



**ACOUSTIC CONSULTANTS LTD**  
*noise and acoustic specialists since 1987*

# Noise Impact Assessment

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Proposed Car School  
**Ysgol Gymraeg Ystalyfera - Phase 3**

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Reference: 8331/BL



| Client:                                                                           | Planning Consultant:                                                              | Acoustic Consultant:                                                               |
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## Document Control

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|         |                      |          |             |                |
|         |                      |          |             |                |

The report has been prepared in good faith, with all reasonable skill and care, based on information provided or available at the time of its preparation and within the scope of work agreement with the Client. We disclaim any responsibility to the Client and others in respect of any matters outside the scope of the above. The report is provided for the sole use of the named Client and is confidential to them and their professional advisors. No responsibility is accepted to other parties.

The report limits itself to addressing solely on the external noise aspects as included in this report. We provide advice only in relation to noise and acoustics. It is recommended that appropriate expert advice is sought on all the ramifications (e.g. CDM, structural, condensation, fire, legal, etc.) associated with any proposals in this report or as advised and concerning the appointment. It should be noted that noise predictions are based on the current information as we understand it and on the performances noted in this report. Any modification to these parameters can alter the predicted level. All predictions are in any event subject to a degree of tolerance of normally plus or minus three decibels. If this tolerance is not acceptable, then it would be necessary to consider further measures.



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## 1. Introduction

Andrew Scott appointed Acoustic Consultants Limited to undertake a noise impact assessment for the proposed redevelopment at Ysgol Gymraeg, Ystalyfera in support of a planning application.

This report addresses the noise impact of the school on the existing sensitive receivers around the site and provides outline mitigation measures as appropriate.

The noise impact assessment has been undertaken in accordance with the guidance in the Planning Policy Wales (PPW), Technical Advice Note 11 (TAN11), Building Bulletin 93 (BB93), British Standard 4142:2014 (BS4142), and British Standard 522-1:2009.

The brief was to monitor existing baseline noise levels, however due to the recent Covid-19 crisis, noise levels are not considered typical, and a survey would not be accurate. As such a desktop assessment has been completed at this stage. This report will be updated with survey data once the road traffic levels return closer to normal.

The author of this report is a Member of the Institute of Acoustics (MIOA) with over 12 years' experience in the field of noise and acoustics, whom as such is considered suitably qualified to undertake a noise assessment.



## 2. The Site & Development

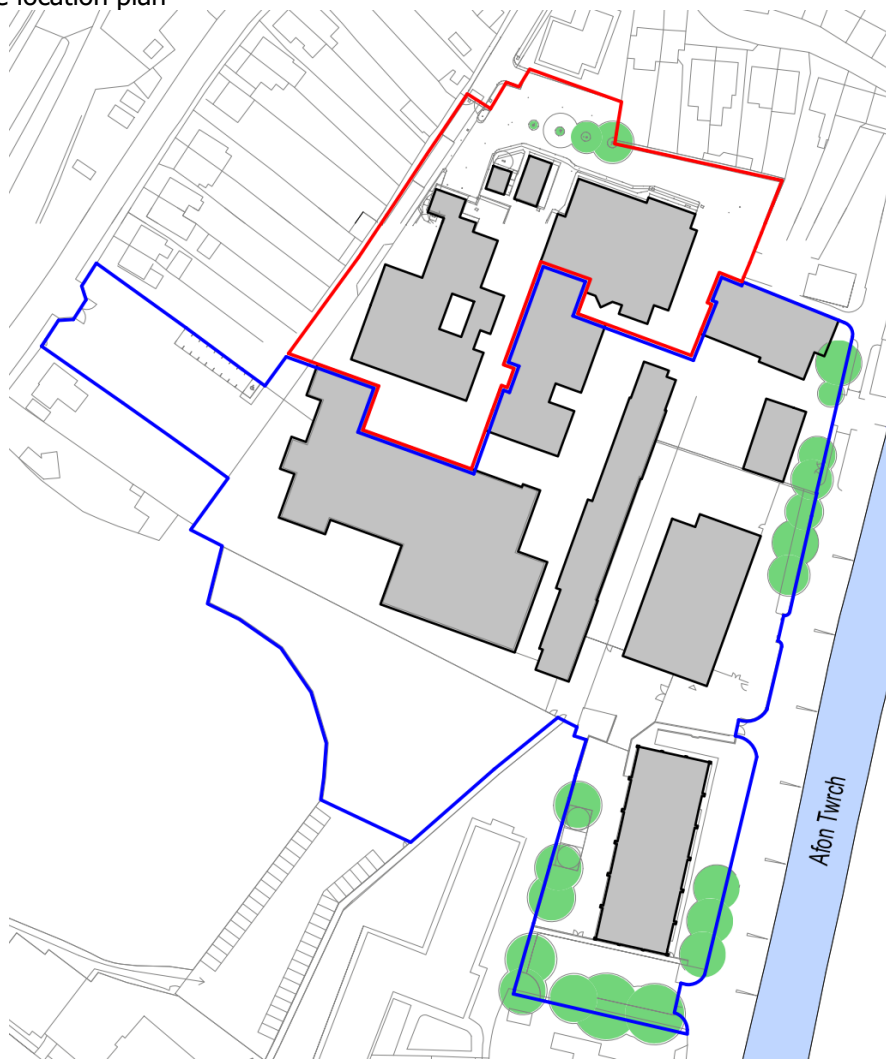
The development site is located within the existing Ysgol Gymraeg Ystalyfera school site on the north western boundary. The school site is bordered to the east by Glanyrafon Road, to the south by Ystalyfera Rugby and Football Club, and to the north and west by residential dwellings.

