MAS ENVIRONMENTAL

Birchwood High School

Development of community artificial grass pitch, sports pavilion and cyclo-cross track

16th November 2020

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1.0 Introduction

1.1 MAS Environmental Ltd (MAS) were appointed by Wilby & Burnett LLP on behalf of Birchwood High School to provide a noise impact assessment for development of an artificial grass pitch (AGP), sports pavilion, pump track and cyclo-cross track. This report details the methodology undertaken to assess noise impact, summarises several environmental noise surveys undertaken to assess noise impact from the site and provides an assessment based on relevant standards, guidance and criteria.

1.2 The development site is located across from the main school site off Parsonage Lane on a field owned by the school. The field is currently used by the school for PE lessons and there is an existing cyclo-cross track around the outside of the field. The development site is bounded by an industrial site to the south and the school site to the north. To the west is Summercroft Primary School and residential development at Friars Wood and Birchwood Mews. To the east of the development site is Dunmow Road, a busy road and one of the main roads into the centre of Bishop's Stortford. Residential development also lies to the east of the site off Dunmow Road and Manor Links. An aerial view of the site is shown on Figure 1 below.

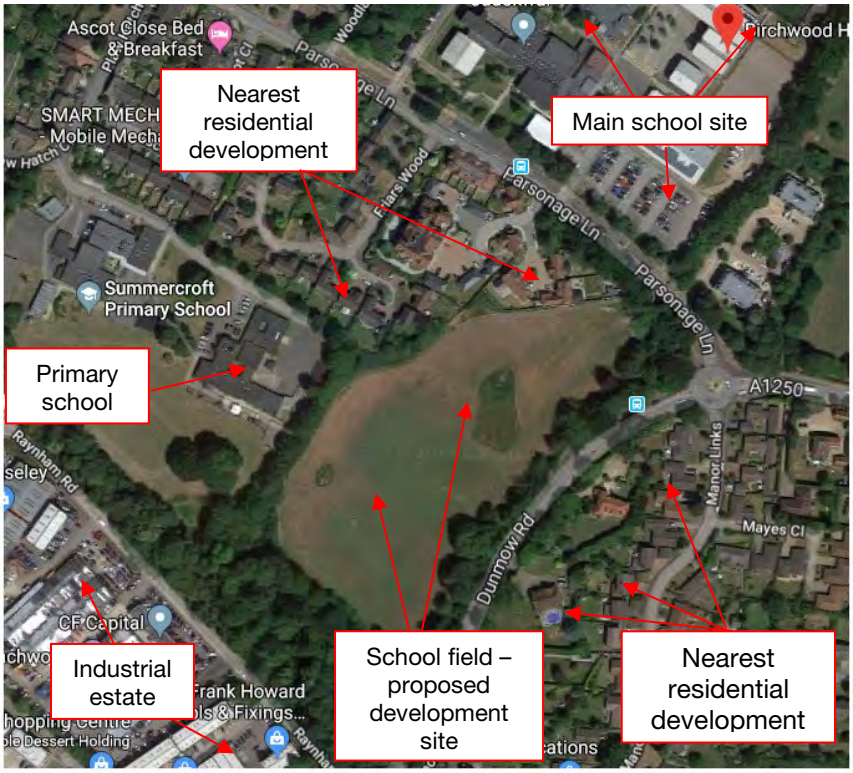

Figure 1: Aerial view of proposed development site and locale

1.3 Figure 2 and Figure 3 below show the layout of the proposed development, including pitch layout, the location of the pavilion, associated car parking, pump track and cyclo-cross track.

Figure 2: Site plan showing proposed AGP, three storey pavilion, pump track and cyclo-cross track

Figure 3: Visual representation of proposed development site

1.4 There are several sources of noise associated with development of the site and that have the potential to impact nearby dwellings. These have been addressed separately below and include:

- Noise associated with games activity on the pitch, e.g. football matches, shouts, ball kicks.
- Internally generated noise associated with the pavilion, e.g. music noise from events taking place in multi-purpose function rooms.
- Externally generated noise associated with the pavilion, e.g. plant noise.
- Noise associated with the car park, e.g. car door impact noise.
- Noise associated with the cyclo-cross / pump track, e.g. voices.

1.5 Environmental noise surveys have been undertaken both at the site and at nearby existing sports pitches in order to establish existing background and ambient sound levels and to obtain typical sound levels for activities likely to take place at the proposed development site. The proposed site is to be shared by Birchwood High School, the local community and by Bishops Stortford Football Club.

1.6 An environmental noise survey was undertaken at the proposed development site between 22nd and 28th May 2019. The aim of the noise survey was to establish typical existing background and ambient sound levels in the area. Additional attended monitoring was undertaken on 22nd and 28th May to obtain source levels for a typical PE lesson and community use of the AGP. Monitoring was undertaken of a Bishops Stortford Football Club match on 9th November 2019 to gain typical noise levels for match day activity.

1.7 The results of the noise surveys are presented in section 3 below. A noise impact assessment based on the results of the survey is provided in section 4 below. The following section provides a review of guidance and standards relevant in this case. This report focuses on noise impact at nearby residential development. Whilst Summercroft Primary School is within close proximity of the site, the use of the proposed development site during daytime (i.e. primarily by Birchwood High School) is unlikely to conflict with activity at the primary school or differ significantly from current activity undertaken at the site.

2.0 Guidance

2.1 There is no specific guidance that prescribes assessment of noise impact for games pitches and AGPs. The most commonly identified noise impact associated with AGPs is that of shouts and impact noises, for example balls hitting perimeter fencing. These types of impulsive noises are best assessed using the LAmax,f parameter rather than long term average levels and as such this report has also compared and contrasted guidance and standards relating to maximum level noise impact as well as average levels. Whilst average levels may be helpful in some cases they rarely relate to the cause of complaints from this type of noise and can underestimate impact when long term averages are used (for example over a 16 hour day).

2.2 Government guidance on the implementation of planning and noise policy can be found primarily in the online Planning Practice Guidance (PPG). The PPG refers to key planning and noise policy documentation including the Noise Policy Statement for England (NPSE) and National Planning Policy Framework (NPPF). [1] [2] [3]

2.3 The NPSE sets three core aims:

- Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.
- Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.
- Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

[1] Great Britain. Department for Communities and Local Government (2019) *Planning Practice Guidance*. London: TSO. Available from: http://planningguidance.planningportal.gov.uk/
2 Great Britain. Department for Environment and Rural Affairs (DEFRA) (2010) Noise Policy Statement for England. London: TSO
3 Great Britain. Department for Communities and Local Government (2019) National Planning Policy Framework. London: TSO. Available from: http://planningguidance.planningportal.gov.uk/

2.4 The NPPF adopts these values and reiterates the aim for planning policies and decisions to:

…enhance the natural and local environment by… preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution…

2.5 This should include mitigating and reducing to a minimum potential adverse noise impact from new development and should "avoid noise giving rise to significant adverse impacts on health and the quality of life".

2.6 Planning Practice Guidance (2014) (PPG).

2.7 Government planning guidance advises on how potential noise impacts can be managed in new development. The Planning Practice Guidance (PPG) refrains from setting guideline decibel values for the assessment of impact. It broadens the noise impact assessment approach to include, for example, consideration of impact in context and other relevant factors such as combining influencing factors affecting impact and the potential for noise mitigation. It notes that whilst noise can override other planning concerns it should not be considered in isolation.

2.8 The guidance states that noise impact should be determined by considering:

- whether or not a significant adverse effect is occurring or likely to occur;
- whether or not an adverse effect is occurring or likely to occur; and
- whether or not a good standard of amenity can be achieved.

2.9 Following from the principles set by the NPSE, government planning policy considers noise impact with respect to observed effect levels. The lowest level, "no observed effect level" is where noise exposure does not affect health and quality of life. The "lowest observed effect level" relates to the onset point of adverse effects on health and quality of life and the point at which noticeable changes are readily detectable. The "significant observed adverse effect level" is the point at which noise exposure results in significant adverse effects on health and quality of life and should be avoided. The effect levels are summarised in Table 1 below, taken from the PPG.

Table 1: Noise exposure hierarchy

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not present	No Effect	No Observed Effect	No specific measures required
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

2.10 The terms 'NOEL' and 'LOAEL' were historically applied to the noise and stress concept within research undertaken prior to 2002 and 2003. There is an absence of contemporary research into the principles of toxicology as now applied by the NPSE and PPG to noise and, particularly, non-transportation noise sources. It is therefore necessary to undertake a quantitative and qualitative assessment in cases of non-transportation noise impact i.e. considering acoustic factors such as decibel level along with non-acoustic factors such as regularity of impact, time of day and context related factors such as character of area, expectation of noise or expectation of freedom from noise etc.

2.11 The guidance notes that 'there is not a simple relationship between noise levels and the impact on those affected' and lists a number of factors that influence whether noise could be a concern including the time of day the noise occurs, spectral content of the noise and the general character of the noise. The PPG seeks that noise exposure should be identified as above or below the significant observed adverse effect level and the lowest observed adverse effect level.

2.12 World Health Organisation Guidelines (1999) (WHO 1999).[4]

2.13 The WHO 1999 guidelines provide general guidance for levels of community noise and specifically exclude impact from industrial noise and noise at work within its guideline values. The guideline values relate to critical health effects. The WHO guideline values for community noise have been adopted by guidance and this includes recommended noise levels for outdoor living areas. Levels of 55dB LAeq,16hour indicate the onset of serious annoyance during daytime and levels of 50dB LAeq,16hour indicate the onset of moderate annoyance. These values relate to the total noise in an area and not one specific source of noise and are based primarily on studies of transportation noise. They are directed at steady continuous sources of noise such as from road traffic.

2.14 Maximum noise levels (LAmax) and the number of maximum events are identified as forming an important part of assessment of human perception and impact:

A noise measure based only on energy summation and expressed as the conventional equivalent measure, LAeq, is not enough to characterize most noise environments. It is equally important to measure the maximum values of noise fluctuations, preferably combined with a measure of the number of noise events.

2.15 When setting guideline values the WHO guidance notes that annoyance depends on both the level of noise but also how that varies over time.[5] The guidance notes "For intermittent noise, it is emphasised that it is necessary to take into account both the maximum sound pressure level and the number of noise events".

[4] Berglund B., Lindvall T., & Schwela D.H., (eds) World Health Organisation (WHO) (1999) *Guidelines for Community Noise.* Geneva: WHO

5 Guidance by the WHO in 2000 to local authorities in Europe also identified the expectation of greater freedom from noise during the evenings and at weekends as well as the importance of non-acoustic factors.

2.16 The WHO has recently published revised guidelines for noise (2018). However, these guideline values relate to specific types of noise source such as transportation and wind farm noise and are not readily applicable in this case.

2.17 Sport England Design Guidance Note. Artificial Grass Pitch (AGP) Acoustics - Planning Implications.[6]

2.18 This Sport England guidance document provides advice for designing AGPs along with different methods for assessing impact from AGPs. The guidance refers to the WHO 1999 guidelines and the 50dB LAeq daytime level for preventing annoyance. Whilst the WHO value relates to a 16 hour average, and to the total noise level in the area from all sources, this guidance suggests that it could be applied for assessment of AGP noise though a shorter time period of one hour should be used. This Sport England guidance, which is based on the WHO 1999 guidelines, is undermined by advice in more recently published (2018) WHO guidance. The 2018 WHO guidance notes that the guideline values do not apply to noise from sources with specific characteristics. Furthermore, the WHO 1999 guidelines specifically limited these guideline values to steady continuous sources of noise.

2.19 The Sport England guidance also suggests comparing the AGP noise against the existing noise climate and references a change in noise levels of less than 3dB as a "slight impact". This statement is applied cautiously as it equates to a doubling of the sound energy but of sources of unequal impact. A typical free field level of AGP noise is provided in the guidance as 58dB LAeq,1 hour 10m away from the side line halfway marking. The guidance notes that the most significant sources of noise were from the voices of players. Other advice on modelling noise impacts and on mitigation (use of barriers and bunds) is provided.

2.20 Clay Target Shooting - Guidance on the Control of Noise (CIEH).

2.21 The CIEH clay target shooting guidance assesses noise from shoots over a continuous 30 minute period during shooting. The guidance relates to maximum impact noises and as such can be reasonably compared and contrasted with

[6] Sport England and Abacus Cost Management Ltd (2015). Artificial Grass Pitch (AGP) Acoustics - Planning Implications. London: Sport England.

the impact noises and shouts from an AGP. This guidance has also been used to assess impacts from similar sources such as skate parks, where the main noise impact is dominated by impulsive sounds such as bangs and shouts. Absent specific guidance on ball hits and shouts that create impulse noise, experience and observations indicates that the approach set out in this guidance (focus on maximum noise levels) provides a reasonably good mechanism for the assessment of this type of noise. It is adopted in this case as experience shows it is an effective measure of acceptability focussing on the character in the noise that intrudes.

2.22 Noise impact is well assessed by measuring short term LAeq (100ms or 125ms) levels, recognised as comparable to the LAmax parameter in the guidance, and using them to calculate the shooting noise level. Rather than a long term average level (LAeq,T) as used in other noise guidance, the CIEH guidance recognises the short and sharp onset of the noise, which draws attention, and as such recommends deriving a shooting noise level from the highest 25 shot levels measured during a 30 minute measurement period. This can be compared to the loudest shouts that in particular attract attention due to voice content.

2.23 The shot level is the maximum A weighted sound pressure level caused during the shot, which can also be described using the highest short term LAeq (100ms / 125ms) or LAmax,f value measured during the shot. The shooting noise level is the logarithmic average of the 25 highest shot levels. For a major shoot the shooting noise level (SNL) should not exceed 55dB where the background sound level is less than 45dB LA90, if planning permission is to be granted. [7] Annoyance caused by clay target shooting is highly likely to occur above SNLs of 65dB(A); annoyance is less likely to occur at levels below 55dB(A). This range is considered likely to provide comparative impact assessment and as stated has been applied in other forms of sport related noise including skate parks and artificial pitches.

[7] A major shoot is defined as operating for more than one day a week, having a number of stands and holding major events.

2.24 Institute of Acoustics Good Practice Guide on the Control of Noise from Pubs and Clubs. (IoA GPG).[8]

2.25 The guidance found in the IoA GPG is suitable for assessing impact and controlling noise affecting dwellings from public houses, clubs, hotels, discotheques, restaurants, cafes, community or village halls and other similar premises. This guidance document is of relevance for considering impact from music noise, for example amplified music played within multi-purpose function rooms proposed at the pavilion.

2.26 The GPG notes music, singing and speech as the main causes of noise disturbance and this relates normally to a cause of complaints. The GPG sets two main controls:

- for premises where entertainment takes place on a regular basis, music and associated sources should not be audible inside noise-sensitive property at any time. In the absence of the objective criteria mentioned in 2.3 of this GPG, what is regular should be determined on a local basis to reflect local expectations and it is recommended this should be incorporated by local authorities in their planning and enforcement policies.
- for premises where entertainment takes place less frequently, music and associated sources should not be audible inside noise-sensitive property between 2300 and 0700. For other times, appropriate criteria need to be developed which balance the rights of those seeking and providing entertainment, with those who may be disturbed by the noise.

2.27 The guidance further clarifies 'inaudibility' as:

...when it is at a low enough level such that it is not recognisable as emanating from the source in question and it does not alter the perception of the ambient noise environment that would prevail in the absence of the source in question...

2.28 The GPG describes various sources that may cause disturbance and sets out the responsibilities of those generating the noise including:

[8] Institute of Acoustics (2003). Good Practice Guide on the Control of Noise from Pubs and Clubs. St Albans: Institute of Acoustics. Whilst this document has been archived by the IoA it remains extant guidance and is extensively applied.

