

Ambient Noise and Building Envelope Assessment (Planning Condition 4)

Proposed Residential Development Land off Moor Lane, Cleckheaton, BD19 4LF

REPORT REFERENCE NO. J005705-9002-CW-01

July 2025

Tel: 01925 759380

Email: enquiries@pdaltd.com



Document Control Sheet

Details of Assessment	
Client	PPJ Developments Ltd
Document Title	Ambient Noise, Vibration and Building Envelope Assessment - Proposed Residential Development – Land off Moor Lane, Cleckheaton, BD19 4LF
Report Reference	J005705-9002-CW-01

Client Address:	Company Address:
93 1 Dock Street, Leeds, England, LS10 1NB	Philip Dunbavin Acoustics Ltd 3 Bridgewater Court Barsbank Lane Lymm WA13 0ER

Issue	Date	Author	Remark	Status
01	28 th July 2025	Chris Wright	First Issue	Issued

	Name	Position
Prepared By	Chris Wright BSc (Hons) MIOA	Senior Acoustic Consultant
Checked By	Joe Meadows BEng (Hons) AMIOA	Acoustic Consultant

This document has been prepared for the client only and solely for the purposes expressly defined herein. We owe no duty of care to any third parties in respect of its content. Therefore, unless expressly agreed by us in signed writing, we hereby exclude all liability to third parties, including liability for negligence, save only for liabilities that cannot be so excluded by operation of applicable law.

This report has been prepared based upon a scope of works and associated resources agreed between the client and Philip Dunbavin Acoustics Ltd (PDA). This report has been prepared with all reasonable skill, care and diligence and has been based upon the interpretation of data collected. This has been accepted in good faith as being accurate and valid at the time of the collection. This report has been based solely on the specific design assumptions and criteria stated herein.



CONTENTS

1.0	SUMMARY.....	4
2.0	SITE DESCRIPTION	5
3.0	ASSESSMENT CRITERIA.....	6
3.1	Planning Conditions (2023/60/92079/E).....	6
3.2	BS8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings.....	6
3.3	WHO Guidelines for Community Noise	7
3.4	Approved Document O (ADO).....	7
4.0	SURVEY DETAILS & RESULTS	8
4.1	Measurement Locations	8
4.2	Weather Conditions	9
4.3	Measurement Equipment and Personnel	9
4.4	Description of Noise Sources	9
4.5	Measured Noise Results	9
5.0	NOISE IMPACT ASSESSMENT AND MITIGATION	10
5.1	Calculations	10
5.2	Design Assumptions	10
5.2.1	Walls.....	10
5.2.2	Ventilation.....	11
5.3	Glazing and Ventilation Specification	11
5.4	Glazing Specification and Installation.....	11
5.5	Ventilator Requirements	12
6.0	EXTERNAL AMENITY SPACES.....	13
7.0	APPROVED DOCUMENT O – CONTROL OF OVERHEATING	13
8.0	CONCLUSION	14

APPENDIX A – DEFINITION OF ACOUSTIC TERMS

APPENDIX B – MEASURED NOISE LEVELS



1.0 SUMMARY

PDA Ltd have been commissioned to carry out an ambient noise and building envelope assessment for the proposed residential development on the land off Moor Lane in Cleckheaton.

We understand that the proposal is to develop the currently vacant land to form 10no. dwelling houses with associated landscaping.

In order to determine the existing ambient noise climate in the vicinity of the proposed development a noise level survey has been undertaken.

Based upon the measured noise levels, calculations have been undertaken to determine acoustic specifications for the proposed residential dwellings. Calculations have been undertaken in octave bands from 63 Hz to 8kHz inclusive, for the night-time L_{eq} , day-time L_{eq} and night-time L_{max} levels.

Recommendations are given for the glazing, ventilation and building façade elements that will be required to achieve the internal noise level requirements. Our calculations suggest that with the glazing and ventilation specifications given in this report suitable internal noise levels can be achieved within the dwellings.