The development comprises of the proposed construction of a 2 storey teaching block at Ysgol Gymraeg Ystalyfera. The site is being redeveloped and this is Phase 3 of the developed. One of the earlier phases included the construction of a 2 storey block facing the Afon Twch under planning Planning Permission P2016/1090.

The Phase 3 proposals include for the demolition of existing buildings, rationalizing external circulation and creation of new teaching and performance spaces. The proposed development is to provide a Hall, Dining Hall, Changing Rooms, Music Classrooms, General Teaching Classrooms.

Figure 1 provides the site location:

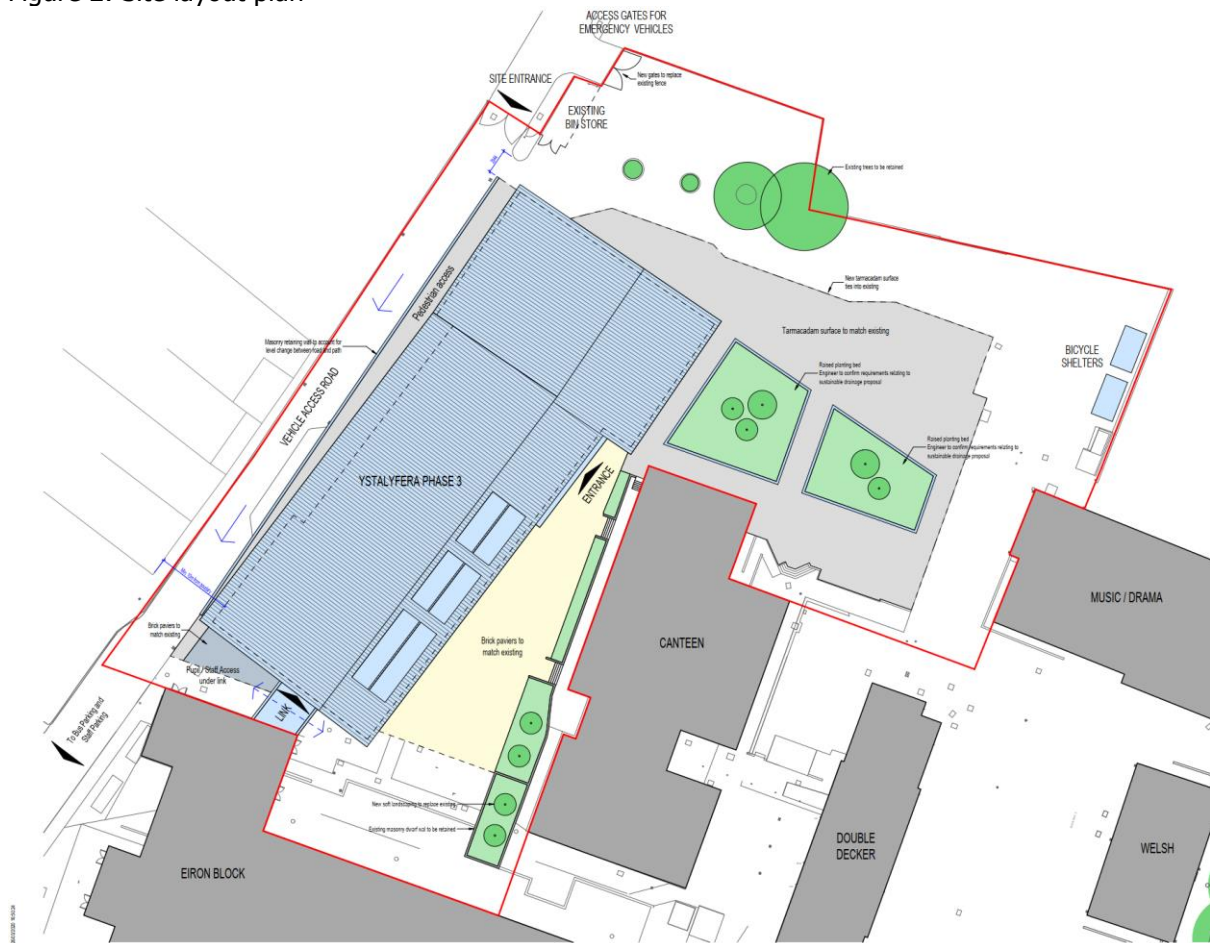
Figure 1: Site location plan





The proposed site layout is as follows:

Figure 2: Site layout plan





### 3. Planning & Noise

The following section outlines what are considered to be the more relevant criteria for the proposed development.

#### 3.1. Planning Policy Wales

Planning Policy Wales (PPW) Edition 10 dated December 2018 sets out the land use planning policies of the Welsh Government. Section 1 states:

*"1.1 Planning Policy Wales (PPW) sets out the land use planning policies of the Welsh Government. It is supplemented by a series of Technical Advice Notes (TANs), Welsh Government Circulars, and policy clarification letters, which together with PPW provide the national planning policy framework for Wales. PPW, the TANs1, MTANs2 and policy clarification letters comprise national planning policy."*

The most relevant statements for noise are provided in Section 6.7 and summarised below:

*"6.7.1 Clean air and an appropriate soundscape, contribute to a positive experience of place as well as being necessary for public health, amenity and well-being. They are indicators of local environmental quality and integral qualities of place which should be protected through preventative or proactive action through the planning system. Conversely, air, noise and light pollution can have negative effects on people, biodiversity and the resilience of ecosystems and should be reduced as far as possible."*

*6.7.6 In proposing new development, planning authorities and developers must, therefore:*

