

Noise Impact Assessment for Proposed Office Development to Support Planning Application

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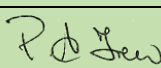
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BRIEF FOR CONSULTANCY:

This report has been prepared by Acoustics & Noise Limited, Newport, South Wales, for Mark Williams, Blue Bell Barn, Peterstone Super Ely, Cardiff, CF5 6NE under the instructions of Fran Clarke, c/o Oscar Clarke Design.

Order No: n/a

OBJECTIVES:

To investigate the noise impact on the proposed office development from the nearby railway and train station.

Where applicable recommend mitigation to meet the external noise intrusion criteria detailed in the British Council for Offices, '*Guide to specification 2019*'.

NON TECHNICAL SUMMARY:

It is proposed to develop a site on land adjacent to Neath Train Station for light industrial and office use. This report assesses the potential impact from railway and train station noise on the proposed office accommodation using 3D acoustic modelling techniques.

In the absence of any objective criteria detailed in Condition 3 of the planning permission, ref: P2020/0771, this report has referred to the acceptable internal noise levels within different categories of office space published in the British Council for Offices (BCO) '*Guide to Specification 2019*'.

Whenever possible, it is desirable to rely on partially open windows to provide the background ventilation. A 3D acoustic CAD model of the site was constructed to predict the noise propagation from the rail traffic across the site to identify for which offices, if any, an open window ventilation strategy would be suitable.

With reference to the provided development plans, the modelling results identified that an open window ventilation strategy would be suitable for all office accommodation as set out in the plans.

The conclusions of this report are only valid for the proposed layout as provided. If the accommodation is reconfigured, it is recommended that further assessment will be required, particularly if the room classification is modified. For example, if an open plan office is reconfigured to a meeting room or cellular office for which the criteria is more stringent.

1.0 DESCRIPTION OF SITE

- 1.1 The site is located on land adjacent to the railway and train station in Neath and was formerly utilised as railway buildings which are now vacant.
- 1.2 The site is bounded by residential development to the east and south with the rail line to the west and north. Neath train station is located 200m to the north of the development buildings.
- 1.3 The acoustic climate at the site is characterised by intermittent train noise with lesser contributions from road traffic.
- 1.4 A satellite view of the site is presented in Appendix 2.

2.0 RELEVANT GUIDANCE

2.1 Relevant Guidance

2.1.1 As a matter of best practice, this assessment has been undertaken based on the relevant guidance on noise. This includes:

2.2 British Council for Offices (BCO) 'Guide to Specification 2019' [1]

2.2.1 Section 11 of this guidance provides information for acoustic design standards that can be adopted to achieve a desired acoustic environment within office spaces.

2.2.2 The acoustic environment in offices affects wellbeing, concentration, communication, and productivity. Excessive noise can cause disturbance and discomfort and, when background levels are too low, unwanted noise causes greater distraction. Good acoustic design is an essential ingredient of the well-designed office. However, it is noted in the guidelines that when choosing acoustic design parameters, it is often unnecessary, and in some cases counter-productive, to set them too onerously.

2.2.3 When considering the design for offices in close proximity to external noise sources such as road and rail traffic, it is important to address the potential noise intrusion via the building envelope.

2.2.4 The BCO Guide provides acoustic criteria for external noise intrusion levels that should not be exceeded plus additional criteria to prevent speech interference from regular individual noise events such as passing trains.

2.2.5 The relevant criteria are summarised in Table 1 below.

Table 1 – BCO Guideline External Noise Intrusion Criteria

Office Category	External Noise Intrusion Guideline NR Levels	Regular Individual Noise Events
Open Plan Offices	NR40	55 dB LA01,1hr
Speculative Offices*	NR38	55 dB LA01,1hr
Cellular Offices/Meeting Rooms	NR35	50 dB LA01,1hr

* The speculative office criterion is a compromise between that for open plan and cellular rooms

- 2.3 **BS8233 - Guidance on Sound Insulation and Noise Reduction for Buildings [2]**
- 2.3.1 The foreword advises that the information detailed in BS8233 [2] “...takes the form of guidance and recommendations. It should not be quoted as it were a specification or a code of practice and claims of compliance cannot be made to it.”.
- 2.3.2 Section 7.7.4 details the guideline values for desirable internal ambient noise levels within non-domestic buildings (when unoccupied). For offices and meeting rooms, these guideline values range from 35 - 45 dB $L_{Aeq,T}$.
- 2.3.3 Annex B of the Guidelines describes the procedures for assessing the acceptability of a noise spectrum for a particular application by comparing the measured or predicted noise level with a series of Noise Rating (NR) curves.
- 2.3.4 BS 8233 [2] provides both simple and detailed calculation methods for determining the internal ambient noise levels attributable to the external noise level. These methods are based on those given in BS EN 12354-3 [3].
- 2.3.5 The indoor sound pressure level is estimated from the measured or calculated outdoor sound pressure level by using the sound level difference of the façade.
- 2.4 **BS EN 12354 Part 3, Airborne Sound Insulation against Outdoor Sound [3]**
- 2.4.1 This Standard specifies a calculation model to estimate the sound insulation or the sound pressure level difference of a façade or other external surface of a building. The calculation is based on the sound reduction index of the different elements from which the façade is constructed. Calculations can be carried out for frequency bands or single number ratings.
- 2.4.2 The results of the calculation can be used to determine the indoor sound pressure level due to external sound sources such as road traffic.
- 2.4.3 BS EN 12354 [3] states that ‘The sound level difference refers to a position 2m in front of the façade. If the calculated or measured outdoor sound pressure level refers to other positions or situations, the level at 2m in front of the façade should be deduced from it. It could, for instance, be deduced from the sound pressure level of the incident sound (without the building) by taking into account the façade

reflection. For a plain façade this will result in a 3dB higher level, globally for all frequency bands'.