- establishment of procedures to assess potential for noise disturbance arising from operations
- establishment of monitoring systems to check on compliance with noise control procedures
- establishment of procedures and methods for recording and responding to any noise complaints
- provision of appropriate training to employees

2.29 BS4142: 2014 +A1:2019 - Methods for rating and assessing industrial and commercial sound. (BS4142).[9]

2.30 BS4142:2014 provides guidance for sound from industrial and manufacturing processes, fixed plant and equipment, loading and unloading of goods / materials at industrial or commercial premises and sound from mobile plant that is part of the overall sound emanating from the premises. The general contextual approach of the guidance is applied in a wide range of situations and can help to identify the impact of a noise source relative to the existing environment. It also includes assessment of noise with particular characteristics, such as tonality and impulsivity. It is of relevance in this case for assessing any plant noise associated with the pavilion.[10]

2.31 The assessment method of BS4142 involves comparing the level of source noise to the existing background sound environment. Typically, the greater the difference the greater the impact. BS4142 gives guidance on the significance of impact depending on the excess of the rated source noise (source level plus any penalties for noise character) over the background sound level (i.e. the difference) subject to the context of that difference.

2.32 In the case of commonly occurring noise, if the difference is around 5dB then this indicates adverse impact is likely to arise. If the difference is around 10dB or more then this indicates that significant adverse impact is likely to arise. The caveat to both of these determinations is that it depends on the context. Contextual considerations might include the absolute level of the sound, the

[9] British Standards Institution (2014) *BS4142:2014: Methods for rating and assessing industrial and commercial sound*. London: BSI.
[10] The standard is not intended to be applied to assessment of sound from recreational activities, music and other entertainment and people.

character and level of the residual sound compared to the character and level of the specific sound and the sensitivity of the receptor.

3.0 Assessment criteria

3.1 The nature of noise from an AGP is one that has distinguishable character and will draw attention due to associated users (speech) and other impulsive noise sources. Due to these attention drawing characteristics it will be more annoying at lower levels than a steady anonymous noise of the same decibel level, such as distant road traffic noise. However, unlike road traffic noise the noise impact from the AGP will not be constant and will be limited to certain times of the day. Thus, important periods of respite from noise will be available to nearby residents. There is also an expectation of necessity of impact from children's activities as part of schooling that is embedded in a community compared to other leisure activities, for example clay target shooting that impacts as a result of other's entertainment. This places the assessment of impact in context.

3.2 It is noted that the proposed AGP is replacing a previously used natural pitch and game's area that is currently used by the school for PE lessons. There is an existing cyclo-cross track at the field currently used by the school. The site also borders a primary school which, as witnessed during equipment set up, also has periods of outside play scheduled throughout the day. As such there is a history of games activity and school associated sources of noise at the site. Noise from the AGP use will not be a new noise source to the area and its location within the school grounds means that it is not an alien or incongruous noise source for this environment. There will be some expectation of this type of noise from existing residents due to both its existence and as an integral part of a community.

3.3 An important consideration of residents historically is greater freedom from noise at weekends and during evenings in general. For people who are retired from active employment this is less well defined but the norms of society currently remain with a noisier working week and less activity at weekends.

3.4 In terms of environmental sources such as traffic noise, different weightings can be applied to evenings but no distinction is made for weekends or neighbourhood sources. Additionally our society is constantly evolving with Sunday trading now a norm impacting dwellings adjacent major supermarkets and shopping complexes where historically this did not arise and schools rarely now are limited to use Monday to Friday. Similarly sporting uses during evenings is common. In cases, people will find aspects of noise unwanted and

unexpected and others may see them as positive elements of society or arising from something they enjoy. Many enjoy the sound of children's voices at play and others may find it intrusive subject to how often and how loud.

3.5 As a consequence of modern expectations important issues in relation to noise could be summarised as:

- ensuring levels are reasonable and not excessive or exceptional having regard to its nature and character;
- ensuring sufficient respite from noise intrusion when balancing the competing needs of society and the individual;
- preventing the loss of key requirements of the home for sleep, rest and relaxation; and,
- avoiding noise becoming an unreasonable stressor / annoyance which prevents normal use of the home.

3.6 The noise criteria applied to this proposed development are applied with these considerations in mind.

3.7 This noise impact assessment has focused on maximum levels of noise impact, for example from shouts and ball impact noises. This is often quoted as the primary source of complaints from AGPs. Average levels have also been assessed but are considered a less reliable indicator of acceptability. The criteria used to assess average and maximum noise is set out below.

3.8 Average noise

3.9 The average noise level of the AGP should be within 0-3dB of the ambient sound environment. This is based on the recommendation of the Sport England guidance that states that the ambient sound environment should not increase by more than 3dB. The existing sound environment, in the absence of activity from nearby schools, is dominated by air traffic and local road traffic. This creates a fairly constant and consistent level of masking noise in the area.

3.10 Maximum noise

3.11 In relation to guidance from the CIEH on shooting noise levels, where background noise levels are below 45dB LA90 the shooting noise level (SNL) for

major shoots should not exceed 55dB. [11] As detailed below background sound levels in this case are in the region of 43-48dB LA90,1hour. It is noted that the guidance states that annoyance is highly likely to occur above SNLs of 65dB(A) and less likely to occur at levels below 55dB(A). This suggests a sliding scale of acceptability. Where possible the average of the highest maximum noise events from the AGP, i.e. following the CIEH protocol, should be reduced to 55dB(A) or lower. This averaged maximum value ties in with a recommendation not to regularly exceed 60dB LAmax,f which has long been used by MAS for these types of activity. The premise of the MAS criteria is that it should not be frequently exceeded as above these levels the intrusion can be excessive.

3.12 Maximum noise levels should not therefore regularly exceed 60dB LAmax,f at nearby residential development. This is slightly higher than values used for prevention of night time sleep disturbance. Higher levels are acceptable to reflect that the AGP is not to be used at night time but use is restricted to daytime and evening hours. Sleep disturbance arises due to unconscious reactions to noise triggering an awakening. This mechanism is clearly not operative daytime. The issue is not therefore, one of causing an awakening but ensuring the noise does not stand out disproportionately in the sound environment or reach a level that regularly draws attention.

[11] A major shoot is considered to one that operates for more than one day a week, having a number of stands and holding major events. Guidance on shooting noise is considered in this case as it is a similar impulsive, maximum type of noise source like that of a ball kick or shout.

4.0 Environmental noise surveys

4.1 Background and ambient sound levels

4.2 An environmental noise survey was undertaken between 22nd and 28th May 2019. The aim of the noise survey was to establish existing background and ambient sound levels in the area. The survey was also used to gain source level measurements for PE lessons and community use of the AGP.

4.3 Both site visits confirmed the sound environment in the area to be typical of a suburban soundscape close to transportation networks. Key noise sources included local and distant road traffic noise as well as aircraft noise (Stansted Airport is approximately 3km to the west of the school).

4.4 A type 1 sound level meter (Norsonic 140) and all weather enclosure was set up at the proposed development site and set to record the 100ms LAeq, 100ms third octave bands, period (1 hour) LAeq and LA90 and high quality audio. The equipment was calibrated at the beginning and end of the survey and no significant drift (+/-0.5dB) was observed. The location of the equipment (see red square) and a photograph of the equipment in situ is shown in Figure 4 below.

Figure 4: Location and photograph of noise monitoring equipment in situ

4.5 The weather during the survey was predominantly dry, warm and with low wind speeds. Audio recordings confirm a lack of contamination from wind or rainfall. The wind was generally from a westerly direction, placing the monitoring location upwind from the nearby A1250 (Dunmow Road) and also upwind from the A120 and M11. This wind direction will result in lower typical ambient and background sound levels, which are generally dictated by local and distant road traffic noise, compared to downwind conditions (easterly wind directions). This is to be compared to predictive modelling (see section 5.0 below) that applies downwind circumstances. This assessment therefore presents a typical worst case approach. When background sound levels are higher under downwind conditions, there will be a greater level of masking noise reducing impact from the proposed AGP.

4.6 A global overview of the measured background and ambient sound levels is shown in Figure 5 below. A typical diurnal variation is observed.

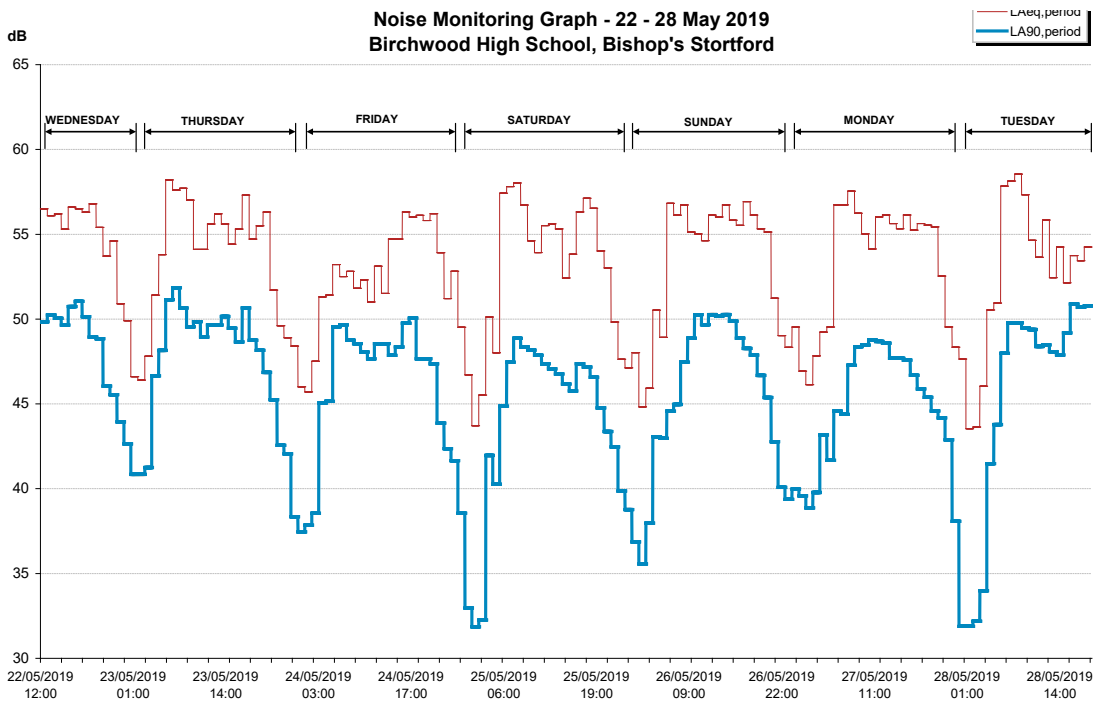

Figure 5: Global overview of measured noise levels during survey 22nd – 28th May 2019

4.7 The AGP will largely be used during daytime and evenings. During daytime background and ambient levels are typically higher than during the evening when noise levels tend to reduce with less road traffic noise following rush hour.

4.8 The two figures below show the distribution of background and ambient sound levels during daytime (Figure 6) and evening (Figure 7) as measured during the survey. Daytime has been taken as 07:00 – 19:00 and evening as 19:00 – 23:00. This statistical analysis of the data facilitates determination of a typical background and ambient sound level for the area.

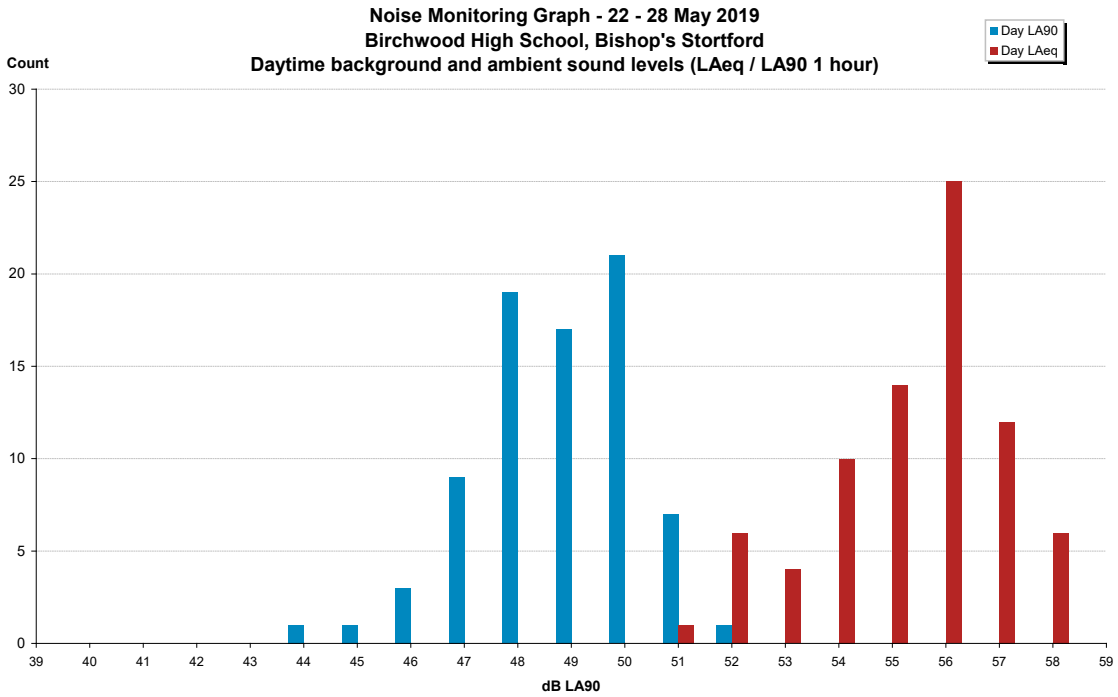

Figure 6: Statistical analysis of daytime background and ambient sound levels 22nd – 28th May 2019

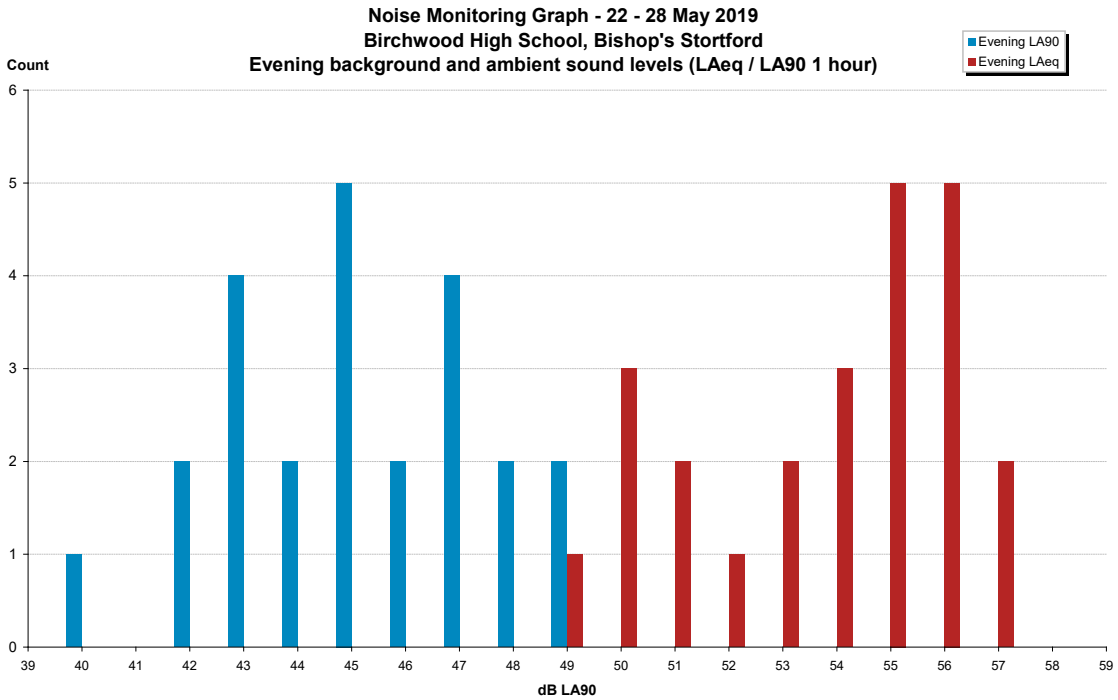

Figure 7: Statistical analysis of evening background and ambient sound levels 22nd – 28th May 2019

4.9 For the purposes of this assessment typical daytime background and ambient sound levels are taken as 48dB LA90,1 hour and 56dB LAeq, 1hour respectively. Typical background and ambient sound levels during the evening are taken as 45dB LA90,1 hour and 55dB LAeq, 1hour respectively.

