

11 Noise and Vibration

Introduction

- 11.1 This Chapter has been prepared by Acoustic and Engineering Consultants Limited (AEC). It assesses the likely significant effects of the Proposed Development with respect to noise and vibration. It also describes the methods used to assess the potential effects; the baseline conditions currently existing at the site and surrounding area; the mitigation measures required to prevent, reduce or offset any significant negative effects; and the likely residual effects after these measures have been adopted.
- 11.2 The assessment and findings included below are based on the revised scheme. However, it is important to note that the findings are in line with the noise and vibration chapter prepared for the original scheme that was submitted in June 2018.
- 11.3 Appendices referred to in this chapter are
- Appendix 11.1 - Acoustic Terminology
 - Appendix 11.2 - Measurement Procedure

Legislative and Policy Context

- 11.4 Relevant Legislation which references noise would include the Control of Pollution Act, 1974 and the Environmental Protection Act, 1990, both of which are discussed below.
- 11.5 Noise policy in the UK is determined by the Noise Policy Statement for England (NPSE), 2010, and the National Planning Policy Framework (NPPF), 2019, both of which are discussed below.

Legislation

- 11.6 Control of Pollution Act, 1974 – With regard to construction, Section 60 of the Control of Pollution Act states that Local Authorities can serve a notice imposing requirements as to the way in which the works are to be carried out and if it deems necessary, specify the following:
- the plant or machinery which is, or is not, to be used;
 - the hours during which the works may be carried out;
 - the level of noise which may be emitted from the premises in question or at any specified point on those premises or which may be so emitted during specified hours, and
 - provide for any change of circumstances.
- 11.7 If the notice is not complied with, the Act includes the power to prosecute the person who “*without reasonable excuse contravenes any requirement of the notice*”.
- 11.8 Environmental Protection Act, 1990 – Where it is deemed that a site is generating unnecessary and objectionable noise the Environmental Protection Act provides the powers for a Local Authority to serve a Noise Abatement Notice.
- 11.9 The site which has been served with the abatement notice can claim that they use ‘Best Practicable Means’ (BPM) in order to control noise emitted from site and no further remedial works can be undertaken.

National Planning Policy

- 11.10 Current national planning policies are set out in the National Planning Policy Framework (NPPF) published by the Department for Communities and Local Government and dated February

2019. This document provides little mention of planning policies relating to noise, with the exception of paragraph 123 that states:

“Planning policies and decisions should aim to:

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

11.11 The terms ‘*significant adverse*’ and ‘*adverse*’ included above are referenced to the Noise Policy Statement for England (NPSE), published by Department for Environment, Food and Rural Affairs (DEFRA) dated March 2010. One of the main aims of this policy is also to avoid significant adverse effects on health and quality of life.

11.12 With respect to the two terms above, the explanatory note for the NPSE introduces two concepts from toxicology that are currently being applied to noise impacts, for example, by the World Health Organisation (WHO). They are:

- NOEL – No Observed Effect Level - This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.
- LOAEL – Lowest Observed Adverse Effect Level - This is the level above which adverse effects on health and quality of life can be detected.
- Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse effect level.
- SOAEL – Significant Observed Adverse Effect Level - This is the level above which significant adverse effects on health and quality of life occur.

11.13 National Planning Practice Guidance (NPPG), an online resource, brings together the aims of the NPPG and NPSE and tries to indicate how the likely perception and average response to noise relates to the effect levels. This is summarised in the Table 11.1, below, replicated from the online NPPG.

Table 11.1 – National Planning Policy Guidance - Noise

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required

Perception	Examples of Outcomes	Increasing Effect Level	Action
Lowest Observed Adverse Effect Level			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

11.14 The policy does not include noise level limits for the different effect levels, instead stating that *"The subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation."*

11.15 These factors include:

- The source and absolute level of the noise together with the time of day it occurs. Some types and level of noise will cause a greater adverse effect at night than if they occurred during the day – this is because people tend to be more sensitive to noise at night as they are trying to sleep. The adverse effect can also be greater simply because there is less background noise at night;
- for non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise;
- the spectral content of the noise (i.e. whether or not the noise contains particular high or low frequency content) and the general character of the noise (i.e. whether or not the noise contains particular tonal characteristics or other particular features). The local topology and topography should also be taken into account along with the existing and, where appropriate, the planned character of the area.

11.16 More specific factors to consider when relevant:

- where applicable, the cumulative impacts of more than one source should be taken into account along with the extent to which the source of noise is intermittent and of limited duration;
- consideration should also be given to whether adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the

proposed mitigation relies on windows being kept closed most of the time. In both cases a suitable alternative means of ventilation is likely to be necessary.

Local Planning Policy

- 11.17 Manchester City Council (MCC) has a Local Development Framework, Core Strategy Development Plan, adopted 11 July 2012 and Section 26 "Development and Noise" of the Development Control Policies (saved Unitary Development Plan Policies). These documents identify the need to consider and assess noise in terms of controlling noise generating developments and considering the potential impact of existing noise on proposed noise sensitive developments.
- 11.18 MCC also has the 'Planning & Noise Technical Guidance' document, which was issued in December 2015. This document sets the following noise limits from residential developments:
- Bedrooms (night time - 23.00 - 07.00) 30 dB L_{Aeq} (individual noise events should not normally exceed 45 dB $L_{Amax,F}$ by more than 15 times)
 - Living Rooms (daytime - 07.00 - 23.00) 35 dB L_{Aeq}
 - Gardens and terraces (daytime) 55 dB L_{Aeq}
- 11.19 It should also be noted that, regarding ventilation, MCC states:
- "Occupants should be provided with a supply of fresh air in habitable rooms without having to open the windows (whilst also having the option to do this for purge ventilation, or at the occupant's discretion)."**
- 11.20 In terms of noise emissions from building services plant, MCC require that the 'rating' noise level from building services plant should not exceed a level 5dB below the existing background noise level at the nearest noise sensitive residential property.

Assessment Methodology and Significance Criteria

Assessment Methodology

- 11.21 The main noise and vibration sensitive receptors within the study area are residential dwellings, flats and rooms for residential purposes on Arundel Street, Worsley Street, Ellesmere Street, and the residential properties within St. George's Church.
- 11.22 In order to assess the potential effects of noise and vibration from the Proposed Development, the pre-existing baseline noise conditions, within the study area, have been surveyed. A daytime noise survey was undertaken on Friday 2 December 2016 from around 0745h to 1100h, and a night-time noise survey was undertaken on Thursday 8 to Friday 9 December 2016, to establish the typical baseline noise climate. As there have been no significant changes in the area that would affect the noise climate, AEC is satisfied that the noise data obtained is entirely representative of the present situation.
- 11.23 Full details of the noise surveys are included as Appendix 11.1 and the findings are summarised in 'baseline conditions', presented later in this chapter.
- 11.24 The main assessment guidance referenced in this study are listed below:
- BS 7445, 1991: "*Description and Measurement of Environmental Noise*". This document provides guidance for when undertaking external noise measurements;
 - BS 5228, 2009: "*Code of practice for noise and vibration control on construction and open sites. Part 1: Noise*" (BS5228-1). This document provides noise levels from typical construction activities, assessment methodologies for predicting noise levels and determining of significant effects, and provides best practice noise control/mitigation advice;
 - BS 5228, 2009: "*Code of practice for noise and vibration control on construction and open sites. Part 2: Vibration*" (BS5228-2). This document provides noise levels from typical

construction activities, assessment methodologies for the determining of significant effects and best practice vibration control/mitigation advice;