- 2.4.4 The indoor A-weighted sound pressure level can be determined from calculation in frequency bands for the appropriate frequency range, applying the A-weighting.
- 2.4.5 Alternatively, the indoor A-weighted sound pressure level can be determined directly from the A-weighted outdoor sound pressure level, provided the level difference is expressed in a single number rating for the relevant outdoor sound spectrum in accordance with BS EN ISO 717-1 [4], i.e. applying the spectrum adaptation terms C_{tr} or C to describe the level difference as, for example, $R_w + C_{tr}$ when the outdoor sound is road or rail traffic travelling at low speeds (<80km/h) or $R_w + C$ when the outdoor sound is road or rail traffic travelling at high speeds (>80km/h).

3.0 DISCUSSION

- 3.1 It is proposed to develop the site for light industrial and office use.
- 3.2 Planning permission for the proposed development, ref: P2020/0771, was granted on 2nd March 2021 by Neath Port Talbot County Borough Council with conditions. The condition relevant to this report is reproduced below:

Condition 3

“Prior to commencement of development hereby permitted a noise impact assessment, prepared by an independent acoustic consultant, shall be submitted to and approved in writing by the LPA. The acoustic consultant shall be a member of the Association of Noise Consultants (ANC) and a member of the Institute of Acoustics. The assessment shall assess the impact of noise from the nearby railway and train station on the proposed development”.

- 3.3 Acoustics and Noise Limited were engaged to carry out an assessment of the noise impact from the nearby railway and train station on the proposed office accommodation and to recommend a scheme of noise reduction measures, where necessary, with regard to the acoustic design standards detailed in the British Council for Offices ‘Guide to Specification 2019’ [1].
- 3.4 Acoustics and Noise Limited are members of the Association of Noise Consultants and all consultants are full members of the Institute of Acoustics.

4.0 ASSESSMENT PROCEDURES

- 4.1 To determine the acoustic conditions across the proposed development site an 8-hour external noise survey was conducted 10m from the rail track. This location enjoyed an uninterrupted view of the rail traffic and Neath train station.
- 4.2 A computer-generated 3D acoustic model was developed to predict the rail traffic noise levels across the proposed development site. Results are displayed in easily understood noise contours representing the external free-field noise emissions, overlaid onto a basemap image of the site.
- 4.3 **Assessment Criteria**
- 4.3.1 A planning application was submitted to Neath Port Talbot County Borough Council, ref: P2020/0771, which was approved with conditions regarding noise. There are no objective criteria detailed in the planning conditions.
- 4.3.2 Suitable guidance on acceptable internal noise levels within different categories of office space can be found in the British Council for Offices (BCO) '*Guide to Specification 2019*' [1]. This provides acoustic criteria for external noise intrusion levels that should not be exceeded plus additional criteria to prevent speech interference from regular individual noise events such as passing trains.
- 4.3.3 With reference to the proposed office plans presented in Appendix 3, the office accommodation is divided into two separate buildings. For ease of identification, this report refers to the smaller building to the north as Block A and the larger building to the south as Block B.
- 4.3.4 Within Block A, there is a single open plan office with associated toilet and kitchen facilities. Within Block B there a number of open plan offices with associated toilets area. At each end of the block is a small meeting room.
- 4.3.5 The criteria for external noise intrusion levels are described in terms of NR levels. Noise Rating (NR) is a graphical method for assigning a single number rating to a noise spectrum. To assess the acceptability of noise for a particular application. This method is now used in the UK, mainly for assessing noise from mechanical ventilation systems in buildings.

- 4.3.6 The noise emissions from mechanical ventilation systems are typically broadband in nature and relatively constant when operating. In the case of intermittent train movements, the noise levels fluctuate and occur randomly. For noise sources of this nature it is more appropriate to use the equivalent A-weighted $L_{eq,t}$ dBA noise descriptor to characterise the noise emissions.
- 4.3.7 Whilst NR values cannot be converted directly to dBA values, BS 8233 [2] does provide an approximate relationship of $NR = dBA - 6$.
- 4.3.8 For the purposes of this report, internal noise levels at the site are assessed against the BCO guideline criteria detailed in Table 2 below.