With regards to noise levels in external amenity spaces, our assessment suggests that the lower guideline value of BS8233 (50 dB L_{Aeq}) will be achieved without the need for mitigation.

Our calculations suggest that the noise criteria of BS8233:2014 and the WHO Guidelines can be achieved within the dwellings and external amenity spaces therefore, we would consider that Planning Condition 4 may be discharged.

Our assessment has also considered the acoustic criteria stipulated within The Building Regulations Approved Document O. The results indicate that open windows will be suitable as a means to mitigate overheating during the night time.

2.0 SITE DESCRIPTION

The proposed development site is located on the currently vacant land off Moor Lane, Cleckheaton, BD19 4LF. We understand that the proposal is to redevelop the site to form 10no. dwelling houses with associated landscaping.

The site is bound by existing residential dwellings in all directions. The A651 Oxford Road is located approximately 100m to the west of the site and the A652 Bradford Road is located approximately 120m to the north east of the site however, the site is well shielded from both the A roads by the intervening dwellings. The M62 is located approximately 400m to the north of the site and was found to be the dominant noise source in the area.

The site location and surroundings can be seen in Figure 1 below:



Figure 1 – Site location and surroundings

3.0 ASSESSMENT CRITERIA

3.1 Planning Condition 4 (2023/60/92079/E)

It is understood that Kirklees Council have permitted the development subject to conditions. Planning Condition 4 relates to noise and stipulate the following:

“4. The Reserved Matters referred to in Condition 1 shall include a report specifying the measures to be taken to protect the development from noise from all significant noise sources that are likely to affect the proposed development (including road traffic), to first be submitted to and approved in writing by the Local Planning Authority”.

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

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 1: BS8233 Recommended Indoor Ambient Noise Levels

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

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’.*

With regard to gardens and external areas, BS 8233:2014 (Section 7.7.3.2) gives the following advice:

For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50dB L_{Aeq,T}, with an upper guideline value of 55dB L_{Aeq,T} which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

3.3 WHO Guidelines for Community Noise

In 1999, the WHO (World Health Organisation) published Guidelines for Community Noise, stating the following noise levels are applicable to residential dwellings.

Table 2: WHO Guidelines for Community Noise Criteria

Specific Environment	Critical Health Effect(s)	L_{Aeq} dB	Time Base (hours) *	L_{AFMAX} dB
Dwelling, indoors	Speech intelligibility & moderate annoyance, daytime & evening	35	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45

* Typically taken to be daytime/evening - 07:00 – 23:00 hours and night time 23:00 – 07:00 hours.

The WHO guidelines state that, “it is recommended that $L_{Aeq,T}$ be used to evaluate more-or-less continuous environmental noises. Where the noise is principally composed of a small number of discrete events, the additional use of L_{Amax} or SEL is recommended.” The guidelines recommend that for a good sleep, the indoor sound pressure levels should not exceed approximately 45dB L_{Amax} more than 10 – 15 times.

3.4 Approved Document O (ADO)

Approved Document O (ADO) 2021, provides guidance on meeting the requirements of the Building Regulations 2010, part ‘O1 Overheating mitigation’. The aim of the Building Regulations part O1 is to protect the health and welfare of occupants of the building by reducing the occurrence of high indoor temperatures.

Building Regulations part O1 requires that dwellings, institutions or any other buildings containing one or more rooms for residential purposes (other than a room in a hotel) to:

- (a) Limit unwanted solar gains in summer:
- (b) Provide an adequate means to remove heat from the indoor environment

However in meeting the obligations of ADO the buildings overheating mitigation strategy for use by occupants must consider ‘Noise at night’ in addition to other non-noise related considerations.

In regards to ‘Noise at night’, ADO stipulates the following.

In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).

Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.

