

Noise Impact Assessment of Proposed Residential Development to Support Planning Application

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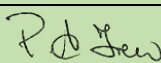
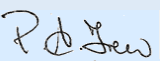
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BRIEF FOR CONSULTANCY:

This report has been prepared by Acoustics & Noise Limited, Newport, South Wales, for Tai Tarian Ltd., Ty Gwyn, Brunel Way, Neath, SA11 2FP under the instructions of Carl Quick, c/o IPlan Architecture Ltd.

Order No: n/a

OBJECTIVES:

To investigate the road traffic noise impact on the proposed development at Lingfield Road, Port Talbot using CAD modelling techniques.

Where applicable recommend outline mitigation to meet anticipated impact criteria.

NON-TECHNICAL SUMMARY:

It is proposed to develop land off Lingfield Avenue, Sandfields, Port Talbot, SA12 6NX for residential purposes comprising 5 single storey bungalows. The significant source of noise is from road traffic travelling along the adjacent dual carriageway known as the A4241 (Afan Way). An existing 2.6m high acoustic barrier (timber fence) is located along the north-east boundary of the site.

Following a request for pre-application advice, the Environmental Health Section with Neath Port Talbot Council provided the following advice:

"...the site benefits from the presence of the large timber fence on the boundary facing Afan Way, the presence of this key arterial road in close proximity to the site means that the Applicant should undertake a Technical Advice Note (TAN) 11 Noise Assessment to demonstrate the suitability of the site for residential development, and/or whether any additional noise mitigation measures will be necessary in the design and build of the proposed dwellings..."

When assessing road traffic noise levels, the requirements of TAN 11 are based on the results of an extensive noise survey. However, in this case, due to the inclement weather and time constraints for the submission of the planning application it was not practicable to carry out a noise survey. It was agreed with the local authority, that for the purposes of this application, the road traffic noise levels at the site could be assessed using the latest available traffic count data and 3D modelling techniques to predict the road traffic noise levels at the site.

A desk study, utilising 3D modelling techniques with the latest available traffic count data for the A4241, was carried out to predict the road traffic noise levels across the proposed development site. The results were used to assess the sites suitability for residential development with regard to the advice presented in TAN 11.

Following consideration of the predicted noise levels at the site, during both the daytime and night time, this site is categorised as Noise Exposure Category (NEC) 'B'. For development sites that fall into NEC 'B', the advice in TAN 11 states that:

"Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise".

It is anticipated that '*an adequate level of protection against noise*' will be attainable through the application of good acoustic design principles.

The 3D acoustic model was updated to include the proposed development buildings and layout and the external free field noise levels were predicted at each habitable room and within any external amenity space to investigate the extent of any potential additional mitigation.

In the absence of any objective criteria detailed in the comments from Neath Port Talbot Council, this report has referred to the guideline criteria for indoor and outdoor noise levels presented in BS 8233 '*Guidance on sound insulation and noise reduction for buildings*'.

Whenever possible, it is desirable to rely on partially open windows to provide the background ventilation for a property. With reference to the proposed development plans, the modelling results identified that an open window ventilation strategy would be suitable for the following habitable rooms:

- Plot 1 Bedroom 2
- Plot 1 Kitchen Dining Room
- Plot 2 Bedroom 2
- Plot 2 Kitchen Dining Room
- Plot 3 Bedroom 2
- Plot 3 Kitchen Dining Room
- Plot 4 Kitchen Dining Room
- Plot 4 Living Room Side

The remaining habitable rooms are exposed to external road traffic noise levels that would result in the anticipated internal ambient noise level criteria being exceeded whilst using a partially open window to provide background ventilation.

This report considers the external noise levels at each of the remaining habitable rooms, to determine the minimum sound reduction required from the glazing units. The minimum sound reduction performance required from the remaining glazing units not identified above, should be $20 \text{ dB } R_w + C_{tr}$.

Manufacturers' data should be used to confirm the above minimum sound reduction performance requirements are achievable from the glazing units specified for the proposed development. The windows to all habitable rooms should be in the closed position to effectively

control noise ingress to acceptable levels. The decision on whether the glazing should be permanently closed is outside the scope of this assessment and our technical expertise. This decision should be taken by appropriate authorities.

All habitable rooms subject to sound mitigation measures will require an alternative, effective means of ventilation. Any ventilation scheme should satisfy the requirements of Approved Document F and provide the required ventilation rates. It is important that any scheme is approved by Building Control and does not compromise the internal noise levels. Recommendations for suitable ventilation are outside the scope of this assessment and technical expertise and independent specialist advice should be obtained to ensure that any ventilation scheme is suitable for purpose.

The predicted noise levels within the external amenity areas for all plots will satisfy the anticipated external amenity noise criteria.

The installation of glazing units with the minimum sound reduction performance when closed, as recommended in this report, results in desirable internal ambient noise levels within all habitable rooms at all times. Therefore, as the results of the modelling demonstrate that implementing the additional noise mitigation measures results in reasonable to good ambient noise levels throughout both external and internal areas, the site could be considered suitable for residential development.

1.0 DESCRIPTION OF SITE

- 1.1 The site is located on land off Lingfield Avenue, Sandfields, Port Talbot, SA12 6NX and is currently utilised as an area of informal open space for the benefit of the local community.
- 1.2 The site is in a predominantly residential area and is bounded by residential properties to the south and west and the A4241 at the north-east boundary.
- 1.3 An existing 2.6m high acoustic barrier (timber fence) is located along the north-east boundary of the site.
- 1.4 The acoustic climate at the site is characterised by road traffic along the A4241 at the north-east boundary.
- 1.5 A satellite view of the proposed development site location is presented in Appendix 1.

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 Technical Advice Note 11 (TAN11) [1]

2.2.1 The requirements for the assessment of noise impact on a proposed development site are detailed in TAN11 (Noise) [1]. This document prescribes the measurement methods and standards to be used for the noise survey. The results of the survey are separated into day and night periods which are compared with four Noise Exposure Categories (NECs).

2.2.2 Noise Exposure Categories for Dwellings (NECs)

When assessing a proposal for residential development near a source of noise, local planning authorities should determine into which of the four noise exposure categories the proposed site falls, taking account of both day and night-time noise levels. Local planning authorities should then have regard to the advice in the appropriate NEC, as shown in Table 1.

Table 1 – Planning Advice as per TAN11

NEC	Planning Advice
A	<i>Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as a desirable level.</i>
B	<i>Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise.</i>
C	<i>Planning permission should not normally be granted. Where it is considered that permission should be given, for example because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.</i>
D	<i>Planning permission should normally be refused.</i>

- 2.3 The noise exposure category for the site is the measured noise level compared with the range of noise levels as shown in Table 2.

Table 2 – Free-Field Noise Levels Corresponding to the NECs, $L_{Aeq,T}$ dB

Noise source		Noise Exposure Category			
		A	B	C	D
Road traffic	0700-2300	<55	55-63	63-72	>72
	2300-0700	<45	45-57	57-66	>66
Rail traffic	0700-2300	<55	55-66	66-74	>74
	2300-0700	<45	45-59	59-66	>66
Air traffic	0700-2300	<57	57-66	66-72	>72
	2300-0700	<48	48-57	57-66	>66
Mixed Sources	0700-2300	<55	55-63	63-72	>72
	2300-0700	<45	45-57	57-66	>66

- 2.3.1 Mixed sources refer to any combination of road, rail, air and industrial noise sources. The 'mixed source' values detailed in Table 2 are based on the lowest numerical values of the single source limits in the table. The 'mixed source' NEC should only be used where no individual noise source is dominant.

2.4 Planning Policy Wales [2]

- 2.4.1 The foreword to the Planning Policy Wales (PPW) document states that '*PPW will help to ensure that the planning decisions taken in Wales, no matter how big, or how small, are going to improve the lives of both our current and future generations. It will support changing the way we live and work, and the buildings and environment of Wales, today, building a better environment to accommodate current and future needs*'.

- 2.4.2 PPW sets out the land use planning policies of the Welsh Government. The primary objective is to ensure that the planning system contributes towards the delivery of sustainable development and improves the social, economic, environmental and cultural well-being of Wales. A well functioning planning system is fundamental for sustainable development and achieving sustainable places.

- 2.4.3 The planning system should create sustainable places (Placemaking) which are attractive, sociable, accessible, active, secure, welcoming, healthy and friendly. Development proposals should create the conditions to bring people together, making them want to live, work and play in areas with a sense of place and well-being, creating prosperity for all.
- 2.4.4 Placemaking in development decisions happens at all levels and involves considerations at a global scale, including climate change, down to the very local level, such as considering the amenity impact on neighbouring properties and people. Negative environmental impacts should be avoided in the wider public interest.
- 2.4.5 The environmental impact relevant to this assessment, will be from noise. PPW refers to the term 'soundscape' which it describes as '*the acoustic environment as perceived or experienced and/or understood by a person or people, in context (ISO definition)*'.
- 2.4.6 An appropriate soundscape contributes to a positive experience of place as well as being necessary for public health, amenity and well-being. Conversely, noise pollution can have negative effects and should be reduced as far as possible.
- 2.4.7 Certain sounds, such as those created by trees, birds or water features, can contribute to a sense of tranquillity whilst others can be reassuring as a consequence of their association with the normality of everyday activities. Problematic forms of sound are generally experienced as noise pollution and can affect amenity and be prejudicial to health or a nuisance. Noise action plans drawn up by public bodies aim to prevent and reduce noise levels where necessary and preserve soundscape quality where it is good. Both high and low levels of noise, depending on context, can be annoying or disruptive and impact on amenity, health and well-being and as such should be protected through the planning process wherever necessary.
- 2.4.8 A key planning policy principle is to consider the effects which proposed developments may have on soundscape quality and the effects which existing soundscape quality may have on proposed developments. Soundscape influences

the choice of location and distribution of development and it will be important to consider the relationship of proposed development to existing development and its surrounding area and its potential to exacerbate or create poor or inappropriate soundscapes.