Table 2 – Assessment Criteria for Internal Ambient Noise Levels within Offices

Office Category	External Noise Intrusion Guideline NR Levels	Regular Individual Noise Events
Open Plan Offices	46 dBA $L_{eq,1hr}$	55 dB $L_{A01,1hr}$
Meeting Rooms	41 dBA $L_{eq,1hr}$	50 dB $L_{A01,1hr}$

- 4.4 **Prediction of Noise Levels Across Proposed Development Site**
- 4.4.1 As the site is relatively large and comprises multiple offices, a 3D acoustic CAD model of the proposed development was constructed to aid in the identification of potential offices that may not meet the stated criteria. This process minimises unnecessary schemes of mitigation.
- 4.4.2 EMS B&K Predictor V2019 Software was utilised to model the rail traffic noise levels across the whole of site. This noise prediction software allows for the investigation of noise emissions in complex or large outdoor environments. The software can be used to analyse industrial noise sources and traffic measurements to the latest European and U.K. Standards.
- 4.4.3 A major advantage of using this method is the ability to remodel changes and alterations to the site and/or sources.
- 4.4.4 **CAD Model Construction**

- 4.4.4.1 The assessment area including the proposed site and the adjacent rail line lie in the same horizontal plane. No topographical data has been used and the ground model has been modelled as flat. Any minor variations are assumed to be acoustically insignificant.
- 4.4.4.2 'OS Open Zoomstack' was used as a background image for the model. 'OS Open Zoomstack' provides a single, customisable basemap of Great Britain made freely available in partnership with the UK government. The data was obtained from 'www.ordnancesurvey.co.uk' under the Open Government Licence (OGL) and contains OS data © Crown copyright and database right 2019.
- 4.4.5 **CAD Model Calibration**
- 4.4.5.1 An 8-hour noise survey was conducted 10m from the nearside rail track.
- 4.4.5.2 A noise receiver was positioned in the model at the position of the actual measurement location used during the noise survey.
- 4.4.5.3 The model assumes that the measured noise levels during the survey are attributable to the rail traffic. All other noise sources are assumed to be insignificant when compared to the primary noise source and represents worst case.
- 4.4.5.4 The daytime $L_{Aeq,1hr}$ and $L_{A01,1hr}$ noise levels at the measurement position are determined from the survey data using B&K 7820 Evaluator software. To represent worst case, and to account for the intermittent nature of the noise, this assessment uses the highest 1-hour values to represent the rail noise at the measurement position.
- 4.4.5.5 The rail traffic is modelled as a moving point source and aligned along the track using the basemap as a guide. The spectrum for the rail traffic is derived from the C_{tr} spectrum detailed in BS EN ISO 717-1 [4] which is appropriate for rail traffic travelling at low speed (<80km/hr).
- 4.4.5.6 The flow was then adjusted until the calculated noise level at the receiver equals the period L_{Aeq} level determined using the procedures detailed above.

- 4.4.5.7 The software calculations for noise propagation follow the procedures set out in ISO 9613 'Acoustics – Attenuation of sound propagation outdoors Parts 1 & 2'.
- 4.4.5.8 When the calculated noise level at the receiver equals the level determined from the survey data, the noise emission level for the rail track has been determined.
- 4.4.6 **CAD Model Prediction**
- 4.4.6.1 Once the model calibration exercise is completed, the proposed development buildings are placed into the model using the basemap and design drawing '096 D AP102', provided by Oscar Clarke Design, as a guide (see Appendix 3).
- 4.4.6.2 The office buildings are modelled with a height of 3m and the light industrial building is modelled with a height of 6m. To account for any noise reflections, adjacent houses have been included and modelled with a height of 8m.
- 4.4.6.3 A noise contour grid covering the whole site is then constructed to display the external free field noise levels at the office accommodation. Each grid is a collection of receivers set 1m apart at a height of 1.5m.
- 4.4.6.4 The results of the assessment are presented in the form of easily understood noise contour maps and are shown in Appendix 5.
- 4.4.6.5 These contour maps indicate the external free field noise levels across the whole of the proposed development with each contour colour boundary assigned a noise level to clearly identify areas where the external noise level would result in the internal noise levels within the office accommodation exceeding the BCO criteria if an open window ventilation strategy were to be utilised.
- 4.4.7 **Noise Contour Maps**
- 4.4.7.1 Colour coded noise contour maps are generated by the acoustic model to aid identification of the following:
- *Open Plan Office Accommodation where the internal noise criteria will be satisfied if using an open window ventilation strategy. Noise levels within any open plan office accommodation located within the green area will satisfy the BCO internal noise criteria with a window partially open for ventilation purposes.*

- *Meeting Room Accommodation where the internal noise criteria will be satisfied if using an open window ventilation strategy. Noise levels within any meeting room accommodation located within the green area will satisfy the BCO internal noise criteria with a window partially open for ventilation purposes.*

4.5 Interpretation of the Noise Contours

- 4.5.1 Whenever possible, it is desirable to open the windows to provide background ventilation and when partially open windows are relied upon for background ventilation, the sound reduction of the façade is typically reduced to 12 dB.
- 4.5.2 The internal noise level in a room is calculated by subtracting the sound reduction performance of the external façade from the calculated noise level outside the room. This is described as the outdoor to indoor noise level difference.
- 4.5.3 For an Open Plan Office, the BCO guideline criteria are detailed in Table 2. To achieve an internal ambient noise level of 46 dB $L_{Aeq,1hr}$, the external noise levels at the office façade should not exceed $46 + 12 = 58$ dB $L_{Aeq,1hr}$ when using an open window to ventilate the room.
- 4.5.4 To prevent speech interference in an open plan office, the internal noise level should not exceed 55 dB $L_{A01,1hr}$. To achieve this, the external noise levels at the office façade should not exceed $55 + 12 = 67$ dB $L_{A01,1hr}$.
- 4.5.5 However, the L_{A01} descriptor is a statistical evaluation of the measured data to represent the loudest event at the measurement position. It is not possible to calculate the noise propagation loss to the receptor in terms of L_{A01} . We can, however, infer the likely value of the equivalent $L_{Aeq,1hr}$ at the receptor based on the difference between the $L_{Aeq,1hr}$ and the $L_{A01,1hr}$ at the measurement position. Inspection of the loudest period measured during the survey, indicates that the $L_{A01,1hr}$ value is 10 dB greater than the $L_{Aeq,1hr}$ value.
- 4.5.6 Therefore, the external noise levels at the open plan office façade should not exceed $67 - 10 = 57$ dB $L_{Aeq,1hr}$.