- address any implication arising as a result of its association with, or location within, air quality management areas, noise action planning priority areas or areas where there are sensitive receptors;*
- not create areas of poor air quality or inappropriate soundscape; and*
- seek to incorporate measures which reduce overall exposure to air and noise pollution and create appropriate soundscapes."*

*6.7.7 To assist decision making it will be important that the most appropriate level of information is provided and it may be necessary for a technical air quality and noise assessment to be undertaken by a suitably qualified and competent person on behalf of the developer."*



*6.7.14 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. In circumstances where impacts are unacceptable, for example where adequate mitigation is unlikely to be sufficient to safeguard local amenity in terms of air quality and the acoustic environment it will be appropriate to refuse permission. Location of Commercial, Industrial and other Potentially Polluting Development*

*6.7.17 The location of potentially polluting development adjacent to sensitive receptors will be unacceptable where health and amenity impacts cannot be minimised through appropriate design and mitigation measures. It is the overall expectation that levels of pollution should be reduced as far as possible and for this reason the location of potentially polluting development should be taken into account as part of overall strategies in development plans to ensure it can be appropriately located and maximum environmental benefits can be gained through measures such as green infrastructure.*

*6.7.21 Regard should be paid to current air quality and noise levels and the quality of the existing soundscape and account taken of any relevant local air quality action plan, noise action plan and/ or local or regional air quality strategy as part of development strategies and proposals in development plans and before determining planning applications. Soundscapes and Compatibility of Uses"*

PPW does not provide any quantifiable criteria and directs you to the Technical Advice Notes (TAN 11).

### **3.2. Technical Advice Note (Wales) 11 – Noise**

The relevant planning criteria for a proposed school development is provided in Technical Advice Note (Wales) 11 entitled "Noise" which was published in October 1997. The document introduction states that

*"3. This note provides advice on how the planning system can be used to minimise the adverse impact of noise without placing unreasonable restrictions on development or adding unduly to the costs and administrative burdens of business. It outlines some of the main considerations which local planning authorities should take into account in drawing-up development plan policies and when determining planning applications for development which will either generate noise or be exposed to existing noise sources.*

*4. Local authorities should adopt a corporate approach and ensure close co-operation between planning and environmental health departments when considering noise and noise generating developments."*

The school is considered both a noise generating development and a noise sensitive development.



TAN 11 states the following in relation to noise generating developments:

*"8. Local planning authorities must ensure that noise generating development does not cause an unacceptable degree of disturbance. They should also bear in mind that if subsequent intensification or change of use results in greater intrusion, consideration should be given to the use of appropriate conditions.*

*9. Noise characteristics and levels can vary substantially according to their source and the type of activity involved. In the case of industrial development, for example, the character of the noise should be taken into account as well as its level. Sudden impulses, irregular noise or noise which contains a distinguishable continuous tone will require special consideration. In addition to noise from aircraft landing and taking off, noise from aerodromes is likely to result from engine testing as well as ground movements. The impact of noise from sport, recreation and entertainment will depend to a large extent on frequency of use and the design of facilities. Advice on assessing noise and on factors to consider in relation to the major noise sources including roads, railways, airports, industrial and recreational noise and their measurement is given in Annex B."*

TAN 11 states the following in relation to Noise-sensitive development:

*"10. Local planning authorities should consider whether proposals for new noise-sensitive development would be incompatible with existing activities, taking into account the likely level of noise exposure at the time of the application and any increase that may reasonably be expected in the foreseeable future. Such development should not normally be permitted in areas which are, or are expected to become, subject to unacceptably high levels of noise and should not normally be permitted where high levels of noise will continue throughout the night."*

TAN 11 does not provide any noise limiting criteria for both external noise affecting a school and activities associated with a school affecting nearby noise sensitive receivers.

As such the following section outlines what are considered to be the more relevant criteria for the noise affecting the proposed development and sensitive receivers in the area.

### **3.3. School Buildings – BB93**

To assess the impact of external noise on the proposed educational use, the most important consideration is the effect of noise on teaching activities. New school buildings are addressed under Part E of the Building Regulations. The normal way of demonstrating compliance with the Approved Document is to comply with the performance standards of Building Bulletin 93 published by the Department for Education entitled "Acoustics design of schools: performance standards".

Table 1 of Building Bulletin 93 gives guidance on the internal ambient noise levels of the spaces. Primarily, this provides the required upper limit for internal ambient noise levels (IANL) due to external off-site sources and building services for different room types and different room volumes.

The basic descriptor used is the ' $L_{Aeq}(30 \text{ minutes})$ ' which is the average noise level over a time period of 30 minutes. Building Bulletin 93 requires an upper limit for internal ambient noise levels in each of the spaces as follows:

Table 1: Building Bulletin 93 Internal noise level criteria

| Room Type                                | Upper Limit for IANL<br>$L_{Aeq}(30 \text{ minutes})$ dB |
|------------------------------------------|----------------------------------------------------------|
| Primary School Teaching space, classroom | 35                                                       |
| Multi-purpose Hall                       | 35                                                       |
| Offices                                  | 40                                                       |
| Toilets and Changing Area                | 50                                                       |

In addition Building Bulletin 93 states:

*"In order to protect students from regular discrete noise events, eg, aircraft or trains, indoor ambient noise levels should not exceed 60 dB LA1, 30mins. This is achieved by default for spaces with IANLs up to 40 dB LAeq, 30min, but requires assessment in spaces with higher IANL limits, eg, 45 and 50 dB."*

In addition Building Bulletin 93 states that the noise level within a school playground should not exceed 55 dB  $L_{Aeq}(30 \text{ minutes})$  and there should be at least one area with noise levels below 50 dB  $L_{Aeq}(30 \text{ minutes})$  which could be used for outdoor teaching.

