- Carrying out regular maintenance of equipment to minimise noise.

7.0 OUTDOOR BATTING AREA

7.1 We understand the Local Authority have requested the creation of a two cricket batting practise nets for the local community to have access to, these will replace the existing all weather batting area which will be removed as part of the site development. We understand the use of the nets will be supervised at all times. The entry to the nets will be via the southern entrance and the balls will be bowled to batters at the northern part of the two nets.

7.2 There are no plans to providing lighting and thus access will be limited to daytime hours between the following periods.

- Monday to Thursday from 17:00 to 20:00
- Friday from 15:00 to 20:00
- Saturday from 10:00 to 18:00
- Sunday from 10:00 to 13:00

7.3 The maximum period of potential use outside of term time, are as follows:

- Monday to Saturday from 10:00 to 15:00
- Sunday and Public Holidays from 10:00 to 15:00

7.4 At this stage the construction of the nets is unknown and therefore a detailed assessment is not possible. However, we would recommend that the introduction of soft netting to absorb ball impacts be considered rather than chain link fencing.

8.0 SUMMARY AND CONCLUSION

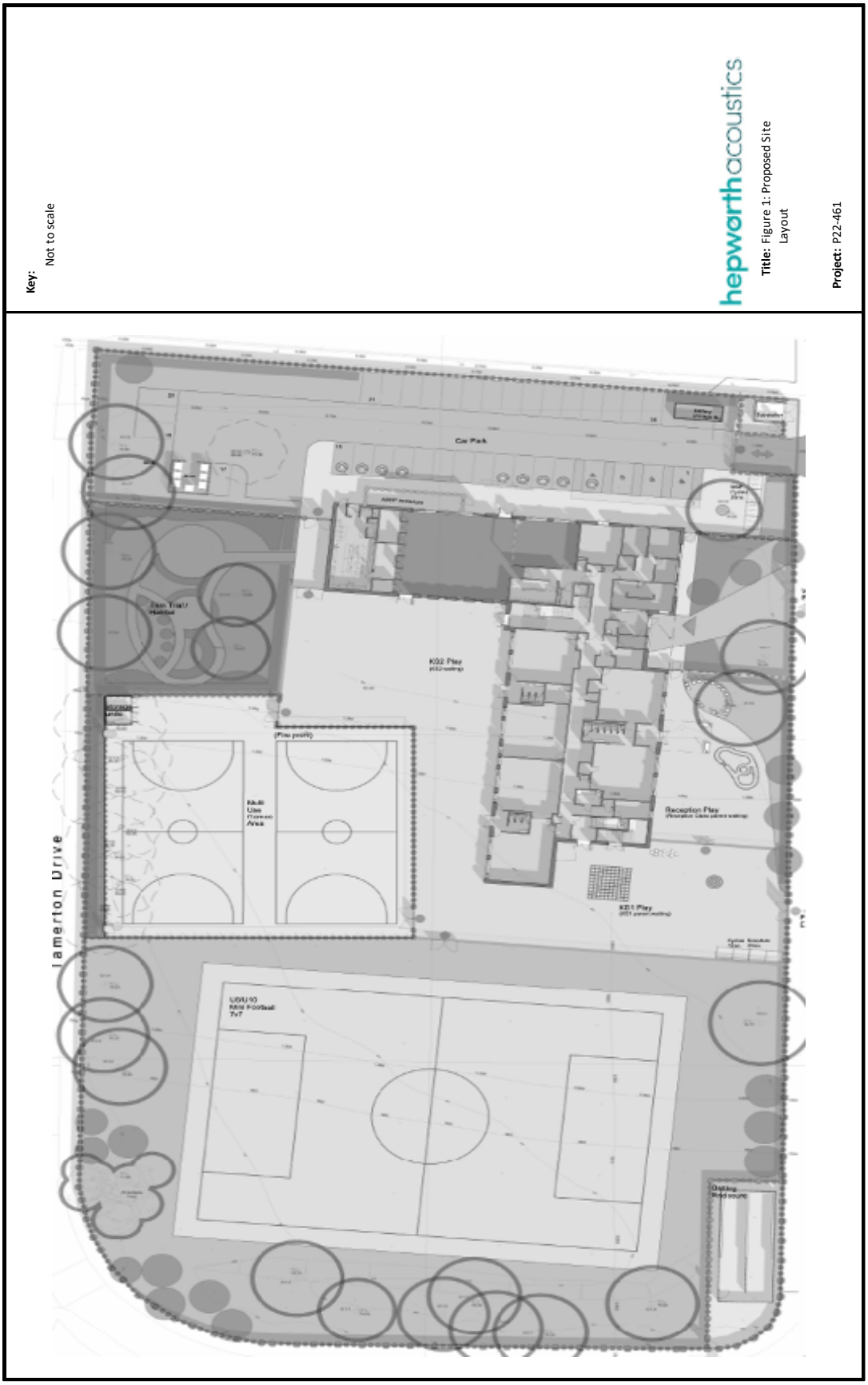
8.1 Hepworth Acoustics Ltd was commissioned by Conlon Construction to provide acoustic consultancy services in connection with the design of new school building at The Olive School in Manchester.

