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ACOUSTIC CONSULTANTS

DUNDAS STREET, HUDDERSFIELD

ENVIRONMENTAL NOISE ASSESSMENT REPORT

architectural

environmental

occupational

industrial

noise control at source

project management

planning

legal services

expert witness

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1.0 SUMMARY

PDA Ltd was commissioned by KAS Property Management Ltd to carry out an environmental noise and building envelope assessment report for the proposed refurbishment development at Dundas Street in Huddersfield. The proposed development consists of the renovation of the existing building to include 53 bedrooms of student accommodation and 11 communal areas throughout basement, ground floor and the 4 additional storeys. The retail units on the ground floor, 'The Fashion Factory' and 'The Card Corner', will be kept in place.

In accordance with the National Planning Policy Framework, a noise measurement survey has been undertaken, to be representative of day and night time periods to quantify the nature and level of incident noise upon the proposed development.

The local noise climate is dominated by road traffic noise on Dundas Street and the surrounding local area; Dundas Street is a one-way road. The traffic included cars, motorbikes, buses and HGVs. There is a bus station on Henry Street to the west of the site. Other significant noise sources were from pedestrians (walking, talking and occasional shouting) in the pedestrian area and Threadneedle Street, with some vehicle movements on Threadneedle Street which is for access only.

There are a number of condenser units located at the rear of Storeys Amusements directly across Threadneedle Street. High noise events measured here were due to car door slams, opening/shutting of the roller shutters of Storeys Amusements during daytime and distant emergency services sirens. It is noted that a two-tone fire alarm was audible at low level throughout the Friday night measurements. We would note that the Plumbers Arms public house had live music (Mod Revue – guitar, bass, drums and vocals) on the evening (6pm) of Sunday 21st May. Measurements at Position 2, the closest position to the public house, do not show any significant increase in level at this time from any other time. Music noise was audible on recordings but was not dominant. It is noted that there is no direct line of sight between the public house and the proposed development with the in-between buildings providing full screening.

Based upon the measured noise levels, calculations have been undertaken for the bedrooms and Living Spaces to evaluate the internal noise levels. Recommendations are given for glazing, ventilation and building façade elements to meet the internal noise level requirements. Calculations suggest that the noise level criteria of BS8233:2014 and Kirklees Council Noise Design Advice leaflet can be achieved within the student accommodation.

2.0 BRIEF FOR CONSULTANCY

PDA Ltd was commissioned by KAS Property Management Ltd to carry out the following for the proposed refurbishment development at Dundas Street in Huddersfield.

A) We will travel to the site in Huddersfield and undertake an ambient noise survey in the vicinity of the proposed development. As the site is an existing building, and the site plan indicates a club and the Plumbers Arms public house which hosts live music, we would look to undertake an unmanned survey from out of an upper floor window(s) over a weekend period. This would involve installing a sound level meter with a microphone mounted on a pole from out of a high level window. If this is not possible, due to issues of security, etc. we would undertake a shortened measurement survey at ground level over peak road traffic times and night time periods for the club/public house (e.g. 23:00 – 01:00 hours and 06:00 – 10:00 hours). The measurements will include the overall dBA levels and octave bands in terms of the L_{eq}, L_{max}, L_{10} and L_{90} parameters.

We will carry out all noise surveys in accordance with the provisions of BS7445 “Description and Measurement of Environmental Noise”.

B) Based the latest drawings provided and the results of the noise survey we shall model the building to determine the external noise levels incident upon the different façades of the proposed development.

C) Once obtained the ambient noise data and calculated incident noise levels will be collated and used to assess the proposed building envelope of the development. The assessment will be undertaken with reference to meeting suitable internal noise level criteria taken from BS8233:2014 and WHO guidelines for community noise, or requirements set out by the Local Authority in their Noise Design Advice document.

D) The results from parts (a), (b) and (c) will be presented in a full and detailed report in a format that is suitable for submission to the Local Authority.

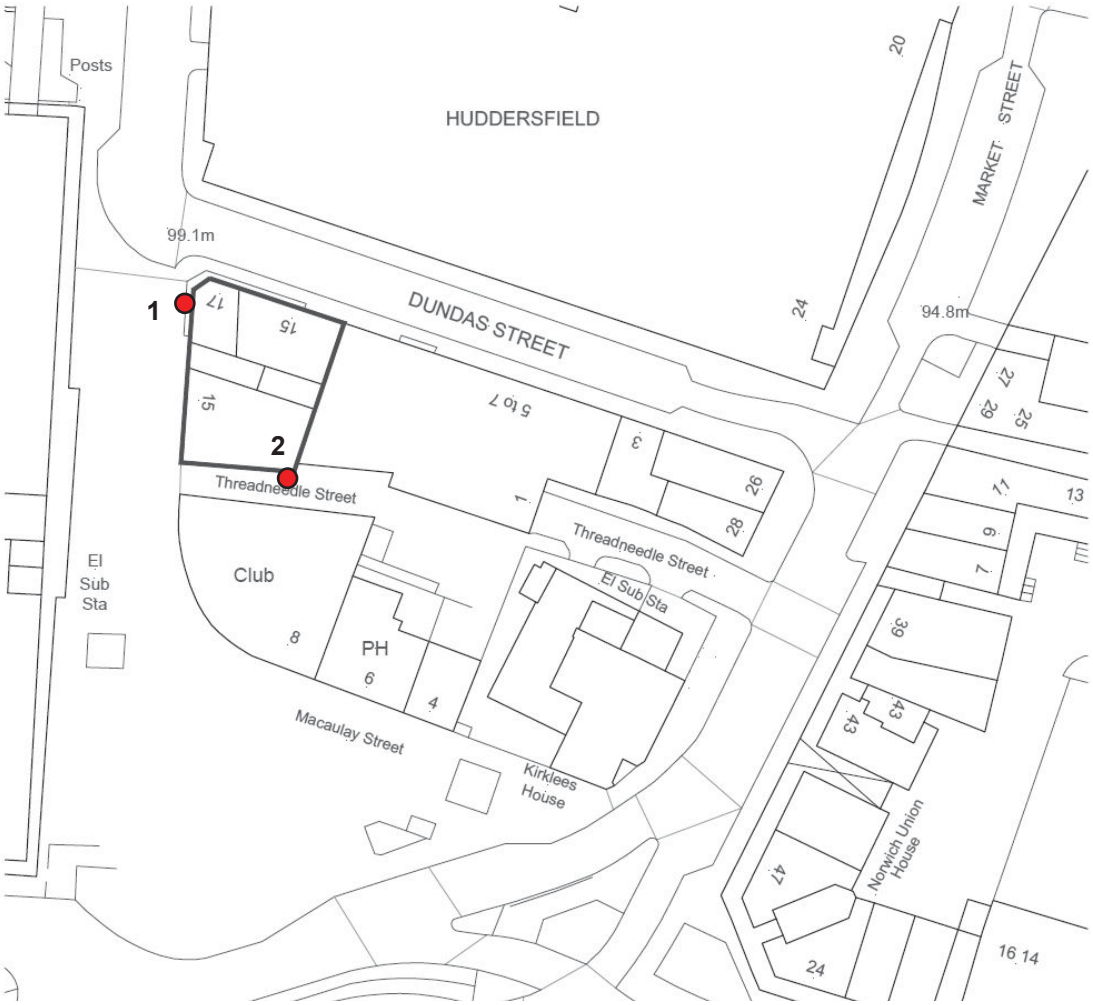
3.0 SITE DESCRIPTION

The proposed development consists of the renovation of the existing building to include 53 bedrooms of student accommodation and 11 communal areas throughout basement, ground floor and 4 additional storeys. The retail units on the ground floor, 'The Fashion Factory' and 'The Card Corner', will be kept in place. An unused café on the ground floor is also to be turned into student accommodation. The existing building is presently part unoccupied and part tenanted by the retail units.

The site is bordered by Dundas Street to the north, with a pedestrianised area to the west and Threadneedle Street to the south, which provides some vehicle access. Huddersfield bus station and its associated car park is directly to the west of the site with some retail units at ground floor and the multi-storey car park above. To the north of the site across Dundas Street is a Sainsbury's store and its associated car park at roof level. To the south across Threadneedle Street is Storeys amusements (marked as Club below) and the Plumbers Arms public house. The surrounding area is primarily commercial (retail and offices) with a mix of some residential developments.

A site plan showing the location of the site and surrounding local area is shown in Figure 1 below.

Figure 1: Site plan showing measurement positions



4.0 NOISE ASSESSMENT CRITERIA

4.1 National Planning Policy Framework

National Planning Policy is guided by the National Planning Policy Framework. With regard to noise, the Framework states the following;

Planning policies and decisions should aim to:

- *avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;*
- *mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;*
- *recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and*
- *identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.*

The terms '*significant adverse impact*' and '*other adverse impacts*' are defined in the explanatory notes of the 'Noise Policy Statement for England (NPSE) which states;

There are two established concepts from toxicology that are currently being applied to noise impacts, for example, by the World Health Organisation. They are:

NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected.

Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse effect level.

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur.

The notes also offer an explanation of the term 'other adverse impacts' as follows;

… refers to the situation where the impact lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development (paragraph 1.8). This does not mean that such adverse effects cannot occur.

Although no specific noise limits for LOAEL and SOAEL have been defined, in 2014 the UK Government published a planning practice guidance document for noise which

indicates where these limits fall with relation to the perception of noise. A summary is reproduced in Section 4.2 below; the full document is published at http://planningguidance.planningportal.gov.uk/blog/guidance/noise/noise-guidance/.

4.2 Planning Practice Guidance – Noise

The UK Planning Practice Guidance on noise offers further guidance on the typical levels which constitute the NOEL, LOAEL and SOAEL and is reproduced in the table below;

Table 1: Planning Practice noise level guidance

Perception	***Examples of Outcomes***	***Increasing Effect Level***	***Action***
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
		Lowest Observed Adverse Effect Level	
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
		Significant Observed Adverse Effect Level	
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

4.3 BS8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

Dwelling houses, flats and rooms in residential use

British Standard 8233:2014, *Guidance on Sound Insulation and noise reduction for buildings*, gives guidance on internal noise levels within dwellings, flats and rooms in residential use when unoccupied. The following criteria are for Living and Dining Rooms for daytime use and Bedrooms for night time.

Table 2: BS8233 recommended indoor ambient noise levels

Activity	***Location***	***07:00 to 23:00***	***23:00 to 07:00***
Resting	Living room	35 dB $L_{Aeq,16hour}$	–
Dining	Dining room/area	40 dB $L_{Aeq,16hour}$	–
Sleeping (daytime resting)	Bedrooms	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

It should however be stressed that the above criterion relates to steady noise, in this case from road traffic etc., excluding unusual noise events departing from the typical noise character of the area.

In addition BS 8233 suggests, '*regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values'.*

4.4 Kirklees Council Noise Design Advice Leaflet

Kirklees Environmental Services PNC Department has produced a Noise Design Advice leaflet in 2007 in which it stipulates the design criteria for noise assessment of a number of scenarios.

For new residential properties near to transportation noise sources (such as busy roads) or in areas of mixed industrial and transportation sources, it offers the following design advice. Although it refers to the previous Planning Policy Guidance 24 - Planning and Noise, which has been superseded by the NPPF discussed above, the internal noise level design targets are still considered to be appropriate. The guideline values are in line with the design criteria of BS8233:2014.

Table 3: Kirklees Council Noise Design Advice leaflet noise criteria

Room/Area	***$L_{Aeq\ (16\ hr)}$ 07:00 – 23:00***	***$L_{Aeq\ (8\ hr)}$ 23:00 – 07:00***	***$L_{A1(15\ min)}$ 23:00 – 07:00***	***L_{Amax} 23:00 – 07:00***
Living Rooms/Studies	35dB	-	-	-
Gardens	55dB	-	-	-
Bedrooms	-	30dB	45dB	55dB

The guidance suggests that, '*all indoor levels shall be taken with windows open or with alternatively provided acoustic ventilation over and above "background" ventilation.*'

The guidance would suggest that for New Noise Sensitive Premises near to Places of Entertainment, NR 20 should be achieved in bedrooms (2300 to 0700) and NR 25 in all habitable rooms (0700 to 2300), measured as a 15 minute linear L_{eq} at the octave band centre frequencies 31.5 Hz to 8 kHz.

5.0 SURVEY DETAILS AND RESULTS

A noise level survey was undertaken at the site between 13:00 on Friday 19th May and 12:00 hours on Monday 22nd May 2017. The noise level surveys were chosen to encompass a full weekend of data.

Measurements were taken at two positions on the site. The measurement positions are detailed in Figure 1 in Section 3.

- Position 1 – from out of a first floor window (5m above ground) on the corner of Dundas St and the Pedestrian area between 0.5 – 1m from the façade of the building.
- Position 2 – from out of a first floor window (5.5m above ground) on Threadneedle Street between 0.5 – 1m from the façade of the building.

The measurements were made by Mr Wesley Charlton of PDA Ltd and were unattended with audio recordings at Position 2. Measurements were of 5 minute samples.

The surveys were conducted using an NTi XL2 (Position 2) sound level meter, and a Rion NL-52 (Position 1) sound level meter, for which calibration certificates are held. The NTi XL2 and Rion NL-52 sound level meters are both Class 1 frequency response as per BS EN 61672-1:2003. For each survey the sound level meters were field calibrated both before and after each measurement period, during which time no significant deviation from the calibrated level was observed. The sound level meters were fitted with microphone windshields at all times.

The microphones of the sound level meters at Positions 1 and 2 were mounted on extended poles from out of the existing building windows between 0.5 – 1 metres from the façade and can therefore be assumed to be façade measurements. All measurements were undertaken with a fast time-weighting and broadband statistics were measured throughout. In addition, the NTi XL2 meter recorded octave band frequency spectra and audio recordings.

The weather during the noise survey was dry with no reported rain showers, with wind speeds of no more than 5m/s and reported temperatures of between 7 – 20 degrees centigrade. The weather was considered conducive to undertaking noise measurements.

Noise Sources

The local noise climate is dominated by road traffic noise on Dundas Street and the surrounding local area; Dundas Street is a one-way road. The traffic included cars, motorbikes, buses and HGVs. There is a bus station on Henry Street to the west of the site.

Other significant noise sources were from pedestrians (walking, talking and occasional shouting) in the pedestrian area and Threadneedle Street, with some vehicle movements on Threadneedle Street which is for access only to car parking spaces and the rear of the buildings located here.

There are a number of condenser units located at the rear of Storeys Amusements directly across Threadneedle Street from Position 2. High noise events measured here were due to car door slams, opening/shutting of the roller shutters of Storeys Amusements during daytime and distant emergency services sirens. It is noted that a two-tone fire alarm was audible at low level throughout the Friday night measurements. We would note that the Plumbers Arms public house had live music

(Mod Revue – guitar, bass, drums and vocals) on the evening (6pm) of Sunday 21st May. Measurements at Position 2, the closest position to the public house, do not show any significant increase in level at this time from any other time. Music noise was audible on recordings but was not dominant. It is noted that there is no direct line of sight between the public house and the proposed development with the in-between buildings providing full screening.

5.1 Measurement Results

Full details of the measured results can be seen in Appendix III included at the end of this report. Measurement positions on site are shown on Figure 1 in Section 3 of this report. A summary of the results is given below:

Table 4: Summary of on-site environmental noise measurements – Position 1 Friday 19th – Monday 22nd May

Position	***Time Period (hh:mm)***	***Duration (hh:mm)***	$L_{Aeq,T}$ ***(dB)***	***Range of*** $L_{Amax,5mins}$ ***(dB)***	***Range of*** $L_{A1,5mins}$ ***(dB)***	***Range of*** $L_{A90,5mins}$ ***(dB)***
1 – Dundas Street	12:55 – 23:00	10:05	60	60 – 89	58 – 76	51 – 61
	23:00 – 07:00	08:00	56	56 – 85	55 – 82	48 – 59
	07:00 – 23:00	16:00	60	59 – 90	55 – 76	47 – 61
	23:00 – 07:00	08:00	50	51 – 82	48 – 71	39 – 53
	07:00 – 23:00	16:00	60	57 – 91	54 – 83	43 – 61
	23:00 – 07:00	08:00	55	45 – 84	43 – 81	37 – 59
	07:00 – 12:10	05:10	62	65 – 87	62 – 84	58 – 60

Table 5: Summary of on-site environmental noise measurements – Position 2 Friday 19th – Monday 22nd May

Position	***Time Period (hh:mm)***	***Duration (hh:mm)***	$L_{Aeq,T}$ ***(dB)***	***Range of*** $L_{Amax,5mins}$ ***(dB)***	***Range of*** $L_{A1,5mins}$ ***(dB)***	***Range of*** $L_{A90,5mins}$ ***(dB)***
2 – Thread needle Street	13:15 – 23:00	09:45	57	57 – 89	56 – 78	53 – 57
	23:00 – 07:00	08:00	54	54 – 76	53 – 69	50 – 54
	07:00 – 23:00	16:00	57	56 – 88	54 – 80	52 – 58
	23:00 – 07:00	08:00	49	49 – 83	46 – 65	43 – 52
	07:00 – 23:00	16:00	58	53 – 92	50 – 87	44 – 56
	23:00 – 07:00	08:00	50	45 – 73	44 – 69	42 – 52
	07:00 – 12:05	05:05	57	57 – 90	55 – 79	52 – 56

5.2 Noise Modelling

The measurement at Position 1 was taken at the corner of the building on the side of the pedestrian area; using historic noise data from a previous noise survey of Dundas Street and applying a distance correction to the measured levels we have determined the level at the façade of Dundas Street would be 2dB greater than that measured at Position 1.

