ACOUSTIC CONSULTANTS LTD

Noise Impact Assessment

Proposed Artificial Grass Pitch
The Ghyll, Southwater, West Sussex

Reference: 9838/PJW

Client:
S&C SLATTER CONSTRUCTED WITH INTEGRITY

Document Control

Version	Revision Description	Date	Author:	Reviewed by:
1.0	-	06/10/2022	Peter J Wheeler MIOA	Daniel Oldaker MIOA
2.0	Revised pitch location	04/11/2024	Daniel Oldaker MIOA	Blake Lucas MIOA

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

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

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1. Introduction

S & C Slatter appointed Acoustic Consultants Limited to undertake an environmental noise assessment for the proposed new artificial grass pitch (AGP) located at The Ghyll, Southwater, West Sussex. The assessment considered the impact of environmental noise on the nearby noise-sensitive residential properties.

The assessment includes the prediction of noise emission from the AGP at the nearby noise-sensitive properties, based on noise level data from activities measured at existing AGPs.

The author of this report is a Member of the Institute of Acoustics with over 19 years of experience is considered suitably qualified to undertake this noise impact assessment.

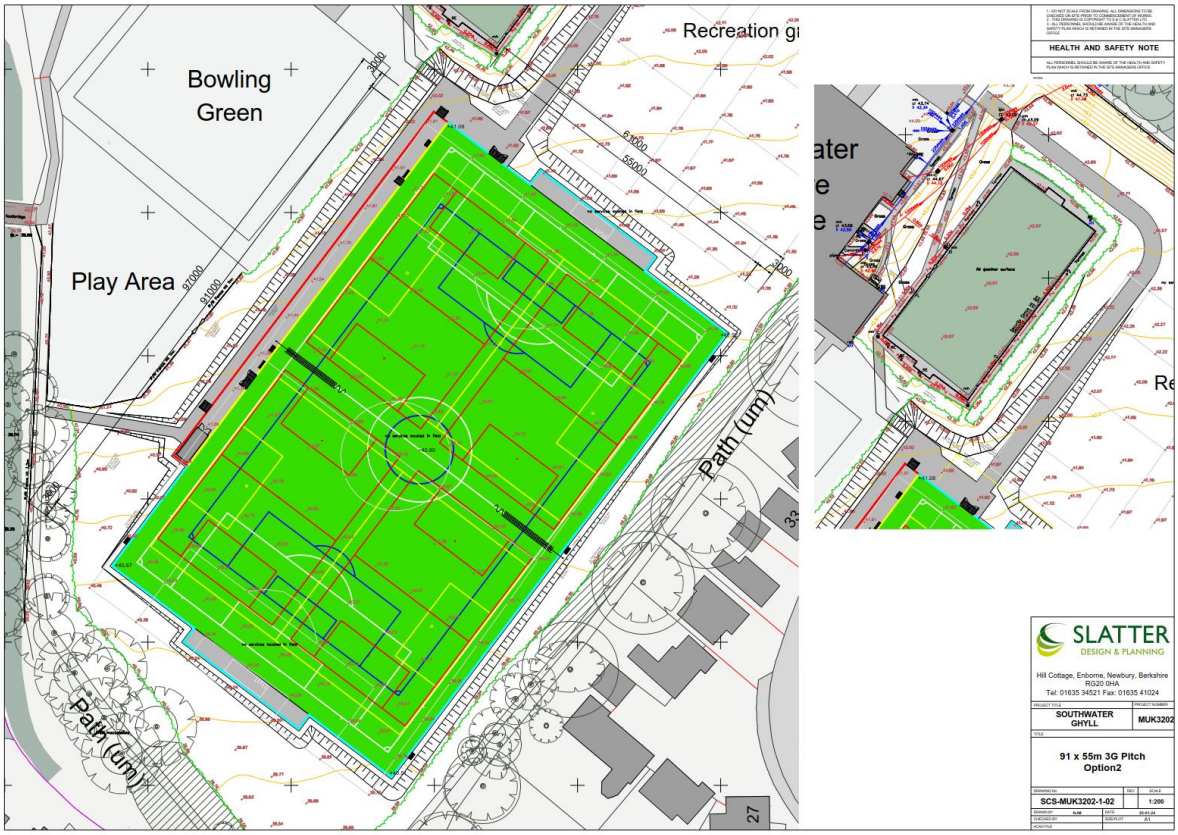
2. The Site

The site is to be located within the Ghyll sports fields, formerly a Southwater Leisure centre. The nearest noise sensitive residential receivers in respect to the proposed AGP are understood to be the dwellings to the south-east of the site on York Close. The proposed AGP will be located approximately 20m from the nearest residential property.

The proposed hours for the AGP are to be up until 22:00 Monday-Friday and 18:00 on Saturday & Sunday.

The site and proposed location are provided below.

Figure 1: Site location. Proposed AGP highlighted in blue



3. Planning and Noise

3.1. National Planning Policy Framework

The National Planning Policy Framework (NPPF) was published in March 2012 and revised in July 2021. Section 15 entitled 'Conserving and enhancing the natural environment' addresses noise as a requirement of planning. Paragraph 174 states:

"174. Planning policies and decisions should contribute to and enhance the natural and local environment by:

e) 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 or land instability…"

Paragraph 185 states:

"185. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;

b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and

c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation."

The document does not prescribe any assessment methodology or criteria to assess the adverse effect of noise.

3.2. Noise Policy Statement for England

The NPPF refers to the Noise Policy Statement for England (NPSE). This was published in March 2010 and aims to provide clarity regarding current policies and practices to enable noise management decisions to be made within the wider context, at the most appropriate level, in a cost-effective manner, in a timely fashion, and applies to all forms of noise including environmental noise, neighbour noise and neighbourhood noise.

The NPSE sets out the long-term vision of Government noise policy. This long-term vision is supported by three noise policy aims as follows:

"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

avoid significant adverse impacts on health and quality of life;
mitigate and minimise adverse impacts on health and quality of life; and
where possible, contribute to the improvement of health and quality of life."

The NPSE introduces the concept of "Significant adverse" and "Adverse" impacts of noise which relate to the noise policy aims. These are applied as follows:

NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected.

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur. With regard to where there is potential for noise impact it states the following in relation to the second noise policy aim:

"The second aim of the NPSE refers to the situation where the impact lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development (paragraph 1.8). This does not mean that such adverse effects cannot occur."

The NPSE does not provide any assessment criteria for the noted effect levels and each case must be considered on its merits. The NPSE does, however, emphasise that in dealing with noise Local Planning Authorities are required to take a balanced approach in considering the benefits of development against any adverse effects which arise. Paragraph 2.18 of the NPSE is particularly relevant in this respect and states:

"There is a need to integrate consideration of the economic and social benefits of the activity or policy under examination with proper consideration of the adverse environmental effects, including the impact of noise on health and quality of life. This should avoid noise being treated in isolation in any particular situation, i.e. not focusing solely on the noise impact without taking into account other related factors."

The planning need is outside the scope of noise and acoustics and will need to be addressed by others.

3.3. National Planning Practice Guidance, Noise (NPPG)

The National Planning Practice Guidance (NPPG) on noise referred to here is based on the current version (July 2019) as provided on the Planning Guidance Website.

It states that "Noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment."

It provides generic guidance on how to determine the noise impact and what factors could be a concern. It includes the option types to mitigate any adverse effects of noise stating that there are four broad types of mitigation. These are engineering, layout, using planning conditions or obligations and noise insulation.

Paragraph 5 of the NPPG provides a table identifying the effect level and examples of effect relating to the impact effect levels provided in the NPSE. The table is duplicated below:

Table 1: NPPG Noise – Perception of Effect Levels

Perception	Examples of Outcomes	Increasing Effect Level	Action
No Observed Effect Level			
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable but not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. 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			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, 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 perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, 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
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

The table does not provide any objective assessment that equates to the noted effect levels.

The NPPG identifies that where noise is audible it is not necessarily intrusive. The effect and impact on people is based primarily on the level of noise.

The Noise Policy Statement for England (NPSE) states that noise levels above the Lowest Observed Adverse Effect Level are acceptable in planning when reduced to a minimum and when taken into account against all other planning considerations.

Section 4 of this report identifies guidance which is considered to provide noise criteria equivalent to effect levels below the Lowest Observed Adverse Effect Level. This is where the perception of noise is "not noticeable" or "noticeable but not intrusive" as indicated in table above.

4. Relevant Noise Guidance for AGP Assessment

The following sections outline what we consider to be relevant guidance and suitable noise criteria within the context of the national planning policy.