4.10 Background sound levels are generally lower at ground floor level than at upper floor levels. This arises for a number of reasons but primarily ground absorption is greater for sound waves travelling nearer the ground and there is generally more near ground screening of sources. As a result, typically at first floor level, ambient and background levels commonly increase about 2dB(A) and will start to decline at much greater heights. [12]

4.11 Whilst lower ground level background sound levels were measured in the region of 43dB LA90, 1hour this was generally found in the hour between 22:00 and 23:00. It is recommended that the AGP is not used after 21:00 providing added respite.

4.12 Attended noise monitoring 22nd May 2019

4.13 A PE lesson was monitored before equipment set up on 22nd May. Figure 8 below shows the location of the PE lesson area, the monitoring location and nearby residential dwellings.

4.14 During the PE lesson there was significant noise from the outside play area at the primary school, including shouts, screams and general chatter. This was often indistinguishable from the noise generated by the PE lesson. A 20 minute extract from the PE lesson is shown in Figure 9 below. Key sources of noise are labelled on the graph. Maximum levels from shouts, screams and whistles were in the region of 73dB LAmax,f and generally in the region of 60-70dB LAmax,f at the measurement microphone. The average level for the period was 59dB LAeq,20min. In the absence of noise from the PE lesson the average level was 58dB LAeq. This indicates that the PE lesson adds minimally to the overall average level and that the dominant noise was from the primary school.

[12] Based on historical and current MAS surveys simultaneously measuring ground and first floor noise levels.

Figure 8: Location of attended monitoring of PE lesson 22nd May 2019

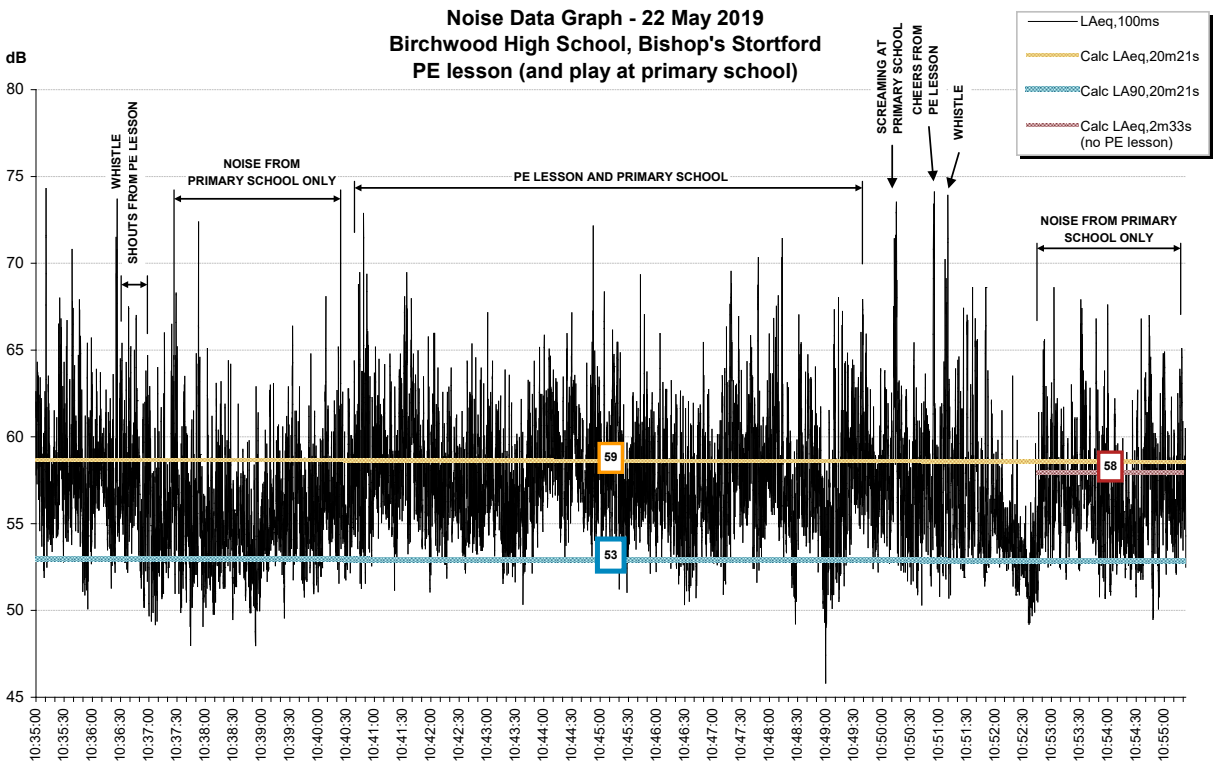

Figure 9: Extract from attended monitoring of PE lesson 22nd May 2019

4.15 The monitoring location was closer to the source(s) of noise than the nearest residential dwellings and there will be some afforded reduction in noise levels

due to distance. Assuming simple distance attenuation of a point source, the expected levels at nearby residential dwellings can be expected to be in the region of 5dB lower. Based on this level of reduction maximum levels could be expected to be in the region of 68dB LAmax,f as a worst case, in the region of 55-65dB LAmax,f more generally and average levels of 53-54dB LAeq,T.

4.16 Attended noise monitoring 28th May 2019

4.17 In order to gain representative source levels for modelling the proposed AGP, an adult men's football training session was monitored at the existing AGP at the school. Figure 10 below shows the monitoring location and the pitch area where the training session was taking place. There were approximately 14 people using the pitch closest to the monitoring location. Training sessions were also taking place during the monitoring on the other two pitches. Approximately 14 people were using the middle pitch and approximately 6 people using the end pitch furthest away from the monitoring location. The measured noise levels were dominated and dictated by the training session taking place closest to the monitoring location.

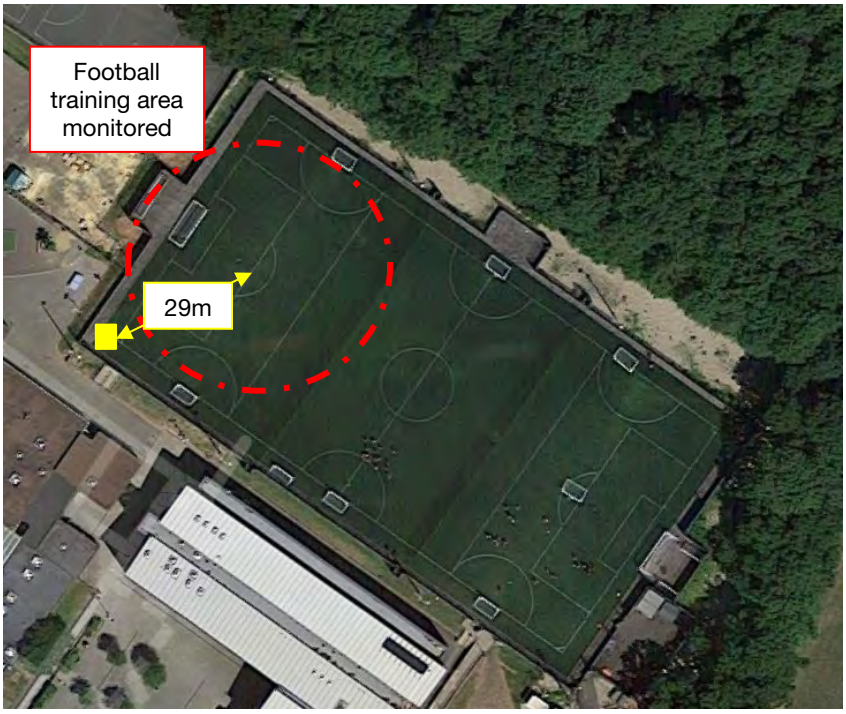

Figure 10: Location of attended monitoring of men's football training session 28th May 2019

4.18 An overview of the monitoring is shown in Figure 11 below. The average level over the 30 minute period monitored was 63dB(A). Maximum levels were measured in the region of 65-78dB LAmax,f. The higher maximum levels were

caused by the ball hitting the fence; however, this occurred infrequently only two or three times during the 30 minute period and not at all from the activity taking place on the other two pitches in use.

4.19 During the monitoring other sources of noise included planes landing and taking off at Stansted Airport, which dominated noise levels for short periods on approximately seven occasions throughout the 30 minute period. Shouts and impact noises from the football training session remained clearly audible above the plane noise. However, additional noise generated by planes has not been deducted from the overall average noise level. This therefore presents a worst case and robust assessment approach.

4.20 The average level for the period shown below, including some noise from planes, has been used to model impact from community use of the proposed AGP. Maximum noise levels have similarly been used to predict impact from the proposed AGP based on a typical level shout, worst case level shout and ball kicks.

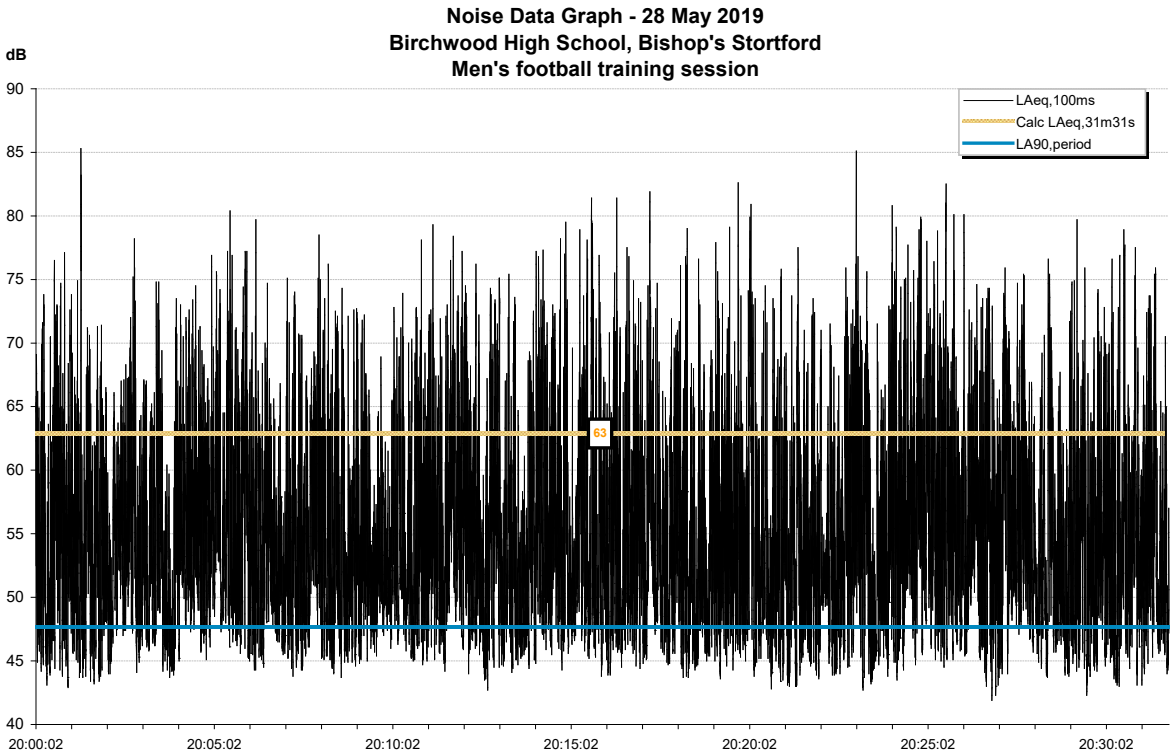

Figure 11: Extract from attended monitoring of men's football training session 28th May 2019

4.21 Attended noise monitoring 9th November 2019 – Bishops Stortford FC

4.22 Attended noise monitoring was undertaken on 9th November in order to gain typical noise levels generated by a Bishops Stortford Football Club official match. Two class 1 sound level meters were used to measure noise levels at the pitch edge. A sound level meter was located approximately 68m from the centre of the pitch for the duration of the match. A second meter was located 38m to the north of the centre of the pitch during the first half and then approximately 40m to the south of the centre of the pitch during the second half.

4.23 The weather during the first half was dry, little / no wind and cold. During the second half light rainfall began and lasted until the end of the match. The measured noise levels for the first half of the match are relied on for assessing noise impact in this case. Figure 12 below shows an aerial view of the pitch and the monitoring locations used during the survey.

Figure 12: Location of attended monitoring of Bishops Stortford Football Club match 9th November 2019

4.24 An overview of the monitoring is shown in Figure 13 and Figure 14 below. Noise levels remained fairly consistently between 67dB(A) and 69dB(A) over 10-15 minute periods when measured 68m from the centre of the pitch. Two periods highlighted on the graph show tannoy use. As tannoy is not proposed at the development site this aspect of noise is excluded from the assessment and is

not considered further. At the monitoring locations 38-40m from the centre of the pitch measured noise levels were consistently in the region of 72dB (A) over 10-15 minute periods.