- 4.5.7 To identify whether any of the open plan office accommodation is suitable for an open window ventilation strategy, the noise contour map is generated with the contour boundary set at 57 dB $L_{Aeq,1hr}$. Inspection of the contour map presented as Figure 5, Appendix 5 clearly indicates that the external noise levels at all facades of the proposed office accommodation lie within the green areas and any open plan office located within either building will be able to achieve the BCO internal ambient noise criteria whilst using an open window ventilation strategy. No further mitigation is recommended.
- 4.5.8 For a meeting room, the BCO guideline criteria are detailed in Table 2. To achieve an internal ambient noise level of 41 dB $L_{Aeq,1hr}$, the external noise levels at the office façade should not exceed $41 + 12 = 53$ dB $L_{Aeq,1hr}$ when using an open window to ventilate the room.
- 4.5.9 To prevent speech interference in a meeting room, the internal noise level should not exceed 50 dB $L_{A01,1hr}$. To achieve this, the external noise levels at the office façade should not exceed $50 + 12 = 62$ dB $L_{A01,1hr}$.
- 4.5.10 As described above, the external noise levels at any meeting room façade should not exceed $62 - 10 = 52$ dB $L_{Aeq,1hr}$.
- 4.5.11 To identify whether any of the open plan office accommodation is suitable for an open window ventilation strategy, the noise contour map is generated with the contour boundary set at 52 dB $L_{Aeq,1hr}$. Inspection of the contour map presented as Figure 6, Appendix 5 clearly indicates that the external noise levels at all facades within Block B of the proposed office accommodation lie within the green areas and any meeting room located within this building will be able to achieve the BCO internal ambient noise criteria whilst using an open window ventilation strategy. No further mitigation is recommended.
- 4.5.12 However, it should be noted that an open window ventilation strategy would not be suitable for Block A if it were to be reconfigured to include a meeting room.
- 4.6 **Resultant Internal Ambient Noise Levels with Open Window**

- 4.6.1 Individual receptors were located at the facades of the most exposed or sensitive offices to calculate the external free field noise levels. The results are presented in Appendix 5.
- 4.6.2 The internal ambient noise levels are calculated using the procedures detailed above and summarised in Table 3 below.

Table 3 – Calculated Internal Ambient Noise Levels

Description	Calculated External Rail Noise Level $L_{Aeq,1hrs}$ (dB)	Sound Reduction for Open Window R_w (dB)	Calculated Internal Ambient Noise Level $L_{Aeq,1hrs}$ (dB)
Block A	55	-12	43
Block B Meeting Room N	44	-12	32
Block B Meeting Room S	39	-12	27

- 4.6.3 The results in Table 3 indicate that the internal ambient noise levels within each of the proposed office accommodation, as set out in the layout plan presented in Appendix 3 comfortably satisfies the BCO criteria for both open plan offices and meeting rooms.

5.0 CONCLUSIONS

- 5.1 The office development proposal was assessed in detail using 3D modelling techniques to ensure that the proposed layout achieves desirable internal ambient noise levels within the office accommodation as described in the '*Guide to Specification 2019*' produced by the British Council for Offices (BCO).
- 5.2 With reference to the proposed office layout presented in Appendix 3, all office accommodation, as planned, will be exposed to external rail noise levels that will satisfy the BCO criteria when using a partially open window to provide ventilation.
- 5.3 No further mitigation is recommended.

6.0 RECOMMENDATIONS

- 6.1 The conclusions of this report are only valid for the proposed layout as provided.
- 6.2 If the accommodation is reconfigured, it is recommended that further assessment will be required, particularly if the room classification is modified. For example if an open plan office is reconfigured to a meeting room or cellular office for which the criteria is more stringent.

P.A.T. 31/03/2021
M.Sc., I.Eng., M.I.O.A.,
M.Inst.SCE., M.A.E.S.

Appendix 1 Railway and Train Station Noise Survey Details

A1.0 RAILWAY AND TRAIN STATION NOISE SURVEY DETAILS

A1.1 Programme of Measurements

A1.1.1 Measurements were carried out on 9th March 2021. The survey commenced at 12:20 for a total survey period of 7 hours 39 minutes.

A1.1.2 The meter was calibrated at the start of the measurement procedure and checked after each set of measurements. No significant deviation i.e. > 0.5 dB was recorded.

A1.1.3 The meter was located in a weather-proof container and powered with heavy duty rechargeable batteries.

A1.1.4 The microphone was located on a tripod 1.2 m from the ground at the position of the most exposed façade of the proposed development. The microphone was inside an approved weather-proof microphone housing and was at least 10m from any sound reflecting surface (free-field) (see Appendix 2).

A1.1.5 The meter was adjusted to log and store in 15-minute periods both L_{Aeq} and L_{A01} . See set up details in Table 5.