This includes advice contained within the Sport England Design Guidance Note 'Artificial Grass Pitch (AGP) Acoustics – Planning Implications' which refers to the following documents.

4.1. World Health Organisation 'Guidelines for Community Noise'

The World Health Organisation 'Guidelines for Community Noise' published in 1999 gives the following description of community noise.

"Community noise (also called environmental noise, residential noise or domestic noise) is defined as noise emitted from all sources except noise at the industrial workplace. Main sources of community noise include road, rail and air traffic, industries, construction and public work, and the neighbourhood. Typical neighbourhood noise comes from premises and installations related to the catering trade (restaurant, cafeterias, discotheques, etc.); from live or recorded music; sport events including motor sports; playgrounds; car parks; and domestic animals such as barking dogs."

This includes "sport events" and, as such, the use of AGP sites.

For noise levels internally and externally to dwellings it states:

"In Dwellings. The effect of noise in dwellings, typically, are sleep disturbance, annoyance and speech interference. For bedrooms the critical effect is sleep disturbance. Indoor guideline values for bedrooms are 30 LAeq for continuous noise and 45 LAmax for single sound events. Lower noise levels may be disturbing depending on the nature of the noise source. At night-time, outside sound levels about 1 metre from façades of living spaces should not exceed 45 dB LAeq, so that people may sleep with bedrooms open. This value was obtained by assuming the noise reduction from outside to inside with the window open is 15 dB. To enable casual conversation indoors during daytime, the sound level of interfering noise should not exceed 35 dB LAeq. The maximum sound pressure level should be measured with the sound pressure meter set at "fast"."

Based on the same methodology used to determine the night time noise level (with a 15 dB(A) for an open window) outside a residential property, the daytime noise level about 1 metre from façades of living spaces should not exceed 50 dB LAeq.

Table 4.1 of the document provides guidelines for community noise in specific environments, suggesting noise levels at which adverse health and annoyance effects are likely. The relevant noise criteria are as follows:

Table 2: WHO Noise Criteria

Specific Environment	Critical Health Effect	$L_{eq(T)}$ dB(A)
Outdoor living area	Serious annoyance, daytime and evening	55
	Moderate annoyance, daytime and evening	50
Dwelling indoors	Speech intelligibility & moderate annoyance, daytime & evening	35

According to the WHO guidance, moderate annoyance is caused by noise levels exceeding 50 $L_{Aeq(T)}$ dB externally and 35 $L_{Aeq(T)}$ dB internally. With relation to the adverse effect level, we would consider this the threshold of the Lowest Observed Adverse Effect Level.

Therefore, where noise levels from the proposed development do not exceed 50 $L_{Aeq(T)}$ dB externally and 35 $L_{Aeq(T)}$ dB internally, the effect is below the Lowest Observed Adverse Effect Level and will have no adverse effect. The noise level of the AGP may be noticeable but not intrusive and is considered acceptable in planning terms.

The equivalent noise level is determined over a specific time period. The World Health Organisation guidelines for residential developments are typically equivalent noise levels calculated over a 16-hour daytime period.

In our opinion, an AGP 16-hour assessment period may not truly reflect the noise impact as it takes into account times of use and non-use. We would propose an alternative, more stringent but appropriate assessment time period of one hour, $L_{Aeq\ (1\ hour)}$, as this is the typical time period for a community sports session on an AGP. Therefore, we would suggest the more stringent target noise level of 50 dB $L_{Aeq\ (1\ hour)}$ is more suitable for the more sensitive evening time.

The WHO criteria were reviewed in a report by the National Physical Laboratory (reference CMAM16) which states:

"Exceedance of the WHO guideline values does not necessarily imply significant noise impact and indeed, it may be that significant impacts do not occur until much higher levels of noise exposure are reached."

Therefore, it is not necessarily the case that where these levels are exceeded the noise will adversely affect nearby residential properties.

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The WHO criteria were reviewed in a report by the National Physical Laboratory (reference CMAM16) which states:

"Exceedance of the WHO guideline values does not necessarily imply significant noise impact and indeed, it may be that significant impacts do not occur until much higher levels of noise exposure are reached."

Therefore, it is not necessarily the case that where these levels are exceeded the noise will adversely affect nearby residential properties.

5.2. British Standard 8233:2014 Guidance on sound insulation and noise reduction for buildings

British Standard 8233:2014 entitled 'Guidance on sound insulation and noise reduction for buildings' came into effect on 28th February 2014 and supersedes British Standard 8233:1999.

Table 4 of the British Standard provides internal ambient noise levels for dwellings from noise sources 'without a specific character' and are based on existing guidelines issued by the World Health Organisation in 1999. The British Standard provides no definition of noise 'without a specific character'.

No reference of guidance on sporting uses is given in the British Standard, unlike the WHO Guidelines. As such, we propose that the definition of community noise is applicable to the proposed noise limits. The British Standard 8233:2014 provides the same guidance levels as the World Health Organisation document.

5.3. British Standard 4142:2014

The British Standard 4142:2014 entitled 'Method for rating and assessing industrial and commercial sound' was published on the 31st October 2014 and replaced British Standard 4142:1997. British Standard 4142:2014 describes methods for rating and assessing sound of an industrial and/or commercial nature by comparing the Rating level of the noise under assessment against the Background Noise Level.

Within section 1 'Scope', paragraph 1.3 states:

"The standard is not intended to be applied to the rating and assessment of sound from:
a) recreational activities, including all forms of motorsport."

Whilst a comparison with Background Noise Levels could be undertaken, there is no way of determining the impact on noise-sensitive properties or the likelihood of complaints from this noise type. It is therefore not considered appropriate to use the British Standard for the assessment of this type of activity and clearly should not be used.

5.4. Transient Sounds

To assess noise from short term sources, we have considered separately the noise from shouts, whistles and the impact of balls on the perimeter fence. There is no specific guidance for the maximum noise level of environmental noise during the daytime and, as such, we have taken a pragmatic approach in considering the most appropriate available guidance.

By assessing both the equivalent noise level for continuous use of the AGP and the maximum noise level of discrete events, we consider that this addresses the character of the noise.

5.5. Comparative Assessment

The criteria set out in section 4.1 is an absolute level in a dwelling or external amenity area. As such, it does not consider existing noise levels on or around the site. However, for certain applications it may be more suitable to consider a comparative assessment as part of the overall impact assessment.

For example, this would be a site where the existing noise levels already exceed the WHO guideline values. This existing noise for example, could be due to transportation noise or other sporting facilities.

In terms of noise level changes, withdrawn Planning Policy Guidance 24 states in the Glossary under dB (A) the following:

"Measurements in dB (A) broadly agree with people's assessment of loudness. A change of 3 dB (A) is the minimum perceptible under normal conditions, and a change of 10 dB (A) corresponds roughly to halving or doubling the loudness of a sound. The background noise 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)."

The Institute of Environmental Management and Assessment (IEMA) Guidelines for Environmental Noise Impact Assessment, Version 1.2 published in November 2014 categorises the significance of a change in noise level, this is summarised as follows and taken from Table 7-14 of the guidance.

Table 3: IEMA Impact from the Change in Sound Levels (Table 7-14)

Sound Level Change LpT	Long-term impact classification	Short-term impact classification
≥ 0 dB and < 1 dB	Negligible	Negligible
≥ 1 dB and < 3 dB		Minor
≥ 3 dB and < 5 dB	Minor	Moderate
≥ 5 dB and < 10 dB	Moderate	Major
≥ 10 dB	Major	

5.6. Proposed Assessment Methodology

The aim of the assessment is to determine whether noise from the proposed pitch can be controlled to acceptable levels during the proposed hours of use.

It is proposed to assess the development against the WHO guidelines. Where the predicted noise level of the AGP is below the WHO guidelines threshold for the onset of 'moderate annoyance'.

Where noise from the proposed development does not exceed the existing noise climate, the increase in noise will be no more than 3 decibels. It is expected there will be no observed effect on nearby residential properties. This would be applicable where noise levels currently exceed the WHO guidelines which would be used as a lower limit. The noise levels are both measured in the $L_{Aeq(T)}$ parameter over the same time period, T.

Where noise levels do not exceed the WHO guidelines, a higher change could be considered acceptable without having an observed adverse effect as the noise levels are suitably low as it is below the threshold for the onset of moderate annoyance.

In terms of the NPPG, the development will have 'no observed adverse effect'. The NPPG states that the perception of 'No Observed Adverse Effect' is 'noticeable and not intrusive' and gives an example outcome as follows:

"Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life."

