

Plant Noise Impact Assessment – Planning Condition 4

Office Development

76 Quay Street, Manchester, M3 4PR

REPORT REFERENCE NO. J005375-8709-CW-01

14th March 2025

Tel: 01925 759380

Email: enquiries@pdaltd.com



Document Control Sheet

Details of Assessment	
Client	Quay Street PD Ltd
Document Title	Plant Noise Impact Assessment Planning (Condition 4) – 76 Quay Street
Report Reference	J005375-8709-CW-01

Client Address:	Company Address:
Quay Street PD Ltd 76 Quay Street Manchester M3 4PR Company Number 13476753 VAT 447262780	Philip Dunbavin Acoustics Ltd 3 Bridgewater Court Barsbank Lane Lymm WA13 0ER

Issue	Date	Author	Remark	Status
01	14/03/2025	Chris Wright	Initial Issue	

	Name	Position
Prepared By	Chris Wright BSc (Hons) MIOA	Acoustic Consultant
Checked By	Richard Cookson BSc (Hons) PhD MIOA	Principal Consultant

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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.



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1.0 SUMMARY

PDA Ltd have been commissioned to undertake an assessment of plant noise emissions from the proposed office development at 76 Quay Street in Manchester City Centre. The proposal is to refurbish the currently vacant building to form office spaces across 4 floors.

This assessment has been undertaken to demonstrate compliance with the requirements of Planning Condition 4 which stipulates the following:

“Externally mounted ancillary plant, equipment and servicing including plant located behind any louvres shall be selected and/or acoustically treated in accordance with a scheme designed so as to achieve a rating level of 5dB (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location. Prior to commencement of the use hereby approved the scheme shall be submitted to and approved in writing by the City Council as local planning authority in order to secure a reduction in the level of noise emanating from the site. The scheme shall be implemented in full before the use commences or as otherwise agreed in writing by the City Council as local planning authority.”

It is understood that the following plant items are proposed:

- 1 no. Samsung AM140AXVGGR Condenser Unit
- 1 no. Samsung AM160AXVGGR Condenser Unit

In order to predict the noise level at the façade of the nearby noise sensitive dwellings due to the proposed development, the site and its surroundings have been modelled in Soundplan noise propagation software.

Our assessment has been undertaken in accordance with the methods described in BS4142:2014 – ‘Methods for rating and assessing industrial and commercial sound’.

Our assessment has indicated that the rating level at the worst affected noise sensitive receiver is likely to be at least 7 dB below the background sound level. In accordance with BS4142:2014 this is an indication that noise emissions from the scheme will have a low impact.

In addition, where plant noise emissions are more than 5 dB below the background noise level the requirements of Planning Condition 4 have been achieved and therefore, the Condition may be discharged.

2.0 SITE DESCRIPTION

The proposed development site is the currently vacant building located at 76 Quay Street in Manchester City Centre. The proposal is to refurbish the currently vacant building for office use across 4 floors. It is understood that the development comprises both private and open plan office space.

The site is bound by Young Street to the north and east, Gartside Street to the north and Quay Street to the south. The immediate surrounding area comprises a number of existing office and commercial uses typical of a city centre urban environment.

We are not aware of any residential uses within the vicinity of the site. As such, it is assumed for the purposes of this assessment that the nearest sensitive receivers (NSR's) are the adjacent offices and proposed hotel development within the Old Granada Studios complex. The NSR's have been identified as follows:

- NSR 1 – Kings Chambers (offices) which adjoin the development to the north.
- NSR 2 – 70 Quay Street (offices)
- NSR 3 – 27 Quay Street (offices)
- NSR 4 – 25 Quay Street (offices)
- NSR 5 – Proposed Hotel Development (127612/FO/2020) – Quay Street
- NSR 6 – Manchester College - Junction of New Quay Street and Gartside Street.

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

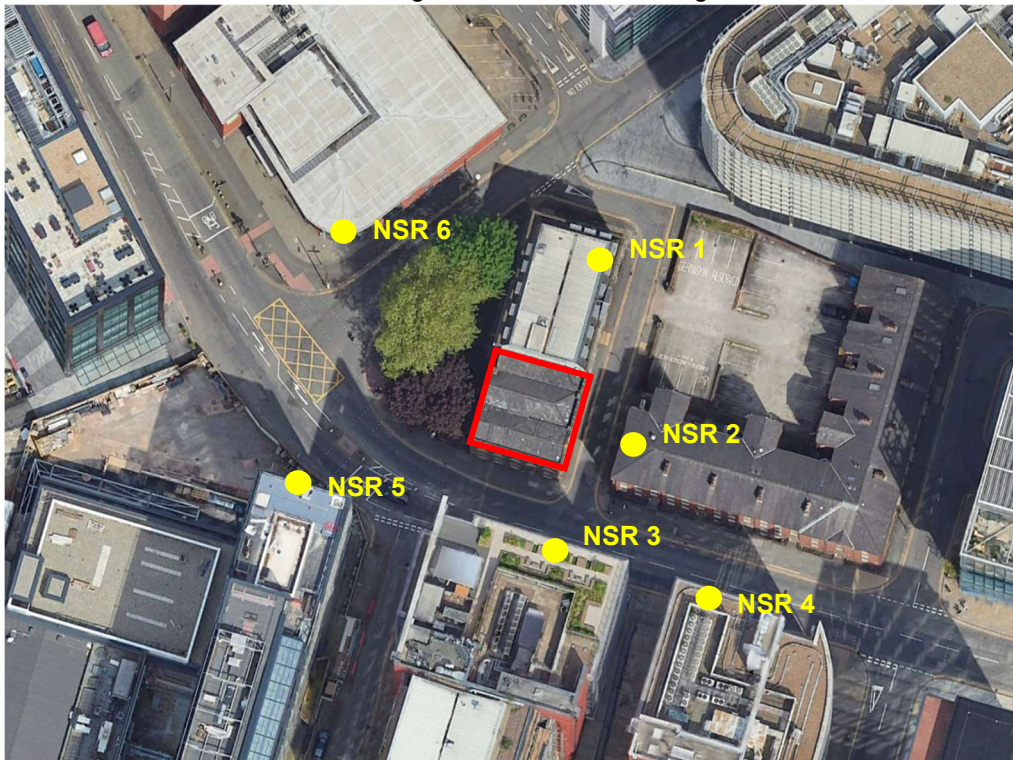


Figure 1: Site Location and Surroundings

3.0 ASSESSMENT CRITERIA

3.1 Planning Condition 4 (app: 133726/FO/2022)

It is understood that planning permission for the development has been approved subject to conditions. Condition 4 relates to plant noise emissions and stipulates the following:

“Externally mounted ancillary plant, equipment and servicing including plant located behind any louvres shall be selected and/or acoustically treated in accordance with a scheme designed so as to achieve a rating level of 5dB (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location. Prior to commencement of the use hereby approved the scheme shall be submitted to and approved in writing by the City Council as local planning authority in order to secure a reduction in the level of noise emanating from the site. The scheme shall be implemented in full before the use commences or as otherwise agreed in writing by the City Council as local planning authority.”