2.4.9 The agent of change principle says that a business or person responsible for introducing a change is responsible for managing that change. In practice, for example, this means a developer would have to ensure that solutions to address noise from nearby pre-existing infrastructure, businesses or venues can be found and implemented as part of ensuring development is acceptable.

2.4.10 Proposed development should be designed wherever possible to prevent adverse effects to amenity, health and the environment but as a minimum to limit or constrain any effects that do occur.

2.5 **Noise and Soundscape Action Plan [3]**

2.5.1 This document sets out action plans for each of the three agglomerations in Wales. These are identified as the Cardiff and Penarth agglomeration, the Newport agglomeration and the Swansea and Neath agglomeration.

2.6 **ProPG: Planning & Noise [4]**

2.6.1 Even though ProPG has been written principally to assist with the planning process in England, PPW recommends that the good acoustic design principles put forward in Supplementary Document 2 may also be adopted in Wales.

2.6.2 A good acoustic design process takes a multi-faceted and integrated approach to achieve optimal acoustic conditions, both internally (inside noise-sensitive parts of the building(s)) and externally (in spaces to be used for amenity purposes).

2.6.3 Good acoustic design should provide the optimum acoustic outcome, without design compromises that will adversely affect living conditions and the quality of life of the inhabitants or other sustainable design objectives and requirements.

2.6.4 In requiring good acoustic design, there is a hierarchy of noise management measures that LPAs should encourage, including the following, in descending order of preference:

- Maximising the spatial separation of noise source(s) and receptor(s).
- Investigating the necessity and feasibility of reducing existing noise levels and relocating existing noise sources.
- Using existing topography and existing structures (that are likely to last the expected life of the noise-sensitive scheme) to screen the proposed development site from significant sources of noise.
- Incorporating noise barriers as part of the scheme to screen the proposed development site from significant sources of noise.
- Using the layout of the scheme to reduce noise propagation across the site.
- Using the orientation of buildings to reduce the noise exposure of noise-sensitive rooms.
- Using the building envelope to mitigate noise to acceptable levels.

2.6.5 It is acknowledged that the inherent challenge of introducing noise-sensitive development in noisy locations can limit the extent to which good acoustic design can be achieved in harmony with the other factors that influence the overall quality of a scheme and that compromises may need to be made e.g. accepting that it may not always be possible to achieve acoustic standards with windows open or accepting that noise levels in parts of the outdoor amenity areas may not be optimal.

2.6.6 Where the scheme relies on windows being closed to achieve good internal noise conditions, details should be provided why this approach has arisen and how the use of layout, orientation, spatial design and non-building envelope mitigation has been considered to minimise the need for reliance upon closed windows.

2.6.7 Where the LPA accepts that there is a justification that the internal target noise levels can only be practically achieved with windows closed, which may be the case in urban areas and at sites adjacent to transportation noise sources, special care must be taken to design the accommodation so that it provides good standards of acoustics, ventilation and thermal comfort without unduly compromising other aspects of the living environment. Furthermore, in this scenario the internal L_{Aeq} target noise levels should not generally be exceeded.

2.6.8 A good acoustic design will be one that continues to minimise noise impacts and to avoid significant noise effects for the lifetime of the development or as long as is practicable taking into account other economic, environmental and social impacts. Ideally new development should also help to mitigate any existing adverse impacts elsewhere, for example by acting as a barrier between noisy infrastructure and any existing noise-sensitive uses that do not benefit from incorporated mitigation.

2.7 **BS8233 - Guidance on Sound Insulation and Noise Reduction for Buildings [5]**

2.7.1 For many common situations, BS8233 [5] suggests criteria, such as suitable sleeping/resting conditions, and proposes noise levels that normally satisfy these criteria for most people.

2.7.2 The foreword advises that the information detailed in BS8233 [5] “...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.”.

2.7.3 Section 7.7.2 details the guideline values for desirable internal ambient noise levels within dwelling houses, flats and in residential use (when unoccupied) when such properties are exposed to steady external noise sources.

2.7.4 These guideline values range from 35 - 40 dB $L_{Aeq,16hrs}$ during the daytime period and 30 dB $L_{Aeq,8hrs}$ during the night time period as detailed in Table 3 below.

Table 3 – BS 8233 Internal Noise Level Guidelines

Activity	Location	07:00 – 23:00 hrs	23:00 – 07:00 hrs
Resting	Living Room	35 dB $L_{Aeq,16hrs}$	--
Dining	Dining Room	40 dB $L_{Aeq,16hrs}$	--
Sleeping (Daytime Resting)	Bedroom	35 dB $L_{Aeq,16hrs}$	30 dB $L_{Aeq,8hrs}$

2.7.5 The guidelines also provide scope for relaxing these values by up to 5 dB and still achieve reasonable internal conditions.

2.7.6 The internal noise level in a room is calculated by subtracting the sound reduction performance of the external façade from the noise level outside the room.

- 2.7.7 It should be noted that the acoustic performance of the building envelope will be reduced in the event windows are opened for ventilation or cooling purposes, typically reducing the sound reduction to no more than 10 to 15 dB(A) [10].
- 2.7.8 For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,16hrs}$ with an upper guideline value of 55 dB $L_{Aeq,16hrs}$ which would be acceptable in noisier environments.
- 2.7.9 It is recognised that these guideline values may not be achievable in all circumstances where development might be desirable. In higher noise areas, a compromise between elevated noise levels and other factors such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces but should not be prohibited.
- 2.7.10 The guideline values presented in BS8233 [5], applies to external noise as it affects the internal acoustic environment from sources without a specific character such as road traffic noise.
- 2.7.11 BS 8233 [5] 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 [6].
- 2.7.12 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.
- 2.8 **BS EN 12354 Part 3, Airborne Sound Insulation against Outdoor Sound [6]**
- 2.8.1 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.

- 2.8.2 The results of the calculation can be used to determine the indoor sound pressure level due to external sound sources such as road traffic.
- 2.8.3 BS EN 12354 [6] 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'*.
- 2.8.4 The indoor A-weighted sound pressure level can be determined from calculation in frequency bands for the appropriate frequency range, applying the A-weighting.
- 2.8.5 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 [7], 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 traffic travelling at low speeds (<80km/h) or $R_w + C$ when the outdoor sound is road traffic travelling at high speeds (>80km/h).
- 2.9 **Calculation of Road Traffic Noise (CRTN) [8]**
- 2.9.1 This memorandum describes the procedures for calculating noise from road traffic. These procedures are necessary to enable entitlement under the Noise Insulation Regulations to be determined but they also provide guidance appropriate to the calculation of traffic noise for more general applications e.g. environmental appraisal of road schemes, highway design and land use planning.
- 2.9.2 Road traffic noise levels are expressed in terms of the index, $L_{A10,t}$ dB. The value of $L_{A10,t}$ is the noise level exceed for just 10% of the time over the time period t . For the purposes of CRTN [8], the time period, t , is 18 hours (06:00 – 00:00 hrs).

- 2.9.3 The procedures for calculating traffic noise, as described in the memorandum, comprise five main stages:
- *Division of road into a number of segments;*
 - *Calculation of the Basic Noise Level (BNL), at a reference distance of 10m from the nearside carriageway edge, for each road segment using traffic flow data (number of vehicles, speed, %HGV);*
 - *For each segment, calculate the noise level at the reception point (1m from exposed façade) by considering the distance to the reception point, ground attenuation and any screening from barriers and or buildings.*
 - *Correction to the calculated noise level to account for site layout features including reflections from nearby buildings and facades and the source segment size;*
 - *Calculate the total noise level at the reception point by combining the contributions from all road segments.*
- 2.9.4 The aim of this memorandum is to enable prediction in as many situations as possible, covering both free and non-free flowing traffic. Prediction is the preferred calculation technique and in complex situations is best carried out using appropriate computer software.
- 2.10 **Converting the UK traffic noise index $L_{A10,18h}$ to EU noise indices for noise mapping [9]**
- 2.10.1 The UK national method for calculating road traffic noise is described in the document 'Calculation of Road Traffic Noise' (CRTN) [8]. The noise index derived using these procedures, L_{A10} is however, different from the more commonly used descriptor for environmental noise, $L_{Aeq,T}$.
- 2.10.2 Defra therefore commissioned TRL Limited to develop an interim computational method to convert $L_{A10,18hr}$ to $L_{Aeq,t}$ to be used in the UK.
- 2.10.3 For UK conditions, TRL recommends that the best interim approach is to adapt CRTN be applying an 'end correction' to obtain the relevant EU indices from calculated values of L_{A10} .

- 2.10.4 Three methods are described dependant on the detail of traffic data available:
- *Method 1: Where the user has available hourly traffic data;*
 - *Method 2: Where detailed hourly traffic data is not available, but the user has, or can estimate, traffic data for the relevant day, evening and night time periods;*
 - *Method 3: Where detailed hourly or period traffic data is not available, but the user has, or can estimate, traffic data for the full 18hr time period.*
- 2.10.5 Each method allows CRTN to calculate the $L_{A10,18hr}$ using the available data and then convert to the relevant period $L_{Aeq,T}$ using defined relationships.
- 2.11 **World Health Organization Guidelines for Community Noise [10]**
- 2.11.1 Community noise (also called environmental noise, residential noise or domestic noise) is defined as noise emitted from all sources except noise at the industrial workplace. Main sources of community noise include road, rail and air traffic, industries, construction and public work, and the neighbourhood.
- 2.11.2 The objective of the World Health Organization (WHO) is '*the attainment by all peoples of the highest possible level of health*'.
- 2.11.3 WHO defines 'health' as '*A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*'. This broad definition of health makes reference to the concept of well-being and thereby includes noise impacts such as annoyance, speech interference, and impaired task performance as 'health' issues.
- 2.11.4 The WHO guidelines [10] deal with all aspects of environmental noise impact and provide guideline values for community noise in specific environments. Most of the noise guidelines are given as period L_{Aeq} values. The relevant values for Dwellings are summarized in Table 4 below.

