

**4 Angel Square (Plot P) and Primary Sub-station
(future 5 Angel Square - Plot Q), NOMA, Manchester**

Planning Report – Acoustics & Vibration

NP4-BHE-04-XX-RP-Y-0004

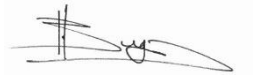
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Glossary

Term	Definition
α (&- α_w)	Sound absorption coefficient (& weighted sound absorption coefficient) is a measure of the effectiveness of materials as sound absorbers; it is the ratio of the sound energy absorbed or transmitted (i.e. not reflected) by a surface to the total sound energy incident upon that surface. The value of the coefficient varies from 0 (perfect reflector) to 1 (perfect absorber).
A (& A_T)	Absorption area (& total absorption area) is equal to the product of multiplying the surface area of a construction (in m2) and its sound absorption coefficient (α).
Ambient Noise (as defined in BS 4142:2014)	Totally encompassing noise in a given situation at a given time; it is usually composed of noise from many sources, near and far.
Background Noise (as defined in BS 4142:2014)	A-weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90% of a given time interval, T, measured using time weighting, F, and quoted to the nearest whole number of decibels.
C_{tr}	Spectrum adaptation term calculated using traffic noise as described in ISO 717-1:1996. This term is provided with weighted single values such as $D_{nT,w}$ or R_w to match with particular requirements (building acoustic or traffic noise spectrum).
Decibel, dB	Commonly used unit used for the comparison of the powers of levels sound. Abbreviation dB. Is the unit of level derived from the logarithm of the ratio between the value of a quantity and a reference value? For sound pressure level (L_p) the reference quantity is 2x10-5 N/m². The sound pressure level existing when microphone measured pressure is 2x10-5 N/m² is 0 dB, the threshold of hearing.
$D_{n,f,w}$	The weighted transmission of sound energy from a source room to a receiving room via structural (vibrational) paths in the construction mainly, e.g. walls, floors, ceilings.
$D_{nT,w}$ – standardised level difference	$D_{nT,w}$ is widely used to denote the weighted sound insulation criteria for residential dwellings, where T_0 is taken as 0.5 seconds. In the instance of testing in schools, T_0 is taken as the rooms T_{mf} .
$D_{n,Tw}$ (C , C_{tr})	Weighted standardized level difference: Single figure value of airborne sound insulation performance. This European index is described in ISO 140-4:1998 and ISO 717-1:1996. This performance describes the installed site performance of the composite separating constructions, including the partition element performance, the flanking path transmission and the reception room reverberation time factors. $D_{nT,w}$ target leads to a selection of adequate construction elements and methods to build the partition that is rated using weighted sound reduction index R_w (C ; C_{tr}).
D_w	Weighted level difference: Single-number quantity that characterizes airborne sound insulation between rooms, but which is not adjusted to reference conditions
Flanking Noise	The transmission of sound around the perimeter or through holes within partitions (or barriers) that reduces the otherwise obtained sound transmission loss of a partition. Examples of flanking paths within buildings are ceiling plenum above partitions or raised floor cavities, ductwork, piping, and electrical conduit penetrations through partitions, back to back electrical boxes within partitions, window mullions, etc.
Frequency	Number of cycles per second, measured in hertz (Hz), related to sound pitch.
IANL – indoor ambient noise level	Table 1.1 in BB93 specifies the upper limit for indoor ambient noise levels within teaching areas. The design criteria are set for a 30-minute average level (i.e. $L_{Aeq,30mins}$). However, where there is a negligible change in the noise level, BB93 states that a much shorter time period (e.g. $L_{Aeq,5min}$) can be used. BB93 also states that for rooms identified having limits of $L_{eq,30min}$ 35 dBA or less, the noise should not regularly exceed $L_{1,30min}$ 55 dBA.
$L_{90,T}$ (& $L_{A90,T}$)	Sound pressure level exceeded 90% of the measurement period. Referred to as background noise level.

$L_{Ar,T}$	Rating Noise Level (as defined in BS 4142:2014), the specific noise level plus any adjustment for the characteristic features of the noise.
$L_{eq,T}$ (& $L_{Aeq,T}$) - equivalent continuous noise level of a time-varying noise	Steady noise level which, over the period of time under consideration, contains the same amount of sound energy as the time-varying noise over the same period of time.
$L_{Fmax,T}$ (& $L_{AFmax,T}$)	The maximum sound pressure level measured during the measurement period T using the fast time constant.
$L'_{nT,w}$	Weighted standardized impact sound pressure level: a single-figure value of impact sound insulation performance. This European index is described in ISO 140-7:1998 and ISO 717-2:1997, used for comparing and rating floors and based on the values of L'_{nT} at different frequencies. L'_{nTw} target leads to a selection of adequate construction elements and methods to build the floor that is rated using weighted normalized impact sound pressure level $L_{n,w}$.
$L_{n,w}$	Weighted normalized impact sound pressure level: European single figure rating for transmission loss of impact sound through building elements as described in ISO 140-6:1998 and ISO 717-2:1997. The lower the $L_{n,w}$ the better the performance.
L_p - sound pressure level	Sound pressure level, in decibels, of a sound is 20 times the logarithm to the base of 10 of the ratio of the sound pressure to the reference pressure. The reference pressure shall be explicitly stated and is defined by the standard.
L_w – sound power level	Sound power level, in decibels, of a sound is 10 times the logarithm to the base of 10 of the ratio of the sound power level to a specified reference level. The reference pressure shall be explicitly stated.
Noise Rating (NR)	Curves developed by the International Organization for Standardization (ISO) to determine the acceptable indoor environment for hearing preservation, speech communication and annoyance. These can be compared to NC curves and also can be referred to as equivalent dBA levels.
Reverberation Time (RT)	The time required for the steady sound pressure level in an enclosed space to decay by 60 dB, measured from the moment the sound source is switched off. Reverberation time is described in ISO 354:2003.
R_w (C , C_{tr})	Weighted sound reduction index: Single-figure value of sound reduction according to ISO 140-3:1995, used for rating partition systems, door-sets or glazing, based on the values of sound reduction index R at different frequencies. The higher the R_w the better the performance.
Single Event Level (SEL [L_{AE}])	The sound level over one second which would have the same energy content as the whole event.
Specific Noise Level (as defined in BS 4142:2014)	The equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source over a given reference time interval.
T_{mf} – mid-frequency reverberation time	Within BB93, the reverberation time criteria are set in terms of the averaged value of the 500 Hz, 1000 Hz and 2000 Hz frequency bands. The various levels for T_{mf} are specified within Table 1.5 of BB93 and are generally upper limits. The Sub-Note to Table 1.5 notes that the specified mid-frequency reverberation times are for ‘finished but unoccupied and unfurnished rooms’.
Vibration	The force which oscillates about some specified reference point. Vibration is commonly expressed in terms of frequency such as cycles per second (cps), Hertz (Hz), cycles per minute (cpm) or (rpm) and strokes per minute (spm). This is the number of oscillations which occurs in that time period. The amplitude is the magnitude or distance of travel of the force.
Weightings (as defined in IEC 61672:2003):	A-Weighting: Frequency weighting devised to attempt to take into account the fact that human response to sound is not equally sensitive to all frequencies; it consists of an electronic filter in a sound level meter, which attempts to build in this variability into the indicated noise level reading so that it will correlate, approximately, with human response.). C-Weighting: One of the frequency weightings corresponding to the 100-phon contour and the closest to the linear or un-weighted value.

1 Introduction

1.1 Scope of Work

Buro Happold (acoustics) have been commissioned by Bowmer and Kirkland to carry out a Noise Impact Assessment to support a planning application for a proposed new office building at 4 Angel Square (Plot P), and a primary sub-station at 5 Angel Square (Plot Q) NOMA site, Manchester.

The assessment details the noise impact upon the proposed development from the existing noise climate as well as the potential noise impact of mechanical plant and equipment installed as part of the proposed development upon existing noise sensitive receptors (NSRs). In summary, the assessment includes the following:

- Description of the proposed development and site;
- Acoustic criteria and pertinent planning guidelines;
- Existing baseline conditions at the site and surrounding area;
- Potential noise impact upon the proposed development;
- Potential noise impact upon existing NSRs;
- Noise mitigation measures such as acoustic façade requirements and limiting noise levels for plant and equipment (where required); and
- Conclusions.

The purpose of this assessment is to evaluate the existing noise climate at and within the vicinity of the proposed development site and where required, provide recommendations for noise mitigation measures in order to achieve an appropriate internal and external acoustic environment. Recommendations within this report are in line with relevant Standards and pertinent Planning Policy.

1.2 Description of Proposed Development and Site

The development proposal includes the redevelopment of land bound by Miller Street to the south and Corporation Street to the west to provide various new buildings within the mixed-use NOMA scheme in Manchester city centre. Currently, the former Ducie Bridge pub and associated buildings occupy the south-west corner of the site with car parks on the remainder of the site.

The 4 Angel Square development is proposed in the south-west corner of the site to include redevelopment and erection of offices (B1); and flexible A1 to A4 and D2 uses at ground floor with associated parking, hard and soft landscaping and access.

The proposed development of 4 Angel Square is to total a maximum gross internal floor area of 20180 m² over 11 stories as follows;

- **Grade A office space** – approx. 17800 m²;
- **Commercial (A1, A2, A3, A4, B1 and D2)** – approx.. 680 m² on the ground floor;
- **Basement** – Car Park - up to 1700 m²; and
- **Roof terrace** – proposed at Level 6 or 10.

An annotated site plan is shown in the figure below.



Figure 1—1 Proposed development site

The following bound the proposed development site:

- Parkers Hotel Apartment adjacent to the western boundary;
- Car parks immediately to the north and east;
- The Co-op building to the north-east;
- Residential properties to the north separated by the car park and Corporation Street road;
- Corporation Street road immediately to the west;
- Miller Street road immediately to the south;
- Corporation Street to the south;
- Corporation Street, Miller Street and Corporation Street junction at the south-west corner boundary;
- Office buildings to the south separated by Corporation Street road;
- Red Bank road at a lower level to the north of the site;
- Manchester Victoria station to the south-west with associated train and tram lines extending west to east to the north of the site; and
- Working construction site to the east.

An annotated aerial site image is shown in the figure below.

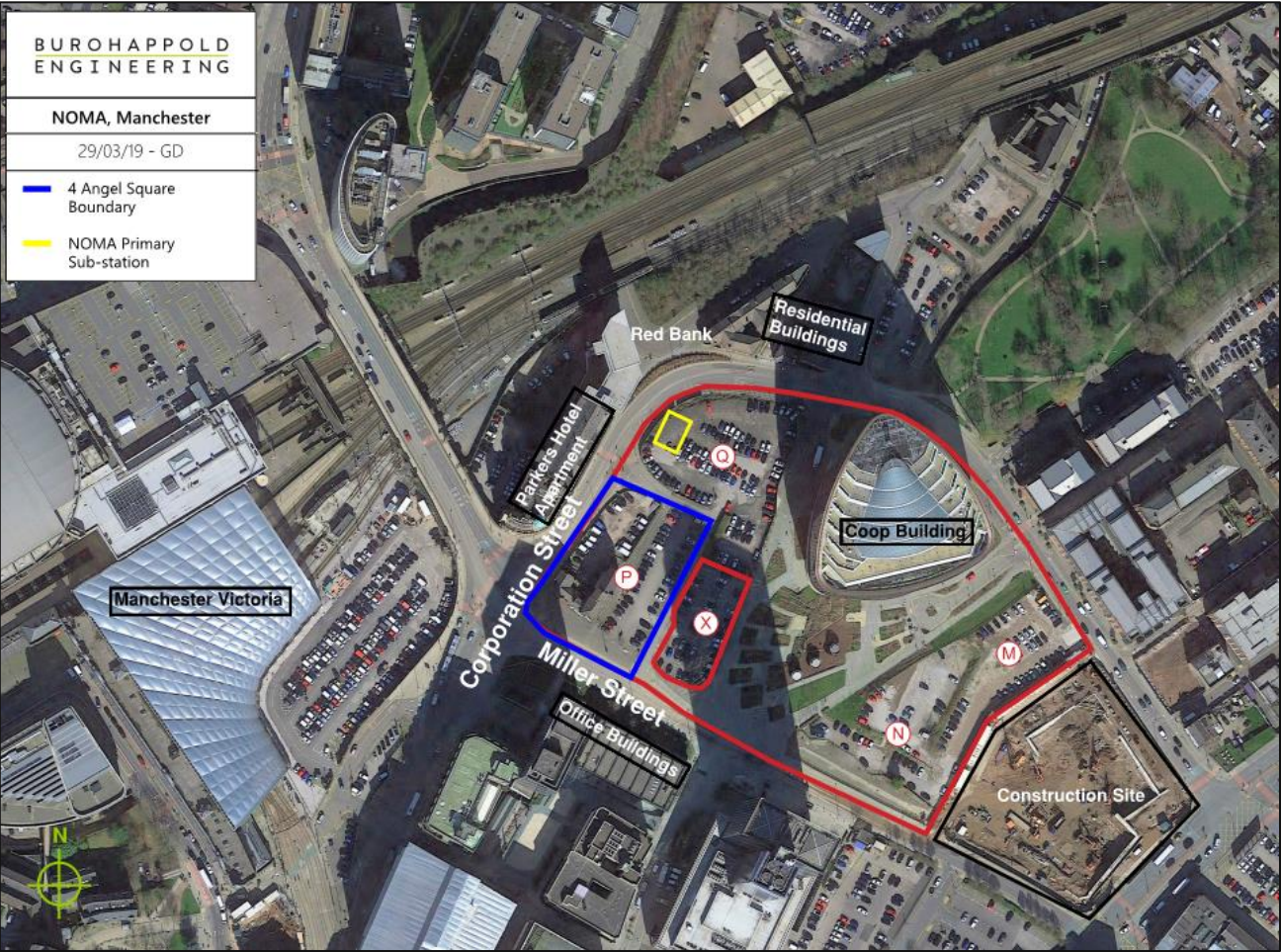


Figure 1—2 Site map

The local road network is considered the primary noise source in the area.

2 Acoustic Design Criteria

2.1 Draft Planning Application

The Draft Application Document Schedule (dated October 2018) by Deloitte provides the following guidance with regards the likely following planning requirements for the proposed development.

