MACH ACOUSTICS

YSGOL GYMRAEG BRO MORGANNWG

Environmental Noise Assessment

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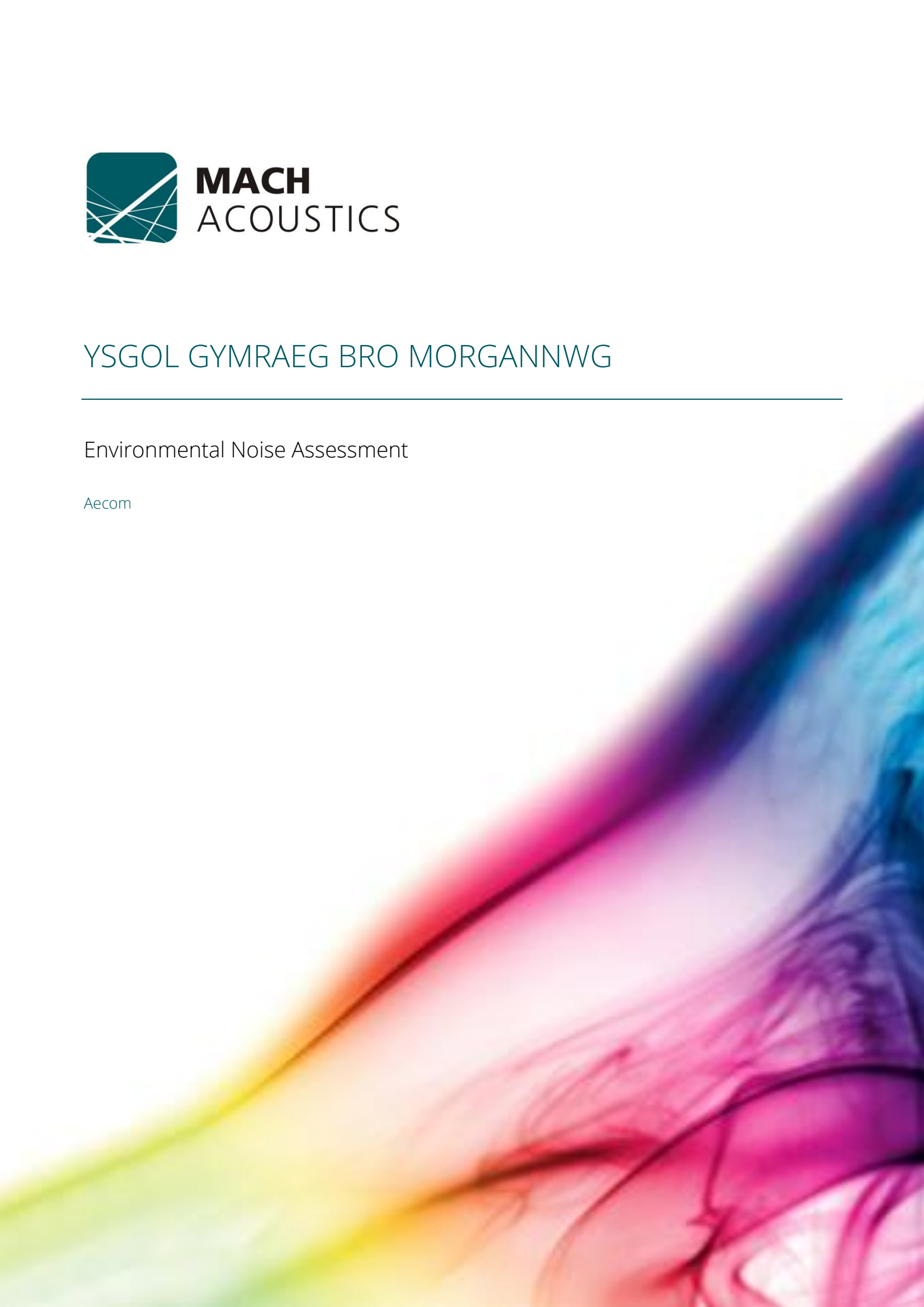

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1.0 INTRODUCTION

MACH Acoustics has been appointed by Aecom to undertake an environmental noise assessment at the proposed site of Ysgol Gymraeg Bro Morgannwg in Barry.