Table 4 – WHO Guideline Noise Levels for Dwellings

Residential Environment	Critical Health Effect(s)	L_{Aeq,T} (dB)	Time Base, T
Outdoor Living Area	Serious Annoyance, daytime and evening	55	07:00 – 23:00 (16 hours)
	Moderate Annoyance, daytime and evening	50	07:00 – 23:00 (16 hours)
Dwelling, indoors	Speech intelligibility & moderate annoyance, daytime & evening	35	07:00 – 23:00 (16 hours)
Inside Bedrooms	Sleep disturbance, night-time	30	23:00 – 07:00 (8 hours)
Outside Bedrooms	Sleep disturbance, window open (outdoor values)	45	23:00 – 07:00 (8 hours)

- 2.11.5 These guideline values consider specific environments and identified health effects. Each value is set at the lowest levels that affect health such as annoyance and were derived from annoyance studies.
- 2.11.6 The guidelines, whilst not having any legal force in the UK, are commonly used by local authorities when setting environmental noise criteria for proposed developments.

3.0 DISCUSSION

- 3.1 It is proposed to develop the site for residential purposes comprising five single storey bungalows.
- 3.2 Following a request for pre-application advice, the Environmental Health Section with Neath Port Talbot Council provided the following advice:
- “...the site benefits from the presence of the large timber fence on the boundary facing Afan Way, the presence of this key arterial road in close proximity to the site means that the Applicant should undertake a Technical Advice Note (TAN) 11 Noise Assessment to demonstrate the suitability of the site for residential development, and/or whether any additional noise mitigation measures will be necessary in the design and build of the proposed dwellings...”*
- 3.3 Acoustics and Noise Limited were engaged to carry out a TAN 11 assessment to determine the suitability of the site for residential purposes. Where appropriate, outline noise mitigation measures were investigated to inform the final design and layout of the scheme.
- 3.4 When assessing road traffic noise levels, the requirements of TAN 11 are based on the results of an extensive noise survey. However, in this case, due to the inclement weather and time constraints for the submission of the planning application it was not practicable to carry out a noise survey. It was agreed with the local authority, that for the purposes of this application, the road traffic noise levels at the site could be assessed using the latest available traffic count data and 3D modelling techniques to predict the road traffic noise levels at the site.
- 3.4.1 The results of the modelling are then compared with the Noise Exposure Categories, as defined in TAN 11, to determine the sites' suitability for residential development.
- 3.5 To enable a robust assessment of the road traffic noise levels at the site, this assessment has utilised the latest available traffic count data for the A4241 which is described in terms of the long term Annual Average Daily Flow (AADF) of traffic.

- 3.6 The use of long term averages provides a more representative description of the road traffic noise levels at the site when compared with a more typical short-term 24-hour snapshot of the sound levels.
- 3.7 Traffic count data provides street level traffic data for every junction-to-junction link on the 'A' road and motorway network in Great Britain.
- 3.8 Traffic count data was obtained from traffic count point 90330 which is located on the A4241, approximately 550m to the north of the development site (see Appendix 4).
- 3.9 The data was obtained from www.dft.gov.uk for the year 2018, which is the latest year for which data is available, and is presented in Appendix 4 as 24-hour Annual Average Daily Traffic Flows (AADF).
- 3.10 AADF figures give the number of vehicles that will drive on that stretch of the road on an average day of the year and are presented as vehicles per day broken down by vehicle type.
- 3.11 For the purposes of a noise assessment, the data is factored into 18-hour flow data for the prediction of road traffic noise as per CRTN [8].

4.0 ASSESSMENT PROCEDURES

4.1 A computer-generated 3D acoustic model was developed to predict the road traffic noise levels across the proposed development site. Results are displayed in easily understood noise contours representing the Noise Exposure Category (NEC) bands described in TAN 11 [1], overlaid onto a basemap image of the site.

4.2 Prediction of Noise Levels Across Proposed Development Site

4.2.1 As the site is relatively large and comprises multiple plots, a 3D acoustic CAD model of the proposed development was constructed to aid in the identification of which NEC the site should be categorised. Additionally, potential areas of the site that may not meet assessment criteria can be clearly identified to minimise unnecessary mitigation.

4.2.2 EMS B&K Predictor V2019 Software was utilised to model the road 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.

4.2.3 A major advantage of using this method is the ability to remodel changes and alterations to the site and/or sources.

4.2.4 CAD Model Construction

4.2.4.1 Topographical information for the site was obtained from the online site 'Lle Geoportal for Wales' in the form of Digital Terrain Model data (2m resolution). The 'Lle Geo-Portal' has been developed as a partnership between Welsh Government and Natural Resources Wales. Lle serves as a hub for data and information covering a wide spectrum of topics, but primarily around the environment.

4.2.4.2 The topographical data was imported into the CAD software and used to construct the 3D terrain for the site.

4.2.4.3 '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.

4.2.5 A proposed site layout drawing was provided by IPlan Architecture Ltd. to be used to locate the development buildings.

4.2.5.1 A 'road item' was positioned at the outer edge of each of the north and south carriageways along A4241 using the basemap as a guide.

4.2.5.2 The modelling software defines a 'road item' as '*a line source used for modelling the sound level emissions of vehicles on a road*'.

4.2.5.3 Using the data from the traffic count point 90330, the total traffic flow over 18 hours, Q_{18} , the average vehicle speed, V , and the percentage of heavy vehicles, p_{HV} are entered into the model to define each of the '*road items*'.

4.2.5.4 In this case, for the north carriageway, $Q_{18} = 8295$, $p_{HV} = 1.1$ and for the south carriageway, $Q_{18} = 6808$, $p_{HV} = 1.1$. The average vehicle speed is estimated to be 80 km/hr as described in paragraph 14.2 in CRTN [8].

4.2.5.5 This data represents the average, daily 18-hour vehicle flow, in each direction for the latest year for which data is available, which in this case was 2018 (see Appendix 4).

4.2.6 CAD Model Prediction

4.2.6.1 All proposed buildings are modelled with a height of 5m.

4.2.6.2 The site benefits from an existing 2.6m high acoustic timber fence which was installed along the highway boundary during the road construction. The height of this fence was confirmed by IPlan Architectural Ltd. following a site survey. This acoustic barrier was included in the model. The acoustic barrier located along the southern carriageway was also included to include any reflected noise to represent worst case.

4.2.6.3 A noise contour grid covering the whole site was then constructed to display the external free field noise levels across the proposed development site. Each grid represents the free field noise levels throughout the site and is actually a collection of receivers set 1m apart at a height of 1.2m.

- 4.2.6.4 Using EMS B&K Predictor V2019 software, calculations were made for the contour grid using the defined 'road items' as the noise source.
- 4.2.6.5 Calculations are made for both the daytime and night-time periods, with separate contour maps generated for each assessment period.
- 4.2.6.6 The results of the assessment are presented in the form of easily understood, colour coded, noise contour maps and are shown in Appendix 3. Each coloured band represents an individual NEC band as defined in TAN 11 [1].

4.3 TAN 11 Assessment

- 4.3.1 The contour maps presented in Appendix 3 indicate that the whole of the site is categorised as NEC 'A' during the daytime period and that the majority of the site is categorised as NEC 'B' during the night-time period.

- 4.3.2 Where the site falls into different categories depending on the assessment period, the worst-case NEC is selected to represent the appropriate category for the site. In this case, the site should be categorised as NEC 'B'.

- 4.3.3 For sites categorised as NEC 'B', TAN11 [1] states:

"Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise".

- 4.3.4 It is anticipated that an '*adequate level of protection against noise*' will be attainable through the consideration of the good acoustic design principles as described in ProPG [4]. Even though ProPG has been written principally to assist with the planning process in England, Planning Policy Wales [2] recommends that the good acoustic design principles put forward in Supplementary Document 2 may also be adopted in Wales.

4.4 Anticipated Assessment Criteria

- 4.4.1 As the site is in NEC 'B' it is expected that acceptable noise criteria will be conditioned by planning approval. It is anticipated that any conditions imposed for this development will refer to the guideline values published in BS 8233:2014 [5].

- 4.4.2 This document suggests that “...in general, for steady external noise sources, it is desirable that the internal ambient noise level does not exceed the guideline values”.
- 4.4.3 BS 8233 also states “For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$ with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments”.
- 4.4.4 For the purposes of this report, noise levels at the site are assessed against the guideline criteria detailed in Table 5 below.

Table 5 – Anticipated Assessment Criteria for Internal and External Ambient Noise Levels

Assessment Period	Maximum Internal Ambient Noise Level*	Maximum External Ambient Noise Level
Daytime (07:00 – 23:00)	35 dB $L_{Aeq,16hr}$	55 dB $L_{Aeq,16hr}$
Night Time (23:00 – 07:00)	30 dB $L_{Aeq,8hr}$	--

* desirable within habitable rooms

- 4.4.5 For the purposes of this assessment, a development layout was provided by IPlan Architecture Ltd. for assessment. The internal and external noise levels for any proposed dwelling will be significantly affected by its final location and orientation to the noise sources.
- 4.5 **Good Acoustic Design**
- 4.5.1 The principles of good acoustic design follow a hierarchy of noise management measures that Local Planning Authorities should encourage, including the following, in descending order of preference:
- Maximising the spatial separation of noise source(s) and receptor(s).
 - Investigating the necessity and feasibility of reducing existing noise levels and relocating existing noise sources.
 - Using existing topography and existing structures (that are likely to last the expected life of the noise-sensitive scheme) to screen the proposed development site from significant sources of noise.