Noise Impact Assessment – Details of the existing noise levels in the area and what measures will need to be implemented on site to meet internal noise requirements. Also, details will be required of any potential noise breakout from the building and transfer between building levels, in particular, the retail uses at ground level and any external equipment that will need to be acoustically insulated. If any external seating areas are proposed, the assessment should consider the noise impact of these spaces. The assessment should be in line with Manchester City Council’s Planning and Noise Technical Guidance (December 2015).

These recommendations have been considered in later sections of this report.

Noise transfer between spaces will be considered as part of the RIBA design reports. It is recommended that the minimum sound insulation performance of separating floors between retail uses at ground floor and office use above, should be $D_{nT,w}$ 55 dB.

External seating areas have not been proposed at the site at this stage, this could be assessed at a later stage, as required, as the design is developed.

2.2 Relevant Guidance Documentation

This report is to be primarily informed by the following standards and guidelines:

- The National Planning Policy Framework, 2012 (NPPF);
- The Noise Policy Statement for England, 2010 (NPSE);
- BS 4142:2014 - Methods for rating and assessing commercial and industrial sound;
- BS 8233:2014 - Guidance on sound insulation and noise reduction for buildings;
- World Health Organisation (WHO) – Guidelines for community noise;
- BREEAM UK New Construction – Non-domestic Buildings (U.K.), Technical Manual SD5078: 1.0 – 2018;
- Manchester City Council (MCC) - Planning and Noise - Technical Guidance (December 2015); and
- Chartered Institution of Building Services Engineering (CIBSE) – Environmental design - CIBSE Guide A (January 2016).

National planning policy and BREEAM criteria are referenced in this section. Quantitative criteria from relevant standards and guidelines are contained within relevant sections of the report.

2.3 English Planning Policy on Noise Impact – The NPPF and NPSE

The NPPF is the over-arching planning policy document that applies to all new developments in England. The guidance and assessment criteria are given (or referred to) in this document can, therefore, be applied to all other standards in terms of assessing the suitability of granting Planning permission with respect to noise impact.

The NPPF states that 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 the 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.

With specific reference to noise impact, the NPPF document refers to the Noise Policy Statement for England (NPSE). The NPSE provides guidance, which enables decisions to be made regarding the acceptable noise burden to place on society, using three key phrases – the No Observed Effect Level (NOEL), the Lowest Observed Adverse Effect Level (LOAEL) and the Significant Observed Adverse Effect Level (SOAEL).

In order to provide a consistent frame of reference (and to allow a view to be taken on the suitability of the application with reference to the relevant Planning guidance), the levels or criteria given in other relevant documents used in the assessment will be re-framed in terms of the following:

2.3.1 No Observed Effect Level (NOEL)

The NOEL is the level of noise impact below which no effect can be detected, and there would be no discernible negative effect on health or quality of life.

2.3.2 Lowest Observed Adverse Effect Level (LOAEL)

The LOAEL is the lowest level of noise impact above which adverse effects on health or quality of life can be detected. Designing noise impacts to be equal-to-or-less-than, the LOAEL should see that any adverse effects on health or quality of life are negligible.

2.3.3 Significant Observed Adverse Effect Level (SOAEL)

The SOAEL is the level above which significant adverse effects on health and quality of life occur. Designs should always seek to avoid a noise impact, which would be categorised as a SOAEL.

2.4 BREEAM Acoustic Requirements

Building Research Establishment’s Environmental Assessment Method (BREEAM) is a method used to assess, rate and certify the sustainability of buildings. The objectives of BREEAM are:

- To provide market recognition of buildings with a low environmental impact;
- To ensure the best environmental practice is incorporated in building planning, design, construction and operation;

- To define a robust, cost-effective performance standard surpassing that required by regulations;
- To challenge the market to provide innovative, cost-effective solutions that minimise the environmental impact of buildings;
- To raise the awareness amongst owners, occupants, designers and operators of the benefits of buildings with a reduced life cycle impact on the environment; and
- To allow organisations to demonstrate progress towards corporate environmental objectives.

2.4.1 Available credits

It is understood that the building is to be assessed and rated according to BREEAM UK New Construction – Non-domestic Buildings (U.K.), Technical Manual SD5078: 1.0 – 2018. This development is targeting all (four) available credits.¹

2.4.2 BREEAM criteria

It is understood that the development is targeting four credits under BREEAM Hea 05 ‘Acoustic Performance’ and Pol 05 ‘Noise Pollution’.

The aim of Hea 05 is:

“To ensure the building is capable of providing an appropriate acoustic environment to provide comfort for building users.”

The aim of Pol 05 is:

“To reduce the likelihood of noise arising from fixed installations on the new development affecting nearby noise-sensitive buildings.”

Table 2—1 details the BREEAM criteria applicable to the development.

Table 2—1 BREEAM 2018 Non-domestic Buildings Criteria

Building Type	BREEAM Reference	Acoustic Parameter	No. of Credits	Criteria
Office	Hea 05 - Acoustic Performance	Sound Insulation	1	<i>“The sound insulation between rooms and other occupied areas complies with the performance criteria given in Section 7 of BS 8233:2014. This should be based on the layout and function of the different spaces within the building.</i> <i>... If testing is to be carried out where the office is not yet furnished, then section 7.5 of BS 8233:2014 should be referred to when determining the performance criteria. Where the office is to be furnished at the time testing is carried out, then refer to section 7.7.6 of BS 8233:2014 for the relevant performance criteria.”</i>
Retail				<i>“The sound insulation between rooms and other occupied areas complies with the performance criteria given in Section 7 of BS 8233:2014. Alternatively, propose performance standard based on demonstrably best practice.”</i>

¹ Confirmed in an e-mail from Ben Wells (Director, Mainer Associates) dated 28 January 2019.

Office / Retail		Indoor ambient noise levels (IANL)	1	<i>“Achieve indoor ambient noise levels that comply with the design ranges given in Section 7 of BS 8233:2014.”</i>
		Room acoustics	1	<i>“Achieve the requirements relating to sound absorption and reverberation times, where applicable, set out in Section 7 of BS 8233:2014.”</i>
Development Wide	Pol 05	Reduction of noise pollution	1	<i>“1 There are no noise-sensitive areas within the assessed building or within 800 m radius of the assessed site.</i> <i>OR</i> <i>2 Where there are noise-sensitive areas within the assessed building or noise-sensitive areas within 800 m radius of the assessed site, a noise impact assessment compliant with BS 4142:2014(222) is commissioned. Noise levels must be measured or determined for:</i> <i>2.a Existing background noise levels:</i> <i>2.a.i at the nearest or most exposed noise-sensitive development to the proposed assessed site</i> <i>2.a.ii including existing plant on a building, where the assessed development is an extension to the building</i> <i>2.b Noise rating level from the assessed building.</i> <i>3 The noise impact assessment must be carried out by a suitably qualified acoustic consultant.</i> <i>4 The noise level from the assessed building, as measured in the locality of the nearest or most exposed noise-sensitive development, must be at least 5dB lower than the background noise throughout the day and night.</i> <i>5 If the noise sources from the assessed building are greater than the levels described in criterion 4, measures have been installed to attenuate the noise at its source to a level where it will comply with the criterion.”</i> <i>In summary, the BREEAM credit Pol 05 requires that the level of noise impact from any newly-introduced plant items is at least 5 dB lower than the background noise level (L_{A90,15mins}) throughout the day and night when assessed at an existing noise-sensitive receptor.</i>

BREEAM targets have been addressed in the following sections of this report.

2.4.3 BREEAM Suitably Qualified Acoustician (SQA)

This report has been prepared by Daniel Bailey, who is a full member of the Institute of Acoustics and is therefore considered a SQA consultant for BREEAM purposes.

3 Site and External Noise Survey Results

3.1 Introduction

Buro Happold Engineering conducted an external noise survey at 4 Angel Square, NOMA, primarily for two purposes, relating both to the design as a whole and the requirements of planning:

- To capture the noise impact from surrounding environmental noise sources (e.g. roads) on the proposed façades. This allows the specification of external building envelope attenuation (i.e. glazing and ventilation) to see that internal ambient noise levels within noise-sensitive rooms can be compliant with appropriate criteria (as a minimum); and
- To capture the existing background noise levels at nearby noise-sensitive (i.e. residential) receivers. This allows the specification of limiting noise levels for any externally located (or external terminations of) services plant, to see that the installation will not unduly increase existing noise levels in the vicinity of the site.

Buro Happold Engineering staff visited the site to undertake an attended noise survey between Tuesday 22 and Wednesday 23 January 2019 to obtain the required data as described above.

This section details the methodology and results of the environmental noise survey.

3.2 Survey Details

The survey methodology, timings and positions were agreed in principle with Laura Miller (Environmental Protection Specialist) at Manchester City Council (MCC) prior to attending site². MCC are interested in the results from measurements taken during the absolute quietest period of a typical week, and also from some of the noisiest periods of a typical week (agreed to be adequately represented by the morning rush hour). As such, the noise survey methodology provides a comprehensive and complete picture of how noise levels change around the site throughout various times of the day and night-time.

Long-term (24 hours) unattended noise measurements were made at one location on site with concurrent short-term (15 minutes) attended noise measurements were undertaken during the day and night-time periods at three locations around the site.

Measurement locations are detailed below and marked on an annotated aerial image in Figure 3—1:

- Location 1** – (Lat.: 53.4878, Long.: -2.2398) – This is a long-term unattended measurement position which is subject to façade corrections (- 3 dB applied to all measurement figures at this location). Noise measurements were undertaken at the south-west corner of the site at Level 2 of the Ducie Bridge building overlooking Miller Street. This measurement location was set back at a distance of approximately 15 m from Miller Street at a height of approximately 8 m. This measurement location is considered representative of noise levels along the proposed south-western site boundary.
- Location 2** – (Lat.: 53.4880, Long.: -2.2387) – Short-term attended noise measurements were undertaken at the north-east corner of the proposed development site approximately 1 m from Beswick Row in free field conditions. This measurement location is approximately 45 m from the Coop Building to the east and approximately 1.5 m above ground level. This measurement position is considered representative of noise levels along the proposed north-eastern site boundary.
- Location 3** – (Lat.: 53.4882, Long.: -2.2393) – Short-term attended noise measurements were undertaken at the north-west corner of the proposed development site approximately 10 m from the Corporation Street in free

field conditions. This measurement location was set approximately 17 m from the nearest noise sensitive receptor to the west (Parkers Hotel Apartment) of the development, and 1.5 m above ground level. This measurement position is considered representative of noise levels along the proposed western site boundary and background noise levels at the nearby noise-sensitive receptors.

- Location 4** – (Lat.: 53.4875, Long.: -2.2391) – Short-term attended noise measurements were undertaken at the south-west corner of the proposed development site, in free field conditions, approximately 8 m from the entrance to Beswick Row, 10 m from the Miller Street, and 1.5 m above ground level. This measurement location is considered representative of noise levels along the proposed south-eastern site boundary.

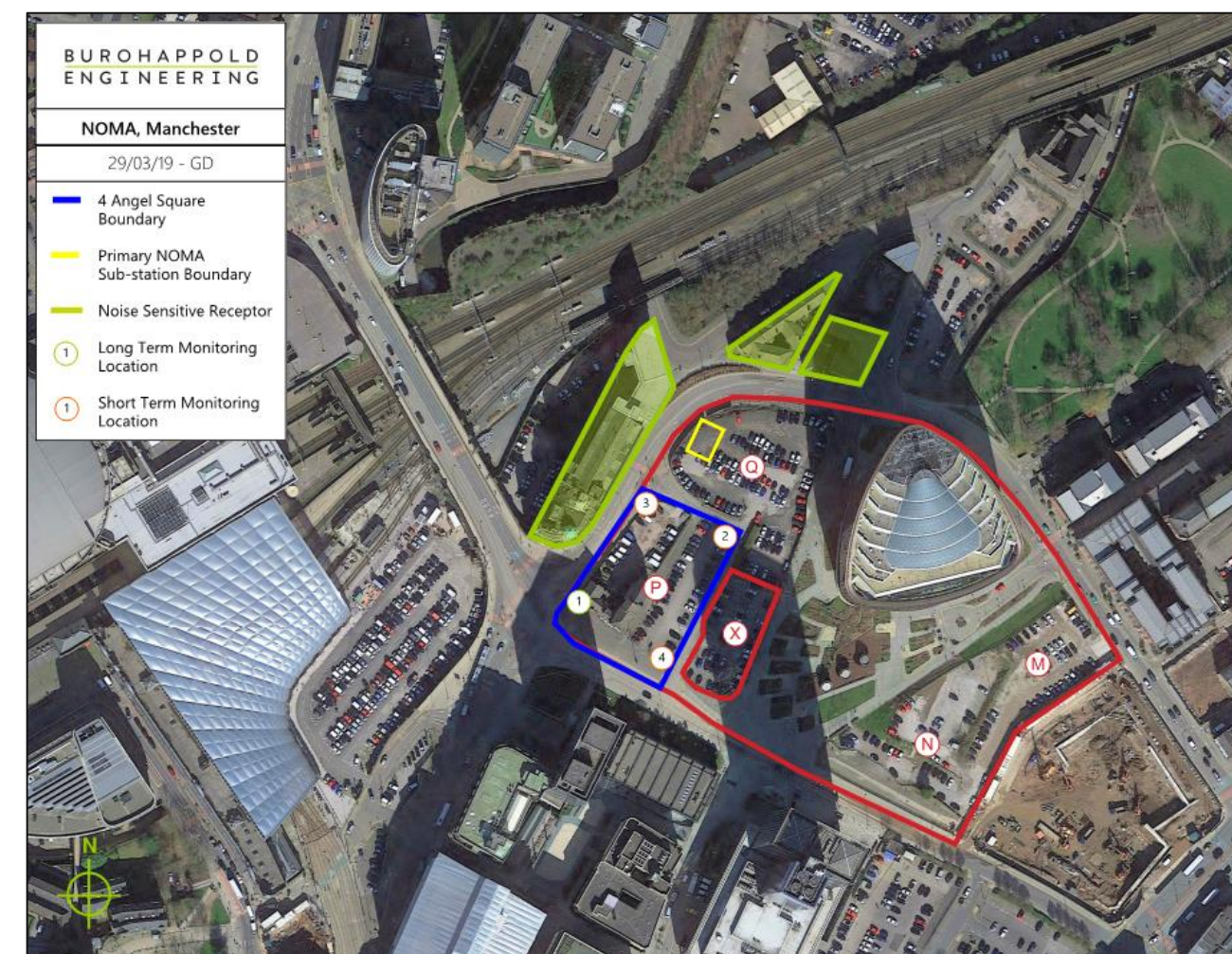


Figure 3—1 Site plan showing measurement locations, NSRs and site boundary

Weather conditions during the noise survey were generally appropriate, being mostly dry with light winds (i.e. <5m/s).

