Noise and Vibration Impact Assessment

C10764

Levenshulme Road, Gorton

Prepared for

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Executive Summary	
Site Address	Levenshulme Road, Gorton
Executive Summary	

Omnia has been commissioned by Watson Homes to provide a Noise and Vibration Impact Assessment for a proposed residential development at Levenshulme Road, Gorton.

Environmental noise surveys have been undertaken to quantify road traffic from Levenshulme Road located west of the site and the Railway line that is situated to the east of the site. Additionally, surveys have been undertaken to quantify the existing levels of background and ambient noise as well as noise associated with the adjacent commercial premises.

The Noise Impact Assessment has been completed with due regard to the requirements as stated within BS8233:2014 and BS4142:2014**.** A CadnaA noise model has been constructed including all significant noise sources, existing buildings and with full topography. The noise model has been used to predict the noise levels incident upon the facades of the proposed residential development due to an existing ventilation unit located at the rear of Big Discount Bargain Store, Gorton.

The assessment has recommended the following mitigation measures in order to ensure an adequate level of protection from noise:

- A ventilation scheme in living rooms for Plots 1, 2 and the block of flats (Plots 7-37) at ground level, the highest specification requiring a ventilation performance of 25dB;
- A ventilation scheme in living rooms for all flats at first level height is required. The highest specification requiring a ventilation performance of 25dB;
- A ventilation scheme in living rooms for all flats at second level height is required. The highest specification requiring a ventilation performance of 25dB;
- A ventilation scheme for proposed the Block of Flats (Plots 7-37) in bedrooms at ground level, the highest specification requiring a performance of 21dB;
- A ventilation scheme for all proposed Plots in bedrooms at First level, the highest specification requiring a performance of 21dB; and
- A ventilation scheme for all proposed Plots in bedrooms at Second level, the highest specification requiring a performance of 20dB.

The corresponding ventilation performance specifications for each plot and façade are listed in Appendix VII and VIII respectively.

The assessment has been based upon robust and worst-case assumptions and demonstrates that, in principal and subject to the incorporated mitigation measures, there should not be any adverse impact due to the proposed development.

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1 INTRODUCTION

1.1 Background

Omnia was instructed by Watson Homes to prepare a Noise & Vibration Impact Assessment. These Assessments are to support the planning application for multiple residential dwellings off Levenshulme Road, hereafter referred to as 'the Site'.

This Assessment has been undertaken to identify and assess any surrounding noise and vibration-generating activities which may have the potential to adversely impact the proposed noise-sensitive development. Accordingly, this Assessment has been completed with due regard to the National Planning Policy Framework and its associated National Planning Policy Guidance. In addition, various British Standard and guidance documents exist which are applicable to the assessment of noise impacts and these are detailed in Section 2.

1.2 Site Location and Proposed Development

The site is situated on the parcel of land off Levenshulme Road, in Gorton, Manchester. The plot is directly adjacent to a rail line which runs along the north easternly boundary, with Ryder Brow train station approximately 100m up the line. The surrounding area predominantly consists of residential dwelling with commercial properties located along the western boundary of the site. These commercial premises consist of off licenses and a takeaway food restaurant.

The proposals include provision of 6 residential dwellings and a block of flats, two of which front on to Levenshulme Road. In addition, the proposals include a 3-storey apartment block including 30 mixed sized apartments with allocated parking.

This assessment has been undertaken with due regard to the supplied planning layout shown on the following planning drawings:

- 'Proposed Site Plan' (02) [P10] dated 04/07/22; and
- 'Proposed Site Plan' (02) [P12] dated 12/07/22

The Site Layout is shown in Figure 1 of Appendix III.

1.3 Acronyms

All acronyms used within this report are defined in the Glossary presented in Appendix II.

1.4 Limitations

The limitations of this report are presented in Appendix I.

1.5 Confidentiality

This report has been prepared solely for the use of the Client. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from Omnia; a charge may be levied against such approval.

2 POLICY & GUIDANCE

2.1 National Planning Policy Framework & National Planning Practice Guidance

The Government updated the National Planning Policy Framework (NPPF) on 20th July 2021 and its associated National Planning Practice Guidance (NPPG) on 22nd July 2019. Together, the NPPF and NPPG set out what the Government expects of local authorities. The overall aim is to ensure the planning system allows land to be used for new homes and jobs, while protecting valuable natural and historic environments.

The NPPG adds further context to the NPPF and it is intended that the two documents should be read together.

Noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment. When preparing local or neighbourhood plans, or taking decisions about new development, there may also be opportunities to consider improvements to the acoustic environment.

Local planning authorities' plan-making and decision making should take account of the acoustic environment and in doing so consider:

- Whether or not a significant adverse effect is occurring or likely to occur;
- Whether or not an adverse effect is occurring or likely to occur; and
- Whether or not a good standard of amenity can be achieved.

In line with the Explanatory Note of the Noise Policy Statement for England, this would include identifying whether the overall effect of the noise exposure (including the impact during the construction phase wherever applicable) is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation.
The Observed Effect Levels are as follows:

- Significant observed adverse effect level: This is the level of noise exposure above which significant adverse effects on health and quality of life occur;
- Lowest observed adverse effect level: this is the level of noise exposure above which adverse effects on health and quality of life can be detected; and
- No observed effect level: this is the level of noise exposure below which no effect at all on health or quality of life can be detected.

Table 2.1 summarises the noise exposure hierarchy, based on the likely average response.

Table 2.1 Noise Exposure Hierarchy

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not Noticeable	No Effect	No observed effect	No specific measures required
Noticeable and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No observed adverse effect	No specific measures required
Lowest Observed Adverse Effect Level			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time	Observed adverse effect	Mitigate and reduce to a minimum

	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.		
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 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

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.

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 and the general character of the noise. The local topology and topography should also be taken into account along with the existing and, where appropriate, the planned character of the area.

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. Further information on ventilation can be found in the Building Regulations; and,

- If external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended.

2.2 BS8233:2014 'Guidance on sound insulation and noise reduction for buildings'

Noise Criteria Limits

The scope of this standard is the provision of recommendations for the control of noise in and around buildings. It suggests appropriate criteria and limits for different situations, which are primarily intended to guide the design of new buildings or refurbished buildings undergoing a change of use, rather than to assess the effect of changes in the external noise climate.

The standard suggests suitable internal noise levels within different types of buildings, including dwellings, as shown in

Table ***2.2***.

Table 2.2 BS8233:2014 Internal Target Noise Levels

Criterion	Typical Situation	Design $L_{Aeq,T}$ (dB)
Suitable resting / sleeping conditions	Living Room	35
	Bedroom*	30
*For a reasonable standard in bedrooms at night, individual noise evens (measured with fast time weighting) should not exceed 45dB L_{max}		

BS8233 goes on to recommend noise levels for gardens as follows:

> *"It is desirable that the external noise level does not exceed 50dB LAeq,T, with an upper guideline value of 55dB LAeq,T which would be acceptable in noisier environments. However, it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors might be warranted".*

BS8233 goes on to say:

> *"In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces but should not be prohibited".*

Ventilation Requirements

Where a partially open window cannot be relied upon to provide an adequate level of facade sound insulation performance, it is necessary to consider alternative ventilation for habitable rooms. Section 8.4.5.4 within BS8233 states:

> *"The Building Regulations' supporting documents on ventilation [48, 49, 50] recommend that habitable rooms in dwellings have background ventilation. Where openable windows cannot be relied upon for this ventilation, trickle ventilators can be used and sound attenuating types are available. However, windows may remain openable for rapid or purge ventilation, or at the occupant's choice.*
>
> *Alternatively, acoustic ventilation units (see 7.7.2 below) are available for insertion in external walls. These can provide sound reduction comparable with double glazed windows. However, ducted systems with intakes on the quiet side of the building might be required in very noisy situations, or where appearance rules out through-the-wall fans."*

Section 7.7.2 states:

> *"NOTE 5 If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level."*

2.3 BS4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'

This standard describes methods for rating and assessing sound of an industrial or commercial nature which includes:

- Sound from industrial and manufacturing processes;
- Sound from fixed installations which comprise mechanical and electrical plant and equipment;
- Sound from the loading and unloading of goods and materials at industrial and / or commercial premises; and,
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from processes or premises, such as that from forklift trucks, or that from train or ship movements on or around an industrial or commercial Site.

The procedure detailed in the standard compares the measured or predicted noise level 'the specific noise level' from any of the above detailed noise sources with the background sound level at a residential dwelling. The measured background sound level at a receptor should be reliable and should not necessarily ascertain a lowest measured background sound level, but rather to quantify what is 'typical.'

The specific noise level also acknowledges the following reference time intervals depending upon whether the noise source operates during daytime or night-time periods:

- Daytime (07:00 - 23:00): 1 hour; and
- Night-time (23:00 - 07:00): 15 minutes.