- Incorporating noise barriers as part of the scheme to screen the proposed development site from significant sources of noise.
- Using the layout of the scheme to reduce noise propagation across the site.
- Using the orientation of buildings to reduce the noise exposure of noise-sensitive rooms.
- Using the building envelope to mitigate noise to acceptable levels.

4.5.2 The above measures are considered in the following sections.

4.5.3 **Maximising the spatial separation of noise source(s) and receptor(s).**

4.5.3.1 As the noise source is out of the control of the developer and the relatively small scale of the development site there is limited scope to increase the source/receptor distance.

4.5.4 **Investigating the necessity and feasibility of reducing existing noise levels and relocating existing noise sources.**

4.5.4.1 As the noise source is out of the control of the developer, reducing existing noise levels or relocating existing noise sources is not applicable.

4.5.5 **Using existing topography and existing structures to screen the proposed development site from significant sources of noise.**

4.5.5.1 For the road traffic travelling along the A4241, beneficial acoustic screening is provided by the existing 2.6m high timber fencing located along the north-east boundary to the site.

4.5.6 **Incorporating noise barriers as part of the scheme to screen the proposed development site from significant sources of noise.**

4.5.6.1 As the existing timber fencing is outside the control of the developer, there is limited scope for modifications to the barrier. Additional barriers between the road and the development would be impractical creating an undesirable and inaccessible area located between any new and existing barrier.

4.5.7 **Using the layout of the scheme to reduce noise propagation across the site.**

4.5.7.1 Due to the relatively compact extent of the site, there is limited scope for alternative layout options that would materially affect the noise propagation to the habitable rooms.

4.5.8 **Using the orientation of buildings to reduce the noise exposure of noise-sensitive rooms.**

4.5.8.1 Due to the relatively compact extent of the site, there is limited scope for alternative orientation options that would materially affect the noise propagation to habitable rooms.

4.5.9 **Using the building envelope to mitigate noise to acceptable levels.**

4.5.9.1 Consideration should be given to the sound reduction performance of the proposed building envelope. The overall sound insulation of the building envelope is typically determined by the weakest acoustic element which would normally be the windows.

4.6 **Assessment of Development Layout**

4.6.1 The only practicable noise management measure suitable for this development is the consideration of the sound reduction performance of the proposed building envelope. As stated earlier, the overall sound insulation of the building envelope is typically determined by the weakest acoustic element which would normally be the glazing units.

4.6.2 With reference to the proposed development layout presented in Appendix 2, this report considers the minimum sound reduction performance for glazing units to all habitable rooms so that the desirable internal ambient noise levels detailed in BS8233 [5] will be achievable.

4.6.3 Planning Policy Wales [2] states *"The planning system should maximise its contribution to achieving the well-being goals, and in particular a healthier Wales, by aiming to reduce average population exposure to air and noise pollution"*.

- 4.6.4 Proposed development should be designed, wherever possible, to prevent adverse effects to amenity, health and the environment. As a minimum, measures should be implemented to limit or constrain any effects that may occur.
- 4.6.5 As the proposed development site is categorised as being in NEC 'B' as per TAN 11 [1], appropriate mitigation will be required to ensure an '*adequate level of protection against noise*'.
- 4.7 **Internal Ambient Noise Levels**
- 4.7.1 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. In this case, to represent worst-case, the sound reduction performance of the external façade is assumed to be equivalent to the weakest acoustic element which will be the glazing.
- 4.7.2 With reference to the layout drawings presented in Appendix 2, habitable rooms will be located on the ground floor only. The height of the ground floor receptor is modelled at 1.2m.
- 4.7.3 The model is updated with individual receptors, placed 1m in front of each habitable room within the development to calculate the external free-field noise levels at each room. The results of the model are presented in Appendix 3.
- 4.7.4 **Open Window Ventilation Strategy**
- 4.7.4.1 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 reduced to 15 dB [10].
- 4.7.4.2 To achieve the internal noise criteria of 35 dB $L_{Aeq,16hrs}$ with an open window during the daytime time period, the external noise level would be required to be below $35 + 15 = 50$ dB $L_{Aeq,16hrs}$. To achieve the internal noise criteria of 30 dB $L_{Aeq,8hrs}$ with an open window during the night time period, the external noise level would be required to be below $30 + 15 = 45$ dB $L_{Aeq,8hrs}$.

- 4.7.4.3 Following inspection of the results, this assessment identified the following habitable rooms where the use of a partially open window for ventilation would be suitable during both the daytime and night time periods.

Table 6 – Habitable Rooms where an Open Window Ventilation Strategy is Suitable

Habitable Room	Calculated External Road Traffic Noise Level Daytime (07:00 – 23:00 hrs) $L_{Aeq,16hrs}$ (dB)	Calculated External Road Traffic Noise Level Night Time (23:00 – 08:00 hrs) $L_{Aeq,8hrs}$ (dB)
Plot 1 Bedroom 2	44	37
Plot 1 Kitchen Dining Room	46	38
Plot 2 Bedroom 2	44	37
Plot 2 Kitchen Dining Room	44	37
Plot 3 Bedroom 2	44	37
Plot 3 Kitchen Dining Room	44	37
Plot 4 Kitchen Dining Room	45	37
Plot 4 Living Room Side	44	36

- 4.7.4.4 The remaining habitable rooms are exposed to external road traffic noise levels that would result in the internal ambient noise level criteria being exceeded whilst using a partially open window to provide background ventilation.

4.7.5 Minimum Sound Reduction Specification, Glazing Units

- 4.7.5.1 It was demonstrated that an open window ventilation strategy would not be suitable for a number of habitable rooms within the proposed development. To achieve the required internal ambient noise levels within these habitable rooms, the windows will need to be in the closed position to control the noise ingress.
- 4.7.5.2 This report assesses the minimum sound reduction performance required from the glazing for each of the habitable rooms exposed to unacceptable levels of external road traffic noise.

- 4.7.5.3 The results of the modelling exercise to determine the external road traffic noise levels at each habitable room are presented in Appendix 3 with the minimum sound reduction calculations for the glazing detailed in Appendix 5.
- 4.7.5.4 A summary of the minimum glazing specifications is presented in Table 7 below.

Table 7 – Summary of Minimum Sound Reduction Performance from Glazing for Habitable Rooms Exposed to Unacceptable Noise Levels

Habitable Room	Minimum Glazing Specification $R_w + C_{tr}$ (dB)
Plot 1 Bedroom 1	20
Plot 2 Bedroom 1	20
Plot 2 Living Room Rear	20
Plot 1 Living Room Rear	20
Plot 3 Bedroom 1	20
Plot 3 Living Room Rear	20
Plot 5 Kitchen Dining Room	19
Plot 5 Living Room Rear	18
Plot 5 Living Room Side	18
Plot 1 living Room Side	18
Plot 5 Bedroom 2	17
Plot 5 Bedroom 1	17
Plot 3 Living Room Side	17
Plot 4 Bedroom 1	17
Plot 4 Bedroom 2	16
Plot 4 Living Room Rear	16
Plot 2 Living Room Side	16

- 4.7.5.5 The above minimum specification is determined from the highest specification required for either of the daytime or night time periods at each habitable room, to ensure good internal acoustic conditions at all times.
- 4.7.5.6 The sound reduction performance is quoted in terms of $R_w + C_{tr}$ where R_w is the weighted sound reduction index and C_{tr} is the correction to account for the low frequencies attributable to road traffic travelling at low speeds (<80km/h) as detailed in BS EN ISO 717 [7].

- 4.7.5.7 Manufacturers' data should be used to confirm the above minimum sound reduction performance requirements are achievable from the glazing units specified for the proposed development.
- 4.7.5.8 The windows are required to be in the closed position to effectively control noise ingress. The decision on whether the windows should be permanently closed is outside the scope of this assessment and our technical expertise. This decision should be taken by appropriate authorities.
- 4.7.5.9 All habitable rooms subject to sound mitigation measures should be provided with an alternative, effective means of ventilation. Any ventilation scheme should satisfy the requirements of Approved Document F and provide the required ventilation rates. Specialist advice should be obtained to ensure that any ventilation scheme is suitable for purpose. It is important that any scheme is approved by Building Control and does not compromise the internal noise levels.
- 4.7.5.10 Recommendations for suitable ventilation are outside the scope of this assessment and technical expertise.
- 4.7.6 **External Amenity Areas**
- 4.7.6.1 A noise contour grid covering the whole site is constructed to display the external free field noise levels within amenity areas. Each grid represents the calculated free field noise levels throughout the site and is actually a collection of receivers set 1m apart at a height of 1.2m.
- 4.7.6.2 The anticipated criterion for the outdoor living areas, detailed in Table 5, require noise levels to be no greater than 55 dB $L_{Aeq,16hr}$.
- 4.7.6.3 The relevant noise contour maps are presented in Appendix 3.
- 4.7.6.4 Figure 7 presents the calculated noise levels at a height of 1.2m and indicates all areas of the development that satisfy this criterion in green. Areas that exceed this criterion are indicated in red.
- 4.7.6.5 The contour maps clearly identify that the external amenity areas associated with all plots are exposed to noise levels lower than 55 dB $L_{Aeq,16hr}$ and satisfies the anticipated criterion.