5.3 Discussion

It is PDA's experience that developments with the measured noise levels above are suitable for residential development provided that adequate acoustic attenuation is provided to habitable areas. Considering the acoustic weak points of a building façade, typically the glazing and the ventilation elements, calculations have been undertaken to determine the internal noise levels. These levels are compared with the criteria detailed in Table 6 below, derived from the guidance in Section 4.

Table 6: Proposed internal noise level criteria

Room/Area	$L_{Aeq\ (16\ hr)}$ ***07:00 – 23:00***	$L_{Aeq\ (8\ hr)}$ ***23:00 – 07:00***	$L_{A1(15\ min)}$ ***23:00 – 07:00***	L_{Amax} ***23:00 – 07:00***
Living Rooms	35dB	-	-	-
Bedrooms	-	30dB	45dB	55dB

These are the internal noise levels proposed by Kirklees Environmental Services PNC Department for new residential properties near to transportation noise sources or in areas of mixed industrial and transportation sources, and are in line with the guidance of BS8233:2014.

The guidance would suggest that for New Noise Sensitive Premises near to Places of Entertainment, NR 20 should be achieved in bedrooms (2300 to 0700) and NR 25 in all habitable rooms (0700 to 2300). We would note that live music from the Plumbers Arms public house was measured at 6pm on Sunday 21st May but not considered to be dominant.

6.0 INTERNAL NOISE LEVEL PREDICTION

Based upon the measured noise levels in Section 5, calculations have been undertaken to determine internal noise levels for the proposed dwellings. The proposed student accommodation layout is as per the 1618 Architects architectural Plan drawings 445 P-11 – P-16, and elevation/section drawings 445 P-18 – P-21, dated October 2016.

6.1 Glazing and Ventilation Attenuation Requirements

The dominant paths for noise transfer to the interior of buildings are generally the glazing and ventilation elements of the façade constructions. Based on this premise, to achieve the required internal noise levels from Table 6 would require the following glazing and ventilation specifications.

The calculation of noise break-in to the residential rooms has been undertaken in accordance with the calculation methods of BS EN 12354-3:2000 *Building Acoustics – Estimation of acoustic performance of buildings from the performance of elements. Part 3: Airborne sound insulation against outdoor sound*, in octave bands. Reverberation time is 0.5 seconds as per BS EN 12354-3 for dwellings.

Figure 1: Site layout for the proposed accomodation

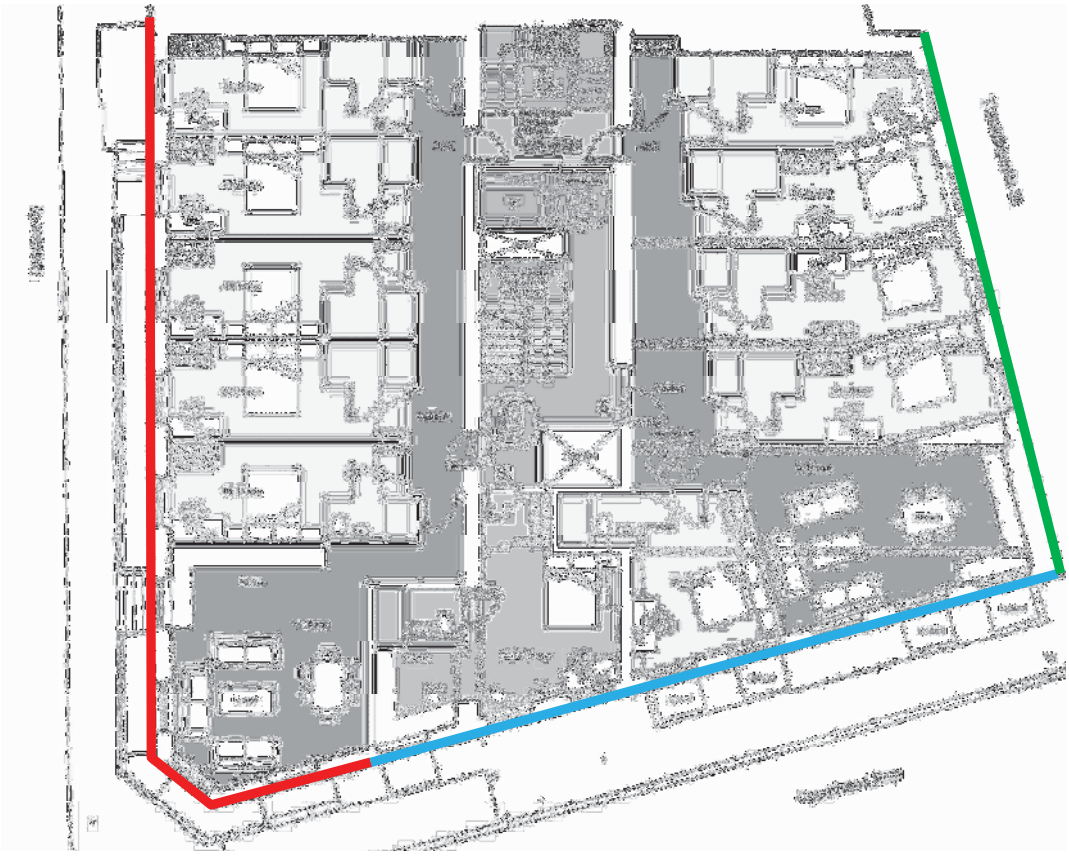


Table 7: Glazing and Ventilator Schedule

Façade	Floor	Room	Minimum Glazing Rating R_w dB	Minimum combined Ventilator Rating $D_{n,e,w}$ dB	Internal Noise Level Target			Calculated Internal Noise Level		
					$L_{Aeq,T}$ dB Day/Night	$L_{A1,15min}$ dB Night	L_{Amax} dB Night	$L_{Aeq,T}$ dB Day/Night	$L_{A1,15min}$ dB Night	L_{Amax} dB Night
Red	All	Bedroom	42	42	35/30	45	55	28/23	45	54
Red	All	Kitchen/ Lounge	33	33	35/-	-	-	34/-	-	-
Blue	All	Bedroom	38	38	35/30	45	55	29/24	45	55
Blue	All	Kitchen/ Lounge	33	33	35/-	-	-	33/-	-	-
Green	All	Bedroom	33	33	35/30	45	55	30/25	41	55
Green	All	Kitchen/ Lounge	33	33	35/-	-	-	33/-	-	-

With the glazing and ventilator specifications proposed in Table 7 above, calculations suggest that the noise level requirements can be achieved. We would note that with the glazing and ventilator specifications for bedrooms on Threadneedle Street (green façade), the noise levels measured during live music would meet NR25 internally within bedrooms during daytime. No music noise was measured during night time hours.

6.1.1 Glazing Specification and Installation Notes

Notes on new Glazing Installation

For the glazing specifications in Table 7, all sound insulation values quoted above must be achieved by the overall **combination of frame and glazing**, and not just by the glazing alone. The frame should not reduce the performance of the system overall.

Glazing framing systems must be fully sealed with any small gaps (<10mm nominal) around the perimeter to be stuffed with dense mineral wool to full frame depth and sealed both sides with acoustic non-setting mastic, with additional weathering protection to be applied additionally externally to this. No gaps should be left unsealed.

Notes on Retaining Existing Glazing

The sound insulation performance of sash framing can be variable and depends on the quality and age of the frames. The specification of the existing glazing is unknown, but assuming a single pane or basic thermal double glazing, measurements of similar windows have been shown to provide a sound insulation of 21 – 25 dB D_w, dominated by gaps between sashes and at the frame edges. It is likely that the performance of the existing glazing would be below the specifications given above.

Where it is proposed to retain the existing glazing it is likely that a secondary pane in a separate frame would need to be installed, behind the existing glazing, in order to increase the sound insulation of the window to meet the specifications above.

All gaps and holes in the existing framing/glazing should be made good, with suitable seals retrofitted to the existing windows. Pilkington acoustic test data would suggest that a secondary pane consisting of a minimum 6mm glass installed a minimum of 150mm behind 4mm glazing would have an acoustic rating of 47 dB R_w which is

sufficient to meet any of the proposed acoustic ratings above. Specialist secondary glazing manufacturers are available, and include Selectaglaze.

Minimum performance requirements for the combination of glazing and framing recommended in the above tables are as follows:

Table 8: Required Minimum Sound insulation of Combined Glazing and Framing

Typical Product	***Minimum Sound Reduction Index R (dB) at Octave Band Centre Frequency (Hz)***							***R_w***
	63	***125***	***250***	***500***	***1k***	***2k***	***4k***	
Standard thermal double glazing e.g. 6/12/6mm	18	20	19	29	38	36	45	33
Acoustic double glazing e.g. 10/12/6mm	20	26	27	34	40	38	46	38
Acoustic laminate double glazing e.g. 8.4lam/12/10mm	23	28	30	39	44	49	56	42
Secondary glazing e.g. 4/150/6mm	23	29	35	45	56	52	50	47

Figures stated in the table above are based on Pilkington and Saint Gobain manufacturer quoted data. Acoustic ratings should be checked with the manufacturer and supported by laboratory test reports where necessary.