- (a) 40dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am).
- (b) 55dB L_{AFmax} , more than 10 times a night (between 11pm and 7am)

It should be noted that the above noise limits are with reference to internal noise levels within a bedroom. Guidance on the simplified assessment method published jointly by the Institute of Acoustics and the Association of Noise Consultants in November 2024 suggests that for sites in Approved Document O designated ‘Moderate Risk Locations’ such as this development, windows should be assumed to be closed during sleeping hours for facades exposed to the following night-time noise levels:

50dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am)

65dB L_{AFmax} , more than 10 times a night (between 11pm and 7am)

Subsequently, where windows are assumed likely to be closed at night (due to the above noise limits being exceeded), the overheating mitigation strategy as required by ADO must provide an alternative method to removing heat other than relying on windows remaining open at night.

Please note that as the requirements of ADO are only for bedrooms at night, the windows may still remain openable to control overheating during the day.

4.0 SURVEY DETAILS & RESULTS

A noise survey was conducted in the vicinity of the site to establish the existing ambient noise climate. Measurements were carried out over a period of 24 hours, between 10:00 on Thursday 24th and 10:00 hours on Friday 25th July 2025. The chosen monitoring period is considered representative of the likely worst-case noise levels during both daytime and night-time hours.

4.1 Measurement Locations

Noise measurements were made from a single position to the west of the site at the approximate facade location of the most exposed proposed dwellings.

From the measurement location the microphone had a clear line to the M62 which was deemed to be the dominant noise source in the vicinity of the site.

The microphone was mounted approximately 1.2m above ground level and were fitted with a windshield for the duration of the survey period.

The measurement locations can be seen in Figure 2 below:



Figure 2 – Ambient noise measurement location

4.2 Weather Conditions

The weather conditions during the survey were deemed to be conducive for noise measurements. A summary of the weather conditions is given in Table 3 below:

Table 3: Weather Conditions

Temperature	Windspeed	Events
14 - 22°C	0 - 2 m/s	Dry / clear

4.3 Measurement Equipment and Personnel

The noise survey was conducted using an NTi XL2 sound level meter. In accordance with IEC 61672-1:2002 the meter has a class 1 frequency response and can operate as an integrating sound level meter with frequency analysis and statistical functions. The meter was set to measure 'A' weighted, broadband and octave band sound pressure levels and various statistical parameters.

The meter was field calibrated to 1kHz at 94dB both before and after the measurement during which time no significant deviation was observed. In addition, a valid calibration certificate is held for both the meter and the calibrator.

All measurements were made and attended by Chris Wright BSc(Hons) MIOA of PDA Ltd.

4.4 Description of Noise Sources

The noise climate across the site was dominated by distant traffic noise on the M62 motorway. Occasional vehicle movements were observed on Moor Lane however, this was relatively infrequent and was not deemed to have a significant contribution to the overall noise climate. Bird song also had an intermittent contribution to the noise climate during the early morning period.

4.5 Measured Noise Results

Full details of the measured results can be seen in the appendix included at the end of this report. A summary of the results is given in Table 4 below, all values have been rounded to the nearest dB.

Table 4: Summary of noise measurements

Period	Average dB $L_{Aeq,T}$	Night-time L_{AFMax}^1
Daytime (07:00 – 23:00)	48	n/a
Night-time (23:00 – 07:00)	44	62

Notes:

- 1 The WHO Guidelines for Community Noise state that sleep disturbance may occur where the specified 45dB L_{Amax} is exceeded internally 10 to 15 times over the 8-hour night-time period.

5.0 NOISE IMPACT ASSESSMENT AND MITIGATION

Noise levels measured at the site were found to be low. In our experience, sites with noise levels similar to those measured are suitable for residential development provided that adequate acoustic attenuation is provided to habitable areas.

The acoustic weak points of a building façade are typically the glazing and ventilation elements, calculations have been undertaken to determine building fabric specifications to ensure that suitable internal noise levels can be achieved within the dwellings.