- 4.7.6.6 The above calculations assume that the existing 2.6m high timber fence, located along the north-east boundary of the site, meets the minimum mass requirements for an effective acoustic barrier as originally intended.

5.0 CONCLUSIONS

- 5.1.1 Utilising 3D acoustic modelling techniques with the latest available traffic flow figures for the A4241, the calculated road traffic noise levels place the whole of the site into NEC 'A' during the daytime period and the majority of the site into NEC 'B' during the night-time period.
- 5.2 Where the site falls into different categories depending on the assessment period, the worst-case NEC is selected to represent the appropriate category for the site. In this case, the site should be categorised as NEC 'B'.
- 5.3 For sites in NEC 'B' TAN11 recommends that:
- "Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise".*
- 5.4 An 'an adequate level of protection against noise' will be attainable through the consideration of good acoustic design principles.
- 5.5 With reference to the proposed development plans, an open window ventilation strategy would be suitable for the following habitable rooms:
- Plot 1 Bedroom 2
 - Plot 1 Kitchen Dining Room
 - Plot 2 Bedroom 2
 - Plot 2 Kitchen Dining Room
 - Plot 3 Bedroom 2
 - Plot 3 Kitchen Dining Room
 - Plot 4 Kitchen Dining Room
 - Plot 4 Living Room Side
- 5.6 The remaining habitable rooms are exposed to external road traffic noise levels that would result in the internal ambient noise level criteria being exceeded whilst using a partially open window to provide background ventilation.

- 5.7 With reference to the proposed development design layout, this report considered the external noise levels, to determine the minimum sound reduction required from the glazing units for these remaining habitable rooms so that desirable internal ambient noise levels are achievable at all times.
- 5.8 The noise levels within the external amenity areas for all plots will satisfy the anticipated external amenity noise criteria.
- 5.9 The installation of glazing units with the minimum sound reduction performance recommended in this report, results in desirable internal ambient noise levels within all habitable rooms at all times.
- 5.10 Therefore, as the results of the modelling demonstrate that implementing the additional noise mitigation measures results in reasonable to good ambient noise levels throughout both external and internal areas, the site could be considered suitable for residential development.

6.0 RECOMMENDATIONS

- 6.1 It has been demonstrated that an open window ventilation strategy would not be suitable for a number of habitable rooms within the proposed development. To achieve desirable internal ambient noise levels within these habitable rooms, the windows should be in the closed position to control the noise ingress.
- 6.2 With reference to the proposed development plans, the following rooms were identified:
- *Plot 2 Living Room Side*
 - *Plot 4 Living Room Rear*
 - *Plot 4 Bedroom 2*
 - *Plot 4 Bedroom 1*
 - *Plot 3 Living Room Side*
 - *Plot 5 Bedroom 1*
 - *Plot 5 Bedroom 2*
 - *Plot 1 Living Room Side*
 - *Plot 5 Living Room Side*
 - *Plot 5 Living Room Rear*
 - *Plot 5 Kitchen Dining Room*
 - *Plot 3 Living Room Rear*
 - *Plot 1 Bedroom 1*
 - *Plot 1 Living Room Rear*
 - *Plot 2 Bedroom 1*
 - *Plot 2 Living Room Rear*
 - *Plot 3 Bedroom 1*
- 6.3 The minimum sound reduction performance required from all glazing units to the above habitable rooms should be 20 dB $R_w + C_{tr}$.
- 6.4 Manufacturers' data should be used to confirm the above minimum sound reduction performance requirements are achievable from the glazing units specified for the proposed development.

- 6.5 The windows to all habitable rooms are required to be in the closed position to effectively control noise ingress to acceptable levels. The decision on whether the glazing should be permanently closed is outside the scope of this assessment and our technical expertise. This decision should be taken by appropriate authorities.
- 6.6 All habitable rooms subject to sound mitigation measures should be provided with an alternative, effective means of ventilation. Any ventilation scheme should satisfy the requirements of Approved Document F and provide the required ventilation rates. Specialist advice should be obtained to ensure that any ventilation scheme is suitable for purpose. It is important that any scheme is approved by Building Control and does not compromise the internal noise levels.
- 6.7 Recommendations for suitable ventilation are outside the scope of this assessment and technical expertise.

P.A.T. 21/02/2020

M.Sc., I.Eng., M.I.O.A.,

M.Inst.SCE., M.A.E.S.

Appendix 1 View of Site Location

A1.0 VIEW OF SITE LOCATION

Figure 1 – Satellite View of Site Location



Appendix 2 Proposed Development Drawings

A2.0

Figure 2 – Plan of Proposed Development

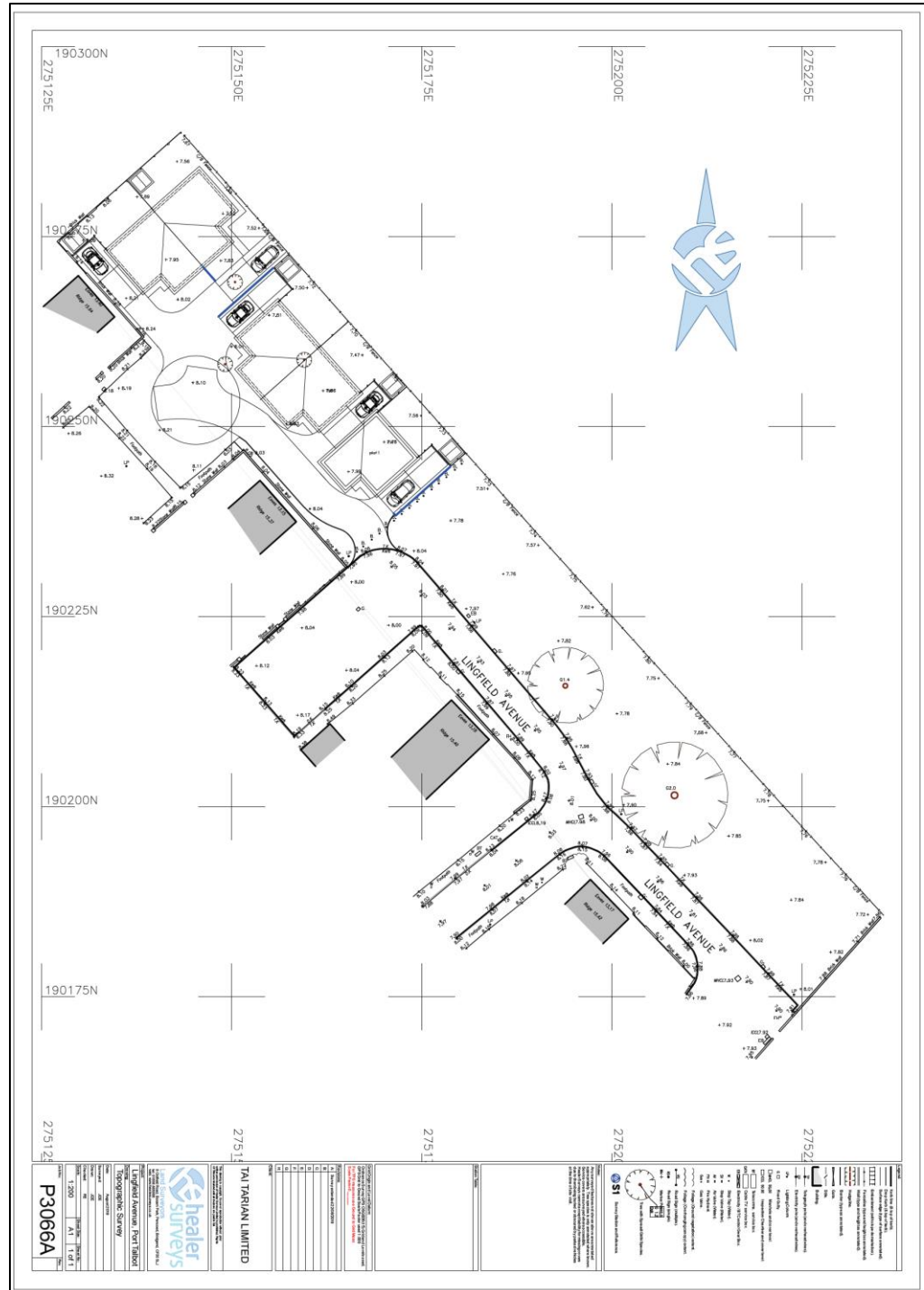
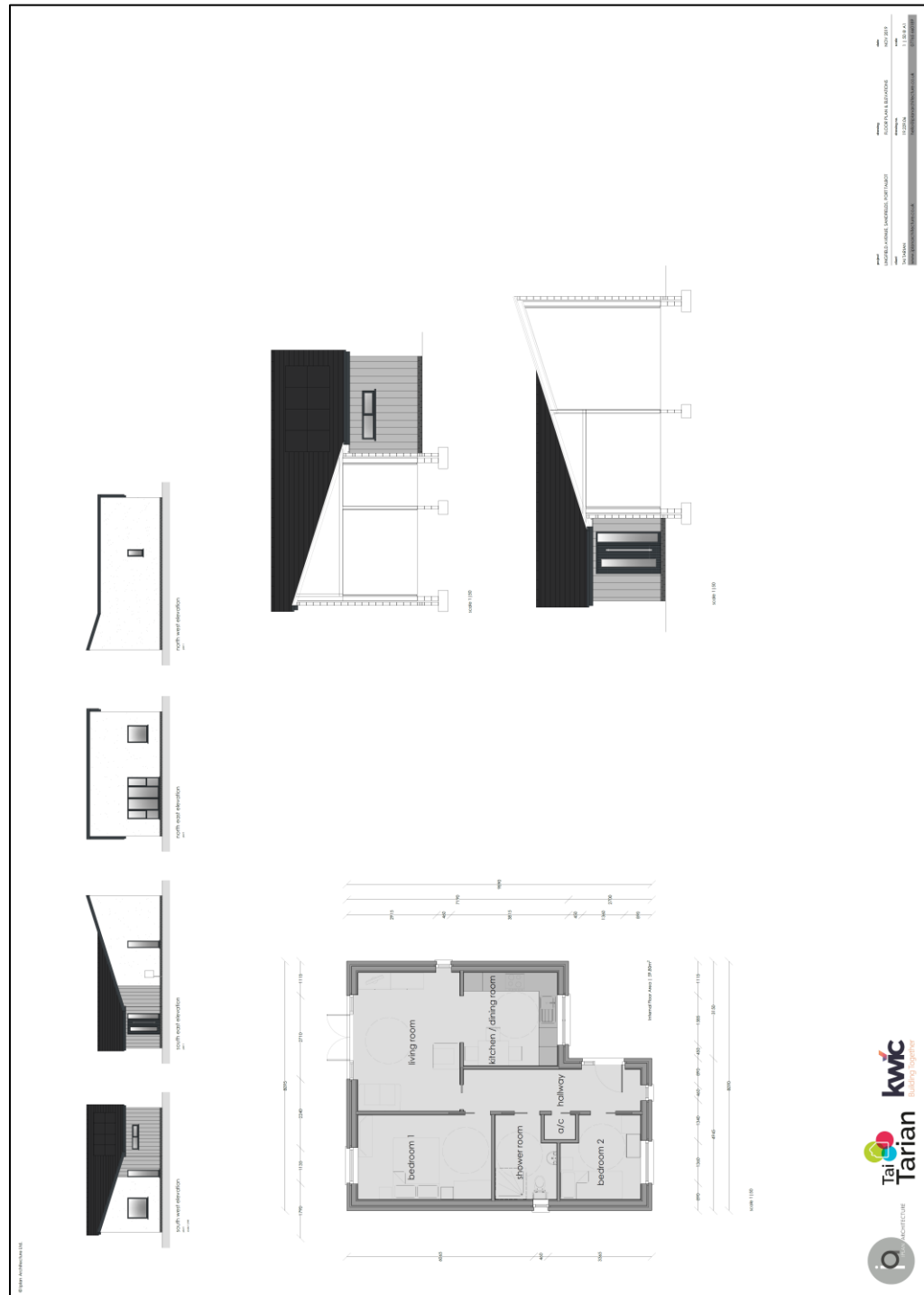