The 'No Observed Adverse Effect' level falls below the Lowest Observed Adverse Effect Level of the NPPG.

It is also considered necessary to consider the maximum noise levels generated by the use.

6. Noise Levels of AGP Use

Noise levels were measured at nine sports sessions on three separate AGPs. The measurements included football, hockey and rugby, with men, women and children participating in different sessions. The purpose of the measurements was to determine a 'typical' noise level for an AGP sports session.

Measurements were undertaken behind the goal line and to the side-line at the halfway line. It was found that noise levels at the halfway line were generally higher than behind the goal.

Noise levels from sporting activity were generally determined by person's voices. This is except for hockey where the balls hitting the backboard of the goal and perimeter boards of the pitch are the main noise sources. The pitch surface is primarily for football and can be used for rugby, it is not suitable for hockey and is not expected to be used for hockey.

From the measurement data, a typical free-field noise level of 58 dB LAeq (1 hour) at a distance of 10 metres from the side-line at the halfway line has been determined as representative for noise from an AGP. The following table summarises the measurement data undertaken.

Table 4: Summary of Measured Noise Levels

Monitoring Session	AGP Activity	Measured Noise Level, $L_{Aeq\ (1\ hour)}$ dB
1	Rugby training on one half of the pitch with approximately 20 players and football training on the other half with approximately 20 players.	60
1	8 a-side training match on one half of the pitch only with the other half unused.	56
1	Football training for a single club of approximately 22 players. The start of the session involved heading drills before the full pitch was used to play an 11 a-side game.	56
1	Ladies Hockey Club training involving stick drills, passing etc., with multiple balls per team and therefore a lot of impact noise from stick on ball. Approximately 30 players on the pitch.	56
1	Ladies Hockey Club undertaking defence/attack drills on different halves of the pitch. Single ball used per team with less stick on ball impacts than previous training. Approximately 30 players on the pitch.	58
1	Men's 6 a-side social football match using half the pitch and hockey goals (12 players).	51
2	Under sixteen football training with the pitch divided into four quarters and a total of approximately fifty players.	58
2	Two adult football games using half the pitch each with a total of 28 players.	56
2	Two 8 a-side adult football games using half the pitch each with a total of 32 players.	56

The following sections provide information on the measurements undertaken to determine the typical AGP noise levels stated above.

6.1. Noise monitoring session 1 – 18th February 2014

Measurements were undertaken at two AGP pitches at Coombe Dingle Sports Complex in Bristol. The Complex is owned and operated by the University of Bristol. The complex has one sand dressed pitch and a newer synthetic pitch.

Noise measurements were undertaken using CEL and B&K sound level meters. The equipment information and calibration status is as follows:

Table 5: Measurement Equipment – session 1

Equipment Description / Manufacturer / Type	Serial number	Date of calibration	Calibration Certification Number
Real Time Analyser, B & K Type 2250-A	3000994	12/03/13	K017112
Pre-Amplifier, B & K, Type ZC0032	14611	12/03/13	K017112
Microphone, B & K, Type 4189	2638388	12/03/13	K017112
Calibrator, B&K Type 4231	1934013	12/03/13	K017111
Real Time Analyser, CEL, Type 593	100972	17/06/2013	K031407
Pre-Amplifier, CEL, Type 527	3/0232063	17/06/2013	K031407
Microphone, GRAS 40AE	34509	17/06/2013	K031407
Calibrator, CEL, Type 284/2	5819051	17/06/2013	K031408

During the noise monitoring the conditions were calm, dry and overcast with an air temperature of 7 degrees centigrade. The conditions were considered suitable for noise monitoring.

Measurements of the synthetic pitch were undertaken at monitoring location 'A' 10 metres from the edge of the pitch on a slightly raised bund. The monitoring location had a full view of the pitch.

Measurements of the sand based pitch were undertaken at monitoring location 'B' 10 metres from the edge of the pitch on a slightly raised bund. The monitoring location had a full view of the pitch.

After the monitoring session, when there was no use of the pitch a five minute ambient noise measurement was undertaken, this was due to distant road traffic on the M5 to the South West.

The monitoring locations and pitches are shown below. The monitoring locations were selected to reduce, as far as feasible, noise contributions from the other pitch.

Figure 2: Monitoring Location Site Plan – session 1

The activities that took place during the monitoring session on each pitch are as follows:

Synthetic AGP

19:00 hours to 20:00 hours

Clifton Hockey Club Ladies First Team. For first 30 minutes exercise and running drills without sticks or balls. The most significant noised was from player's voices but some extraneous noise from the other pitch (rugby and football training) was observed. Approximately 15 players on the pitch.

The second 30 minutes of the session involved the first team on one half and the third team on the other. The activities involved stick drills, passing etc, with multiple balls per team and therefore a lot of impact noise from stick on ball. Approximately 30 players on the pitch.

20:00 hours to 21:00 hours

Clifton Hockey Club Ladies first and third teams (approximately 30 players) undertaking defence/attack drills on different halves of the pitch. Single ball used per team so less stick on ball impacts than previous training.

21:00 hours to 22:00 hours

Men's 6-a-side social football match using half the pitch and hockey goals. It was observed that noise from the other pitch during this session was significant at the monitoring location.

Sand-Dressed Pitch

19:00 hours to 20:00 hours

Rugby training on one half of the pitch with approximately 20 players and football training on the other half with approximately 20 players.

20:00 hours to 21:00 hours

8-a-side training match on one half of the pitch only with the other half unused.

21:00 hours to 22:00 hours

Football training for a single club of approximately 22 players. The start of the session involved heading drills before the full pitch was used to play an 11-a-side game.

Measured Noise Levels

Noise measurements were undertaken at monitoring locations 'A' and 'B'; the measured noise levels have been corrected for ambient noise determined from the noise measurements undertaken after the pitches were in use.

The pitch noise levels are as follows:

Table 6: Measured Noise Levels

Session Period	Synthetic pitch Monitoring location 'B'		Sand dressed pitch Monitoring location 'A'	
	$L_{Aeq\ (1\ hour)}$	$L_{Amax\ (fast)}$	$L_{Aeq\ (1\ hour)}$	$L_{Amax\ (fast)}$
19:00 to 20:00 hours	56	83	60	78
20:00 to 21:00 hours	58	86	56	82
21:00 hours to 22:00 hours	51	78	56	78

6.2. Noise monitoring session 2 – 5th March 2014

Measurements were undertaken at a 3G AGP pitch at Clifton College Sports Ground on the outskirts of Bristol. The complex has a number of artificial pitches, the newest one being the 3G pitch on which monitoring took place.

Noise measurements were undertaken using Svantek and B&K sound level meters. The equipment information and calibration status is as follows:

Table 7: Measurement Equipment – session 2

Equipment Description / Manufacturer / Type	Serial number	Date of calibration	Calibration Certification Number
Real Time Analyser, B & K Type 2250-A	3000994	12/03/13	K017112
Pre-Amplifier, B & K , Type ZC0032	14611	12/03/13	K017112
Microphone, B & K, Type 4189	2638388	12/03/13	K017112
Calibrator, B&K Type 4231	1934013	12/03/13	K017111
Sound Level Meter, Svantek 959	14784	08/04/13	K0200009
Calibrator, CEL, Type 110	045169	08/04/13	K020983
Microphone, GRAS 40AE	98073	08/04/13	K0200009

During the noise monitoring the conditions were calm, dry and overcast with an air temperature of 8 degrees centigrade. The conditions were considered suitable for noise monitoring.

Measurements of the pitch were undertaken at monitoring location 'A' 10 metres behind the goal line of the pitch and monitoring location 'B' 10 metres from the halfway line of the pitch. The monitoring locations had a full view of the pitch.

The monitoring locations are shown below.

Figure 3: Monitoring Location Site Plan – session 2

The activities that took place during the monitoring session are as follows:

18:00 hours to 19:00 hours

Under sixteen football training with the pitch divided into four quarters and a total of approximately fifty players.

19:00 hours to 20:00 hours

Two adult football games using half the pitch each with a total of 28 players.

20:00 hours to 21:00 hours

Two 8 a-side adult football games using half the pitch each with a total of 32 players.