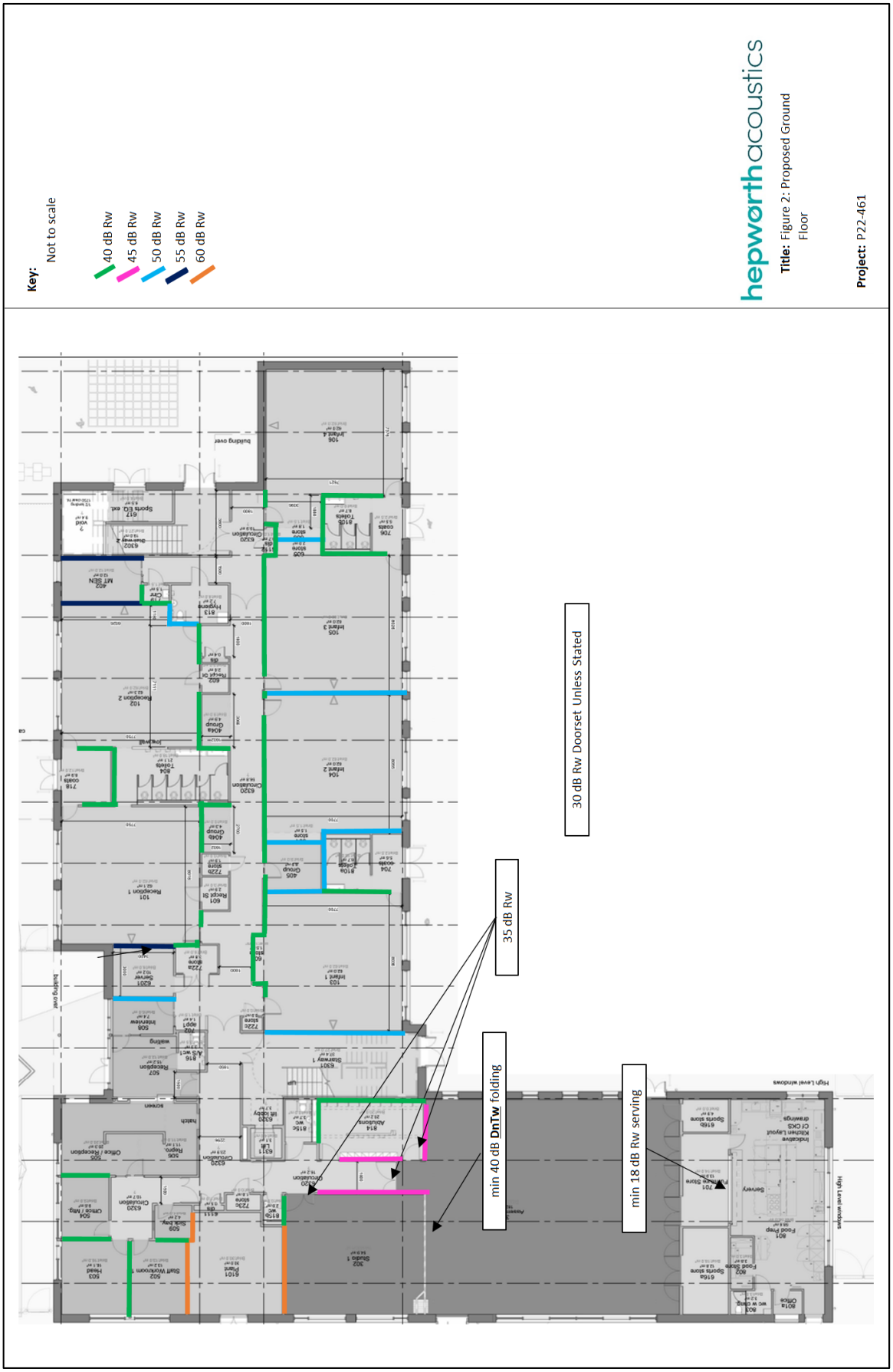
8.2 An assessment has been carried out which considers break-in of external noise, airborne and impact sound insulation between spaces, and the control of reverberation of sound.