The proposed development is a refurbishment of the existing school along with some additional new build elements to increase the capacity of the existing school.

Such to establish the existing noise levels across the site, a noise survey has been undertaken. This report describes the noise survey, its results, and the outcomes of the subsequent assessment.

The following subsections describe the purpose of each assessment.

1.1 Natural Ventilation Feasibility Assessment

The purpose of this assessment is to determine whether natural ventilation will be feasible based upon measured noise levels and the currently proposed building location.

1.2 Plant Noise Break-Out Assessment

The purpose of this assessment is to determine the existing ambient background noise level representative of the nearest noise sensitive receivers to the proposed development. Based on this level, a plant noise rating limit can be set.

2.0 ASSESSMENT CRITERIA – INTERNAL NOISE LEVELS

2.1 Internal Ambient Noise Level - BB93

BB93 specifies maximum indoor ambient noise levels for all teaching and ancillary spaces. These levels are seen to be the overall noise levels, made up of the sum of building services noise, external noise break-in and any other noise sources present within the unoccupied, fully operational building.

Typically, the most onerous indoor ambient noise level requirement given within BB93 is 35 dB $L_{Aeq,30min}$, which applies to most teaching spaces. Music spaces and teaching spaces specifically for pupils with special hearing and communication needs target a lower indoor ambient noise level of 30 dB $L_{Aeq,30min}$. For refurbished classrooms this limit is relaxed by 5dB.

BB93 sets a maximum "L1" noise level of 60 dB $L_{A1,30min}$ in teaching spaces and is used to assess short transient noise levels associated with aircraft, railways and other similar sources. This is achieved by default for spaces with indoor ambient noise levels up to 40 dB $L_{Aeq,30min}$, but requires assessment in spaces with indoor ambient noise level targets of 45dB $L_{Aeq,30min}$ or above.

2.1.1 BB93 Relaxations

Natural/Hybrid Ventilation

Where a natural ventilation strategy is to be employed, the indoor ambient noise limits can be relaxed by 5dB $L_{Aeq,30min}$ where the "normal condition" is achieved. However, this does not apply to spaces with an indoor ambient noise limit of 45dB $L_{Aeq,30min}$ or higher.

For hybrid ventilation systems, the mechanical system noise component must comply with the limits set out in Table 1 of BB93, however the overall noise limit can also be relaxed by 5dB $L_{Aeq,30min}$, if the "normal condition" is achieved.

BB93 states that;

> "The "normal condition" for a natural or hybrid ventilation mode is defined as when the system is operating to limit the daily average carbon dioxide concentration to no more than 1,500ppm with the maximum concentration not exceeding 2,000ppm for more than 20 consecutive minutes on any day. This would normally equate to a minimum ventilation rate of approximately 5l/s per person.
> The mid-season design condition can be used in simple ventilation calculations and is defined as an outside temperature of 11 °C and an internal air temperature of 20 °C with no external wind effect....

> … Where there is a hybrid system, any mechanical system components should meet the IANL limits from table 1. The total noise level including external noise ingress may exceed the IANL limit from table 1 by up to 5 dB."

Summertime/Intermittent Boost Ventilation

BB93 also permits a further relaxation during the summertime. Summertime is defined as the hottest 200 hours in peak summertime. During summertime, natural and hybrid ventilation systems are permitted to relax indoor ambient noise limits to an upper limit of 55 dB $L_{Aeq,30min}$.

Mechanical Ventilation

Mechanical ventilation systems are also permitted to relax indoor ambient noise limits by 5dB $L_{Aeq,\ 30min}$ for the purpose of summertime / intermittent boost, under teacher control. Again, this does not apply to spaces with an indoor ambient noise limits of 45 dB $L_{Aeq,30min}$ or higher.

3.0 ASSESSMENT CRITERIA – NOISE POLLUTION

3.1 BS 4142: 2014 Criteria

BS 4142:2014 "Methods for rating and assessing industrial and commercial sound" describes a method of determining the level of noise of an industrial nature, together with the procedures for assessing whether the noise in question is likely to give rise to complaints from persons living in the vicinity. As such, an assessment to BS 4142 is typically called for within planning conditions. The likelihood of complaints in response to a noise depends on various factors. BS 4142 assesses the likelihood of complaints by considering the margin by which the noise in question exceeds the background noise level.