Unattended noise measurements were made generally in accordance with BS EN 61672:2003 and BS 7445:2003 using the following equipment:

- Rion NL-52 Class 1 sound level meter (serial number: 01265411).

Attended noise measurements were made generally in accordance with BS EN 61672:2003 and BS 7445:2003 using the following equipment:

- Class 1, Brüel & Kjær sound level meter (serial number: 3008216).

² In a telephone conversation on 22 January 2019.

On-site calibration checks were performed on all the meters before and after the measurements and were found to be within the permitted tolerance of BS EN 61672-1:2013. All equipment had a valid calibration certificate at the time of the survey.

Sources of significant vibration such as over-ground rail and tram lines are more than 65 m away from the development site. Therefore baseline vibration monitoring was not conducted as it is generally considered that at a distance of 10 m or more the effects of ground-borne vibration will be minimal. No significant levels of noise vibration were experienced by the site survey engineer during the course of the survey.

3.3 Results

3.3.1 Unattended noise survey

Results of the unattended noise survey are shown in the table below. The presented noise levels are the period log averaged façade corrected $L_{Aeq,T}$ value, lowest measured $L_{A90,15min}$, and the highest typically occurring façade corrected $L_{AF,max}$ event (i.e. road traffic events) during the period.

Table 3—1 Unattended noise measurements with façade corrections at Location 1 (22/01/18 – 23/01/18)

Period (hours)	Elapsed Time (HH:MM)	$L_{Aeq,T}$ dBA	$L_{A90,15min}$ dBA	$L_{AF,max}$ dBA
Daytime (07:00 – 23:00)	16:00	69	58	100
Office hours (09:00 – 17:00)	07:00	72	63	100
Night-time (23:00 – 07:00)	08:00	64	46	77

In order to compare unattended and attended measurements the following table provides the approximate concurrent noise measurements from the unattended position.

Table 3—2 Unattended noise measurements with façade corrections at Location 1 (22/01/18 – 23/01/18)

Date	Start Time (HH:MM)	Elapsed Time (MM:SS)	$L_{Aeq,T}$ dBA	$L_{A90,15min}$ dBA	$L_{AF,max}$ dBA
23/01/19	08:15	15:00	68	62	84
	08:30	15:00	67	62	83
	08:45	15:00	68	62	83
23/01/19	06:00	15:00	65	58	74
	06:15	15:00	67	60	77
	06:30	15:00	69	63	92

	06:45	15:00	68	63	77
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3.3.2 Attended noise survey

Measured noise levels at each attended monitoring location are reproduced in Table 3—3 to Table 3—5. The presented noise levels are the period log averaged $L_{Aeq,T}$, $L_{A90,15min}$ values, and the highest typically occurring $L_{AF,max}$ event (i.e. road traffic events) during the period.

Table 3—3 Attended noise measurements at Location 2

Date	Start Time (HH:MM)	Elapsed Time (MM:SS)	$L_{Aeq,T}$ dBA	$L_{A90,15min}$ dBA	$L_{AF,max}$ dBA
23/01/19	08:16	15:00	62	56	76
23/01/19	06:00	15:00	59	51	77

Table 3—4 Attended noise measurements at Location 3

Date	Start Time (HH:MM)	Elapsed Time (MM:SS)	$L_{Aeq,T}$ dBA	$L_{A90,15min}$ dBA	$L_{AF,max}$ dBA
23/01/19	08:32	15:00	69	59	84
23/01/19	06:23	15:00	68	54	79

Table 3—5 Attended noise measurements at Location 4

Date	Start Time (HH:MM)	Elapsed Time (MM:SS)	$L_{Aeq,T}$ dBA	$L_{A90,15min}$ dBA	$L_{AF,max}$ dBA
23/01/19	08:49	15:00	69	60	84
23/01/19	06:45	15:00	70	58	85

3.4 Measurement Summary

A summary of typical, measured noise levels to be used for the assessment are overlaid onto an aerial site image in the image below.

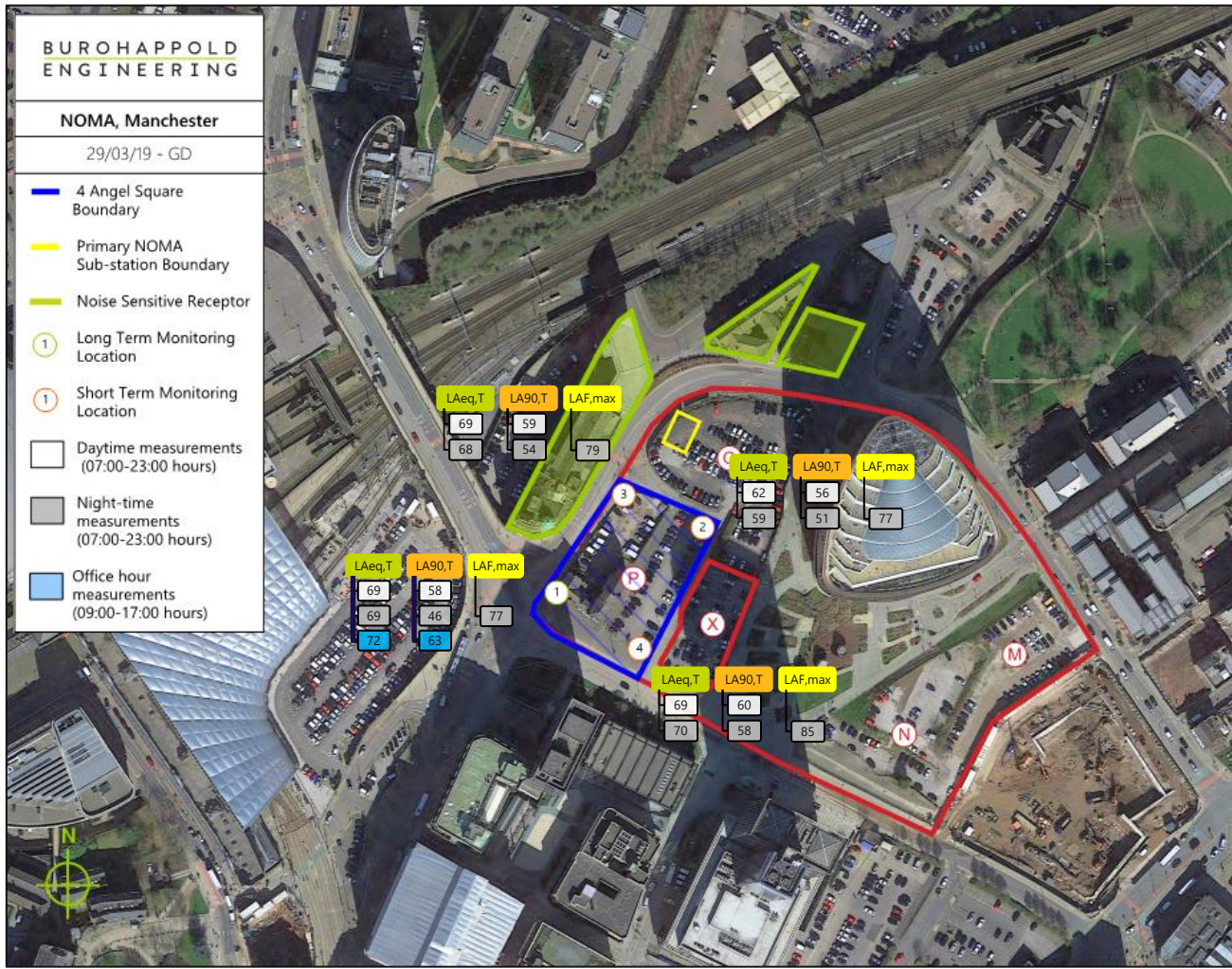


Figure 3—2 Site plan showing noise measurement summary

3.5 Discussion

The prevailing noise source at all locations was perceived to be traffic on the surrounding road network, particularly on Corporation Street and Miller Street. This is evident in the survey results, which show higher noise levels at locations that are closer to Corporation Street and Miller Street. Furthermore, it is noted that worst-case noise levels were measured at Location 1 during office hours (09:00-17:00 hours).

During attended noise measurements up to 15 cars, in 15 minutes, entered surrounding car parks via Beswick Row and Munster Street. These movements affected attended noise measurements and have been included in the presented results. Other audible noise sources included construction to the east of the site, and tram and train movements to the north above Red Bank road. However, it was noted, that these did not significantly contribute to measured noise levels.

4 Modelling

4.1 Introduction

A noise modelling exercise has been undertaken to estimate what the likely noise levels are at the façades of the proposed development. In addition, the NOMA development as a whole has been modelled according to Simpson Haugh architects Plot P – Planning Application Boundary drawing 10257-SHP-ZZ-XX-SK-A-G100-107 rev. P03 dated 6 March 2019. This includes the proposed sub-station building to the north on NOMA Primary Sub-station and the removal of Munster Street to the north and Oswald Street to the east. The plans for the whole of the NOMA development include pedestrianised areas between the proposed commercial buildings which will replace access roads that currently serve the car parks on site. The key outcome of this exercise is the assessment of required ventilation conditions and the selection of appropriate glazing specification(s) for the proposed commercial building (4 Angel Square).

4.2 Methodology

In order to determine noise propagation across the development site, a noise model has been produced using CadnaA 4.3 acoustic modelling software. The noise model has been constructed based on detailed Google Earth and OpenStreetMap mapping data. Local roads were added into the model to simulate noise sources that were measured during the on-site noise surveys.

The model predicts and maps the noise impacts on the proposed façades, considering factors such as distance attenuation, natural and man-made barrier attenuation, reflections and source directivity.

It has been established that the dominant, continuous noise source affecting the site during both daytime and night-time periods is the adjacent Corporation Street and Miller Street roads to the south and west. The constructed noise model has therefore been calibrated, based upon the measurement results summarised in Figure 3—2 to represent the noise climate on site as closely as possible. Furthermore, it is noted that worst-case noise levels were measured at Location 1 during office hours (09:00-17:00 hours) and, in-line with MCC recommendations (see Section 3.2), these noise levels have been used in the noise model to provide a worst-case assessment of predicted façade incident noise levels.

4.3 Limitations

The assessment has been based on the results produced through a noise modelling exercise, which provides predictions on the likely future noise levels. In order to increase the reliability of the results, the models have been calibrated to the noise levels measured on site during worst-case time periods, as described in Section 3.3. However, this does not guarantee the full accuracy of the predicted noise levels. Typically, an uncertainty within a range of approximately +/- 3 dB could be expected from computer noise modelling software. However, this uncertainty has been controlled as far as practicable by cross-referencing the levels of predicted noise impact against the measurements captured on site.

4.4 Results

The following noise maps show how noise is predicted to impact the proposed elevations during office hours (as identified above.)

Figure 4—1 to Figure 4—4 illustrate the predicted noise levels incident on the façades of the development during the daytime.

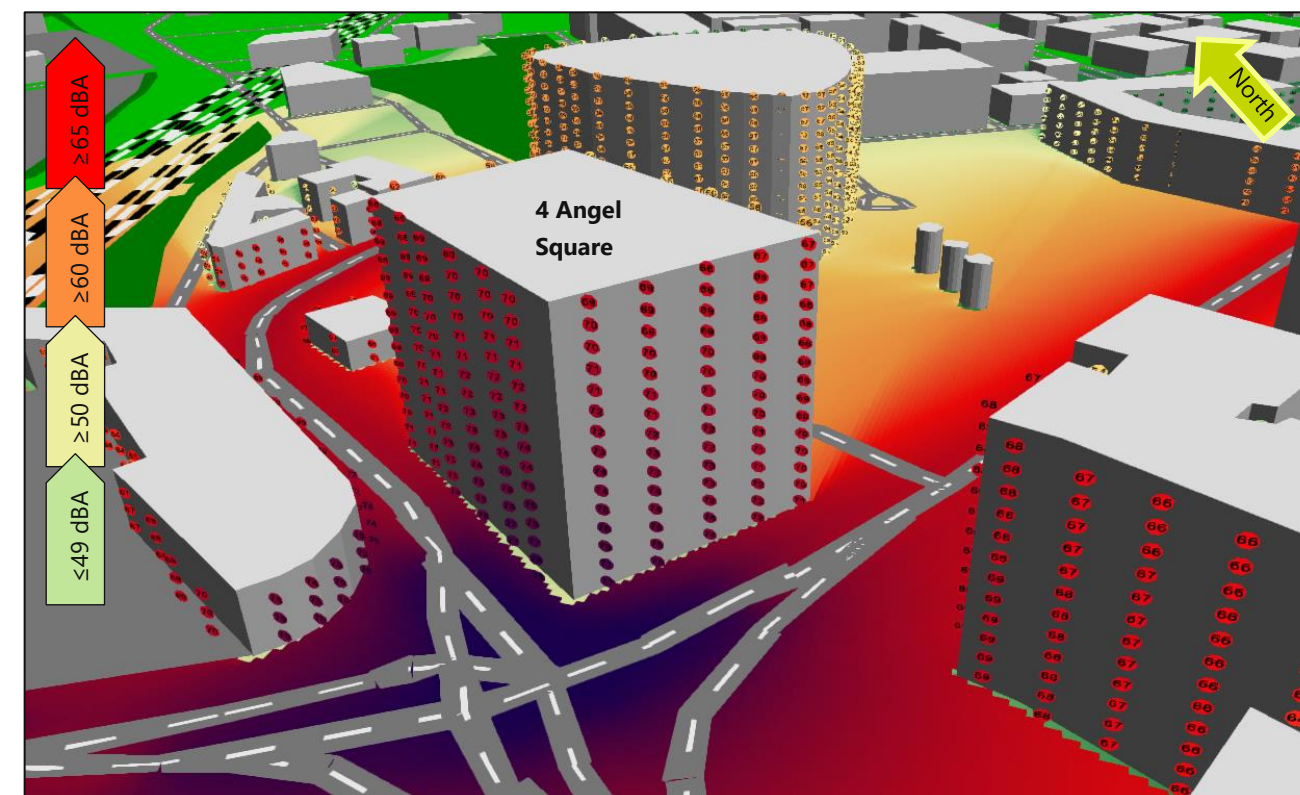


Figure 4—1 3D view of predicted daytime site wide noise levels ($L_{Aeq,T}$ dBA) south and west elevations