A1.1.6 On completion of the survey, the data was downloaded to a computer for further analysis.

A1.1.7 The analysis consisted of dividing the results into 1-hour time periods. Using B & K Evaluator Software the relevant $L_{Aeq,T}$ and $L_{A01,T}$ values were calculated.

A1.1.8 Weather conditions: Dry, 9°C, 75% cloud cover, light intermittent breeze less than 4 ms⁻¹.

A1.2 SUBJECTIVE IMPRESSIONS

A1.2.1 The acoustic environment during the survey was characterised by intermittent train movements with lesser contributions from distant road traffic.

A1.2.2 The equipment was monitored by a guard who made notes on any extraneous noise events and weather conditions.

A1.2.3 Measurement periods where any of these events occurred were excluded from the analysis. In this case, following inspection of the results there were no extraneous

events that materially affected the measurement results, and no periods were excluded from the assessment.

A1.3 Windspeed Log

A1.3.1 The windspeed was measured by the security guard at regular intervals during the survey period as detailed in Table 4.

Table 4 – Windspeed Log

Time	Windspeed (m/s)	Time	Windspeed (m/s)
11:45	1.6	16:00	1.4
12:00	1.4	16:15	2.2
12:15	1.0	16:30	0.6
12:30	1.6	16:45	0.6
12:45	2.0	17:00	1.2
13:00	1.4	17:15	0.2
13:15	2.4	17:30	1.3
13:30	2.0	17:45	0.3
13:45	3.6	18:00	0.2
14:00	1.2	18:15	0.2
14:15	3.1	18:30	1.1
14:30	2.0	18:45	1.4
14:45	2.9	19:00	1.8
15:00	1.2	19:15	--
15:15	1.5	19:30	--
15:30	1.0	19:45	--
15:45	1.9	20:00	--

A1.4 Equipment Used

Table 5 – Meter Details

Instrument:		2250
Application:		BZ7224 Version 4.7.6
Start Time:		03/09/2021 12:20:38
End Time:		03/09/2021 19:59:44
Elapsed Time:		07:39:06
Bandwidth:		Broadband
Max Input Level:		142.70
	Time	Frequency
Broadband (excl. Peak):	FSI	AZ
Broadband Peak:		A
Instrument Serial Number:		2559188
Microphone Serial Number:		2556132
Input:		Top Socket
Windscreen Correction:		None
Sound Field Correction:		Free-field
Calibration Time:		03/09/2021 12:18:02
Calibration Type:		External reference
Sensitivity:		40.83 mV/Pa