There are a number of 'penalties' which can be attributed to the specific sound level, either subjectively or objectively, depending upon the 'acoustic features' of the sound level under investigation as follows. These penalties vary in their weighting depending upon the severity of the acoustic feature, as follows (with regards to the subject method):

Tonality

- +2dB: where the tonality is just perceptible;
- +4dB: where the tonality is clearly perceptible; and
- +6dB: where the tonality is highly perceptible.

Impulsivity

- +3dB: where the impulsivity is just perceptible;
- +6dB: where the impulsivity is clearly perceptible; and
- +9dB: where the impulsivity is highly perceptible.

Intermittency

- +3dB: where the intermittency is readily distinctive against the acoustic environment.

Where the assessment is carried out using the objective method, the tonality penalty is either 0dB or 6dB and the impulsivity penalty can range from 0dB up to 9dB in increments of 1dB, depending on the level of impulsivity identified.

In addition to the above acoustic features, there is a penalty for 'other sound characteristics' of +3dB where a sound exhibits characteristics that are neither tonal nor impulsive, though is readily distinctive against the acoustic environment.

BS4142 goes on to state that the rating level is equal to the specific sound level if there are no such features present or expected to be present.

Assessment of the rating level relative to the background noise level can yield the following commentary:

- Typically, the greater this difference (between the rating level and the background sound level), the greater the magnitude of impact;
- A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context; and
- 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. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact.

Whilst the amended 2019 Standard does make various references to it not being intended to assess noise impacts at indoor locations, section 1.1 does state 'The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident'. Example 6 in the Standard states 'In addition to the rating/background sound level comparison shown in Table A.6, the primary concern is the potential for disturbance of residents who could be sleeping with open bedroom windows. Other guidance, such as BS 8233, might also be applicable in this instance'.

With the above in mind, and for a clear need to ensure that any potential commercial or industrial noise impacts at the building façade do not give rise to internal noise level which causes sleep disturbance in bedrooms, this Assessment will ensure that the predicted rating level (specific sound level including any character corrections) does not exceed 30dB in bedrooms.

2.4 British Standard BS6472: 2008: Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)

With respect to human exposure to building vibration, BS6472 provides guideline values of the Vibration Dose Value (VDV) above which various degrees of adverse comment may be expected from the occupants of residential buildings. The VDV is defined mathematically as the fourth root of the time integral of the fourth power of the vibration acceleration, after it has been frequency weighted. The guideline values recommended by BS6472 are shown in Table 2.3 below.

Table 2.3 BS8233:2014 Internal Target Noise Levels

Place	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
Residential Buildings (16 Hour Day)	0.2 – 0.4	0.4 – 0.8	0.8 – 1.6
Residential Buildings (8 Hour Night)	0.1 – 0.2	0.2 – 0.4	0.4 – 0.8

Office Building	0.4 – 0.8	0.8 – 1.6	1.6 – 3.2

Where the vibration is intermittent rather than continuous in nature, BS6472 defines procedures for calculating the estimated Vibration Dose Value (eVDV), based on the number and duration of vibration events and the recorded value of the root mean square frequency weighted vibration acceleration. The frequency weighting takes into account the response of the human body to vibrations of different frequency and whether the person is lying down or standing. The eVDV can then be taken as the VDV for use in the assessment of human exposure to vibration in buildings.

The above guidance relates to vibration measured at the point of entry into the human body, which is usually taken to mean the ground surface or at a point mid-span of an upper storey floor, rather than the point of entry into the building (a foundation element).

2.5 Manchester City Councils (MCC) Planning & Noise Technical Guidance: June 2022

The NPPF, NSPE and NPPG do not present absolute noise level criteria which define SOAEL, LOAEL and NOAEL which is applicable to all sources of noise in all situations in a planning context.

One of the aims of this document, therefore, is to address this ambiguity and provide a suite of noise level design targets for typical developments (which are in accordance with current policies and standards).

Where certain developments are not specifically covered, the applicant/consultant is encouraged to contact us with a view of discussing the best that can be achieved for the given situation (in the context of the scenarios listed in section 3.6).

3.7.1.1 Residential Developments

The Council has adopted the following noise limits for residential properties:

- 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 10 times)
- Living Rooms (daytime - 07.00 - 23.00) 35 dB L_{Aeq}
- Gardens and terraces (daytime) 55 dB L_{Aeq}

These criteria have been adopted for the following reasons:

- BS 8233: 2014 recognizes these levels as a good standard for resting/sleeping conditions.
- The WHO document 'Guidelines for Community Noise' recommends an internal L_{Aeq} of 30dB for optimal sleep conditions (and no more than 35dB for internal rooms during daytime).
- The performance of acoustic insulation schemes can often be below that specified, according to the quality of installation, materials, noise spectrum and deterioration / wear and tear of building elements. A high design specification introduces a 'safety margin' should building elements not perform as well as expected ('on-site' performance).
- Performance specification for glazing does not usually take into account the detrimental effect of vents on the sound insulation. Even 'acoustic' vents will reduce the performance of the facade insulation, as they will inherently contain a free open area for air exchange.
- There is a general increase in urban noise levels, which can in the future be reasonably accommodated by these standards.
- The standards support the Local Authority corporate objective to prevent ill-health and improve local peoples' health and wellbeing.

2.6 Local Authority Correspondence – Manchester City Councils Environmental Health Department

Omnia contacted the Environmental Health Department at Manchester City Council via an internal contact form to discuss the proposed survey and assessment methodology which stated:

> *'Good Morning,*
>
> *Omnia have been commissioned to undertake a noise impact assessment to support a planning application for a residential development for the land off Levenshulme Road, Gorton.*
>
> *If I could have a contact for a member of staff in the Environmental Health Department*
>
> *Kind regards,'*

The Manchester City Council responded with the following;

> *'Please supply a site location plan so that we can advise you of the appropriate area officer's contact details for your below request.*
>
> *Regards,'*

Omnia responded with the following:

> *'Please see the attached for the site location at Levenshulme Road, Gorton and the location of the completed survey works as listed:*
>
> - *Noise Measurement Position 1 (NMP1): A noise measurement of vehicles using the Levenshulme Road will be completed in line with the guidance presented in Calculation of Road Traffic Noise;*
> - *Noise Measurement Position 2 (NMP2): A rail traffic noise survey will be completed on the Site boundary with the railway line in order to me measures the level of noise generated by each train service provider;*
> - *Noise Measurement Position 3 (NMP3): A noise measurement of any commercial activity associated with the commercial units situated on the Western site boundary of the Site will be completed over a weekday period;*
> - *Noise Measurement Position 4 (NMP4): Omnia will undertake a background and ambient noise survey over a full weekday and weekend period. The measurement position shall we located away from existing source noise; and*
> - *Vibration Measurement Position 1 (VMP1): Omnia will undertake assessment of the potential impact of vibration from the south easterly rail line on the proposed development will be assessed in accordance with BS6472-1.*
>
> *Kind regards,'*

The Manchester City Council responded with the following;

> *'This falls within my area and I can confirm that the survey works are acceptable.*
>
> *Regards,'*

3 NOISE SURVEYS

3.1 Road Traffic Noise Survey – Levenshulme Road

Omnia has conducted a Road Traffic Noise Survey in order to measure the level of noise generated by vehicles using Levenshulme Road. The noise survey took place over the following period:

- 10:31 to 13:31 on 7th July 2022

The following location was chosen for the survey:

- Noise Measurement Position 1 (NMP1): Omnia undertook a Road Traffic Measurement of Levenshulme Road approximately 3.96m away from the nearest kerbside in accordance with CRTN. The microphone was located at a height of 1.5m.

A summary of the measured sound pressure levels is presented below.

Table 3.1: Summary of Measured Road Traffic Noise Levels; NMP1

Period Start Time	Average Measured Sound Pressure Levels, Free-Field (dB)		10th highest $L_{Amax,fast}$
	$L_{Aeq,T}$	$L_{A10,T}$	
21/07/2022 11:00	63.5	67.4	76.6
21/07/2022 12:00	62.8	67.2	
21/07/2022 13:00	63.1	67.6	
$L_{Aeq,16hr}$ as calculated from CRTN	64.4		
$L_{Aeq,8hr}$ as calculated from CRTN and TRL Document	54.2		

The L_{AMax} parameter tabulated is obtained by outputting the $L_{AMax,f}$ parameter for each 1 minute interval during the 3 hour survey. These are ordered in declining intensity and the 10th highest selected.

3.2 Background and Ambient Noise Survey

Omnia has undertaken a Background Sound Survey. The survey was carried out over the following period:

- 10:29 on Friday 22nd July 2022 to 10:27 Monday 25th July 2022.

During this recorded period an air ambulance had to emergency land within the premises of the site boundary. This resulted in hourly data exceeding +70dBL_{Aeq} for periods 12:00 and 13:00 on Friday the 22nd, as seen in Appendix VI.