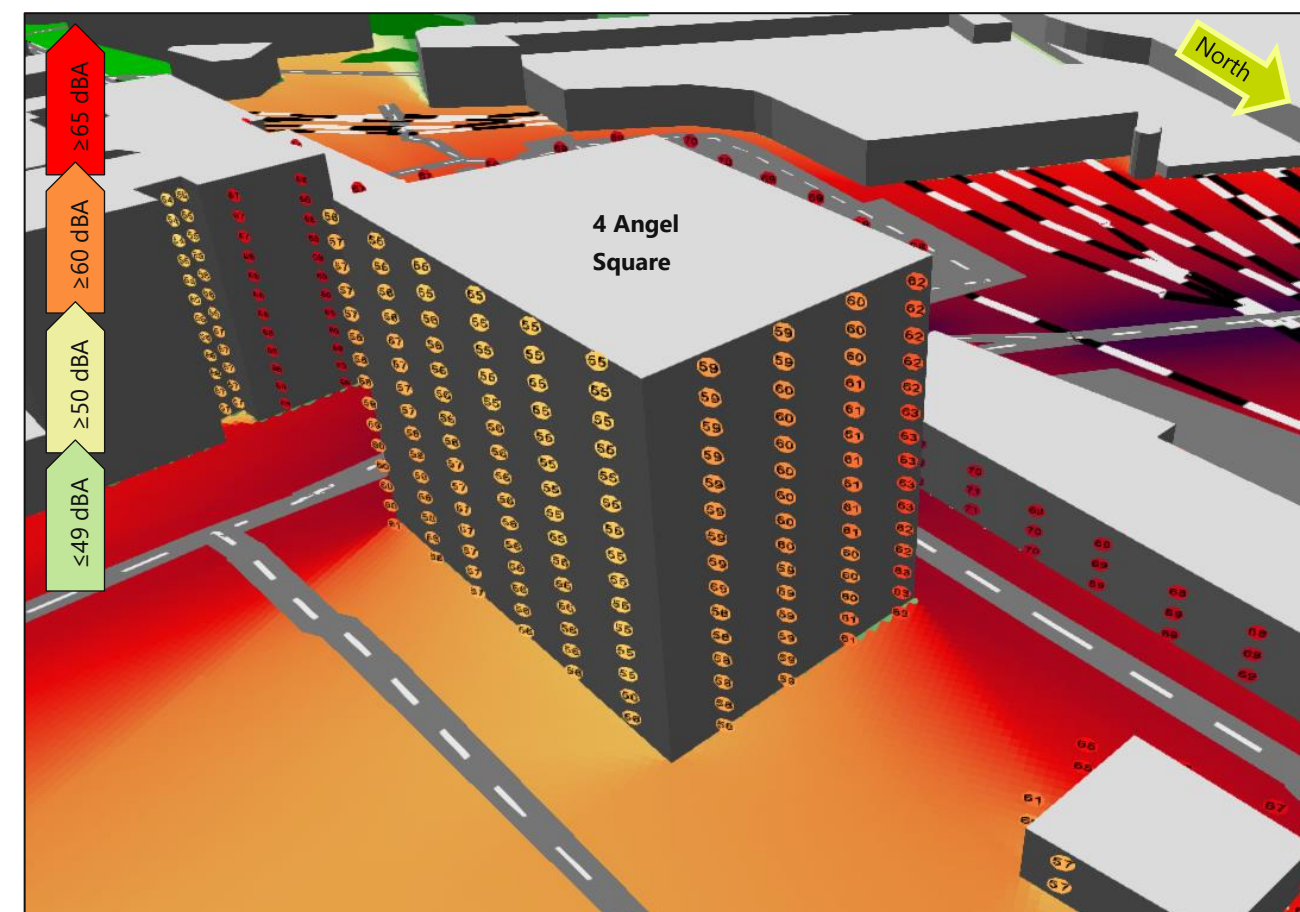


Figure 4—2 3D view of predicted daytime Plot P noise levels ($L_{Aeq,T}$ dBA) north and east elevations

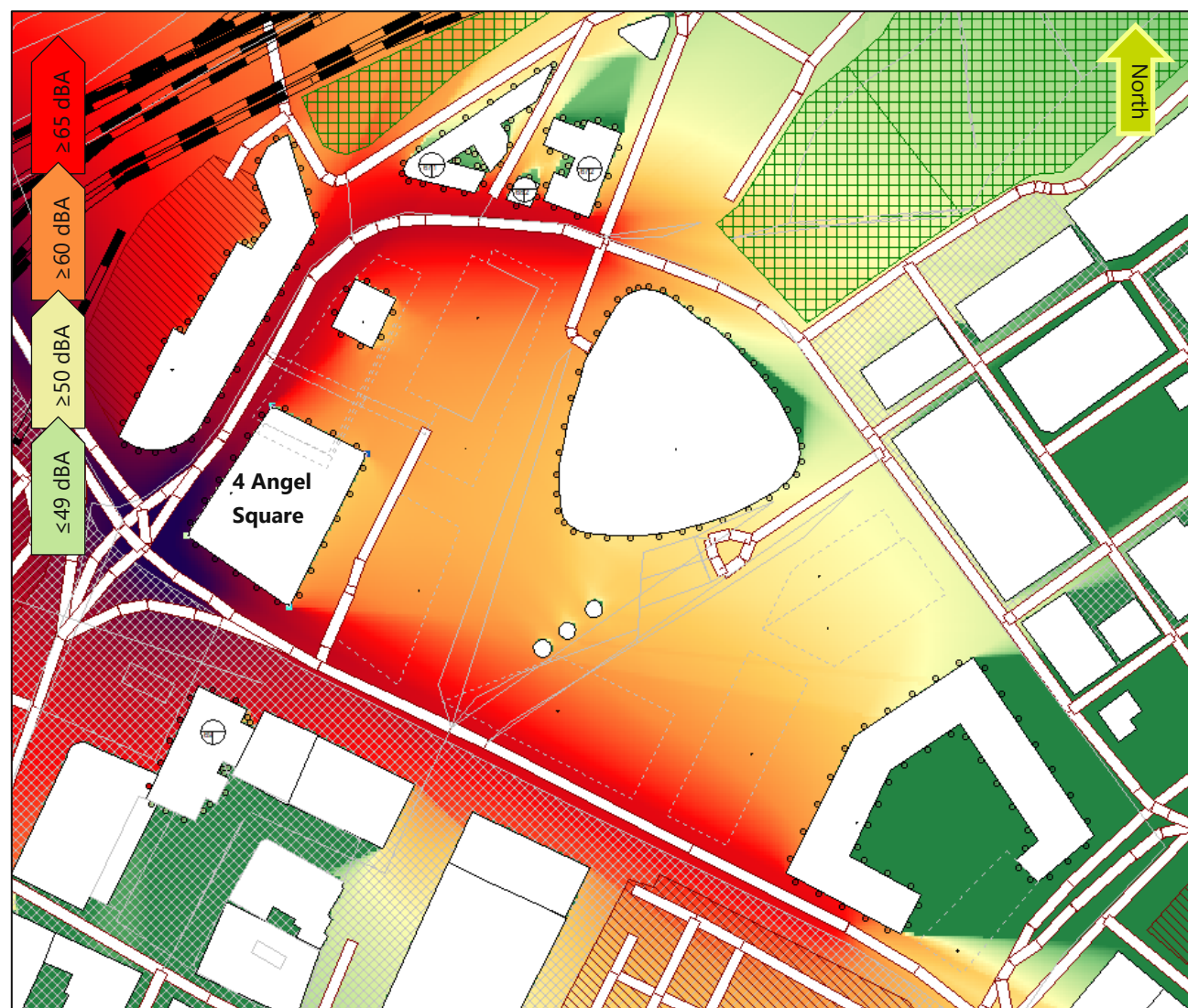


Figure 4—3 Plan view of predicted daytime site wide noise levels ($L_{Aeq,T}$ dBA)

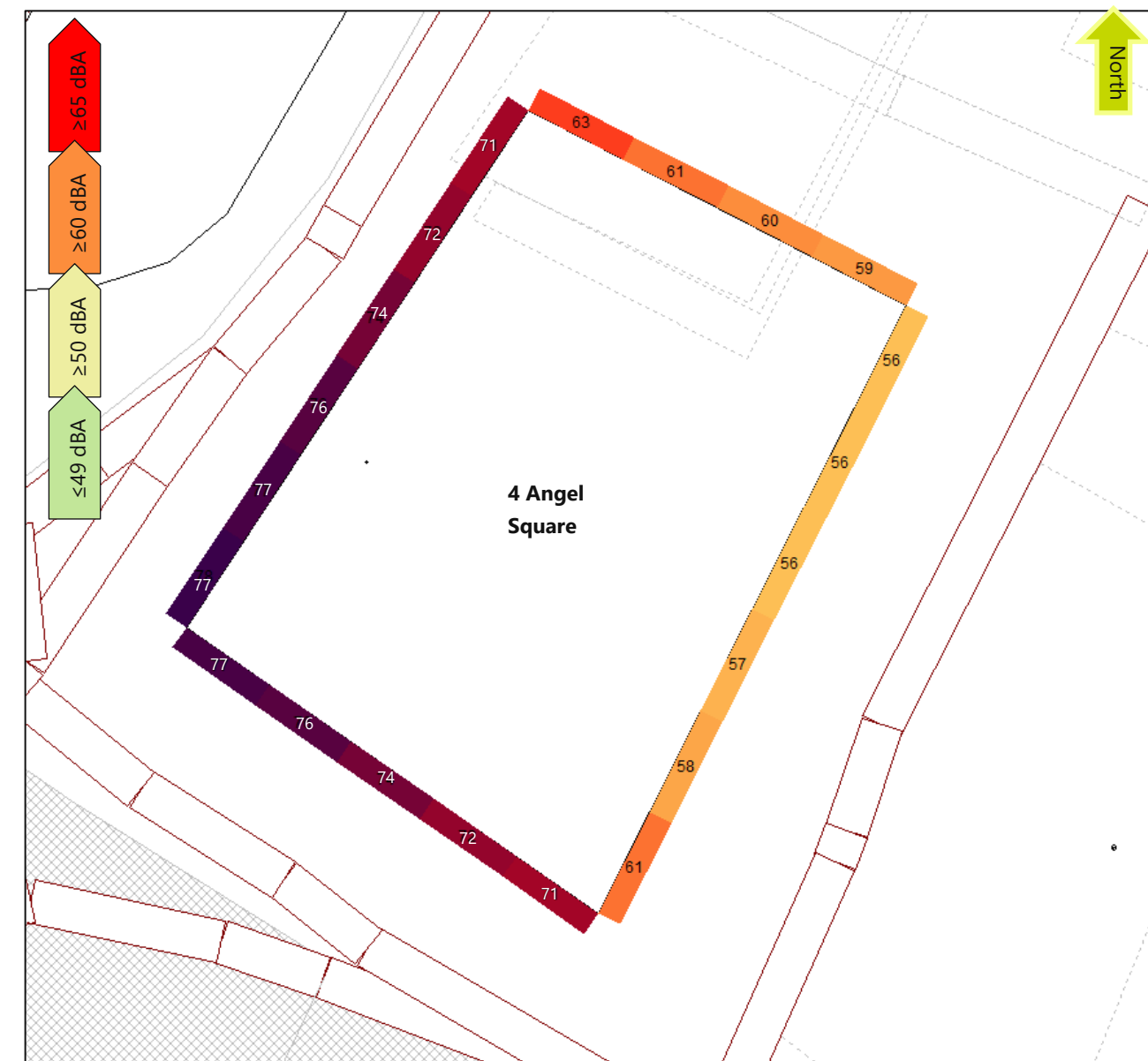


Figure 4—4 Predicted highest daytime 4 Angel Square façade incident noise levels ($L_{Aeq,T}$ dBA) for all elevations

4.5 Discussion

As can be seen from predicted noise levels presented in Figure 4—4, south and west elevations of the proposed 4 Angel Square building are likely to be exposed to high levels of traffic noise, up to approximately 77 $L_{Aeq,T}$ dBA, from the adjacent Miller Street and Corporation Street roads during the daytime. Moderate noise levels, up to approximately 63 $L_{Aeq,T}$ dBA, are predicted where elevations are at least partially screened from Miller Street and Corporation Street, or the junction of these roads on the south-west corner of the site.

As shown in Figure 4—1 and Figure 4—2, higher elevations benefit from an increased distance from the road network resulting in a decrease in noise levels with worst-case predicted noise levels located at ground floor level. In addition, the proposed roof terrace at Level 10 is likely to be subject to worst-case daytime noise levels of approximately 68 $L_{Aeq,T}$ dBA at the south façade.

5 Façade Acoustic Design & Noise Break-In

5.1 Introduction

The following section sets out the acceptable internal ambient noise level (IANL) criteria within commercial areas. Preliminary façade sound insulation requirements are also outlined in this section.

Regarding acoustics, the primary function of the building envelope (façade) is to attenuate external noise levels to achieve acceptable IANLs.

5.2 Building Orientation and Layout

As shown in Section 4, the dominant noise source is the Miller Street to the South and Corporation Street to the west and north of the site. If at all possible, the design of the building should aim to locate the most noise-sensitive spaces away from elevations which front the Miller Street and Corporation Street. It would also be helpful if the building is located as far away from these roads as possible.

It is understood that 4 Angel Square is to accommodate the following layout:

- Basement level - back-of-house (BOH) areas;
- Ground floor level - retail, back-of-house (BOH) and office lobby areas. These are considered double height areas i.e. 7 m high facades;
- Levels 1 to 11 – open plan office areas (shell and core);
- Roof terrace – proposed at Level 10; and
- Level 12 – enclosed roof plant area.

5.2.1 NOMA site development layout

The Proposed Development comprises the development on 4 Angel Square for office use and on part of 5 Angel Square to accommodate a Primary Sub-Station. The proposals are located within the 8.1 hectare / 20 acre NOMA Strategic Regeneration Framework Area located on the northern fringe of Manchester city centre. It is bounded by Corporation Street to the west, Angel Street to the north, Rochdale Road to the east and Balloon Street to the south.