Appendix 2 View of Measurement Position

A2.0 VIEW OF MEASUREMENT POSITION

Figure 1 – Satellite View of Measurement Position



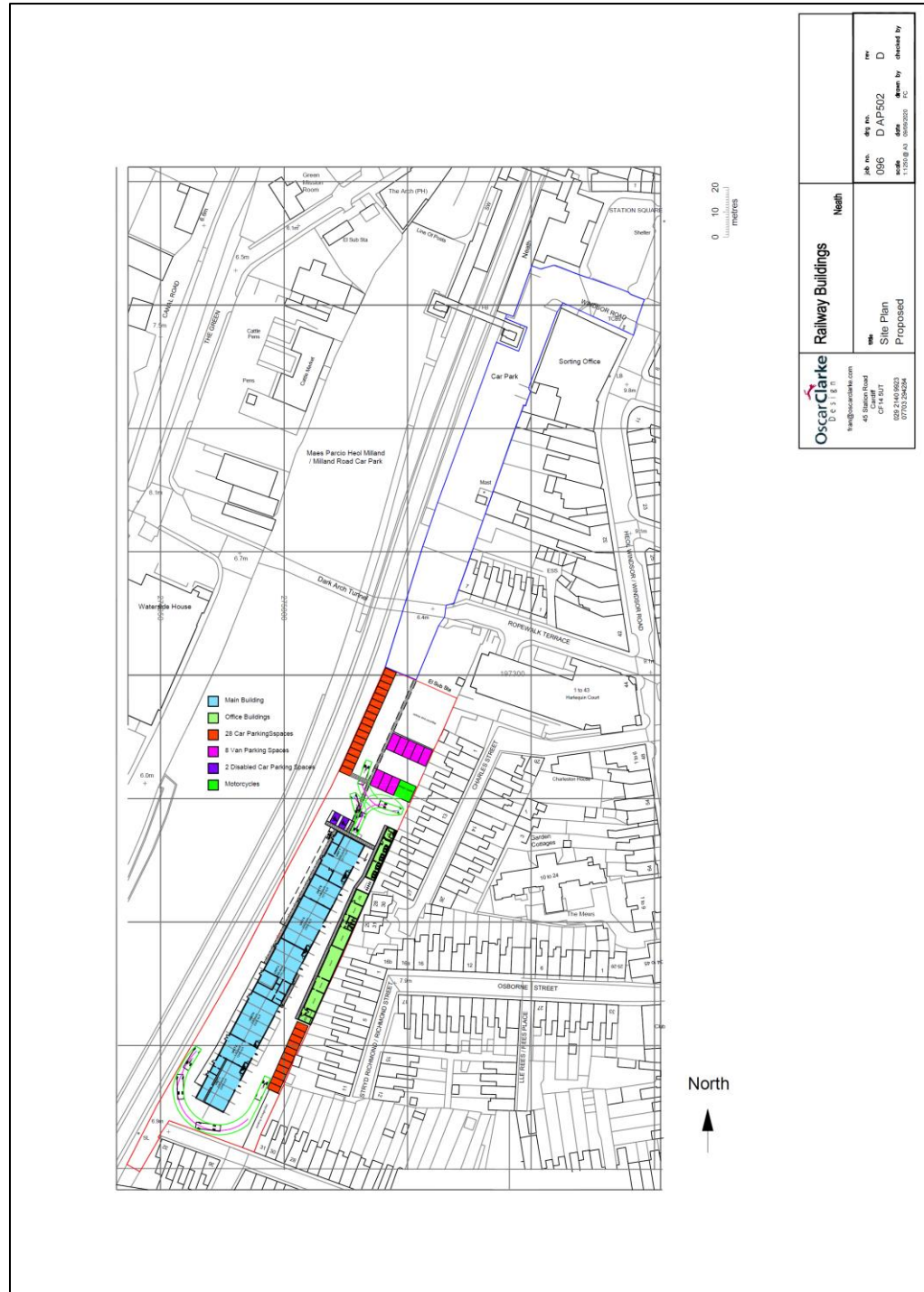
Figure 2 – View of Survey Equipment



Appendix 3 Proposed Development Drawings

A3.0 PROPOSED DEVELOPMENT DRAWINGS

Figure 3 – Plan of Proposed Development

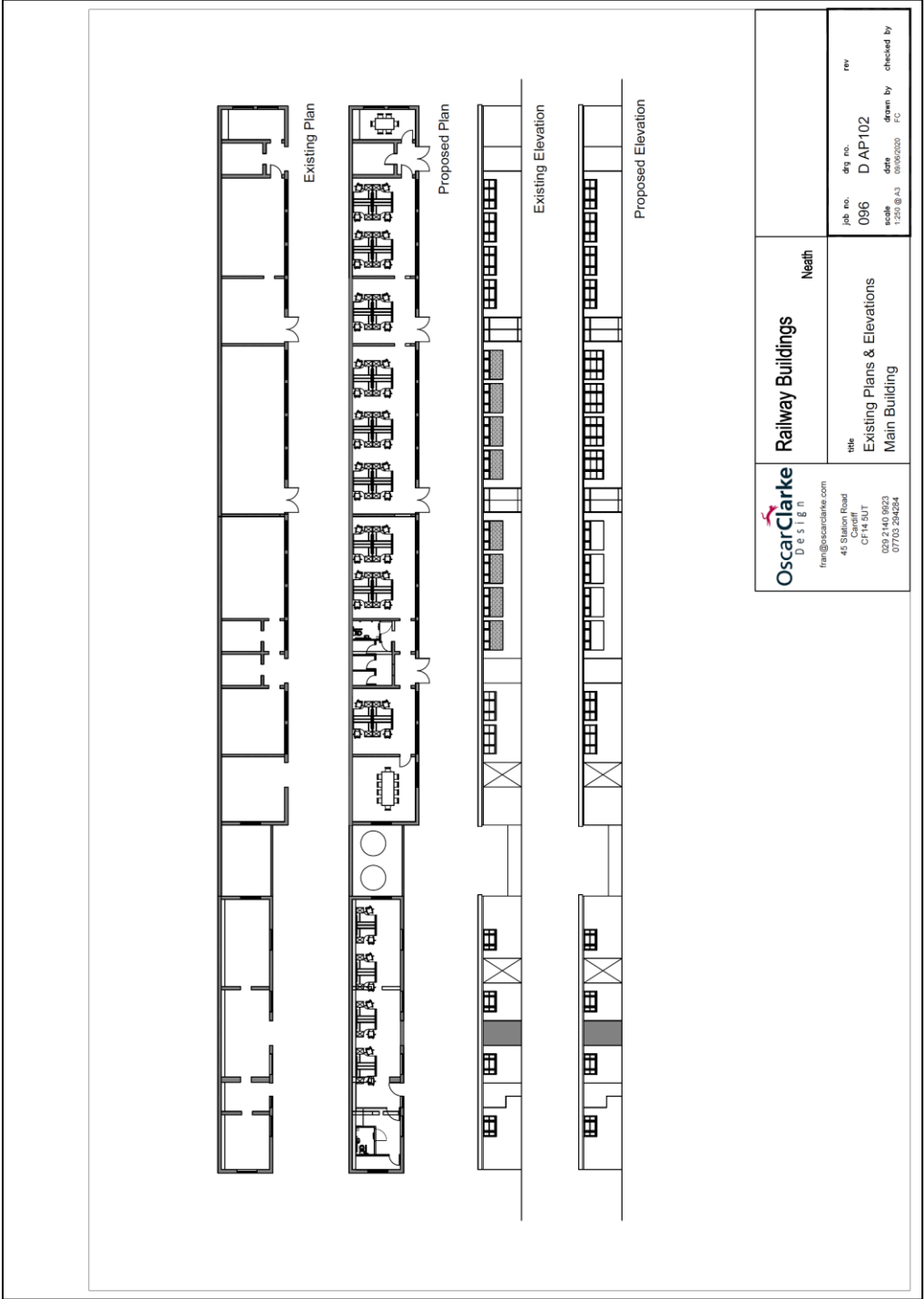


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Noise Impact Assessment for Proposed Office Development to Support Planning Application