### 3.4. Fixed Plant Noise - British Standard 4142:2014

The main source of noise from a new school building on an existing school site is fixed plant noise. Fixed plant noise is assessed in accordance with British Standard 4142:2014 entitled 'Method for rating and assessing industrial and commercial sound'. The former version of BS4142 is referred to in TAN11, we consider it appropriate to work to the current version.

The methods described in the British Standard use outdoor sound levels to assess the likely effects of sound upon people who might be inside or outside a dwelling or other premises used for residential purposes. The principle is that of establishing the 'difference' between the 'rating sound level' and the 'background sound level'.

The 'rating sound level' is the specific sound level' of the source over a period of 1 hour during the day (07:00 to 23:00 hours) and over a period of 15 minutes during the night (23:00 to 07:00 hours). Section 9 entitled 'Rating Level' states:



*"Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, add a character correction to the specific sound level to obtain the rating level."*

An acoustic character correction should be added to the 'specific sound level' if it exhibits any tonality, impulsivity, other specific characteristics and/or intermittency at the assessment location. The value of the character correction varies, dependent on the prominence of the character of the noise source at the assessment location.

In Section 11 of the Standard, 'Assessment of the Impacts', it states:

*"Obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level (see Clause 8) from the rating level (see Clause 9), 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."*

As such, where the assessment difference is 0 dB or less, the impact is likely to be low, depending on the context.

### **3.5. Construction Noise – British Standard 5228-1:2009**

British Standard 5228-1:2009 entitled "Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise" provides guidance on the methods that can be used to predict and measure noise from construction activities and how to assess the impact on those exposed to it.

Annex E provides different methods of determining the significance of noise effects due to construction works. Annex E states:

*A pragmatic approach needs to be taken when assessing the noise effects of any construction project, i.e. the guidance provided below would generally only apply to projects of significant size, and lesser projects might not need to be assessed or might only require general consideration of noise effects and mitigation. Generally, the local planning authority, or a planning consultant experienced in these matters, will be able to advise as to the extent of the assessment that might be required."*



For the construction noise limits we have used the ABC method detailed of Annex E of British Standard 5228-1:2009.

The ABC method states that for the appropriate period (night, evening/ weekends or day) the measured ambient noise level ( $L_{Aeq(T)}$ ) without construction noise present is rounded to the nearest 5 dB. This is then compared with the cumulative  $L_{Aeq(T)}$  ambient noise and construction noise rounded to the nearest 5 dB.

If the total noise level exceeds the appropriate category value, then a significant effect is deemed to occur. The example thresholds for significant effects at dwellings are shown below and extracted directly from Annex E of British Standard 5228-1:2009.

Table E.1 Example threshold of significant effect at dwellings

| Assessment category and threshold value period<br>( $L_{Aeq}$ ) | Threshold value, in decibels (dB) |                          |                          |
|-----------------------------------------------------------------|-----------------------------------|--------------------------|--------------------------|
|                                                                 | Category A <sup>A)</sup>          | Category B <sup>B)</sup> | Category C <sup>C)</sup> |
| Night-time (23.00–07.00)                                        | 45                                | 50                       | 55                       |
| Evenings and weekends <sup>D)</sup>                             | 55                                | 60                       | 65                       |
| Daytime (07.00–19.00) and Saturdays (07.00–13.00)               | 65                                | 70                       | 75                       |

**NOTE 1** A significant effect has been deemed to occur if the total  $L_{Aeq}$  noise level, including construction, exceeds the threshold level for the Category appropriate to the ambient noise level.

**NOTE 2** If the ambient noise level exceeds the threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a significant effect is deemed to occur if the total  $L_{Aeq}$  noise level for the period increases by more than 3 dB due to construction activity.

**NOTE 3** Applied to residential receptors only.

<sup>A)</sup> Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.

<sup>B)</sup> Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.

<sup>C)</sup> Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

<sup>D)</sup> 19.00–23.00 weekdays, 13.00–23.00 Saturdays and 07.00–23.00 Sundays.

## 4. External Noise Affecting the School

### 4.1. Welsh Government Noise Modelling

The brief was to monitor existing baseline noise levels, however due to the recent Covid-19 crisis, noise levels are not considered typical, and a survey would not be accurate. As such a desktop assessment has been completed at this stage.

