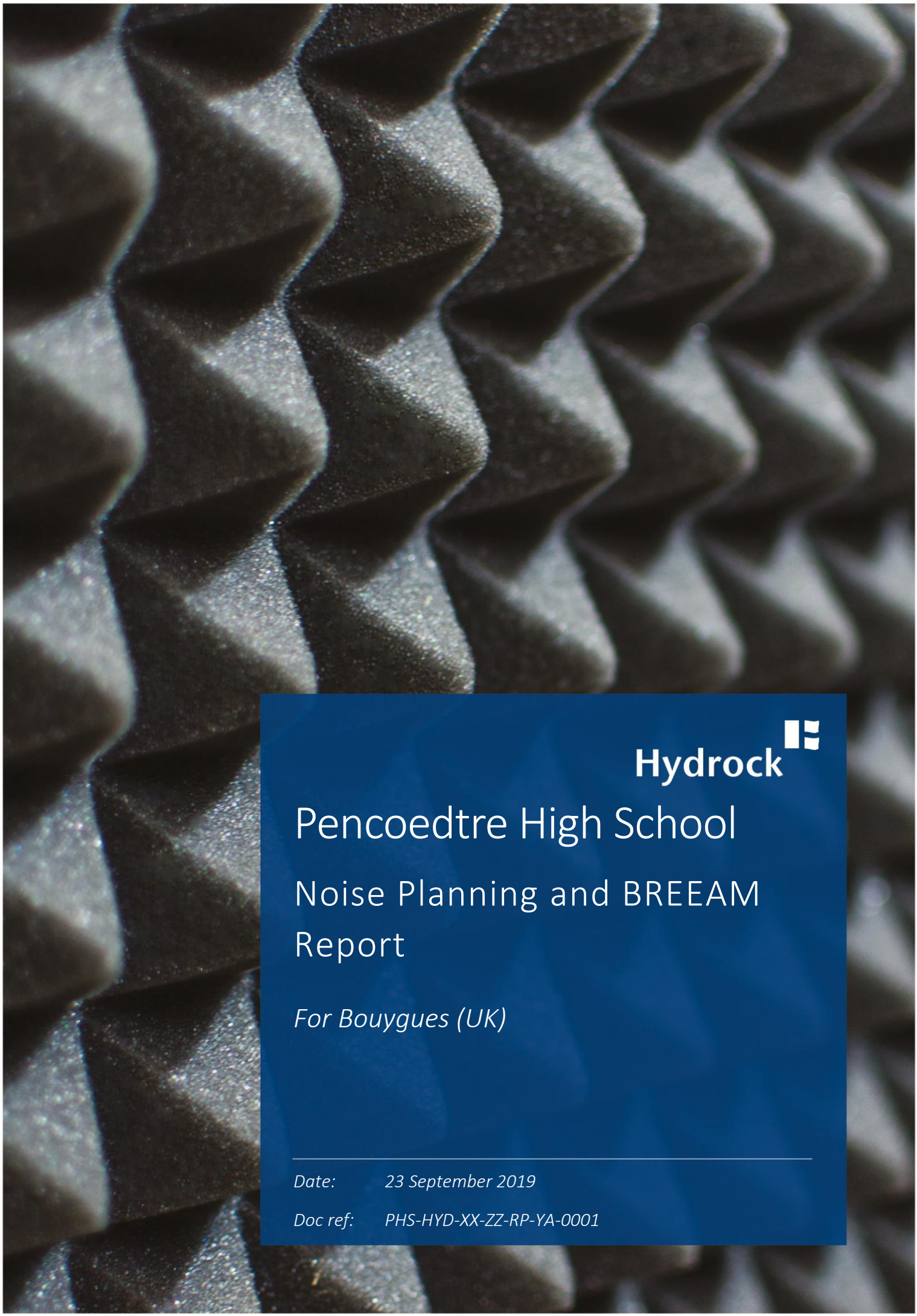

Hydrock

Pencoedtre High School

Noise Planning and BREEAM Report

For Bouygues (UK)

Date: *23 September 2019*

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Issued by	Hydrock Consultants Limited Merchants House North Wapping Road Bristol BS1 4RW United Kingdom	T +44 (0)117 9459225 E bristolcentral@hydrock.com www.hydrock.com
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1. INTRODUCTION

Hydrock have been appointed by Bouygues to provide acoustic consultancy services relating to the proposed development of a new school building for Pencoedtre High School, Barry. The existing school building will be demolished and a new building constructed to the south.