6.1.2 Ventilator Requirements

The ventilator inlets described in the following table are calculated to provide adequate sound insulation to maintain internal noise levels compliant with the guidance criteria when used in conjunction with the selected glazing. Selected ventilation inlets should provide equal or greater sound insulation performance across the frequency range to the values in Table 9; example products are noted below.

The acoustic specification relates to the combined performance of all ventilation elements. Where two or more ventilators are required to meet the ventilation requirement, the acoustic performance for a single ventilator must be selected so that the combined performance is as stated in the table below, e.g. for 2 no. ventilators, the acoustic performance of each will need to be $D_{n,e,w}$ 36 dB to meet a combined $D_{n,e,w}$ 33 dB specification. Requirements should be checked with the manufacturer.

Table 9: Required Minimum Sound insulation of Ventilators

Example Product	***Minimum Normalised Element Level Difference $D_{n,e}$ (dB) at Octave Band Centre Frequency (Hz)***						***$D_{n,e,w}$***
	125	***250***	***500***	***1000***	***2000***	***4000***	
Acoustic trickle vent e.g. Simon Acoustic FV	39	36	35	31	32	37	33
Acoustic trickle vent e.g. Simon Acoustic EHAS	40	36	34	35	44	40	38
Acoustic trickle vent e.g. Greenwood 5000EA + 2 acoustic modules	40	37	32	47	54	48	42

The guidance of Kirklees Environmental Services PNC Department Noise Design Advice leaflet suggests that, '*all indoor levels shall be taken with windows open or with alternatively provided acoustic ventilation over and above "background" ventilation.*' It

will not be possible to meet the internal noise level targets above with open windows. Discussions may be required between the mechanical engineer and the LA to determine what 'over and above "background" ventilation' means from a technical perspective.

Ventilation strategy needs to be checked with Local Authority and other standards and regulations for compliance. It should be noted that inclusion of ventilators alone does not ensure compliance with Building Regulations or other regulatory requirements for ventilation. The ventilation strategy should be checked by others.

6.2 External Walls

From inspection on-site and architects drawings, the external wall build-up for the existing building is masonry (likely solid), with an overall thickness of approximately 400-500mm. From laboratory test data for a similar massive wall (350mm brick) it is assumed that the above build-up would provide a laboratory sound insulation in excess of 54 dB R_w which is considered acceptable.

For new proposed sections at high level, concept drawings indicate that the proposed external leaf will be a lightweight cladding panel. The internal leaf is likely to be a lightweight construction e.g. Metsec or similar, lined to one side with minimum 12mm cement board with an internal lining of 2 no. layers of 15mm sound resistant plasterboard and min. 100mm cavity fully filled with mineral wool insulation (minimum density 10kg/m^3). From Insul sound prediction software, it is assumed that the build-up has an acoustic performance of at least 49 dB R_w.

Please note that the external façade should have no unsealed penetrations, and any openings for ventilation should meet the specifications for ventilators above.

6.3 Roof

From concept drawings the roof construction for the student accommodation is assumed to be a lightweight cladding panel (single ply membrane or standing seam or similar). It is recommended that the internal ceiling within top floor bedrooms is a minimum of 2 no. layers of 12.5mm plasterboard (min. total mass per unit area 20kg/m^2) with a minimum 100mm mineral wool insulation (minimum density 10kg/m^3) in the cavity.

Insul sound prediction software would suggest the above structure has a laboratory sound insulation of at least 45 dB R_w, which is considered to be acceptable. It is assumed that there will be a partial shielding correction for the roof from the road noise sources located below.

6.4 Quality Control

Please note that achieving performance standards requires strict adherence to best practice construction methodology on site. A checklist of acoustic requirements for quality control is attached at the rear of this report.

7.0 CONCLUSIONS

PDA Ltd was commissioned by KAS Property Management Ltd to carry out an environmental noise and building envelope assessment report for the proposed refurbishment development at Dundas Street in Huddersfield. The proposed development consists of the renovation of the existing building to include 53 bedrooms of student accommodation and 11 communal areas throughout basement, ground floor and the 4 additional storeys. The retail units on the ground floor, 'The Fashion Factory' and 'The Card Corner', will be kept in place.

In accordance with the National Planning Policy Framework, a noise measurement survey has been undertaken, to be representative of day and night time periods to quantify the nature and level of incident noise upon the proposed development.

The local noise climate is dominated by road traffic noise on Dundas Street and the surrounding local area; Dundas Street is a one-way road. The traffic included cars, motorbikes, buses and HGVs. There is a bus station on Henry Street to the west of the site. Other significant noise sources were from pedestrians (walking, talking and occasional shouting) in the pedestrian area and Threadneedle Street, with some vehicle movements on Threadneedle Street which is for access only.

There are a number of condenser units located at the rear of Storeys Amusements directly across Threadneedle Street. High noise events measured here were due to car door slams, opening/shutting of the roller shutters of Storeys Amusements during daytime and distant emergency services sirens. It is noted that a two-tone fire alarm was audible at low level throughout the Friday night measurements. We would note that the Plumbers Arms public house had live music (Mod Revue – guitar, bass, drums and vocals) on the evening (6pm) of Sunday 21st May. Measurements at Position 2, the closest position to the public house, do not show any significant increase in level at this time from any other time. Music noise was audible on recordings but was not dominant. It is noted that there is no direct line of sight between the public house and the proposed development with the in-between buildings providing full screening.

Based upon the measured noise levels, calculations have been undertaken for the bedrooms and Living Spaces to evaluate the internal noise levels. Recommendations are given for glazing, ventilation and building façade elements to meet the internal noise level requirements. Calculations suggest that the noise level criteria of BS8233:2014 and Kirklees Council Noise Design Advice leaflet can be achieved within the student accommodation.

Appendix I – Definition of Acoustic Terms (Environmental)

The decibel

This is the basic unit of noise, denoted dB.

A Weighting

This is a weighting process which simulates the human ear's different sensitivity at different frequencies. A weighting can be shown two typical ways, 50 dB(A) L_{eq} or 50 dB L_{Aeq}. Both mean the same thing. (See below for a definition of L_{eq}). The dB(A) level can be regarded as the overall level perceived by human beings.

L_{eq} and $L_{eq(s)}$

This is the equivalent continuous noise level which contains the same acoustic energy as the actual time-varying sound. In other words it is a kind of average noise level. It is denoted dB L_{eq} or, for A-weighted figures dB(A) L_{eq} or dB L_{Aeq}. It can also be expressed in terms of frequency analysis (see below). $L_{eq(s)}$ is the sample L_{eq} level.

L_n

This is the level exceeded for n% of the time. It is denoted dB L_n or, for A-weighted figures dB(A) L_n or dB L_{An}. It can be expressed in terms of frequency analysis (see below). L_{90} is the level exceeded for 90% of the time and is a measure of the lowest level typically reached. L_{10} is the level exceeded for 10% of the time and is the highest level typically reached. L_{50} is the level exceeded for 50% of the time and, mathematically, it is the median.

L_{max}

This is the maximum level reached during a measurement period. The "time constant", or the ability of the equipment to respond to impulses is usually expressed along with it, e.g. "Fast", "Slow", etc. It is denoted dB L_{max} or, for A-weighted figures dB(A) L_{max}, dB L_{Amax}, etc. It can also be expressed in terms of frequency analysis.

Frequency Analysis

Whereas dB(A) gives a very useful overall figure, it has its limitations in that it cannot be used to model or predict the effect of noise control and mitigation as this nearly always has radically different performance at different frequencies.

Frequency analysis expresses an overall noise level at each frequency or band of frequencies in the audible range. Octave band analysis divides the audible range into 10 bands from 31.5 Hz to 16 kHz and the noise level in each band can be expressed in any form e.g. L_{eq}, L_{90}, L_{max}, etc. One third octave band analysis uses 30 bands.

Narrow band analysis takes the process to resolutions of less than 1 Hz. This is useful for identifying the existence of tones (whines, hums, etc.) and in pin-pointing the sources.

Appendix II – Acoustic Requirements for Quality Control

1. **Blockwork**

All blockwork to be mortared to an almost fair faced standard both horizontally and vertically. Only perfect blocks may be used with no pitting or cracks. The blockwork must seal effectively to the underside of the soffit.

Where blockwork walls form a cavity wall, care should be taken to avoid rubble and snots from bridging the cavity. This is especially important where one or more of the leaves is floating.

2. **Plasterboard**

All plasterboard joints are to be butted tight. The rule of thumb is that the joint should be tight enough over its entire length to prevent a normal business card from being inserted. Multiple layers should be fitted with staggered joints.