The following noise measurement position was chosen for the Background and Ambient Sound Survey:

- Noise Measurement Position 2 (NMP2): Omnia conducted a background and ambient noise survey, over a full weekday and weekend period. The sound level meter was positioned towards the southern boundary as seen in Figure 1.

Table 3.2 Summary of Measured Background Noise Levels

Day	Average Measured Sound Pressure Level, Free-Field (dB)		Weather Summary
	Day: $L_{A90,1hr}$	Night: $L_{A90,15mins}$	
22/07/2022	39.7	31.8	Partially wet weather with low wind speeds
23/07/2022	38.5	36.1	Partially wet weather with low wind speeds
24/07/2022	40.0	34.9	Partially wet weather with low wind speeds
25/07/2022	41.2	-	Partially wet weather with low wind speeds

3.3 Commercial Source Measurements

Omnia has conducted attended measurements of the noise associated with the adjacent commercial units surrounding the Site to capture any audible noise that may impact upon the proposed development. Noise at this location comprised of ventilation outlets that were situated approximately 4 meters mounted at the rear of the Big Discount Bargain Store Gorton which is situated west of the proposed development. The noise survey took place over the following period:

- 14:39 to 15:39 on the 21st July 2022.

The following noise measurement position was chosen for the survey:

- Noise Measurement Position 3 (NMP3): Omnia undertook source measurements of nearby ventilation from the western boundary of the site. The sound level meter weas positioned approximately 20m from the ventilation system mounted approximately 4 meters to the rear of Big Discount Bargain Store Gorton.

The following table summarises the measured noise levels.

Table 3.3: Commercial Source Mesurements

NMP	Sources	Location	Measurement Period (mm:ss)	Measured specific level L_{Aeq} (dB) 1-hour
NMP3	Ventilation unit	53.455620°N 2.171997° W	60:00	46.8

3.4 Train Noise Survey

Omnia has conducted attended noise measurements in order to quantify noise levels due to passing trains. The "Real Time Trains" online resource was used for timetable information.

This took place using the equipment set up at NMP2 over the following period:

- 08:20 to 10:21 on the 22nd July 2022.

The following noise measurement position was chosen for the Survey:

- Noise Measurement Position 4 (NMP4): Omnia undertook a Rail Traffic Measurement of the railway line to the north, in a position considered representative of the noise present across the site in accordance with CRN. The Microphone was located on the eastern site boundary at a height of 1.5m and an approximate distance of 13.7 meters.

The SLM coding function was used in conjunction with the dBTrait software to extract the train pass-bys and reject contribution from background sources between such train pass-bys, though these were minimal. A summary of the measured sound pressure levels from the Noise Survey is presented below. Survey and online train timetable data indicate that freight trains are not operational on this railway line, this report concerns the passenger train vibration and noise.

Table 3.4: Measured Noise Levels at NMP4 due to Train Pass-Bys and Calculation of Overall Day/Night Levels

Parameter	Passenger	
	Daytime	Night-time
	(0700-2300)	(2300-0700)
Timetabled Number of Trains	59	8
Number of Train Pass-Bys Measured	9	
Measured $L_{AMax,f}$ (dBA)	81.7	
Total Measured SEL of Trains (dBA)	89.7	
Calculated SEL of One Train (dBA)	78.6	
Calculated SEL of all Trains per Period (dBA)	96.3	87.6
Resultant L_{Aeq} per Period (dBA)	48.7	43.0

3.5 Train Pass-by Vibration Survey

Omnia has conducted attended vibration measurements of passing trains during a typical weekday period, simultaneously with the train noise survey described above and in the same location:

- Vibration Measurement Position 1 (VMP1): Located coincident with NMP4 above. The geophone of the meter was secured to the soft ground using the supplied spikes.

A summary of the measured vibration levels is presented in Appendix IV.

3.6 Noise and Vibration Survey Equipment

The following equipment was used for the Noise Surveys.

Table 3.5 Noise Measurement Equipment

Measurement Position	Equipment Description	Manufacturer & Type No	Serial No.	Calibration Due Date
All NMPs	Sound Level Meter	01dB Fusion	14009	22nd April 2023
	Pre-amplifier	01dB PRE22	2018032	
	Microphone	GRAS 40CD	428395	
	Calibrator	01dB CAL-31	95428	15th March 2023

The sound level meters were field calibrated prior to and following the noise surveys and there was no drift beyond the allowable limit of 1dB.

During the noise surveys the weather conditions were conducive to the measurement of environmental noise, i.e. wind speeds of no more than 5m/s and dry conditions.

The following equipment was used for the vibration survey.

Table 3.6 Vibration Measurement Equipment

Measurement Position	Equipment Description	Manufacturer & Type No	Serial No.	Calibration Due Date
VMP1	Vibration Meter	01dB ORION	10229	N/A

4 NOISE & VIBRATION IMPACT ASSESSMENT

4.1 Transport Noise

In order to accurately assess road traffic noise across the Site, a 3D Noise Model has been constructed using the modelling software CadnaA 2019 MR2.

The following assumptions, inputs and considerations have been included in the model:

- Planning Layout Drawing as described in Section 1;
- Existing buildings that provide shielding from any of the noise sources have been included in the model;
- Noise Measurement Positions 1 and 4 have been used to calibrate the noise model;
- A reflection order of 2 has been used in all calculations;
- Building heights are as supplied by the client; and,
- Noise levels generated using ISO 9613-1 and ISO 9613-2 "Acoustics – Attenuation of sound during propagation outdoors" as incorporated into CadnaA software.

4.1.1 Internal Noise Impact for Proposed Dwellings

In order to accurately determine the noise levels within habitable rooms, noise levels immediately outside the façades have been calculated in the noise model for the proposed layout.

BS8233:2014 suggests that a standard double-glazing unit with configuration 6mm glass/12mm air space/6mm glass affords sound insulation performance of the order of 33dB; this however this is for a pink noise spectrum. The same unit, weighted for road traffic noise using the '+Ctr' correction, has a sound insulation performance of approximately 30dB and so this value has been used to determine internal noise levels. BS8233:2014 also goes on to recommend that a partially open window provides approximately 15dBA attenuation, and this value is also used in the following.

Table 4.1 below summarises the façade noise level requirements for habitable rooms in accordance with BS8233:2014.

Table 4.1 Alternative Glazing and Ventilation Limit Requirements

Period	Parameter	Incident Façade Noise Level Above Which Higher Specification Glazing is Required (dB)	Incident Façade Noise Level above which Alternative Ventilation is Required (dB)
Daytime (07:00 – 23:00)	$L_{Aeq, 16hr}$	>65	>50
Night-time (23:00 – 07:00)	$L_{Aeq, 8hr}$	>60	>45
Night-time (23:00 – 07:00)	L_{Afmax}	>75	>60

Using the attenuations and the internal noise criteria of BS8233:2014, Appendix III Figures 2 to 6 show representative noise grids of the development. Colours on the facades show where mitigation is required or otherwise.

Note that night-time criteria apply only to bedrooms and daytime only for sensitive rooms used for daytime amenity, and not kitchens/bathrooms etc.

During the daytime period, the highest predicted façade level on site is 60dB $L_{Aeq,16hr}$, at the western façade of Plot 1, which has been used as a worst-case assessment. When considering standard glazing, the internal noise level in living rooms would be 30dB. This would fall within the internal criterion for living rooms as set out in BS8233:2014. However, with a partially open window, the resultant internal noise level would be 45dB, a +10dB exceedance above the criterion.

During the night-time period the highest predicted noise level at the façade is 51dB $L_{Aeq,8h}$. When considering standard glazing, the internal noise level in bedrooms would be 21dB. This would fall within the internal criterion for living rooms as set out in BS8233:2014 by 9dB, assuming a 30dB standard double glazing. A partially open window would result in the internal noise level achieving 36dB which is a +6dB exceedance in criterion.

4.1.2 External Amenity

The CadnaA noise model has been informed by drawings as listed in Section 1.2. The Noise Impact Assessment has determined that all external amenity areas across the development with the addition of the proposed fencing heights will meet the criterion within BS8233, with the worst-case level experiencing 48.8dB as seen in Figure 5.

Accordingly, no further mitigation measures are required for the proposed external amenity areas.

4.2 Rail Vibration Assessment

The total VDV values for the day and night time periods for trains have been calculated in accordance with the methodology contained within the BS6472:2008 using the appropriate weightings.

The total number of trains passing during both the day and night time periods have been obtained from the train timetables published on realtimetrains.co.uk and corresponds to the timetable on the day of the survey resulting in a representative and robust assessment.

The table below summarises the results of the vibration assessment.