A noise survey at the site was originally carried out by Mach Acoustics for a previous scheme to redevelop the existing school building. Redevelopment is no longer proposed. However, the results of the previous noise survey have been referenced in this assessment. Additional noise measurements were made by Hydrock on the 18th April 2018 to assess background sound level at local residential properties. Following the initial version of this report an updated noise survey on the school site was carried out on the 27th June 2019.

This report provides the following:

- A summary of the results and methodologies of the noise surveys;
- An assessment of external noise levels affecting the school building in terms of BB93[1] and BREEAM Hea 05;
- Recommended noise mitigation in terms of building envelope sound insulation and the ventilation strategy;
- Plant noise limits for proposed building services in line with BREEAM Pol 05.

2. DESCRIPTION OF DEVELOPMENT

Pencoedtre High School is to the north of Barry. The existing school building is approximately 140m from Port Road (A4050). The existing school vehicle access is from Merthyr Dyfan Road. The school grounds are surrounded by housing and open fields. An aerial photograph of the existing school building and surrounding area is provided in Figure 1, below. The Hydrock noise survey location are also shown.

[1] Building Bulletin 93 (BB93): Acoustic Design of Schools - Performance Standards

Figure 1: Aerial photograph of site and surroundings showing noise survey locations

The proposed scheme comprised demolition of the existing school building and construction of a new three storey school building to the south. The new building will be approximately 200m from the A4050. The proposed site layout is provided in Figure 2.