3.2 BS4142:2014

The standard describes a method of determining the level of a noise of commercial or industrial nature, together with procedures for assessing the impact of such a noise outside nearby noise sensitive areas.

The standard provides a procedure for comparing the noise from commercial sources with background noise levels in the absence of the commercial noise and determining the likely impact of the noise on NSRs.

Specific sound level, $L_s = L_{Aeq,Tr}$

The sound source being assessed. Defined as the equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r .

This is the noise level associated with site in isolation, not including any other noise sources and is logarithmically averaged over the reference time period.

Rating level, $L_{Ar,Tr}$

Specific sound level plus any adjustment for the characteristic features of the sound.
Reference time interval, T_r

Specified interval over which the specific sound level is determined:

- 1 hour during the day; 0700-2300
- 15 minutes at night; 2300-0700

Ambient sound level, $L_a = L_{Aeq,T}$

Equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time, usually from many sources near and far, at the assessment location over a given time interval, T .

Residual sound level, $L_r = L_{Aeq,T}$

The ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound. Defined as the equivalent continuous A-weighted sound pressure level at the assessment location over a given time interval, T .

Background sound level, $L_{A90,T}$

A-weighted sound pressure level that is exceeded by the Residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels.

Regarding defining the rating level, certain acoustic features can increase the impact over that expected from a simple comparison between the specific noise level and the background level. Where such features are present, these are considered by adding corrections to the specific noise level.

The corrections are applied based on whether the following features occur, or are expected to be present. The correction values can either be determined subjectively, or by various objective measurement procedures:

- The noise contains a distinguishable, discrete, continuous tone (whine, hiss, screech, hum, etc.). 0 – 6 dB penalty
- The noise contains distinct impulses (bangs, clicks, clatters, or thumps). 0 – 9 dB penalty.
- Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied. In addition the standard indicates that if the noise is intermittent and the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.

In addition, BS4142 notes that where tonal and impulsive characteristics are present in the specific sound within the same reference period then these two corrections can both be taken into account. If one feature is dominant then it might be appropriate to apply a single correction. Where both features are likely to affect perception and response, the corrections ought normally to be added in a linear fashion.

From the addition of the above penalties where appropriate the rating level is established, this being the value that is compared with the background noise.

According to BS4142, an initial estimate of the impact is given for a rating level of:

- 10 dB(A) or more above the background is an indication of significant adverse impact, depending on the context.
- 5 dB(A) above the background is an indication of an adverse impact, depending on the context.
- where the rating level does not exceed the background level, this is an indication of the specific sound source having a low impact, depending on the context.

The above initial assessment may then be modified, depending on the context, to take into account:

- The absolute level of the sound.
- The character and level of the residual sound compared to the character and level of the specific sound.
- The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as:
 - i. Façade insulation treatment
 - ii. Ventilation and / or cooling that will reduce the need to have windows open to provide rapid or purge ventilation.
 - iii. Acoustic screening

3.3 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 other typical indoor uses e.g. office space when unoccupied. The recommended internal noise levels for residential uses are summarised in the table below:

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}
Study and work requiring concentration	Open Plan Office	45 – 50 L _{Aeq}	
	Executive Office	35 – 40 L _{Aeq}	

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

3.4 WHO Guidelines for Community Noise

In 1999, the WHO (World Health Organisation) published Guidelines for Community Noise, stating the following internal noise levels are applicable to 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
Outside Bedrooms	Sleep disturbance, window open (outdoor values) night time	45	8	-

¹ Typically taken to be daytime/evening - 07:00 – 23:00 hours, and night time 23:00 – 07:00 hours.

WHO guidelines state, ‘To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55 dB L_{Aeq} on balconies, terraces and in outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50 dB L_{Aeq}.’

4.0 EXISTING AMBIENT NOISE CLIMATE

4.1 Measurement Time & Location

Measurements were taken between 13:00 hours on Monday 3rd and 09:00 hours on Tuesday 4th February 2025. All measurements were made and partially attended by Mr Chris Wright of PDA Ltd. All measurements were of 15 minute samples and were undertaken continuously throughout the survey period.

Further measurements were undertaken at the southern facade of the development overlooking Quay Street. Measurements were made over a period of approximately 20 hours between 15:00 hours on Thursday 13th and 11:15 hours on Friday 14th March 2024.

- Position 1 – 1st floor level of of the existing building overlooking Gartside Street
- Position 2 – 1st floor level of of the existing building overlooking Young Street
- Position 3 – 2nd floor level of the existing building overlooking Quay Street

The measurement locations can be seen below in Figure 2 below.