Table 4.2 Measured Vibration Data

Train Type	Wd VDV (X)	Wd VDV (Y)	Wb VDV (Z)
Passenger	0.003026	0.001814	0.003642

Table 4.2 Summary of predicted Vibration Levels

Train Type	Timetabled Train Movements		Predicted Vibration Dose Value ($m/s^{1.75}$)	
	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Passenger	23	5	0.0	0.0

The following table determines the appropriate comment in accordance with BS6472:2008.

Table 4.3 Determination of Applicable Comment

Place	Calculated Vibration Dose Value ($m/s^{1.75}$)	Applicable Comment	Percentage up to 'low probability of adverse comment likely'
Residential Buildings (16-hour day)	0.0	Less than 'low probability of adverse comment'	0.01%

Residential Buildings (8-hour night)	0.0	Less than 'low probability of adverse comment'	0.01%

The applicable comment for the residential dwellings is below the threshold for 'Low Probability of adverse comment'.

As such, no mitigation is required.

4.3 Commercial Noise

There is the potential of the noise associated with the surrounding commercial premises to impact upon the proposed development. The assessment has therefore used the measured sound levels and BS4142:2014 to quantify the likelihood of adverse impact on the closest proposed residential dwellings.

The table below calculates the specific noise level for the worst affected hour of commercial noise from the Big Discount Bargain Store, Groton store. An 'On-Time' correction has been made to the measured noise levels and distance corrected to the nearest external amenity which is presented in 'Calculated Specific 1-hour Noise Level at nearest Proposed External amenity' below.

Table 4.4 On'Time Calculations

Source	Measured Noise Level	Measured On-time (Seconds)	BS4142:2014 Reference Period (seconds)	Calculated Specific 1-hour Noise Level at nearest Proposed External amenity
Big Discount Bargain Store, Gorton	46.8	3300	3600	17.9

Using the calculated specific 1-hour noise level as determined within the above table, the grid noise map, presented within Figure 6 of Appendix III, has determined that the highest specific noise level at the nearest proposed façade is 17.9dB. Accordingly, this specific level is used to inform a worst-case scenario.

Table 4.5 indicates penalties applied using the subjective methodology described in BS4142:2014.

Table 4.5 Noise Penalties

Penalty	Applicable?	Attributable Penalty	Comment
Tonality	Yes	+2dB	Tonality is just perceptible
Impulsivity	Yes	+2dB	Impulsivity penalties have been added due to the sporadic usage associated with a ventilation unit.
Intermittency	Yes	+3dB	Intermittent penalties have been added as the ventilation unit is able to turn off and on.
Other Sound Characteristics	No	-	Not applicable

The table below illustrates the BS4142:2014 calculation for the daytime and night-time periods for the nearest proposed residential dwellings.

This assessment is based on LA,r = LA90, the strictest criterion provided by BS4142:2014. This is considered robust. The median background sound levels from the survey period have been adopted.

Table 4.6 BS4142:Assessment

Day	Period	Calculated Specific Noise Level, $L_{Aeq,15min}$ (dB)	Acoustic Penalty (dB)	Rating Level (dB)	Background Sound Level, L_{A90} (dB)	Difference +/- (dB)
weekend	Day	17.9	+7dB	24.9	39.7	-14.8
	Night				31.8	-6.9
Saturday	Day				23.5	+1.4
	Night				36.1	-11.2
Sunday	Day				40.0	-15.1
	Night				34.9	-10

Table 4.6 indicates that the resultant noise levels would exceed the existing background level by +1.4dB during the daytime period. This exceedance is defined less likely to cause an adverse impact. Whereas, the other the rating levels do not exceed the background sound level, as such, the ventilation unit will have a low impact upon the proposed dwellings. Accordingly, no further mitigation is required.

5 MITIGATION

5.1 BS8233:2014 Internal

The above assessment has found the day and night time internal noise limits are exceeded on some facades with a partially open window. These facades are marked up on figures 2 to 4 for day and night time respectively.

Accordingly, it is necessary to consider an alternative ventilation scheme which does not require the opening of windows to provide fresh air flow and background ventilation, for all such rooms dependent upon their use whether for daytime or night-time amenity. The highest predicted exceedance with a partially open window has been found to be 45dB, which will require a ventilation performance of 25dB Dn,e,w +Ctr, during the daytime. The highest predicted exceedance with a partially open window has been found to be 36dB which will require a ventilation performance of 21dB Dn,e,w +Ctr during the night time period.

The exact requirement for alternative ventilation ultimately falls to the developer and, from an acoustics perspective, needs to ensure that fresh air flow can be achieved without the need for opening windows. It is necessary to meet the requirements given in BS8233:2014, Section 8.4.5.4, which states that:

"The Building Regulations' supporting documents on ventilation [48, 49, 50] recommend that habitable rooms in dwellings have background ventilation. Where openable windows cannot be relied upon for this ventilation, trickle ventilators can be used and sound attenuating types are available. However, windows may remain openable for rapid or purge ventilation, or at the occupant's choice.

Alternatively, acoustic ventilation units (see 7.7.2) are available for insertion in external walls. These can provide sound reduction comparable with double glazed windows. However, ducted systems with intakes on the quiet side of the building might be required in very noisy situations, or where appearance rules out through-the-wall fans."

Section 7.7.2 states:

"NOTE 5 If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level."

With mitigation in place, it is concluded that the NOAEL is achieved which would be noticeable and not intrusive resulting in the following:

"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.

5.2 BS8233:2014 External

The CadnaA noise model has been informed by drawings as listed in Section 1.2. The drawings provided by the client for external fencing provide sufficient acoustic treatment for the external amenities. As such, no further mitigation measures are required for the proposed external amenity areas.

5.3 BS4142:2014+A1:2019 External

The CadnaA noise model has been informed by existing ventilation unit data as surveyed and distance corrected in Section 4.3. This assessment has determined that noise associated with the unit will fall below the existing background noise level within the external amenity areas. As such, no mitigation is required.

6 CONCLUSION

Omnia has been commissioned by Watson Homes to provide a Noise Impact Assessment for a proposed residential development at Levenshulme Road, Gorton.

Environmental noise surveys have been undertaken to quantify road traffic from Levenshulme Road located west of the site and the Railway line that is situated to the east of the site. Additionally, surveys have been undertaken to quantify the existing levels of background and ambient noise as well as noise associated with the adjacent commercial premises.

The Noise Impact Assessment has been completed in accordance to the requirements as stated within BS8233:2014 and BS4142:2014**.** A CadnaA noise model has been constructed including all significant noise sources, existing buildings and with full topography. The noise model has been used to predict the noise levels and the potential effect upon the facades of the proposed residential development.

The Noise Impact Assessment has determined that mitigation measures in the form of an alternative ventilation scheme are required to ensure that the internal noise criteria are met. Plots are listed in Appendix VII and VIII for the day and night time periods, these tables concern ventilation performance specifications for bedrooms and living rooms respectively.

The assessment has been based upon robust and worst-case assumptions and demonstrates that, in principal and subject to the incorporated mitigation measures, there should not be any adverse impact due to the proposed development.

END OF REPORT

APPENDIX I

LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between Omnia and the Client as indicated in Section 1.3.

2. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.

3. Omnia cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by Omnia is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by Omnia in this connection without their explicit written agreement there to by Omnia.

4. Where a noise survey is required to inform the assessment, Omnia will endeavour to ensure that all noise measurements taken are robust, representative and reliable in order to inform an accurate noise impact assessment. Where limitations or constraints exist which prevent a suitable noise survey being completed, Omnia will take all reasonable steps to make the client fully aware of any such limitations or constraints with a view to achieving the best possible outcome for the client. Where additional sound surveys are required, over and above those specified in our scope of works, then Omnia reserves the right to charge additional fees.

5. Where mitigation measures are specified in our report, it should be noted that these measures are relative to a specific sound source, both in terms of the measured sound pressure level and the character of the source. Where either the sound pressure level or the character of the sound varies following completion of the sound survey, Omnia cannot be held responsible for any subsequent variations in the proposed mitigation performance.

APPENDIX II

GLOSSARY OF ACOUSTIC TERMINOLOGY

Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 20 Hz (deep bass) to 20,000 Hz (high treble) and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude, but is more responsive to mid- frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear.

Furthermore, the perception of noise may be determined by a number of other factors, which may not necessarily be acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time. In some cases, the time of day and other acoustic features such as tonality or impulsiveness may be important, as may the disposition of the affected individual. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source.

The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or LAeq, LA90 etc., according to the parameter being measured.

The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10 dB(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB(A) is generally regarded as the minimum difference needed to perceive a change under normal listening conditions.

An indication of the range of sound levels commonly found in the environment is given in the following table.