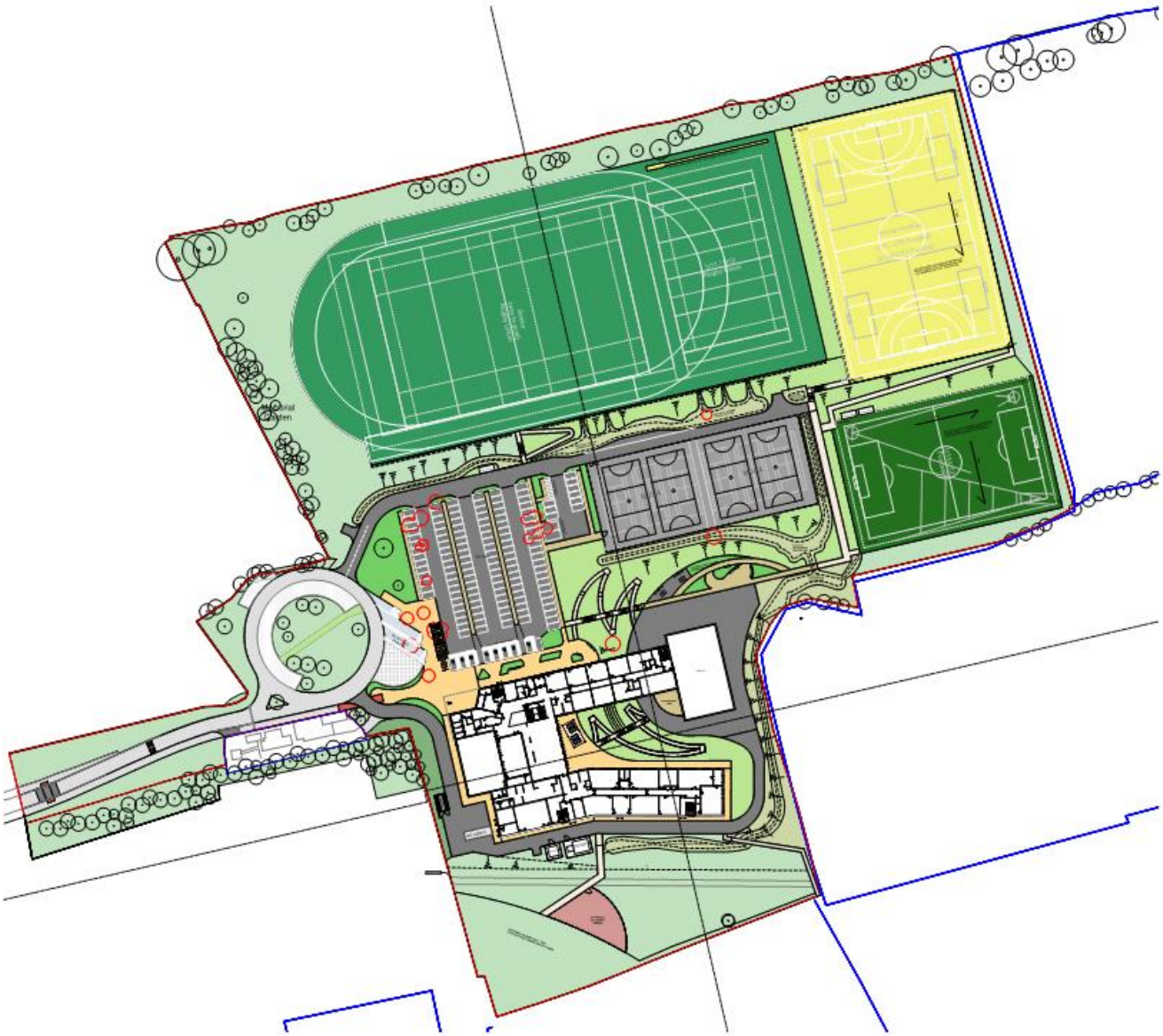

Figure 2: Proposed site layout drawn by HLM Architects

3. GUIDANCE - SCHOOL ACOUSTIC CONDITONS (HEA 05)

3.1 Building Regulations

Requirements for acoustic conditions within new school buildings are mandated by Part E of Schedule 1 to The Building Regulations 2010. Requirement E4 states:

> *"Each room or other space in a school building shall be designed and constructed in such a way that it has the acoustic conditions and the insulation against disturbance by noise appropriate to its intended use."*

Approved Document E (2015) provides further information on complying with the Building Regulations and includes the following statement:

> *"In the Secretary of State's view the normal way of satisfying Requirement E4 will be to meet the values for sound insulation, reverberation time and indoor ambient noise which are given in Building Bulletin 93 Acoustic*

> *Design of Schools: performance standards, published by the Department for Education and available on the internet at www.gov.uk".*

The performance standards described in BB93 should therefore form the basis for the acoustic design of new schools. Note, the Building Regulation apply only to spaces used for teaching and learning, from BB93:

> *"The Building Regulations are not intended to cover the acoustic conditions in administration and ancillary spaces not used for teaching and learning except where they affect conditions in neighbouring teaching and learning spaces"*

3.2 BREEAM Hea 05

There is a total of three credits available under BREEAM Hea 05 for achieving acoustic requirements in schools relating to the following:

- Sound insulation;
- Indoor ambient noise levels;
- Reverberation time.

All three credits can be targeted for the proposed school building. This report addresses internal ambient noise levels resulting from environmental noise and therefore relates to the second credit. From the BREEAM New Construction Scheme Document 2018 the criteria for the second credit are as follows:

> *"Achieve the indoor ambient noise level standards set out within Section 1 of BB93 for all room types."*

The other two credits also reference criteria from BB93. Therefore, all three BREEAM Hea 05 credits are generally achieved if the BB93 performance criteria are achieved. Note, the Building Regulations mandates only BB93 criteria that relate to teaching and learning spaces. However, the BREEAM Hea 05 credits will require all criteria from BB93 to be achieved, including those relating to ancillary spaces.

3.3 Building Bulletin 93 (BB93) Acoustic Design Criteria

BB93 acoustic design criteria are set in terms of the following:

- Internal Ambient Noise Levels
- Sound insulation
- Impact Sound Insulation
- Reverberation time
- Control of reverberation in circulation areas
- Rain noise.

More generally, the criteria can be classified in terms of internal noise levels, sound insulation and reverberation control. This report is concerned only with the impact of external noise on internal ambient noise levels.