It’s understood that the NOMA site is to consist of up to seven plots including 4 Angel Square which is understood to be the first building, alongside the NOMA Primary Sub-station enclosure, to be built as part of the latest NOMA site development. As such, the replacement of existing car parks and access road Munster Street with a pedestrianised area to north and east of 4 Angel Square, between the proposed commercial buildings has been outlined. In addition, the MCC draft planning application (see Section 2.1), states that consideration should be given if “any external seating areas are proposed, the assessment should consider the noise impact of these spaces.”

In order to protect 4 Angel Square from noise ingress on the existing site before screening via the proposed NOMA plots has been established, worst-case predicted noise levels as detailed in Figure 4—4 have been used in this assessment. This more onerous approach is likely to lead to over-specification should further plots be constructed on the NOMA site which later provides screening to 4 Angel Square. It will also allow for some degree of comfort from pedestrianised activities, which have not been detailed at this stage.

Furthermore, it has been agreed with MCC Highways regards car parking proposals and HGV movements for the NOMA development, “that the net impact of the proposal is very small as there are only circa 60 parking spaces and these replace

existing car parking.”³ Accordingly, this assessment includes the existing site conditions bordering 4 Angel Square, i.e. existing car parks and Beswick Row road, as the difference in traffic movements on the proposed site is understood to be ‘very small’.

5.3 Acoustic Criteria – Internal Ambient Noise Levels

Proposed internal ambient noise levels, based on BS 8233:2014 for the development are detailed in Table 5—1.

Table 5—1 Acceptable internal ambient noise levels within commercial and retail units (BS 8233:2014)

Activity	Location	Design range L _{Aeq,T} dBA
Speech or telephone communications	Department store Cafeteria, canteen, kitchen	50 - 55
-	Open plan office	45 - 50
Study and work requiring concentration	Executive office	35 - 40
Study and work requiring concentration	Staff / meeting room, training room	35 - 45
-	Restaurant	40 - 55
-	Night club, public house	40 - 45

Based on the proposed usages across the development, it is anticipated that internal ambient noise levels may need to be controlled to levels as low as L_{Aeq,T} 40 dBA. This level of internal ambient noise would be relevant for private offices where quiet concentration is required. Guidance documents such as the British Council for Offices (BCO) guidelines and BS 8233 recommend that the average internal noise level in private offices is typically ≤ L_{Aeq,T} 40 dBA, facilitating the users to carry out their daily tasks in relative peace and quiet. Levels within other spaces in the building (e.g. department store) could be considerably higher, however, the sections below focus on showing that levels within the most noise-sensitive spaces can be adequately controlled to ≤ L_{Aeq,T} 40 dBA. By definition, this indicates that the noise levels in less sensitive spaces are likely to be within required target values.

5.4 Façade Design Noise Levels

The design spectra is derived (based on a typical traffic noise spectrum) from the measured and subsequently calculated noise levels, in the CadnaA model to provide octave band design values. The figure below details the façade design noise levels across each elevation.

³ Confirmed in an e-mail from Alex Vogt (Technical Director, Curtins) dated 4 January 2019.

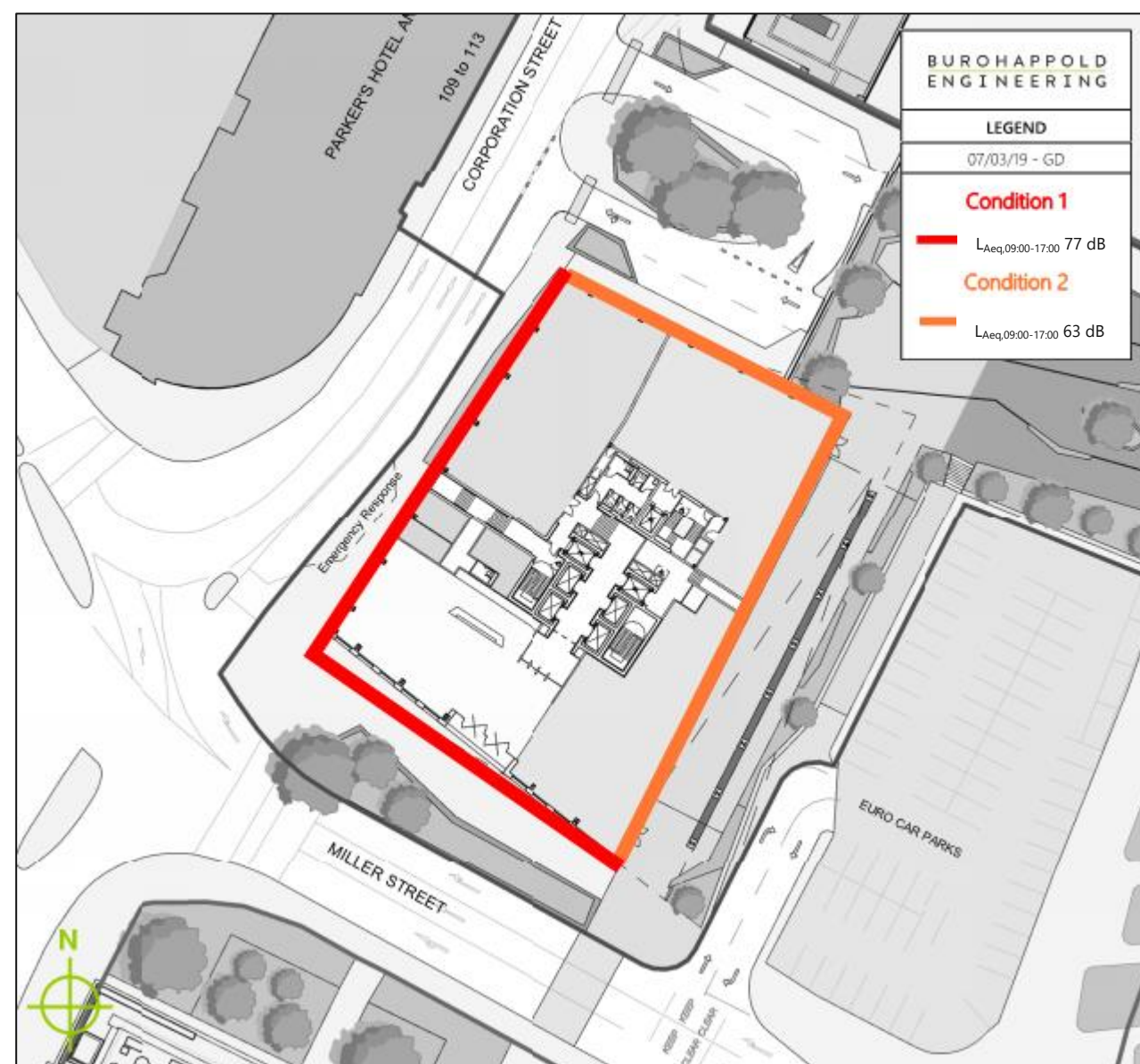


Figure 5—1 Façade design noise levels

5.5 Feasibility of Natural Ventilation

Natural ventilation is likely to be acceptable only where external levels are very low i.e. $L_{Aeq, daytime}$ 55 dBA. This is based on the following formula for the likely attenuation performance of a façade containing an open window and proposed internal noise levels (Section 5.3):

$$external\ level - 15\ dB = internal\ level$$

With reference to measured and predicted noise levels summarised in Section 5.4, it is likely that external noise levels will not be low enough in the majority of locations of the proposed development to consider natural ventilation.

5.6 Ventilation Strategy

Following consultation with Buro Happold MEP (the MEP consultants for the scheme) it is understood that 4 Angel Square, NOMA will be mechanically ventilated throughout, via a centralised system providing balanced supply and extract.

Mechanical ventilation, by its nature, is effective at preventing the ingress of environmental noise, due to the lack of need for un-ducted/un-attenuated openings in the external elevation required by natural systems (i.e. trickle vents). On that basis, the level of external noise break-in through the systems is likely to be negligible. Duct noise break-out into the commercial areas via the façade inlet/outlet terminations will be considered such that the noise path is negligible in comparison to the path through the façade and its elements (masonry and glazed).

In-line with the above, it is expected that the weakest elements of the external elevation will be the glazing systems. The specification of these elements will be the primary factor in determining the internal ambient noise level within commercial areas due to noise ingress from outside.

Calculation procedures follow the "more rigorous calculation method" outlined in BS 8233:2014, based on the following equation:

$$L_{eq,2} = L_{eq,ff} + 10 \log_{10} \left(\frac{A_0}{S} 10^{\frac{-D_{ne}}{10}} + \frac{S_{wi}}{S} 10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S} 10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S} 10^{\frac{-R_{rr}}{10}} \right) + 10 \log_{10} \left(\frac{S}{A} \right) + 3$$

Where:

- S_f is the total façade area in square metres (m²) of the room in question;
- S_{wi} is the area in square metres (m²) of the windows of the room;
- S_{ew} is the area in square metres (m²) of the external wall of the room;
- S_{rr} is the area in square metres (m²) of the ceiling of the room;
- S is the total area in square metres (m²) of elements through which sound enters the room, i.e. $S_f + S_{rr}$;
- $D_{n,e}$ is the insulation of the trickle ventilator measured according to BS EN ISO 10140;
- R_{wi} is the sound reduction index (octave band value) of the window;
- R_{ew} is the sound reduction index (octave band value) of the external wall;
- R_{rr} is the sound reduction index (octave band value) of the roof/ceiling;
- A is the equivalent absorption area of the receiving room being considered; and
- 3 is a correction factor.

5.7 Calculation Assumptions

The façade sound insulation requirements have been calculated using the design noise levels shown in Figure 5—1, an indoor ambient noise level of $\leq L_{Aeq,T}$ 40 dBA (Section 5.3), and the following indicative typical dimensions taken from Simpson Haugh architect drawings.

Dimensions used for cellular (executive) offices:

- 20 m² floor area;
- 13 m² (total) façade area;
- 13 m² of glazing within the façade;
- Mechanical ventilation; and
- 0.8 s reverberation time.

Open Plan Offices:

- 100 m² floor area;
- 26 m² (total) façade area;
- 26 m² of glazing within the façade;
- Mechanical ventilation; and
- 1.0 s reverberation time.

It is understood that designs are still subject to further development, therefore the glazing specification provided in this report are for guidance purposes only.

5.8 Glazing Requirements

The façade acoustic requirements are given in terms of $R_w + C_{tr}$, which are described as:

- **Weighted Sound Reduction Index, R_w** – a single figure value which describes the standardised performance of partitions when measured in a laboratory; and
- **Correction Traffic, C_{tr}** – a single correction value applied which takes into account the urban traffic noise spectrum.

The glazing for Conditions 1 and 2 should achieve sound reduction values, at each octave band centre frequency, equal to or greater than the values given below. Table 5—2 should be viewed in conjunction with Figure 5—1 to determine the sound insulation requirements across each elevation. These are considered worst-case glazing requirements due to the assumptions detailed in Section 5.3.

Table 5—2 Façade glazing requirements using mechanical ventilation

Condition	Room Type	Sound Reduction (dB) at Octave Band Centre Frequencies (Hz)						$R_w + C_{tr}$ dB	Example glazing Construction
		125	250	500	1K	2k	4k		
Condition 1	Cellular Office	29	40	45	47	56	68	42	Pilkington Optiphon double glazing - 16.8 mm laminated glass / 6 to 20 mm air gap / 16.8 mm laminated glass
	Open Plan Office	28	36	39	45	46	58	39	Saint Gobain Glass double glazing – 8 mm glass / 16 mm air gap / 16 mm glass with 2No. PVB interlayer
Condition 2	Cellular Office	20	18	28	38	34	38	27	Typical double glazing performance for 6 mm glass / 20 mm air gap / 6 mm
	Open Plan Office	21	17	25	35	37	31	25	Typical double glazing performance for 4 mm glass / 20 mm air gap / 4 mm

Calculations for the glazing requirements are for guidance purposes only, and are reproduced in Appendix A. Results of the calculations will be reviewed as the design progresses, and room sizes and glazing areas are confirmed.

6 Limiting Levels for Plant Noise Break-Out

6.1 Introduction

This section outlines mechanical plant noise limits to meet the requirements of the Local Planning Authority.

At this stage, plant selections have not been finalised and the most robust method in terms of controlling noise output will be to set limiting noise levels for plant at nearby noise-sensitive receptors (NSRs).

6.2 Noise Sensitive Receptors

The following noise sensitive receptors (NSRs) have been identified, these have been outlined in green on the annotated aerial image in Figure 6—1.

- Parkers Hotel Apartment adjacent to the western boundary separated by Corporation Street; and
- Residential properties to the north separated by Corporation Street.