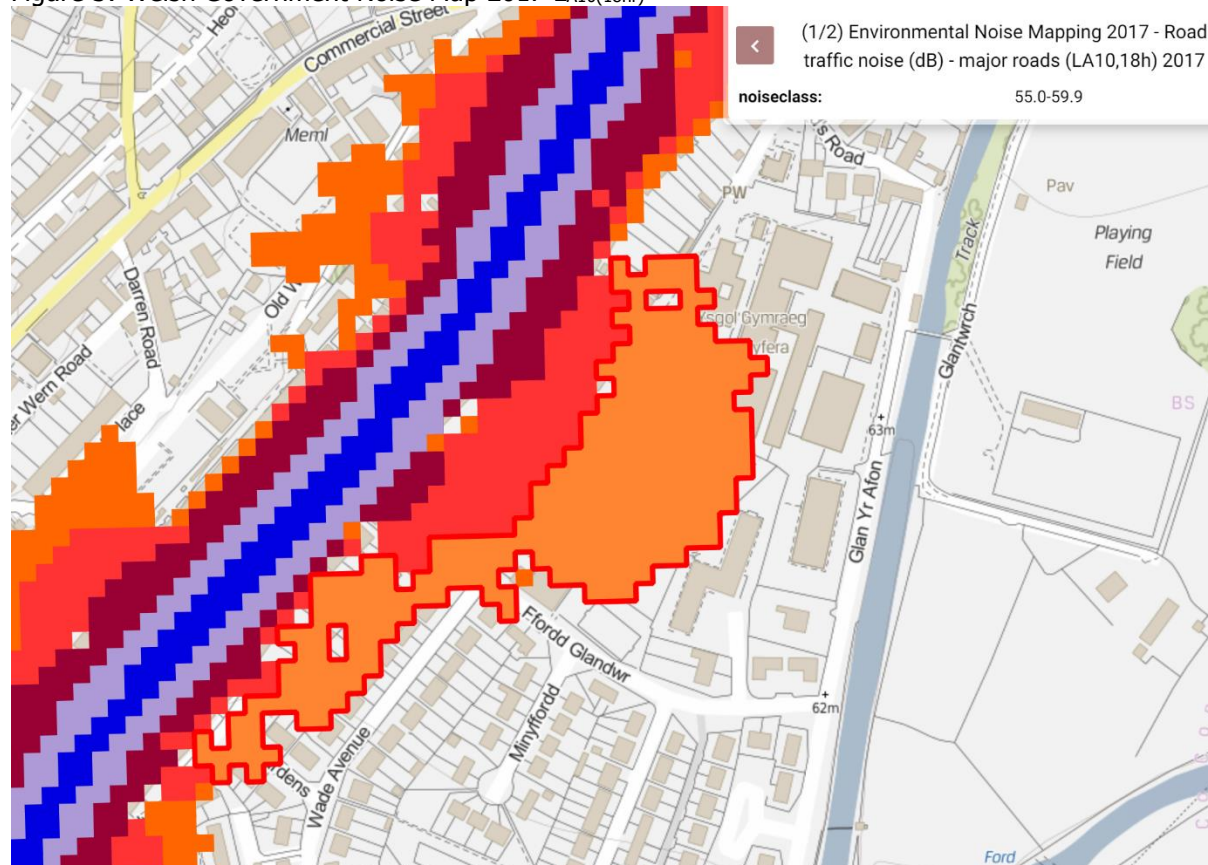
To assess the noise levels affecting the site there are many sources available to demonstrate the suitability of the site for its use. These include historic survey data (such as the survey completed by WSP under application P2016/1090) and Environmental Noise Mapping 2017 produced by the Welsh Government.

This noise mapping was produced under the Environmental Noise Directive required the Welsh Government to produce noise maps in 2017. The level reported in these noise maps is the  $L_{A10,18h}$  which indicates the average of the sound levels exceeded for 10% of each hour over the 18-hour period from 0600 to 2400.

The  $L_{A10(18hr)}$  noise modelling results are provided below:

The main source of noise is road traffic.

Figure 3: Welsh Government Noise Map 2017  $L_{A10(18hr)}$



## 4.2. Noise Levels Affecting the Development

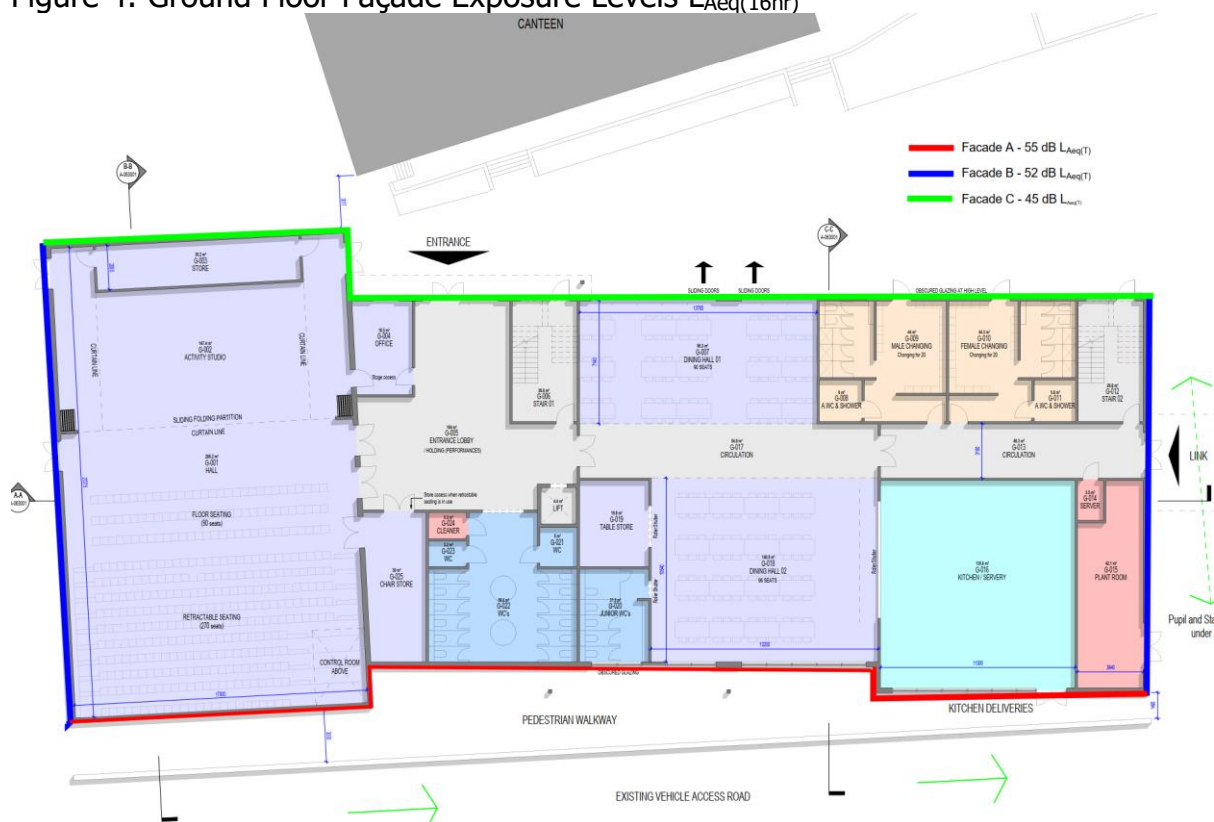
The levels noted above are  $L_{A10,18h}$ , to convert to a representative daytime level, 2 dB is subtracted from this data for the facades overlooking the roads when determining the external  $L_{Aeq}(16hr)$ .