- BS 6472:2008 – “*Guide to evaluation of human exposure to vibration in buildings*”, this document provides guideline limits for ground-borne vibration affecting people in buildings.
- ISO 9613-2:1993: Acoustics – “*Attenuation of sound during propagation outdoors - Part 2: General method of calculation*”. This document provides a calculation methodology for predicting external noise levels.
- BS 4142, 2014: “*Methods for rating and assessing industrial and commercial sound*” (BS4142). This document provides an assessment methodology for assessing the likelihood of complaints from industrial and building services noise affecting residential areas;
- World Health Organisation - “*Guidelines for Community Noise*”, 1999. This document provides guidance as to what could be considered to be acceptable noise levels inside and outside residential buildings, in order to minimise risk of adverse effects of noise on outside amenity and health and wellbeing.
- BS 8233:2014 – Guidance for “*Sound Insulation and Noise Reduction for Buildings*” (BS8233). This document provides recommendations for internal noise levels in various noise sensitive buildings and assessment methods for predicting the sound insulation performance of building envelopes;
- Calculation of Road Traffic Noise (CRTN), Department of Transport (Welsh Office), 1988. This document details a calculation procedure for the prediction of road traffic noise levels; and
- Design Manual for Roads and Bridges Volume 11, Part 3, Section 7, HMSO, 1994 (DMRB 11:3:7), 2011. This document provides a procedure for assessing the potential noise impact of proposed road transport schemes;

11.25 The above calculation and assessment methodology guidance documents have been utilised, alongside AEC’s professional experience on similar previous projects, to assess the potential noise and vibration effects of the Proposed Development.

11.26 The assessment is based on information provided by others, including, the illustrative masterplan layout from Simpson Haugh (refer to Chapter3: The Proposed Development) and traffic forecast information from Curtins (refer to Transport Statement).

Significance Criteria

Construction Noise

11.27 The magnitude and significance of effects due to construction noise can be determined with reference to guidance in BS5228-1. This document presents different methods of assessing the significance of noise effects, which reflects the conventional approach within EIA methodologies. However, the methods are largely concerned with determining as to whether or not there has been a ‘significant effect’ as opposed to the level of significance.

11.28 Two methods are introduced which relate to the significance based on fixed noise limits and the significance based on noise change. The fixed limits suggested are 70dB(A) (07:00 to 19:00 hours) for rural, suburban and urban areas away from road traffic and industrial sources and 75dB(A) for urban areas near main roads.

11.29 For the second method the ‘Total noise’ (pre-construction ambient plus construction noise) exceeds the pre-construction ambient noise by 5dB or more, subject to lower cut-off values of 65 dB, 55 dB and 45 dB $L_{Aeq,T}$ period, from construction noise alone, for the daytime (07:00-19:00), evening (19:00-23:00) and night-time (23:00-07:00) periods, respectively.

11.30 As indicated there is no method to determine if any predicted significant adverse effects are of ‘minor’, ‘moderate’ or ‘major’ significance, consistent with the EIA terminology adopted,

however with reference to the guidance, it is considered the following approach could be taken where there is a +5dB change or greater for the period of (07:00 to 19:00 hours):

- Total Noise 65-70dB(A) – Minor Significance;
- Total Noise 70-75dB(A) – Moderate Significance;
- Total Noise >75dB(A) – Major Significance.

- 11.31 It is also suggested that, depending on if the effect is for a short or long duration, the reported effects can move to adjacent bands. I.e. piling noise may be >75dB, but may only occur over 1 week duration therefore would be considered as of 'moderate' significance.

Operational Noise – Commercial/Industrial Noise

- 11.32 The only operations which could impact on the nearest noise sensitive receptors relate to noise from activities associated with the ground floor commercial units, and from any building services plant connected to the scheme.
- 11.33 The assessment of noise from these sources is presented in BS4142, which compares the 'rating' noise level ($dB_{L_{Ar,Tr}}$) from a noise source with the background noise level (dB_{LA90}) without the noise source operating.
- 11.34 A 'rating' noise level is derived from the character correction applied to the 'specific' noise level ($dB_{Aeq,Tr}$) of the source if the noise has a defined acoustic character such as being tonal, impulsive, distinctive or intermittent in nature.
- 11.35 The impact of the noise source is calculated by subtracting the background noise level from the rating level, the resulting difference is then used to determine the likelihood of impact, as presented in Table 11.2, below. BS4142 states "*Typically, the greater this difference, the greater the magnitude of impact*".

Table 11.2 – BS4142 Assessment Parameters

Difference between rating and background noise level	Assessment
+10dB or more	Significant adverse impact
+5dB	Adverse impact
< 0dB	Low impact

- 11.36 Further to this, when one noise is 10dB lower than another (e.g. the background noise), the lower noise is generally inaudible. On this basis, the significance criteria detailed in Table 11.3, below, are proposed for building services noise.

Table 11.3 – Plant Noise Significance Criteria

Difference between rating and background noise level	Significance Assessment
≥+10dB	Major (SOAEL)
-9dB - +9dB	Minor-Moderate LOAEL
≤-10dB	Negligible (NOEL)

- 11.37 As stated above, MCC requires that the 'rating' noise level from building services plant does not exceed a level 5dB below the existing background noise level at the nearest noise sensitive residential property.

Operational Noise – Transport

- 11.38 Traffic noise, particularly from freely flowing traffic, is a relatively uniform noise source without strong tonal or impulsive characteristics. It is common practice to use the change in noise level brought about by a scheme as the basis for evaluating noise impacts (i.e. the impact of the scheme on the pre-existing noise environment and the effects this may have on the receptors in that environment).
- 11.39 The scale or severity of any noise change, positive or negative, requires description to indicate the degree of impact where possible. This leads to the common practice of defining noise change impact categories with an associated semantic scale.
- 11.40 The latest version of DMRB 2011 uses this guidance in developing the classification of magnitude of noise impacts in the short term included in Table 11.4, below. In order to determine the significance of any change in the noise environment at the location of nearby sensitive receptors, the significance criteria appear to reflect advice defined in the draft document Guidelines for Noise Impact Assessment, published by the Institute of Environmental Management and Assessment (IEMA) and the Institute of Acoustics (IOA).

Table 11.4 - Significance of changes in road traffic noise levels in short term

Change in Noise Level, dB	Impact Magnitude Category	Initial Indicator of Significance Effect
≥ +5	Major adverse	Potentially significant adverse Effect
+3 to +4.9	Moderate adverse	
+1 to +2.9	Minor adverse	
-0.9 to +0.9	Negligible	Unlikely to be significant
-1 to -3	Minor beneficial	Potentially significant beneficial Effect
-3 to -5	Moderate beneficial	
≤ -5	Major beneficial	

- 11.41 The significance of the noise impacts from vehicle movements and car parking upon nearby sensitive receptors has primarily been assessed by comparing the predicted change in vehicle movements to and from the site with the existing situation. Any noise impact is calculated using the formula $10 \times \log(\text{new movements/existing movements})$. A doubling of movements would, for example, potentially result in a 3dB increase in noise levels.

Gym (Amplified Music/Sound)

- 11.42 Where a residential property is structurally connected to an 'entertainment venue' (assumed to also relate to gyms where amplified music is played), MCC's 'Planning & Noise Technical Guidance' document states that music noise should be inaudible in all habitable rooms.
- 11.43 Specifically MCC states:
- "...a criterion that would achieve a condition of 'inaudible' / 'virtually inaudible' which is applicable for new residential developments that are structurally connected to entertainment venues (or vice versa) would be:**
- 'Music noise levels in the 63Hz and 125Hz octave centre frequency bands (Leq) should be controlled so as not to exceed (in habitable rooms) 47dB and 41dB (Leq), respectively'."**
- 11.44 On this basis, in order to meet MCC's planning condition, music noise would be inaudible, and hence the significance would be negligible (NOEL).
- 11.45 In terms of music noise affecting buildings not structurally connected to the venue, MCC's guidance document states:

"A planning application for a new entertainment venue that is structurally detached from other building uses should demonstrate that music noise from the proposal will not be 'audible' in nearby residential properties, assuming that the residential properties in question have their windows open. The criterion here is:

'Entertainment noise (L_{Aeq}) should be controlled to 10dB below the background noise level (L_{A90}) without the entertainment noise present, in each octave band at the nearest noise sensitive location'."