Table 1 of BB93 lists indoor ambient noise level requirements. The requirements are set in terms of the equivalent continuous noise level (L_{Aeq}, dB). The L_{Aeq} is the equivalent steady-state noise level with the same energy as the actual time-varying noise over the measurement period. It can be considered the average noise level over the time period. The requirements for rooms relevant to this project are listed in Table 1 below.

Table 1: BB93 Indoor Ambient Noise Level (IANL) Requirements

Type of Rooms	Upper Limit for Indoor Ambient Noise Level (IANL) $L_{Aeq\ 30\ minutes}$, dB
Classroom, general teaching and seminar rooms	35
Atrium, circulation space (considered to include reception/admin)	45
Science Laboratory	40
Gym, Activity Studio	40
Music classrooms, practice rooms and performance/recital rooms	35
Individual study, quiet study, resource areas (LRC) and break out spaces	40
Drama studio, assembly hall, multi-purpose hall (drama, PE, audio/visual presentations, assembly, occasional music), performance and recital rooms.	35
D&T, Food Tech, Textiles, Art	40
Dining Hall	45
Sports Hall	40
Changing Area, Toilets, Kitchen (non-teaching)	50
Staff Room, Offices, Medical Rooms	40

BB93 states that for naturally ventilated classrooms, the internal noise level can be 5dB higher than the IANL (Table 1). With regard to this, BB93 provides guidance on external noise levels appropriate for single sided and cross ventilation via open windows. Where cross ventilation is provided window openings typically can be reduced and therefore greater levels of attenuation can be expected via the open window.

> *"Where external ambient free field noise levels at the facade expressed as the $L_{Aeq,30mins}$, do not exceed the IANL figures given in Table 1 by more than 16 dB for single sided ventilated spaces and 20 dB for cross ventilated or roof ventilated spaces, the criteria for natural ventilation can usually be achieved. However, the ventilation strategy still requires 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."*

Therefore, there are effectively external noise limits of 51 dB L_{Aeq} (35 dB L_{Aeq} + 16 dB) for single sided natural ventilation to standard classrooms and most other teaching rooms. For technology classrooms and less sensitive teaching rooms, the external noise limit is 56 dB L_{Aeq} (40 dB L_{Aeq} + 16 dB) for single sided natural ventilation. Where site noise levels exceed the noise limit for single sided ventilation, cross ventilation can be considered up to external levels of 55 dB L_{Aeq} for standard classrooms (35 dB L_{Aeq} + 20 dB) and 60 dB L_{Aeq} for technology classrooms (40 dB L_{Aeq} + 20 dB). The same limits would apply to specific hybrid systems. However, fan noise alone would have to achieve the IANL.

The BB93 IANL for the drama studio and multipurpose hall with (occasional) music is the same as for a standard classroom (35 dB L_{Aeq}). With the 5 dB relaxation for natural ventilation the internal noise limit could then be 40 dB L_{Aeq}. However, this may be sub-optimal for a large hall used as a theatre and designed for unamplified speech were lower masking noise levels are preferred to optimise speech intelligibility.

For the hottest 200 hours of the year (including the school summer holiday period) the noise limits can be relaxed to 5dB greater than the Table 1 values (to a maximum of 50 dB L_{Aeq}) for mechanical systems (under local control of the teacher) and 55 dB L_{Aeq} for natural or hybrid ventilation. The 55 dB L_{Aeq} relaxation is also allowable for intermittent boost for natural ventilation systems or hybrid systems where the "boost" is by opening windows. For mechanical systems or hybrid systems boosted by mechanical fans, the Table 1 value +5dB is allowable for boost mode.

4. GUIDANCE – NOISE IMPACT ON SURROUNDINGS (POL 05)

4.1 BREEAM Pol 05

A single credit is available under BREEAM 2018 Hea 05 for controlling the rating level of noise from fixed plant and equipment associated with the school to 5 dB below the measured background sound level in accordance with BS 4142:2014. Compliance can be demonstrated by a compliant noise assessment carried out by a suitably qualified acoustic consultant. A compliant noise assessment can be based on predicted or measured plant noise levels. It is too early in the development of the design to predict noise levels from fixed plant. However, this report provides plant noise limits which have been derived from the measured background sound levels and the Pol 05 requirement.