Base details and deflection heads are to be as per the British Gypsum White Book, or similar approved, with copious amounts of mastic to be used to seal the joints to the floor and ceiling respectively.

3. **Mineral Fibre**

Mineral fibre slabs are to be butted tightly together and to boundary structures, to form a homogeneous layer.

4. **Windows**

All window frames are to be a good tight fit into the building structure with any gaps to be filled both internally and externally with a non-setting mastic in addition to the usual weather proofing seal to the exterior. Any gaps between the frame and building that are greater than 5mm are to be packed with a dense mineral fibre prior to mastic sealing.

5. **Electrical Sockets**

Electrical sockets must not be fitted back to back and removed areas of blockwork and plasterboard should be kept to an absolute minimum.

6. **Water Pipes**

All water pipes (and any other pipework) are to be resiliently mounted to avoid “water hammer”. This is particularly important for plasterboard walls.

7. **Penetrations**

Details for specific services penetrations may be supplied upon request.

8. **Approved Samples and Inspections**

Samples of each individual acoustic element should be provided for inspection at the beginning of its installation. Once approved, the Clerk of Works must ensure that the same level of quality continues throughout construction.

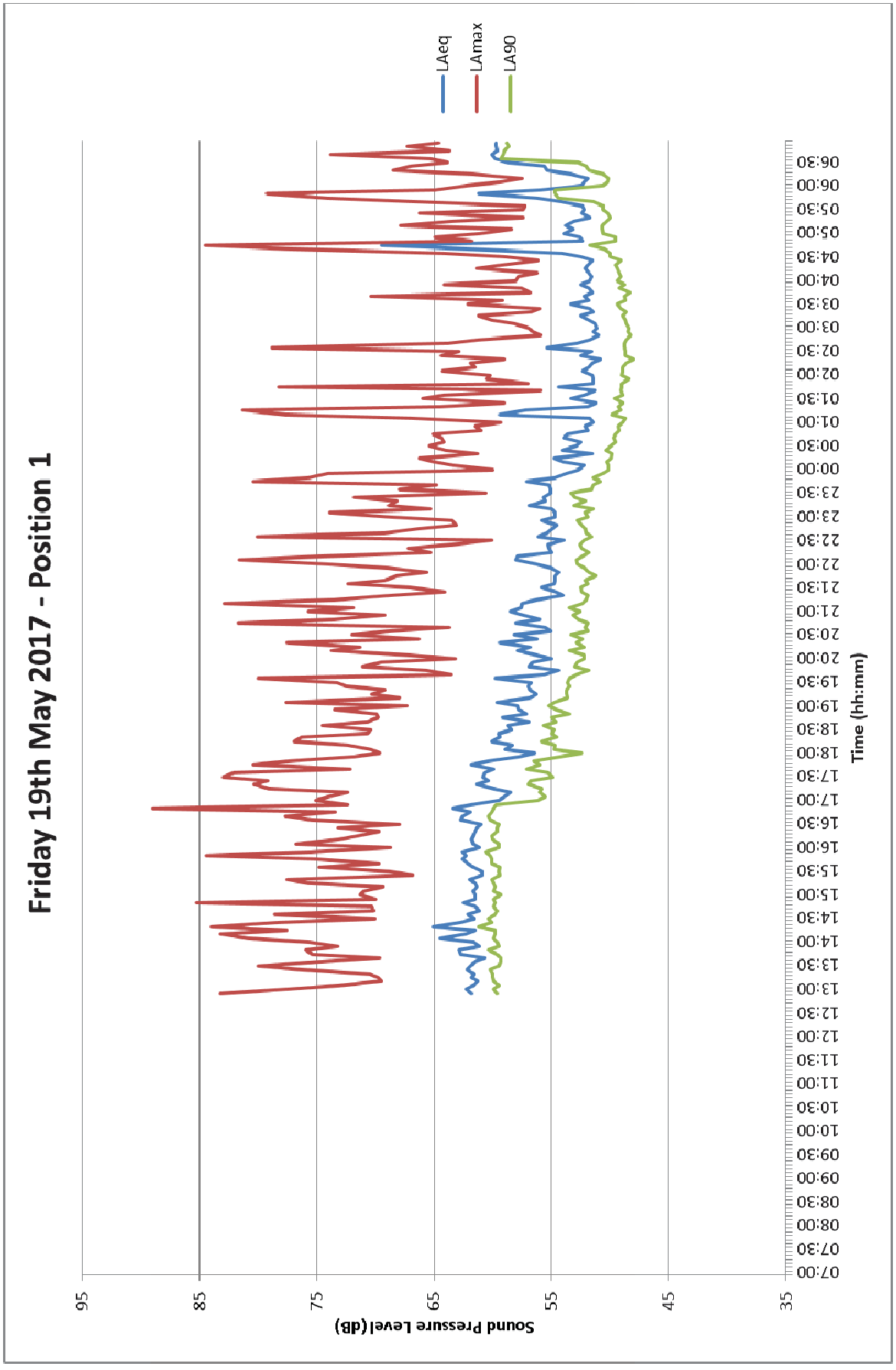
Appendix III – Environmental Noise Measurement Results

Position 1 (Corner of Dundas Street) – Friday 19th – Monday 22nd May 2017

Day	Period	Time	L_{eq} dB, Octave band centre frequency Hz								L_{Aeq} dB	Range of L_{Amax} dB	Range of L_{A1} dB	Range of L_{A90} dB
			63	125	250	500	1k	2k	4k	8k				
Friday	Day	12:55 – 23:00	-	-	-	-	-	-	-	-	60.0	60.1 - 89	57.9 - 75.6	51.2 - 61.2
Friday	Night	23:00 – 07:00	-	-	-	-	-	-	-	-	55.8	55.9 - 84.5	54.6 - 81.6	48 - 59.3
Sat'day	Day	07:00 – 23:00	-	-	-	-	-	-	-	-	60.5	58.5 - 89.8	55 - 75.8	46.7 - 61
Sat'day	Night	23:00 – 07:00	-	-	-	-	-	-	-	-	49.9	51.3 - 81.6	47.9 - 71.3	39.2 - 52.8
Sunday	Day	07:00 – 23:00	-	-	-	-	-	-	-	-	59.6	57.4 - 91	53.5 - 82.7	42.9 - 61.3
Sunday	Night	23:00 – 07:00	-	-	-	-	-	-	-	-	54.5	45.3 - 84	43.2 - 81.3	36.7 - 59
Monday	Day	07:00 – 12:10	-	-	-	-	-	-	-	-	62.2	65 - 87.4	61.8 - 83.7	58.3 - 60