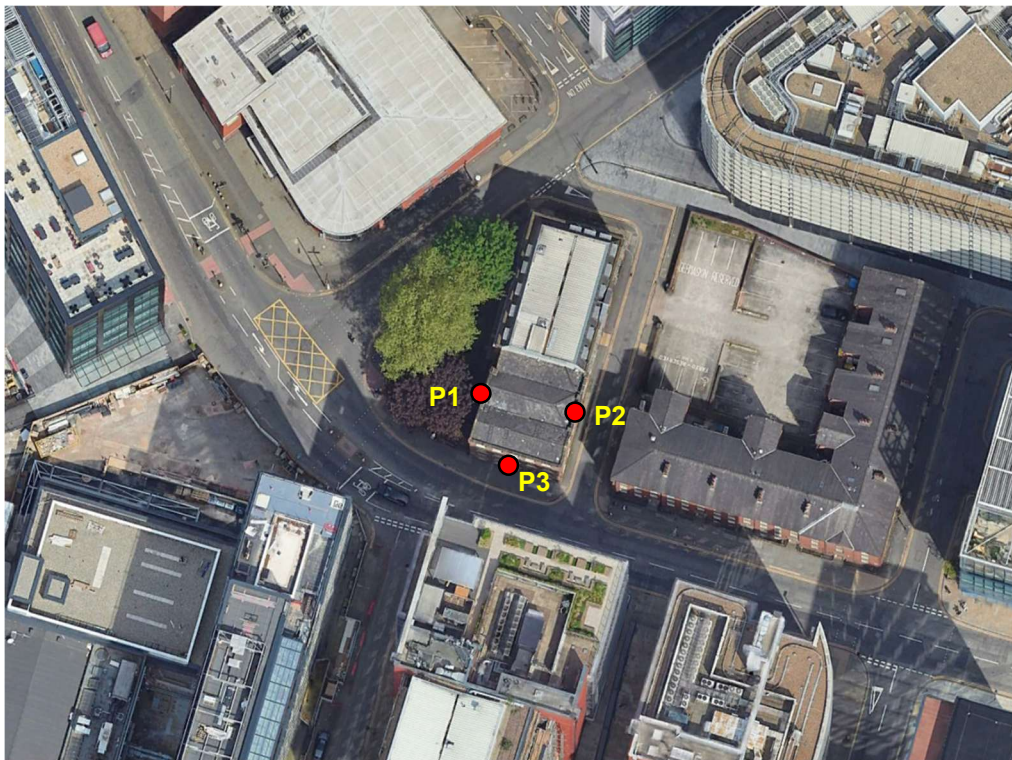


Figure 2: Noise survey locations

4.2 Measurement Equipment

The survey was undertaken using an NTi XL2 and Rion NL52 sound level meter. In accordance with IEC 61672-1:2002 both meters have a class 1 frequency response and can operate as an integrating sound level meter with frequency analysis and statistical functions. The meters were set to measure 'A' weighted, broadband and octave band sound pressure levels and various statistical parameters.

The meters were mounted approximately 1 metre from the facade and were fitted with a windshield for the duration of the survey period. The sound level meters were field calibrated both before and

after the survey period, during which time no significant deviation from the calibrated level was observed. A range of statistical noise indicators were measured, including L_{Aeq} and L_{A90} in 15-minute intervals. Note that a valid calibration certificate is held for both the meters and the calibrators.

Definitions of the above terms are listed below:

$L_{Aeq,T}$: The equivalent A-weighted noise level containing the same energy within the measured time period T.

L_{A90} : This is a statistical parameter that is equivalent to the noise level that is exceeded 90% of the measurement period, representative of background noise.

4.3 Measured Noise Results

A summary of the measured noise results is given in Table 4 below, all values have been rounded to the nearest dB.

Table 4. Summary of noise measurements

Measurement Position	Time Period	$L_{Aeq,15min}$ (dB)	Range of $L_{A90,15min}$ (dB)
Position 1	Daytime	61	47 – 58
	Night Time	58	41 – 51
Position 2	Daytime	60	46 – 60
	Night Time	56	41 – 53
Position 3	Daytime	71	55 – 71
	Night Time	68	43 – 58

4.4 Description of Noise Sources

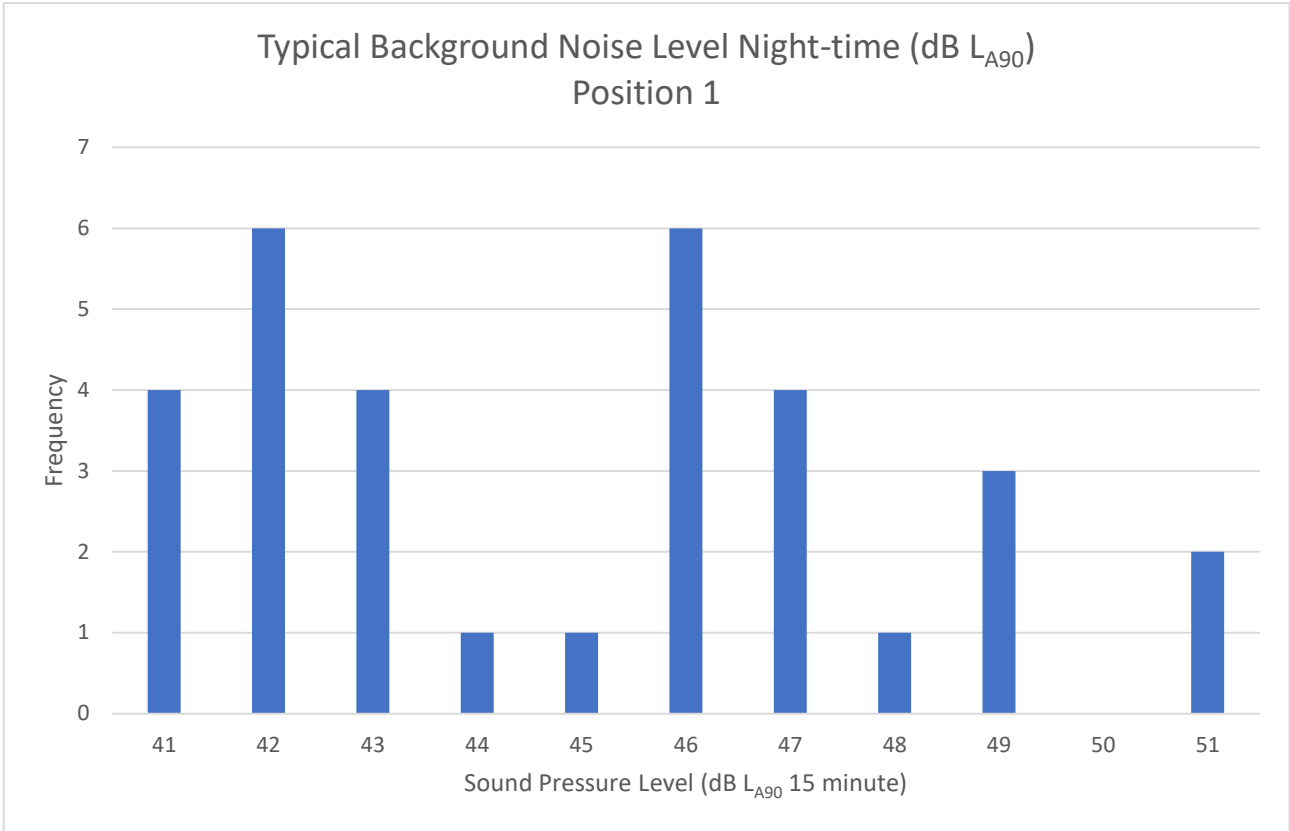
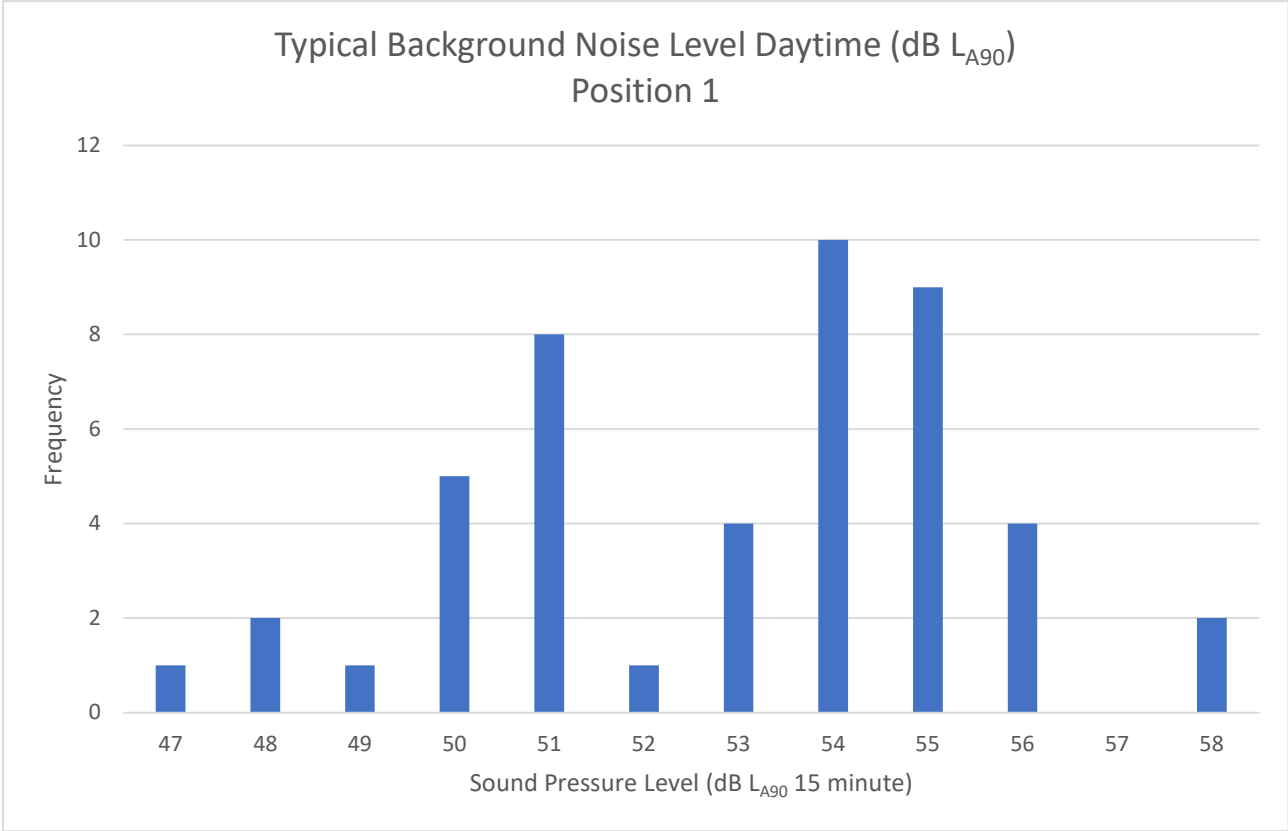
While attending site, it was noted that the ambient noise climate was dominated by road traffic on the surrounding road network. In addition, plant noise from the surrounding buildings was audible during lulls in road traffic although at a low absolute level.