Measured Noise Levels

Noise measurements were undertaken at monitoring locations 'A' and 'B'; the pitch noise levels are as follows:

Table 8: Measured Noise Levels

Session Period	Monitoring location 'A' Behind Goal Line		Monitoring location 'B' On Halfway Line	
	$L_{Aeq(1\ hour)}$	$L_{Amax(fast)}$	$L_{Aeq(1\ hour)}$	$L_{Amax(fast)}$
18:00 to 19:00 hours	42 dB	71 dB	58 dB	82 dB
19:00 to 20:00 hours	39 dB	71 dB	56 dB	76 dB
20:00 to 21:00 hours	39 dB	65 dB	56 dB	85 dB

7. Site Noise Monitoring

An attended site noise survey was undertaken on the 16th of August 2022. The purpose of the site survey was to determine the existing noise climate at a location representative of the nearest residential property during the hours of proposed operation.

The measurements were undertaken generally in accordance with British Standard 7445. Sound pressure levels were measured using a Class 1 sound level meter, with a half-inch condenser microphone, using the 'fast' setting. The equipment is checked regularly using a Quality System meeting the requirements of British Standard EN ISO/IEC 17025:2005, and in accordance with British Standard EN 10012:2003, and traceable to the National Standards. This equipment was checked and calibrated as noted below and the certificates are available for inspection.

7.1. Monitoring Equipment

Sound Pressure Levels were measured using a Class 1 sound level meter with a half-inch condenser microphone, using the 'fast' setting. The equipment is checked regularly using a Quality System meeting the requirements of British Standard EN ISO/IEC 17025:2017 "General requirements for the competence of testing and calibration laboratories"; in accordance with British Standard EN 10012:2003 "Measurement management systems. Requirements for measurement processes and measuring equipment"; and traceable to the National Standards.

This equipment was checked and calibrated as noted below and the certificates are available for inspection.

Table 9: Equipment and Calibration Status

Equipment Description / Manufacturer / Type	Serial number	Date of calibration	Calibration Certification Number
SLM, NTI, XL2	A2A-19045-E0	09/07/2021	UK-21-058
Pre-Amp, NTI, MA220	9568	09/07/2021	UK-21-058
Microphone, NTI, MC230A	A19772	09/07/2021	UK-21-068
Calibrator, Larson Davis, CAL200	13392	17/11/2021	39495

The measurement system was checked before and after use with the calibrator and no significant drift was detected.

7.2. Weather Conditions

The monitoring was carried out in generally dry conditions with wind speeds below 5 m/s and temperatures approximately 19 degrees Celsius. A summary of the weather conditions during the survey are presented below.

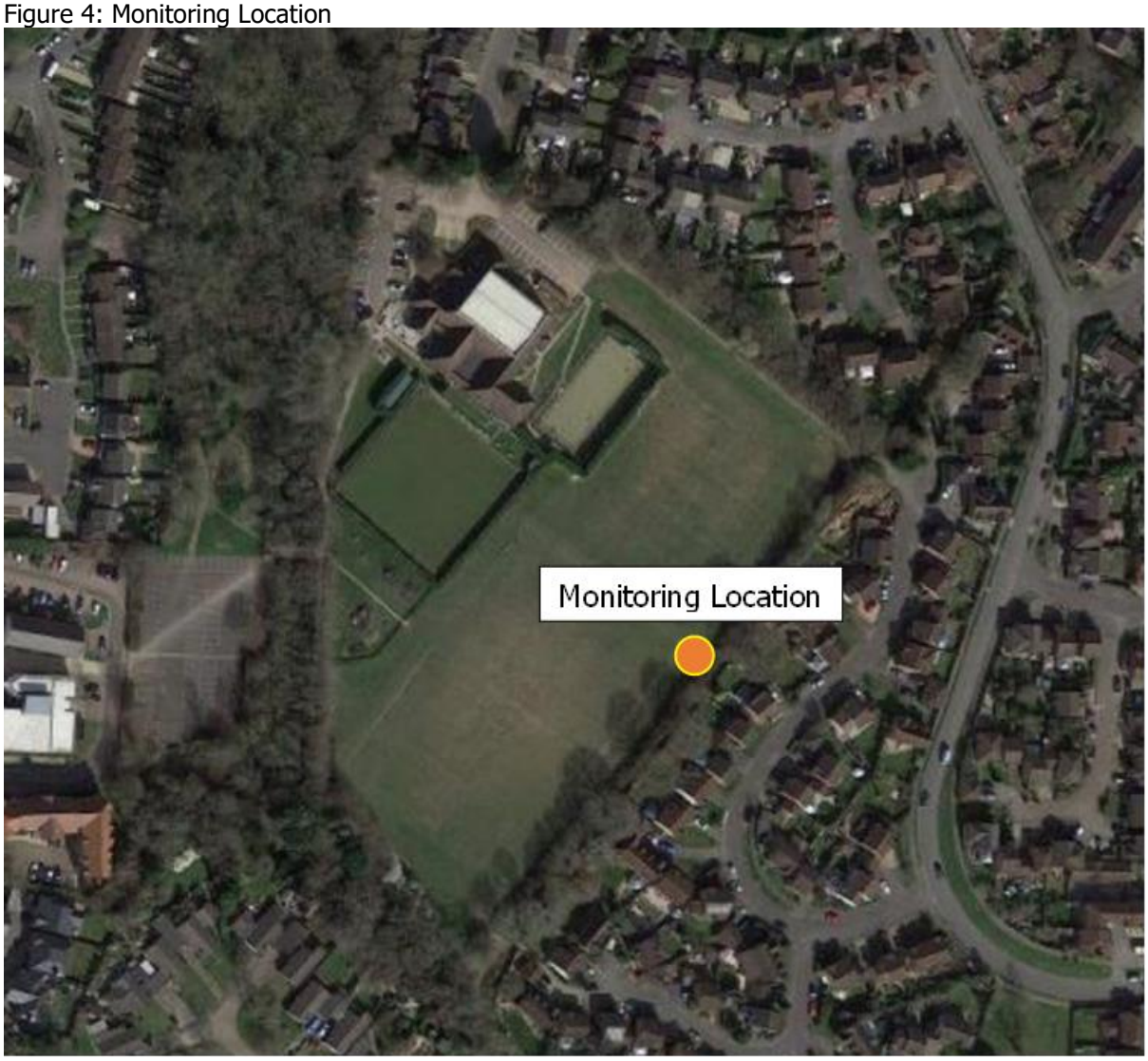
Table 9: Weather summary

Survey Date	Wind Speed (m/s)	Prevailing Wind Direction	Average Air Temperature (°C)	Precipitation (time/hrs)	Cloud Cover (%)
16/08/2022	4.5	E / ESE / SE	19	0	5

7.3. Monitoring Procedure

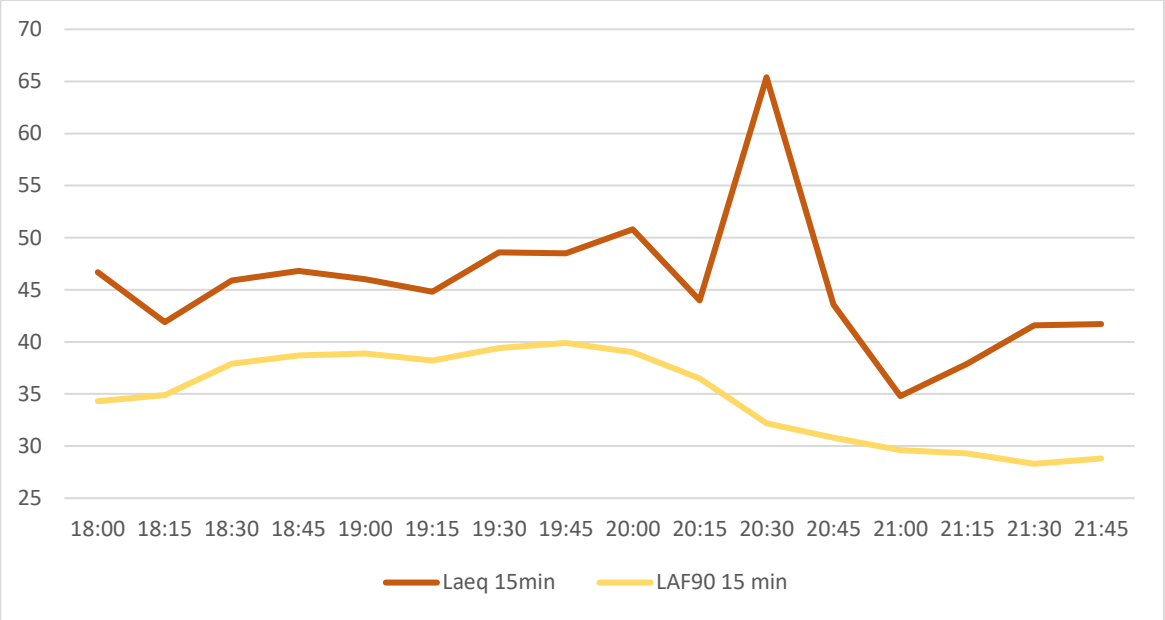
The equipment was set up in free-field position, on a tripod 1.5 metres above the ground. The monitoring location is shown below in Figure 4. Noise monitoring was undertaken at a location which was representative of the boundary of the nearest NSR.