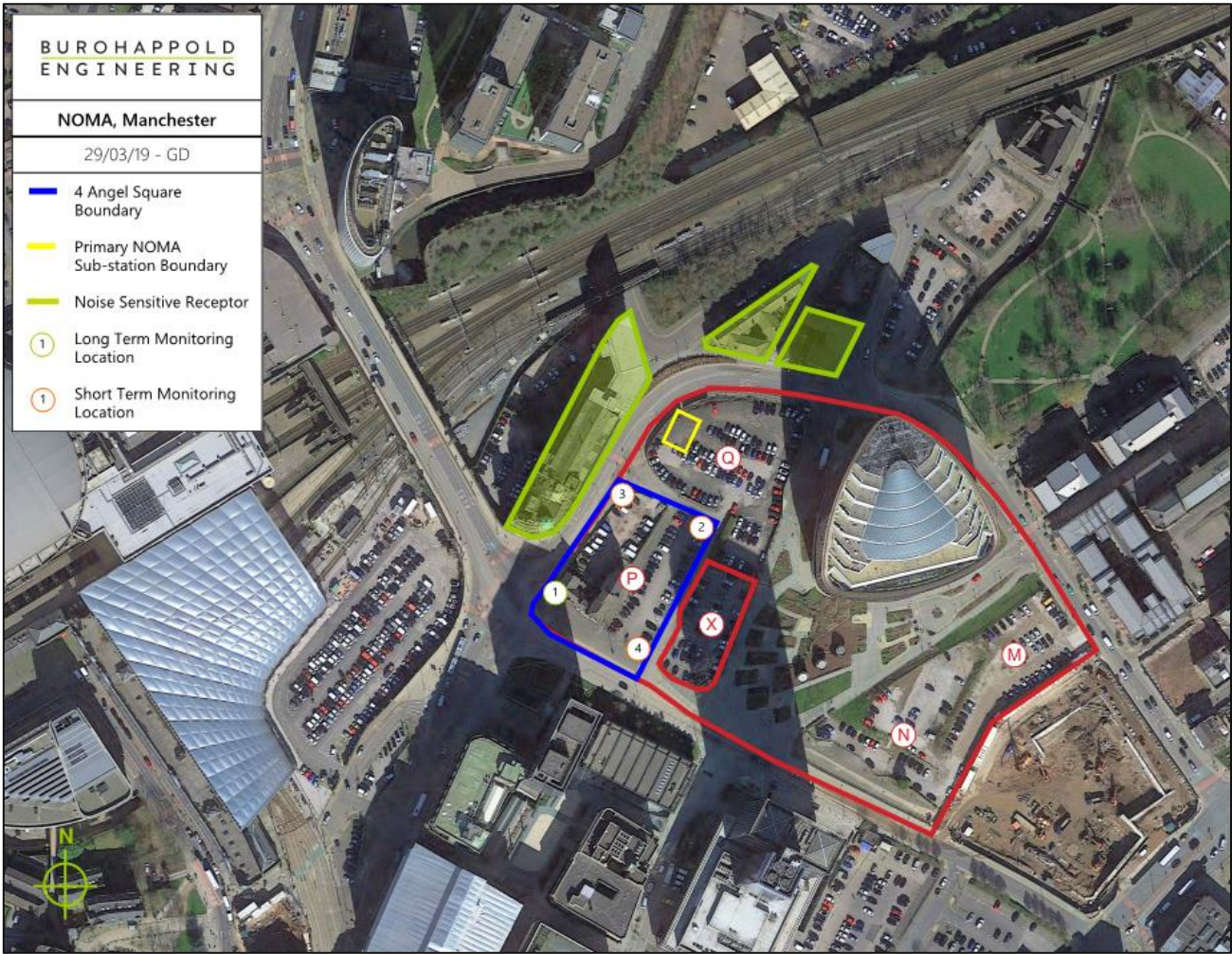


Figure 6—1 Site plan showing measurement locations, NSRs and site boundary

6.3 Design Criteria

6.3.1 Manchester City Council (MCC) - Planning and Noise - Technical Guidance

MCC state the following regards “Industrial / commercial developments” in Section 3.6.1.5 of the Planning and Noise - Technical Guidance document dated December 2015:

“BS 4142 should be used to assess the likely impact of noise from industrial and commercial sources at noise sensitive premises (section 3.5). One of the indications of the impact of a BS 4142 assessment is the lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

The Council consider that new developments should contribute and enhance the area in which they are located and where possible, contribute to the improvement of people’s health and quality of life as per the NPSE. With this in mind, the design objective should be:

‘The development should be designed so as to achieve a rating level of 5dB (LAeq) below the typical background (LA90) level at the nearest noise sensitive location’.

Furthermore, Section 3.6.1.5.1 in the MCC document states:

“Where fixed plant, equipment or machinery is attached to a building the vibration caused by it can pass through the building structure and cause structure-borne noise elsewhere in the building. Where it is to be installed in or on a building containing a noise sensitive use structure-borne noise, should be considered in the noise assessment and adequate control measures should be proposed.”

Selections of plant have not been made at this stage of the design process and therefore no mitigation measures have been specified. All plant should be mounted on suitable anti-vibration mounts which should adequately control structure-borne noise transfer into the proposed development.

6.3.2 Emergency Plant Criteria

MCC do not outline criteria for emergency plant in their guidance. However, a standard criterion adopted by the majority of Local Authorities is for noise emissions from emergency plant to not exceed 10 dB above the typical background level at 1 metre from the window of the nearest NSR. Correction factors may need to be applied to noise sources to account for tonality, impulsivity, and intermittency in general accordance with BS 4142:2014+A1:2019.

In order to limit the impact on nearby NSRs, scheduled testing of emergency plant equipment should be restricted to between Monday and Friday, 09:00 and 17:00 hours.

6.3.3 BREEAM – Pol 05 criteria

The BREEAM credit Pol 05 requires that the level of noise impact from any newly-introduced plant items is at least 5 dB lower than the background noise level (LA90,15mins) throughout the day and night when assessed at an existing noise-sensitive receptor. This is in-line with Local Authority criteria as detailed in Section 6.3.1, and as a result, applicable BREEAM credits are likely to be attained when compliance with the Local Authority is achieved.

6.3.4 British Standard 4142:2014

BS 4142:2014 provides methods for rating and assessing sound of an industrial and/or commercial nature. This includes sound from industrial and manufacturing processes, fixed services plant, sound generated by the loading/unloading of goods and sound from mobile plant / vehicles associated with industrial / commercial premises (e.g. forklift trucks).

The standard utilises various descriptors to assess complaints, the impact of sound associated with proposed industrial / commercial activities on existing noise-sensitive receptors, or the impact and likely suitability of siting new noise-sensitive receptors in the vicinity of existing industrial / commercial noise sources.

The standard is specifically precluded from being used to determine likely internal sound levels arising from external noise, or from the assessment of various sound sources for which other (more relevant) guidance exists, including music/entertainment noise, person noise and construction noise.

The magnitude of impact is assessed by subtracting the measured background sound level at a location representative of the nearest noise-sensitive receptor indices, from the ‘rating level’ indices (the specific sound source to be introduced into the locality, corrected for acoustically distinguishing characteristics which may make it more subjectively prominent).

Typically, the greater the difference between the background and rating level, the greater the magnitude of impact, although BS 4142 emphasises that this is highly context-specific.

As a guideline, BS 4142 states that:

- A difference (between the background and rating level) of around +10 dB or more is likely to be indicative of significant adverse impact, depending on context;
- A difference (between the background and rating level) of around +5 dB or more is likely to be indicative of adverse impact, depending on context;
- The lower the rating level relative to the background level, the less likely it is that the specific sound will have an adverse impact; and
- Where the rating level does not exceed the background level, this is an indication that the specific sound will have a low impact, depending on the context.

In addition to the above, Note 2 and Note 3 of BS 4142:2014 state that:

NOTE 2 Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact.

Where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration, including the following.

1) The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.

Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.

Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse.

2) The character and level of the residual sound compared to the character and level of the specific sound. Consider whether it would be beneficial to compare the frequency spectrum and temporal variation of the specific sound with that of the ambient or residual sound, to assess the degree to which the specific sound source is likely to be distinguishable and will represent an incongruous sound by comparison to the acoustic environment that would occur in the absence of the specific sound. Any sound parameters, sampling periods and averaging time periods used to undertake character comparisons should reflect the way in which sound of an industrial and/or commercial nature is likely to be perceived and how people react to it.

NOTE 3 Consideration ought to be given to evidence on human response to sound and, in particular, an industrial and/or commercial sound where it is available. A number of studies are listed in the “Effects on humans of industrial and commercial sound” portion of the “Further reading” list in the Bibliography.

3) 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 so as to provide rapid or purge ventilation; and*
- iii) acoustic screening.*

As such, BS 4142:2014 requires qualified engineering consultants and technical planning professionals (e.g. Environmental Health Officers) to use a combination of quantitative assessment techniques and rational qualitative judgements to come to a reasoned conclusion.

6.4 External Plant Noise Limits

Below, worst-case plant noise limiting levels are set for the proposed 4 Angel Square and Primary Sub-Station developments, based on the lowest measured background noise levels during the day and night-time periods (summarised in Figure 3—2) and Local Authority Criteria (Section 6.3.1). As a result, where plant noise levels are limited to those identified in Table 6—1, it is considered that the amenity of existing NSRs surrounding the proposed development site should be suitably protected in line with Local Planning Authority guidelines.

However, when further plant details are available (i.e. proposed locations), it may be suitable to base limiting noise levels on accompanying higher measured noise levels. It should be noted that the levels given in the table below are Rating levels i.e. include any required corrections for acoustically distinguishable features.

Table 6—1 Measured background noise levels and limiting plant noise levels at NSRs

NSR	Lowest measured daytime background noise level LA90,15min dBA (07:00-23:00)	Plant daytime noise limit at 1 metre from NSR Façades LA,r,T dBA (07:00-23:00)	Lowest measured night-time background noise level LA90,15min dBA (23:00-07:00)	Plant night-time noise limit at 1 metre from NSR Façades LA,r,T dBA (23:00-07:00)
All	56	51	46	41

It is considered likely that the separation distances between the mechanical plant inlet/outlet terminations and the noise sensitive elements (e.g. façade) of the proposed development itself will be much less than the distances to existing NSRs. Therefore, it is anticipated that the noise impact on proposed elevations will determine the likely noise levels at source, resulting in lower targets than given in Table 6—1, and as a result, the limiting plant sound pressure levels at existing NSRs should also be met.

6.4.1 Emergency Plant Noise Limits

As seen in Table 6—2, an emergency limiting plant noise level is proposed based upon measured background levels and uplifted by +10 dB to account for the irregularity of the noise occurring, in-line with typical Local Authority guidance. In order to limit the impact on nearby NSRs, scheduled testing of emergency plant equipment should be restricted to between Monday and Friday, 09:00 and 17:00 hours.

Table 6—2 Measured background sound levels and limiting rating emergency plant noise levels at NSRs

NSR	Lowest measured daytime background noise level LA90,15min dBA (07:00-23:00)	Emergency plant daytime rating limit at 1 metre from NSR Façades LA,r,T dBA (09:00-17:00)
All	56	66

6.5 NOMA Primary Sub-station

A single storey standalone housing construction for a sub-station consisting of 2No. transformers and cooling auxiliaries has been proposed on NOMA Primary Sub-station to the north of 4 Angel Square (see Figure 6—2). This sub-station will serve the whole NOMA Masterplan including 4 Angel Square.

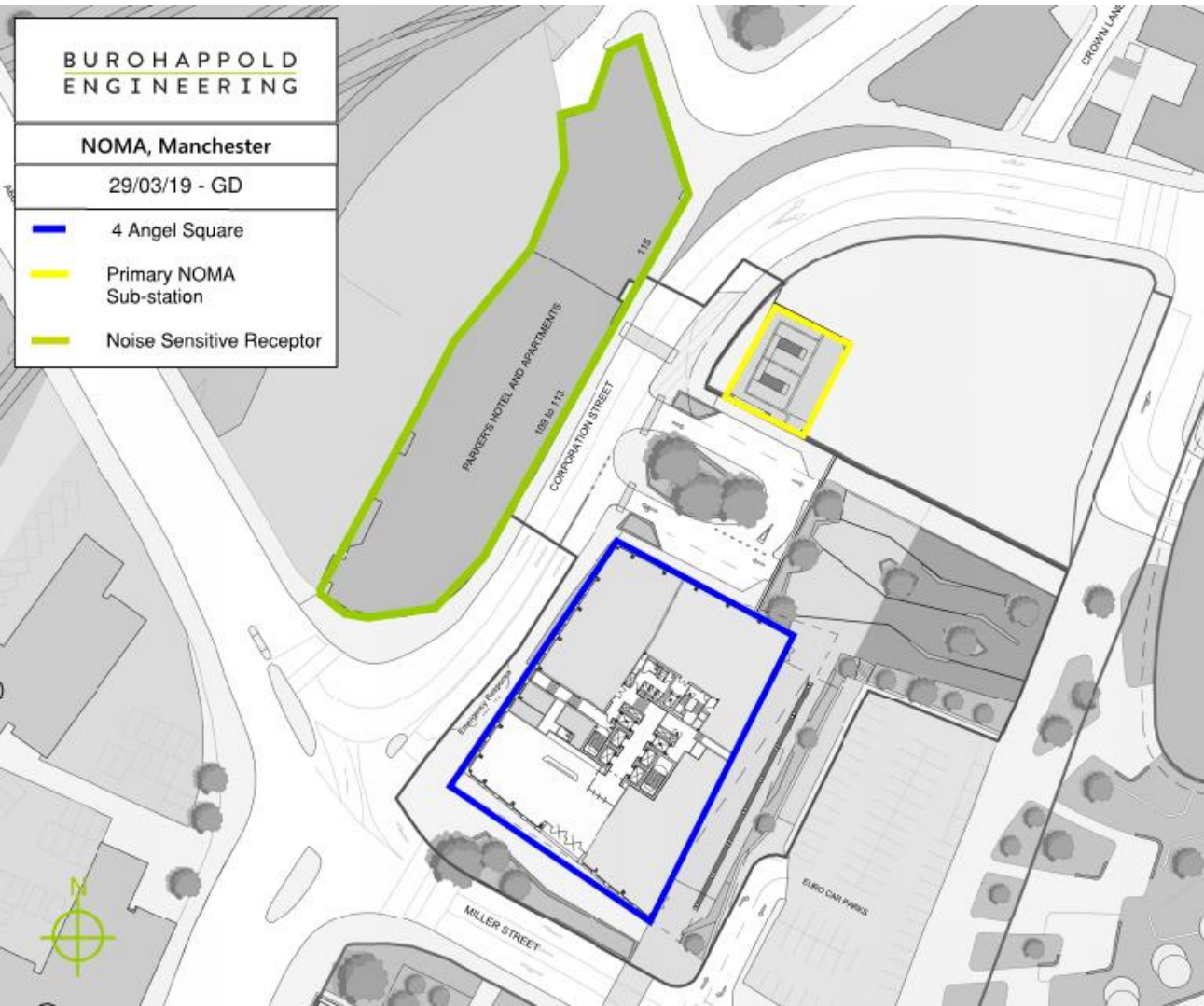


Figure 6—2 Site plan showing NOMA Primary Sub-station location, nearest NSR and 4 Angel Square

The following assessment has been based on sub-station layout, elevation, section and site plan drawings as received from Simpson Haugh architects (ref. 10257-SHP-Z1-XX-SK-A-G200-725 to 728 dated 10 April 2019).

The following assessment has been based on the following worst-case noise levels as agreed with Power On and Buro Happold Mechanical. All figures are in Sound Power Level (SWL):

- Daytime = SWL 78 dBA
- Night time = SWL 59 dBA

It is understood that the sub-station is to be naturally ventilated (i.e. no ducted fans). The sub-station will ventilate via acoustic louvres, DucoWall Acoustic W150, taking up 75.5 m² of the west elevation and 33 m² of the north elevation, and achieve the following performance levels.

