Appendix: Noise and Vibration

Annex 1: Glossary

Annex 1 Glossary of Terms

'A' weighting	Frequency weighting based on the frequency response of the human ear which has been found to correlate well with the subjective response to sound.
Decibel (dB)	A logarithmic unit used for many acoustic values to indicate the level with respect to a reference level
Frequency	The number of cycles per second. The unit of frequency is the Hertz (Hz). Frequency gives a sound its distinctive tone.
Hz	Hertz (Hz) is the unit of frequency (see also 'Frequency')
$L_{A90,T}$	The A-weighted sound pressure level exceeded 90% of the measurement period (T) over which a noise is measured (ie, the quietest 10% of the period). When not weighted it is denoted $L_{90,T}$. This parameter is generally considered to be representative of a constant noise source, or background noise level.
$L_{Aeq,T}$	Equivalent A-weighted sound pressure level of a steady noise that has the same acoustic energy as a fluctuating noise over the measurement period (T). When not weighted it is denoted $L_{eq,T}$.
$L_{Amax,T}$	The highest A-weighted sound pressure level measured in the period (T) with either fast (L_{AFmax}) or slow (L_{ASmax}) time weightings. When not weighted it is denotedL_{Fmax} or L_{Smax}.
SEL	Sound Exposure Level (SEL), is the A-weighted sound pressure level which, if occurring over a period of one second, would contain the same amount of A-weighted sound energy as the event.
VDV	Vibration Dose Value (VDV), is a cumulative vibration level received over an 8-hour or 16-hour period. Used to assess human response to vibration.
PPV	Peak Particle Velocity (PPV), a measure of vibration in mm/s, used to assess likelihood of damage and perceptibility of vibration.
Free-field noise level	A noise level measured at least 3 m from the building façade and does not contain reflected sound.

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Facade noise level	A noise level measured close to (1-2 m) from the façade of a building, which contains a reflection of sound from the building. Façade noise levels are 3 dB higher than the equivalent free-field noise level measured

Annex 2: Legislation, Planning Policy and Other Relevant Standard and Guidance

Annex 2 Legislative and Planning Policy Context

Control of Pollution Act 1974

Powers are given to Local Planning Authorities (LPAs) under the Control of Pollution Act 1974 (COPA) for the control of noise from construction sites. Sections 59A, 60 and 61 of COPA 1974 allow LPAs to serve notices imposing conditions on the way in which construction work is conducted. It is a criminal offence to contravene such a notice without a reasonable excuse, which can be avoided provided the work is carried out under a consent issued under Section 61 of the Act. Such consents may be applied for in advance of construction work being carried out.

LPAs can produce Regulations to control noise from plant or machinery under Section 68 of COPA 1974, but the reference is generally to use codes of practice issued under Section 71 to minimise noise. Although breach of a code of practice is not a criminal offence, these may be taken into account in legal proceedings.

Under COPA 1974, a LPA may designate all or part of its area as a noise abatement zone. The consequence of this is that noise levels are recorded and entered into a public register. Noise levels may only exceed pre-defined limits with prior consent from the LPA.

National Planning Policy

National Planning Policy Framework, 2018

The National Planning Policy Framework (NPPF) sets out the government planning requirements, and supersedes previous guidance notes such as PPG24. No specific noise criteria are set out in the NPPF, or in the Noise Policy Statement for England (NPSE) to which it refers.

The NPPF states:

'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:

- *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 quality of life;*
- *Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason…'*

In addition, the following is noted:

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'Ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed.'

National Planning Practice Guidance, 2014

The National Planning Practice Guidance (NPPG) provides further context to the NPPF and the two documents should be read together. The document provides guidance on how to recognise when noise could be a concern and the factors that influence this, along with outline guidance on noise mitigation through engineering and design, etc.

Noise Policy Statement for England, 2010

The Noise Policy Statement for England (NPSE) sets out the long-term vision of Government noise policy. The NPSE states that its aims are 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 adopts established concepts from toxicology that can be applied to noise impacts. The concept details noise levels, at which the effects of an exposure may be classified into a specific category. The classification categories as detailed within the NPSE are as follows:

- No Observed Effect Level (NOEL) - the level below which no effect can be detected. Below this level no detectable effect on health and quality of life due to noise can be established;
- Lowest Observable Adverse Effect Level (LOAEL) - the level above which adverse effects on health and quality of life can be detected; and
- Significant Observed Adverse Effect Level (SOAEL) - the level above which significant adverse effects on health and quality of life occur.

The SOAEL does not have a single objective noise level that is applicable to all sources of noise in all situations and therefore, the SOAEL is likely to be different for different sources, different receptors and at different times of the day.

The first aim of the NPSE is to avoid significant adverse effects on health and quality of life, taking into account the guiding principles of sustainable development. The second aim considers situations where impacts are established between the LOAEL and SOAEL. In such circumstances, all reasonable steps should be taken to mitigate and minimise the effects. However, this does not mean that such adverse effects cannot occur. The third aim seeks to improve health and quality of life, where possible, through the pro-active management of noise, whilst also taking account of the guiding principles of sustainable development.

DEFRA have led a study to identify the SOAEL and LOAEL for a limited range of noise sources. The study was understood to have ended in 2012. However, no guidance from this research has been issued at the time of writing (August 2018).

Regional Planning Policy

The South East Plan

The South East Plan was adopted in May 2009. However, in March 2013, most of the South East Plan (except for Policy NRM6: Thames Basin Heath SPA) was revoked. As a result, the South East Plan now consists of Policy NRM6. There is no material consideration as part of this development.

Local Planning Policy

Woking 2027 (Local Development Documents)

Woking Borough Council have collated all the Local Development Documents (LDDs) together in what is referred to as Woking 2027. The LDDs give guidance on planning and development within the borough until 2027.

Woking 2027 comprises the Woking Core Strategy (2012), Development Management Policies Development Pan Document (DPD) (2016), proposal maps and various neighbourhood specific plans.

Woking Core Strategy (2012)

Woking Core Strategy contains the following relevant local policy, namely CS21 *Design and* CS23 *Renewable and low carbon energy generation*.