Figure 4: Monitoring Location



The following charts provide the measurement noise levels for the duration of the measurement period.

Chart 1: Measured noise levels at the monitoring location



From Chart 1 it is apparent that there is a non-typical period at 20:30. This was caused by a number of dog walkers shouting close to the measurement location. For use in the assessment this 15-minute period has been excluded as it is not representative of the typical level.

The proposed AGP will just be used during the daytime hours up until 22:00. The following table provides the noise levels measured for the final 4 hours of this period.

The levels measured during this four-hour period are likely to be representative of the lowest levels through the daytime period and thus represent a worst case for level for assessment. As mentioned above, the measurement period of 20:30 – 20:45 has been excluded.

Table 10: Measured noise levels

Time	$L_{Aeq,1\ hour}$ (dB)
18:00 – 18:59	46
19:00 – 19:59	47
20:00 – 20:59	47
21:00 – 21:59	40

8. Noise Modelling Methodology

The measured AGP noise emission data has been used to generate a noise map of the site, in order to predict the noise level at the nearby noise-sensitive residential properties.

The modelling has been undertaken using noise mapping software CadnaA by Datakustik. This uses the calculation method of ISO 9613 to predict noise levels.

The assessment is based on the noise modelling methodology using an area source covering the playing surface as the noise source. The area source is at a height of 1.5 metres representative of head height.

To validate the modelling methodology, we have created a noise map of one of the sites where AGP noise was measured (Coombe Dingle in Bristol). The noise map in Figure 4 shows the noise propagation of an area source created from thirty moving point sources. The second noise map (5) shows the noise propagation of thirty individual point sources spread across the playing surface.

Figure 5: Noise model using an area source

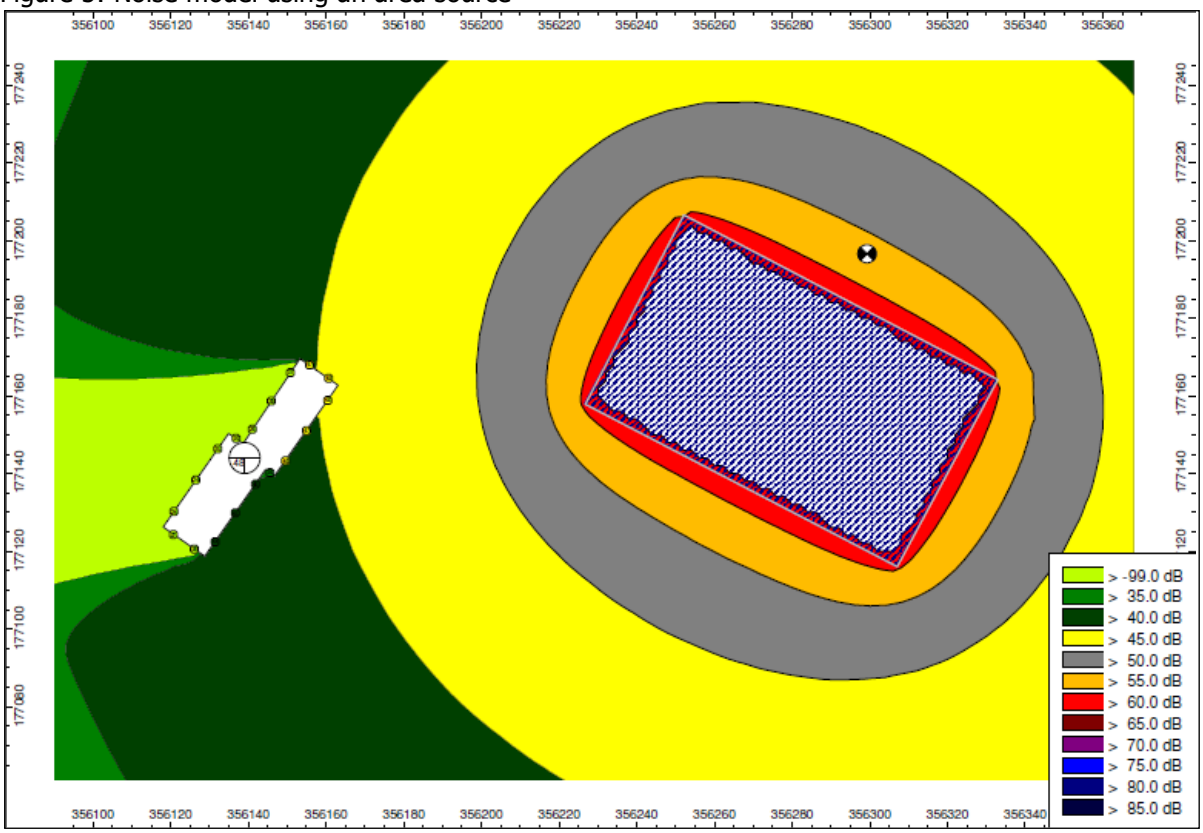
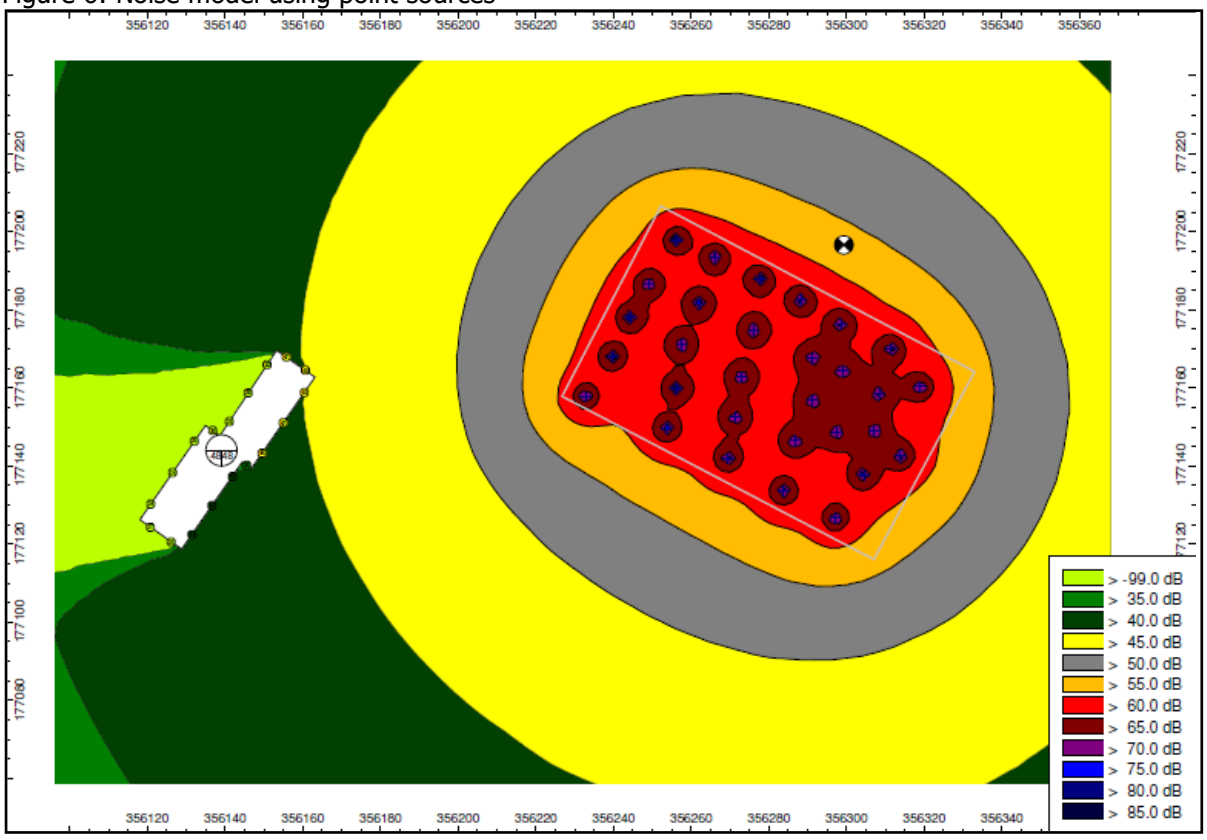


Figure 6: Noise model using point sources



As can be seen from the two maps, there is no significant difference in the noise propagation and as such, it is our opinion that an area source is suitable for noise modelling of AGPs.