BS 4142 states that one should *'obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level from the rating level and consider the following:*

a) *Typically, the greater this difference, the greater the magnitude of the impact.*
b) *A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.*
c) *A difference of around + 5 dB is likely to be an indication of an adverse impact, depending on the context.*
d) *The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.*

The aforementioned rating level is based upon the specific noise level of the noise source in question. A correction should be applied to the specific noise level to obtain an increased rating level if *'a tone, impulse or other characteristic occurs, or is expected to be present, for new or modified sound sources.* To summarise, BS4142 section 9.2 advises the following in regards to corrections for acoustic characteristics:

- Tonality – *for sound ranging from not tonal to prominently tonal the Joint Nordic Method gives a correction of between 0 dB and +6 dB for tonality. Subjectively, this can be converted to a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible.*
- Impulsivity – *A correction of up to +9 dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level., Subjectively, this can be converted to a penalty of 3 dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible, and 9 dB where it is highly perceptible.*
- Other sound characteristics – *Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied*
- Intermittency – *When the specific sound has identifiable on/off conditions, if the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.*

3.2 Design Target

Plant noise break-out will be designed to be 5 dB below background noise levels, which is seen to be the most robust approach.

The proposed design criteria are subject to agreement from the local authority.

4.0 SITE DESCRIPTION

The proposed development is located in Barry and situated on an existing school site. The surrounding area includes residential areas towards the west, east and south, The Barry Hospital to the north-east. A new school, Whitmore High School, is proposed to the north.

The proposed site in relation to its surroundings is shown in the site map presented in Figure 4.1 below.

Figure 4.1: Site Location

4.1 Environmental Noise Sources

In order to conduct the assessment, the development must be assessed against the existing noise climate, where the primary contributors to ambient noise levels on site is the traffic noise from Port Road/A4226.

4.2 Noise Sensitive Receptors

The nearest noise sensitive receptor is seen to be residential buildings located 100m away towards the South-west, 140m towards the East, and The Barry Hospital located 65m towards the North-east of the proposed development. The locations of the noise sensitive receptors identified are marked on the site location figure above.

5.0 ENVIRONMENTAL NOISE SURVEY

5.1 Methodology

To establish the existing environmental noise levels on site, a noise survey was conducted between 9:30 to 12:00 on the 15/05/2018.

A fixed microphone position was used to determine the change in noise levels during typical operating hours of the development, with the fixed long term meter set to measure consecutive 'A' weighted 5 minute time samples. Measurements have been taken in free-field conditions, or have been corrected where appropriate.

Measurement locations are shown in Figure 5.1 below. Appendix A of the report presents photographs taken during the noise survey, which help provide a good understanding of the site. The results of the environmental noise survey are provided within Section 6 of this report.

Figure 5.1: Measurement location map

5.2 Measurement Equipment

The measurement equipment illustrated in Table 5.1 was used during the survey, all equipment complies with BS EN 60942:2003 i.e. a class 1 device.

Name	Serial Number	Last Calibrated	Certificate Number	Calibration Due
Norsonic Precision Sound Analyser Type 131	1313109	Mar-18	15588	Mar-20
Norsonic Type 1207 Pre-amplifier	12303	Mar-18	15588	Mar-20
Norsonic Type 1227 Microphone	170603	Mar-18	15587	Mar-20
Norsonic Sound Calibrator Type 1251	32090	Jun-17	1606317	Jun-18

Table 5.1: Measurement Equipment Calibration

5.3 Weather Conditions

The following climate conditions were recorded for the site:

Wind: Less than 5 m/s
Humidity: 85%
Temperature: 15°C.

The above weather conditions are suitable for the measurement of environmental noise in accordance with BS7445 *Description and Measurement of Environmental Noise.*

6.0 RESULTS

6.1 Fixed Measurement Results

The following graph presents the noise levels recorded over the measurement period at the fixed location (F1). The complete set of measurement data is available on request.