CS21 states:

> *Proposals for new development should meet the criteria below:*
>
> *….be designed to avoid significant harm to the environment and general amenity, resulting from noise, dust, vibrations, light or other releases.*

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CS23 states:

> *… Applicants should take appropriate steps to mitigate any adverse impacts of proposed development through careful consideration of location, scale, design and other measures. All reasonable steps to minimise noise impacts should be taken.*

Development Management Policies Development Pan Document (2016)

Development Management Policies Development Pan Document (DPD) contains the following relevant local policy, namely DM3 *Facilities for outdoor sport and outdoor recreation,* DM5 *Environmental pollution* and DM7 *Noise and Light Pollution*. The most applicable and practical of these policies is DM7, which is summarised below:

> *The council will require noise generating forms of development or proposal that would affect noise-sensitive uses to be accompanied by a statement detailing potential noise generation levels and any mitigation measures proposed to ensure that all noise is reduced to an acceptable level…*
>
> *…Development will only be permitted where mitigation can be provided to an appropriate standard with an acceptable design, particularly in proximity to sensitive existing uses or sites.*
>
> *Development proposals for noise sensitive uses in areas of significant existing environmental or neighbourhood noise will only be supported where the need for development outweighs impacts on amenity of future occupiers, and where a robust scheme of mitigation is provided. In general, the following values will be sought for residential development*
>
> *a) Daytime (7 am – 11 pm) 35 dB LAeq 16 hours in all rooms and 50 dB in outdoor living areas.*
>
> *b) Night time (11 pm 7 am) 30 dB LAeq 8 hours and LAmax less than 45 dB in bedrooms.*
>
> *For proposals involving residential and other noise-sensitive development that would be sited closed to commercial/industrial noise source, the Council will consider applications against the current version of BS 4142 (or any future equivalent) in order to assess the likelihood of complaints from future occupiers and therefore the acceptability of the proposed development. A similar approach will be taken for noise sensitive development sited close to any other form of noise-generating use.*

The reasoned justification provides further guidance, which references other documents listed in the Annex, ie, Control of Pollution Act, BS 8233, BS 4142, BS 5228 etc.

British standards and guidance

The following paragraphs summarise the outline assessment British Standards and guidance documents used to set target criteria for the identification of noise and vibration impacts:

Construction noise and vibration

Estimation of noise and vibration generated during each principal phase of the construction works and an assessment of the likely significant effects on surrounding sensitive receptors using the methodology set out in British Standard BS 5228:2009 Code of Practice for Noise and Vibration on Construction and Open Sites (Part 1: Noise, Part 2: Vibration).

Road traffic noise

For the assessment of noise associated with road traffic, reference will be made to the Calculation of Road Traffic Noise (CRTN). Further advice is also given in the Design Manual for Roads and Bridges (DMRB) for road traffic noise assessments. Each of these documents offer a means of predicting noise levels and changes in noise level and assessment of the impact of the changes. Guidance on the impact assessment of traffic noise is provided within the Institute of Environmental Management and Assessment (IEMA) Guidance Note No. 1 Guidelines for the Environmental Assessment of Road Traffic.

Building services noise egress

For the assessment of building services noise egress, reference will be made to BS 4142:2014: Methods for Rating and Assessing Industrial and Commercial Sound. The standard provides a method of measuring background noise levels and assessing the likelihood of complaint regarding external noise levels. The noise level resulting from plant operation is measured or predicted at a distance of one metre from the facade of the nearest noise sensitive premises. The plant noise level is compared to the existing background noise level in the area, as determined by a noise survey, over the proposed operational hours.

Human response to vibration

British Standard BS 6472-1: Guide to Evaluation of Human Exposure to Vibration in Buildings. Part 1: Vibration Sources other than Blasting. BS 6472-1 provides guidance on the measurement and assessment of vibration levels affecting humans in buildings resulting from sources such as road and rail traffic or building services systems. The probability of adverse comment is assessed by considering the vibration dose value (VDV), which quantifies the total exposure to vibration over a specified period.

IEMA Guidelines for Environmental Noise Impact Assessment, 2014

IEMA Guidelines for Environmental Noise Impact Assessment 2014. The IEMA guidelines set out guidance on significance criteria for noise impact based on the changes in noise levels.

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ProPG: for planning and noise, 2017

The Professional Practice Guidance on Planning and Noise (ProPG) is a recently introduced document that provides guidance on the management of noise within the planning system in England.

The document emphasises that good acoustic design should avoid 'unreasonable' acoustic conditions and prevent 'unacceptable' acoustic conditions both internally (inside noise-sensitive parts within buildings), and externally in spaces intended for amenity purposes. The document highlights that care should be taken not to over-design mitigation, and states that:

"Good acoustic design should provide an integrated solution whereby the optimum acoustic outcome is achieved, without design compromises that will adversely affect living conditions and the quality of life of the inhabitants or other sustainable design objectives and requirements."

This typically involves careful consideration of:

- Checking the feasibility of relocating or reducing noise levels from relevant sources
- Consider options for planning the site or building layout
- Consider the orientation of proposed building(s)
- Select construction types and methods for meeting building performance requirements
- Examine the effects of noise control measures on ventilation, fire regulation, health and safety cost, CDM etc
- Assess the viability of alternative solutions.

Internal and external noise levels for residential development

For the assessment of noise ingress into the introduced apartments and in amenity spaces, reference will be made to BS 8233:2014: Guidance on sound insulation and noise reduction for buildings. The standard provides recommendations on acceptable internal noise levels within different building uses, including residential. Recommendations are also provided for acceptable noise levels in residential amenity spaces amongst other things.

Annex 3: Environmental Noise and Vibration Report

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19108-R02-A

22 May 2019

Woking Football Club, Woking

Environmental noise survey report

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Version	Date	Comments	Author	Reviewer
A	22 May 19		Vynn Keane Lim	Philip Owen

Summary

Sandy Brown has been appointed to provide acoustic advice in relation to the proposed development at Woking Football Stadium.

An environmental noise survey has been carried out to determine the existing background and ambient sound levels in the area. The results from the survey will be used to access potential noise impacts from the proposed development site and establish the baseline conditions of the site, the current noise generated by the football stadium and form the basis of design.

The unattended noise survey was performed between 12:10 on 6 April 2019 and 17:55 on 13 April 2019.

The attended noise survey was performed on two days, between 13:40 to 17:15 on 6 April 2019 and 13:35 to 17:00 on 13 April 2019.

The representative background sound levels measured during the survey were:

- Location A: $L_{A90,5min}$ 45 dB during the daytime and $L_{A90,\ 5min}$ 30 dB at night,
- Location B: $L_{A90,5min}$ 44 dB during the daytime and $L_{A90,\ 5min}$ 43 dB at night,
- Location C: $L_{A90,5min}$ 43 dB during the daytime and $L_{A90,\ 5min}$ 29 dB at night.