4.25 The attendance on the day was approximately 200, which match officials commented was a lower than average turnout. As such the measured noise levels could slightly underestimate impact (at least from crowd noise). Average attendance levels obtained from internet sites indicate that over 19 matches between August 2019 and March 2020 the average attendance for home games was 260 and for the 2018-2019 season average attendance was approximately 300.[13]

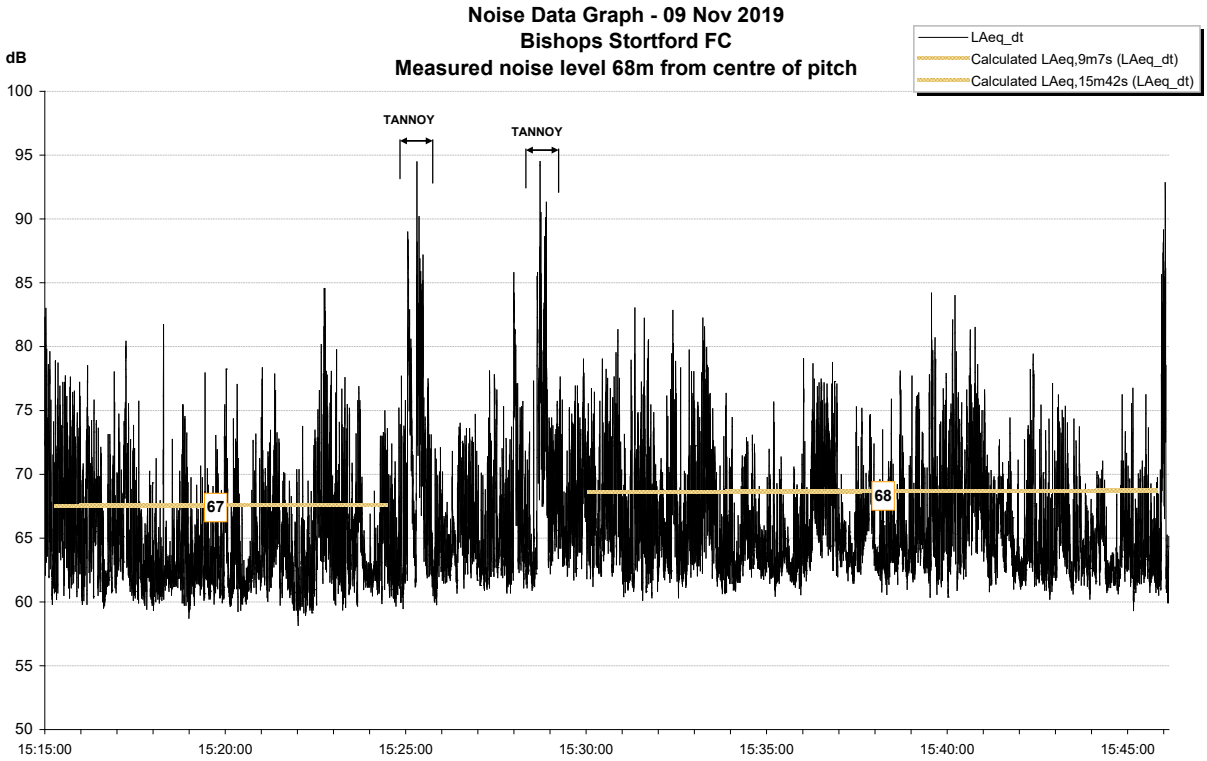

Figure 13: Extract from attended monitoring of Bishops Stortford Football Club match 9th November 2019 – 68m from centre of pitch

[13] Bishops Stortford Home Attendances 2019-2020. [Online] Available from: https://www.footballwebpages.co.uk/bishops-stortford/attendances/2019-2020 [Accessed 04/11/2020]

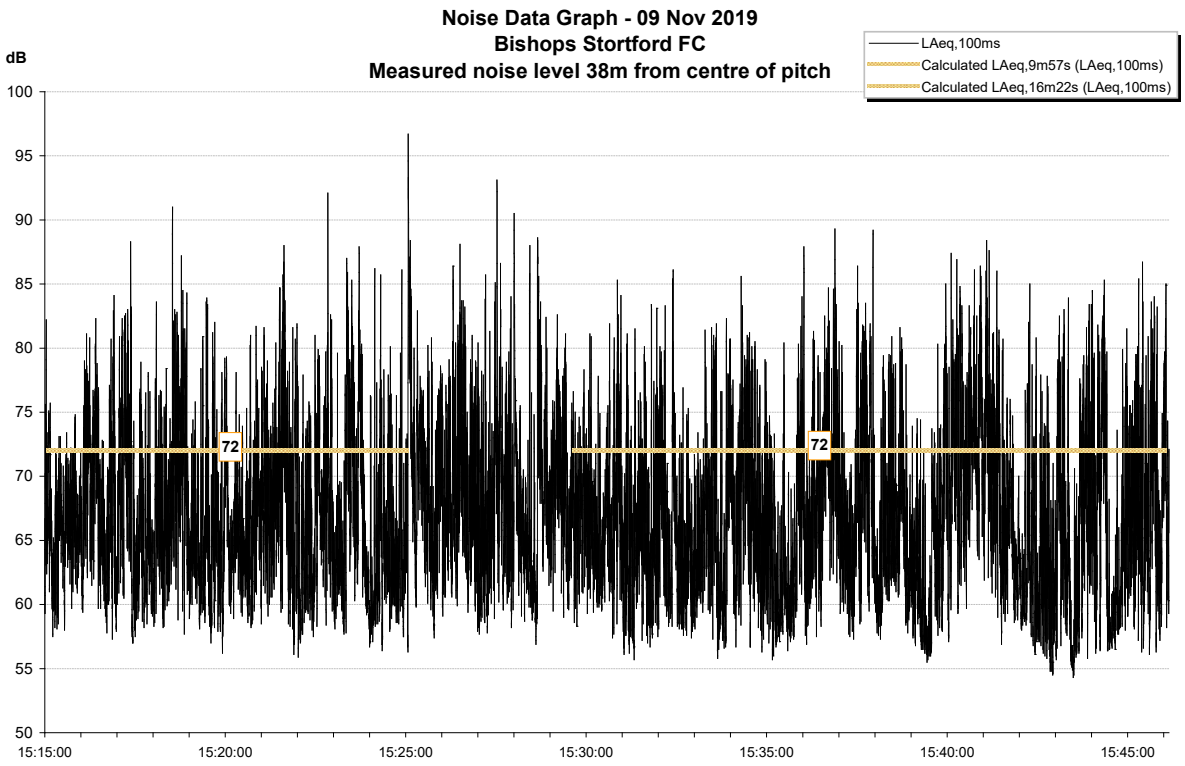

Figure 14: Extract from attended monitoring of Bishops Stortford Football Club match 9th November 2019 – 38m from centre of pitch

4.26 Summary of noise monitoring

4.27 The monitored PE lesson indicates that there is a level of clearly audible impact already existing at nearby residential dwellings. The level and type of noise from the proposed AGP is not a new source in the area. Development of the AGP will result in similar levels of impact during the daytime from PE lessons, with the potential for an increase in use during the daytime.

4.28 The levels recorded during the men's football training session have been used as a basis for modelling noise impact from the proposed community use of the AGP. In addition, use of the pitch by Bishops Stortford Football Club has been modelled based on the noise levels occurring during an official match. This is a worst case assumption as training sessions would not generate the same levels of noise. As noise from community use and Bishops Stortford Football Club use constitute the worst case levels of noise, impact assessment has been based on achieving a level of acceptability from these sources. The results and noise modelling are discussed further in section 5 and 6 below.

5.0 Predicted noise impact

5.1 The proposed development site has been modelled using Datakustik software Cadna A. All noise maps assume hard ground (G=0.0) representative of worst case ground conditions for sound propagation and second order reflections. Receiver grid spacing is 5m from area sources and 2m for point sources. Predictions are made in accordance with ISO9613-2. Predicted noise levels are calculated at 1.5m height above ground level to represent ground floor amenity and 4.5m height above ground level to represent first floor amenity (e.g. bedrooms).

5.2 The layout of the noise model is shown in Figure 15 below. Two area sources have been used to model potential impact from average noise emitted from community use of the AGP. These are labelled Area 1 and Area 2. A larger area source has been used to model average noise from a Bishops Stortford Football Club match, labelled BSFC Area. To model impact of maximum noise, five source locations have been used around the proposed AGP. These locations are primarily around the goal area of pitches, which was observed during the monitoring on 28th May to be the location where most noise is generated. These source locations are labelled point source (PS) 1 -5.

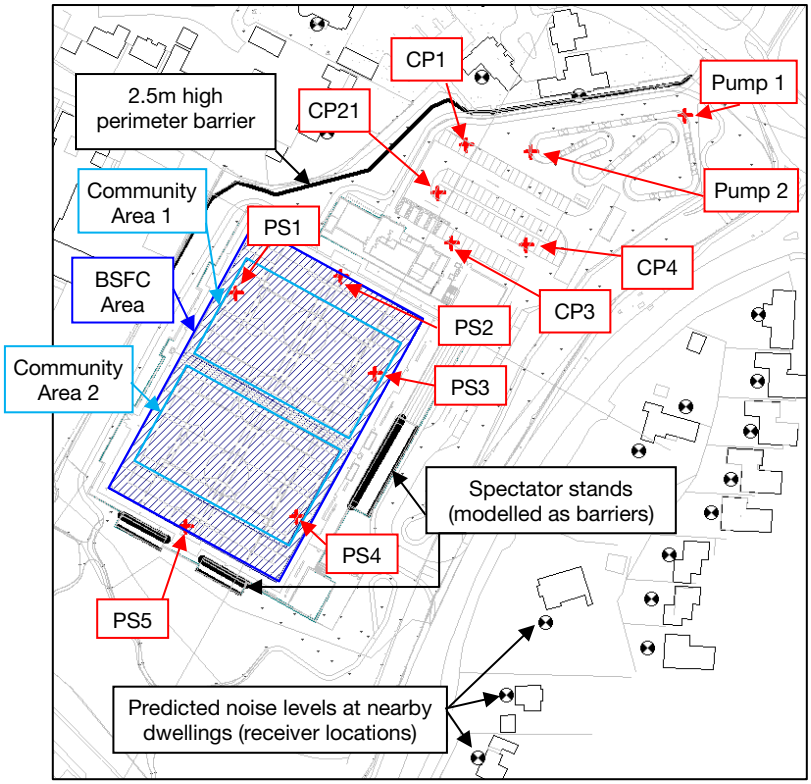

Figure 15: Noise model layout showing noise source and receiver locations

5.3 Aside from pitch noise, additional noise sources include maximum noise generated by use of the car park and use of the pump track. Maximum noise levels of a car door shutting have been modelled in four different locations around the car park (CP) 1-4. Two locations have been used to predict impact from noise associated with the pump track, labelled Pump 1 and Pump 2.

5.4 As most of the noise from the AGP is generated by speech, the area source has been modelled at 1.2m height, which combines voices and ball kicks etc. Maximum noise sources are modelled as point sources and at a height of 1.5m with the exception of ball kicks, which are modelled at 0.7m height.

5.5 Noise mitigation considerations have influenced the site design and layout. Measures to reduce noise impact include perimeter barriers and lowering the pitch level towards the northern end of the site (closest to the pavilion) in order to increase the effect of screening at ground floor amenity areas of nearby housing. Figure 15 shows locations of barriers around the site, which includes a 2.5m high perimeter barrier to the west and north west of the site and the spectator stands, which will act as a barrier to noise.

5.6 Predicted noise levels for various noise source scenarios are tabulated below. The receiver numbers are marked on Figure 16 below.

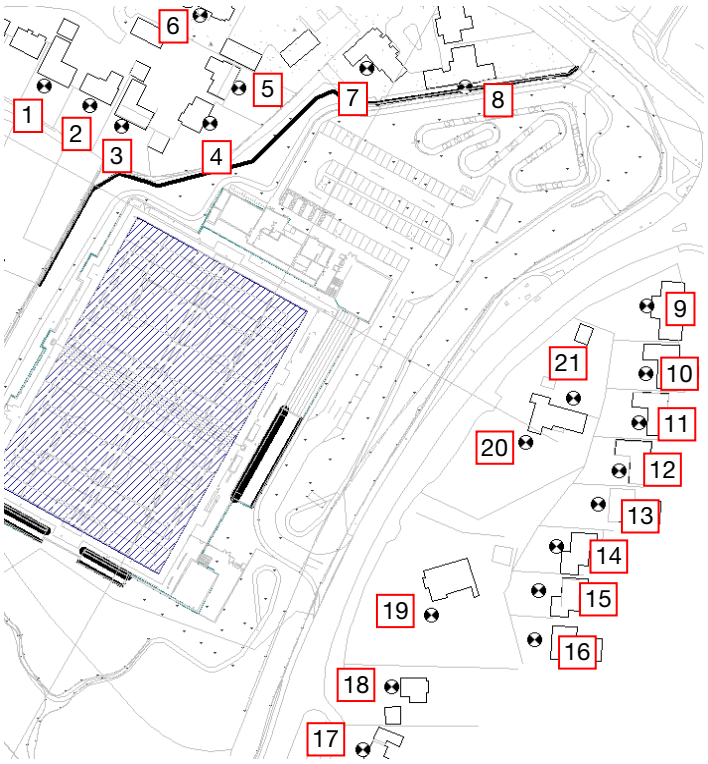

Figure 16: Plan of noise model showing receiver numbering

5.7 Two example noise maps are shown below, the full results are presented in tables below. The first noise map below shows the predicted average noise level from the BSFC area source at 1.5m receiver height with noise mitigation in place. This noise map excludes all other sources of noise that would be co-existing such as road traffic and aircraft noise.

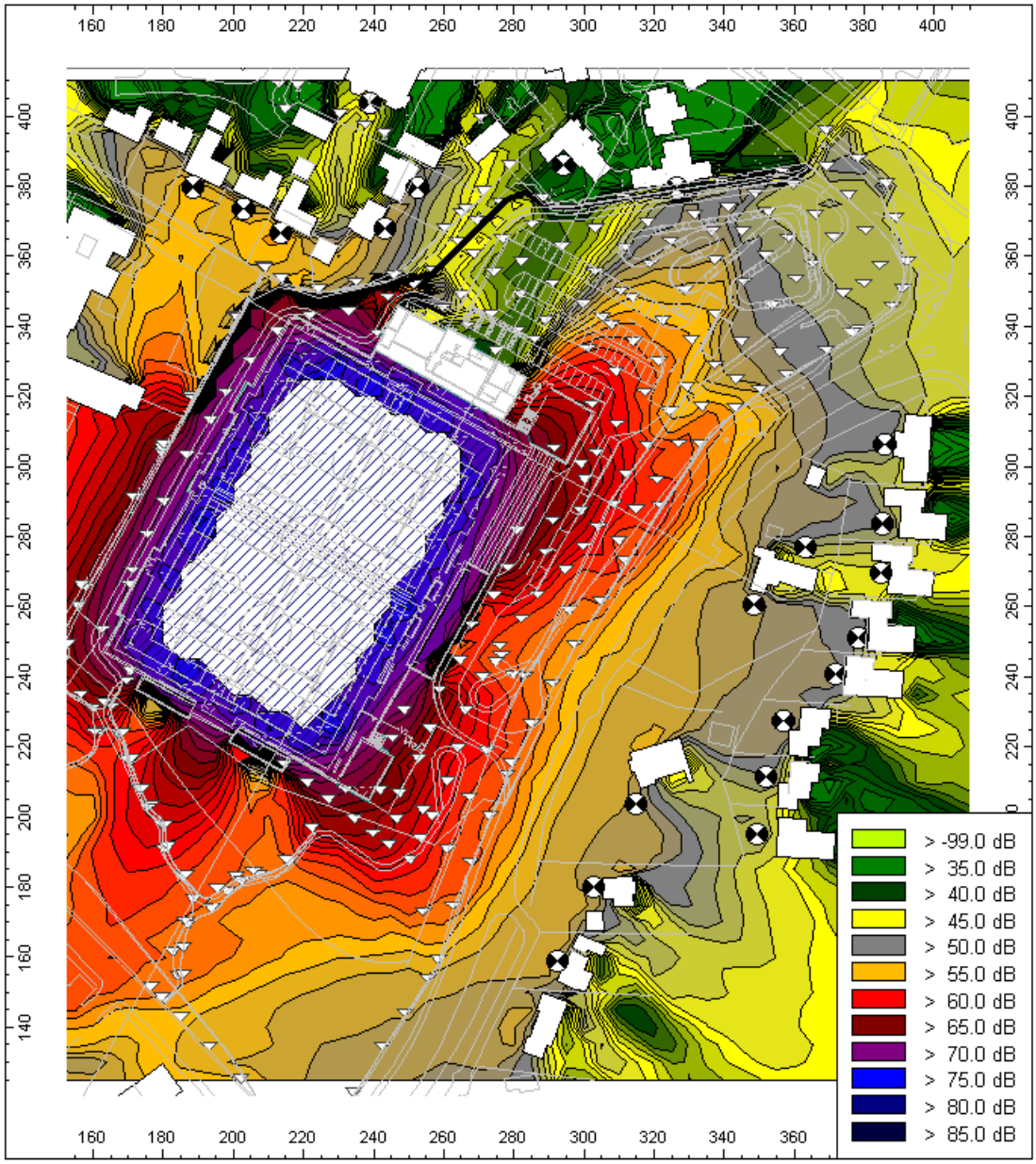

Figure 17: Predicted average noise level from a BSFC match at 1.5m receiver height

5.8 The second noise map below shows a combination of point sources occurring at the AGP simultaneously. Predicted noise levels are calculated at 4.5m height, representative of first floor rooms and windows. Point source locations 1, 3 and 5 are modelled as a typical level shout and point source location 2 and 4 as a

ball kick. These are modelled as a worst case scenario with all sources occurring within the same one tenth of a second and each being omni-directional.