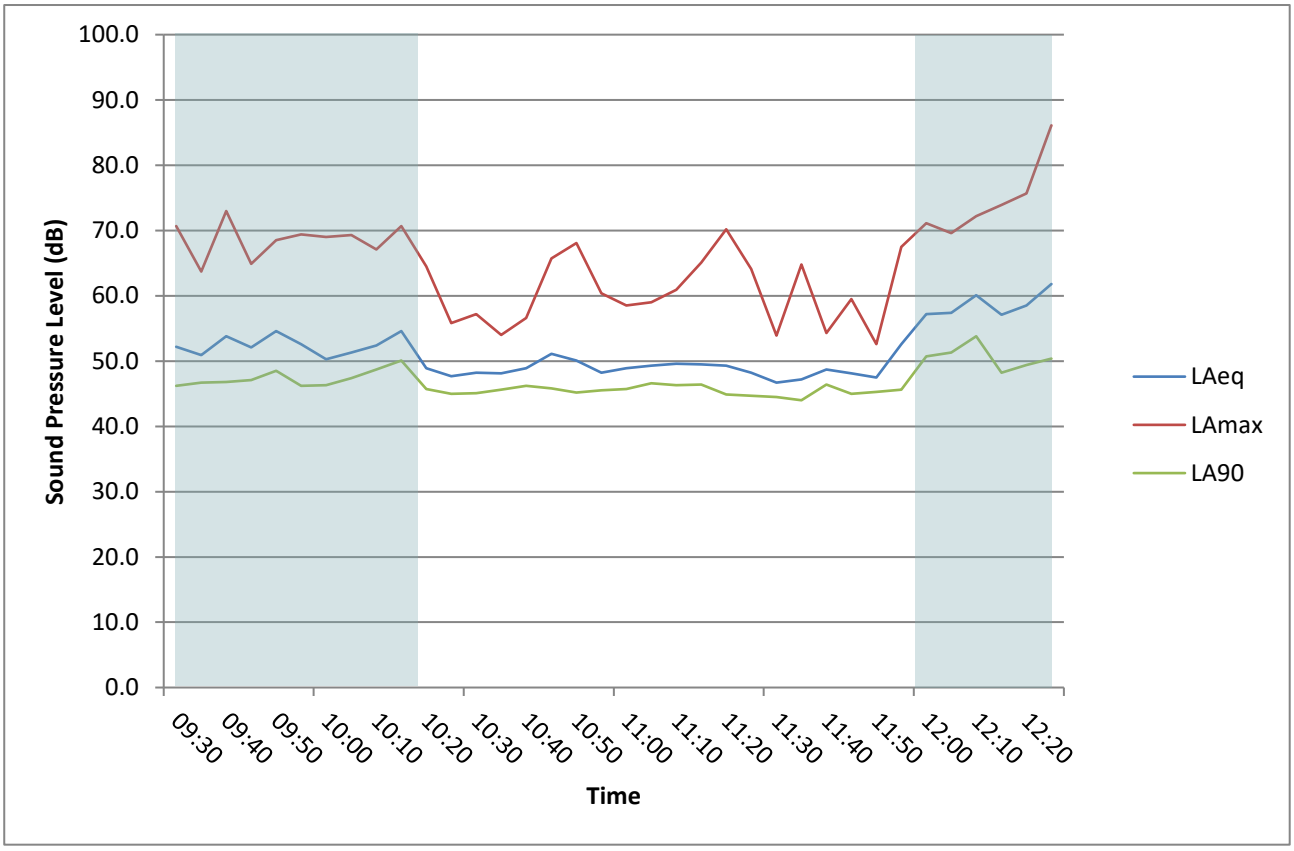

Figure 6.1: Sound pressure level at fixed location, F1

During the survey there were pupils in the sports fields, which resulted in increased noise levels at the measurement position. These noise levels are not considered representative of normal ambient conditions, and therefore have been omitted from subsequent assessments.

6.1.1 Summary of Fixed Location Measurements – BB93

BB93 requires that noise levels are assessed over 30-minute periods during the operational hours of the school. The fixed measurement data has therefore been transformed into 30-minute average noise levels ($L_{Aeq,30min}$) by means of logarithmically averaging the above fixed measurement data.