- 11.46 Again, as MCC's standard condition is to achieve inaudibility, the significance would be negligible (NOEL).

Vibration

Construction Vibration

- 11.47 The threshold of perception for vibration depends on the frequency. The human body is most sensitive to vibration in the frequency range 1-80 Hz. The threshold of perception is typically taken to be 0.14 mm/s and 0.3 mm/s peak particle velocity at frequencies between 8 Hz and 80 Hz. At 1mm/s the vibration levels are such that they could cause complaints from people in residential properties. For levels at or above 10mm/s vibration is likely to be intolerable for anything more than a brief exposure.
- 11.48 BS6472:1992 contains guidance relating to human exposure to vibration. A methodology is presented for assessing the human response to vibration in terms of the vibration dose value (VDV).
- 11.49 Experience shows that disturbance or annoyance from vibration in residential situations is likely to arise when the magnitude of vibration is only slightly in excess of the threshold of perception.
- 11.50 For building damage criteria, Table 1 of BS 7385: Part 2:1993: "Evaluation and Measurement for Vibration in Buildings - guide to damage levels from groundborne vibration", sets out limits for primarily transient vibration above which cosmetic damage could occur. This is reproduced in Table 11.5, below.

Table 11.5 – Vibration levels above which cosmetic damage could occur

Building Type	Peak Particle Velocity (mm/s)	
Reinforced or framed structures. Industrial and heavy commercial buildings.	50mm/s at 4Hz and above	
Unreinforced or light framed structures. Residential or light commercial type buildings.	4Hz to 15Hz	15Hz and above
	15mm/s at 4Hz increasing to 20mm/s at 15Hz	20mm/s at 15Hz increasing to 50mm/s at 40Hz and above

- 11.51 It is assumed that all buildings surrounding the site would be reinforced.
- 11.52 Taking the above into consideration, the following significance criteria are proposed;

Table 11.6 – Significance Criteria, Vibration

Peak Particle Velocity (mm/s)		Significance Criteria
Human Perception	Building Damage	
≥10	≥50	Major (SOAEL)

Peak Particle Velocity (mm/s)		Significance Criteria
>0<10	>0<50	Minor-Moderate
0	0	Negligible (NOEL)

- 11.53 Any predicted vibration effects which are significantly above the thresholds of perception and above the thresholds for cosmetic damage, would be considered as being of minor to major adverse significance, depending on the duration of the effects and the sensitivity of the receptor(s).

Operational Vibration

- 11.54 There are no expected operational vibration effects due to the Proposed Development. Heavy good vehicles will not pass within 10 metres of noise sensitive properties and road surfaces will be well maintained to avoid pot holes. Speed bumps or any other surface imperfections or discontinuities will not be located near noise sensitive properties.

Limitations and Assumptions

- 11.55 At this stage of the project the use of the ground floor commercial units has not been confirmed (Planning Permission is sought for Use Classes A1, A2, A3 B1, D1 or D2 uses) and neither has the type or location of any building services plant. Therefore, noise level limits have been provided, based on the baseline noise levels measured on site, which can be the basis for any planning conditions relating to noise from the development. Confirmation can be provided at a later stage that the limits set within the planning conditions will be achieved. This is considered an appropriate approach in EIA terms as noise can be controlled using conventional mitigation measures, including location/selection of plant, screening and/or plant attenuation.

Baseline Conditions

- 11.56 The proposed buildings are to be located on land adjacent to the A57(M) Mancunian Way, a large dual carriageway with slips roads, as indicated on the attached Figure 11.1. The north and east of the site is bound by the A57(M) which is the dominant noise source affecting the proposed development site. There are other residential developments located opposite the site on the other side of the A57(M).
- 11.57 The site is bound by Ellesmere St to the south, Arundel Street to the west and Worsley Street to the north (access only), however, there is currently comparatively little traffic on these roads. There is a railway line on a viaduct at least 100 metres away to the north of the site.
- 11.58 There are existing residential buildings to the south and west of the site and the former St George's Church to the south, which has been converted to residential use.
- 11.59 The Proposed Development comprises an 11 storey building and 23 storey tower overlooking the A57(M), a 9 storey block overlooking Worsley Street and an 8 Storey block overlooking Arundel Street. The existing 'DOT' building, which is proposed to be retained, provides acoustic screening to the internal elevations of the proposed buildings, effectively forming a courtyard. It is understood that ventilation to the Proposed Development will be provided mechanically with the option for purge ventilation via openable windows/doors.

Baseline Noise Survey

- 11.60 Noise level measurements were undertaken by AEC on Friday 2 December 2016 between approximately 0745h and 1100h and Thursday 8 to Friday 9 December 2016 between approximately 2300h and 0120h.

- 11.61 Measurements were undertaken at four locations on the development site, identified as A to D on Figure 11.1, below.
- 11.62 During both the daytime and the night-time periods, the dominant noise source was road traffic on Mancunian Way A57(M), although vehicle pass-by noise on the other local roads surrounding the site also contributed at times. Due to constant road traffic noise, any noise from rail movements and/or any other noise from nearby building services plant, was not clearly audible during the survey and did not appear to affect any noise measurements undertaken.
- 11.63 Additionally, no noise from any nearby commercial units (i.e. the Binary Bar on Ellesmere St, the Banyan Tree Restaurant/Bar on Ellesmere Street, or the Train Cross Fit Gym on Arundel Street) was audible at any time.
- 11.64 The typical measured daytime, evening and night-time noise levels are presented in Table 11.7, below.

Table 11.7 – Typical Noise Levels Affecting Development

Location	Daytime (0700-2300)				Night-Time (2300-0700)			
	L _{Aeq}	L _{A10}	L _{A90}	L _{Amax, F}	L _{Aeq}	L _{A10}	L _{A90}	L _{Amax, F}
A	63	65	59	77	60	62	55	78
B	73	75	70	85	71	74	66	84
C	63	64	60	80	63	63	57	72
D	63	65	59	81	59	61	56	71

Vibration

- 11.65 MCC's guidance document states;
- "A vibration assessment (which is usually based on BS 6472: 2008) may be required where railway/tram lines are within 75m of a proposed development site."**
- 11.66 As the site is at least 100m from the nearest railway line, no vibration survey was considered to be required, and this was agreed with the Local Authority.
- 11.67 No vibration was perceived during the noise survey.

Identification and Evaluation of Likely Significant Effects

- 11.68 This section considers the potential noise effects associated with the construction and operational stages of the proposed development on the existing noise sensitive receptors, which are approximately 10m to the northwest and southwest on Worsley Street and Arundel Street, respectively.

Construction Effects

- 11.69 The site working hours will be based upon Manchester City Council Guidance of 07.30hrs to 18.00hrs Monday to Friday and 08.30 – 14.00 on Saturdays. It is envisaged however, that late working will be required during the concrete frame construction. Noisy works will be limited during these hours and local residents and stakeholders will be notified and kept up to date with activities and working hours during these periods through neighbourhood engagement and regular leaflet drops.
- 11.70 On Sundays the contractor will, in the majority of cases abide to Manchester City Council rules. There will however be a need from time to time to work on a Sunday. These works will be limited and only conducted if entirely necessary. For example; when installing and dismantling the tower cranes due to safety and welfare of the staff on site, the works will have to be conducted when the site is closed to all but the teams carrying out the works. During these

periods the Environmental Health Officer (EHO) will be notified and engage residents to coordinate these works in a timely manner suitable to all.