4.2 BS 4142:2014 – Assessment Principles

The standard method for assessing noise from mechanical plant at dwellings is British Standard BS 4142 "Method for rating and assessing industrial and commercial sound". A BS 4142 assessment is made by determining the difference between the specific noise under consideration and the background sound level as represented by the L_{A90} parameter, determined in the absence of the industrial or commercial noise. The L_{A90} parameter is defined as the level exceeded for 90% of the measurement time. Therefore, it represents the underlying noise in the absence of short-term events.

The plant noise is assessed in terms of the equivalent continuous noise level, L_{Aeq}. The equivalent continuous noise level, L_{Aeq}, is defined as the steady-state noise level with the same energy as the actual fluctuating sound over the same time period. It is effectively the average noise level during the period. For the daytime period, the assessment is made over a period of one hour and for the night, 15 minutes. However, for steady noise sources, such as most building service plant, the L_{Aeq} parameter is the same for any duration.

A character correction penalty can be applied to the specific noise level (L_{Aeq}) where the noise exhibits distinguishable tones, impulsiveness, intermittency or other characteristics which "are otherwise readily distinctive against the residual acoustic environment".

The specific noise level (L_{Aeq}) with the character correction (if necessary) is known as rating level, L_{Ar}, and the difference between the background sound level and the rating level is determined to make the BS 4142 assessment.

The standard then states:

> - *"Typically, the greater the difference, the greater the magnitude of the impact.*
> - *A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.*
> - *A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context*
> - *The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound 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 standard also highlights the importance of considering the context in which a sound occurs. The standard indicates that factors including the absolute sound level, the character of the sound, the sensitivity of the receptor and the existing acoustic character of the area should be considered when assessing the noise impact.

5. SURVEYS

To establish the existing environmental noise levels on site, a noise survey was carried out on the 16th May 2018 by Mach Acoustics. Full details of this survey are available in Mach Acoustics Pencoedtre High School Environmental Noise Assessment. The Mach report makes reference to BS 7445-2:1991 and appears to have been carried out to this standard. Measurements were undertaken at two locations, one close to the A4050 and one a similar distance from the road to houses on Glenbridge Close. The distance from the road of the A4050 measurement was not reported but from the provided photographs it is estimated this was approximately 8m from the curb.

Additional noise measurements were undertaken by Hydrock over the period 17th to 18th April 2018 at locations L1 & L2, shown on Figure 1, and on the 27th June 2019 at Locations L3, L4 & L5.

A Rion NL 52 Sound Level meter was used at L1 & L3. On both occasions this meter was left unattended to measure various noise parameters including L_{Aeq}, L_{A90} & L_{A01} in 5-minute intervals. Location L3 was approximately 8m from the curb of the A4050.

A Brüel & Kjær Type 2250 sound level meter was used at L2, L4 & L5. At L2, on the 18th April 2019, three 20-minute measurements were made at approximately 2m from the A4050 curb. A series of 5-minute measurements were made at L4 & L5 on the 27th June 2019. These measurement locations were approximately the same distance from the A4050 as the closest proposed school facades. The meter was attended for the duration of the measurements and was paused to exclude school activity noise and gusts in wind.

All meters were calibrated with a Brüel & Kjær Type 4231 calibrator before and after the measurement periods. Calibration drift was within normal tolerances. The surveys were carried out to the guidance within BS 7445-2:1991 and BS 4142:2014.

During measurements at L2, on the 18th April 2019, and during setup and collection of the meter at L1, the wind speed was below 5m/s and there was no precipitation. Cloud cover was almost total. Publicly available weather data from nearby Cardiff Airport shows light south westerly winds for the majority of the Hydrock survey, turning south east at approximately 09:00 on the 18th April 2018. There were some light and brief rain showers in the area but there is no indication that these affected the measured noise levels. Daytime temperatures were around 15°C.

During measurements at L3, L4 & L5, on the 27th June 2019, the temperature was approximately 15°C and there was no precipitation. Wind speeds at the microphone during measurements were below 5m/s although there were some gusts of stronger wind. The meter was paused to exclude gusts. The wind was from approximately 70°N (ENE).