Table 6—3 Proposed acoustic louvre performance – DucoWall Acoustic W150

Transmission loss (dB) at Octave Band Centre Frequencies (Hz)						
63	125	250	500	1k	2k	4k
8	5	4	7	11	12	13

The nearest noise sensitive receptors will be windows located at ground floor level on the adjacent Parkers Hotel Apartment, which is 21.5 m to the west and separated from the proposed sub-station by Corporation Street. In order to carry out a preliminary assessment a typical spectrum for a transformer noise has been used and adjusted to the single figure manufacturer data.

Based on the information within this section, noise levels at the nearest noise sensitive receptor are likely to be within the required Local Authority criteria outlined in Section 6.

Recommendations have been based on the details above and will not hold should plant be reselected and / or proposed sub-station design is altered. Furthermore, further design developments and / or consultation with suppliers may negate the proposed acoustic louvres should Local Authority Criteria still be achieved.

6.6 Proposed Plant

The proposed rooftop plant consists of: 5No. Air Handling Units (AHU), 2No. Air Source Heat Pumps (ASHP), 1No. Smoke ventilation fan, and 1No. Generator, as shown in Figure 1 in Appendix B. The roof is to be covered in a perforated metal deck that supports solar panels, which are considered unlikely to provide any significant attenuation of noise from rooftop plant. However, the predicted noise break out levels are acoustically acceptable based on proposed plant noise data as detailed in Appendix B.

6.7 Discussion and Implications

As can be seen above, plant must be limited to L_{A,T} 51 dBA / 41 dBA during daytime and night-time periods, respectively. These are reasonably high limits due to the high background noise in the vicinity of the nearest NSRs (dwellings adjacent to Corporation Street). It is understood that the design currently includes boilers within the basement for heating and chillers on the roof for cooling. Air handling plant is also proposed on the roof. It is understood operating hours are likely to be for 24 hours a day.

It is expected that noise from plant can be controlled to satisfy Local Authority criteria by selecting low noise plant items, and use of noise mitigation measures. These could include but are not limited to, atmosphere-side attenuators, duct lagging and mass barrier screens, examples of these are shown below. Selections for the development shall be made at the detailed design stage, once proposed plant details are known.

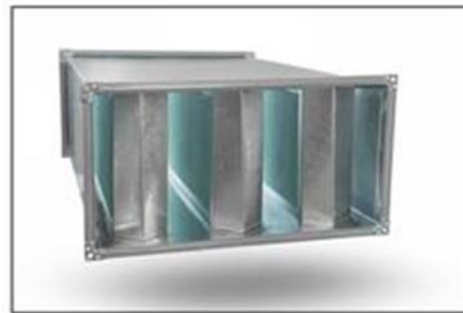


Figure 6—3 Rectangular attenuator

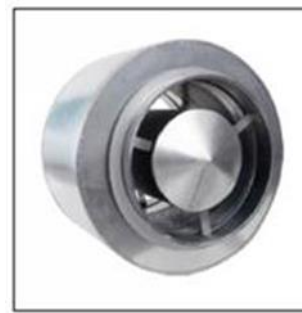


Figure 6—4 Circular attenuator



Figure 6—5 Duct lagging



Figure 6—6 Noise barrier with acoustic lining

7 Conclusions

The existing noise climate at the proposed development is such that acceptable internal ambient noise levels can be achieved with conventional double-glazed constructions.

It is understood that mechanical ventilation systems are to be used to provide the ventilation requirements for all internal spaces.

Limiting plant noise levels have been set in terms of $L_{A,T}$. These levels are based on achieving 5 dB below the representative background noise level at the nearest existing noise-sensitive receptors. It is anticipated that these limiting plant noise levels will be achieved due to the need to control noise levels at noise sensitive areas of the proposed development which are noted to be much closer. Furthermore, emergency plant noise criteria is also anticipated to be achieved in-line with proposed plant noise data.

Based on the above, the proposed development is considered suitable in terms of noise and planning, and acoustic concerns are not considered to represent any barrier to development.

Appendix A Noise Break-in Calculations

FAÇADE BREAK-IN CALCULATION														
Project Name	Plot P, NOMA, Manchester					BUROHAPPOLD ENGINEERING								
Room or space	Cellular Office - N and E													
Date	06/03/19													
ROOM CONSTANT & FAÇADE AREA														
Façade area (incl. window)	13.0 m ²					Area of the external wall	0 m ²	Room reverberation time (s)						
Area of the louver	0.0 m ²							Tmf	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
Area of the windows	13.0 m ²							0.8	0.8	0.8	0.8	0.8	0.8	0.8
Area of the roof/ceiling	20.0 m ²					Area of exposed envelope	33 m ²							
Room Depth (x)	5.0 m													
Room Width (y)	4.0 m													
Ceiling height (z)	2.6 m					Room Volume	52 m ³							
DISTANCE ATTENUATION CALCULATION														
Distance correction	No					Calculated Distance Attenuation	-							
Type of distance correction	Line source													
Distance from source to microphone	-													
Distance from source to receiver	-													
FREE FIELD LEVELS AT 1m FROM THE NOISE SENSITIVE FAÇADE														
LAeq						dB(A)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz		
	Free Field Leq in octave bands (dB)					63	65	61	59	59	55	50		
	Resultant Free-Field Leq with distance attenuation (dB(A))					63	65	61	59	59	55	50		
LAmix (if applicable)						dB(A)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz		
	Free Field Lfmax in octave bands					-	-	-	-	-	-	-		
	Resultant Free-Field LAmix with distance					-	-	-	-	-	-	-		
SOUND REDUCTION PROPERTIES OF BUILDING ELEMENTS														
						125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	R _w	R _w +C _{tr} (dB)	
Window (R _w)	Rw+Ctr 27dB BS12354 6/20/6					20	18	28	38	34	38	31	27	
Louver (R _w)	No Louver					0	0	0	0	0	0	0	0	
External wall Construction (R _w)	Typical external wall construction					46	44	46	54	62	67	52	49	
Roof Construction (R _w)	Typical roof construction					99	99	99	99	99	99	99	99	
						125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	D _{n,ew}	(dB)	
Trickle Vent (D _{n,ew})	No Vent					200	200	200	200	200	200	-	-	
CALCULATED INTERNAL LAeq AND LAF,max LEVELS														
						125Hz	250Hz	500Hz	1kHz	2kHz	4kHz			
Calculated LAeq in the receiver room (dB)						49	47	35	25	25	16			
Calculated LAFmax in the receiver room (dB)						-	-	-	-	-	-			
						L _{Aeq} (125-4000Hz)				L _{Amax} (125-4000Hz)				
						40 dB(A)				-				

FAÇADE BREAK-IN CALCULATION														
Project Name	Plot P, NOMA, Manchester					BUROHAPPOLD ENGINEERING								
Room or space	Cellular Office - S and W													
Date	06/03/19													
ROOM CONSTANT & FAÇADE AREA														
Façade area (incl. window)	13.0 m2					Area of the external wall	0 m2	Room reverberation time (s)						
Area of the louver	0.0 m2							Tmf	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
Area of the windows	13.0 m2							0.8	0.8	0.8	0.8	0.8	0.8	0.8
Area of the roof/ceiling	20.0 m2					Area of exposed envelope	33 m2							
Room Depth (x)	5.0 m													
Room Width (y)	4.0 m													
Ceiling height (z)	2.6 m					Room Volume	52 m3							
DISTANCE ATTENUATION CALCULATION														
Distance correction	No					Calculated Distance Attenuation	-							
Type of distance correction	Line source													
Distance from source to microphone	-													
Distance from source to receiver	-													
FREE FIELD LEVELS AT 1m FROM THE NOISE SENSITIVE FAÇADE														
LAeq						dB(A)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz		
	Free Field Leq in octave bands (dB)					77	79	75	73	73	69	64		
	Resultant Free-Field Leq with distance attenuation (dB(A))					77	79	75	73	73	69	64		
LAMax (if applicable)						dB(A)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz		
	Free Field Lfmax in octave bands					-	-	-	-	-	-	-		
	Resultant Free-Field LAMax with distance					-	-	-	-	-	-	-		
SOUND REDUCTION PROPERTIES OF BUILDING ELEMENTS														
						125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	R _w	R _w +C _{tr} (dB)	
Window (R _w)	Rw+Ctr 42dB 16.8 Pilkington Optiphon/ 6 to 20 mm / 16.8 Pilkington Optiphon					29	40	45	47	56	68	48	42	
Louwer (R _w)	No Louwer					0	0	0	0	0	0	0	0	
External wall Construction (R _w)	Typical external wall construction					46	44	46	54	62	67	52	49	
Roof Construction (R _w)	Typical roof construction					99	99	99	99	99	99	99	99	
						125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	D _{n,ew} (dB)		
Trickle Vent (D _{n,e,w})	No Vent					200	200	200	200	200	200	-		
CALCULATED INTERNAL LAeq AND LAF,max LEVELS														
						125Hz	250Hz	500Hz	1kHz	2kHz	4kHz			
Calculated LAeq in the receiver room (dB)						54	39	32	30	17	0			
Calculated LAFmax in the receiver room (dB)						-	-	-	-	-	-			
						L _{Aeq} (125-4000Hz)					L _{Afmax} (125-4000Hz)			
						40 dB(A)					-			

FAÇADE BREAK-IN CALCULATION															
Project Name	Plot P, NOMA, Manchester						BUROHAPPOLD ENGINEERING								
Room or space	Open Plan Office - S and W														
Date	06/03/19														
ROOM CONSTANT & FAÇADE AREA															
Façade area (incl. window)	26.0 m2						Area of the external wall	0 m2	Room reverberation time (s)						
Area of the louver	0.0 m2								Tmfr	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
Area of the windows	26.0 m2						Area of exposed envelope	####	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Area of the roof/ceiling	100.0 m2														
Room Depth (x)	10.0 m														
Room Width (y)	10.0 m						Room Volume	####							
Ceiling height (z)	2.6 m														
DISTANCE ATTENUATION CALCULATION															
Distance correction	No						Calculated Distance Attenuation	-							
Type of distance correction	Line source														
Distance from source to microphone	-														
Distance from source to receiver	-														
FREE FIELD LEVELS AT 1m FROM THE NOISE SENSITIVE FAÇADE															
LAeq							dB(A)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz		
	Free Field Leq in octave bands (dB)						77	79	75	73	73	69	64		
	Resultant Free-Field Leq with distance attenuation (dB(A))						77	79	75	73	73	69	64		
LAmax (if applicable)							dB(A)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz		
	Free Field Lfmax in octave bands						-	-	-	-	-	-	-		
	Resultant Free-Field LAmax with distance						-	-	-	-	-	-	-		
SOUND REDUCTION PROPERTIES OF BUILDING ELEMENTS															
						125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	R _w	R _w +C ₁ (dB)		
Window (R _w)	Rw+Ctr 39dB SGG 8/16/16 PVB interlayer (2no.)						28	36	39	45	46	58	44	39	
Louver (Rw)	No Louver						0	0	0	0	0	0	0	0	
External wall Construction (Rw)	Typical external wall construction						46	44	46	54	62	67	52	49	
Roof Construction (Rw)	Typical roof construction						99	99	99	99	99	99	99	99	
						125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	D _{n,ew}	(dB)		
Trickle Vent (D _{n,ew})	No Vent						200	200	200	200	200	200	-		
CALCULATED INTERNAL LAeq AND LAF,max LEVELS															
						125Hz	250Hz	500Hz	1kHz	2kHz	4kHz				
Calculated LAeq in the receiver room (dB)						52	40	35	29	24	7				
Calculated LAFmax in the receiver room (dB)						-	-	-	-	-	-				
						L _{Aeq} (125-4000Hz)			L _{Amax} (125-4000Hz)						
						39 dB(A)			-						

FAÇADE BREAK-IN CALCULATION															
Project Name	Plot P, NOMA, Manchester						BUROHAPPOLD ENGINEERING								
Room or space	Open Plan Office - N and E														
Date	06/03/19														
ROOM CONSTANT & FAÇADE AREA															
Façade area (incl. window)	26.0 m2						Area of the external wall	0 m2	Room reverberation time (s)						
Area of the louver	0.0 m2								Tmf	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
Area of the windows	26.0 m2								1.0	1.0	1.0	1.0	1.0	1.0	1.0
Area of the roof/ceiling	100.0 m2						Area of exposed envelope	####							
Room Depth (x)	10.0 m														
Room Width (y)	10.0 m														
Ceiling height (z)	2.6 m						Room Volume	####							
DISTANCE ATTENUATION CALCULATION															
Distance correction	No						Calculated Distance Attenuation	-							
Type of distance correction	Line source														
Distance from source to microphone	-														
Distance from source to receiver	-														
FREE FIELD LEVELS AT 1m FROM THE NOISE SENSITIVE FAÇADE															
LAeq							dB(A)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz		
	Free Field Leq in octave bands (dB)						63	65	61	59	59	55	50		
	Resultant Free-Field Leq with distance attenuation (dB(A))						63	65	61	59	59	55	50		
LAmax (if applicable)							dB(A)	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz		
	Free Field Lfmax in octave bands						-	-	-	-	-	-	-		
	Resultant Free-Field LAmax with distance						-	-	-	-	-	-	-		
SOUND REDUCTION PROPERTIES OF BUILDING ELEMENTS															
						125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	R _w	R _w +C ₁ (dB)		
Window (R _w)	Rw+Ctr 25dB BS12354 4/20/4						21	17	25	35	37	31	29	25	
Louver (Rw)	No Louver						0	0	0	0	0	0	0	0	
External wall Construction (Rw)	Typical external wall construction						46	44	46	54	62	67	52	49	
Roof Construction (Rw)	Typical roof construction						99	99	99	99	99	99	99	99	
						125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	D _{n,ew}	(dB)		
Trickle Vent (D _{n,ew})	No Vent						200	200	200	200	200	200	-		
CALCULATED INTERNAL LAeq AND LAF,max LEVELS															
						125Hz	250Hz	500Hz	1kHz	2kHz	4kHz				
Calculated LAeq in the receiver room (dB)						45	45	35	25	19	20				
Calculated LAFmax in the receiver room (dB)						-	-	-	-	-	-				
						L _{Aeq} (125-4000Hz)				L _{Amax} (125-4000Hz)					
						39 dB(A)				-					

Appendix B Rooftop Plant Noise Break-Out Assessment

Rooftop Plant Acoustic information

Noma Manchester



SES Engineering Services.
Think Park,
Building Three,
2nd Floor,
Mosley Road,
Trafford Park,
Manchester
M17 1FQ

Submitted and Prepared by: Andy Mills
Date: November 2022
Document No: NP4-SES-XX-XX-0001
Issue: P2

Document History

Issue	Date	Purpose	Author
P1	18/11/2022	Issued for comment	Andy Mills
P2	14/12/2022	Comments incorporated	Andy Mills

Approvals

This document requires the following approvals. Signed approval forms are filed in the Management section of the project files.