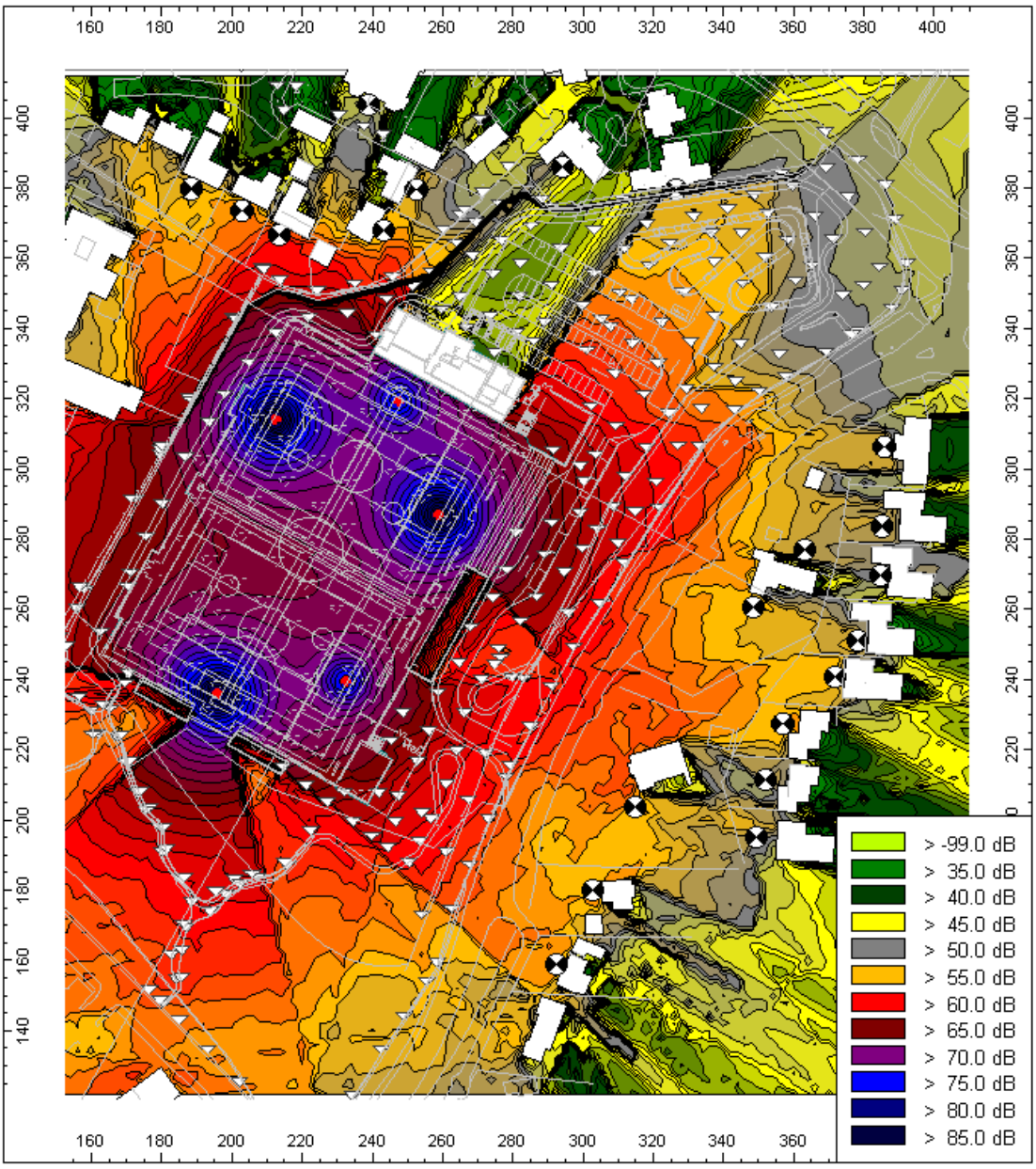

Figure 18: Predicted maximum noise level from point sources at 4.5m receiver height

5.9 The following analysis shows the tabulated predicted noise levels for pitch noise, car park noise and pump track noise.

5.10 Pitch noise

5.11 As described above, activities occurring on the pitch are likely to be the main sources of noise associated with the proposed development site. Average noise levels generated on the pitch have been modelled assuming community use (two

smaller area sources) and Bishops Stortford Football Club use (one larger area source). Maximum noise levels have been modelled separately and include assessment of noise from typical and worst case shouts and ball kicking.

5.12 Table 2 below shows the predicted noise levels from the AGP as an average level. The first two columns give the predicted levels from community use of the pitch assuming that both smaller pitches are in use simultaneously. This presents a worst case prediction. The second two columns give the predicted noise levels for Bishops Stortford Football Club's use of the pitch, assuming a larger area source.

Table 2: Predicted average noise levels from AGP

	Community use 'Area 1' and 'Area 2'		BSFC use 'BSFC Area'	
	1.5m height	**4.5m height**	**1.5m height**	**4.5m height**
R1	47	49	55	56
R2	48	52	55	59
R3	50	55	57	62
R4	46	52	52	59
R5	45	49	52	56
R6	40	44	47	51
R7	33	38	39	46
R8	29	41	35	48
R9	44	49	50	54
R10	44	48	50	54
R11	40	41	46	48
R12	44	46	51	54
R13	45	46	51	54
R14	45	47	52	54
R15	43	45	50	51
R16	41	42	49	50
R17	46	52	53	58
R18	47	52	54	58
R19	46	49	53	56
R20	46	50	52	56
R21	43	48	50	55

5.13 The criterion used in this assessment for average noise is not to exceed the existing ambient sound level by more than 3dB(A). As noted above, typical daytime ambient sound levels at ground level height are 56dB LAeq,1 hour and typical ambient sound levels during the evening are 55dB LAeq,1 hour. This gives an upper limit of 58-59dB LAeq,1 hour (0-3dB above existing ambient

sound levels). This provides a robust form of analysis for first floor level rooms where ambient and background sound levels will be higher in terms of the near ground sources such as road traffic which is the primary source in the area.

5.14 For community use of the pitch predicted noise levels at all locations at both ground and first floor height are below typical ambient daytime and evening noise levels based on ground floor level measurements. This is true also for the majority of locations for the BSFC scenario. This is a positive indication of acceptability using the average level guidance.

5.15 At a small number of locations predicted noise levels at first floor height are at the upper limit of the acceptability criteria. At R2, R4, R17 and R18 the predicted noise levels at first floor height are 58-59dB LAeq,1hour. This is just within the range of 0-3dB()A above existing ambient sound levels (56dB(A) during daytime and 55dB(A) during evening) and well within if first floor ambient levels are about 2dB(A) higher.

5.16 R3 is one of the closest dwellings to the proposed AGP and as such predicted noise levels here are higher. At ground level height predicted noise levels are 57dB(A) (assuming BSFC use of the pitch), which is within the 0-3dB(A) criteria with respect to typical ambient noise levels. However, at first floor height predicted noise levels are 62dB(A), which is 6-7dB(A) above ambient sound levels and 4-5dB(A) above if, as expected, first floor ambient levels are higher than at ground floor level. This worst case assessment indicates potentially a slight occurrence of excess noise at first floor level but not within daytime ground floor amenity areas externally or ground floor living rooms.

5.17 The new facilities include extensive screening compared to the existing noise exposure residents experience from use that is unscreened albeit the new use means an increase in frequency of activity. Critically maximum noise levels from individual shouts etc. do fall below acceptability criteria. The balancing of this exceedance falls to a balancing of the lateness of use of the facility and hence it is recommended that the pitch is not used beyond 21:00.

5.18 The two tables below give the predicted noise levels from specific maximum sources of noise at the AGP. The first table gives the predicted noise levels at 1.5m (ground floor) height and the second table the predicted noise levels at 4.5m height (first floor). The criterion used in this case for maximum noise levels

is that they should not regularly exceed 60dB LAmax,f at nearby residential development.

5.19 The columns show the predicted noise level for each noise source (ball kick, typical level shout, worst case (loud) level shout) and at each source location (PS1-5). The final column shows the predicted noise levels where a maximum noise source arises at each of the source locations (PS1-5) simultaneously. These are lower at some properties than individual shouts because of the location used to model sources.

Table 3: Predicted maximum noise levels from AGP at 1.5m receiver height

	Ball kick					Typical shout					Loud shout					Comb. point sources[14]
	PS1	PS2	PS3	PS4	PS5	PS1	PS2	PS3	PS4	PS5	PS1	PS2	PS3	PS4	PS5	
R1	41	38	39	39	41	47	44	46	46	48	53	51	53	53	55	52
R2	43	39	40	40	40	49	45	47	48	48	56	52	54	55	55	53
R3	45	42	41	41	40	52	47	47	48	46	59	54	54	56	54	54
R4	43	33	31	35	37	50	36	32	43	45	57	43	39	50	52	52
R5	42	30	30	29	38	50	33	31	32	44	56	41	38	42	52	51
R6	37	27	24	30	36	41	32	29	31	42	47	39	36	42	49	45
R7	32	29	30	30	29	33	31	33	32	31	40	38	40	38	37	38
R8	24	25	32	29	23	28	29	36	32	24	34	36	42	39	31	38
R9	37	35	39	33	36	44	40	46	36	40	51	47	53	42	46	49
R10	37	38	38	31	31	43	45	46	32	33	51	52	53	38	39	48
R11	35	36	35	33	32	41	43	42	37	36	49	50	48	43	42	46
R12	37	36	37	36	39	44	43	44	43	48	51	50	51	50	55	51
R13	37	38	37	38	39	43	45	44	45	46	51	52	51	53	53	50
R14	37	39	37	38	39	44	47	45	46	46	51	54	51	53	53	50
R15	36	38	36	36	33	44	46	44	42	36	51	53	51	49	43	48
R16	34	37	36	36	40	40	44	43	44	45	47	51	50	51	53	49
R17	38	38	35	41	40	45	46	43	49	48	52	53	49	56	55	51
R18	39	38	36	42	42	45	45	42	49	50	52	52	48	57	57	52
R19	38	40	38	40	39	46	47	46	48	47	54	54	52	55	55	52
R20	37	39	39	37	39	44	45	47	44	46	51	53	54	50	53	51
R21	37	39	38	29	30	44	46	46	31	31	52	53	53	37	37	49

[14] Point source locations 1, 3 and 5 are modelled as a typical level shout and point source location 2 and 4 as a ball kick.

Table 4: Predicted maximum noise levels from AGP at 4.5m receiver height

	Ball kick					Typical shout					Loud shout					Comb. point sources[14]
	PS1	PS2	PS3	PS4	PS5	PS1	PS2	PS3	PS4	PS5	PS1	PS2	PS3	PS4	PS5	
R1	43	41	40	40	41	51	48	48	48	48	58	55	55	56	56	54
R2	46	44	43	44	44	53	51	50	52	52	60	58	58	60	59	57
R3	50	47	44	45	44	58	53	52	53	51	66	60	60	60	58	60
R4	47	40	36	43	41	56	42	38	50	49	63	49	44	58	56	57
R5	45	31	34	36	41	53	34	35	39	49	60	42	42	48	56	54
R6	41	28	29	35	37	48	32	34	38	44	55	39	40	47	51	50
R7	42	31	34	33	33	48	33	37	36	35	55	40	43	42	41	49
R8	32	29	43	40	33	35	31	50	47	36	41	38	58	54	42	51
R9	45	36	40	36	35	51	39	47	43	42	58	46	54	50	49	53
R10	45	39	40	33	36	51	46	46	40	39	58	54	54	47	45	53
R11	43	37	36	33	33	49	45	42	36	40	56	53	48	43	46	51
R12	45	38	39	37	43	51	43	47	46	50	58	49	54	52	58	55
R13	45	39	39	39	46	51	46	47	46	51	58	54	54	53	59	55
R14	45	40	40	40	46	51	48	47	47	53	58	56	54	54	60	56
R15	44	39	39	37	34	50	46	47	43	37	57	54	54	50	43	52
R16	39	38	38	38	46	41	47	44	45	50	49	54	51	52	57	52
R17	45	38	36	42	48	52	46	44	49	54	59	53	50	56	62	57
R18	40	39	36	43	48	48	45	43	50	55	55	53	50	57	62	56
R19	42	40	40	41	47	50	49	47	48	54	57	57	54	55	62	56
R20	44	46	40	37	41	51	53	47	45	49	58	60	55	51	56	55
R21	45	46	40	29	33	51	50	46	31	34	58	57	54	38	40	53

5.20 The tables show that the predicted maximum noise levels at all receiver locations are below 55dB LAmax,f for the ball kick source. For a typical level shout, the majority of locations are below 55dB LAmax,f, only R3 and R4 exceed 55dB LAmax,f and only at first floor height. For a loud (worst case) shout, predicted noise levels do not exceed 60dB LAmax,f at ground floor height. At first floor height there are five receiver locations where a maximum noise level above 60dB LAmax,f is predicted for the worst case shout (R3, R4, R17, R18 and R19).

5.21 Under the combined sources scenario, a worst case assumption using multiple sources occurring simultaneously, the predicted noise level at all receiver locations is below 55dB LAmax,f at ground floor level. At first floor level the predicted noise levels at a majority of locations will not exceed 55dB LAmax,f and at all locations predicted noise levels do not exceed 60dB LAmax,f.

5.22 The predicted maximum noise levels from use of the pitch indicate that at the majority of locations maximum noise levels will be below 55dB LAmax,f. The criterion for maximum noise is to avoid regularly exceeding 60dB LAmax,f. At ground floor height this level is not predicted to be exceeded at any location. At first floor level it is exceeded at a minority of locations and only in the case of a worst case (loud) shout. This is a positive indication that the maximum noise level criteria will be met widely and levels exceeding 60dB LAmax,f will not arise frequently. Those worst case levels identified are also only marginally above 60dB LAmax,f. In context of dwelling use and having regard to the times of use of the site this indicates an acceptable level of noise.

5.23 Car park noise

5.24 Average noise levels generated by the car park are not expected to result in significant increases in ambient noise levels. The ambient noise survey indicated road traffic noise as a major noise source in the area determining background and ambient sound levels. As such, engine noise from vehicles using the car park is unlikely to stand out significantly from the existing sound environment especially as traffic movement noise is not steady in the area due to nearby junctions.

5.25 Maximum noise levels from voices or car doors shutting are more likely to be audible at nearby locations and as such impact assessment is based on maximum noise levels. Four different locations have been used to assess the

noise impact of a car door shutting. This is modelled as a single event and multiple incidences would be expected within a longer time period. As above, a criterion of not regularly exceeding 60dB LAmax,f is used. A source height of 1m has been modelled as representative of a car door / boot shutting.

5.26 Table 5 below gives the predicted noise levels at ground floor (1.5m) and first floor (4.5m) height. The table shows that at all but two locations maximum noise levels are below 55dB LAmax,f and no locations exceed 60dB LAmax,f. This is a positive indication that car park noise will not cause disturbance.