Assessment

- 11.71 Construction activities are a potential, albeit temporary, source of noise and vibration. British Standard BS 5228 "*Code of practice for noise and vibration control on construction and demolition sites*" provides methodologies for the assessment and control of noise and vibration from construction operations. The Standard contains detailed information on noise reduction measures and promotes the 'best practicable means' (BPM) approach to control noise and minimise the impact on local residents and construction workers.
- 11.72 For construction noise and vibration, it is not possible at the planning application stage to predict detailed noise effects given the uncertainty as to construction methods, processes and plant. However, indicative noise levels have been calculated at the closest noise sensitive receivers for assumed plant and processes. These calculations have been undertaken for three of the construction stages expected to cause the highest levels of noise.
- Demolition of existing buildings;
 - Ground works and excavation; and
 - Rotary bored piling.
- 11.73 In terms of demolition, the distance has been calculated from the centre of each building to be demolished to the nearest residential property. For construction activities, the distance has been calculated from the centre of the site to the nearest dwelling, both to indicate 'average' noise levels over the site.
- 11.74 For all activities, as the buildings surrounding the site are relatively high (between 6 to 9 storeys) no barrier attenuation has been considered.
- 11.75 The impacts of these works have been assessed using the 5dB change method described in Section E. 3. 2 of BS5228: Part 1: Noise, and the measured baseline daytime noise levels.
- 11.76 Based on generic noise levels of construction activities detailed in BS 5228, 2009, the potential noise impact from construction and demolition activities are shown in Table 11.8, below.

Table 11.8 – Example Construction Noise Level Assessment

Scenario	Activity	dBLAeq @ 10m	Distance to receiver, m	dB	No. of	Correction, dB	% On Time	Correction, dB	Activity Noise Level dBLAeq
Demolition Arundel Street - Breaking concrete	Hand held breaker	85	25	-8	2	3	10	-10	70
	Excavator mounted breaker	90	25	-8	1	0	25	-6	76
Demolition Worsley Street - Breaking concrete	Hand held breaker	85	30	-10	2	3	10	-10	68
	Excavator mounted breaker	90	30	-10	1	0	25	-6	74
Groundworks & excavation	Excavators	80	35	-11	2	3	50	-3	69
	Trucks	85	35	-11	2	3	50	-3	74
Piling	Rotary bored	80	35	-11	1	0	25	-6	63
Concreting	Pump	80	35	-11	1	0	50	-3	66
	Power float	75	35	-11	2	3	25	-6	61
	Vibrators	85	35	-11	2	3	10	-10	67

- 11.77 Measured ambient noise levels on Arundel Street were around 63dBL_{Aeq,T}.
- 11.78 Based on the above example activities, the following assessment of significant noise effects would apply based on the BS5228 '5dB Change' method:

Table 11.9 – Example Construction Noise Assessment Effects

Scenario	Activity	Activity Noise Level @ Receptors dBLAeq, day	Baseline Noise Levels dBLAeq, day	Resultant Noise Level @ Receptors dBLAeq, day	Increase (dB)	Assessment of Significance
Demolition Arundel Street - Breaking concrete	Hand held breaker	70	63	70.8	+7.8	Moderate
	Excavator mounted breaker	76	63	76.2	+13.2	Major
Demolition Worsley Street - Breaking concrete	Hand held breaker	68	63	69.2	+6.2	Minor
	Excavator mounted breaker	74	63	74.3	+11.3	Moderate
Groundworks & excavation	Excavators	69	63	70	+7	Moderate
	Trucks	74	63	74.3	+11.3	Moderate
Piling	Rotary bored	63	63	66	+3	Negligible
Concreting	Pump	66	63	67.8	+4.8	Negligible
	Power float	61	63	65.1	+2.1	Negligible
	Vibrators	67	63	68.5	+5.5	Minor

- 11.79 Based on the 5dB change assessment method, there are certain activities that are expected to generate adverse impacts of between minor to major significance, at times, during demolition/construction, including: use of breakers during demolition and large truck movements. However, effective use of screening and other practicable attenuation measures should be able to mitigate predicted noise impacts. Further consideration may need to be given when particularly noisy activities are scheduled to occur simultaneously.
- 11.80 Furthermore, it should be noted that the noise data provided in BS5228 is considered to be representative of older machinery. Based on the implementation of best practical means with the contractors CEMP, the above noise levels are likely to reduce in the order of 5-10dB.
- 11.81 If evening, night-time and/or Sunday working is to be required, then this would need to be agreed with the Local Authority under CoPA. A noise and vibration management plan and possibly a prior, CoPA Section 60 agreement with the Local Authority, could also be considered.

Construction Vibration Impacts

- 11.82 With regards to construction vibration levels, these are discussed in BS 5228 Part 2. The document provides basic methods of vibration control relating to construction sites where work activities/operations generate significant vibration levels, describes the legislative background

to vibration control and provides recommendations given regarding procedures for the establishment of effective liaison between developers, site operators and local authorities.

- 11.83 Vibration during construction work may arise from activities such as piling (e.g. for building foundations), ground improvement and road construction. Selection of plant and methods will need to consider the possible effects of vibration on nearby buildings and their occupants.
- 11.84 The nearby buildings which may be affected are the buildings on Arundel Street (Moho Residential Apartments; the buildings on Worsley Street (Base/Box Works residential apartments), and the DOT building. We have assumed a distance from the activity to each building of around 10m, which is the worst case assessment. Activities carried out at a greater distance would result in lower vibration levels.
- 11.85 Groundborne vibration from construction work has broadly two potential impacts; cosmetic/structural damage and human sensitivity.
- 11.86 Structural damage to buildings by vibration is extremely rare and, if at all, only occurs when receiving buildings or structures are located very close (e.g. at least within around 10m) to very intensive vibration generating activities and/or are vulnerable due to their structural condition.
- 11.87 As most of the buildings surrounding the site are relatively new, it is that vibration will not cause any structural damage to these buildings. However, this will be reviewed as more detailed information is available regarding construction methods etc. If necessary, means available to minimise potential impact would be using appropriate construction methods, and/or use of vibration barriers.
- 11.88 In terms of the impact on humans, perceptible vibration can give rise to complaints of disturbance over a wider area from the works. Depending on details of any proposed vibration causing activities, it is possible that certain activities such as piling/compacting, occurring close to the existing residential buildings, could give rise to perceptible vibration.
- 11.89 However, this is likely to be short in duration and hence the severity of any effects are likely to be minor (given appropriate good practice and notification).
- 11.90 It is not possible to provide any detailed vibration assessment without full details of the plant and methods to be used. However, an indicative assessment, based on guidance in BS5228, is provided in Table 11.10, below.

Table 11.10 – Assessment of Potential Vibration Impact During Construction

Activity	Estimated Vibration Level at Receptor, mm/s	Significance
Piling (CFA)	0.4	LOAEL
Piling (Rotary)	4.0	LOAEL
Compacting	1.4	LOAEL

- 11.91 Nonetheless, the strategic, Best Practical Means approach to vibration control is the same as that described in the construction noise section above (the Control of Pollution Act explicitly applies to vibration as well as noise).

Operational Noise – Commercial Units/Building Services Plant/Road Traffic

Commercial Units – Retail/Office / Leisure

- 11.92 The exact usage of the ground floor commercial units are unknown at this stage. However, it is understood that they may contain usage classes A1, A2, B1, D1 or D2. However, there is also

the possibility of a relatively noisy usage such as a gym. As this is the worst case, an assessment of potential noise from gyms is detailed below.

- 11.93 Noise levels measured by AEC in a gym during an exercise class incorporating amplified music were around 100dB_{L_{Amax}}, as detailed in Table 11.12, below.