Table A1: Typical Sound Pressure Levels

Sound Pressure Level (dB)	Location/Example
0	Threshold of hearing
20 - 30	Quiet bedroom at night
30 - 40	Living room during the day
40 - 50	Typical office
50 - 60	Inside a car
60 - 70	Typical high street
70 - 90	Inside factory
100 - 110	Burglar alarm at 1m away
110 - 130	Jet aircraft on take off
140	Threshold of pain

Table A2: Terminology

Descriptor	Explanation
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean square pressure of the sound field and a reference pressure (2x10-5Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
$L_{Aeq, T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A – weighted fluctuating sound measured over that period.
L_{Amax}	L_{Amax} is the maximum A - weighted sound pressure level recorded over the period stated. L_{Amax} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall Leq noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
L_{10} & L_{90}	If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The Ln indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L_{90} is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L_{10} index to describe traffic noise.
Free-field Level	2A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally as measured outside and away from buildings.
Fast	A time weighting used in the root mean square section of a sound level meter with a 125millisecond time constant.
Slow	A time weighting used in the root mean square section of a sound level meter with a 1000millisecond time constant.

APPENDIX III

FIGURES

Figure 1 – Site Layout and Noise Measurement Positions (NMP's)

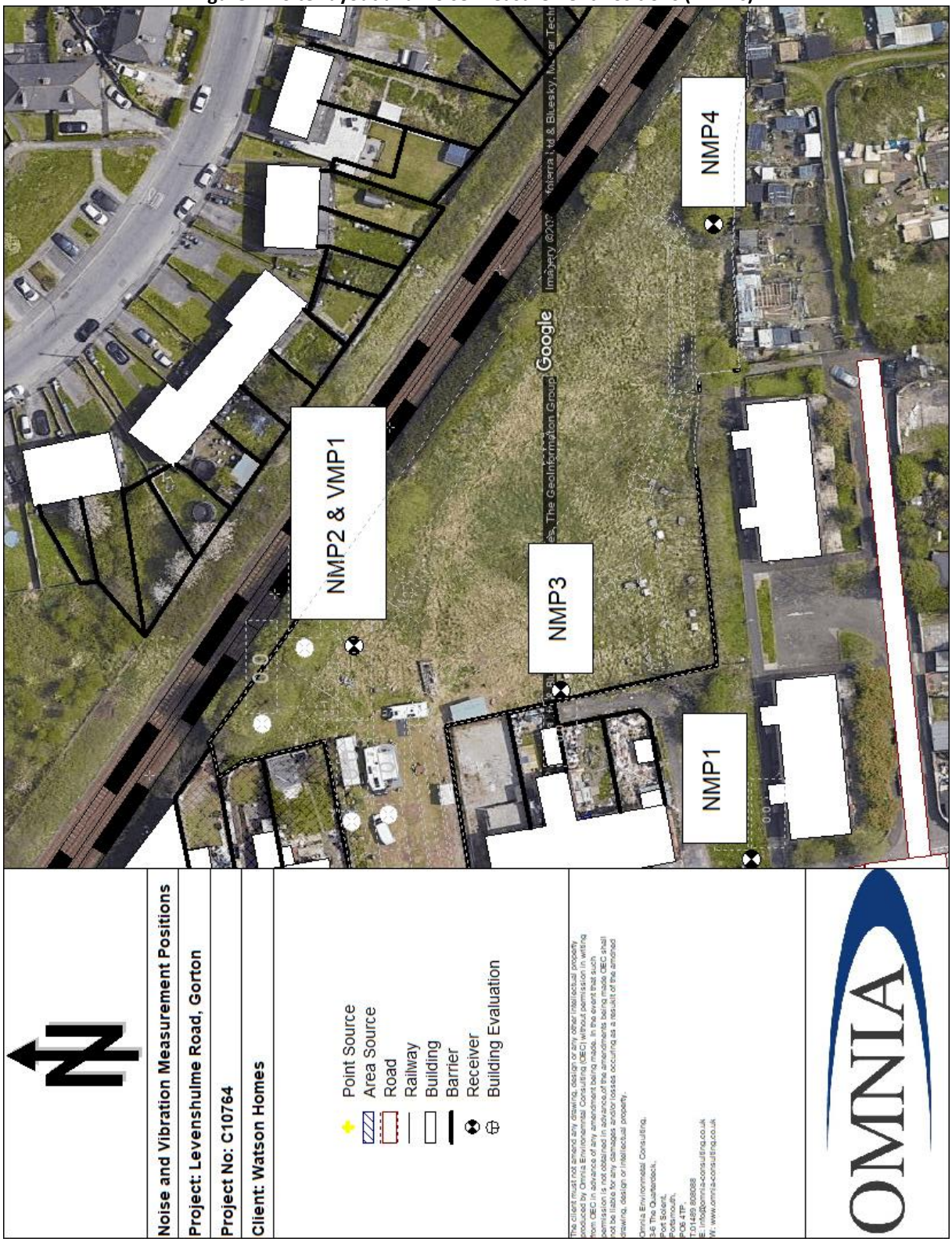


Figure 2 – Daytime BS8233:2014 Assessment

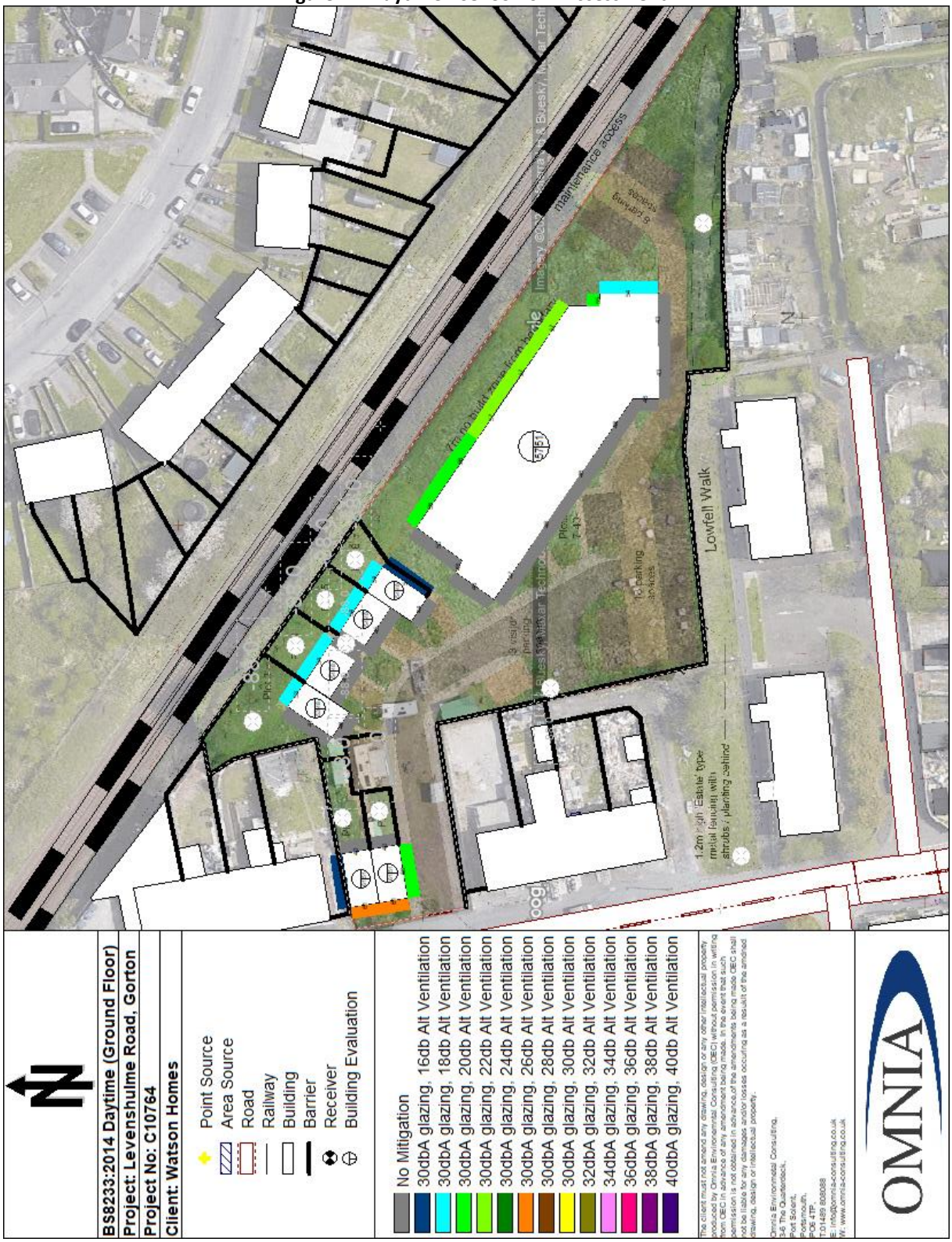


Figure 3 – Night time BS8233:2014 Assessment (First Floor)