Figure 3 – Proposed Floor Plan and Elevations, Plot 1



The image displays architectural drawings for the Tai Tien 1100 project. On the left, there are four elevation drawings showing different facades of the building, including a gabled roof section and a flat roof section. The central part of the image features a large floor plan of the building, which is a rectangular structure with a central corridor and multiple rooms. The rooms are labeled: living room, kitchen / dining room, bedroom 1, bedroom 2, shower room, and a/c. The floor plan includes dimensions for each room and the overall building footprint. To the right of the floor plan, there are two more elevation drawings showing the building's profile from different angles. The bottom right corner contains the project name 'Tai Tien 1100' and the company logo 'Tai Tien Building Together'.

Appendix 3 Modelling Results

A3.0 MODELLING RESULTS

Figure 5 – TAN 11, NEC Categories, Daytime

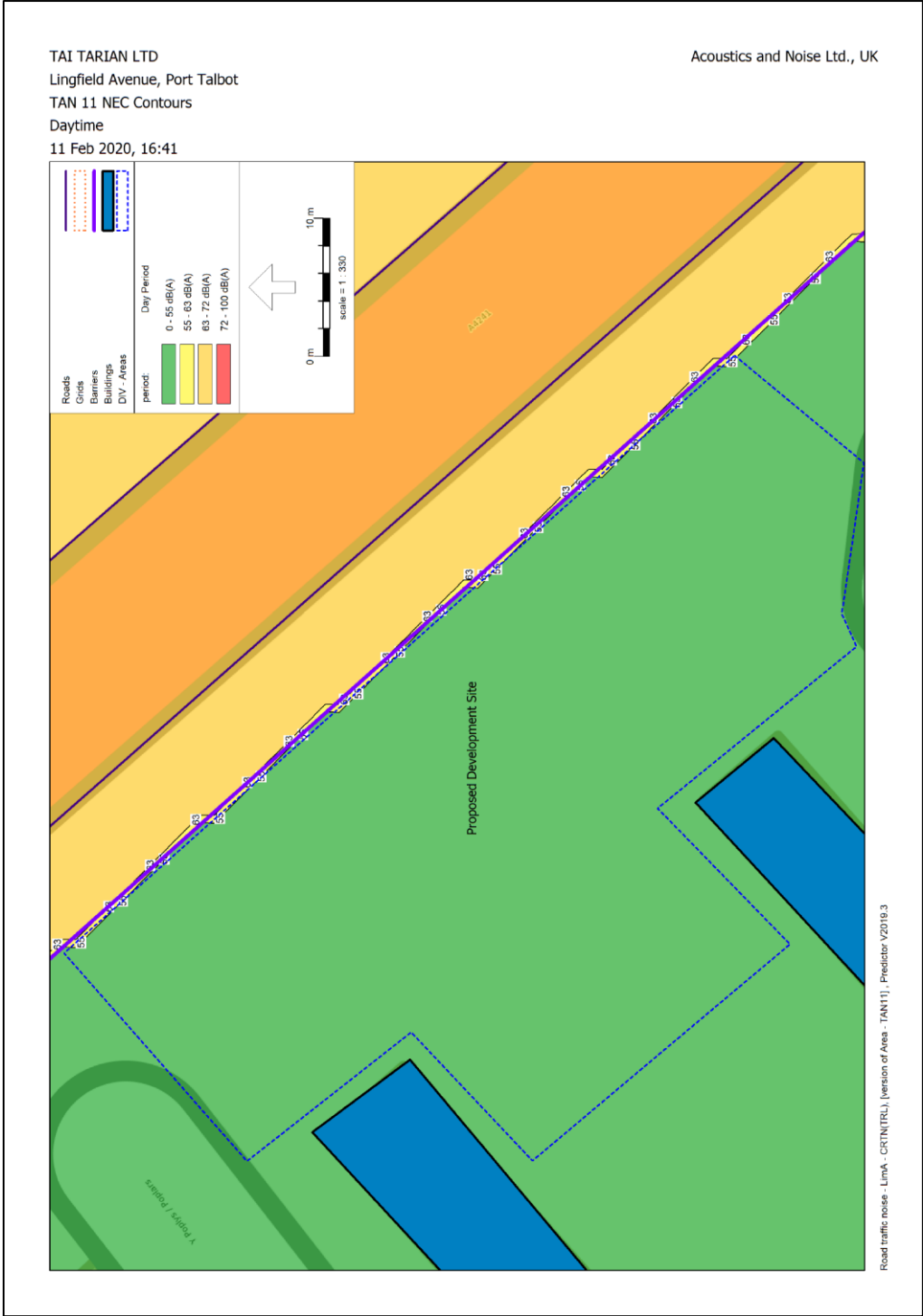


Figure 6 – TAN 11, NEC Categories, Night Time

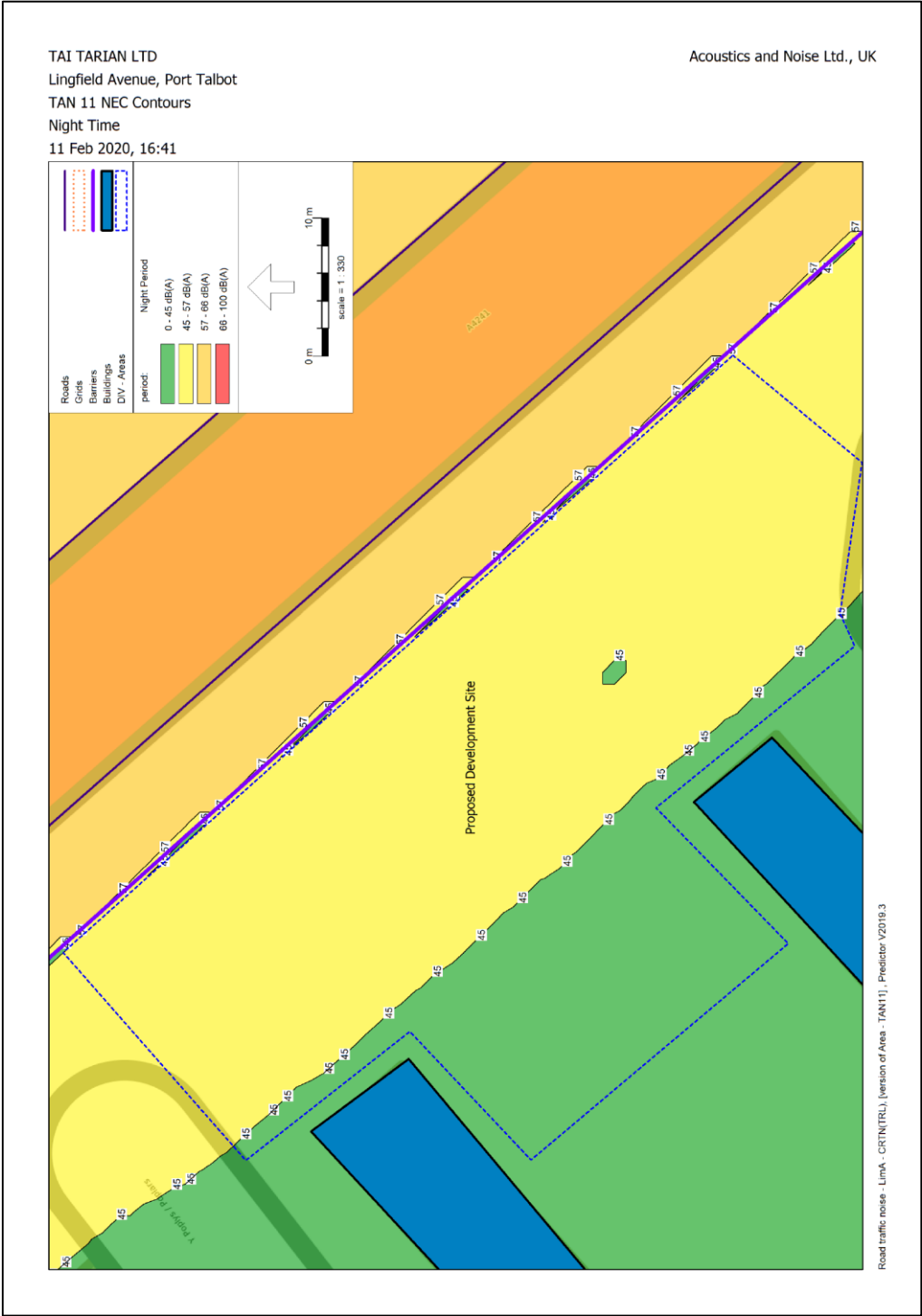


Figure 7 – External Road Traffic Noise, Amenity Areas

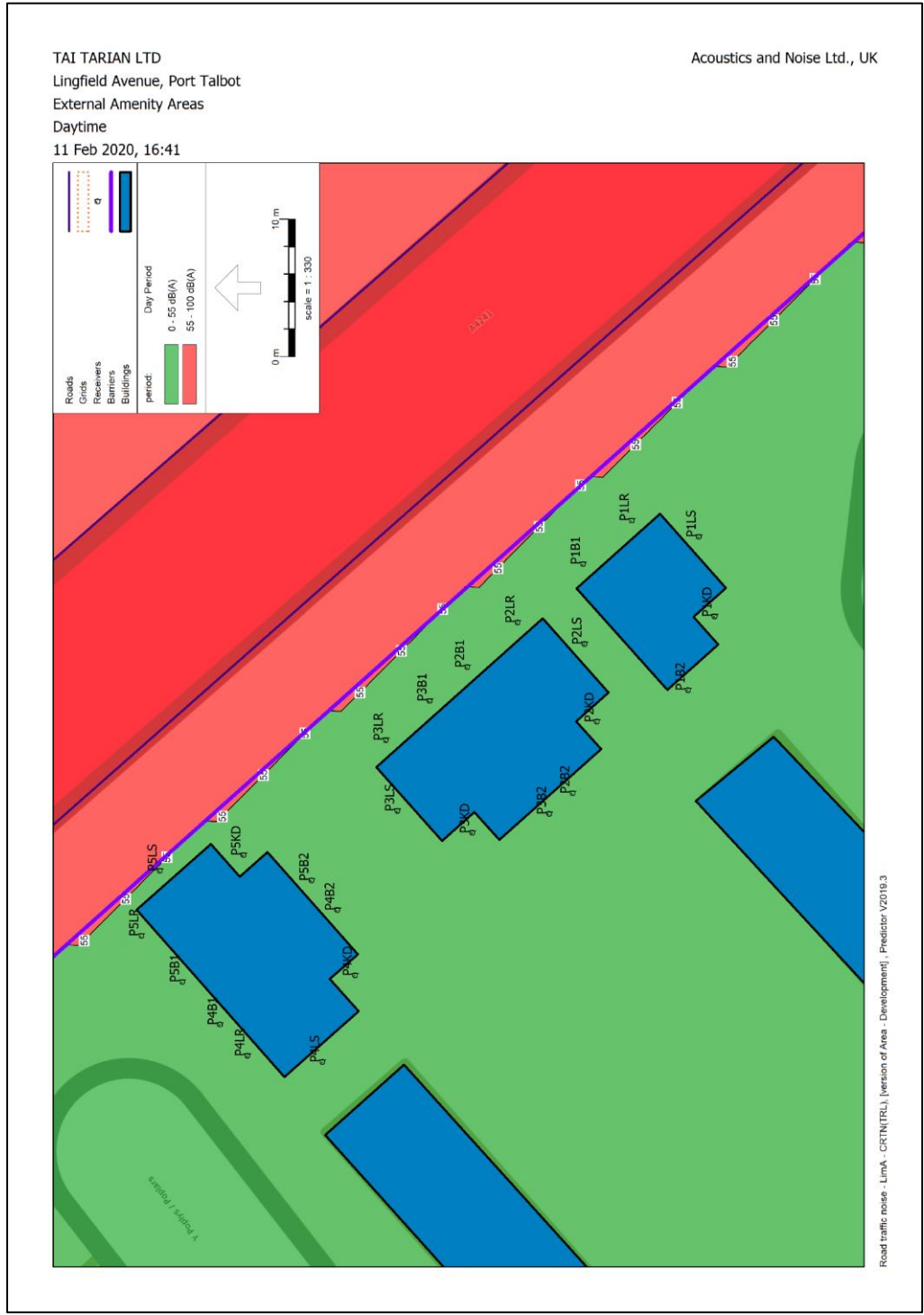


Table 8 – Calculated External Road Traffic Noise Levels at Habitable Rooms

Habitable Room	Calculated External Road Traffic Noise Level Daytime (07:00 – 23:00 hrs) $L_{Aeq,16hrs}$ (dB)	Calculated External Road Traffic Noise Level Night Time (23:00 – 08:00 hrs) $L_{Aeq,8hrs}$ (dB)