Note:
The data presented in the table below is taken from 9:30 to 12:00 on the 15/05/2018.

Time (hh:mm)	$L_{Aeq,30min}$ dB
09:30 - 10:00	53
10:00 - 10:30	52
10:30 - 11:00	49
11:00 - 11:30	49
11:30 - 12:00	49

Table 6.1: 30 minute 'average' noise levels ($L_{Aeq,30min}$)

As discussed, noise levels highlighted in grey are not considered representative of normal ambient conditions, and therefore have been omitted from subsequent assessments. Omitting these results, Table 6.1 shows that the highest logarithmically averaged $L_{Aeq,30min\ noise}$ level, at the fixed position was 49 dB(A) during the survey.

6.1.2 Summary of Fixed Location Measurements – Background Noise

BS4142: 2014 states that '*in using the background sound level in the method for rating and assessing industrial and commercial sound it is important to ensure that values are reliable and suitably represent both the particular circumstances and periods of interest. For this purpose, the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods.*'

BS4142 further states that '*a representative level ought to account for the range of background sound levels and ought not automatically to be assumed to be either minimum or modal value*'. Hence BS4142 does not provide a black and white method of obtaining the assessment level for background noise.

For the purposes of assessment, MACH Acoustics has derived the minimum L_{A90} that occurred during the survey.

Position	L_{A90}, dB
F1	44

Table 6.2: Assessment Background Noise Levels

7.0 ENVIRONMENTAL NOISE BREAK-IN ASSESSMENT

7.1 Façade Assessment

7.1.1 Natural Ventilation Feasibility

An open window typically provides between 10 to 15 dBA of sound attenuation and has been referenced within PPG24 and other documents. MACH Acoustics typically take 13 dBA as the sound attenuation provided by an open window ventilation strategy.

Subtracting this figure from the measured external noise level gives a predicted internal noise level. The predicted internal noise level is approximately 36 dBA.

	$L_{Aeq,30min}$ (dB)
Highest Measured	49
Open window attenuation	-13
Predicted Indoor Ambient Noise Level	36

Table 7.1: Predicted BB93 indoor ambient noise level

The predicted internal noise level is below 40dB L_{Aeq}, therefore the majority of spaces can be naturally ventilated through simple openable windows.

It is worth noting that music spaces and teaching spaces for pupils with special hearing and/or communication needs have a lower indoor ambient noise limit of 30dB $L_{Aeq,30min}$, relaxed to 35 dB $L_{Aeq,30min}$ with a natural ventilation strategy.

As the table shows based on this simple calculation noise levels could exceed this limit, albeit only marginally. Therefore, should there be any music spaces and/or teaching spaces specifically for pupils with special hearing and/or communication needs within the development, then noise break-in to these spaces would require further assessment.

8.0 NOISE BREAK-OUT ASSESSMENT

8.1 Nearest Noise Sensitive Receiver

Section 4.2 has highlighted where noise sensitive receptors are located.

8.2 Noise Rating Level Limit

Noise rating levels are to be assessed against the stated criteria given in Section 3.0, when compared against the existing background noise levels, L_{A90}, which have been presented in Section 6.0. The table below presents these values with the maximum noise rating level which must not be exceeded at the noise sensitive receptor.

Measurement Period	Location	Assessed Background Noise Level (dB L_{A90})	Noise Rating Level Design Criteria (dB)	Plant Noise Rating Level Limit dB $L_{Aeq,T}$	
				At Nearest Sensitive Receiver	At Nearest Teaching Window
09:00 – 12:00	F1	44	- 5	39	48

Table 8.1: Target background noise at nearest residential window

9.0 CONCLUSION

MACH Acoustics has been appointed by Aecom to undertake an environmental noise assessment for the proposed development at Ysgol Gymraeg Bro Morgannwg.

A natural ventilation feasibility assessment has been undertaken in order to determine an indicative ventilation strategy for the proposed development.

Section 7.0 indicates that to comply with the internal noise level targets specified within BB93, simple openable windows will be suitable for this development for spaces with indoor ambient noise level targets of 40dB $L_{Aeq,30min}$ or greater. Spaces with indoor ambient noise level targets of lower than 40 dB $L_{Aeq,30min}$ will require a more detailed assessment once their location within the development is established.