Table 11.12 – Typical Maximum Noise Levels in a Gym (Due to Classes)

Area/Period	dBL _{Amax}	Maximum Noise Level L _{max} , dB, at Octave Band Centre Frequency, Hz							
		63	125	250	500	1k	2k	4k	8k
Gym, amplified music	99	85	85	94	92	98	85	81	73

- 11.94 In order to achieve MCC's criteria of reducing music noise levels in the 63Hz and 125Hz octave centre frequency bands (L_{eq}) to exceed (in habitable rooms) 47dB and 41dB (L_{eq}), respectively, the floor would need to achieve a minimum sound insulation performance of around 70dBR_w.
- 11.95 The proposed floor comprises a 250mm thick concrete slab, with a plasterboard ceiling beneath, forming a cavity of around 300mm. This would be expected to achieve at least 70dBR_w and hence would meet MCC's criterion, and, since MCC's criterion is based on inaudibility, No Observable Effect is anticipated.
- 11.96 In terms of the glazing, to meet MCC's criterion of 10dB below the background noise level, in each octave band, calculations indicate that the windows should have a sound insulation performance of at least 38dBR_w (e.g. 10/12/6mm double glazing) in order to meet this requirement.
- 11.97 Again, as this criterion is based on inaudibility, there would be No Observable Effect.
- 11.98 External seating is proposed along Worsley Street. It is anticipated that noise from this area should be no greater than 55dB_{L_{Aeq}} at the existing properties on Worsley Street, which as 10dB lower than the typical daytime L_{Aeq} noise levels in this area. It is considered that this represents at worst a minor impact during the daytime and potentially a moderate impact if the seating is used in the late evening. Any impact can be controlled by means of limiting the usage hours of the seating, a management plan for the operators and limits to the number of seats.

Building Services Plant

- 11.99 As at this stage the building services plant has not been specified in any detail, noise from this source cannot be quantified exactly. However, there are many tried and tested mitigation measures for controlling noise from building services plant and, as such, noise level limits can be presented in a suitably worded planning condition.
- 11.100 As existing night-time background noise levels are relatively high (≥56dB_{L_{A90}} on Arundel Street, the quietest location), achieving the MCC requirement would require noise from all building services plant to not exceed 51dB(A) at the nearest noise sensitive receptors, assuming no noise character.
- 11.101 Controlling noise from this source to the noise level limits presented above (i.e. 51dB(A)), is not likely to be onerous. Hence the effects of building services plant areas can be considered to have no significant adverse effect.

Road Traffic

- 11.102 The potential change in road traffic has been assessed by Curtins (refer to Transport Statement).

- 11.103 The below is information from this report from the previous scheme, which included less residential properties and, as such is considered to represent a worst-case scenario.
- The number of car trips generated by the residential uses equates to 25 two-way movements in the AM peak period and 34 two-way movements in the PM peak period.
 - This is broadly comparable to that which could be generated by the existing uses and on-site parking, potentially resulting in no net impact.
 - It is likely that the retail/commercial elements at ground floor level will be ancillary to the primary residential uses on the site and also ancillary to the existing surrounding residential apartments in the area. On this basis customer trips for these uses have not been calculated.
 - With regard to waste and servicing, refuse collection is expected to occur once per week and the amount of commercial space is likely to generate a maximum of 1 or 2 deliveries per day.
 - The maximum traffic generation set out above, equates to circa one vehicle every two minutes which would have no material impact on the operation of the adjacent highway network.
 - This is considered to be imperceptible and no further assessment is required.
- 11.104 As can be seen above, no net impact is predicted in terms of traffic movements associated with the Proposed Development. Therefore, there would be no change in terms of noise levels, and hence there are no Observed Effects associated with any vehicle movements on the existing highways, due to the proposed development site, and hence no specific mitigation measures are required.

Operational Noise – Site Suitability

Noise Break-in to Proposed Apartments

- 11.105 Based on the measured noise levels identified in Table 11.4 and the preliminary results from a noise modelling exercise using CADNA-A® software, the noise levels affecting the various building elevations have been estimated, and are presented in Table 11.13 and Figures 8.2 to 8.6, below.
- 11.106 The above noise levels represent the anticipated 'worst-case' level for each façade, because the elevations are very large and noise levels will vary at different points. However, the above levels have been used to calculate the likely sound insulation performance of glazed elements. A full 3D computer noise model has been developed to assist with more detailed calculations as the scheme develops. An example of the noise modelling output is presented in Figures 11.2 to 11.7, below.

Table 11.13 – Anticipated Daytime and Night-time Noise Levels at Points on Selected Elevations

<i>Elevation (≈ Orientation)</i>	<i>Noise Level, dB</i>		
	<i>Day 0700- 2300h, L_{Aeq, 16h}</i>	<i>Night 2300- 0700h L_{Aeq, 8h} L_{Amax}</i>	
Ellesmere Street (South)	63	61	77
Mancunian Way – A57M (East) - Floors 0-7	74	72	84
Mancunian Way – A57M (East) - Floor 8-19	71	69	79
Worsley Street (North)	65	63	72
Arundel Street (West)	50	48	70
Internal elevations	50	45	60

- 11.107 Based on the above noise levels, windows/openings to all habitable rooms will need to remain closed in order to achieve the internal noise level limits presented in Table 11.13, above, and avoid significant adverse effects. Windows can be openable provided that they are effectively sealed when closed.
- 11.108 The typical glazed areas on the proposed 8-11 storey buildings are understood to be up to 50% of the façade for each room. Based on this and the external noise levels in Table 11.7 above, the highest performance glazing performance required would be approximately 48dBR_w & 42dBR_{w+Ctr} to achieve appropriate internal noise levels to rooms overlooking the A57(M). This is a very high acoustic standard of double or triple glazing. Lower acoustic performance specifications would be suitable on the internal (courtyard) and Arundel Street elevations, indicatively, 38dBR_w & 32dBR_{w+Ctr}. This represents a good standard of acoustic glazing.
- 11.109 Controlling average external ambient noise levels is the more onerous requirement, therefore, typical maximum noise levels would also be suitably controlled by default.
- 11.110 It should be noted that any frames/framing systems and seals must not downgrade the glazing sound insulation performances indicated. Where a larger % glazed area is used, a higher sound insulation performance will be required and, where a smaller glazed area is used the performance can be decreased and the requirements will be specified in detail at the design stage.
- 11.111 The calculations have been based on a fully ducted mechanical ventilation system with no trickle vents to the rooms.
- 11.112 It is understood that the Mechanical Ventilation and Heat Recovery (MVHR) units will be sized to allow for increased air flow rates over and above the standard Approved Document Part F minimum rates (typically 2-2.5 ac/hr) to allow the tenants to increase the ventilation to help minimise the risk of overheating, thus minimising the need for occupants to open windows/doors to provide comfort cooling. However, where façade noise levels are higher than 50dBL_{Aeq, 8hr} at night, consideration has been given to provision of acoustically attenuated façade vents/openings to minimise indoor ambient noise levels on occasions where residents are required to open windows to provide cooling.
- 11.113 In addition to the above, at this stage, all non-glazed elements overlooking the A57 (Mancunian Way) should achieve a minimum sound insulation performance of around 58dBR'_w. This is not a particularly onerous requirement and can be achieved using typical external wall build-ups although careful design will be required. This required performance can obviously be reduced to the other facades. For external walls incorporating a rainscreen cladding, the internal linings to habitable rooms would typically need to be at 2x15mm dense plasterboard and mineral wool insulation would be required in the cavity.
- 11.114 Ducted mechanical services system should be designed to no greater than approximately 30dBL_{Aeq} (NR25) in bedrooms at night and 35dBL_{Aeq} (NR30) in living rooms during the daytime.
- 11.115 With regard to ground floor ancillary spaces, any standard thermal glazing will adequately control external to internal noise levels, unless they are considered noise sensitive, e.g. offices/meeting areas.

External Amenity Spaces

- 11.116 Roof top gardens/amenity spaces are proposed for the new roof tops on the 8, 9 and 11 and ground level of Worsley Street. At the edge of the rooftop overlooking the A57, the noise levels could be up to approximately 60dBL_{Aeq} at seated head height. As such, any barrier along this edge should be solid to control noise from the A57. A 1m higher barrier should reduce the noise levels to 55dBL_{Aeq} or lower.
- 11.117 In terms of the blocks on Arundel Street and Worsley St. the noise levels at the rooftop level should be 55dBL_{Aeq} or lower.

Mitigation Measures

- 11.118 Based on the above assessment, some mitigation measures have been identified and already discussed in brief above, including: construction noise and vibration; operational building services noise and building envelope for site suitability.