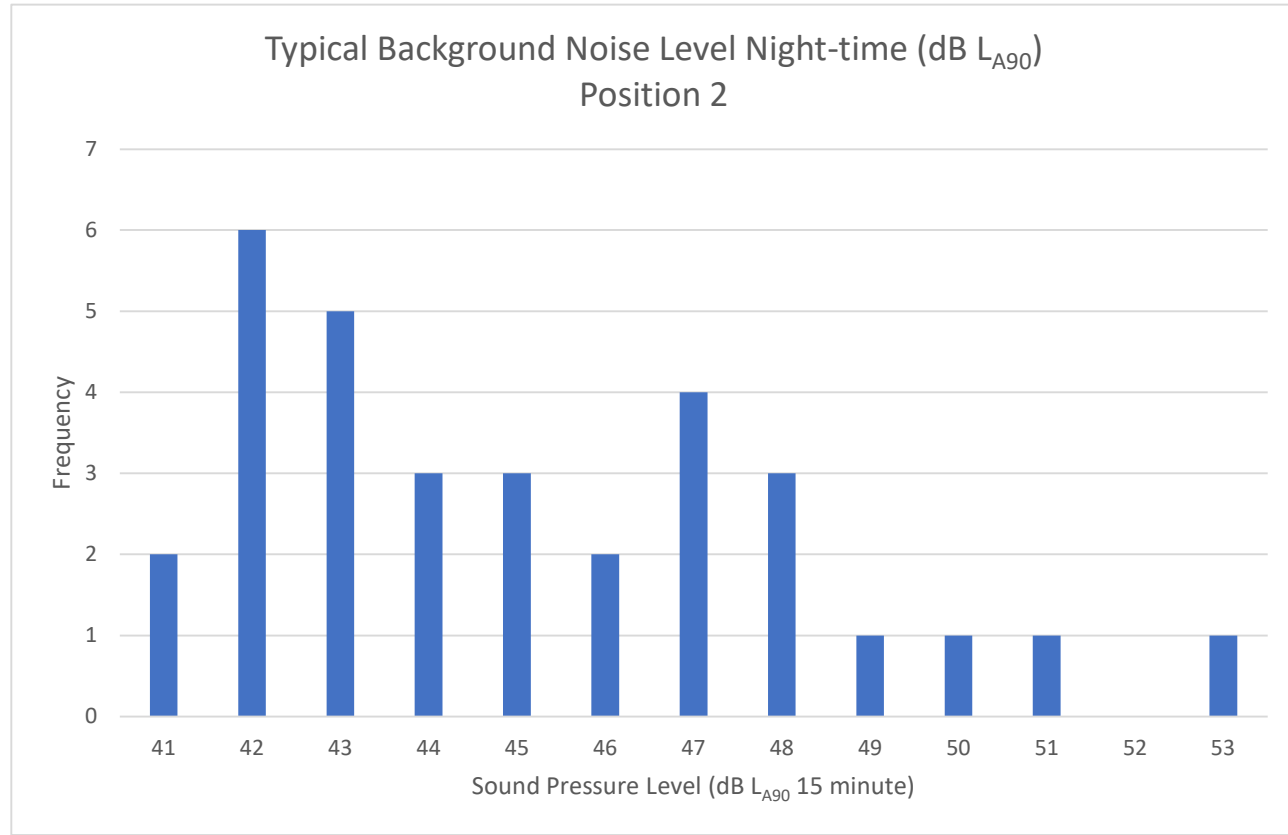
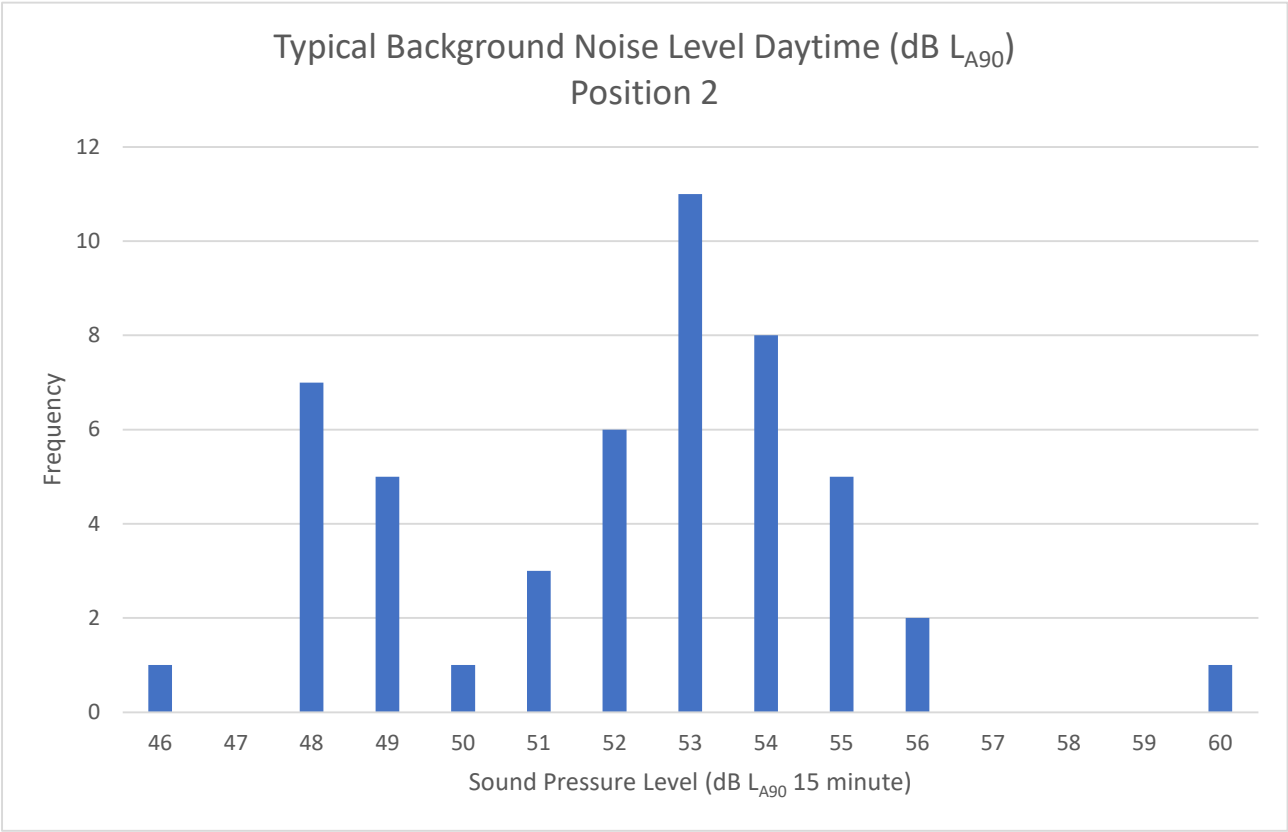
4.5 Derivation of Typical Background Noise Levels