Position 2 (Threadneedle Street) – Friday 19th – Monday 22nd May 2017

Day	Period	Time	L_{eq} dB, Octave band centre frequency Hz								L_{Aeq} dB	Range of L_{Amax} dB	Range of L_{A1} dB	Range of L_{A90} dB
			63	125	250	500	1k	2k	4k	8k				
Friday	Day	13:15 – 23:00	63.8	55.2	54.2	54.6	53.0	50.1	45.8	36.5	57.5	57.3 - 89.3	55.8 - 78.1	53.4 - 56.9
Friday	Night	23:00 – 07:00	57.6	51.5	48.9	47.8	45.9	49.1	44.9	30.7	53.5	53.6 - 76.1	52.6 - 69.4	49.6 - 54
Sat'day	Day	07:00 – 23:00	63.9	56.5	54.9	54.7	53.0	49.3	43.5	35.9	57.3	55.7 - 88.3	54.3 - 80	51.8 - 57.5
Sat'day	Night	23:00 – 07:00	56.2	47.6	48.3	46.5	45.3	40.7	32.9	24.6	49.2	48.5 - 82.9	45.8 - 64.6	42.9 - 52.1
Sunday	Day	07:00 – 23:00	64.6	57.5	54.7	54.7	53.6	50.4	46.6	43.8	58.1	52.8 - 92.2	50.2 - 86.5	44 - 55.7
Sunday	Night	23:00 – 07:00	57.6	48.7	48.7	47.8	45.1	41.1	35.0	28.3	49.7	45.3 - 73.4	44.3 - 69	42.2 - 52.1
Monday	Day	07:00 – 12:05	65.8	55.8	54.1	54.7	51.9	48.4	43.7	38.1	56.7	57.2 - 90.3	55.4 - 79	51.8 - 56.1
Sunday	Live Music	18:25 – 18:40	63.2	55.3	56.1	54.6	52.0	46.4	39.1	28.5	56.3	-	-	-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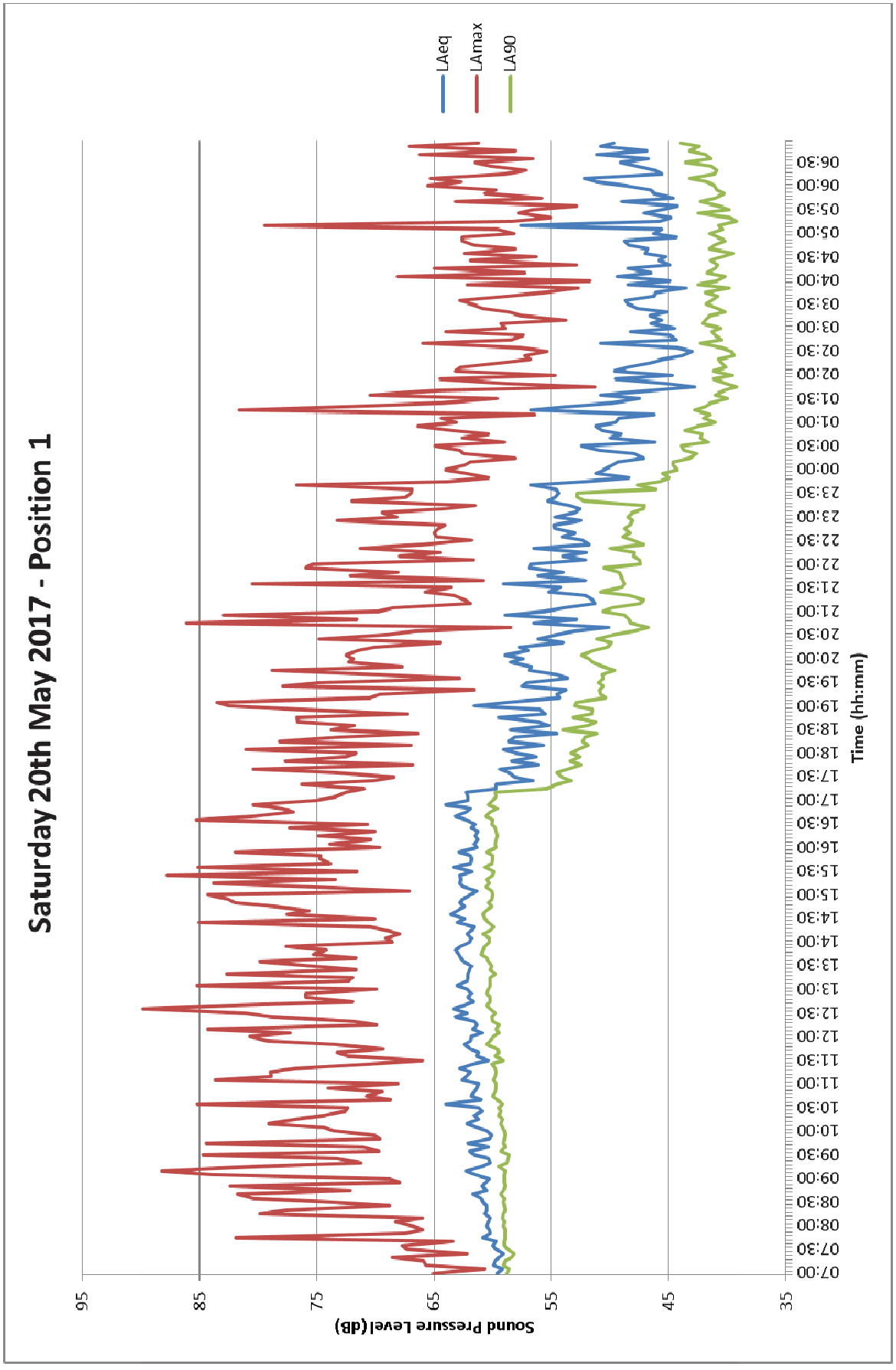