Construction Noise & Vibration

- 11.119 Noise from construction activities would be minimised in line with the contractor's Construction Environmental Management Plan (CEMP) which will outline all Best Practical Means (BPM) measures to be implemented on site, as required by the CoPA. Typical BPM measures that could be applied during the construction stage may include, but are not limited to the following:
- The servicing of vehicles and machinery at regular intervals;
 - Installing silencers or attenuators where practicable;
 - Replacing older equipment with quieter alternatives;
 - Using broadband reversing alarms on site;
 - Not leaving engines idling when not in use;
 - Siting any generators away from the nearby residential properties; and
 - Erecting a close boarded timber fence around the development site.

Operational Building Services Noise

- 11.120 At this stage a limit of $51\text{dBL}_{\text{Aeq,T}}$ has been set at the nearest residential properties based on the existing night-time background (L_{A90}) noise levels. Mitigation measures are likely to be required to meet this Local Authority limits, in terms of one or more of the following: appropriate locating of all equipment away/screened from residential receptors; appropriate selection of quiet operating plant; atmosphere side attenuation of plant and/or acoustic screening/parapets. This will be developed at detailed design stages relating to ground floor commercial and residential elements of the proposed development.

Operational – Site Suitability

- 11.121 Appropriately specified glazing (See 1.82) is required to mitigate noise levels to achieve appropriate indoor ambient noise levels. The sound insulation requirement for the A57(M) elevation is quite high at approximately 48dBR_w & $42\text{dBR}_{w+\text{Ctr}}$, which is at the upper end of what is practicably achievable and care will need to be taken to ensure other elements such as frames and seals do not downgrade overall façade sound insulation performance.
- 11.122 Provided that any rooftop balustrade is at least 1m in height and solid around the areas of rooftop amenity space (glass is appropriate) closest to the A57, noise levels at rooftop level should be around $55\text{dBL}_{\text{Aeq}}$ or lower.

Cumulative Effects

- 11.123 This Proposed Development will have a zero and/or negligible contribution in terms road traffic noise, plant noise and noise due to the commercial units and hence will not contribute, when considering the cumulative noise impacts of other nearby committed developments, which may or may not generate noise effects due to changes in traffic flows, speed and/or composition on nearby roads. These are summarised in Table 11.14, below

Residual Effects

- 11.124 Residual effects apply where mitigation is proposed above. The effects are summarised in Table 11.14 below.

Construction Noise & Vibration

- 11.125 This requires further detailed assessment, however, the majority of the effects which are of minor to major significance, should be controlled to negligible or minor significance, following

implementation of Best Practicable Means with further detail of potential significant effects to be provided in an agreed noise management plan for the construction stages.

Operational Building Services Noise

11.126 Residual Effects should be negligible.

Operational – Site Suitability

11.127 Residual Effects should be negligible.

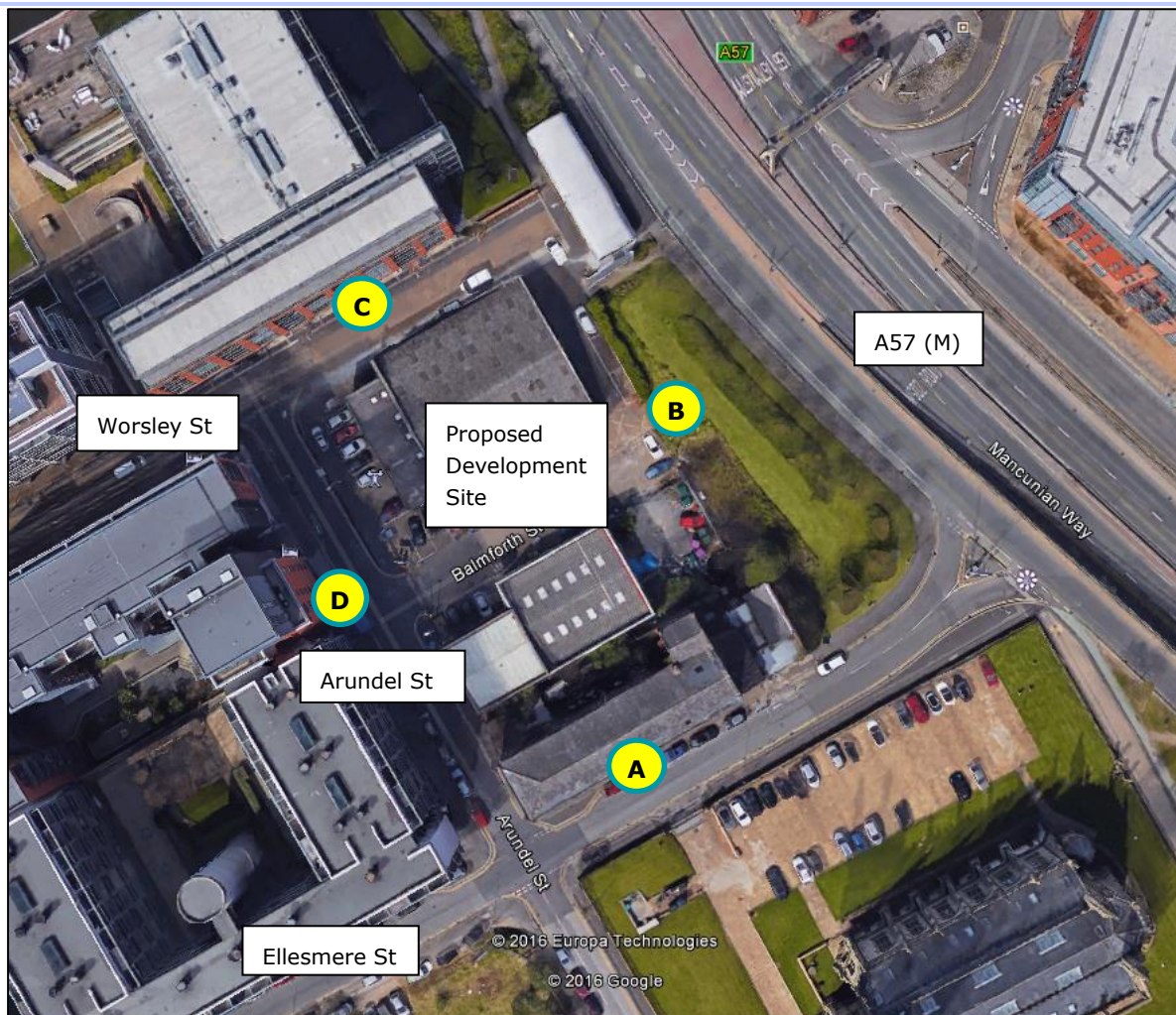
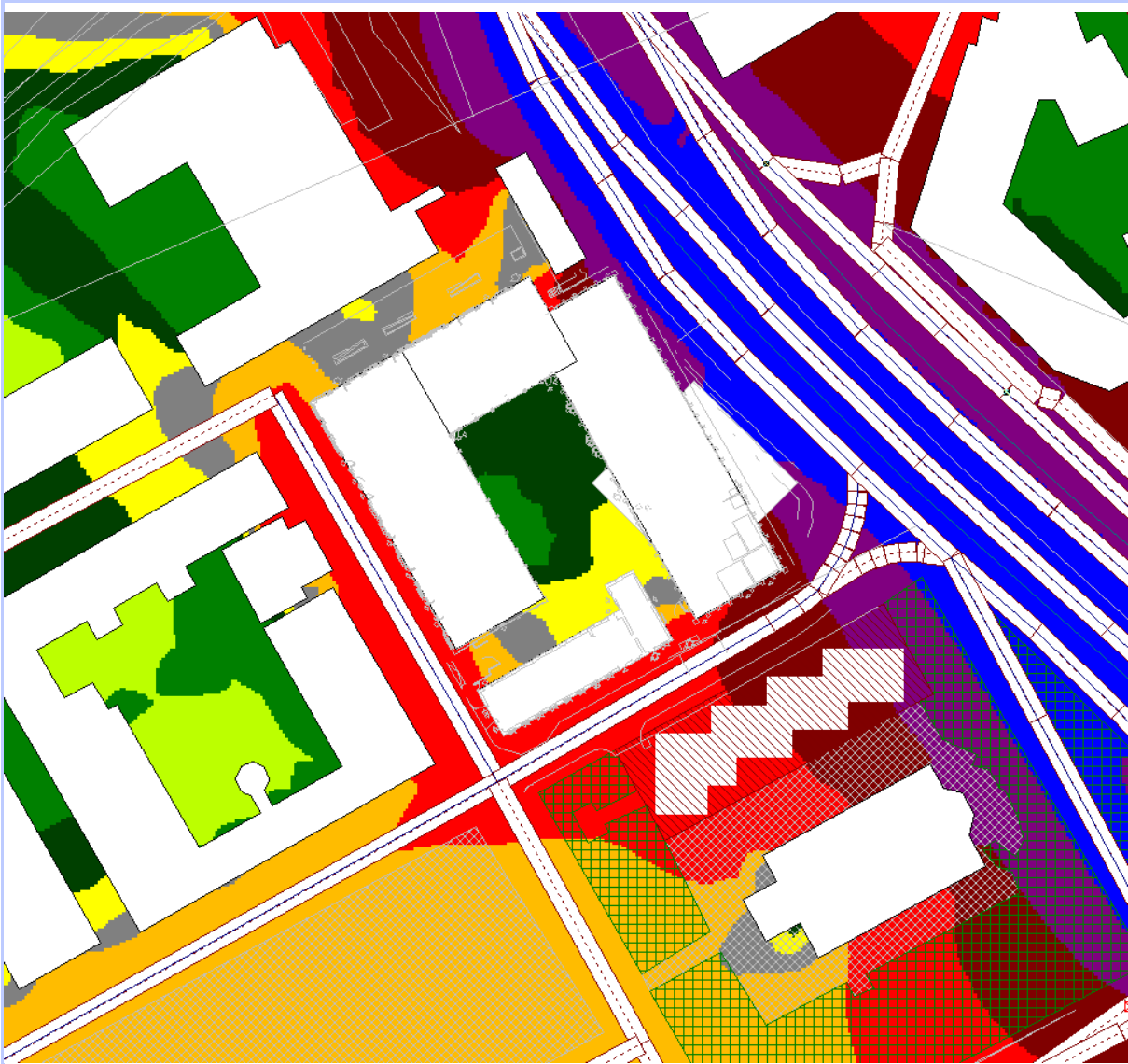