The ambient sound levels measured during the survey were:

- Location A: $L_{Aeq,5min}$ 52 dB during the daytime and $L_{Aeq,5min}$ 45 dB at night,
- Location B: $L_{Aeq,5min}$ 50 dB during the daytime and $L_{Aeq,5min}$ 47 dB at night,
- Location C: $L_{Aeq,5min}$ 50 dB during the daytime and $L_{Aeq,5min}$ 42 dB at night.

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Contents

1 Introduction

Sandy Brown has been appointed to provide acoustic advice in relation to the proposed development at Woking Football Stadium.

As part of this, an environmental noise survey has been completed, the purpose of which is to establish the existing background and ambient sound levels on non-match days and match days. The results from the survey will be used to access potential noise impacts from the proposed development site and establish the baseline conditions of the site, the current noise generated by the football stadium and form the basis of design.

This report presents the survey method and results of the environmental noise survey.

2 Site description

2.1 The site and its surrounding

The site location in relation to its surroundings is shown in Figure 1, where the site is outlined in red. The site is currently occupied by the existing football ground and a collection of large buildings, including a David Lloyd Club. It is bound by residential properties along Kingfield Road and Kingfield Drive to the north, a football field and residential properties along Westfield Road to the south, residential properties in Kingfield Close to the east and Westfield Ave to the west and south.

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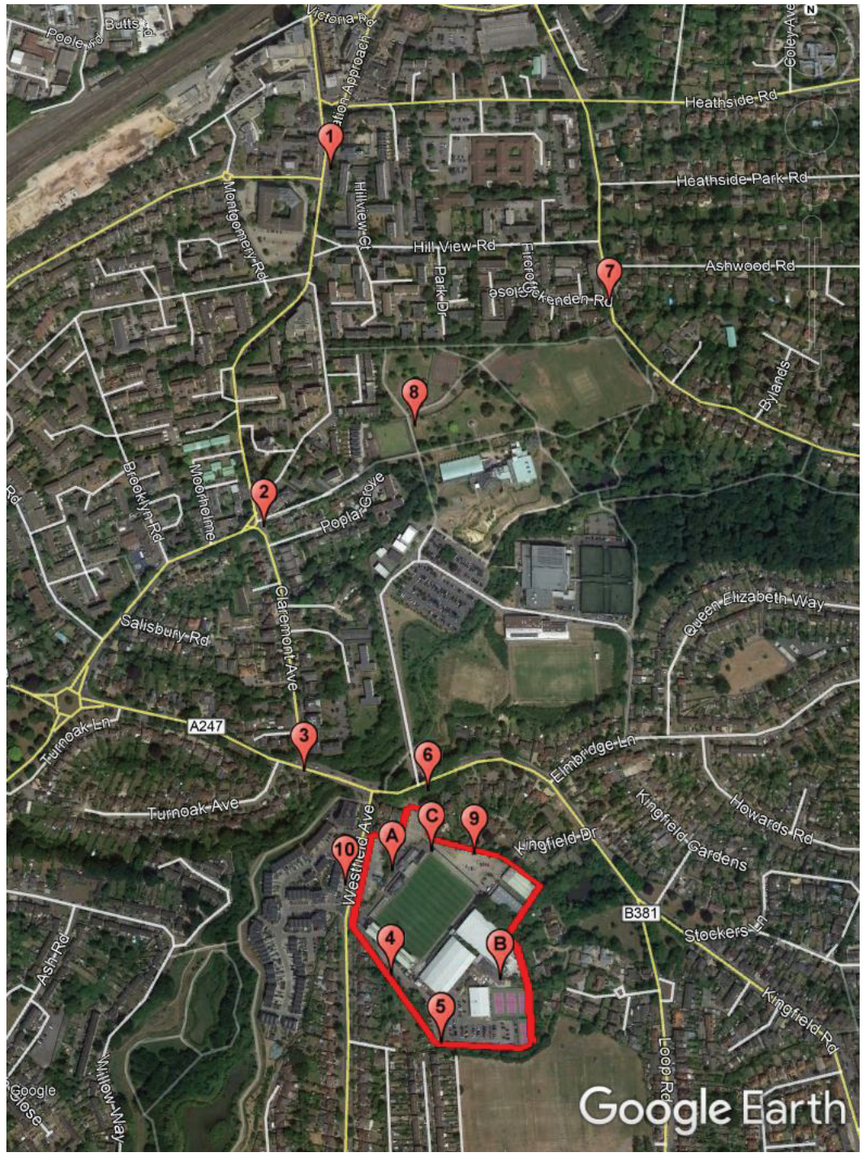

Figure 1 Site map (courtesy of Google Earth Pro)

2.2 Adjacent premises

The site is situated adjacent to predominantly residential properties.

3 Method

Details of the equipment used, the noise indices and the weather conditions during the survey are provided in Appendix A. Further information on the specific survey method is provided in this section.

3.1 Unattended measurements

Unattended noise monitoring was undertaken at the site over 8 days to determine the existing background sound levels and ambient sound levels in the vicinity of nearby noise sensitive premises.

The unattended measurements were performed over 5 minute periods between 12:10 on 6 April 2019 and 17:55 on 13 April 2019. The equipment was installed by Philip Owen and Nicolas Lum, and collected by Philip Owen and Vynn Keane Lim.

The measurement positions used during the survey are indicated in Figure 1, denoted by the letters ‘A’ for Location A, ‘B’ for Location B, ‘C’ for Location C. Photographs showing the measurement locations are provided in Figure 2 and Figure 3. These locations were chosen to be reasonably representative of the noise conditions surrounding the football stadium.

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Figure 2 Unattended noise measurements at Location A (left) and Location C (right)

Noise measurements at Location A and Location C were taken approximately 3 m above ground floor.

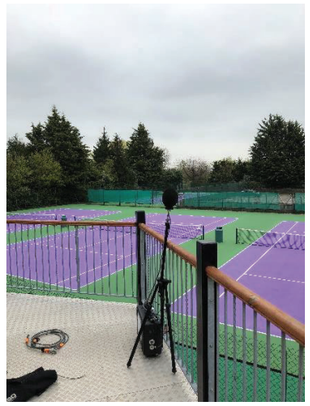

Figure 3 Unattended noise measurements at Location B

Noise measurements at Location B were taken approximately 1.2-1.5 m above floor of the balcony of the David Lloyds Club.

3.2 Attended measurements

Attended sample measurements were performed by Philip Owen and Vynn Keane Lim at a number of locations. These are indicated in Figure 1 as positions 1 to 10. The attended measurements were carried out on 6 April 2019 and 13 April 2019, over 5 minute periods.