For the north and south facades of the development, there will be an elements of reduced angle of view, and therefore 5dB is subtracted from the data to the rear when determining the external  $L_{Aeq}(16hr)$ .

For the rear of the development, there will be an elements of barrier attenuation, and therefore 12dB is subtracted from the data to the rear when determining the external  $L_{Aeq}(16hr)$ .

Therefore the following outline façade exposure levels have been determined:

Figure 4: Ground Floor Façade Exposure Levels  $L_{Aeq}(16hr)$



## 4.3. Building Fabric and Ventilation

### 4.3.1. External Wall Construction

The external wall construction technique is not known at this stage. Based on the low external noise climate, the development could be constructed using a number of techniques including masonry, light weight (SIPS, Steel/Timber Frame etc.) and easily meet the BB93 Internal Ambient Noise Level requirements.



#### 4.3.2. Glazing Construction

The external glazing and construction technique is not known at this stage. Based on the low external noise climate, the windows could comprise of a standard double glazed system such as 4mm glass, 12mm void, 4mm glass.

#### 4.3.3. Ventilation

With noise levels of this magnitude to achieve acceptable levels within the school, the building could be naturally ventilated. This would be on the basis BB93 allows a 5dB uplift over the criteria in Section 3.3 above with a naturally ventilated building.

##### ***Façade A***

It should be noted that on Façade A the ventilation will need to be a cross ventilation/roof ventilated solution and not openable windows. However this is based on the Welsh Government noise mapping results. We would expect that once the full survey is completed this could be reduced to a openable window solution.

The ventilation strategy will require appropriate design of façade openings, height differences between low and high level openings, corridor transfer vents/stacks, etc, to limit the required façade open areas appropriately.

Alternatively a Mechanical system (MVHR) or Natural ventilation system (NVHR). If this is the case, the ventilation system should achieve a sound level difference outside to inside of at least 30 dB(A). Noise from the MVHR system should also not exceed 35 dB  $L_{Aeq(30minutes)}$  within the rooms.

##### ***Façade B and C***

On these facades open window ventilation is acceptable. This is not expected to change with the survey results.

#### 4.4. Outdoor Areas

The predicted equivalent noise levels at locations representative of the playgrounds, playing fields and other outdoor areas is less than 50 dB  $L_{Aeq(30minutes)}$  and as such could be used for outdoor teaching if required.

Therefore no mitigation is required to the external teaching areas.



## 5. Plant Noise Limits for School

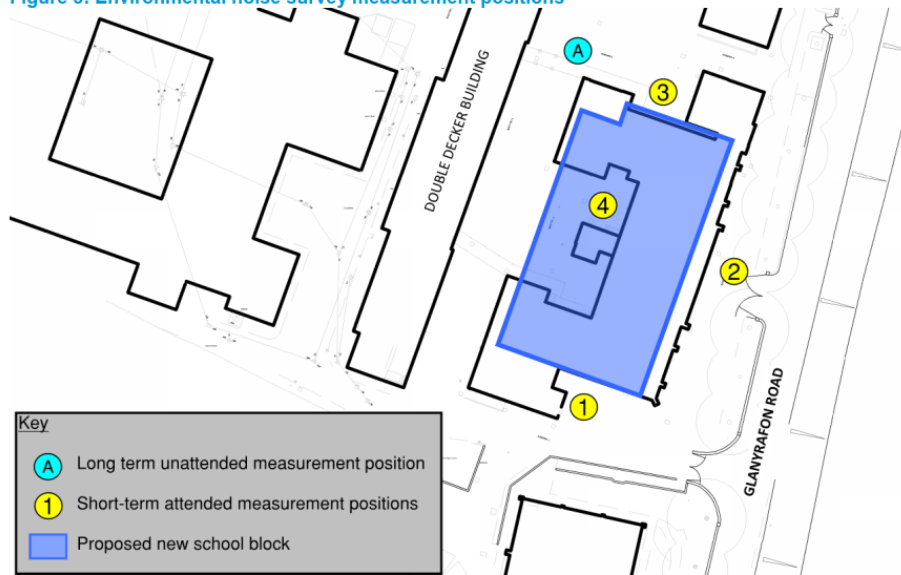
Noise from plant affecting nearby noise sensitive receivers will need to be suitably controlled. The criteria for plant is based on the assessment methodology of British Standard 4142:2014.