Typical background noise levels during the day and night have been established such that limits can be set for any fixed mechanical plant noise sources proposed to be installed on the site.

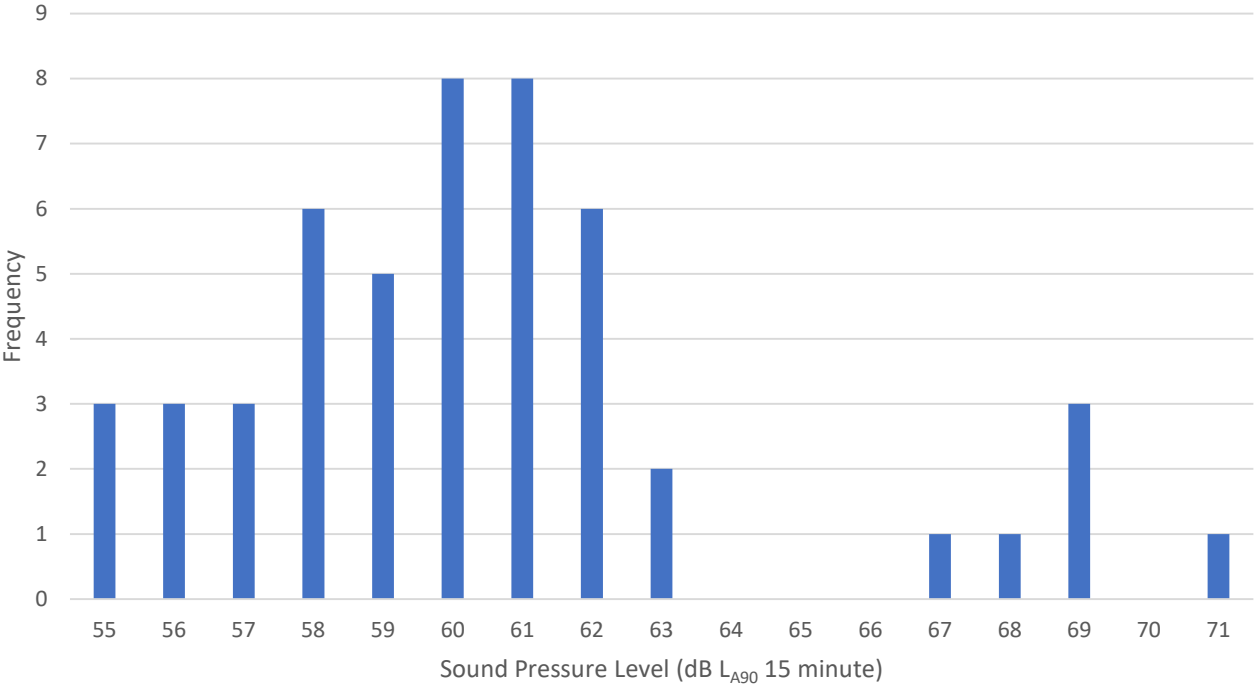
With regards to the time periods when fixed plant may be operating our assessment considers both the typical background during daytime (07:00 – 23:00) hours and night time (23:00 – 07:00) hours.