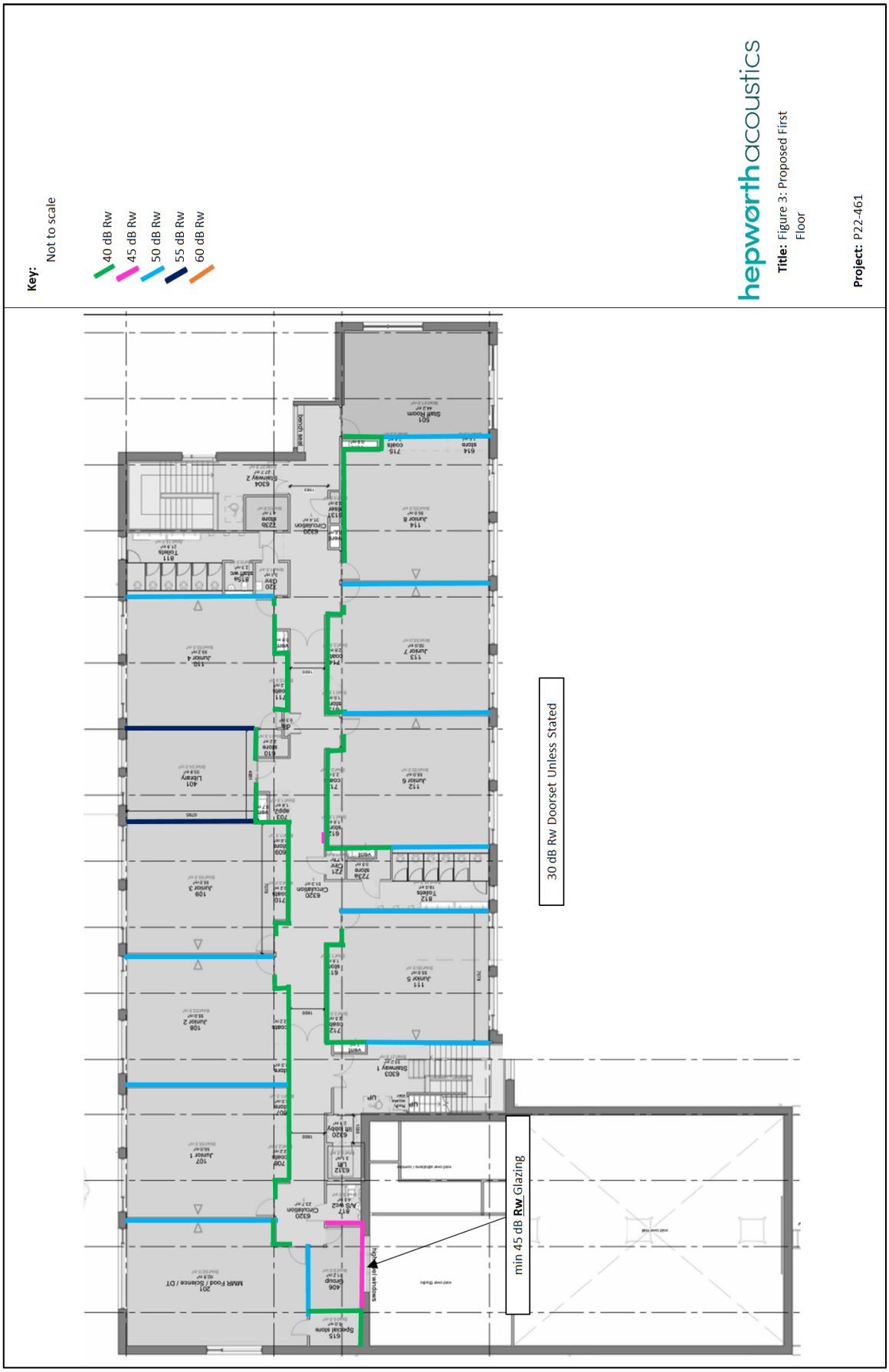
8.3 Recommendations have been given for the design of the scheme to achieve an appropriate standard of acoustic performance in accordance with guidance in BB93:2015.

8.4 Also, appropriate environmental noise design limits have been specified for any building services equipment, in accordance with the relevant British Standard, in order to ensure that there is no unacceptable noise impact on residential amenity.