On 6 April 2019, the measurements were carried out with the purpose of determining the existing noise levels during a match day along with any other significant noise sources.

On 13 April 2019, the measurements were carried out with the purpose of determining the existing noise levels during a non-match day along with any other significant noise sources.

Photographs of the measurement locations are indicated in Figure 4 to Figure 8. In each case the microphone was mounted on a tripod approximately 1.5 m above the ground level and at least 3 m from any other reflective surface.

A description of each measurement position is provided in Section 4.3.

Figure 4 Attended monitoring at Positions 1 (left) and 2 (right)

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Figure 5 Attended monitoring at Positions 3 (left) and 4 (right)

Figure 6 Attended monitoring at Positions 5 (left) and 6 (right)

Figure 7 Attended monitoring at Positions 7 (left) and 8 (right)

Figure 8 Attended monitoring at Positions 9 (left) and 10 (right)

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4 Measurement results

4.1 Observations

The noise sources for the unattended and attended surveys are described in Section 4.2 and Section 4.3 respectively.

4.2 Unattended measurement results

The results of the unattended noise measurements are summarised in the following tables. A graph showing the results of the unattended measurements is provided in Appendix B.

The day and night time ambient noise levels measured during the unattended survey are presented in Table 1, Table 3 and Table 5.

4.2.1 Location A – Elevation above pitch facing Westfield Avenue

The dominant noise sources observed at Location A were crowd noise during setting up (match day) and traffic noise from Westfield Avenue during collection (non-match day).

Less significant noise sources included occasional patron noise from the nearby club bar.

Table 1 Ambient noise levels measured during the survey for Location A

Date	Daytime (07:00 – 23:00) $L_{Aeq,16h}$ (dB)	Night (23:00 – 07:00) $L_{Aeq,8h}$ (dB)
Saturday 6 April 2019	-	44
Sunday 7 April 2019	50	45
Monday 8 April 2019	53	46
Tuesday 9 April 2019	53	45
Wednesday 10 April 2019	52	45
Thursday 11 April 2019	52	45
Friday 12 April 2019	54	44
Average	52	45

Table 2 shows a comparison of match and non-match day ambient noise between 15:00 to 17:00. The comparison also includes the highest maximum levels L_{AFmax}, and the lowest background levels $L_{A90,5min}$ experienced during this period.

Table 2 Comparison of match and non-match day noise levels for Location A

Day	$L_{Aeq,2hr}$ dB (15:00 – 17:00)	L_{AFmax} dB (maximum)	$L_{A90,5min}$ dB (lowest)
Match day	74	98	61
Non match day	62	86	46

In line with BS 4142:2014, for the purpose of analysis and establishing representative background sound levels, day and night time typical levels have been quantified using statistical analysis from the continuous logging measurements.

Daytime and night time statistical analysis of representative values for Location A are given in Figure 9 and Figure 10.

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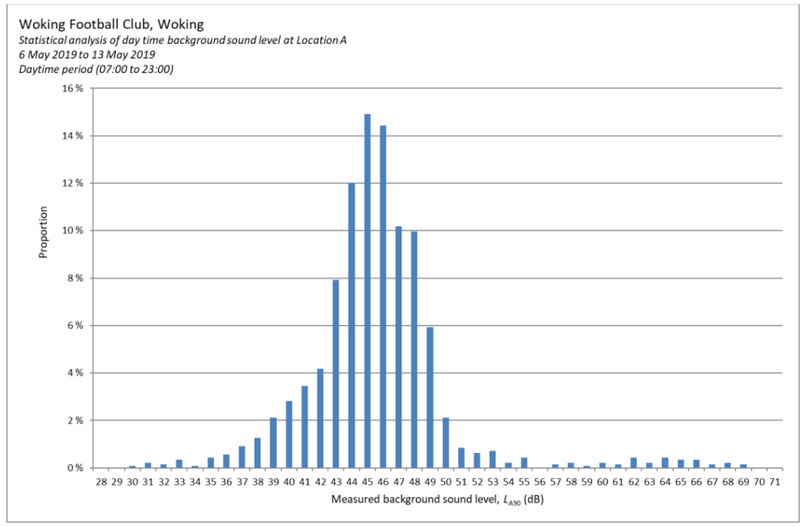

Figure 9 Statistical analysis of day time background sound level at Location A

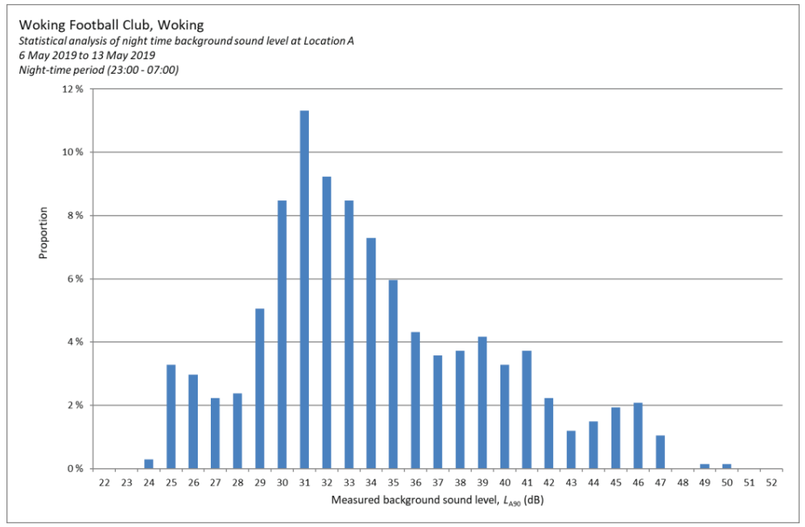

Figure 10 Statistical analysis of night time background sound level at Location A

From this analysis, the representative background sound levels measured for Location A during the survey were $L_{A90,5min}$ 45 dB during the daytime and $L_{A90,5min}$ 30 dB at night.

4.2.2 Location B – David Lloyd Club

The dominant noise sources observed at Location B during setting up and collection consisted of building services plant noise associated with the club.

Less significant noise sources included club members using the tennis courts.