5.1 Calculations

Based upon the measured noise levels, calculations have been undertaken to determine acoustic specification requirements for the proposed residential dwelling. Calculations have been undertaken in octave bands from 63 Hz to 8kHz inclusive, for the night-time L_{eq} , day-time L_{eq} and night-time L_{max} levels.

The sound insulation provided by the building envelope is a combination of the sound reduction indices of the individual façade elements and the area of the façade they cover. The result is a composite sound insulation value for the whole façade.

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 the BS EN 12354-3 reference time for dwellings.

Information on the sound insulation properties for specific element details has been sourced from either manufacturer's literature or Insul® Sound insulation prediction software.

5.2 Design Assumptions

The calculated internal noise levels are dependent on the size of room, location and relative glazing area. We have not been provided with internal layout drawings and as such, our assessment is based on the following typical dimensions from similar developments.

Bedrooms	Living / Dining Rooms
Volume – 25m ³	Volume – 50m ³
Glazing Area – 2.5m ²	Glazing Area – 5m ²
Facade Area – 5m ²	Facade Area – 10m ²

5.2.1 Walls

It is understood that the external walls are to be of timber frame construction. For the purposes of this assessment, it is assumed that the proposed façades for the buildings will comprise brickwork outer leaf with insulated timber frame and an internal plasterboard lining.

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

The sound insulation properties for the assumed external wall construction has been predicted using Insul®, see Table 5 below:

Table 5: External Façade Elements Acoustic Properties

Façade Element	Octave Band (Hz) Sound Insulation, R (dB)							R _w
	63	125	250	500	1000	2000	4000	
External Wall	26	43	47	46	54	60	66	53

5.2.2 Ventilation

Our calculations suggest that suitable internal noise levels can be achieved using acoustically attenuated trickle vents. It is noted however, that during periods when windows are open internal noise levels will likely exceed the criteria of Section 3. It is understood that the proposal is to utilise trickle ventilators to provide background ventilation throughout the development.

With regards to ventilation BS 8223:2014 states:

“The Building Regulations’ supporting documents on ventilation recommend that habitable rooms in dwellings have background ventilation. Where openable windows cannot be relied upon for this ventilation, trickle ventilators can be used and sound attenuating types are available. However, windows may remain openable for rapid or purge ventilation, or at the occupant’s choice.

5.3 Glazing and Ventilation Specification

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 as discussed in Section 3 the development would require the following glazing and ventilation specifications. Note that the following specification apply to habitable rooms only.

Table 6: Glazing and Ventilation Schedule

Room Type	Minimum Glazing Rating R _w dB	Minimum combined Ventilator Rating D _{n,e,w} dB	Calculated Highest Internal Noise Level dBA (Day/Night/Max)
Bedrooms	30	29 ¹	27/22/36
Living Areas	30	29 ¹	24/-/-

Notes:

- 1 A standard non-acoustic trickle vent is likely to achieve a performance of 29 dB D_{n,e,w}. Recommendations for suitable trickle vents are provided in Section 5.6 below.

Our calculations indicate that with the façade treatments specified above the internal noise criterion as given in Section 3 can be achieved within the habitable rooms of the proposed development.

5.4 Glazing Specification and Installation

For the glazing specification in Table 6 (above), 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 gaps around the perimeter to be stuffed with dense mineral wool to full frame depth and sealed both sides with acoustic non-setting mastic. No gaps should be left unsealed.

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

Table 7: 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	1000	2000	4000	
4mm pane /16mm cavity /4mm pane	16	22	17	26	36	40	34	30

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

5.5 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 8; example products are noted below.

Table 8: 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	
Titon Maxi-glaze	35	32	33	27	30	33	29

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.

The acoustic specification relates to the combined performance of all ventilation elements. We have allowed for up to 2 trickle ventilators however, where 3 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. This may be calculated as follows:

$$D_{n,e,w} \text{ (of single vent)} + 10 \cdot \log(\text{number of vents required}) = \text{required } D_{n,e,w} \text{ for individual vent}$$

Requirements should be checked with the manufacturer.