6. SURVEY RESULTS

6.1 Road Noise Measurements

The reported results of the Mach Acoustics measurement position close to A4050 are reproduced in Table 2, below.

Table 2: Results of Mach Acoustics Noise Measurements Close to A4050 (Estimated 8m from curb)

Measurement Period	Measured Noise Level @ 8m
16/05/2018 09:00 - 09:30	72 dB L_{Aeq},30min
16/05/2018 09:30 - 10:00	72 dB L_{Aeq},30min
16/05/2018 10:00 - 10:30	72 dB L_{Aeq},30min

The results of the Hydrock noise measurements at 2m from the A4050 on the 18th April 2019 (L2) are presented in Table 3. For comparison with the Mach Acoustics measurements, the predicted noise levels at 8m are also presented. Note, the distance attenuation calculation is made as described in CRTN[2], taking account of geometric divergence only. The assumed source location is 3.5m in from the curb.

Table 3: Results of Hydrock Noise Measurements 2m from A4050 (L2)

Measurement Period	Measured Noise Level @ 2m	Predicted Noise Level @ 8m
18/04/2019 12:50 - 13:10	78 dB $L_{Aeq,20min}$	71 dB $L_{Aeq,20min}$
18/04/2019 13:20 - 13:40	79 dB dB $L_{Aeq,20min}$	72 dB $L_{Aeq,20min}$
18/04/2019 14:00 - 14:20	79 dB dB $L_{Aeq,20min}$	72 dB $L_{Aeq,20min}$

The results of the Hydrock noise measurements at 8m from the A4050 on the 27th June 2019 (L3) are presented in Table 4.

Table 4: Results of Hydrock Noise Measurements 8m from A4050 (L3)

Measurement Period	Measured Noise Level @ 8m
27/06/2019 10:00 - 10:30	73 dB $L_{Aeq,30min}$
27/06/2019 10:30- 11:00	73 dB $L_{Aeq,30min}$
27/06/2019 11:00- 11:30	73 dB $L_{Aeq,30min}$

There is good correlation between the Mach Acoustics and Hydrock survey results close to the A4050. Road noise measurements were consistently 1dB higher during the second Hydrock survey on the 27th June 2019.

6.2 Hydrock Survey on School Site

Noise levels ($L_{Aeq\ 5\ minutes}$) measured at location L4 during normal school teaching hours are presented in Table 5.

[2] CRTN Calculation of Road Traffic Noise (CRTN), 1988, Department of Transport, HMSO

Table 5: Summary of Noise Levels Measured at L4

Start Time	Measured $L_{Aeq, 5\ minutes}$, dB
27/06/2019 10:10	50.7
27/06/2019 10:15	51.3
27/06/2019 10:20	50.1
27/06/2019 10:25	49.8
27/06/2019 10:30	50.9
27/06/2019 10:35	51.1
27/06/2019 10:35	51.1
27/06/2019 10:40	49.5
27/06/2019 10:45	50.1
27/06/2019 10:50	49.4
Average	50.4

Noise levels ($L_{Aeq\ 5\ minutes}$) measured at location L5 during normal school teaching hours are presented in Table 6

Table 6: Summary of Noise Levels Measured at L5

Start Time	Measured $L_{Aeq, 5\ minutes}$, dB
27/06/2019 11:00	50.9
27/06/2019 11:10	51.1
27/06/2019 11:20	50.6
Average	50.9

Noise levels measured during the school day at L4 & L5 are below 51 dB L_{Aeq}. The dominant noise source was the A4050.

6.3 Background Sound Measurements

The Mach Acoustics report presented the lowest measured background sound level (L_{A90}) at a location estimated to be 100m from the A4050. The lowest predicted background sound level in the area was also presented. The measured and predicted background sound levels from the Mach Acoustics report are presented in Table 7.

Table 7: Background Sound Levels Presented in Mach Acoustics Report

Period	Lowest Measured Background Sound Level	Lowest Predicted Background Sound Level
Daytime	50 dB L_{A90}	42 dB L_{A90}

The result of the Hydrock noise monitoring at location L1 are presented in Table 8 in terms of the lowest and mode average $L_{A90, 5\ minute}$ for the day, evening and night-time periods.