Plot 1 Bedroom 1	55	47
Plot 1 Bedroom 2	44	37
Plot 1 Kitchen Dining Room	46	38
Plot 1 Living Room Rear	55	47
Plot 1 Living Room Side	53	45
Plot 2 Bedroom 1	55	47
Plot 2 Bedroom 2	44	37
Plot 2 Kitchen Dining Room	44	37
Plot 2 Living Room Rear	55	47
Plot 2 Living Room Side	51	43
Plot 3 Bedroom 1	55	47
Plot 3 Bedroom 2	44	37
Plot 3 Kitchen Dining Room	44	37
Plot 3 Living Room Rear	55	47
Plot 3 Living Room Side	52	44
Plot 4 Bedroom 1	52	44
Plot 4 Bedroom 2	51	44
Plot 4 Kitchen Dining Room	45	37
Plot 4 Living Room Rear	51	43
Plot 4 Living Room Side	44	36
Plot 5 Bedroom 1	52	44
Plot 5 Bedroom 2	52	45
Plot 5 Kitchen Dining Room	54	46
Plot 5 Living Room Rear	53	46
Plot 5 Living Room Side	53	45

Appendix 4 Data and Calculations used in Model

A4.0 DATA AND CALCULATIONS USED IN MODEL

Figure 8 – Location of Traffic Count Point 90330

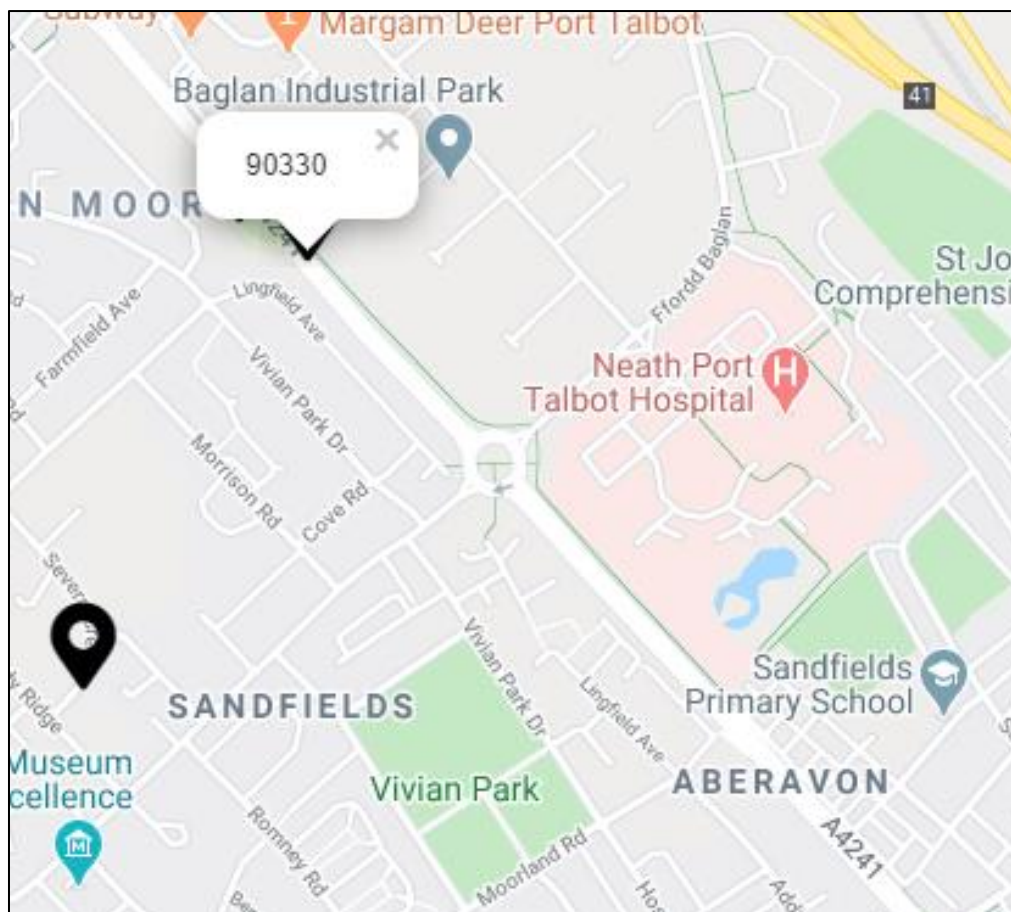


Table 9 – Traffic Count Data for Year 2018

AADF Year	CP	Road	All HGVs	All Motor Vehicles	18 hr Flows*	%HGV
2018	90330	A4241 (N)	99	8796	8295	1.1
2018	90330	A4241 (S)	83	7219	6808	1.1

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

A4.1 Assumptions Made in Model

- A4.1.1 Traffic flows along the A4142 were modelled as two separate road noise sources corresponding to each carriageway (North and South). Each source is positioned at the outer edge of the carriageway with the source emissions modelled at 3.5m from the outer edge of the road.