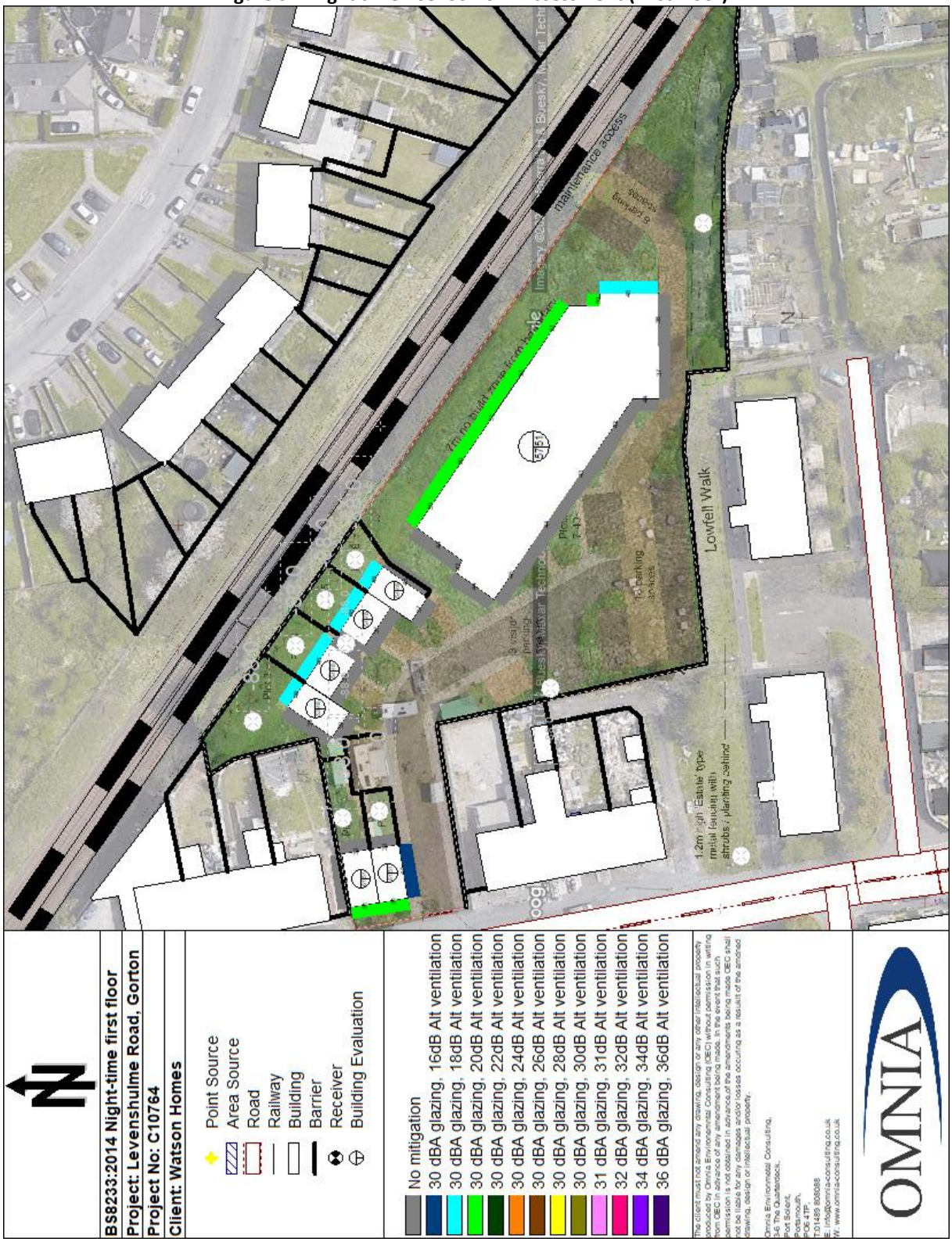


Figure 4 – Night time BS8233:2014 Assessment (Second Floor)