The following statistical analysis is based on the measurement data acquired from all measurement data which is considered to be representative of background noise levels to the closest sensitive receivers to the proposed development.

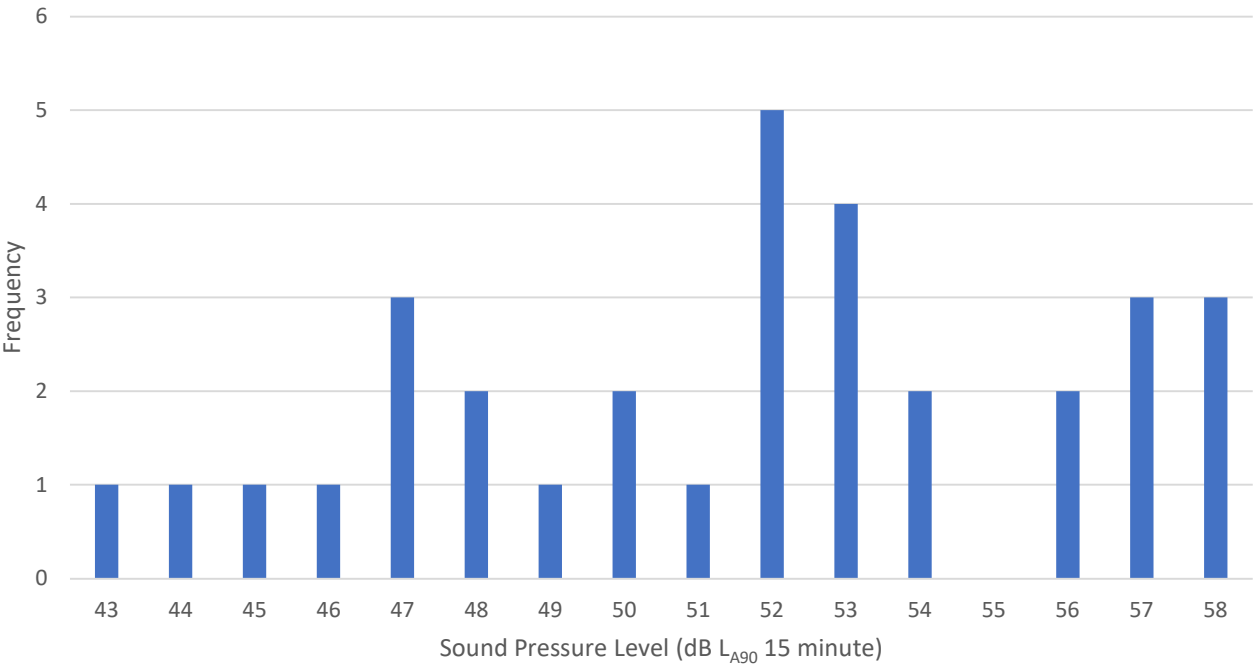




Typical Background Noise Level Daytime (dB L_{A90})
Position 3



Typical Background Noise Level night-time (dB L_{A90})
Position 3



With reference to the statistical analysis of the measurement data above we would consider the modal value to be representative of the typical background noise level in the vicinity of the development and nearby noise sensitive receivers.

The typical background noise levels are summarised in the Table below:

Table 5. Typical Background Noise Levels

Measurement Position	Time Period	Range of $L_{A90,15min}$ (dB)	Typical $L_{A90, 15min}$ (dB)
Position 1	Daytime	47 – 58	54
	Night Time	41 – 51	42
Position 2	Daytime	46 – 60	53
	Night Time	41 – 53	42
Position 3	Daytime	55 – 71	60
	Night Time	43 – 58	52

4.6 Plant Noise Limits (Planning Condition 4)

Based on the typical background noise level measured at the site, to comply with the requirements of Condition 4, any external plant installations should be designed such that the following limits are not exceeded at the nearest noise sensitive receivers.

Table 6. Plant Noise Limits at Receivers

Receiver Location	Time Period	Plant Noise Limit (dB L_{Aeq})
Quay Street (south)	Daytime	55
	Night-time	47
Young St, Gartside Street	Daytime	48
	Night-time	37

5.0 NOISE IMPACT ASSESSMENT

5.1 Proposed Plant Items

We have been provided with the details of the proposed external plant installations for the development which are understood to be as follows:

- 1 no. Samsung AM140AXVGGR Condenser Unit
- 1 no. Samsung AM160AXVGGR Condenser Unit

It is understood that the condenser units are to be mounted on a plant deck at roof level, the location of which can be seen in the Figure below:

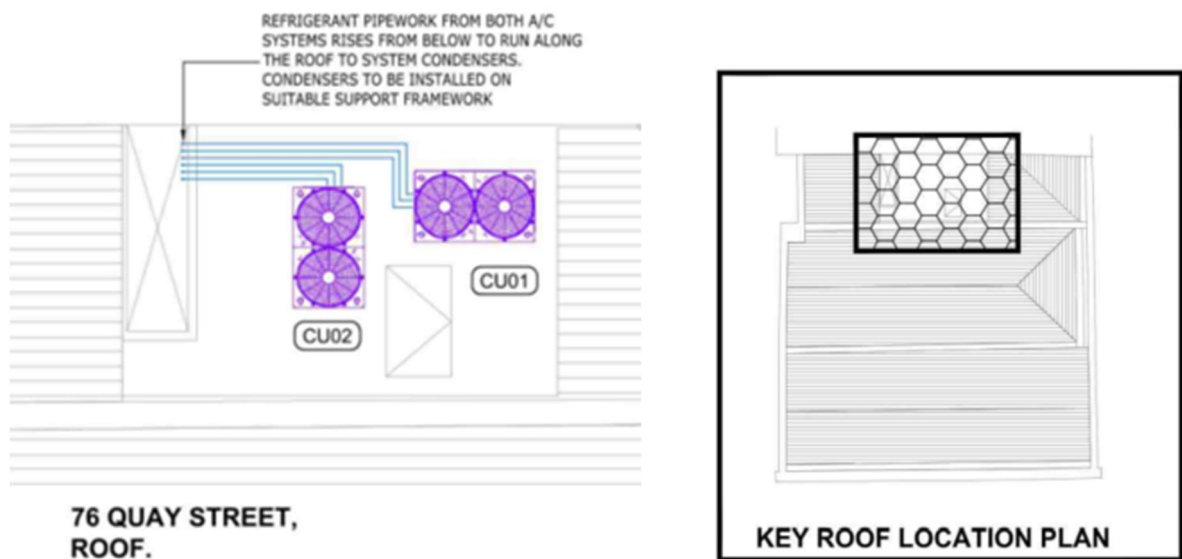


Figure 3 – Location of Roof Top Plant Deck

5.2 Sound Power Levels of Proposed Condensers

We have reviewed the manufacturers literature provided to us which indicates the sound power level radiating from the proposed Condensers would be as follows:

Table 7. Summary of sound power levels

Type	Sound Power Level (dB) in Octave bands (Hz)							SWL dB(A)
	63	125	250	500	1k	2k	4k	
AM140AXVGGR	72	72	75	77	78	71	65	81
AM160AXVGGR	69	69	75	77	78	71	65	81

Note that the spectral data has been taken from manufacturers literature for the specific units proposed.

6.0 NOISE EMISSION CALCULATIONS

6.1 Calculation Details

In order to determine the likely impact associated with plant noise emissions from the development we have undertaken an assessment in accordance with the requirements of BS 4142:2014+A1:2019 “Methods for rating and assessing industrial and commercial sound”.

In order to predict the noise level at the façade of the nearby noise sensitive properties due to the proposed development, the site and its surroundings have been modelled in Soundplan noise propagation software.

The software uses the method of ISO 9613 ‘*Acoustics – attenuation of sound during propagation outdoors – general method of calculation*’ and takes into account geometric spreading, ground effects, air attenuation, barrier attenuation and reflections.

The model is based on the sound power levels and frequency spectra detailed in Section 5 above and assume that all plant will be operating simultaneously during both day and night-time periods.

6.2 Calculation Results

Based upon the source levels detailed within Section 5 and the noise prediction methodology detailed within Section 6.1 we have calculated the resultant noise level at the various receiver locations.

Details of the calculation results are summarised within the following figure:

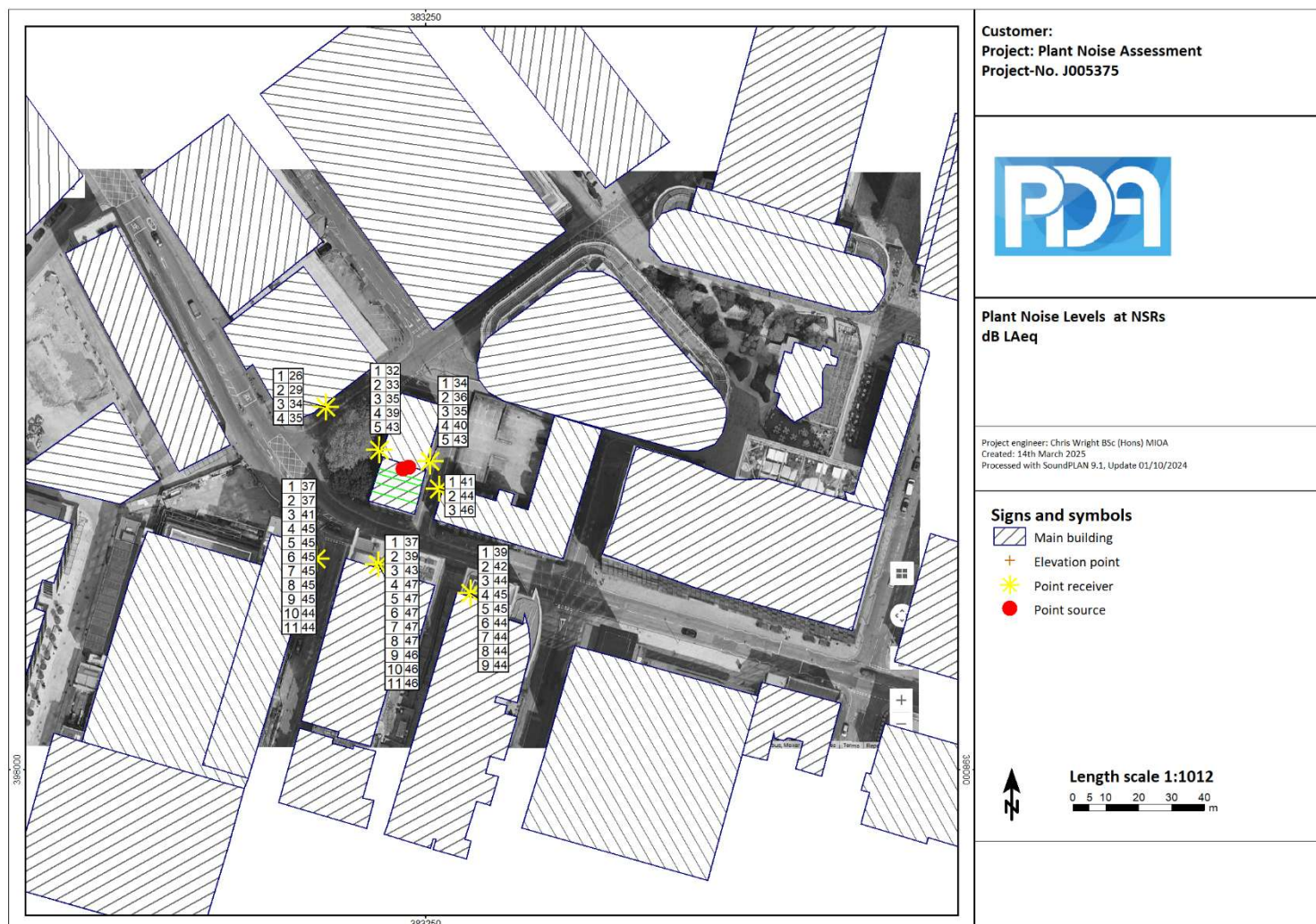


Figure 4 - Noise Emissions to Existing Sensitive Receivers

We have compared the predicted plant noise levels against the typical background noise levels measured the results of our assessment can be seen in the table below. Note that only the worst case noise level at each location has been considered.