Table 3 Ambient noise levels measured during the survey for Location B

Date	Daytime (07:00 – 23:00) $L_{Aeq,16h}$ (dB)	Night (23:00 – 07:00) $L_{Aeq,8h}$ (dB)
Saturday 6 April 2019	-	45
Sunday 7 April 2019	49	45
Monday 8 April 2019	50	47
Tuesday 9 April 2019	52	48
Wednesday 10 April 2019	50	49
Thursday 11 April 2019	50	48
Friday 12 April 2019	51	48
Average	50	47

Table 4 shows a comparison of match and non-match day ambient noise levels between 15:00 to 17:00. The comparison also includes the highest maximum levels L_{AFmax}, and the lowest background levels $L_{A90,5min}$ experienced during this period.

Table 4 Comparison of match and non-match day noise levels for Location B

Day	$L_{Aeq,2hr}$ dB	L_{AFmax} dB (maximum)	$L_{A90,5min}$ dB (lowest)
Match day	53	75	45
Non match day	49	70	44

In line with BS 4142:2014, for the purpose of analysis and establishing representative background sound levels, day and night time typical levels have been quantified using statistical analysis from the continuous logging measurements.

Daytime and night time statistical analysis of representative values for Location B are given in Figure 11 and Figure 12.

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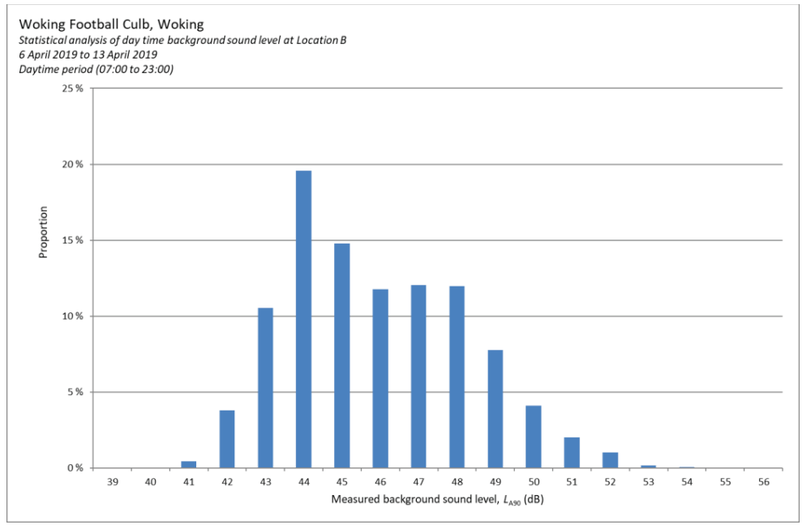

Figure 11 Statistical analysis of day time background sound level at Location B

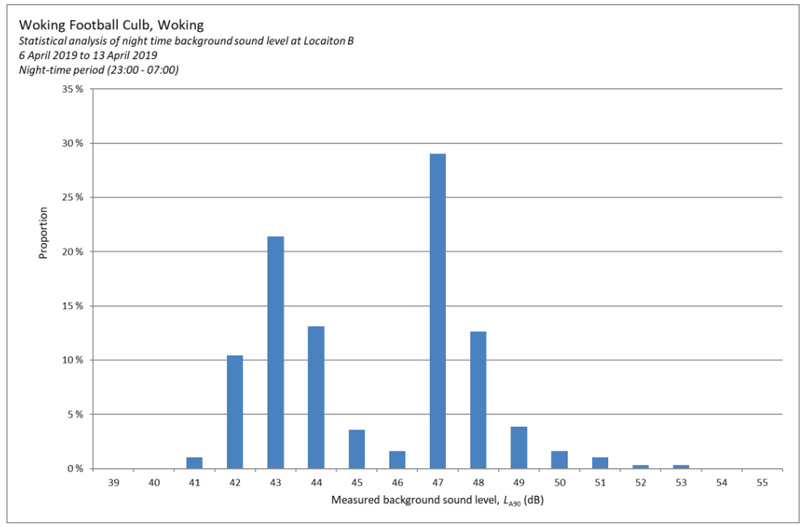

Figure 12 Statistical analysis of night time background sound level at Location B

From this analysis, the representative background sound levels measured for Location B during the survey were $L_{A90,5min}$ 44 dB during the daytime and $L_{A90,5min}$ 43 dB at night.

4.2.3 Location C – Pitch side

The dominant noise sources observed at Location C were crow noise during setting up (match day) and distant screened traffic noise during collection (non-match day).

Table 5 Ambient noise levels measured during the survey for Location C

Date	Daytime (07:00 – 23:00) $L_{Aeq,16h}$ (dB)	Night (23:00 – 07:00) $L_{Aeq,8h}$ (dB)
Saturday 6 April 2019	-	41
Sunday 7 April 2019	47	40
Monday 8 April 2019	51	46
Tuesday 9 April 2019	51	41
Wednesday 10 April 2019	49	42
Thursday 11 April 2019	52	42
Friday 12 April 2019	51	42
Average	50	42

Table 6 shows a comparison of match and non-match day ambient noise levels between 15:00 to 17:00. The comparison also includes the highest maximum levels L_{AFmax}, and the lowest background levels $L_{A90,5min}$ experienced during this period.

Table 6 Comparison of match and non-match day noise levels for Location C

Day	$L_{Aeq,2hr}$ dB	L_{AFmax} dB (maximum)	$L_{A90,5min}$ dB (lowest)
Match day	79	105	65
Non match day	64	89	46

In line with BS 4142:2014, for the purpose of analysis and establishing representative background sound levels, day and night time typical levels have been quantified using statistical analysis from the continuous logging measurements.

Daytime and night time statistical analysis of representative values for Location C are given in Figure 13 and Figure 14.

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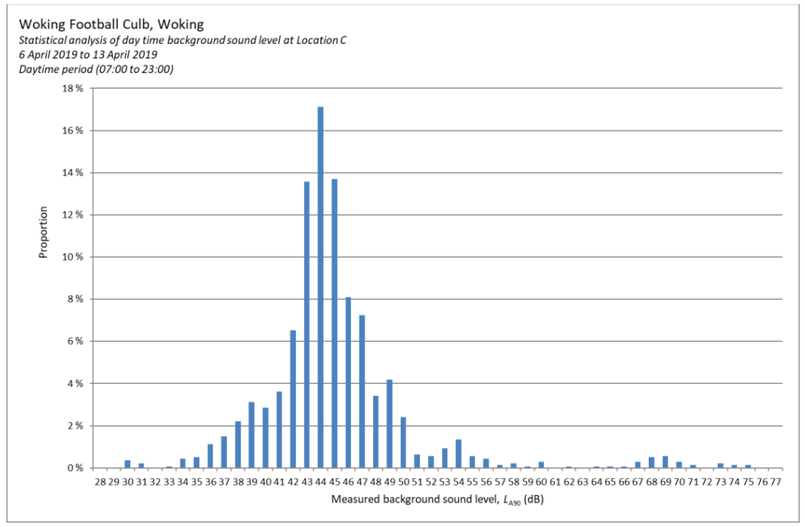