Table 5: Predicted maximum noise levels from car park noise (doors shutting)

	1.5m height (ground)				4.5m height (first floor)			
	CP1	**CP2**	**CP3**	**CP4**	**CP1**	**CP2**	**CP3**	**CP4**
R1	25	23	30	2	28	30	36	11
R2	25	25	31	3	30	35	40	21
R3	27	34	31	12	35	44	43	22
R4	47	50	43	24	51	55	50	30
R5	49	49	44	26	53	54	50	31
R6	28	30	27	5	32	34	30	13
R7	50	48	43	26	56	56	51	33
R8	45	40	34	16	56	52	47	31
R9	51	49	42	27	50	49	43	32
R10	47	41	40	24	46	42	42	28
R11	49	40	39	22	48	46	40	29
R12	36	32	32	16	36	34	32	18
R13	44	40	41	19	43	45	43	24
R14	47	40	40	20	46	46	41	27
R15	42	39	40	20	46	46	41	28
R16	40	38	39	19	46	45	39	26
R17	44	34	36	23	42	32	37	25
R18	45	39	37	24	43	37	44	26
R19	44	40	39	23	43	46	46	24
R20	49	49	41	25	47	48	44	30
R21	49	49	42	25	49	48	45	31

5.27 Pump track

5.28 The pump track is proposed in close proximity of dwellings to the north of the site. Whilst noise from bikes using the track itself is unlikely to generate significant impact, associated noise impacts including voices from users of the track and, in a worst case scenario, shouts could impact nearby residential

dwellings. As such maximum noise levels have been modelled in two locations assuming a typical level shout (i.e. the same source used in modelling of the AGP, at 1.5m source height).

5.29 Table 6 below gives the predicted maximum noise levels from typical level shouts. At all locations at ground floor height a maximum noise level of 55dB LAmax,f is not exceeded. At first floor height at the majority of locations, 55dB LAmax,f is not exceeded. At R7 and R8 maximum noise levels of 60dB LAmax,f are exceeded by 1dB(A) and 4dB(A). This is not considered a common scenario for this activity.

Table 6: Predicted maximum noise levels from pump track (typical level shout)

	Pump 1		Pump 2	
	1.5m height	4.5m height	1.5m height	4.5m height
R1	28	35	24	30
R2	29	37	27	32
R3	29	47	26	38
R4	53	58	48	53
R5	53	58	48	51
R6	48	49	28	34
R7	55	61	39	45
R8	50	64	48	61
R9	54	57	55	58
R10	51	56	53	56
R11	50	52	52	56
R12	48	47	49	52
R13	40	41	47	48
R14	47	52	36	36
R15	46	51	36	36
R16	44	50	43	47
R17	41	48	42	49
R18	43	49	42	41
R19	40	39	33	31
R20	50	54	39	39
R21	54	57	53	53

5.30 Pavilion indoor event noise / plant noise

5.31 Predicted noise levels for indoor events have not been calculated in this report. The resulting noise levels will depend on the indoor source levels and reduction of the building structure, which is not defined at this stage. Similarly, at this stage

there are no details of the plant to be installed at the site and as such plant noise levels have not been predicted. The potential impact of these sources is discussed along with the results from the modelled sources in the following section.

6.0 Discussion

6.1 Pitch noise

6.2 The noise modelling shows that community use of the proposed AGP will meet the criteria set in this case for preventing adverse impact. Average noise levels at most nearby receiver locations were predicted equal to or below the existing ambient sound levels. At all locations the criterion of not exceeding existing ambient sound levels by more than 3dB(A) is achieved. Predicted maximum noise levels at nearby receiver locations were also broadly found to meet proposed criterion.

6.3 Use of the proposed AGP for a larger football match, i.e. Bishops Stortford Football Club, resulted in higher predicted noise levels around the site. At ground floor height predicted average noise levels were equal to or below existing ambient noise levels at all locations except for R3, where predicted noise levels were 1dB(A) above existing ambient daytime levels and 2dB above existing ambient evening levels. This is a positive indication that ground floor amenity spaces at nearby dwellings are well screened and protected from adverse noise impacts. It falls within the criteria applied.

6.4 At first floor height, boundary screening is less effective and higher predicted noise levels arise. At R2, R4, R17 and R18 predicted noise levels were in the region of 58-59dB(A), 2-3dB above existing ambient daytime levels and 3-4dB(A) above existing evening levels. However, this is partly counteracted by the fact ambient noise levels will be higher, typically by 2dB(A) at this level than the ground level recordings. This is not shown in the analysis tables. As a result of this and also the infrequency of such a worst case this is appropriately considered to be within the criteria and therefore largely acceptable providing that this level of impact does not arise frequently. At R3 at first floor level predicted average noise is 62dB(A), this is 6dB(A) above existing ground floor ambient daytime noise levels and 7dB(A) above existing ground floor ambient evening noise levels. Even when accounting for a slight increase in ambient levels at first floor, this level of impact is expected to have some adverse effect and will need to be controlled by frequency and duration of that activity causing impact as discussed further below.

6.5 Predicted maximum noise levels at nearby receiver locations were broadly found to meet proposed criterion and in most cases there was a significant margin. At ground floor height maximum noise levels are predicted to be below 60dB LAmax,f at all locations and at the majority of locations below 55dB LAmax,f. At first floor height, maximum noise levels exceeding 60dB LAmax,f are predicted at R3, R4, R17, R18 and R19; however, these exceedances arise in each case for only one of the five point source locations modelled. As such, maximum noise levels are not regularly expected to exceed 60dB LAmax,f though there may be some incidences at these locations where this level arises. It is further noted that the 60dB LAmax,f value is only exceeded in the worst case (loud) shout scenario. Modelled typical level shouts did not exceed 60dB LAmax,f.

6.6 Currently the locality does not benefit from the proposed screening and as a result higher levels of noise could potentially arise for similar activity from the current facility but much less often. In balancing the issues there will therefore be some benefit from the development in reducing noise levels from all use of the land overall but this needs to be compared to the additional use the development introduces and periods of more intense activity.

6.7 Providing considerate use of the site and noise management, post development, higher maximum noise levels can be avoided and the maximum level criteria should be expected to be met as a whole across all locations.

6.8 In summary, noise associated with the use of the pitch is found to be largely acceptable and within criteria for both average noise and maximum noise impact. Predicted noise levels at R3 are above criteria applied in this assessment relating to the worst case level of noise generated, particularly at first floor level where there is less screening. This is partly countered as masking noise levels will be higher at first floor level and the screening will lead to increased attenuation of noise generally. R3 is one of the closest locations to the pitch and is not afforded additional screening by the pavilion, as is the case for R4 and R5. Where higher noise levels arise and cannot be further mitigated with physical measures (e.g. barriers) passive controls such as limits on frequency and duration of activity and noise management should be considered. These controls are discussed further below.

6.9 Car park noise

6.10 Noise from vehicles arriving at and leaving the site will be audible at the closest residential locations; however, the existing sound environment is dominated by road traffic noise and as such noise associated with the car park should not stand out as a distinctive source from the underlying sound environment. Maximum noise levels have been predicted at various locations around the car park. Predicted levels at nearby dwellings are all below 55dB LAmax,f with the exception of the two closest modelled source locations to R7 and R8 (source locations CP1 and CP2), which results in maximum noise levels of 56dB LAmax,f. As these maximum noise levels are within the range of measured daytime and evening ambient noise levels, car park noise is not expected to cause significant disturbance. Car park noise in relation to evening / night time events is discussed further below.

6.11 Pump track noise

6.12 The noise from the use of the pump track itself is not expected to cause significant disturbance and the primary source of noise from this area is expected to be from users of the track. A typical level shout has been modelled to assess impact. At all locations at ground floor height a maximum noise level of 55dB LAmax,f is not exceeded. At first floor height at the majority of locations, 55dB LAmax,f is not exceeded. At R7 and R8 maximum noise levels of 60dB LAmax,f are exceeded by 1-4dB(A) for a worse case assessment. If this level of noise were to arise with regularity then a level of adverse impact at R7 and R8 could be expected. However, this aspect of the noise can readily be managed both in terms of controls over users and times of use. Providing considerate use of the track and appropriate noise management controls are implemented then adverse noise impact can be prevented. This is discussed further below in relation to noise management of the site.

6.13 Indoor event noise

6.14 The internal layout of the pavilion indicates several multi use spaces that could be used for exercise classes or functions such as parties. The primary noise impacts from such uses are amplified music noise and in the case of functions, people leaving the venue during later evening / night time.

6.15 Amplified music should be controlled from the site such that assuming regular events take place, music noise is not audible within nearby dwellings. Where windows / doors serving a function room at the pavilion are left open, there is a strong likelihood that music noise could cause disturbance at nearby dwellings. As such, the pavilion should be designed such that during noisy events windows and doors can be kept closed but suitable ventilation is put in place to allow adequate cooling and airflow. Where function rooms are in close proximity of dwellings the building façade and windows should include additional measures for sound insulation above that used in typical construction. For example this might include solid fire doors, acoustic glazing and additional isolation within the building construction to prevent music noise breakout. Providing that these additional measures are implemented music noise can be contained sufficiently so as not to cause disturbance to nearby dwellings.

6.16 Even in poor acoustically designed buildings music noise control can be achieved generally through modern dance floor located music reproduction systems and limiting devices. This would also mainly be controlled through Licensing Act restrictions. This is not an impediment to development.

6.17 Predicted noise levels from car park noise have been assessed against typical ambient daytime and evening levels for noise impact associated with the pitch. At night time background and ambient sound levels in the area fall lower and there is a greater risk that those leaving a function later at night could cause disturbance to nearby dwellings. Noise management is a key control factor to minimising disturbance of this type of impact, for example asking those at the event to leave quietly and having management of events on site (i.e. staff ensuring attendees leave quietly, using a screened taxi location and if possible staggered leaving times).

6.18 At modelling locations CP1 and CP2, closest to R7 and R8, predicted maximum noise levels from a car door shutting were in the region of 56dB LAmax,f. However, at locations further away from the dwellings, CP3 and CP4, predicted maximum noise levels at R7 and R8 were in the region of 47-51dB LAmax,f (CP3) and 31-33dB LAmax,f (CP4). Thus, events lasting into later evening / night time could be managed so that parking is only in areas furthest away from R7 and R8 so as to minimise disturbance.

6.19 Timing of events and control over their finish time also enables control over any late night noise. In general this is readily manageable in different ways and where not managed it leads to restrictions upon use. This is not therefore an impediment to development and is a suitable element for inclusion in any noise management plan.

6.20 Plant noise

6.21 No details on plant to be installed at the site have been finalised; however, the methodology for assessing impact from this type of noise requires comparison of the source noise to existing background sound levels. Typical daytime background sound levels were measured in the region of 48dB LA90, 1hour, during evening 45dB LA90, 1hour and at night time (at around 0200-0300) 32dB LA90,15min. Any plant to be installed at the site should be assessed against background sound levels. This can be controlled with a noise condition and as such adverse noise impact can be avoided assuming an appropriate assessment of impact is made with any relevant mitigation implemented. The levels of background sound provide surety that excessive plant noise emissions are readily avoidable.

6.22 Noise impact assessment of effects

6.23 National planning guidance requires an assessment of whether adverse or significant adverse noise impacts will arise as a result of development. Where adverse impacts are expected to arise, these must be mitigated and minimised. At the majority of locations around the site, noise impact from various noise sources has been found to meet appropriate criteria. Adverse impact at these locations is unlikely to arise. However, at a few locations around the site higher levels of impact are predicted when applying a worst case assessment approach.

6.24 At R7 and R8 predicted maximum noise from use of the pump track exceeds criterion levels of 60dB LAmax,f but only in relation to anyone shouting at users of the track. The noise source is modelled as a typical level shout and as such can be controlled and minimised by noise management of the site, asking users to act considerately when using the site and prohibiting use of the track by those who do not comply or their coaches and supporters. As a general rule there is

good reasonable behaviour by sports facilities users and this rightly is to be assumed.

6.25 At R3, and to some extent at R2 and R4, higher levels of noise are predicted as a result of the AGP in limited circumstances. This arises primarily as a result of larger football games, i.e. an official BSFC match. At first floor level, predicted noise levels exceed the criterion at R3 and a level of adverse impact could arise, depending on the context. In this case context is largely dependent on the frequency and duration of this level of impact.

6.26 The site has been designed to achieve good acoustic design through use of screening and barriers to reduce noise impact at nearby dwellings. This includes a 2.5m high perimeter barrier around the west and north west of the site. The effect is not just to reduce worst case noise but noise generally. At the northern end of the AGP the pitch is sunken into the ground to further increase the effect of screening within amenity areas at dwellings closest to the pitch. The location of the pavilion aims to screen a majority of nearby dwellings. The site has been designed to maximise attenuation of noise at ground level to reflect the predominant usage of the site during daytime and evenings when it can be reasonably expected that first floor rooms at dwellings (typically bedrooms) will not be used to the same extent as ground floor amenity areas. The criteria for all noise sources are met at ground floor level across all receiver locations. It is only at first floor level that exceedances of criteria for worst case noise activity are found at a minority of locations.

6.27 The proposed development site has been used historically for recreation and PE lessons by the school and as such noise associated with leisure activities is not a new source to the area. Road traffic noise from the car park is similarly not a new source to the area. However, the proposed development does increase the scale of potential use for these activities and there will be an intensification of leisure type noise in the area. Noise from people using the site will be clearly audible at nearby dwellings. In most cases average and maximum noise levels are within ambient noise levels in the area; however, due to the nature and character of the noise (speech and impact noise) activity at the site will be clearly distinguishable from other sources of noise in the environment.

6.28 Government planning practice guidance (PPG) provides a hierarchy table for determining whether adverse effects will arise from noise. The development in

this case is expected to fall partly within the lowest observed adverse effect level and partly within the observed adverse effect level. The noise at dwellings nearest to the site will be heard and could cause small changes in behaviour, attitude or other physiological response, for example having to close windows for some of the time because of the noise. In this case it is unlikely that there is the potential for sleep disturbance; however the development is likely to affect the acoustic character of the area such that there is a small actual or perceived change in the quality of life at a small number of locations. Where the site is used intensively, noise impact is likely to fall within this category (observed adverse effect level) and the appropriate action is to mitigate noise and reduce it to a minimum. The proposed development has implemented a number of design measures that meet this requirement, including location and orientation of the site and boundary screening. Further control of noise may be needed by limiting frequency and duration of use such that noise impact is balanced against respite periods for residents. As an example, it is recommended that the pitch is not used beyond 21:00 other than in exceptional cases.

6.29 At dwellings further away and / or where there is less intense use of the facilities (for example where there are evenings / weekend periods with prolonged periods of respite from noise) the site will fall in to the lowest observed adverse effect level. Here noise can be heard but does not change behaviour or attitude. Noise may slightly affect the acoustic character of the area but not such that there is a change in the quality of life. At this level no further mitigation of noise is needed.

6.30 Noise management

6.31 Having shown that the criteria can be met at the majority of locations, the remaining consideration for noise impact is the frequency and duration of noise impact from the site. Noise is one of several factors to be balanced in the planning process. It is recommended that a noise management plan is implemented at the site for control of noise. This will help to ensure that noise levels are controlled to acceptable levels and if any issues emerge they are dealt with. For example, community groups found to generate high levels of noise or anti-social behaviour (e.g. foul language) can be prohibited from using the site.

6.32 At R3 (and R2 and R4), higher noise levels than desired were predicted assuming an official BSFC match. In reality these noise levels should only occur every couple of weeks, or potentially with other fixtures once weekly. Thus, there

should be limited frequency and duration of such noise levels and then only sporadically within an event. Practice sessions would be subject to similar noise management methods as community use and would be expected to generate lower levels of noise, similar to predicted noise levels from community use.