9. AGP Predicted Noise Levels

A noise model has been generated of the development site. The location has been determined from the drawing SCS-MUK3202-1-02.

The surrounding area has been determined from Google Maps imagery.

The ground of the playing fields is considered to be 'soft' (i.e. grass) for the purposes of the assessment. Roads and car parks are considered to be 'hard' surfaces, where a ground absorption of zero has been assumed.

Residential buildings in the vicinity of the playing fields have been built within the model. The height of these buildings has been determined via Google Maps imagery.

The noise from an AGP is primarily from voice. The noise source is at a height of 1.5 metres above the ground (approximately head height).

The ground topography has been determined by Environment Agency LiDar data. The height of the pitch has been modified in the model to reflect that stated on the drawing.

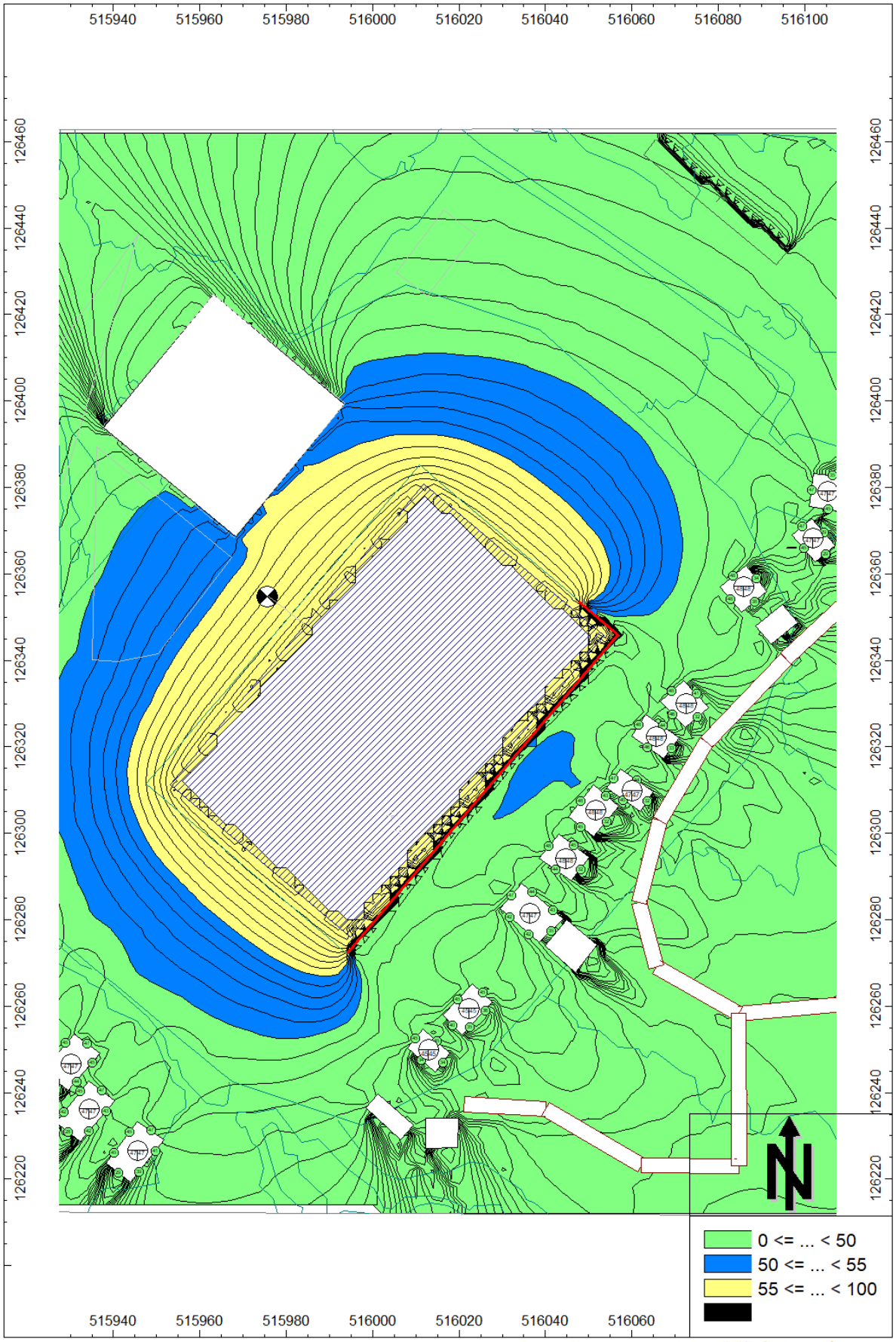
Third-order reflections are calculated.

Initial noise modelling has determine the need for a 3.5m acoustic barrier to protect dwellings to the South East. This barrier is to be constructed at the same ground level as the pitch approximately 500mm from the Weldmesh fencing. The barrier is to have a minimum surface density of 10 kilograms per metre squared and no gaps. The proposed barrier location is shown in red on the noise map below.

The sound reduction provided by the boundary fences around the gardens is not considered in the modelling as it cannot be demonstrated that the construction complies with the requirements of ISO 9613.

The noise map in Figure 7 below shows noise emission from the pitch predicted at ground floor level (1.5 metres above the ground), which is typical of a 'daytime' habitable room in a house and external amenity areas.

Figure 7: Predicted Noise Emission (1.5 metres above the ground).



The highest predicted noise levels from the proposed AGP at the ground floor façade of the worst-case residential property is 48 dB $L_{Aeq\ (1\ hour)}$.

The predicted noise levels at the nearby residential properties are below the proposed criterion of 50 dB $L_{Aeq\ (1\ hour)}$ derived from WHO1999 as being the threshold for the onset of moderate community annoyance.

The World Health Organisation provides a sound reduction through a partially open open window of 15 dB(A) from a façade level which results in a predicted internal equivalent noise level of 33 dB $L_{Aeq\ (1\ hour}$).

The World Health Organisation guidance states "To enable casual conversation indoors during daytime, the sound level of interfering noise should not exceed 35 dB L_{Aeq}." British Standard 8233:2014 provides the same noise criteria for a bedroom during the daytime period.

The highest predicted noise level in gardens is 49 dB $L_{Aeq\ (1\ hour)}$ which falls below the criteria at which moderate community annoyance in outside living areas (such as gardens) can begin to occur, stated in World Health Organisation 1999 as 50 dB L_{Aeq} (1 hour).

On the basis of the above, the proposals are considered acceptable in terms of noise.

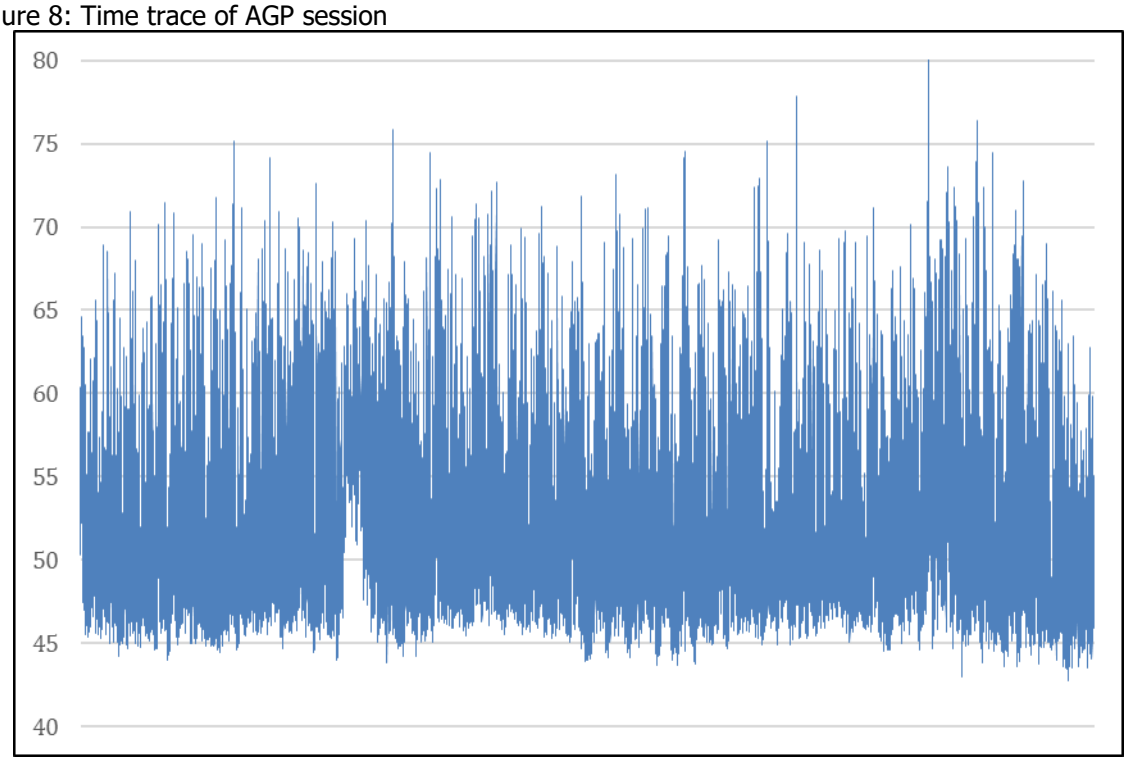
10. Assessment of Transient Noise Levels

The following section addresses the maximum noise levels generated by AGP activity. This would include whistles, voice, and ball impact.