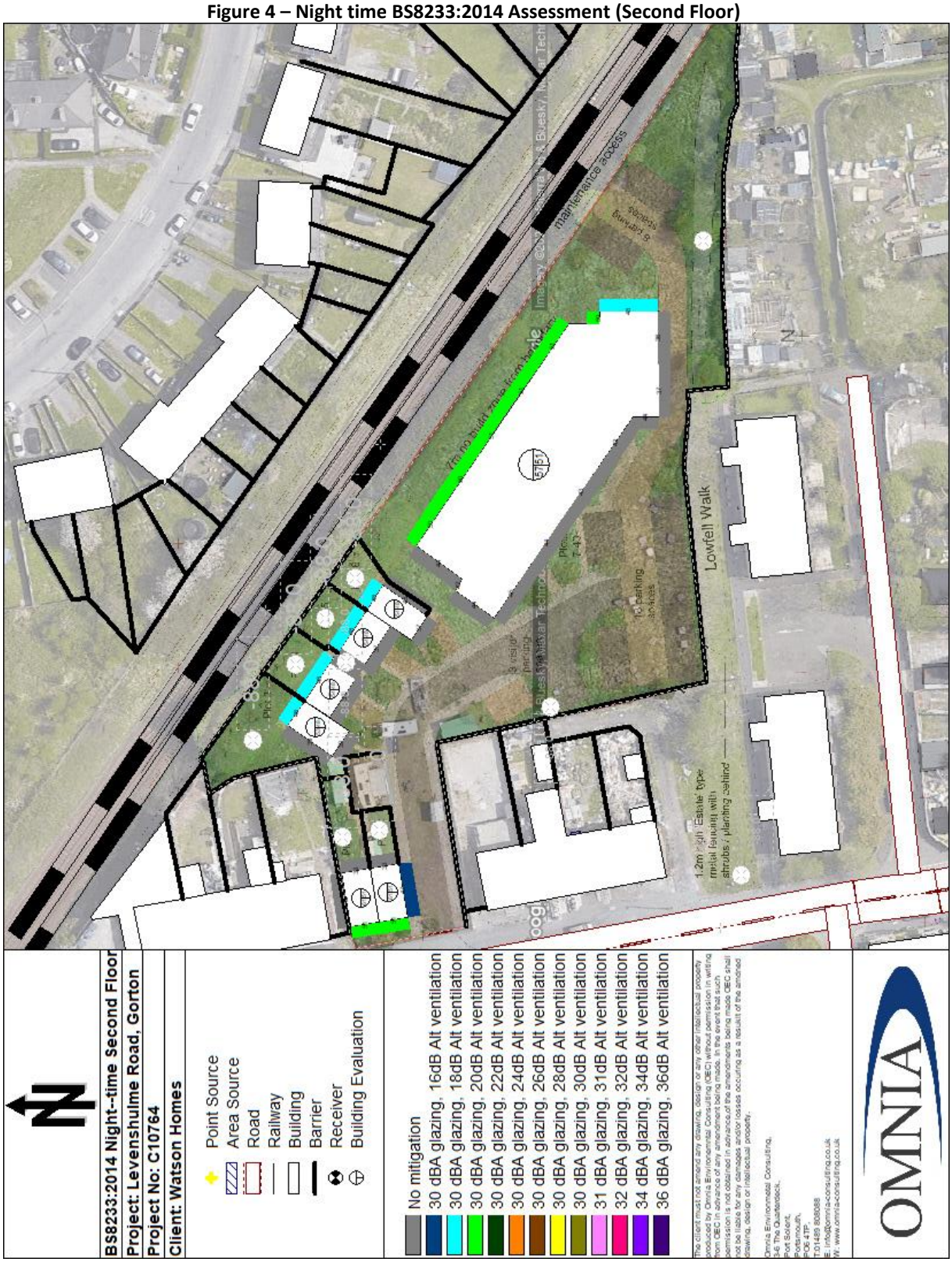


Figure 5 – BS8234:2014 External Amenity Assessment

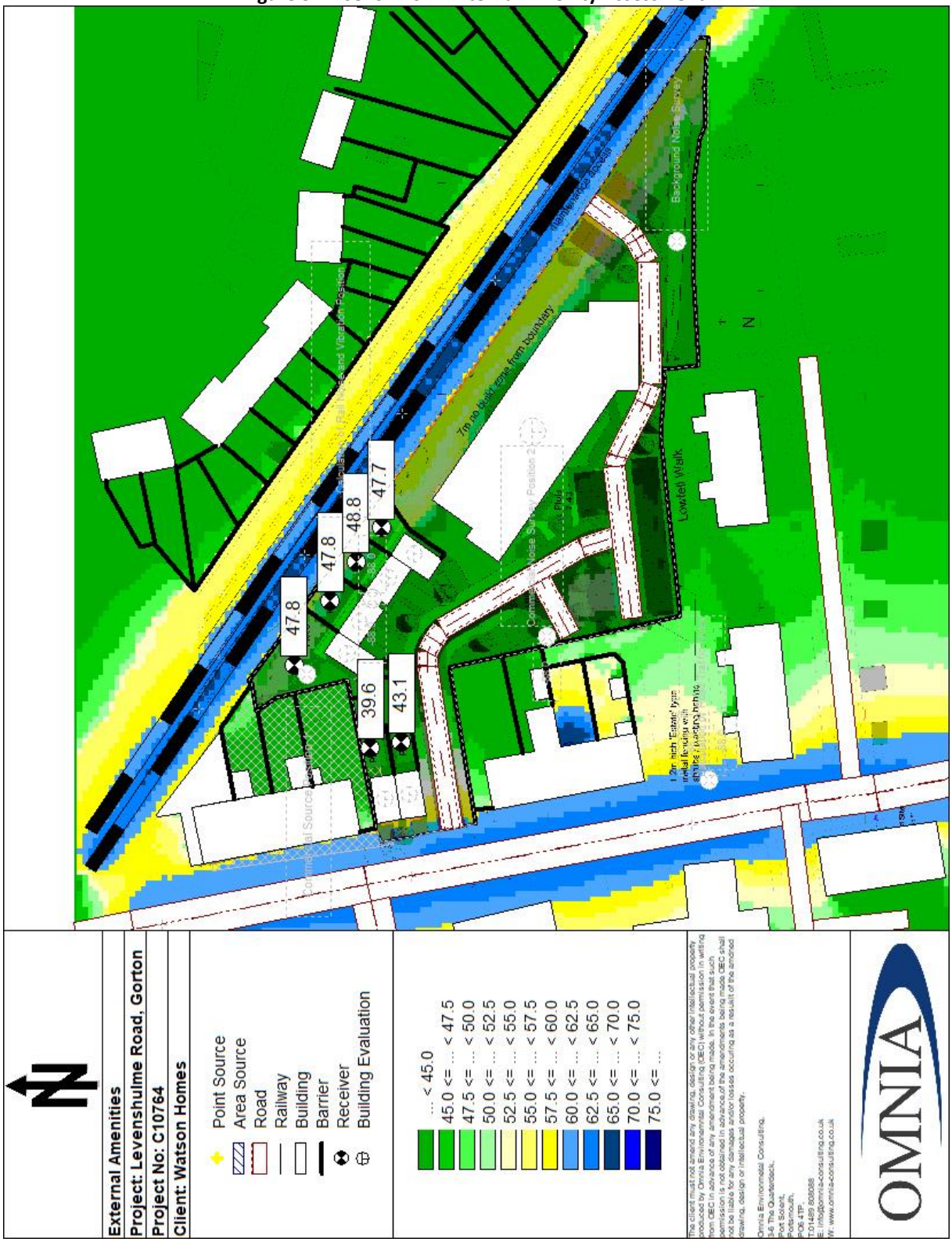
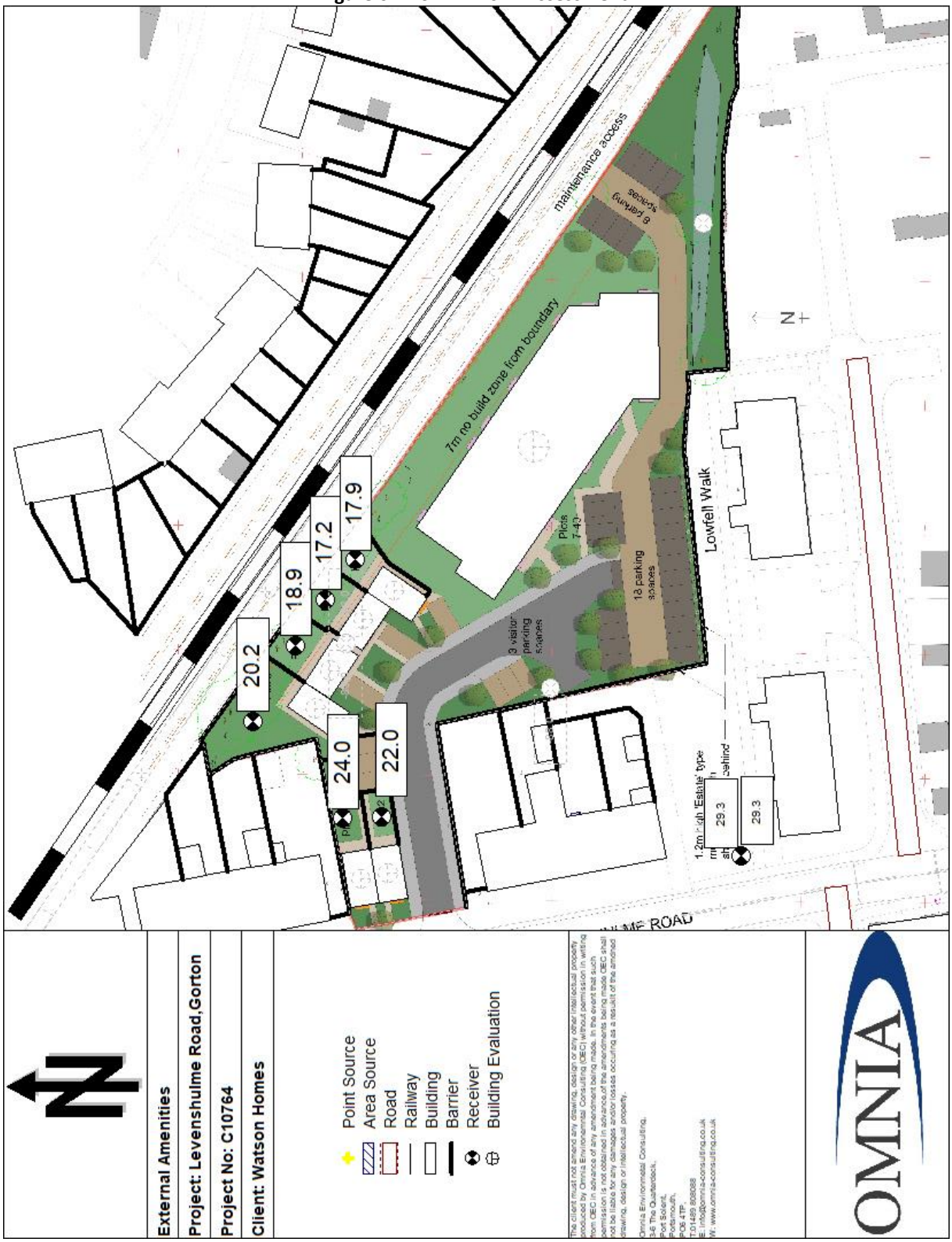


Figure 6 – BS4142:2014 Assessment



APPENDIX VI

BACKGROUND & AMBIENT SOUND LEVELS

Table A3: Background & Ambient Sound Levels (Daytime)

Period start	Measured Sound Pressure Level, dB	
	LAeq,1hr	LA90,1hr
22/07/2022 10:00	53.5	42.6
22/07/2022 11:00	49.4	46.1
22/07/2022 12:00	78.5	41.6
22/07/2022 13:00	77.4	40.9
22/07/2022 14:00	45.1	40.8
22/07/2022 15:00	46.2	40.2
22/07/2022 16:00	45.6	40
22/07/2022 17:00	46.9	40.5
22/07/2022 18:00	45.2	39.9
22/07/2022 19:00	44.1	38.8
22/07/2022 20:00	44.3	38.4
22/07/2022 21:00	43.8	35.7
22/07/2022 22:00	40.5	35.7
22/07/2022 23:00	39.3	34.5
23/07/2022 07:00	44.2	34.0
23/07/2022 08:00	47.7	36.3
23/07/2022 09:00	45.6	34.8
23/07/2022 10:00	43.6	37.9
23/07/2022 11:00	45.9	38.3
23/07/2022 12:00	45.5	38.9
23/07/2022 13:00	43.7	38.2
23/07/2022 14:00	44.2	38.8
23/07/2022 15:00	42.9	39
23/07/2022 16:00	46.6	40.1
23/07/2022 17:00	44.8	40.1
23/07/2022 18:00	45.2	40.2
23/07/2022 19:00	46.6	40.3
23/07/2022 20:00	48.1	40.2
23/07/2022 21:00	45.7	40.6
23/07/2022 22:00	45.1	39.5
23/07/2022 23:00	41.6	36.8
24/07/2022 07:00	45.5	38.8
24/07/2022 08:00	47.2	38.8
24/07/2022 09:00	45.4	40.0
24/07/2022 10:00	46.3	41.4
24/07/2022 11:00	48.2	40.1
24/07/2022 12:00	45.4	39.8

24/07/2022 13:00	47.9	38.9
24/07/2022 14:00	49.9	41.6
24/07/2022 15:00	49.4	44.7
24/07/2022 16:00	47.9	41.8
24/07/2022 17:00	48.7	43.6
24/07/2022 18:00	46.9	41.2
24/07/2022 19:00	45.4	40.5
24/07/2022 20:00	45.0	39.2
24/07/2022 21:00	42.2	37.5
24/07/2022 22:00	43.8	37.9
24/07/2022 23:00	40.4	34.3
25/07/2022 07:00	46.3	39.8
25/07/2022 08:00	45.3	40.4
25/07/2022 09:00	48.0	43.4