6.33 Measured background and ambient sound levels were found to significantly reduce from 22:00 and to begin reducing from 21:00. It is recommended that the proposed AGP should not be used after 21:00, reflecting the increased noticeability of the noise after this time. The restriction on hours of use provides additional mitigation and respite for residents. Additional restrictions on use may need to be imposed depending on the intensification of use of the site. Where residents previously had respite from school related noise during evenings and weekends, this will not exist when the AGP is in full use.

6.34 Much of the additional noise impact from AGPs can be controlled through management measures and providing users with information and guidance on how to limit noise impact for nearby residents. It is recommended that a noise management plan is developed for the site and is subject to ongoing review depending on community and school feedback. This could include balancing respite for nearby residential use with use of the AGP by, for example, restricting use on Sunday afternoons and evenings but unlimited use on Saturdays and during the week.

6.35 The noise management plan should also include requirements such as:

- Guidance and hiring rules such as not repeatedly kicking balls against fencing.
- Covering and maintaining back boards with rubber strips to reduce impact and vibration noise.
- The reporting and recording of issues which generate noise and their review.
- Securely fixing and maintaining fencing panels, use of resilient fixings to avoid vibration noise.
- Asking coaches and users of the pitch to be mindful of nearby residents when using raised voices (i.e. minimise shouting). In some cases there can include financial use penalties or bans.
- Not using profanities or socially offensive language.
- Keeping the pitches locked outside of hours of use.

- Ensuring there is a pitch supervisor and a clear process for logging and dealing with any noise complaints.
- Site security and control including CCTV where necessary for the identification and control of incidents.
- Complaint recording and action along with contact information provision and an events schedule which allows residents to plan their own social activities where these are noise sensitive.

6.36 Pitch management could also be used to control noise levels so that typically noisier uses are prioritised for earlier evening bookings and where feasible, located further from the main residential locations impacted and quieter uses for later evening bookings. For example, adult men's football training could be held earlier in the evening and walking football held later in the evening. Ultimately noise levels can be controlled by either monetary penalties for any users who abuse the noise management rules or their barring from use and thus in the event there is adverse impact due to an unreasonable user, this can be prevented.

6.37 Whilst the proposed AGP site will also be used for other activities, these have not all been individually considered in this assessment. The assessment is based on the typical worst case noise impacts and as such all other potential uses are considered to have a much lower level of impact.

6.38 Additional noise management measures will need to be implemented depending on the use of the pavilion for fitness classes and / or functions. As described above, management of such events is key to reducing impact and could include limits on levels of internally generated amplified music and use of security staff to ensure late night functions do not cause disturbance as attendees leave. These forms of control are well recognised and commonly applied and provide, therefore suitable means of control over any potential noise issues.

6.39 Summary

6.40 With regard to planning guidance, noise impacts have been considered and assessed against suitable criteria. Whilst noise from the proposed AGP will be readily audible at the closest residential dwellings, this is not different in character from the type of noise impact currently experienced. However, there will be an intensification of impact and introduction of more adult voices compared to those primarily of children.

6.41 It is considered that the proposed development will not result in a significant adverse effect on nearby housing and for the majority of dwellings around the site will fall in to the lowest observed adverse effect level as defined in the guidance. For dwellings close to the site there is the potential for adverse effect when applying a worst case assessment and depending on frequency and duration of use of the site. Where impact intensifies, potentially a minority of dwellings could fall within the observed adverse effect level. The level of impact will depend on frequency and duration of use and this should be controlled with a noise management plan and balanced against other considerations relevant to the planning process.

6.42 There will be an increase in the use of the site and this will result in a loss of respite for residents compared to the existing sound environment. Predicted noise levels are considered acceptable and are not expected to result in significant adverse impact at the majority of locations. Noise will be audible at nearby dwellings but not significantly above existing ambient noise levels.

6.43 At some locations closer to the site higher average and maximum noise levels are predicted than desired to arise at first floor level. Here a balance of frequency and duration as well as the time of impact from this is required. However, it is to be noted that the development has been designed to ensure that appropriate noise criteria is met at all ground floor locations around the site and those above are worst case in limited circumstances. The criterion is for limits not to be regularly exceeded and this is met.

6.44 Based on the predicted noise levels and an increase in the frequency and duration of use of the site, the site is considered to fall in the lowest observed adverse effect level at the majority of locations and at some of the closest locations to the site within the observed adverse effect level. The relevant action to be taken where sites fall within the observed adverse effect level is to mitigate and reduce impact to a minimum. This has already been largely achieved by the use of boundary screening to reduce noise levels, lowering areas of the pitch, location of the pavilion to act as screening and restriction on activity after 21:00. It is recommended that the site and its frequency and duration of use is controlled with a noise management plan that can be reviewed and can reduce or extend hours of use as necessary. This can be made subject to prior written approval of the planning authority and such a form of control is common.

6.45 The changing demands of communities and the need for such facilities or their improvement and wider use by communities compared to the reasonableness of some limited additional noise are planning balance matters outside of this noise assessment.

7.0 Summary and conclusions

7.1 MAS Environmental Ltd (MAS) were appointed by Wilby & Burnett LLP on behalf of Birchwood High School to provide a noise impact assessment for development of an artificial grass pitch (AGP), sports pavilion, pump track and cyclo-cross track. The facilities at the proposed development site are to be shared by Birchwood High School, the local community and Bishops Stortford Football Club.

7.2 There are several sources of noise at the site that have the potential to impact nearby dwellings including:

- Noise associated with games activity on the pitch, e.g. football matches, shouts, ball kicks.
- Internally generated noise associated with the pavilion, e.g. music noise from events taking place in multi-purpose function rooms.
- Externally generated noise associated with the pavilion, e.g. plant noise.
- Noise associated with the car park, e.g. car door impact noise.
- Noise associated with the cyclo-cross / pump track, e.g. voices.

7.3 The site is currently used for activities which contain similar noise impacts although not as intense or over the wider period of use now intended.

7.4 The AGP will largely be used during daytime and evenings. Typical daytime background and ambient sound levels were measured at 48dB LA90,1 hour and 56dB LAeq, 1hour respectively. Typical background and ambient sound levels during the evening were measured at 45dB LA90, 1 hour and 55dB LAeq, 1 hour respectively.

7.5 The criterion used in this assessment for average noise is not to exceed the existing ambient sound level by more than 3dB(A). For noise sources where maximum noise levels are assessed, where possible the average of the highest maximum noise events should be reduced to 55dB(A) or lower. Maximum noise levels should not therefore regularly exceed 60dB LAmax,f at nearby residential development.

7.6 Two area sources have been used to model potential impact from average noise emitted from community use of the AGP. A larger area source has been used to model average noise from a Bishops Stortford Football Club match, labelled

BSFC Area. To model impact of maximum noise, five source locations have been used around the proposed AGP. Aside from pitch noise, additional noise sources include maximum noise generated by use of the car park and use of the pump track. Maximum noise levels of a car door shutting have been modelled in four different locations around the car park. Two locations have been used to predict impact from noise associated with the pump track.

7.7 The noise modelling shows that community use of the proposed AGP will meet the criteria set in this case for preventing adverse impact. Average noise levels at most nearby receiver locations were predicted equal to or below the existing ambient sound levels. At all locations the criterion of not exceeding existing ambient sound levels by more than 3dB(A) is achieved. Predicted maximum noise levels at nearby receiver locations were also broadly found to meet proposed criterion.

7.8 Use of the proposed AGP for a larger football match, i.e. Bishops Stortford Football Club, resulted in higher predicted noise levels around the site. At ground floor height predicted average noise levels were equal to or below existing ambient noise levels at all locations except for R3. This is a positive indication that ground floor amenity spaces at nearby dwellings are well screened and protected from adverse noise impacts.

7.9 At first floor height, boundary screening is less effective and higher predicted noise levels arise. At locations where predicted noise levels are higher than ambient levels, impact remains within the criteria identified in guidance and therefore largely acceptable providing that this level of impact does not arise frequently. At R3 at first floor level predicted average noise is 62dB(A), this is 6dB(A) above existing ambient daytime noise levels at ground floor level and 7dB(A) above existing ambient evening ground floor noise levels. Exceedance will be less as first floor level ambient noise is higher. This level of impact is expected to have some adverse effect on first floor rooms facing the site and will need to be controlled by frequency and duration of impact so that this level of noise does not arise frequently, for long periods or too late within the evening.

7.10 Noise associated with the use of the pitch is found to be largely acceptable and within criteria for both average noise and maximum noise impact. Overall levels are reduced at many residential locations due to boundary acoustic screening. Predicted noise levels at R3 are above criteria for predicted worst case noise,

particularly at first floor level in limited cases where there is less screening. Where higher noise levels arise and cannot be further mitigated with physical measures (e.g. barriers) passive controls such as limits on frequency and duration of activity and impact and noise management must be considered as discussed in this report.

7.11 Noise from vehicles arriving at and leaving the site will be audible at the closest locations; however, the existing sound environment is dominated by road traffic noise and as such noise associated with the car park should not stand out as a distinctive source from the underlying sound environment. Maximum noise levels have been predicted at various locations around the car park. Predicted levels at nearby dwellings are within the range of measured daytime and evening ambient noise levels, car park noise is not expected to cause significant disturbance.

7.12 The noise from the use of the pump track itself is not expected to cause significant disturbance and the primary source of noise from this area is expected to be from voices of users of the track or their coaches / supporters. At all locations at ground floor height a maximum noise level of 55dB LAmax,f is not exceeded. At first floor height at the majority of locations, 55dB LAmax,f is not exceeded. At R7 and R8 maximum noise levels of 60dB LAmax,f are exceeded for worst case noise; however, this aspect of the noise can be managed and providing considerate use of the track and appropriate noise management controls then adverse noise impact can readily be prevented and controlled by consent condition. This is addressed in this report

7.13 The internal layout of the pavilion indicates several multi use spaces that could be used for exercise classes or functions such as parties. The primary noise impacts from such uses are amplified music noise and in the case of functions, people leaving the venue during later evening / night time. The pavilion should be designed such that during noisy events windows and doors can be kept closed but suitable ventilation is provided to allow adequate cooling and airflow. Where function rooms are in close proximity of dwellings the building façade and windows should include additional measures for sound insulation above that used in typical construction. The internal design and construction will dictate the form, level and lateness of activity within the pavilion. Music noise can be controlled through a range of modern methods that can ensure unacceptable noise emissions are prevented from most buildings, especially where detached.

Events lasting into later evening / night time could be managed so that parking is only in areas furthest away from R7 and R8 so as to minimise disturbance and take it well below limits of acceptability.

7.14 No details on plant to be installed at the site have been finalised. Plant noise can be controlled with a noise condition and as such adverse noise impact can be avoided assuming an appropriate assessment of impact is made against existing background sound levels with any necessary mitigation implemented. Background sound levels are sufficiently high that most forms of standard plant can be installed without adverse impact.

7.15 The site has been designed to achieve good acoustic design through use of screening and barriers to reduce noise impact at nearby dwellings. This includes a 2.5m high perimeter barrier around the west and north west of the site. At the northern end of the AGP the pitch is sunken into the ground to further increase the effect of screening within amenity areas at dwellings closest to the pitch. The location of the pavilion provides further screening to nearby dwellings. The site has been designed to maximise attenuation of noise at ground level to reflect the predominant usage of the site during daytime and evenings when it can be reasonably expected that first floor rooms at dwellings (typically bedrooms) will not be used to the same extent as ground floor amenity areas. The criteria for all noise sources are met at ground floor level across all receiver locations. It is only at first floor level that exceedances of criteria are found at a minority of locations and then only for worst case noise predictions. Acceptability is then a matter of how regular intrusion is and this can be managed / controlled.

7.16 Government planning practice guidance (PPG) provides a hierarchy table for determining whether adverse effects will arise from noise. The development in this case is expected to fall partly within the lowest observed adverse effect level and partly within the observed adverse effect level. The noise at dwellings nearest to the site will be heard and could cause small changes in behaviour, attitude or other physiological response, for example having to close windows for some of the time because of the noise. In this case it is unlikely that there is the potential for sleep disturbance; however the development is likely to affect the acoustic character of the area at a minority of dwellings closest to the pitch such that there is a small actual or perceived change in the quality of life. Where the site is used intensively, noise impact is likely to fall at this level (observed adverse effect level) and the appropriate action is to mitigate noise and reduce

it to a minimum. The site has implemented a number of design measures that meet this requirement, including location and orientation of the site and boundary screening. Further control of noise will be needed by limiting frequency and duration of use such that noise impact is balanced against the provision of respite periods for residents. As an example, it is recommended that the pitch is not used beyond 21:00.

7.17 There will be an increase in the use of the site and this will result in a loss of respite for residents compared to the existing sound environment. Predicted noise levels are acceptable are not expected to result in adverse impact at the majority of locations with limited effect at others. This requires balancing against the planning objectives and the wider needs of the school and community. Such a balance is a planning consideration and not one of noise impact in isolation.

7.18 Noise will be audible at nearby dwellings but not significantly above existing ambient noise levels. At some locations closer to the site higher average and maximum noise levels are predicted to arise at first floor level. Here a balance of frequency and duration of impact and respite is required and considered in this assessment.

7.19 At dwellings further away and / or where there is less intense use of the facilities (for example where there are evenings / weekend periods with prolonged periods of respite from noise) the site will fall in to the lowest observed adverse effect level range. Here noise can be heard but does not change behaviour or attitude. Noise may slightly affect the acoustic character of the area but not such that there is a change in the quality of life. At this level no further mitigation of noise is needed. It is recommended that the site and its frequency and duration of use is controlled with a noise management plan that can be reviewed and can reduce or extend hours of use as necessary as well as exert control over any uses found to unreasonably increase impact.

7.20 The assessment set out in this report presents a worst case approach using the worst case scenario in terms of noise impact. This includes typical worst case noise sources and typical worst case (lowest masking) background and ambient sound levels. In downwind conditions, high levels of road traffic noise can be expected to increase background and ambient sound levels, which would increase masking noise thereby reducing perceived noise impact from the AGP.

At first floor level slightly higher ambient levels can be expected which better mask the noise. This has not been assessed.

7.21 Noise impacts will fall largely within the lowest observed adverse effect level. However, at a minority of locations closest to the site a level of adverse impact may arise on limited occasions under limited circumstances, depending on the frequency and duration of use of the site. Noise management, including a noise management plan, is key to the acceptability of the site so that where at some dwellings noise levels are higher than desired, sufficient respite from noise is provided as a balance. At the majority of locations around the site a good standard of amenity can be maintained following development of the site and boundary screening provides some gain in terms of general noise from the current uses. As a whole it is concluded that the development meets the requirements of the NPPF, PPG and the principles of guidance applied within the noise impact assessment process. Noise is one consideration where an element of impact upon residential property, albeit manageable, needs to be balanced against the wider objectives of community sport facilities and those for the school.

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MAS Environmental Ltd

Appendix A - Glossary of terms

This glossary is harmonised with relevant British and ISO standards which are referenced. Some definitions vary slightly due to updates since written and with other noise guidance documents.

A-Weighting - This is a function which attempts to simulate the characteristics of human hearing at lower levels. Hence a dB(A) reading is an estimate of what we actually hear for quieter sounds whereas dB(LIN), {dB(C) on simpler instruments}, is an objective reading of what is actually physically present. However, for louder and low frequency sounds dB(C) correlates better to the human ear.

> **Note**, dB(A) has been proven not to be so effective in weighting for human hearing at low frequencies.