In our opinion, considering the maximum noise level parameter as well as the equivalent noise level would address the character of the noise. Maximum noise levels would include sounds that make up the general noise from an AGP and would also determine the equivalent noise level. Examples of this would be the voices of players and coaches and impacts of balls on the fences.

The following figure shows the time trace (100ms) of noise from one of the measured AGP sessions stated in the noise impact assessment previously provided during the one-hour measurement period. During this measurement exercise there was football training for a single club of approximately 22 players. The start of the session involved heading drills before the full pitch was used to play an 11 a-side game. During the monitoring exercise maximum noise levels were generated by occasional shouts, whistles and balls hitting the fence.

Figure 8: Time trace of AGP session



The maximum noise levels are typically in the range of 70-75 dB(A).

It is not possible to accurately undertake a prediction for a maximum noise level in the same way as an equivalent noise level. This is because the maximum noise level by its nature takes place at a finite location whereas the equivalent noise level over a time period takes place over many locations across the pitch.

The following considers three noise sources, that from voice, whistle, and that from the impact of ball on fence.

10.1. Noise from Voice

If we consider the maximum noise level from voice, a typical level of shouting is in the order of 90dB(A) at 1 metre.

Noise modelling has been undertaken using noise mapping software Cadna:A by Datakustik. This uses the calculation method of ISO 9613 to predict noise levels. Predictions have been undertaken to determine the maximum noise levels from an individual point source at multiple locations around the pitch.

The highest predicted noise levels from the proposed AGP at the ground floor façade of the worst-case residential property is 49 dB L_{AFmax}.

10.2. Noise from Whistle

Measurements have been previously undertaken to determine the noise level from an Acme Thunderer referees whistle. The measured maximum noise level was 85dB $L_{Amax(fast)}$ at a distance of 10 metres.

Noise modelling has been undertaken using noise mapping software Cadna:A by Datakustik. This uses the calculation method of ISO 9613 to predict noise levels. Predictions have been undertaken to determine the maximum noise levels from an individual point source at multiple locations around the pitch.

The highest predicted noise levels from the proposed AGP at the ground floor façade of the worst-case residential property is 64 dB L_{AFmax}.

10.3. Noise from Ball Impact

Noise is generated when a ball hitting the fence panel causes it to rattle against the supporting post and adjoining and overlapping adjacent fence panel. To minimise this noise, it is recommended that neoprene isolators are located between the panels and the posts.

Measurements of ball impact upon a fence were undertaken at a recently completed AGP in Swindon, Wiltshire.

The fence under tests was 4.5 metres tall with neoprene isolators between the panels and posts as proposed for this project. The neoprene isolators, fence and monitoring set up is shown in the figures below.

Figure 9: Image showing neoprene isolators

Figure 10: Fence and tests setup

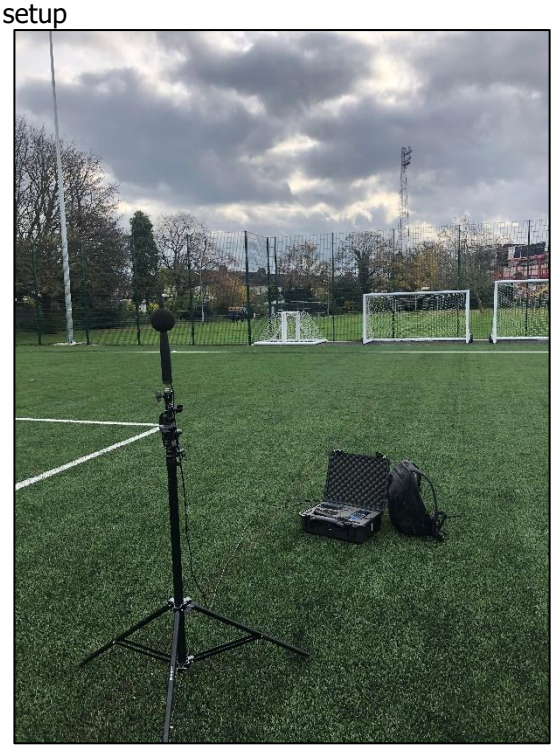
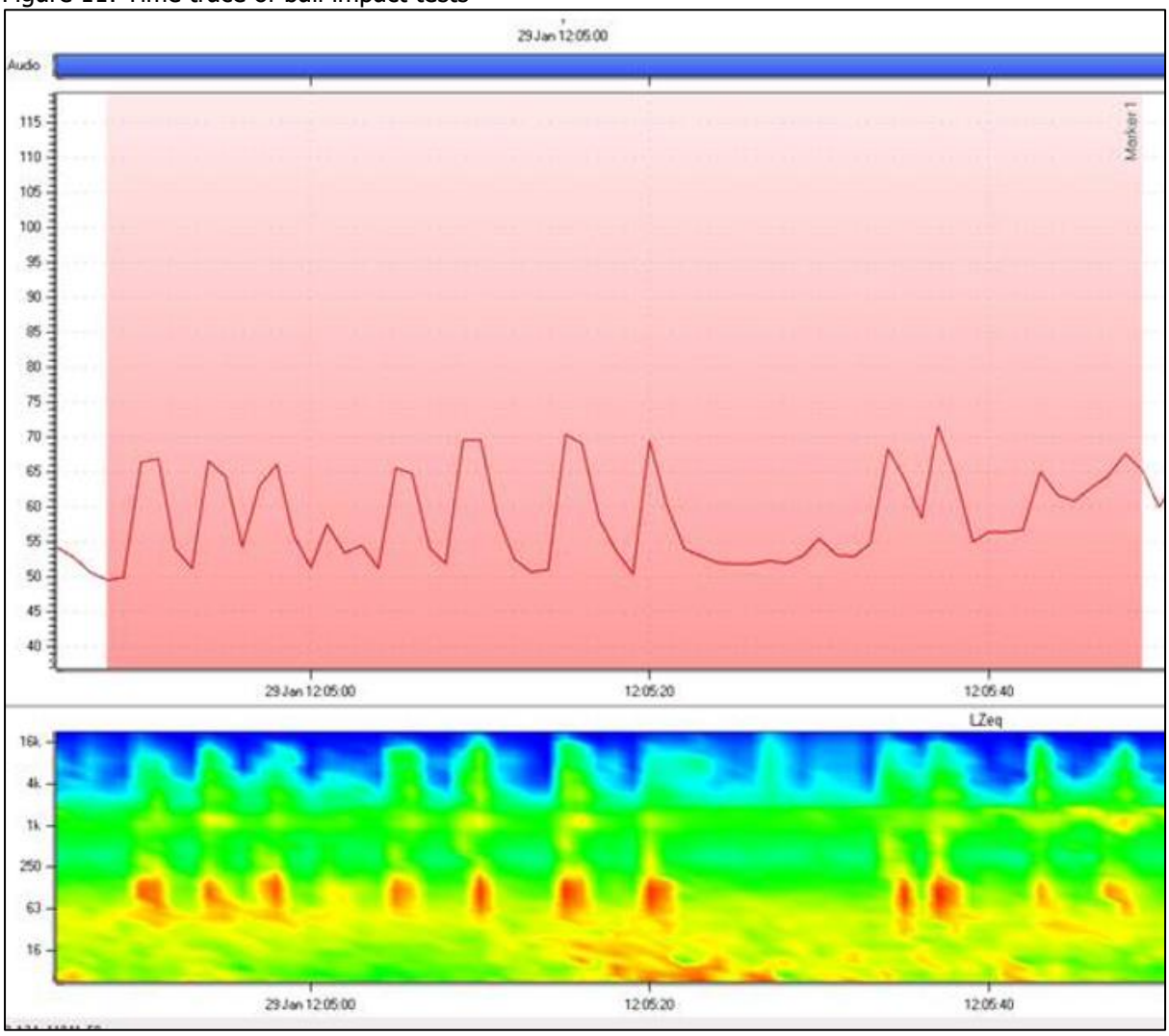


Figure 11 shows the time trace and spectral content of the fence impact tests.