Figure 4 – Proposed Offices, Plans and Elevations



Appendix 4 Survey Results

A4.0 SURVEY RESULTS

Table 6 – Summary of Survey Results (Free Field Noise Levels)

Start time	Duration, t (h:mm:ss)	L _{Aeq,t} (dB)	L _{A01,t} (dB)
09/03/2021 12:20:38	1:09:22	56.3	66.2
09/03/2021 13:30:00	1:00:00	56.2	62.1
09/03/2021 14:30:00	1:00:00	57.4	64.9
09/03/2021 15:30:00	1:00:00	60.5	71.2
09/03/2021 16:30:00	1:00:00	59.0	67.6
09/03/2021 17:30:00	1:00:00	57.9	68.4
09/03/2021 18:30:00	1:00:00	55.7	64.1
09/03/2021 19:30:00	0:29:44	55.1	61.1

Appendix 5 Modelling Results

A5.0 MODELLING RESULTS

Figure 5 – External Noise Levels, Open Window Ventilation for Open Plan Offices



Figure 6 – External Noise Levels, Open Window Ventilation for Meeting Rooms



Table 7 – Calculated External Rail Traffic Noise Levels at Office Receptors

Office Room	Calculated External Rail Noise Level $L_{Aeq,1hrs}$ (dB)
Block A Open Plan Offices	55.3
Block B Meeting Room North	43.7
Block B Meeting Room South	39.0

Appendix 6 Data and Calculations used in Model

A6.0 DATA AND CALCULATIONS USED IN MODEL

Figure 7 – Location of Traffic Count Point xxxxx

Table 8 – Traffic Count Data for Year xxxx

AADF Year	CP	Road	All HGVs	All Motor Vehicles	18 hr Flows*	%HGV

* A COBA factor (0.943) is used convert the flows from 24 hour to 18 hour

A6.1 Assumptions Made in Model

A6.1.1 The ground attenuation was modelled as hard with a ground factor value of 0.0

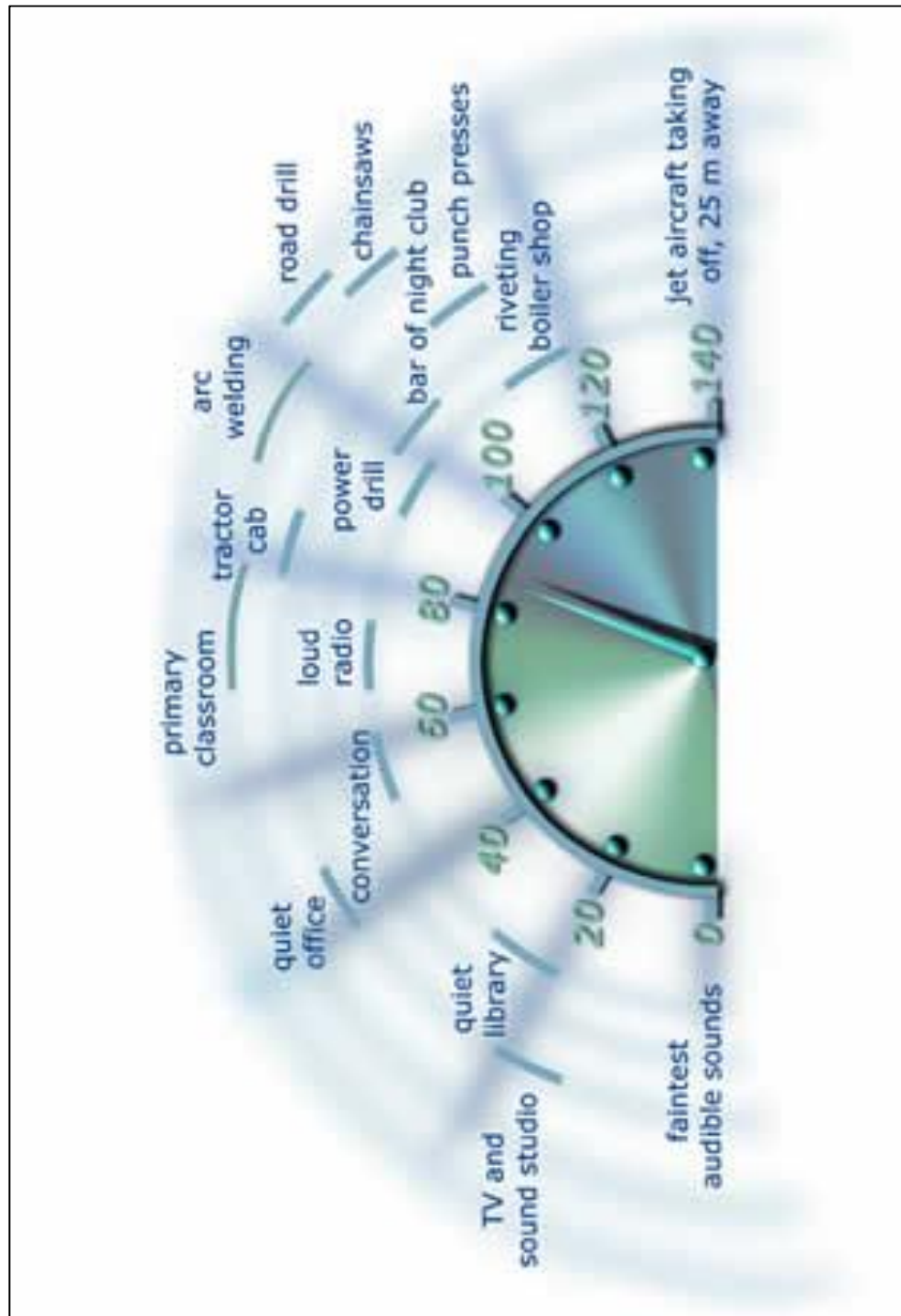
A6.1.2 Atmospheric conditions were modelled as