Figure 13 Statistical analysis of day time background sound level at Location C

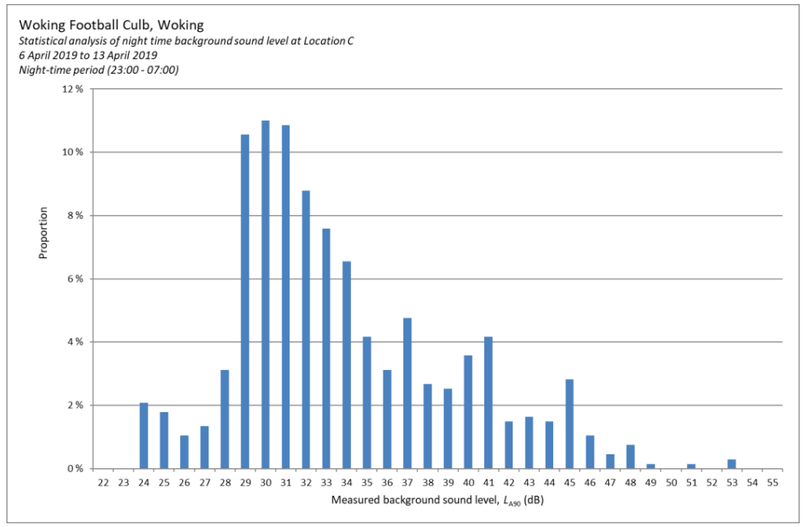

Figure 14 Statistical analysis of night time background sound level at Location C

From this analysis, the representative background sound levels measured for Location C during the survey were $L_{A90,5min}$ 43 dB during the daytime and $L_{A90,5min}$ 29 dB at night.

4.3 Attended measurement results

The locations of the attended measurements are indicated in Figure 1 as positions 1 to 10. The sound pressure levels recorded during the attended measurements are summarised in the following sections. The dominant noise sources noted during the measurements are also described in the tables. All the attended measurements were performed over 5 minute periods. All measurements taken are considered as free-field measurements.

Table 7 to Table 26 lists the measured sound pressure levels and relevant notes about the samples, including the dominant noise source observed for each position on match day and non-match day.

4.3.1 Position 1 – Guildford Road

The measurements at Position 1 were taken along Guildford Road.

Table 7 Sound pressure levels from attended measurements at Position 1 during match day

Start time	Sound pressure levels (dB)			Noise sources
	$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
13:40	71	79	64	Traffic along Guildford Road and football supporters.
13:50	84*	111*	62	
13:55	69	71	69	

* Anomalous measurement due to football supporters shouting close to measurement position

Table 8 Sound pressure levels from attended measurements at Position 1 during non-match day

Start time	Sound pressure levels (dB)			Noise sources
	$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
13:40	73	85	63	Traffic along Guildford Road.
13:45	72	82	59	
13:50	72	89	63	

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4.3.2 Position 2 – Claremont Avenue (junction)

The measurements at Position 2 were taken at the junction of Claremont Avenue and Guildford Road.

Table 9 Sound pressure levels from attended measurements at Position 2 during match day

Start time	Sound pressure levels (dB)			Noise sources
	$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
14:10	68	84	65	Road traffic.
14:15	68	78	63	
14:20	69	78	66	

Table 10 Sound pressure levels from attended measurements at Position 2 during non-match day

Start time	Sound pressure levels (dB)			Noise sources
	$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
14:05	70	82	64	Road traffic.
14:10	68	84	65	
14:15	68	78	63	

4.3.3 Position 3 – Wych Hill Lane (junction)

The measurements at Position 3 were taken at the junction of Wych Hill Lane and Claremont Avenue.

Table 11 Sound pressure levels from attended measurements at Position 3 during match day

Start time	Sound pressure levels (dB)			Noise sources
	$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
14:35	65	75	58	Road traffic.
14:40	66	74	60	
14:45	66	75	59	
14:50	65	77	58	

Table 12 Sound pressure levels from attended measurements at Position 3 during non-match day

Start time	Sound pressure levels (dB)			Noise sources
	$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
14:25	69	84	60	Road traffic.
14:30	68	82	60	
14:35	69	91	60	

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4.3.4 Position 4 –Entrance to David Lloyd Club car park

The measurements at Position 4 were taken along the road of the David Lloyd Club car park entrance.

Table 13 Sound pressure levels from attended measurements at Position 4 during match day

Start time	Sound pressure levels (dB)			Noise sources
	$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
15:15	57	70	50	Noise from football stadium that consisted of crowd noise, PA system and a football match. Less significant noise sources included distant screened traffic from Westfield Avenue, faint operating condenser noise and birdsong.
15:20	60	74	49	
15:25	61	72	57	
15:50	57	71	49	
16:00	59	75	49	
16:05	64	95	49	

Table 14 Sound pressure levels from attended measurements at Position 4 during non-match day

Start time	Sound pressure levels (dB)			Noise sources
	$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
15:00	57	72	44	Noise from football stadium that consisted of people shouting and playing football. Distant screened traffic from Westfield Avenue. Less significant noise sources included faint operating condenser noise, birdsong and occasional PA system operating.
15:05	57	71	43	
15:10	56	71	42	
15:45	57	72	44	
15:50	54	71	44	
15:55	56	69	43	

4.3.5 Position 5 – David Lloyd Club car park

The measurements at Position 5 were taken facing the road of the David Lloyd Club car park.

Table 15 Sound pressure levels from attended measurements at Position 5 during match day

Start time	Sound pressure levels (dB)			Noise sources
	$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
15:35	58	73	54	Noise from football stadium that consisted of crowd noise, PA system and a football match. Less significant noise sources included cars occasionally driving into the car park. Leaf blower nearby operating during measurement 15:35.
15:40	55	65	48	
15:45	54	68	46	

Table 16 Sound pressure levels from attended measurements at Position 5 during non-match day

Start time	Sound pressure levels (dB)			Noise sources
	$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
15:20	48	64	41	Noise from football stadium and behind the car park that consisted of people shouting and playing football, and distant screened traffic from the surrounding roads. Less significant noise sources included cars occasionally driving into the car park, aircraft flyovers and birdsong.
15:25	49	65	41	
15:30	49	66	43	
16:05	48	66	41	
16:10	43	57	40	
16:15	54	68	40	

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4.3.6 Position 6 – Entrance of the stadium – Kingfield Road

The measurements at Position 6 were taken at the entrance of the stadium, facing Kingfield Road.