Figure:	11.1		
Title:	Existing Site Location Plan Showing Noise Monitoring Locations.		
Project:	Arundel Street		
Date:	20/9/2017	Scale:	Scale /NTS



- > -99.0 dB
- > 35.0 dB
- > 40.0 dB
- > 45.0 dB
- > 50.0 dB
- > 55.0 dB
- > 60.0 dB
- > 65.0 dB
- > 70.0 dB
- > 75.0 dB
- > 80.0 dB
- > 85.0 dB

Figure:	11.2		
Title:	Predicted Noise Map – Daytime L _{Aeq} (0700-2300)		
Project:	Arundel Street		
Date:	22/3/2019	Scale:	Scale /NTS

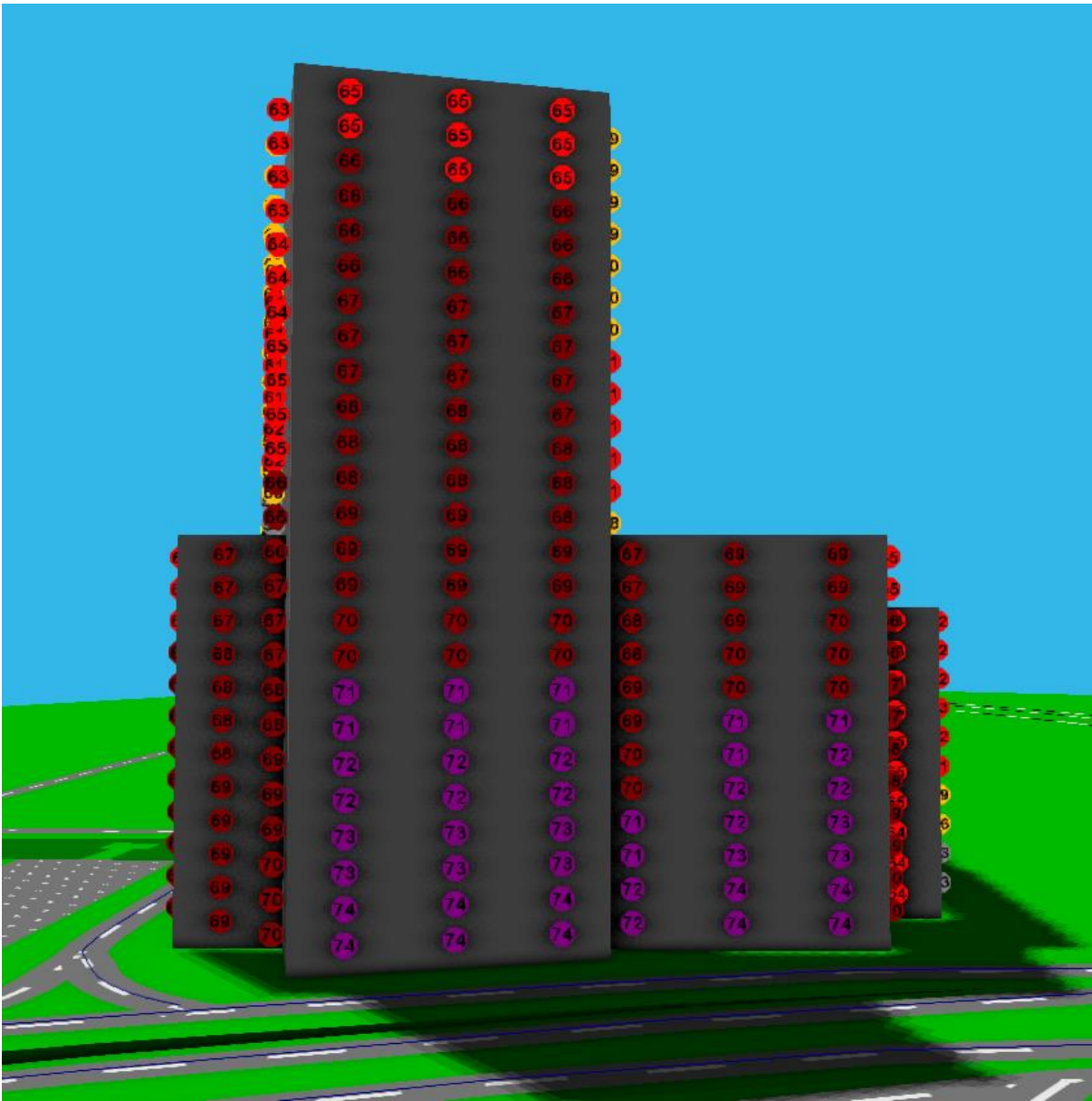


Figure:	11.3		
Title:	Predicted Noise Map – Mancunian Way – Daytime LAeq (0700-2300)		
Project:	Arundel Street		
Date:	22/3/2019	Scale:	Scale /NTS