- Temperature: 293.15 K
- Pressure: 101.33
- Air Humidity: 60%

Appendix 7 Range of Typical Noise Levels

A7.0 RANGE OF TYPICAL NOISE LEVELS

Figure 8 – Range of Typical Noise Levels



Appendix 8 Glossary of Acoustic Terms

A8.0 GLOSSARY OF ACOUSTIC TERMS

A8.1 Acoustic Environment:

Sound from all sound sources as modified by the environment.

A8.2 Ambient Sound:

Totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far.

NOTE: The ambient sound comprises the residual sound and the specific sound when present.

A8.3 Ambient Sound Level, $L_a = L_{Aeq,T}$:

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

NOTE: The ambient sound level is a measure of the residual sound and the specific sound when present.

A8.4 A-Weighting:

Normal hearing covers the frequency (pitch) range from about 20 Hz to 20,000 Hz but sensitivity is greatest between about 500 Hz and 5,000 Hz. The 'A-weighting' is an electrical circuit built into noise meters to approximate this characteristic of human hearing.

A8.5 Background Sound Level, $L_{A90,T}$:

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

A8.6 Decibel (dB):

The logarithmic measure of sound level. 0dB (A) is the threshold of normal hearing. 140 dB (A) is the level at which instantaneous damage to hearing is caused. A change of 1 dB is detectable only under laboratory conditions.

A8.7 dB(A):

Decibels measured on a sound level meter incorporating a frequency weighting (A-weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with an individual's assessment of loudness. A change of 3 dB (A) is the minimum perceptible under normal conditions and a change of 10 dB(A) corresponds roughly to doubling or halving the loudness of a sound.

A8.8 Equivalent Continuous A-weighted Sound Pressure Level, $L_{Aeq,T}$

Value of the A-weighted sound pressure level in decibels of continuous steady sound that, within a specified time interval, $T = t_2 - t_1$, has the same mean-squared sound pressure as a sound that varies with time, and is given by the following equation:

$$L_{Aeq,T} = 10 \lg_{10} \left\{ \left(\frac{1}{T} \right) \int_{t_1}^{t_2} \left[\frac{p_A(t)^2}{p_0^2} \right] dt \right\}$$

where

p_0 is the reference sound pressure (20 μ Pa); and

$p_A(t)$ is the instantaneous A-weighted sound pressure at time t

NOTE: the equivalent continuous A-weighted sound pressure level is quoted to the nearest whole number of decibels.

A8.9 Free Field:

A sound field in which no significant sound reflections occur

A8.10 Frequency:

The number of cycles per second of a vibration usually expressed in units of Hertz, Hz

A8.11 Hertz:

Unit of frequency, equal to one cycle per second. Frequency determines the pitch of a sound.

A8.12 $L_{A10,T}$:

The 'A-weighted' noise level exceeded for 10% of the specified measurement period (T). It gives an indication of the upper limit of fluctuating noise such as that from

road traffic. $L_{A10,18hr}$ is the arithmetic average of the 18 hourly $L_{A10,1hr}$ values from 06:00 - 24:00.

A8.13 L_{Amax} :

The maximum 'A-weighted' level of noise recorded during a noise event. The time weighting used (Fast or Slow) should be stated.

A8.14 Measurement Time Interval, T_m :

Total time over which measurements are taken.

NOTE: This may consist of the sum of a number of non-contiguous, short-term measurement time intervals.

A8.15 Rating Level, $L_{Ar,Tr}$:

Specific sound level plus any adjustment for the characteristic features of the sound.

A8.16 Reference Time Interval, T_r :

Specified interval over which the specific sound level is determined.

NOTE: This is 1h during the day from 07:00 h to 23:00 h and a shorter period of 15min at night from 23:00 h to 07:00 h.

A8.17 Residual Sound:

Ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound.

A8.18 Residual Sound Level, $L_r = L_{Aeq,T}$:

Equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given time interval, T .

A8.19 Specific Sound Level, $L_s = L_{Aeq,T}$:

Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r .

A8.20 Specific Sound Source:

Sound source being assessed.

A8.21 Tonality:

The degree to which a noise contains audible pure tones. Broadband noise (across a wider range of frequencies) is generally less annoying than noise with identifiable tones.

Appendix 9 References

A9.0 REFERENCES

- 1 'Guide to Specification 2019', British Council for Offices, 2019
- 2 BS 8233:2014. 'Guidance on sound insulation and noise reduction for buildings', British Standards Institution 2014
- 3 BS EN 12354-3, "Building acoustics – Estimation of acoustic performance of buildings from the performance of elements – Part 3: Airborne sound insulation against outdoor sound", British Standards, 2000
- 4 BS EN ISO 717-1:1997, 'Acoustics - Rating of sound insulation in buildings and of building elements, Part 1: Airborne sound insulation', British Standards