Table 17 Sound pressure levels from attended measurements at Position 6 during match day

Start time	Sound pressure levels (dB)			Noise sources
	$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
14:25	62	79	58	Noise from football stadium that consisted of crowd noise, PA system, football match. Traffic along Kingfield Road.
14:30	63	82	57	
14:35	64	77	58	
14:40	73	91	61	
14:45	66	78	61	
14:50	64	77	60	
16:20	65	82	58	
16:25	63	71	58	
16:30	69	90	59	
16:35	67	77	59	
16:40	64	75	59	
16:45	67	85	61	
16:50	66	76	62	
16:55	64	76	60	
17:00	70	84	61	
17:05	63	76	60	
17:10	69	87	60	

Table 18 Sound pressure levels from attended measurements at Position 6 during non-match day

Start time	Sound pressure levels (dB)			Noise sources
	$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
14:20	61	74	55	Traffic along Kingfield Road.
14:25	62	78	56	
14:30	60	72	54	
14:35	60	67	56	
14:45	60	67	55	
14:50	63	71	53	
16:30	61	66	55	
16:35	61	70	57	
16:40	60	70	54	

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4.3.7 Position 7 – Ockenden Road (junction)

The measurements at Position 7 were taken at the junction of Ockenden Road and White Rose Lane.

Table 19 Sound pressure levels from attended measurements at Position 7 during match day

Start time	Sound pressure levels (dB)			Noise sources
	$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
13:40	60	73	45	Traffic noise along Ockenden Road.
13:45	60	74	47	Less significant noise sources included pedestrians. Pedestrians were mostly football supporters.
13:50	58	74	44	

Table 20 Sound pressure levels from attended measurements at Position 7 during non-match day

Start time	Sound pressure levels (dB)			Noise sources
	$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
13:35	62	79	50	Traffic noise along Ockenden Road.
13:40	57	70	46	Less significant noise sources included pedestrians.
13:45	57	73	45	

4.3.8 Position 8 – Woking Park

The measurements at Position 8 were taken in Woking Park.

Table 21 Sound pressure levels from attended measurements at Position 8 during match day

Start time	Sound pressure levels (dB)			Noise sources
	$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
14:00	57	82	45	A crowd of loud football supporters, except for measurements during 16:30, 16:35, 16:40 and 17:15, where only non-football supporters were in the vicinity.
14:05	66	88	47	
14:15	50	63	46	
16:30	49	67	43	
16:35	49	71	42	
16:40	46	58	43	
16:45	55	75	43	
17:05	60	82	47	
17:10	57	78	50	
17:15	48	66	43	

Table 22 Sound pressure levels from attended measurements at Position 8 during non-match day

Start time	Sound pressure levels (dB)			Noise sources
	$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
14:00	47	57	42	Occasional on-site traffic.
14:05	48	60	42	
14:10	46	58	43	
16:45	49	66	44	
16:50	49	61	42	
16:55	49	74	43	

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4.3.9 Position 9 – Car park, northeast of stadium

The measurements at Position 9 were taken in the car park to the northeast of the stadium.

Table 23 Sound pressure levels from attended measurements at Position 9 during match day

Start time	Sound pressure levels (dB)			Noise sources
	$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
15:10	69	87	61	Noise from football stadium that consisted of crowd noise and occasional PA system operating.
15:15	67	80	59	
15:20	67	80	57	
16:00	66	83	52	
16:05	71	85	59	
16:10	66	80	56	

Table 24 Sound pressure levels from attended measurements at Position 9 during non-match day

Start time	Sound pressure levels (dB)			Noise sources
	$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
14:55	63	75	46	Noise from football stadium that consisted of PA system and football players shouting. Gardening noise nearby during measurement 14:55.
15:00	52	63	45	
15:05	53	76	43	
15:50	56	81	50	
15:55	53	62	48	
16:00	51	68	44	
16:25	51	69	43	
16:30	52	69	42	
16:35	57	74	43	

4.3.10 Position 10 – Westfield Avenue

The measurements at Position 10 were taken along Westfield Avenue.

Table 25 Sound pressure levels from attended measurements at Position 10 during match day

Start time	Sound pressure levels (dB)			Noise sources
	$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
15:25	65	79	58	Noise from football stadium that consisted of PA system and crowd noise. Less significant noise sources included traffic noise along Westfield Avenue.
15:30	68	82	59	
15:35	70	87	60	
15:40	68	83	58	
15:50	70	83	59	
15:55	67	79	61	

Table 26 Sound pressure levels from attended measurements at Position 10 during non-match day

Start time	Sound pressure levels (dB)			Noise sources
	$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
15:15	65	79	50	Traffic noise along Westfield Avenue. Less significant noise sources included noise from football stadium that consisted of PA system and football noise.
15:20	64	76	50	
15:25	64	77	50	
15:30	66	83	50	
15:35	65	79	51	
15:40	67	88	51	
16:05	63	78	46	
16:10	65	79	49	
16:15	65	79	49	

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5 Conclusion

A noise survey has been carried out to determine the existing background sound levels and ambient sound levels on non-match days and match days in the vicinity of the site and surrounding noise sensitive premises.

The results from the survey will be used to access potential noise impacts from the proposed development site and establish the baseline conditions of the site, the current noise generated by the football stadium and form the basis of design.

Appendix A

Survey details

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Equipment

Three Rion NL-52 sound level meters were used to undertake the unattended measurements. The attended measurements were carried out using one Rion NL-52 and two Brüel & Kjær sound level meters. The calibration details for the equipment used during the survey are provided in Table A1.