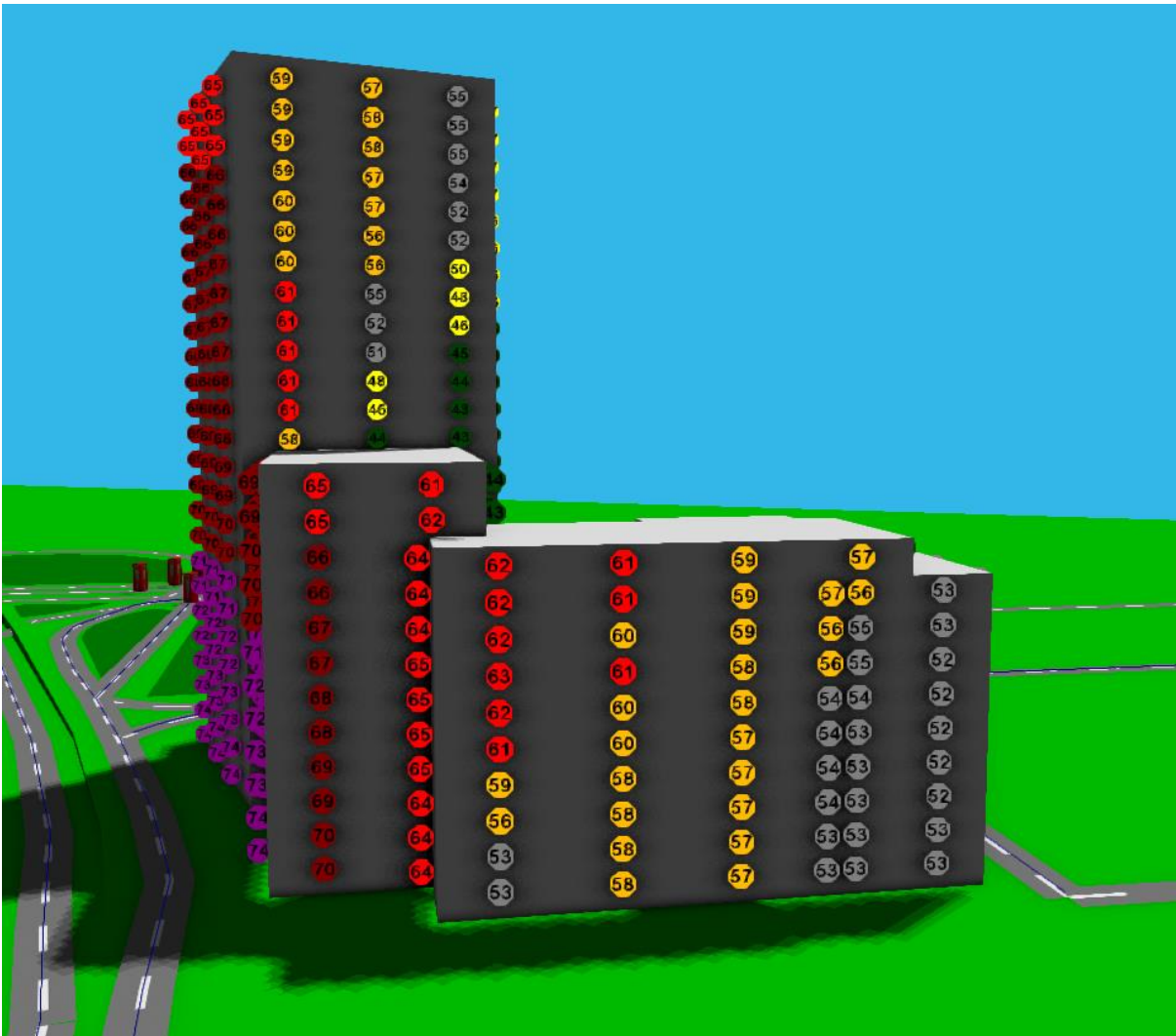


Figure:	11.4		
Title:	Predicted Noise Map – Worsley Street – Daytime L_{Aeq} (0700-2300)		
Project:	Arundel Street		
Date:	22/3/2019	Scale:	Scale /NTS

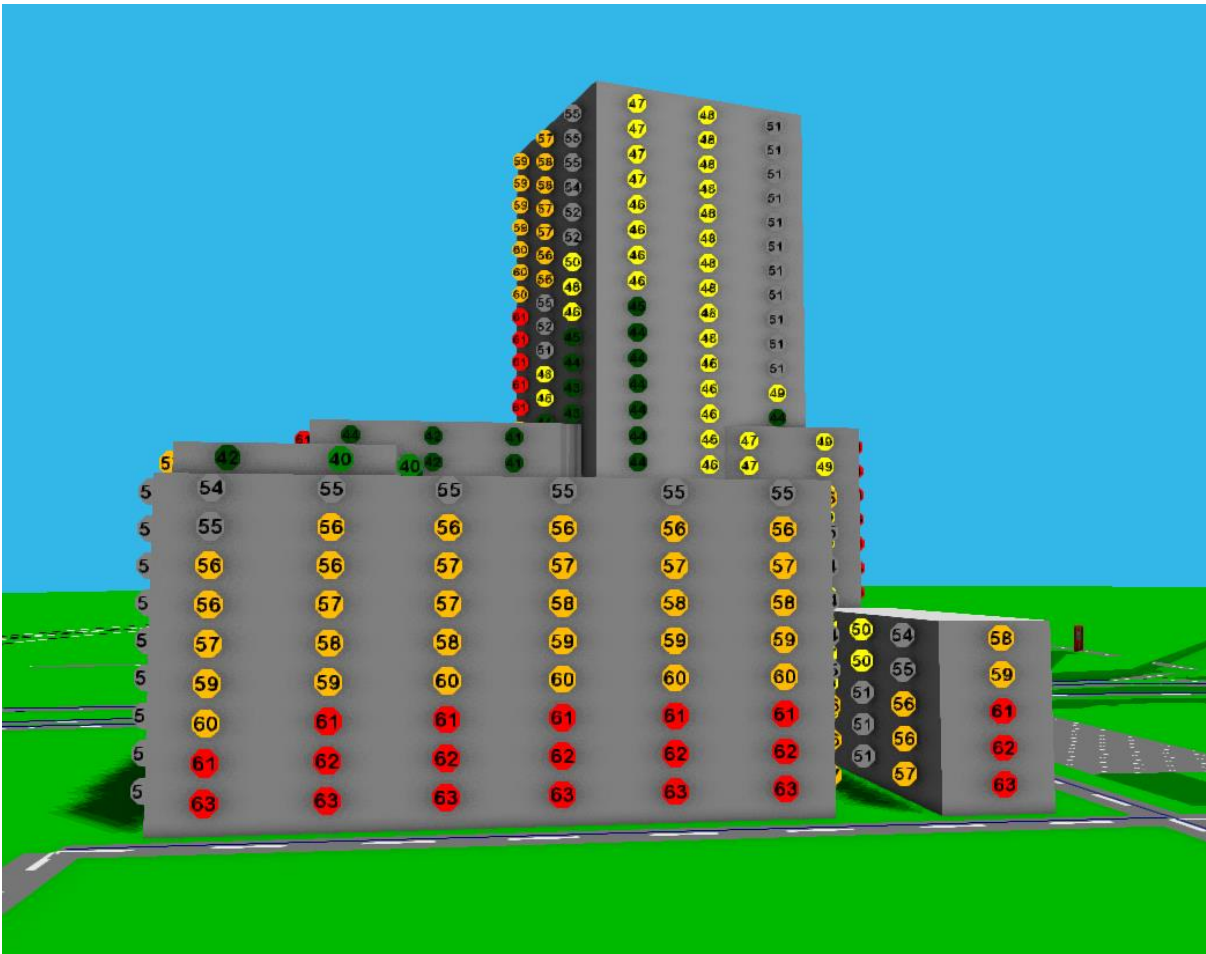


Figure:	11.5		
Title:	Predicted Noise Map – Arundel Street – Daytime L _{Aeq} (0700-2300)		
Project:	Arundel Street		
Date:	23/9/2017	Scale:	Scale /NTS



Figure:	11.6		
Title:	Predicted Noise Map – Ellesmere Street – Daytime L_{Aeq} (0700-2300)		
Project:	Arundel Street		
Date:	22/3/2019	Scale:	Scale /NTS