Table A4:: **Background & Ambient Sound Levels (Night-time)**

Period start	Measured Sound Pressure Level, dB	
	LAeq,15min	LA90, 15min
22/07/2022 23:00	39.1	34.5
22/07/2022 23:15	37.0	34.3
22/07/2022 23:30	40.5	34.5
22/07/2022 23:45	39.7	34.5
23/07/2022 00:00	50.6	44.9
23/07/2022 00:15	47.4	42.6
23/07/2022 00:30	39.1	35.5
23/07/2022 00:45	35.5	31.9
23/07/2022 01:00	34.7	30.8
23/07/2022 01:15	33.2	28.6
23/07/2022 01:30	32.7	27.7
23/07/2022 01:45	33.5	28.4
23/07/2022 02:00	31.9	26.9
23/07/2022 02:15	30.4	26.3
23/07/2022 02:30	31.2	26.7
23/07/2022 02:45	32.3	27.4
23/07/2022 03:00	31.3	26.9
23/07/2022 03:15	30.8	26.6
23/07/2022 03:30	41.8	27.8
23/07/2022 03:45	33.4	27.1

23/07/2022 04:00	31.0	27.5
23/07/2022 04:15	35.3	27.6
23/07/2022 04:30	35.8	28.1
23/07/2022 04:45	39.0	31.4
23/07/2022 05:00	39.3	32.3
23/07/2022 05:15	40.5	33.5
23/07/2022 05:30	43.8	34.4
23/07/2022 05:45	44.8	36.2
23/07/2022 06:00	46.4	34.6
23/07/2022 06:15	52.3	34.8
23/07/2022 06:30	52.8	36.3
23/07/2022 06:45	44.8	35.3
23/07/2022 07:00	43.6	35.1
23/07/2022 23:00	41.9	38.1
23/07/2022 23:15	41.8	39.2
23/07/2022 23:30	42.7	36.6
23/07/2022 23:45	39.3	35.8
24/07/2022 00:00	41.1	37.3
24/07/2022 00:15	47.2	34.5
24/07/2022 00:30	38.4	35.1
24/07/2022 00:45	45.1	34.0
24/07/2022 01:00	37.6	34.7
24/07/2022 01:15	39.4	34.2
24/07/2022 01:30	40.9	35.9
24/07/2022 01:45	40.7	35.9
24/07/2022 02:00	38.7	34.8
24/07/2022 02:15	40.3	35.8
24/07/2022 02:30	39.5	34.8
24/07/2022 02:45	38.9	34.9
24/07/2022 03:00	41.8	36.8
24/07/2022 03:15	40.9	36.0
24/07/2022 03:30	43.4	37.9
24/07/2022 03:45	39.1	34.7
24/07/2022 04:00	39.3	34.3
24/07/2022 04:15	40.9	36.8
24/07/2022 04:30	40.8	36.6
24/07/2022 04:45	42.0	36.8
24/07/2022 05:00	40.8	36.9
24/07/2022 05:15	44.2	35.6

24/07/2022 05:30	40.6	35.5
24/07/2022 05:45	41.5	35.9
24/07/2022 06:00	42.0	35.8
24/07/2022 06:15	40.2	35.7
24/07/2022 06:30	49.0	38.3
24/07/2022 06:45	44.5	37.6
24/07/2022 07:00	43.3	37.7
24/07/2022 23:00	37.7	34.8
24/07/2022 23:15	40.5	34.3
24/07/2022 23:30	40.5	34.6
24/07/2022 23:45	41.9	33.7
25/07/2022 00:00	37.4	34.9
25/07/2022 00:15	37.0	33.8
25/07/2022 00:30	36.8	33.6
25/07/2022 00:45	44.4	34.4
25/07/2022 01:00	39.5	34.6
25/07/2022 01:15	42.2	37
25/07/2022 01:30	41.5	36.2
25/07/2022 01:45	42.9	35.2
25/07/2022 02:00	39.3	34.9
25/07/2022 02:15	41.1	34.9
25/07/2022 02:30	40.6	36.0
25/07/2022 02:45	40.0	35.8
25/07/2022 03:00	40.0	34.9
25/07/2022 03:15	42.3	38.5
25/07/2022 03:30	40.0	33.5
25/07/2022 03:45	37.9	32.8
25/07/2022 04:00	41.0	34.6
25/07/2022 04:15	38.0	33.1
25/07/2022 04:30	38.5	33.7
25/07/2022 04:45	45.7	32.6
25/07/2022 05:00	39.6	32
25/07/2022 05:15	42.1	33.3
25/07/2022 05:30	38.9	34.1
25/07/2022 05:45	42.9	34.2
25/07/2022 06:00	44.1	34.7
25/07/2022 06:15	50.8	38
25/07/2022 06:30	44.5	37.3
25/07/2022 06:45	47.3	37.7

25/07/2022 07:00	45.0	38.0

APPENDIX VII

DAYTIME MITIGATION SPECIFICATIONS
(Affected Facades only)

Table A5: Daytime Ground Floor Specifications

Plot	Facade Direction	Calculated $L_{Aeq, 16hr}$ at Facade (dB)	Calculated Noise Level Inside Room (Assuming 30dB Standard Double Glazing) (dB)	Criterion Met 35dB (Y/N)	Glazing Required	Calculated Internal Noise Level with a Partially Open window (assuming 15dB) (dB)	difference in criterion	Ventilation Performance (dB)
1	W	60	30	Yes	--	45	10	25
2	W	60	30	Yes	--	45	10	25
	S	54	24	Yes	--	39	4	19
7-37	NE	52	22	Yes	--	37	2	17

Table A6: Daytime First Floor Daytime Specifications

plots	Facade Direction	Calculated $L_{Aeq, 16hr}$ at Facade (dB)	Calculated Noise Level Inside Room (Assuming 30dB Standard Double Glazing) (dB)	Criterion Met (Y/N)	Glazing Required	Calculated Internal Noise Level with a Partially Open window (assuming 15dB) (dB)	difference in criterion	Ventilation Performance (dB)
7-37	E	53	23	Yes	--	38	3	18
	N	55	25	Yes	--	40	5	20
	NE	56	26	Yes	--	41	6	21

Table A7: Second Floor Daytime Specifications

plots	Facade Direction	Calculated $L_{Aeq, 16hr}$ at Facade (dB)	Calculated Noise Level Inside Room (Assuming 30dB Standard Double Glazing) (dB)	Criterion Met (Y/N)	Glazing Required	Calculated Internal Noise Level with a Partially Open window (assuming 15dB) (dB)	difference in criterion	Ventilation Performance (dB)
7-37	E	54	24	Yes	--	39	4	19
	N	55	25	Yes	--	40	5	20
	NE	56	26	Yes	--	41	6	21

APPENDIX VIII

NIGHT-TIME MITIGATION SPECIFICATIONS

Table A8: Night-time Ground Level Specifications

Plots	Facade Direction	Calculated $L_{Aeq, 8hr}$ at Facade (dB)	Calculated Noise Level Inside Room (Assuming 30dB Standard Double Glazing) (dB)	Criterion Met (Y/N)	Glazing Required	Calculated Internal Noise Level with a Partially Open window (assuming 15dB) (dB)	difference in criterion	Ventilation Performance (dB)
1	W	51	21	Yes	--	36	6	21
2	W	50	20	Yes	--	35	5	20
7-37	NE	47	17	Yes	--	32	2	17

Table A9: Night-time First Level Specifications

plots	Facade Direction	Calculated $L_{Aeq, 8hr}$ at Facade (dB)	Calculated Noise Level Inside Room (Assuming 30dB Standard Double Glazing) (dB)	Criterion Met (Y/N)	Glazing Required	Calculated Internal Noise Level with a Partially Open window (assuming 15dB) (dB)	difference in criterion	Ventilation Performance (dB)
7-37	E	48	18	Yes	--	33	3	18
	N	49	19	Yes	--	34	4	19
	NE	51	21	Yes	--	36	6	21

Table A10: Night-time Second Level Specifications

plots	Facade Direction	Calculated $L_{Aeq, 8hr}$ at Facade (dB)	Calculated Noise Level Inside Room (Assuming 30dB Standard Double Glazing) (dB)	Criterion Met (Y/N)	Glazing Required	Calculated Internal Noise Level with a Partially Open window (assuming 15dB) (dB)	difference in criterion	Ventilation Performance (dB)
7-37	E	48	18	Yes	--	33	3	18
	N	49	19	Yes	--	34	4	19
	NE	50	20	Yes	--	35	5	20