A noise impact assessment of the proposed development on the nearest residential receivers has been conducted in accordance with BS4142. Plant noise rating limits have been specified at nearest sensitive receptor and nearest teaching window within the development.

ACOUSTIC TERMINOLOGY

Absorption Classes	The sound absorption of a material is rated from Class A to Class E, where Class A materials provide the highest levels of sound absorption.
Ambient Noise Levels	Noise levels measured in the absence of noise requiring control, frequently measured to determine the situation prior to the addition of a new noise source.
dB	Decibel. The logarithmic unit of sound level.
dBA	A-weighted decibel. The A-weighting approximates the response of the human ear.
$D_{nT,w}$	Weighted standardized level difference. A single number quantity of the sound level difference between two rooms. $D_{nT,w}$ is typically used to measure the on-site sound insulation performance of a building element such as a wall, floor or ceiling. Measured in accordance with BS EN ISO 16283-1 and weighted in accordance with BS EN ISO 717-1.
$D_{n,e,w}$	The weighted element-normalized level difference. A single number rating of the sound reduction provided by a sound passing through an individual element. $D_{n,e,w}$ is typically used to define the sound insulation provided by ventilators. Measured in accordance with BS EN ISO 10140-2:2010 and rated in accordance with BS EN ISO 717-1.
Flanking	Transmission of sound energy through paths adjacent to the building element being considered. For example, sound may be transmitted around a wall by travelling up into the ceiling space and then down into the adjacent room.
Frequency	Sound can occur over a range of frequencies extending from the very low, such as the rumble of thunder, up to the very high such as the crash of cymbals. Sound is generally described over the frequency range from 63Hz to 4kHz, roughly equal to the range of frequencies on a piano.
Impact Sound	Sound produced by an object impacting directly on a building structure, such as footfall noise or chairs scrapping on a floor.
$L_{Aeq,t}$	The equivalent continuous sound level measured in dBA. This is commonly referred to as the average noise level. "t" is the interval time for the measurement which is most often 30 minutes when demonstrating compliance with BB93.
$L_{A90,t}$	The noise level exceeded for 90% of the measurement period, measured in dBA. This is commonly referred to as the background noise level.
$L'_{nT,w}$	Weighted, standardized impact sound pressure level. A single number rating of the impact sound insulation of a floor/ceiling when impacted on by a standard 'tapper' machine. The lower the $L'_{nT,w}$, the better the acoustic performance. Measured in accordance with BBS EN ISO 140-7 and rated in accordance with BS EN ISO 717-2.
NR	Noise Rating. A single number rating which is based on the sound level in the octave bands 31.5Hz – 8kHz inclusive, generally used to assess noise from mechanical services in buildings.
Octave band	Frequencies are often grouped together into octaves for analysis. Octave bands are labelled by their centre frequency which are: 63Hz, 125Hz, 250Hz, 500Hz 1kHz, 2kHz and 4kHz.
Reverberation time (T_{mf})	Reverberation time is used for assessing the acoustic qualities of a space. It is defined as the time it takes for an impulse to decay by 60dB. T_{mf} is the arithmetic average of the reverberation time in the mid frequency bands (500Hz, 1k Hz and 2 kHz).
R_w	Weighted sound reduction index. A single number rating of the sound insulation performance of a specific building element. R_w is measured in a laboratory. R_w is commonly used by manufacturers to describe the sound insulation performance of building elements such as plasterboard and concrete. Measured in accordance with BS EN ISO 10140-2:2010 and rated in accordance with BS EN ISO 717-1
Sound Absorption	When sound hits a surface, some of the sound energy is absorbed by the surface material. Sound absorption refers to the ability of a material to absorb sound, rated from 0, complete reflection, to 1, complete absorption.
Sound Insulation	When sound hits a surface, some of the sound energy travels through the material. 'Sound insulation' refers to the ability of a material to prevent the travel of sound.
Structure-borne transmission	Transmission of sound energy as vibrations via the structure of a building.

APPENDIX A - SITE PHOTOS