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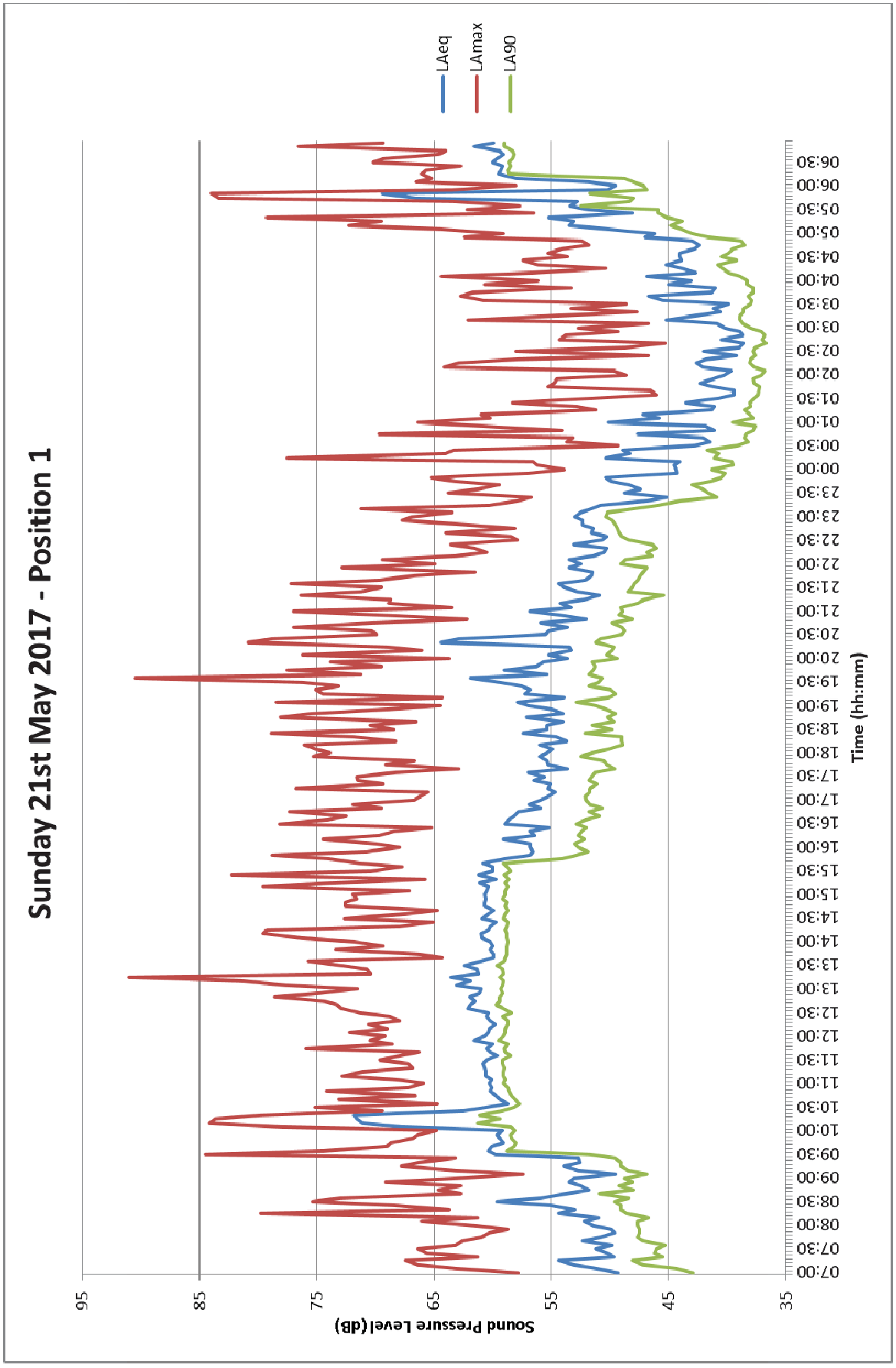
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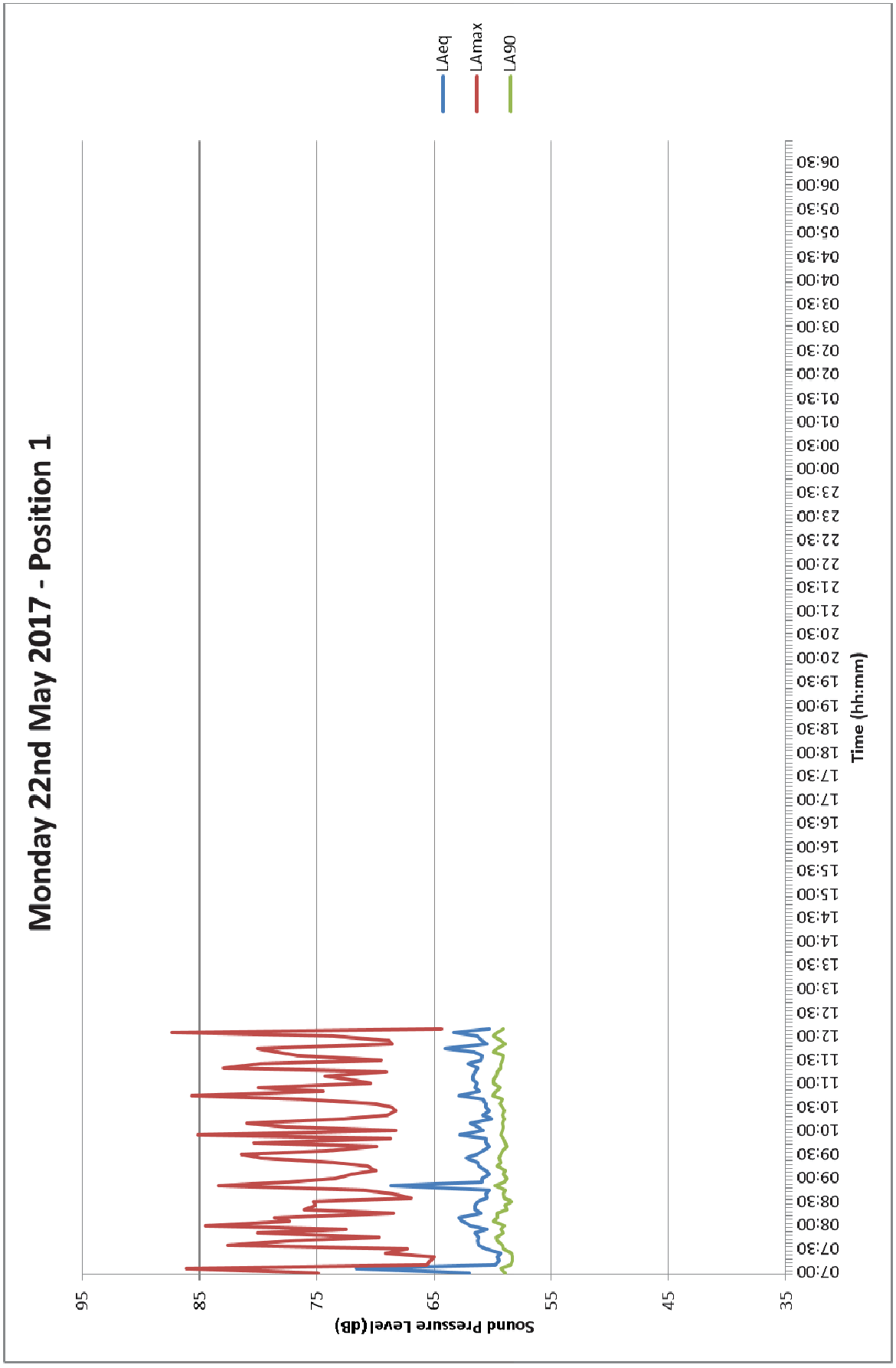
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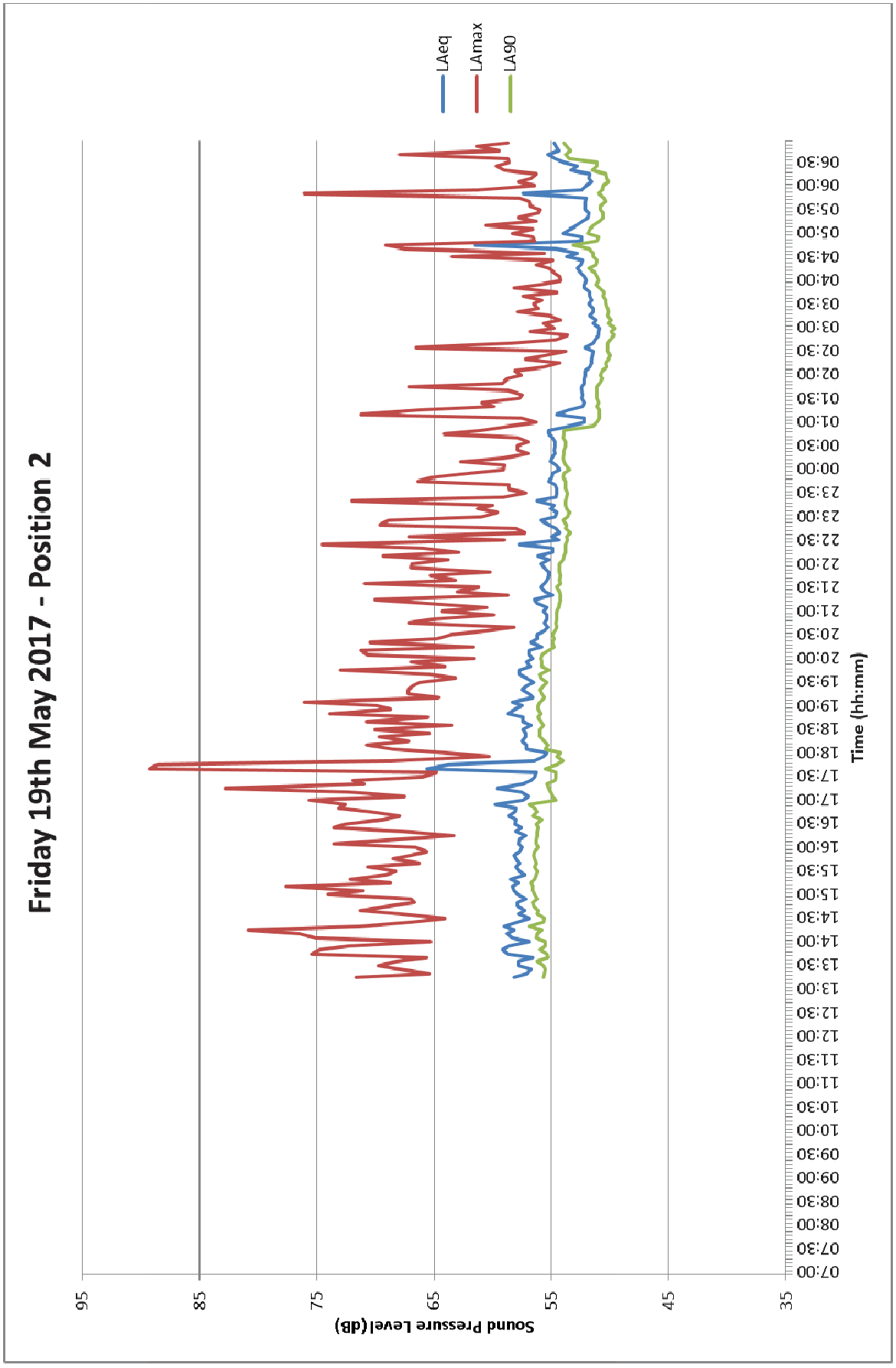
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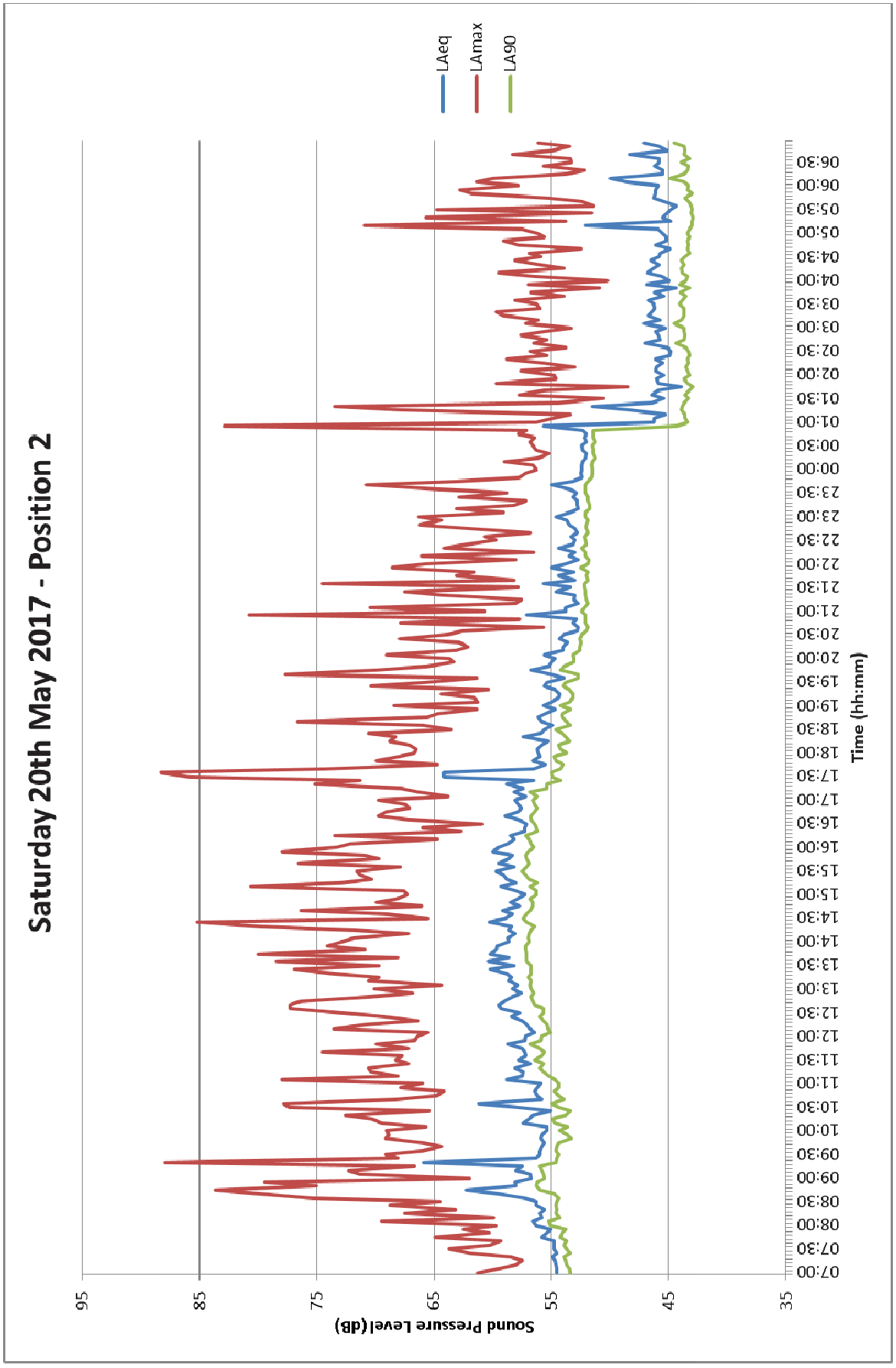
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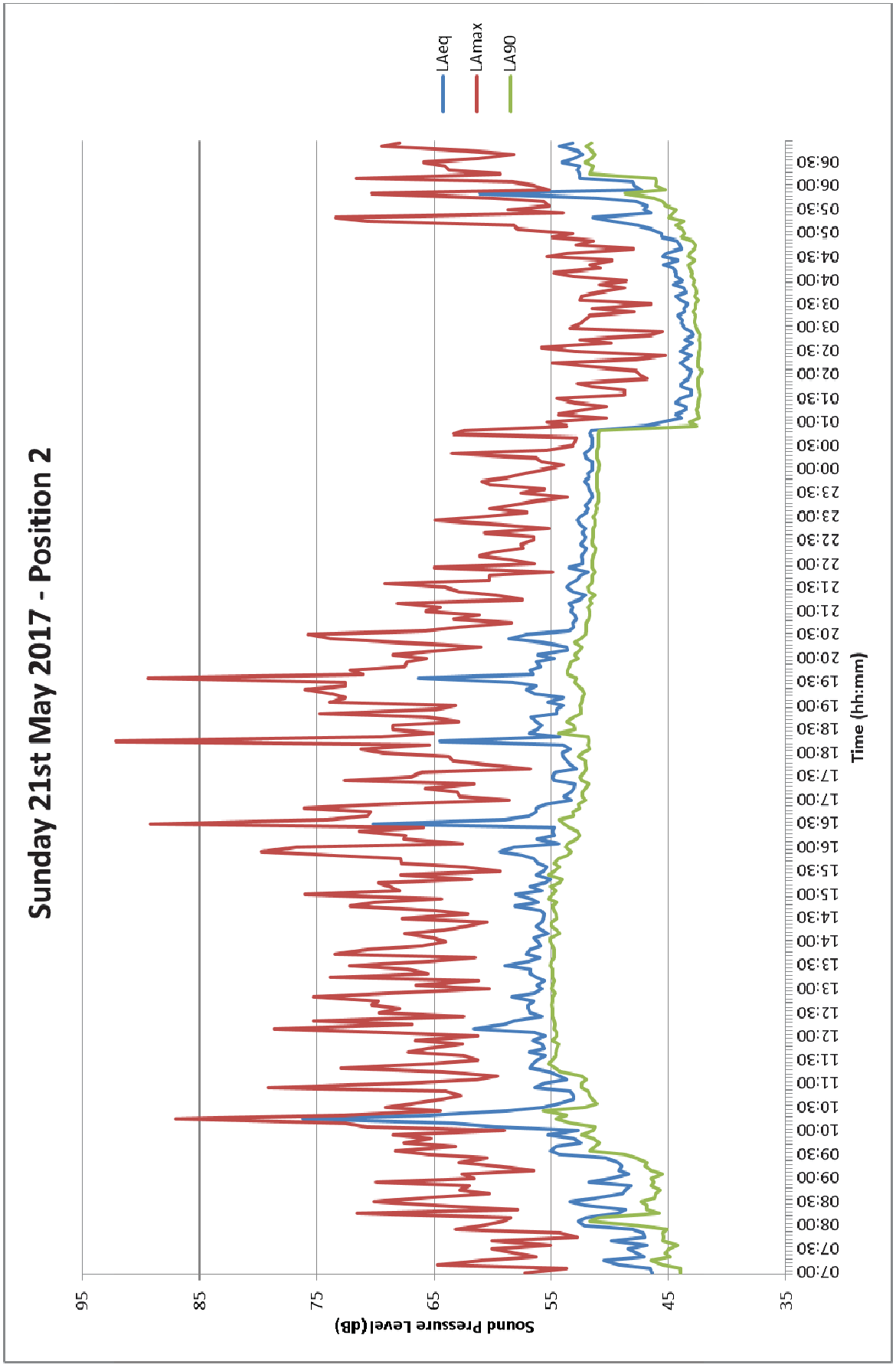
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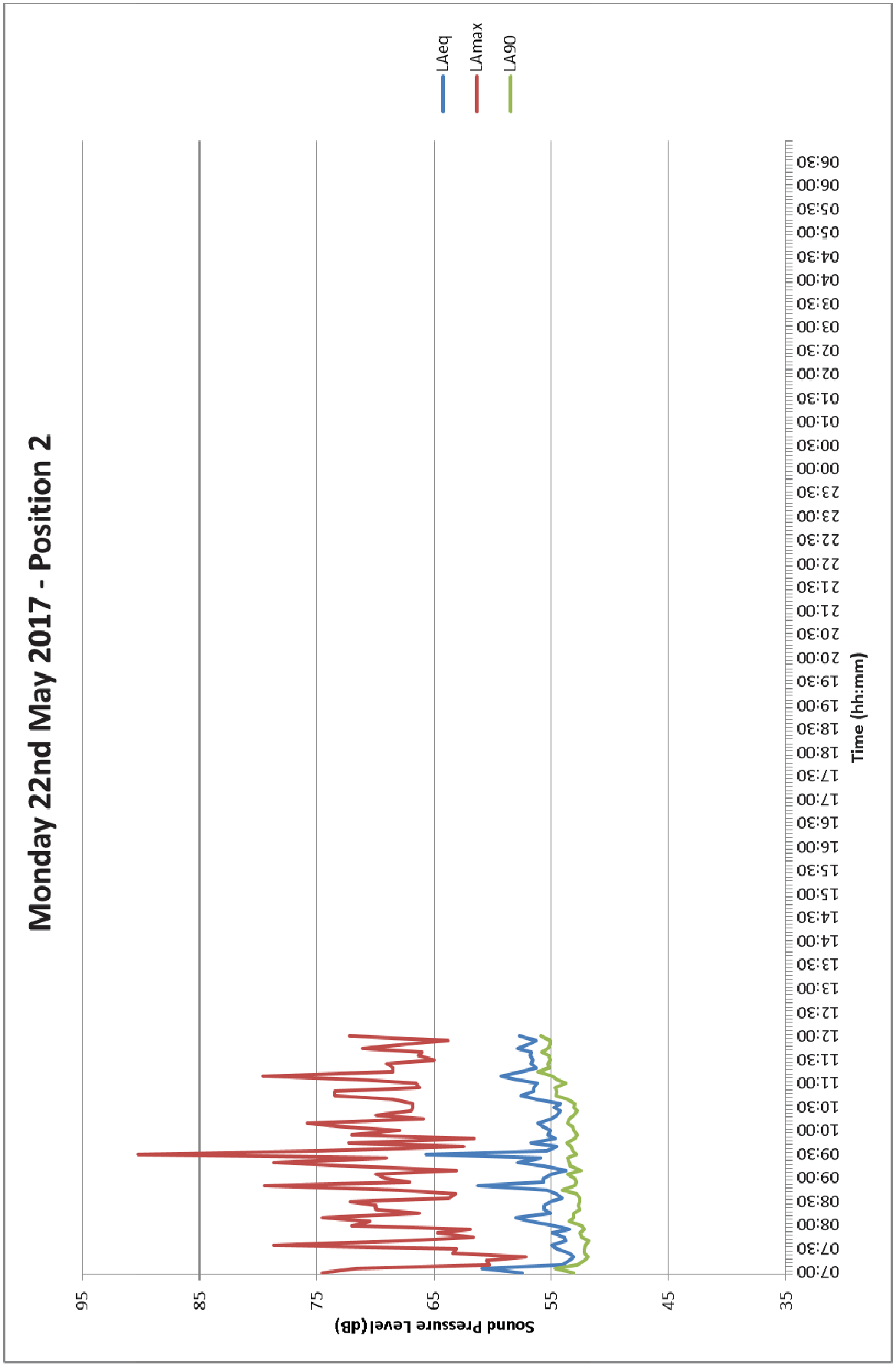
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