- A4.1.2 The source height is modelled at 0.5m and the gradient correction was calculated by the modelling software using the site topography.
- A4.1.3 The ground attenuation was modelled as mixed with a ground factor value of 0.5.
- A4.1.4 The existing roadside acoustic barriers were modelled as reflective with a height of 2.6m.
- A4.1.5 Atmospheric conditions were modelled as
- Temperature: 293.15 K
 - Pressure: 101.33
 - Air Humidity: 60%

Appendix 5 Minimum Sound Reduction Performance Calculations for Glazing

A5.0 MINIMUM SOUND REDUCTION PERFORMANCE CALCULATIONS FOR GLAZING

Table 10 – Minimum Sound Reduction Performance for Glazing, Daytime (07:00 – 23:00 hrs)

Receptor	Calculated External Free- field Noise Level $L_{Aeq,16hrs}$ (dB)	Internal Ambient Noise Level Criteria (07:00 – 23:00 hrs) $L_{Aeq,16hrs}$ (dB)	Minimum Sound Reduction Performance for Glazing $R_w + C_{tr}$ (dB)
Plot 1 Bedroom 1	55	35	20
Plot 1 Bedroom 2	44	35	9
Plot 1 Kitchen Dining Room	46	35	11
Plot 1 Living Room Rear	55	35	20
Plot 1 living Room Side	53	35	18
Plot 2 Bedroom 1	55	35	20
Plot 2 Bedroom 2	44	35	9
Plot 2 Kitchen Dining Room	44	35	9
Plot 2 Living Room Rear	55	35	20
Plot 2 Living Room Side	51	35	16
Plot 3 Bedroom 1	55	35	20
Plot 3 Bedroom 2	44	35	9
Plot 3 Kitchen Dining Room	44	35	9
Plot 3 Living Room Rear	55	35	20
Plot 3 Living Room Side	52	35	17
Plot 4 Bedroom 1	52	35	17
Plot 4 Bedroom 2	51	35	16
Plot 4 Kitchen Dining Room	45	35	10
Plot 4 Living Room Rear	51	35	16
Plot 4 Living Room Side	44	35	9
Plot 5 Bedroom 1	52	35	17
Plot 5 Bedroom 2	52	35	17
Plot 5 Kitchen Dining Room	54	35	19
Plot 5 Living Room Rear	53	35	18
Plot 5 Living Room Side	53	35	18

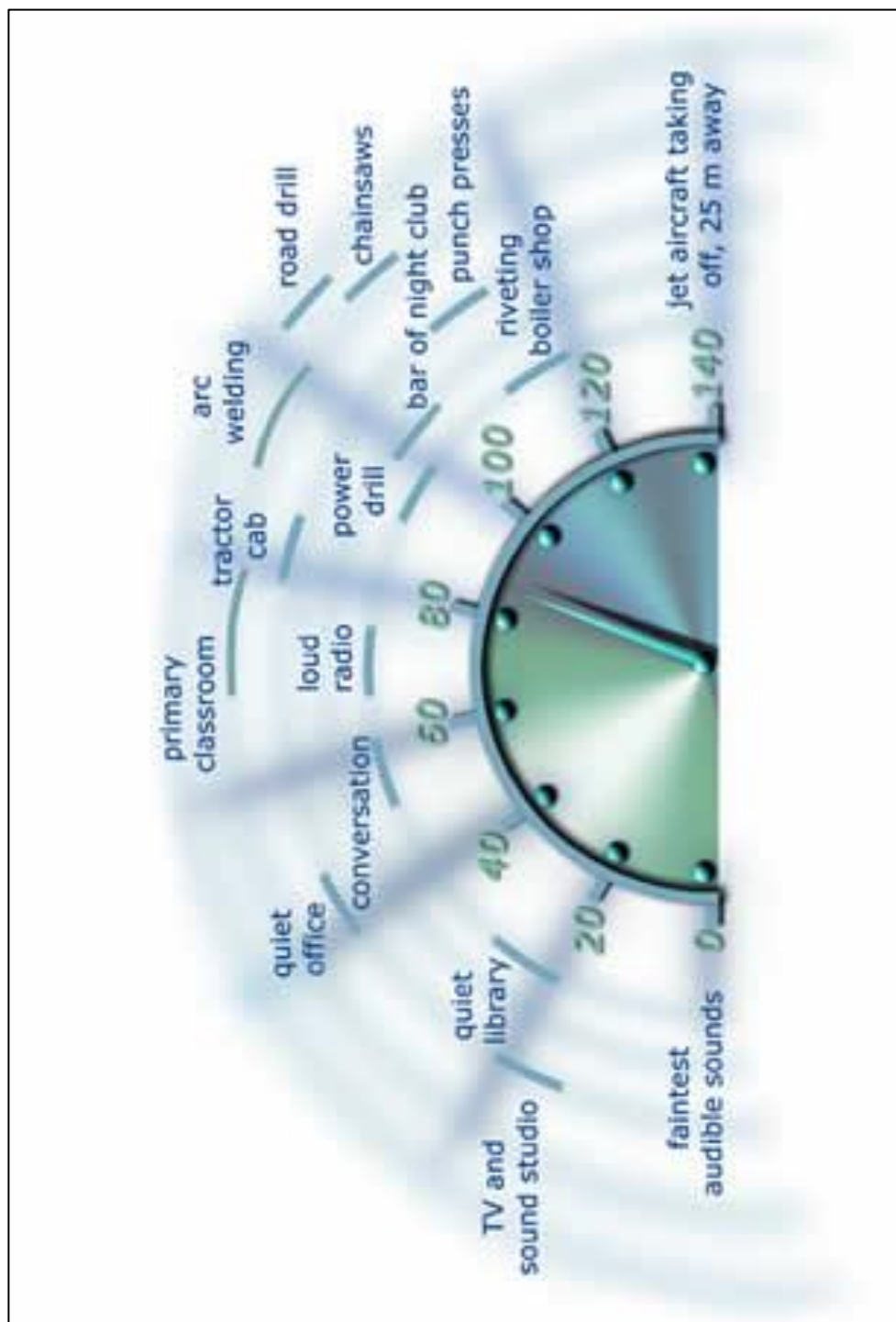
Table 11 – Minimum Sound Reduction Performance for Glazing, Night Time (23:00 – 07:00 hrs)

Receptor	Calculated External Free- field Noise Level $L_{Aeq,8hrs}$ (dB)	Internal Ambient Noise Level Criteria (23:00 – 07:00 hrs) $L_{Aeq,8hrs}$ (dB)	Minimum Sound Reduction Performance for Glazing $R_w + C_{tr}$ (dB)
Plot 1 Bedroom 1	47	30	17
Plot 1 Bedroom 2	37	30	7
Plot 1 Kitchen Dining Room	38	30	8
Plot 1 Living Room Rear	47	30	17
Plot 1 living Room Side	45	30	15
Plot 2 Bedroom 1	47	30	17
Plot 2 Bedroom 2	37	30	7
Plot 2 Kitchen Dining Room	37	30	7
Plot 2 Living Room Rear	47	30	17
Plot 2 Living Room Side	43	30	13
Plot 3 Bedroom 1	47	30	17
Plot 3 Bedroom 2	37	30	7
Plot 3 Kitchen Dining Room	37	30	7
Plot 3 Living Room Rear	47	30	17
Plot 3 Living Room Side	44	30	14
Plot 4 Bedroom 1	44	30	14
Plot 4 Bedroom 2	44	30	14
Plot 4 Kitchen Dining Room	37	30	7
Plot 4 Living Room Rear	43	30	13
Plot 4 Living Room Side	36	30	6
Plot 5 Bedroom 1	44	30	14
Plot 5 Bedroom 2	45	30	15
Plot 5 Kitchen Dining Room	46	30	16
Plot 5 Living Room Rear	46	30	16
Plot 5 Living Room Side	45	30	15

Appendix 6 Range of Typical Noise Levels

A6.0 RANGE OF TYPICAL NOISE LEVELS

Figure 9 – Range of Typical Noise Levels



Appendix 7 Glossary of Acoustic Terms

A7.0 GLOSSARY OF ACOUSTIC TERMS

A7.1 Acoustic Environment:

Sound from all sound sources as modified by the environment.

A7.2 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.

A7.3 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.

A7.4 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.

A7.5 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.

A7.6 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.

A7.7 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.

A7.8 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.

A7.9 Free Field:

A sound field in which no significant sound reflections occur

A7.10 Frequency:

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

A7.11 Hertz:

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

A7.12 $L_{A10,T}$:

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.

A7.13 L_{Amax} :

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

A7.14 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.

A7.15 Rating Level, $L_{Ar,Tr}$:

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

A7.16 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.

A7.17 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.

A7.18 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 .

A7.19 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 .

A7.20 Specific Sound Source:

Sound source being assessed.

A7.21 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 8 References

A8.0 REFERENCES

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