### 5.1. Noise Survey

A noise survey was completed WSP under application P2016/1090. The survey results are considered suitable for setting plant limits for the scheme. Extracts from the WSP report 70026148\_NSR\_Rev01 are provided below, with position A being the most suitable for these plant limits:

- 3.1.1 An environmental noise survey was carried at the site over a two day period commencing at 10:50 hours on Tuesday 25<sup>th</sup> October 2016 and finishing at 10:50 hours on Wednesday 26<sup>th</sup> October 2016.
- 3.1.2 During the time spent on site, it was noted that the noise climate was contributed to by:
- infrequent road traffic movements along Glanyrafon Road;
  - occasional distant aircraft;
  - low level occasional construction noise from adjacent school buildings;
  - water flow from nearby river (Afon Twrch) and occasional birdsong;
  - occasional sounds from pedestrians; and
  - low level plant noise from adjacent school buildings.
- 3.1.3 All noise measurement positions are indicated in Figure 3, and described in more detail below.

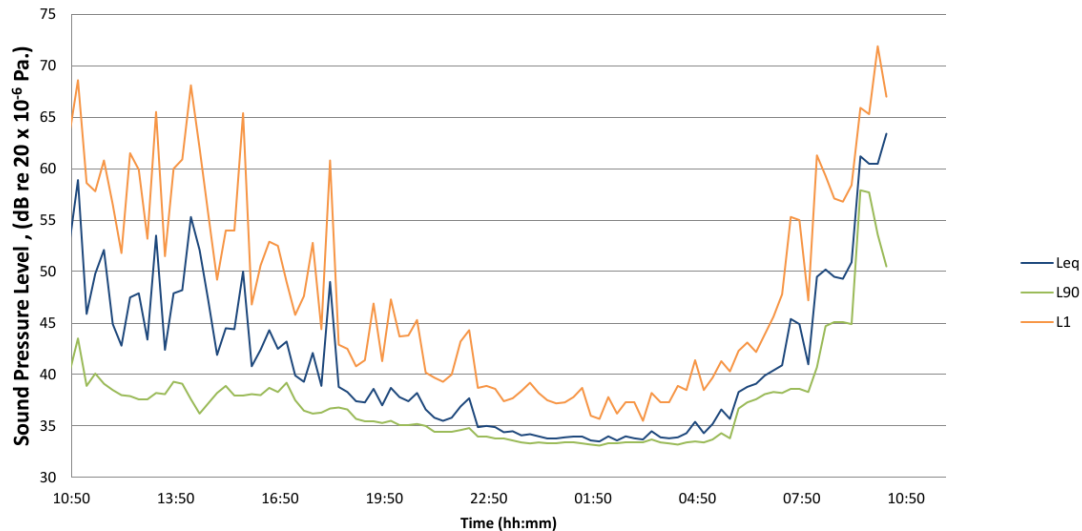
Figure 3: Environmental noise survey measurement positions



- 3.1.4 Unattended continuous measurements were undertaken at one location on site, namely:
- Measurement Position A
- Unattended monitoring between 10:50 hrs on 25<sup>th</sup> October and 10:50 hrs on 26<sup>th</sup> October 2016. The equipment was located within the playground of the main school site, shielded from road traffic movements on Glanyrafon Road by the existing school building.

A chart of the data is provided below:

Figure 5: Chart of WSP Data at Position A



## 5.2. Plant Noise Limits

Based on the above data the following noise limits are to be applied to plant associated with the school development and should be determined at the nearby noise sensitive residential properties.

Table 2: School Plant Noise Limits

| Time Period            | Plant Noise Limits                |
|------------------------|-----------------------------------|
| School Hours (7am-4pm) | 37 dB $L_{Ar(1\text{hour})}$      |
| Evening (4pm-11pm)     | 34 dB $L_{Ar(1\text{hour})}$      |
| Night-time (11pm-7am)  | 33 dB $L_{Ar(15\text{ minutes})}$ |

The plant location is not currently known and as such the most sensitive locations cannot be determined at this time. However a suitable planning condition could be placed on the scheme to limit plant noise levels at the noise sensitive residential properties.

The above plant noise limits are the cumulative plant noise limits at the most sensitive receivers around the site. With plant meeting the above limits the plant rating noise level will result in a "difference" of +0 decibels at the façade of the noise sensitive dwellings. A difference of +0 decibels is normally considered acceptable in planning terms and a British Standard 4142:2014 assessment.

The plant should be suitably designed to ensure it exhibits no features that require a "character correction". As such, noise from the plant should not exhibit any tonality, impulsivity, other specific characteristics and/or intermittency internally or externally to the nearest existing or proposed residents.



## 6. Construction Noise Limits

For the construction noise assessment we have used the ABC method detailed of Annex E of British Standard 5228-1:2009. The ABC method states that for the appropriate period (night, evening/ weekends or day) the measured ambient noise level ( $L_{Aeq(T)}$  without construction noise present) is rounded to the nearest 5 dB. This is then compared with the cumulative  $L_{Aeq(T)}$  of ambient noise and construction noise rounded to the nearest 5 dB.

If the total noise level exceeds the appropriate category value, then a significant effect is deemed to occur.

Based on the measured baseline equivalent noise levels (measured by WSP) and using the ABC method of British Standard 5228-1:2009, we would advise that noise from construction activities should not exceed the following limits at the sensitive receivers around the site:

Table 3: Construction Noise Limits

| Time Period                 | Construction Noise Limit         |
|-----------------------------|----------------------------------|
| Daytime (07.00 to 19.00)    | 65 dB $L_{Aeq}(12 \text{ hour})$ |
| Evening (19.00 to 23.00)    | 55 dB $L_{Aeq}(4 \text{ hour})$  |
| Night-time (23.00 to 07.00) | 45 dB $L_{Aeq}(8 \text{ hour})$  |

With construction noise meeting the above limits, construction noise is expected to be suitably controlled to within the British Standard 5228-1:2009 criteria.