Acoustic environment – Sound at the receiver from all sounds as modified by the environment. The acoustic environment can be the actual environment or simulated, outdoors or inside, as experienced or in memory. [ref BS ISO 12913-1 2014]

Ambient sound – Totally encompassing sound in a given situation at a given time usually composed of sound from many sources near and far. The ambient sound comprises the residual sound and the specific sound when present. [ref BS4142 2014]

Ambient sound level (La = LAeq,T) – Equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time usually composed of sound from many sources near and far at the assessment location over a given time interval, T. [ref BS4142 2014]

Amplitude Modulation - The cyclic rise and fall in noise level (loudness) often described as a 'swish', 'whoomph' or 'thump'. In relation to large wind turbines it corresponds to the blade passing frequency of the wind turbine blades, typically around once per second.

Attenuation – The loss in energy level of the sound usually used in relation to the loss due to sound passing through a structure or enclosure.

Background sound level (LA90,T) – The 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 number of decibels. It is the underlying level of noise in the absence of the source and normally excludes most short duration noises (depending on time interval relative to the presence of source noise) (see Residual sound level). [ref BS4142 2014]

> **Note**: Many other guidelines and documents reference background noise level. There is a general move to sound level.

Background sound level ("influenced") - In many situations the background sound level can be measured either when the source or premises from which sound emanates, or is associated with, is not operating. Alternatively the intermittency of the source means that it does not have any appreciable effect on the background level, which is a statistical level based mainly on sound that continues with limited breaks. Where this is not the case the measured sound level will be increased and thus influenced.

Background sound level ("uninfluenced") - This refers to any measurement of the background sound level that has not been increased due to noise associated with the source.

Broadband Noise – This is noise covering the whole of the audible frequency range. Compare to narrow band noise which is noise made up of only a very narrow band of frequencies. It will normally exhibit tonality.

Character (of the noise) - Noise character refers to specific features of a noise or sound that render it more intrusive and / or more likely to attract a listeners attention. Noise character can refer to distinguishable or discrete continuous tones (for example hums, whines, hissing or screeching), distinct impulsivity (bangs, clatters, thumps, clicks, pulses) or any other irregularity that attracts attention or makes the noise readily distinctive in relation to the pre-existing acoustic environment.

Context - This includes the interrelationships between person and activity and place, in space and time. The context may influence the soundscape through auditory sensation, interpretation of auditory sensation and the responses to the acoustic environment (see Soundscape). Context is also objectively measured using weightings for character and emergence of the sound above the background sound environment (loudness and relative character).

C-Weighting – see A-Weighting above.

Decibel (dB) - A unit or level, derived from the logarithm of the ratio between the value of a noise energy quantity and a reference value. For sound pressure level the reference quantity is 20 Pa, the threshold of normal hearing is in the region of 0 dB and 140 dB is the threshold of pain / instantaneous damage. A change of 1 dB of the same sound is only perceptible under special conditions.

dB(A): (see A-Weighting) - This is decibels measured on a sound level meter weighted by a scale which is designed to reflect the weighting placed on noise by the human ear. A noise meter incorporates a frequency weighting device to create this differentiation. The dB(A) scale is now widely accepted. Measurements in dB(A) broadly agree with people's assessment of loudness for broadband noise. A change of 3 dB(A) of the same sound is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound. The background sound level in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A).

dB(Z): The Z-weighting is a flat frequency response of 10Hz to 20kHz ±1.5dB. This response replaces the older "Linear" or "Unweighted" responses as these did not define the frequency range over which the meter would be linear.

DnT,w: See weighted level difference.

Equivalent continuous A-weighted sound pressure level (LAeq,T) - The sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period. LAeq is used to describe many types of noise and can be measured directly with an integrating sound level meter. It is obtained by continuously integrating ('adding up the energy of') a fluctuating sound signal and dividing by the elapsed time, to give the true mathematical average of any time varying signal. An LAeq reading must always be related to a measurement time interval and should not be read as an instantaneous value of sound pressure.

Façade level - Sound pressure level 1m in front of the façade. Façade level measurements are typically argued 1 to 2dB higher than corresponding free-field measurements because of the reflection from the façade in BS8233 2014 and 2-3dB in many other standards and guidance documents giving a range of 1-3dB.

FFT (Fast Fourier transform) Analysis – A method using digital signal processing to produce very rapid narrowband frequency analysis of acoustic signals. It can be used to equate audible sounds into decibel levels and / or enable a range of analysis of temporal sounds.

Filtering - Octaves & 1/3 Octaves - In general most noise is broad band i.e. it contains energy in virtually all the frequencies across the audio range in different combinations so that it has certain recognisable characteristics. To determine the frequencies at which most of the energy is concentrated, a sound signal is filtered into bands, commonly octave and 1/3 octave bands. Information from such filtering is widely used for diagnostic work and to determine noise control measures. (see Octave band 1/1 and Octave band 1/3)

Free-field level - Sound pressure level away from reflecting surfaces. These are typically measurements made between 1.2 to 1.5m above the ground and at least 3.5m away from other reflecting surfaces. To minimize the effect of reflections the measuring position has to be at least 3.5m to the side of the reflecting surface (not 3.5m from the reflecting surface in the direction of the source). [ref BS8233 2014]

Frequency – This is the number of air vibrations or pressure fluctuations per second. The unit is the hertz (Hz).

Hertz (Hz) – See Frequency above.

Impact Insulation class (IIC) - (American) a number rating (in decibels) indicating how well a structure attenuates impact sound.

Impulsivity - Used to describe an acoustic feature of single or repeated sound events of short duration such as a bang, shot or sudden impact of metal on metal etc. It is generally assessed subjectively as perceived by the listener and demonstrates rapid onset in the change in sound level and overall change in sound level. [ref BS4142 2014]

Lnight,outside - The long term equivalent outdoor A weighted sound pressure level established over a period of a year during night time hours (8 hours, typically 23:00 - 07:00). The Lnight,outside is a key parameter of the WHO 2009 Night Noise guidelines which was taken from the Environmental Noise Directive and is typically taken at the facade without reflections (free field level) rather than the facade level given for night time noise disturbance in the WHO 1999 guidelines. It is normally measured / calculated at a height of 4m.

Logarithmic – A scale where the exponent indicating the power to which a fixed number, the base, must be raised to produce a given number. The base used in acoustics is 10. Thus the logarithm of 10 = 1, the logarithm of 100 = 2 and the logarithm of 1000 = 3. In terms of sound energy, an increase of 10 decibels equates to a 10 fold increase. The human ear is sensitive to a very wide range of sound pressure levels (intensities). Measuring human response to sound with a linear scale would not be practical as the scale would be too large and so a logarithmic scale, in the form of decibels, is used.

Loudness – An observer's auditory impression of the strength of a sound. It is a subjective effect which is a function of the ear and brain as well as the amplitude and frequency of the sound. Whilst loudness is a subjective perception, a value can be attributed to loudness, which is typically measured in phons. Loudness is related to sound intensity and takes account of the sensitivity of the human to ear to certain frequencies.

Low frequency noise – This is normally considered to be noise ranging from 20 Hertz (pressure fluctuations per second) to 200-250 Hertz, depending on the reference. In music it is the bass region as opposed to alto and soprano.

Masking – The process by which the threshold of hearing of one sound is raised due to the presence of another.

Maximum (A weighted) sound level (LAmax) - The highest value A-weighted sound level with a specified time weighting that occurs during a given event. The time weighting (see below) used (F or S) should be stated. All measurements were 'fast' in this survey. [ref BS5228-1 2009+A1 2014]

Measurement time interval - Total time over which measurements are taken. [ref BS4142 2014]

Meter response and time weightings - Most practical sound sources cause fluctuating readings. If the level fluctuates too rapidly, an analogue pointer may move so erratically that it will not be possible to obtain a meaningful reading, or with impulsive sound the meter may not respond quickly enough to obtain an authentic reading. Sound level meters are therefore provided with a variable time response control with settings:-

> **'S' Slow** - Meter response is over damped with a time constant of approx 1 second or 1000ms**.** The setting tends to average out fluctuations in the readings.
>
> **'F' Fast** - Permits the instrument to follow and indicate levels that do not fluctuate too rapidly; the time constant response is 125ms.
>
> **'I' Impulse** - Uses a special electrical circuit with a time constant of about 35ms (of the same order as the response time of the human ear) to permit a very rapid response for investigating very sudden, short duration, impulsive sounds. This setting incorporates a detector which in effect stores the signal for sufficient time to allow it to be displayed. Also a slow decay rate is incorporated with time response of approx 1500ms to allow more easy reading of the maximum value as the indicator moves back relatively slowly.
>
> **'P' Peak** - Higher grade meters often incorporate this setting which enables the absolute peak (as opposed to the rms) value of an impulsive waveform to be measured. A time constant of the order of 20 - 50 micro seconds is now involved to permit the following of very sharp impulsive events. Evidently electrical signal storage is also required to permit the meter to register the peak of such very fast events.

Noise - Sound perceived by the receiver to be unwanted.

Octave band 1/1 (single) - Band of frequencies in which the upper limit of the band is twice the frequency of the lower limit. [ref BS4142 2014]

Octave band 1/3 (third)- Band of frequencies in which the upper limit of the band is 21/3 times the frequency of the lower limit. [ref BS4142 2014]

Percentile level (LAN,T) - A-weighted sound pressure level obtained using time-weighting "F" which is exceeded for N% of a specified time interval. Typically the percentile level can be changed on modern sound level meters e.g. LA90,T, LA10,T, LA50,T etc. [ref BS8233 2014].

> **LA90,T**: The A-weighted sound pressure level exceeded for 90% of the specified measurement time interval. It is a statistical measurement. In BS4142 2014 (and generally) it is used to describe the background sound level. Thus for a measurement time interval of 1 minute it would equate to the quietest 6 seconds of sound. For a measurement time interval of one hour it would be the quietest sound for 10% of the time (or 6 minutes). If a machine runs continuously without a reduction in sound for 54 minutes and then stops it would represent the quietest 6 minutes of sound but if run for 55 minutes it would represent the quietest period of machine sound.
>
> **LA10,T:** The A-weighted sound pressure level exceeded for 10% of the time. It represents the highest sound pressure levels within any measurement time interval. The LA10,18hour is typically used as a measure of road traffic noise.

Pitch – Frequency is an objective measure whereas the term pitch is subjective and although mainly dependent on frequency, is also affected by intensity. See also Tonality.

Rating level (LAr,Tr) – The specific sound level of a source plus any adjustment (penalty or weighting) for the characteristic features of the sound. It is used in BS4142 2014 for rating and assessing industrial and commercial sound. [ref BS4142 2014 and BS7445-1 2003 for tonal character and impulsiveness of sound]

Receiver - Person or group of persons who are or who are expected to be exposed to environmental noise.

Reference time interval (Tr) - Specific interval over which the specific sound is determined. For BS4142 2014 this is 1 hour during the day from 0700 to 2300hrs and a shorter period of 15 min at night from 2300 to 0700hrs. [ref BS4142 2014]

Residual sound level - Equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given time interval, T. [ref BS4142 2014]

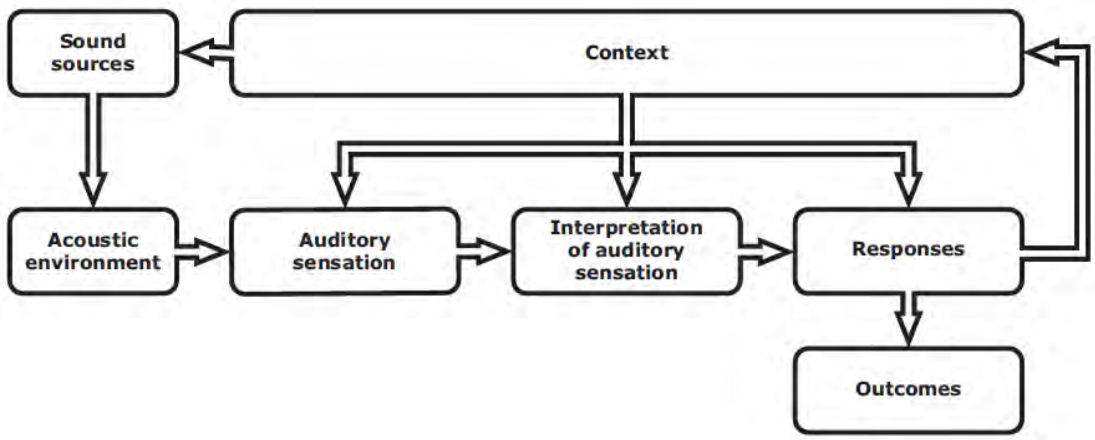
Rw - See sound reduction index.

Sound power level - Sound power is a measure of the flow of sound energy with reference to a unit of time measured in watts (W). The sound power level is an expression of this energy in a logarithmic scale. The sound power level, unlike the sound pressure level, is independent of room or environmental effects and distance.

Sound pressure level - Sound pressure is measured in pascals (Pa) and is created by fluctuations in air caused by sound. The sound pressure level is an expression of this pressure in decibels. The sound pressure level is variable depending on distance from the source and the interaction of the source with the environment (e.g. reflections).

Soundscape – The acoustic environment as perceived or experienced and/or understood by a person or people, in context (see 'acoustic environment' and 'context'). Figure 1 illustrates that soundscape is people's perceptions or experiences and/or understanding of an acoustic environment. The measurement, assessment or evaluation of soundscape is through the human perception of the acoustic environment.

Figure 1 - Elements in the perceptual construct of soundscape [ref BS ISO 12913-1 2014]



Sound reduction index, R, Rw, Rw + Ctr - a level that describes the sound reducing properties of a building element or partition. The weighted sound reduction index (Rw) is a laboratory measurement undertaken in accordance with ISO 717 and provides a standardised value, using a reference curve, which allows comparison between different building elements using the Rw value. The addition of the "Ctr" term, i.e. Rw + Ctr, provides an additional weighting which allows for sound sources with lower frequency spectral dominance.

Sounds Transmission Class - (American) a number rating indicating how well a structure attenuates airborne sound. It is roughly equivalent (in intent) to the sound reduction index.

Specific sound level (Ls = LAeq,Tr) - The equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given time interval, T. [ref BS4142 2014]

Tonality – Tonal sound gives a definite pitch sensation. It usually occurs where the sound energy in a narrow range of frequencies is greater than those either side of that narrow range. It will appear as a peak on a graph of sound energy shown in decibels versus the audible spectrum. It can often be shown by comparing adjoining octave band (1/3) spectra. A formal definition of tonality varies between standards. Where one 1/3rd octave band is more than 5dB above those either side, the noise contains a tone or alternatively as assessed by narrow band analysis. [ref BS7445-2 1991 / ISO1996-2 1987]. In BS4142 2014 the level differences between adjacent 1/3rd octave bands that identify a tone are:

- 15dB in the lower frequencies (25Hz - 125Hz)
- 8dB in the mid frequencies (160Hz - 400Hz)
- 5dB in the higher frequencies (500Hz - 1000Hz)

Weighted level difference Dw, DnTw, DnTw + Ctr - The weighted level difference gives a single number value for the airborne sound insulation performance of building elements or partitions etc. As with the sound reduction index, the DnTw is a standardised weighted level difference, standardised to a reverberation time of 0.5 seconds, and allows comparison of different building elements. The addition of the "Ctr" term, i.e. DnT,w + Ctr, provides an additional weighting which allows for sound sources with lower frequency spectral dominance.

Wind shear - The variation in wind speed with height. Wind speed typically increases with height. Wind shear varies depending on the time of day and depending on many other factors such as atmospheric stability effects, terrain, season etc. High wind shear in relation to wind turbines results in high wind speed at turbine hub height and therefore near maximum power output but low wind speeds at ground level height at the dwelling therefore typically resulting in low background sound levels.