Table 8: Results of Hydrock Background Sound Measurements (L1)

Period	Lowest Measured Background Sound Level	Average (mode) for Period
Day (07:00 to 19:00)	42 dB L_{A90}	45 dB L_{A90}
Evening (19:00 to 23:00)	33 dB L_{A90}	35 dB L_{A90}
Night (23:00 to 07:00)	26 dB L_{A90}	35 dB L_{A90}

The primary noise source at the measurement location was road traffic on the A4050. It is noted that the measurement interval was lower than the 15 minutes recommended under normal circumstances in BS 4142:2014. However, a shorter measurement interval will typically result in a lower background sound level and therefore a more onerous plant noise limit.

7. ASSESSMENT OF NOISE LEVELS AND IMPLICATIONS

Based on the measurements made by Hydrock at L4 & L5, school daytime noise levels at the road facing façades of the proposed school building are below 51 dB L_{Aeq}. The A4050 was noisier during these measurements than it had been during the other two surveys. Based on the measurements made on the 27th June 2019, it will be possible to use single-sided natural ventilation via openable windows for all accommodation shown on the current plans.

Some rooms intended specifically for students with Special Hearing and Communications Needs (SHCN) may require an alternative ventilation strategy unless positioned on the quieter side of the building. The current plans show SHCN rooms positioned on the quieter side of the building. Note, the definition of SHCN includes students with conditions such as Attention Deficit Hyperactivity Disorder (ADHD) and Autistic Spectrum Disorders (ASD).

It should be noted that environmental noise levels are on at the limit of acceptability for single-sided natural ventilation. If the wind were blowing directly from the road, noise levels could be slightly higher and the noise levels in teaching rooms would exceed the BB93 limits. Therefore, it is recommended to consider a cross-ventilation strategy. This would provide greater attenuation of external noise due to the smaller window openings required. Cross ventilation could be achieved with passive vents in the corridor partitions but attenuated vents would be required to limit sound transfer between corridor and teaching rooms.

8. PLANT NOISE LIMITS (POL 05)

Noise limits for fixed plant and equipment based on the requirements of Pol 05 and the average (mode) measured background sound levels at L1 are presented in Table 6, below. The noise limits in Table 5 are applicable to all receptors. Background sound levels at receptors in the vicinity of Glenbridge Close and Heol Leubren are likely to be higher than those measured at L1.

Table 9: Plant Noise Limits Applicable to all Receptors

Period	Average (mode) for Period	Pol 05 Plant Noise Limit
Day (07:00 to 19:00)	45 dB L_{A90}	40 dB L_{A90}
Evening (19:00 to 23:00)	35 dB L_{A90}	30 dB L_{A90}
Night (23:00 to 07:00)	35 dB L_{A90}	30 dB L_{A90}

The plant noise limits are in terms of the BS 4142:2014 rating level (L_{Ar}, dB). Therefore, a penalty may be applicable if noise from the proposed plant exhibits distinguishable tones, impulsiveness, intermittency or other distinctive characteristics. Building services plant is not typically tonal, distinctive or impulsive but some demand-controlled plant may be intermittent.

9. SUMMARY

Hydrock has carried out a noise survey at Pencoedtre High School to determine environmental noise levels effecting a proposed new school building and background sound levels at local receptors. The results are supplemented by measurements made by Mach Acoustics for a previous scheme at the same site. Measured noise levels have been used to advise on the ventilation strategy for the proposed school building and provide outline advice on achieving internal noise limits from BB93 as required by BREEAM Hea 05. Both surveys followed the principals of BS 7445-2:1991.

The results of the noise surveys have also been used to set plant noise limits in line with guidance from BS 4142:2014 and the requirements of BREEAM Pol 05. Further assessment will be required when plant selections are made.

The site is affected by noise from the A4050. Nevertheless, it will be possible to meet the internal noise limits from Building Bulletin 93 (BB93) “Acoustics Design of Schools” with open windows in all accommodation.