Figure 1: Proposed Site Layout




Key:
Not to scale
40 dB Rw
45 dB Rw
50 dB Rw
55 dB Rw
60 dB Rw
hepworthacoustics
Title: Figure 2: Proposed Ground Floor
Project: P22-461
30 dB Rw Doorset Unless Stated
35 dB Rw
min 40 dB DnTw folding
min 18 dB Rw serving


Key:
Not to scale
40 dB Rw
45 dB Rw
50 dB Rw
55 dB Rw
60 dB Rw
hepworthacoustics
Title: Figure 3: Proposed First Floor
Project: P22-461
30 dB Rw Doorset Unless Stated
min 45 dB Rw Glazing

Appendix I: Noise Units & Indices

Sound and the decibel

A sound wave is a small fluctuation of atmospheric pressure. The human ear responds to these variations in pressure, producing the sensation of hearing. The ear can detect a very wide range of pressure variations. In order to cope with this wide range of pressure variations, a logarithmic scale is used to convert the values into manageable numbers. Although it might seem unusual to use a logarithmic scale to measure a physical phenomenon, it has been found that human hearing also responds to sound in an approximately logarithmic fashion. The dB (decibel) is the logarithmic unit used to describe sound (or noise) levels. The usual range of sound pressure levels is from 0 dB (threshold of hearing) to 120 dB (threshold of pain).

Due to the logarithmic nature of decibels, when two noises of the same level are combined together, the total noise level is (under normal circumstances) 3 dB(A) higher than each of the individual noise levels e.g. 60 dB(A) plus 60 dB(A) = 63 dB(A). In terms of perceived 'loudness', a 3 dB(A) variation in noise level is a relatively small (but nevertheless just noticeable) change. An increase in noise level of 10 dB(A) generally corresponds to a doubling of perceived loudness. Likewise, a reduction in noise level of 10 dB(A) generally corresponds to a halving of perceived loudness.

The ear is not equally sensitive to sound at all frequencies. It is less sensitive to sound at low and very high frequencies, compared with the frequencies in between. Therefore, when measuring a sound made up of different frequencies, it is often useful to 'weight' each frequency appropriately, so that the measurement correlates better with what a person would actually hear. This is usually achieved by using an electronic filter called the 'A' weighting, which is built into sound level meters. Noise levels measured using the 'A' weighting are denoted dB(A) or dBA.

Frequency and Hertz (Hz)

As well as the loudness of a sound, the frequency content of a sound is also very important. Frequency is a measure of the rate of fluctuation of a sound wave. The unit used is cycles per second, or hertz (Hz). Sometimes large frequency values are written as kiloHertz (kHz), where 1 kHz = 1000 Hz.

Young people with normal hearing can hear frequencies in the range 20 Hz to 20 kHz. However, the upper frequency limit gradually reduces as a person gets older.

Glossary of Terms

When a noise level is constant and does not fluctuate, it can be described adequately by measuring the dB(A) level. However, when the noise level varies with time, the measured dB(A) level will vary as well. In this case it is therefore not possible to represent the noise climate with a simple dB(A) value. In order to describe noise where the level is continuously varying, a number of other indices can be used. The indices used in this report are described below.

C_{tr} This is an A-weighted urban traffic noise spectrum, which can be added to $D_{nT,w}$ or R_w in some standards to take into account different source spectra such as low frequency sound.

R_w This is the 'Weighted Sound Reduction Index', and is a single figure quantity of R, the laboratory measured Sound Reduction Index.

L_{Aeq} This is the A–weighted 'equivalent continuous noise level' which is an average of the total sound energy measured over a specified time period. In other words, L_{Aeq} is the level of a continuous noise which has the same total (A–weighted) energy as the real fluctuating noise, measured over the same time period. It is increasingly being used as the preferred parameter for all forms of environmental noise.

L_{Amax} This is the maximum A–weighted noise level that was recorded during the monitoring period.

L_{A1} This is the A–weighted noise level exceeded for 1% of the time period. L_{A1} is usually used as a measure of peak noise in the assessment of noise break-in in BB93.

L_{A10} This is the A–weighted noise level exceeded for 10% of the time period. L_{A10} is usually used as a measure of traffic noise.

L_{A90} This is the A–weighted noise level exceeded for 90% of the time period. L_{A90} is used as a measure of background noise.

D_{nT} This is the Standardised Level Difference, which is equivalent to the measured D_n and corrected to a standardised reverberation time of 0.5s.

$D_{nT,w}$ This the Weighted Standardised Level Difference, is a single figure value of D_{nT}, and is the field measurement of airborne sound transmission