## 7. Summary & Conclusions

Andrew Scott appointed Acoustic Consultants Limited to undertake a noise impact assessment for the proposed redevelopment at Ysgol Gymraeg, Ystalyfera in support of a planning application.

This report addresses the noise impact of the school on the existing sensitive receivers around the site and provides outline mitigation measures as appropriate.

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The brief was to monitor existing baseline noise levels, however due to the recent Covid-19 crisis, noise levels are not considered typical, and a survey would not be accurate. As such a desktop assessment has been completed at this stage. This report will be updated with survey data once the road traffic levels return closer to normal.

The assessment indicates the scheme can be naturally ventilated with standard glazing and construction techniques and outdoor areas can be used for teaching. Therefore the noise limits of BB93 can be met. This will need to be verified with further survey data after the health crisis. However this is not a requirements of planning and is a requirement of Building Regulations.

Noise limits from both plant associated with the development and construction have been provided. By these noise sources meeting these limits the impact is low in terms of the relevant standards and Planning Policy Wales



## 8. Appendix 1 – Glossary of Acoustic Terminology

*A-weighted sound pressure  $p_A$*  – value of overall sound pressure, measured in pascals (Pa), after the electrical signal derived from a microphone has been passed through an A-weighting network

*A-weighted sound pressure level,  $L_{pA}$*  – quantity of A-weighted sound pressure given by the following formula in decibels (dBA)

$$L_{pA} = 10 \log_{10} (p_A/p_0)^2$$

where:

$p_A$  is the A-weighted sound pressure in pascals (Pa);  
 $p_0$  is the reference sound pressure (20  $\mu$ Pa)

*Background sound level,  $L_{A90,T}$*  – A-weighted sound pressure level that is exceeded by the residual sound assessment location for 90% of a given time interval, T, measured using weighting F and quoted to the nearest whole number of decibels

*Break-in* - noise transmission into a structure from outside.

*Decibel (dB)* – The decibel is the unit used to quantify sound pressure levels. The human ear has an approximately logarithmic response to acoustic pressure over a very large dynamic range (typically 20 micro-Pascals to 100 Pascals). Therefore, a logarithmic scale is used to describe sound pressure levels and also sound intensity and power levels. The logarithms are taken to base 10. Hence an increase of 10 dB in sound pressure level is equivalent to an increase by a factor of 10 in the sound pressure level (measured in Pascals). Subjectively, this increase would correspond to a doubling of the perceived loudness of sound.

*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:

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

where:

$p_0$  is the reference sound pressure (20  $\mu$ Pa); and

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

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

*Façade level* – sound pressure level 1 m in front of the façade. Façade level measurements of  $L_{pA}$  are typically 1 dB to 3 dB higher than corresponding free-field measurements because of the reflection from the façade.



*Free-field level* – sound pressure level away from reflecting surfaces. Measurements made 1.2 m to 1.5 m above the ground and at least 3.5 m away from other reflecting surfaces are usually regarded as free-field. To minimize the effect of reflections the measuring position has to be at least 3.5 m to the side of the reflecting surface (i.e. not 3.5 m from the reflecting surface in the direction of the source).

*Octave and Third Octave Bands* – The human ear is sensitive to sound over a range of frequencies between approximately 20 Hz to 20 kHz and is generally more sensitive to medium and high frequencies than to low frequencies within the range. There are many methods of describing the frequency content of a noise. The most common methods split the frequency range into defined bands, in which the mid-frequency is used as the band descriptor and in the case of octave bands is double that of the band lower. For example, two adjacent octave bands are 250 Hz and 500 Hz. Third octave bands provide a fine resolution by dividing each octave band into three bands. For example third octave bands would be 160 Hz, 250 Hz, 315 Hz for the same 250 Hz octave band.

*Sound pressure level* – Sound pressure level is stated on many of the charts. It is the amplitude of the acoustic pressure fluctuations in a sound wave, fundamentally measured in Pascals (Pa), typically from 20 micro-Pascals to 100 Pascals, but commonly simplified onto the decibel scale.

*Sound reduction index,  $R$*  – laboratory measure of the sound insulating properties of a material or building element in a stated frequency band.

*Specific sound level,  $L_S = L_{Aeq,Tr}$*  – equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval,  $T_r$ .

*Structure-borne noise* – audible noise caused by the vibration of elements of a structure, the source of which is within a building or structure with common elements

*Rating level,  $L_{Ar,Tr}$*  – Specific sound level plus any adjustment for the characteristic features of the sound.

*Reverberation Time,  $T$*  – The reverberation time is defined as the time taken for a noise level in an enclosed space to decay by 60 dB from a steady level, once the noise source has stopped. It is measured in seconds. Often a 60 dB decay cannot be measured so the reverberation time is measured over a lesser range and corrected back to the time for a 60 dB drop assuming a constant decay rate. Common parameters are T20 (time taken for a 20 dB decay multiplied by three) and T30 (time taken for a 30 dB decay multiplied by two).

*Vibration Dose Value, VDV* – measure of the total vibration experienced over a specified period of time.



*Estimated Vibration Dose Value, eVDV* – estimation of the total vibration experienced over a specified period of time. This is usually based on the number of events and shortened measurement data.

*Weighted sound reduction index,  $R_w$*  – Single-number quantity which characterizes the airborne sound insulating properties of a material or building element over a range of frequencies. The weighted sound reduction index is used to characterize the insulation of a material or product that has been measured in a laboratory (see BS EN ISO 717-1).



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