With regards to the background noise level, where the receiver is an office / commercial premises we have considered the daytime noise level only as it is assumed the premises will be vacant during the night-time.

We note that NSR5 is a proposed hotel development as such, our assessment has been undertaken based on the night-time noise levels at this location.

Table 8. Comparison of predicted plant noise emissions with background

Location	Specific Sound Level dB (L _{Aeq})	Feature Correction (dB)*	Rating Level dB (L _{Ar})	Typical Background Level dB (L _{A90})	Exceedance of Background (dB)
NSR1	43	0	43	53	-10
NSR2	46	0	46	53	-7
NSR3	47	0	47	60	-13
NSR4	45	0	45	60	-15
NSR5	45	0	45	52	-7
NSR6	35	0	35	53	-18

* BS4142:2014 indicates that a feature correction should be applicable if the noise sources are impulsive, tonal or is irregular enough to attract attention. In our experience modern plant equipment does not tend to be tonal or impulsive and therefore, we would not consider it appropriate to apply a feature correction.

Our initial assessment would suggest that the rating sound level is likely to be at least 7 dB below the typical background sound at the nearby sensitive receivers.

BS4142 would suggest that:

“10 dB(A) or more above the background is an indication of significant adverse impact, depending on the context.

5 dB(A) above the background is an indication of an adverse impact, depending on the context.

Where the rating level does not exceed the background level, this is an indication of the specific sound source having a low impact, depending on the context.”

Our assessment has indicated that the rating level at the worst affected NSR is likely to be 7 dB below the background sound level. In accordance with BS4142:2014 this is an indication that noise emissions from the scheme will have a low impact.

It can also be noted that this complies with the requirements of Planning Condition 4 which stipulates that plant noise emissions from the development are controlled to at least 5 dB below the background sound level.

7.0 CONTEXT AND DISCUSSION OF RESULTS

The BS4142 initial estimate is described within Section 6.2 and indicates that the noise impact is likely to be low however, BS4142 indicates that this initial estimate of impact needs to be modified for context.

With reference to the context BS4142 indicates that the significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs.

BS4142 indicates that pertinent factors that could modify context would include: the absolute level of sound; the character and level of the residual sound compared to the character and level of the specific sound; the sensitivity of the receptor and whether dwellings or other premises used for residential purpose already incorporate design measurements that secure good internal and/or outdoor acoustic conditions.

The majority of the receivers adjacent to the proposed development are office / commercial uses which we would not necessarily consider to be noise sensitive. However, to ensure that our assessment is conservative we have treated these premises as if they are noise sensitive.

The worst-case specific noise level at the facade of the adjacent office / commercial premises is predicted to be 47 dB. Allowing for an attenuation of ~13 dB for a partially open window this would result in an internal noise level of 35dB.

BS8233 recommends that the internal ambient noise level within an open plan office should be between 45 – 50 dB L_{Aeq} with a more stringent criteria for executive offices of 35 – 40 dB L_{Aeq} . As such, noise emissions from the development are likely to achieve this criteria.

Further, we note that the offices adjacent to the site on Quay Street appear to be relatively modern in which case they are likely to have MVHR / cooling systems installed. If these systems are present within the offices this would reduce the need to have windows open and as such, during periods when windows are closed, noise ingress due to plant on the adjacent offices would likely be significantly lower than 35dB.

With regards to the proposed hotel development the worst case noise level is predicted to be 45 dB at the facade of the development. It should be borne in mind that the measured residual noise level on Quay Street was found to be between ≥ 68 dB L_{Aeq} . Therefore, plant noise emissions from the proposed development are unlikely to have a significant contribution to the noise climate.

We would consider that the contextual factors discussed above would further reduce the impact however, our initial assessment already indicates the site would have a low impact and therefore, this does not affect the conclusions of our assessment.

8.0 UNCERTAINTY

BS4142 indicates that an assessment of noise impact should consider uncertainty within the assessment. This uncertainty can arise from: uncertainty in measurements; uncertainty in sound emission and sound power level; and uncertainty in calculation method.

8.1 Uncertainty in Measurements

It is noted that the instrumentation used for the assessment, it conforms to Class 1 accuracy in accordance with IEC 61672. In addition, the instrumentation has been calibrated to national standards and was field calibrated at the time of the measurements.

We would therefore consider that the effect of uncertainty on the measurement of background sound would be minimal.

8.2 Uncertainty in Sound Power Levels

Our assessment is based on sound levels obtained from manufacturers literature provided to us by the client. In addition, it is conservatively assumed that all plant will be operating simultaneously.

It will need to be ensured that the equipment installed complies with the levels stated by the manufacturer as detailed in Section 5 of this report.

However, on this basis we would consider the effect of uncertainty on the assessment of sound power levels is likely to be minimal.

8.3 Uncertainty in Calculation Method

It is noted that the calculations have been undertaken utilising a known prediction method and have utilised the standard ISO 9613. In addition calculations have been undertaken utilising commercial prediction software. We would therefore consider that this would minimise uncertainty in the assessment.

9.0 RECOMMENDATIONS

Any plant mounted at roof level should be mounted on heavy framework and be supported by manufacturer proprietary anti-vibration mounts or resilient pads of selected isolation performance to take into account the floor slab mass and span to suppress vibration energy transfer to the structure.

Flexible connections should be employed between plant and non-isolated components. These connections should allow unrestricted movement of the plant item. It should be ensured that any plant does not cause excessive sound or vibration transfer to top floor offices below.

10.0 CONCLUSION

PDA Ltd have been commissioned to undertake an assessment of plant noise emissions from the proposed office development at 76 Quay Street in Manchester City Centre. The proposal is to refurbish the currently vacant building to form office spaces across 4 floors.

This assessment has been undertaken to demonstrate compliance with the requirements of Planning Condition 4.

In order to predict the noise level at the façade of the nearby noise sensitive dwellings due to the proposed development, the site and its surroundings have been modelled in Soundplan noise propagation software.

Our assessment has been undertaken in accordance with the methods described in BS4142:2014 – 'Methods for rating and assessing industrial and commercial sound'.

Our assessment has indicated that the rating level at the worst affected noise sensitive receiver is likely to be at least 7 dB below the background sound level. In accordance with BS4142:2014 this is an indication that noise emissions from the scheme will have a low impact.

In addition, the results of our assessment suggest that the requirements of Planning Condition 4 have been achieved and therefore, the Condition may be discharged.

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.