6.0 EXTERNAL AMENITY SPACES

With regards to external noise levels within amenity spaces BS 8233:2014 (section 7.7.3.2) gives the following advice:

“For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50dB $L_{Aeq,T}$, with an upper guideline value of 55dB $L_{Aeq,T}$ which would be acceptable in noisier environments.”

The results of our noise survey indicate that the ambient noise level during the daytime is unlikely to exceed 48 dB L_{Aeq} and therefore, achieves the lower guideline value of BS8233 (50 dB L_{Aeq}). We would also note that currently the site is vacant however, once the development is complete we would expect noise levels to be further reduced due to the additional shielding provided from the new dwellings.

On this basis noise levels within external amenity areas are considered to be acceptable without the need for mitigation.

7.0 APPROVED DOCUMENT O – CONTROL OF OVERHEATING

Approved Document O (ADO) 2021, provides guidance on meeting the requirements of the Building Regulations 2010, part ‘O1 Overheating mitigation’. The aim of the Building Regulations part O1 is to protect the health and welfare of occupants of the building by reducing the occurrence of high indoor temperatures.

Building Regulations part O1 requires that dwellings, institutions or any other buildings containing one or more rooms for residential purposes (other than a room in a hotel) to:

- (a) *Limit unwanted solar gains in summer:*
- (b) *Provide an adequate means to remove heat from the indoor environment*

However in meeting the obligations of ADO the buildings overheating mitigation strategy for use by occupants must consider ‘Noise at night’ in addition to other non-noise related considerations.

In regards to ‘Noise at night’, ADO stipulates the following.

In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).

Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.

- a. *40dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am).*
- b. *55dB L_{AFmax} , more than 10 times a night (between 11pm and 7am)*

It should be noted that the above noise limits are with reference to internal noise levels within a bedroom. Guidance on the simplified assessment method published jointly by the Institute of Acoustics and the Association of Noise Consultants in November 2024 suggests that for developments in Approved Document O designated ‘Moderate Risk Locations’ such as this development, windows should be assumed to be closed during sleeping hours for facades exposed to the following night-time noise levels:

50dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am)

65dB L_{AFmax} , more than 10 times a night (between 11pm and 7am)

Subsequently, where windows are assumed to be closed at night (due to the above noise limits being exceeded), the overheating mitigation strategy as required by ADO must provide an alternative method to removing heat other than relying on windows remaining open at night.

The results of our noise survey indicate that ambient noise levels at the site are unlikely to exceed 44 L_{Aeq} and 62 dB L_{AFmax} during the night-time.

Therefore, in accordance with ADO open windows will be suitable as a means to mitigate overheating during the night. Note that this will be subject to the outcome of a TM59 dynamic thermal modelling assessment to be undertaken by others.

8.0 CONCLUSION

PDA Ltd have been commissioned to carry out an ambient noise and building envelope assessment for the proposed residential development on the land off Moor Lane in Cleckheaton.

In order to determine the existing ambient noise climate in the vicinity of the proposed development a noise level survey has been undertaken.

Recommendations are given for the glazing, ventilation and building façade elements that will be required to achieve the internal noise level requirements. Our calculations suggest that with the glazing and ventilation specifications given in this report suitable internal noise levels can be achieved within the dwellings.

With regards to noise levels in external amenity spaces, our assessment suggests that the lower guideline value of BS8233 (50 dB L_{Aeq}) will be achieved without the need for mitigation.

Our calculations suggest that the noise criteria of BS8233:2014 and the WHO Guidelines can be achieved within the dwellings and external amenity spaces therefore, we would consider that Planning Condition 4 may be discharged.

Our assessment has also considered the acoustic criteria stipulated within The Building Regulations Approved Document O. The results indicate that open windows will be suitable as a means to mitigate overheating during the night time.

APPENDIX A – DEFINITION OF ACOUSTIC TERMS

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 later). $L_{eq(s)}$ 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 later). 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 B – MEASURED NOISE LEVELS