Name	Signature	Title	Date of Issue	Version
Michael Thomas	<i>M. Thomas</i>	Project Manager	18/11/2022	P1
Sam Butterworth	<i>S. Butterworth</i>	Snr Project Engineer	14/12/2022	P1

Noise criteria:

Table 5—1 Measured background sound levels and limiting rating plant noise levels at NSRs

NSR	Lowest measured daytime background sound level $L_{A90,15min}$ dBA (07:00-23:00)	Plant daytime rating limit at 1 metre from NSR Facades $L_{A7,Tf}$ dBA (07:00-23:00)	Lowest measured night-time background sound level $L_{A90,15min}$ dBA (23:00-07:00)	Plant night-time rating limit at 1 metre from NSR Facades $L_{A7,Tf}$ dBA (23:00-07:00)
All	56	51	46	41

Measured background sound levels and limiting rating emergency plant noise levels at NSRs

NSR	Lowest measured daytime background sound level $L_{A90,15min}$ dBA (09:00-17:00)	Emergency plant daytime rating limit at 1 metre from NSR Facades $L_{A7,Tf}$ dBA (09:00-17:00)
All	56	66

Emergency plant are likely to require regular testing (approx. once a week). This should be restricted to Monday to Friday between 09:00 and 17:00 hours, and not on public holidays. Furthermore, it is generally accepted that plant noise limits for emergency plant are relaxed in comparison to fixed plant associated with the normal operation of the building. A standard criterion adopted by the majority of Local Authorities is for noise emissions from emergency plant to not exceed 10 dB above the typical background level at 1 metre from the window of the nearest NSR.

In-line with measured background noise levels, an emergency limiting plant noise level is proposed based upon measured background levels and uplifted by +10 dB to account for the irregularity of the noise occurring, in line with typical local authority guidance. Levels are given in the table above and are rating levels i.e. include any required corrections for acoustically distinguishable features. On this basis correction factors may need to be applied for noise sources that contain certain acoustic features such as the tonality, impulsivity and intermittency, general accordance with BS 4142:2014+A1:2019.

5.9.2 Roof solar deck

The roof is to be covered in a perforated metal deck that supports solar panels, which are considered unlikely to provide any significant attenuation of noise from rooftop plant.

MEP Access and Maintenance Strategy

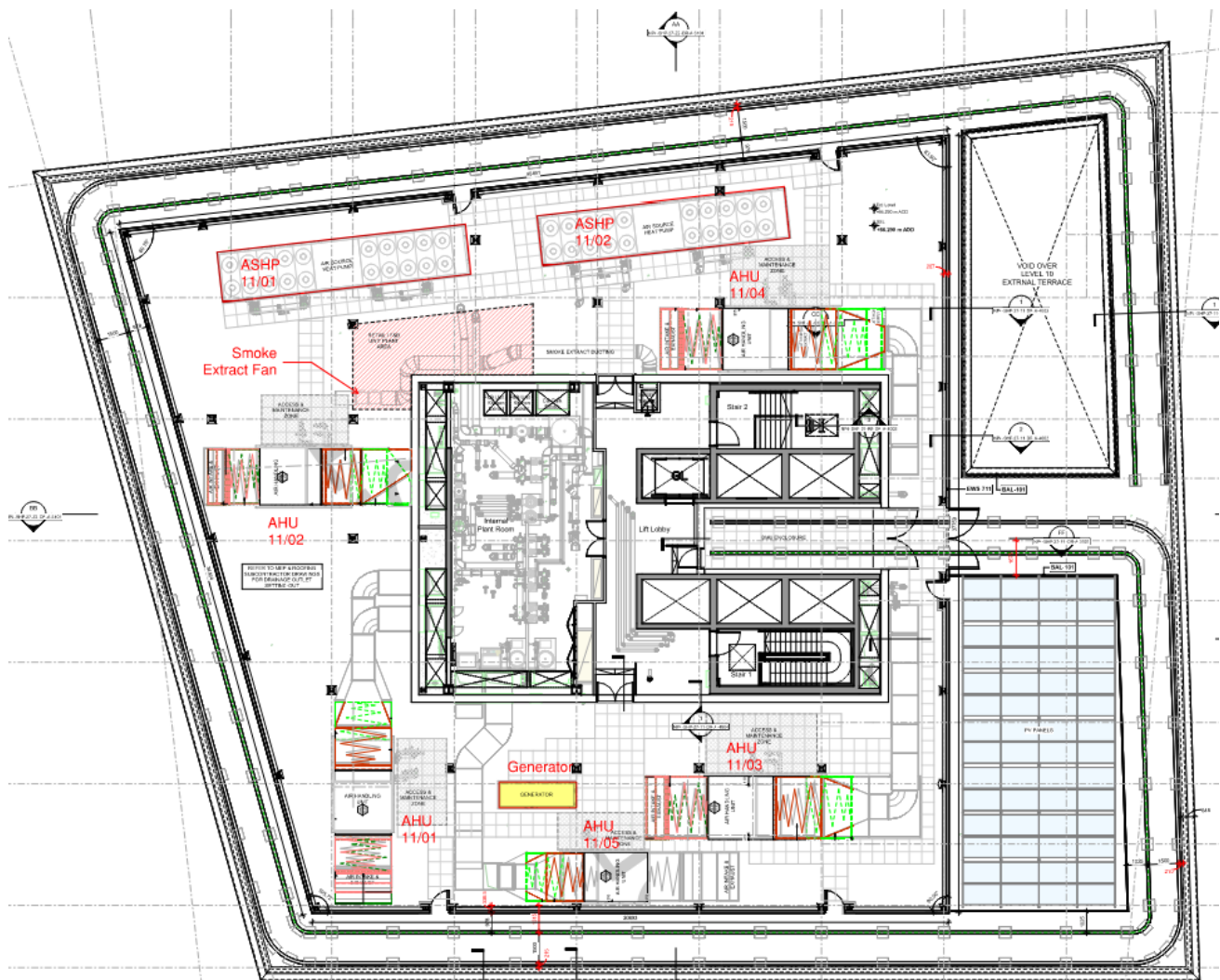
As illustrated in **Figure 1**, all roof plant AHU's, ASHP's, Generator, Smoke ventilation fans.) will be contained within the dedicated screened plant enclosure at roof level.

The scope of work is to install all major plant on the roof. The MEP plant comprises of:

- 5no. Air Handling Unit (AHU)
- 2no. ASHP's
- 1no. Generators
- 1no. Smoke Ventilation Fan

With exception to the ASHP's and essential services standby generator all plant, equipment, located within the external roof plant enclosure will be mounted on a proprietary 'Big Foot' plant support system.

Figure 1 – Rooftop Plant Layout



Air Handling Units – Sound Spectrum

AHU-11-01

FREQUENCY (Hz)	63	125	250	500	1K	2K	4K	8K
SUPPLY FAN DB INLET	70	84	77	74	71	68	65	64
SUPPLY FAN DB OUTLET	75	88	79	81	79	75	72	67
EXTRACT FAN DB INLET	69	79	75	73	69	65	63	62
EXTRACT FAN DB OUTLET	73	85	77	79	77	72	69	64

Breakout Noise

Ahu 11-01 47 DBA @ 5 Meters

AHU-11-02

FREQUENCY (Hz)	63	125	250	500	1K	2K	4K	8K
SUPPLY FAN DB INLET	69	83	77	74	71	67	65	64
SUPPLY FAN DB OUTLET	74	88	78	81	79	74	71	66
EXTRACT FAN DB INLET	71	78	74	72	68	65	63	61
EXTRACT FAN DB OUTLET	74	83	77	79	76	72	68	63

Breakout Noise

Ahu 11-02 46 DBA @ 5 Meters

AHU-11-03

FREQUENCY (Hz)	63	125	250	500	1K	2K	4K	8K
SUPPLY FAN DB INLET	77	82	78	75	73	70	67	68
SUPPLY FAN DB OUTLET	80	87	82	84	81	78	75	71
EXTRACT FAN DB INLET	80	81	78	75	72	69	66	67
EXTRACT FAN DB OUTLET	82	86	82	83	80	76	73	70

Breakout Noise

Ahu 11-03 49 DBA @ 5 Meters

AHU-11-04

FREQUENCY (Hz)	63	125	250	500	1K	2K	4K	8K
SUPPLY FAN DB INLET	76	82	78	75	73	70	67	68
SUPPLY FAN DB OUTLET	79	87	82	83	81	78	75	71
EXTRACT FAN DB INLET	79	81	78	75	72	69	66	67
EXTRACT FAN DB OUTLET	81	87	81	83	80	76	73	70

Breakout Noise

Ahu 11-04 49 DBA @ 5 Meters

AHU-11-05

FREQUENCY (Hz)	63	125	250	500	1K	2K	4K	8K
SUPPLY FAN DB INLET	71	87	77	74	71	67	66	64
SUPPLY FAN DB OUTLET	75	90	80	81	79	74	71	66
EXTRACT FAN DB INLET	70	80	74	72	69	65	63	61
EXTRACT FAN DB OUTLET	74	85	77	79	76	72	68	63

Breakout Noise

Ahu 11-05 48 DBA @ 5 Meters

AHU Attenuation

Refer to attenuator tech sub for conformation of the attenuator selection has been sized to achieve 50dB @ 5m from louvre in line with the acoustic report.

On the basis that this applies to all atmospheric terminations (i.e. supply fan inlets and extract fan outlets) then the proposed AHU design is acoustically acceptable including stated breakout noise as shown above.

Smoke extract Fan – Sound Spectrum

	Sound Spectrum (Hz)								Overall	
	63	125	250	500	1k	2k	4k	8k	Lw*	LpA @ 3 m**
Inlet*	94	94	97	97	96	94	91	85	103	80
Outlet*	94	94	97	97	96	94	91	85	103	80
Breakout*	86	78	77	77	76	73	76	66	88	61
Silencer B1D*	-3	-5	-10	-17	-13	-11	-10	-8	-	-

* Lw dB re 10⁻¹² W

** dBA re 2x10⁻⁵ Pa

Sound data at requested duty.

Acoustically agreeable in-line with proposed emergency plant criteria to be agreed with MCC.

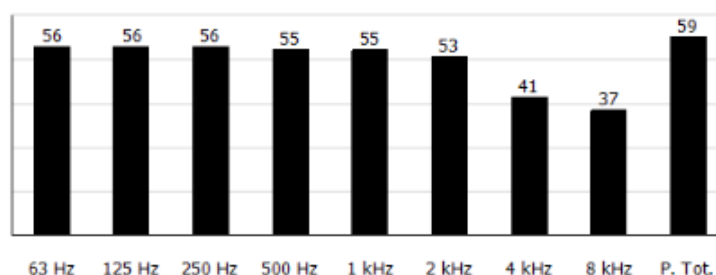
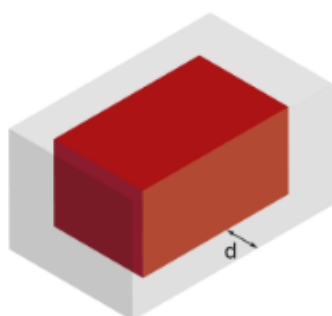
During test mode, we will programme the fans to run in a much lower speed than in fire mode to reduce the noise so the data shown above is only for fire mode.

During fire mode, the fans are designed to run at the duty required to clear smoke from the building and we would therefore seek relaxation of the planning consent on the basis that this is a life safety system, and that clearance of smoke should take priority over the noise.

Air Source Heat Pump – Sound Spectrum

SOUND DATA COLD

Frequencies	Hz	63	125	250	500	1000	2000	4000	8000
Sound power (spectrum)	dB	89	89	89	88	88	86	74	70
Total sound power level in cooling	dB(A)	92							
Sound pressure level (spectrum)	dB	56	56	56	55	55	53	41	37
Total sound Pressure	dB(A)	59							



SOUND DATA OUTDOOR HOT

Total sound power level in heating	dB(A)	92
------------------------------------	-------	----

Note

Distance	m	10
Note	Average sound pressure level at 10 m distance, unit in a free field on a reflective surface; non-binding value calculated from the sound power level. Sound power on the basis of measurements taken in compliance with ISO 9614.	

Acoustically acceptable and in-line with reported noise levels as follows:

Assuming noise from AHUs and other ventilation equipment are controlled to the levels stated in Section 5.9.4, the maximum sound power level each ASHPs can generate is L_{WA} 92 dB. Should preferred unit selections exceed this sound power level limit then localised screening may be required to reduce sound transmission to Parkers Apartments. A summary calculation showing the resulting noise level is given in Table 5—6.

Generator – Sound Spectrum

Dimensions DW soundproofed version

M139-DW

Length (mm) * Width (mm) * Height (mm)	3590 * 1200 * 2072
Dry weight (kg)	3045
Tank capacity (L)	868
Acoustic pressure level @1m in dB(A) 50Hz (75% PRP)	81
Sound power level guaranteed (Lwa) 50Hz (75% PRP)	97
Acoustic pressure level @7m in dB(A) 50Hz (75% PRP)	71



The sound data of the generator is suitable for hours of 7:00 – 23:00, we will therefore ensure all testing of the generator is written into the O&M's to be within this timeframe.

In the event of an emergency, we would seek relaxation of the planning conditions on the basis that this is a life safety piece of equipment that has been designed to support all life safety systems in the building for up to 12 hours.

Acoustically agreeable in-line with proposed emergency plant criteria to be agreed with MCC.

However, please note that testing should be restricted between 09:00 and 17:00 hours not 07:00 to 23:00 hours as stated above.

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