Figure 11: Time trace of ball impact tests



The typical level of a loud ball impact is around 66-70 dB $L_{Amax(fast)}$ at 20 metres.

To determine the possible impact of ball hitting the fence panel noise modelling has been undertaken using noise mapping software Cadna:A by DataKustik. This uses the calculation method of ISO 9613 to predict noise levels. Predictions have been undertaken to determine the maximum noise levels from an individual point source at multiple locations around the pitch.

The highest predicted noise levels from the proposed AGP at the ground floor façade of the worst-case residential property is 64 dB L_{AFmax}.

10.4. Assessment of Maximum Noise Levels

There are no specific noise criteria for maximum noise levels from this type of noise during the day. There is a night-time maximum noise criterion of 45dB $L_{Amax(fast)}$ for bedrooms at night in BS8233:2014 and WHO1999. With sound reduction through an open window this would equate to 60dB $L_{Amax(fast)}$ outside a dwelling.

During the daytime, a higher maximum noise level is likely to be permissible but is not stated in any relevant guidance documents. The difference between the daytime and night-time equivalent noise criteria in both WHO and BS8233:2014 is 5 decibels, it may therefore be that a 5 decibel increase to the maximum noise level is appropriate. This produces a 60 dB $L_{Amax\ (fast)}$ + 5dB assessment criteria of 65 dB $L_{Amax\ (fast}$.

The predicted maximum noise levels from voices, whistles and ball impacts are predicted to be below 65dB $L_{Amax(fast)}$ externally and thus, considered acceptable.

11. Impact on Existing Noise Climate

The impact of the proposals on the existing noise climate has been assessed using the IEMA guidelines, predicted noise level at the façade of the residential property and existing noise levels.

The following table gives overall change in noise level and IEMA classification at the most noise sensitive location based on proposed pitch operation and predicted noise levels above. These were found to be dwellings located to the south-east of the proposed pitch.

Table 11: Change in noise levels

Time	Existing Equivalent Noise Level	Predicted Equivalent Noise Level	Change	Long-term Classification
18:00	46	48	+4.1	Minor
19:00	47		+3.5	Minor
20:00	47		+3.5	Minor
21:00	40		+8.6	Moderate

Based on the IEMA guidelines the proposals result in a minor to moderate change in noise levels to the residential houses to the East of the site.

Whilst there is the potential for a moderate impact on the existing noise climate to occur between 21:00 and 22:00 on the the generated noise levels from the AGP are still below that which, based on WHO 1999, result in the onset of annoyance. On this basis the noise will likely be audible but is not considered to have an observed adverse impact and is thus considered acceptable.

12. Noise Management Plan

The assessment undertaken in this report considers noise levels against relevant criteria to avoid an adverse effect on nearby residential properties.

In addition to the level of noise, it is also important to consider the content. From past experience, we have found that where complaints have been made it is often due to anti-social behaviour such as swearing. Anti-social behaviour is not necessarily related to the noise level and is something that cannot effectively be 'engineered out'.

As such, it is proposed that a noise management plan is implemented as part of the development.

The noise management plan should include a method of informing the users that swearing and anti-social behaviour is unacceptable and that the centre reserves the right to dismiss users from the pitch and ban future use if this is the case.

It is advised that neighbours are given a facility to report excessive noise or anti-social behaviour directly to the operator. This will allow the complaint to be investigated and addressed quickly.

It is important that complaints are investigated swiftly, that action is taken where necessary and that the complainant is kept informed of progress, especially where it is not possible to address or resolve complaints straight away.

Staff at the site should have a written action plan to deal with complaints. This would include the ability to warn or ban user groups from the pitches. A log of complaints should also be kept.

It is also advised that all perimeter fencing is fixed to the support posts with a neoprene isolator installed to fully isolate the panels from the posts. This measure greatly reduces the 'rattling' associated with ball impacts on metal fencing.

The noise management plan should make it clear to those using the pitch should avoid the use of whistles.

13. Summary and Conclusions

S & C Slatter appointed Acoustic Consultants Limited to undertake an environmental noise assessment for the proposed new Artificial Grass Pitch located at The Ghyll, Southwater, West Sussex. The assessment considered the impact of environmental noise on the nearby noise-sensitive residential properties.

The proposed hours for the AGP are to be up until 22:00 Monday – Friday and up until 18:00 Saturday & Sunday. The nearest noise sensitive residential receivers in respect to the proposed AGP are understood to be the dwellings to the East of the site on York Close, with the AGP proposed at 35-40m to the nearest property.

The assessment includes the prediction of noise emission from the AGP at the nearby noise-sensitive properties, based on noise level data from activities measured at existing AGPs.

Noise levels were measured at nine sports sessions on four separate AGPs. The measurements included football, hockey and rugby, with men, women and children participating in different sessions. The purpose of the measurements was to determine a 'typical' noise level for an AGP sports session.

A noise model has been generated of the development site, utilising the previous measurements as its basis.

Noise modelling has determine the need for a 3.5m acoustic barrier to protect dwellings to the South East. This barrier is to be constructed at the same ground level as the pitch approximately 500mm from the Weldmesh fencing. The barrier is to have a minimum surface density of 10 kilograms per metre squared and no gaps. The proposed barrier location is shown in red on the noise map below.

The highest predicted noise levels from the proposed AGP at the ground floor façade of the worst-case residential property is 48 dB $L_{Aeq\ (1\ hour)}$.

The predicted noise levels at the nearby residential properties are below the proposed criterion of 50 dB $L_{Aeq\ (1\ hour)}$ derived from WHO1999 as being the threshold for the onset of moderate community annoyance.

The World Health Organisation provides a sound reduction through a partially open open window of 15 dB(A) from a façade level which results in a predicted internal equivalent noise level of 33 dB $L_{Aeq\ (1\ hour}$).

The World Health Organisation guidance states "To enable casual conversation indoors during daytime, the sound level of interfering noise should not exceed 35 dB L_{Aeq}." British Standard 8233:2014 provides the same noise criteria for a bedroom during the daytime period.

The highest predicted noise level in gardens is 49 dB $L_{Aeq\ (1\ hour)}$ which falls below the criteria at which moderate community annoyance in outside living areas (such as gardens) can begin to occur, stated in World Health Organisation 1999 as 50 dB L_{Aeq} (1 hour).

On the basis of the above, the proposals are considered acceptable in terms of noise.

The predicted maximum noise level from voices, ball impacts and whistles have been assessed and are considered to be acceptable.

The impact of the proposals on the existing noise climate has been assessed using the IEMA guidelines, predicted noise level at the façade of the residential property and existing noise levels. Based on the IEMA guidelines the proposals result in a minor to moderate change in noise levels to the residential houses to the East of the site.

Whilst there is the potential for a moderate impact on the existing noise climate to occur between 21:00 and 22:00 on the the generated noise levels from the AGP are still below that which, based on WHO 1999, result in the onset of annoyance. On this basis the noise will likely be audible but is not considered to have an observed adverse impact and is thus considered acceptable.

A noise management plan has also been proposed.

With regards to planning policy, we would expect that the development would potentially be noticeable but not intrusive and would result in 'no observed adverse effect'. This is defined in the NPPG as 'Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life'.

On the basis of the above, the proposals are considered acceptable in terms of noise.

14. Appendix 1 – Glossary of Acoustic Terminology

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

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

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

where:

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

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

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

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

Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$ – value of the A-weighted sound pressure level in decibels of continuous steady sound that, within a specified time interval, T = t2 – t1, has the same mean-squared sound pressure as a sound that varies with time, and is given by the following equation:

$$L_{AeqT} = 10\lg_{10}\left\{(1/T)\int_{t1}^{t2}[p_A(t)^2/p_0^2]dt\right\} \quad (1)$$

where:

p_0 is the reference sound pressure (20 µPa); and
$p_A(t)$ is the instantaneous A-weighted sound pressure (Pa) at time t

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

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

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

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

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

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

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

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

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

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

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

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

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

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