Table A1 Equipment calibration data

Equipment description	Type/serial number	Manufacturer	Calibration expiry	Calibration certification number
Sound level meter	NL-52/00320633	Rion	25 May 20	TCRT18/1462
Microphone	UC-59/12576	Rion	25 May 20	TCRT18/1462
Pre-amp	NH-25/10641	Rion	25 May 20	TCRT18/1462
Calibrator	N7-74/34125430	Rion	15 May 20	TRCT18/1420
Sound level meter	NL-52/00242702	Rion	30 Jan 21	TCRT19/1091
Microphone	UC-59/06185	Rion	30 Jan 21	TCRT19/1091
Pre-amp	NH-25/32730	Rion	30 Jan 21	TCRT19/1091
Calibrator	CAL200/4499	Larson Davis	30 Jan 21	TCRT19/1090
Sound level meter	NL-52/00375679	Rion	6 Jul 19	TCRT17/1440
Microphone	UC-59/11168	Rion	6 Jul 19	TCRT17/1440
Pre-amp	NH-25/65806	Rion	6 Jul 19	TCRT17/1440
Calibrator	SV30A/10576	Svan	3 Jul 19	TCRT17/1418
Sound level meter	NL-52/00264531	Rion	25 Jun 20	TCRT18/1553
Microphone	UC-59/09678	Rion	25 Jun 20	TCRT18/1553
Pre-amp	NH-25/64656	Rion	25 Jun 20	TCRT18/1553
Calibrator	NC-74/34367630	Rion	25 Jun 20	TCRT18/1551
Sound level meter	2250/3011195	Brüel & Kjær	21 Mar 21	UCRT19/1358, UCRT19/1356
Microphone	4189/3086746	Brüel & Kjær	21 Mar 21	UCRT19/1358, UCRT19/1356
Pre-amp	ZC0032/25565	Brüel & Kjær	21 Mar 21	UCRT19/1358, UCRT19/1356
Calibrator	4231/3017676	Brüel & Kjær	21 Mar 21	UCRT19/1355

Equipment description	Type/serial number	Manufacturer	Calibration expiry	Calibration certification number
Sound level meter	2250/3011096	Brüel & Kjær	14 Mar 21	UCRT19/1318, UTRC19/1319
Microphone	4189/3060575	Brüel & Kjær	14 Mar 21	UCRT19/1318, UTRC19/1319
Pre-amp	ZC0032/25430	Brüel & Kjær	14 Mar 21	UCRT19/1318, UTRC19/1319
Calibrator	4231/3017675	Brüel & Kjær	13 Mar 21	UCRT19/1316

Calibration of the sound level meters used for the tests is traceable to national standards. The calibration certificates for the sound level meters used in this survey are available upon request.

The sound level meters and microphones were calibrated at the beginning and end of the measurements using their respective sound level calibrators. No significant deviation in calibration occurred.

Noise indices

The equipment was set to record a continuous series of broadband sound pressure levels. Noise indices recorded included the following:

- $L_{Aeq,T}$ The A-weighted equivalent continuous sound pressure level over a period of time, T.
- $L_{AFmax,T}$ The A-weighted maximum sound pressure level that occurred during a given period with a fast time weighting.
- $L_{A90,T}$ The A-weighted sound pressure level exceeded for 90% of the measurement period. Indicative of the background sound level.

The L_{A90} is considered most representative of the background sound level for the purposes of complying with any local authority requirements.

Sound pressure level measurements are normally taken with an A-weighting (denoted by a subscript 'A', eg L_{A90}) to approximate the frequency response of the human ear.

A more detailed explanation of these quantities can be found in BS7445: Part 1: 2003 *Description and measurement of environmental noise, Part 1. Guide to quantities and procedures.*

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Weather conditions

During the attended measurements carried out on 6 April 2019, the weather was generally cloudy and dry and no rain occurred. Wind speeds varied between approximately 6 m/s and 5 m/s.

During the attended measurements carried out on 13 April 2019, the weather was generally clear and dry and no rain occurred. Wind speeds varied between approximately 6 m/s and 1 m/s.

During the unattended noise measurements between 6 April 2019 and 13 April 2019, weather reports for the area indicated that temperatures varied between 1°C at night and 12°C during the day, and the wind speed typically was less than 5 m/s.

These weather conditions are considered suitable for obtaining representative measurements.

Appendix B

Results of unattended measurements at Location A

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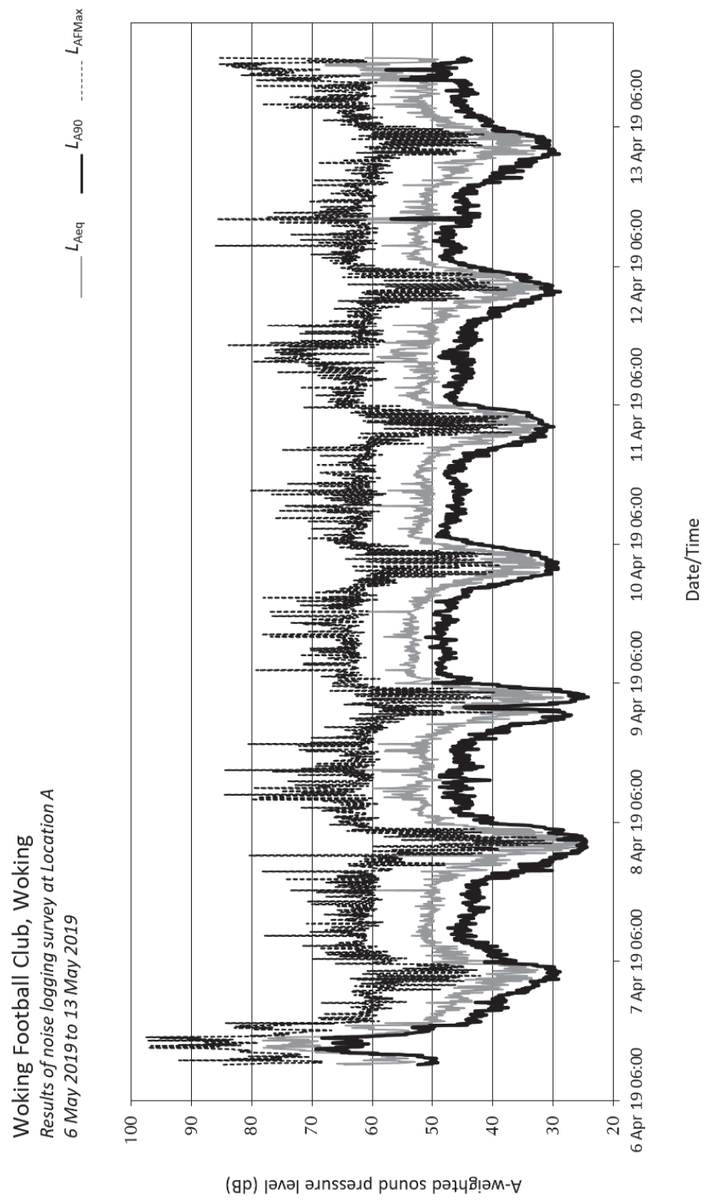

Results of unattended measurements at Location B

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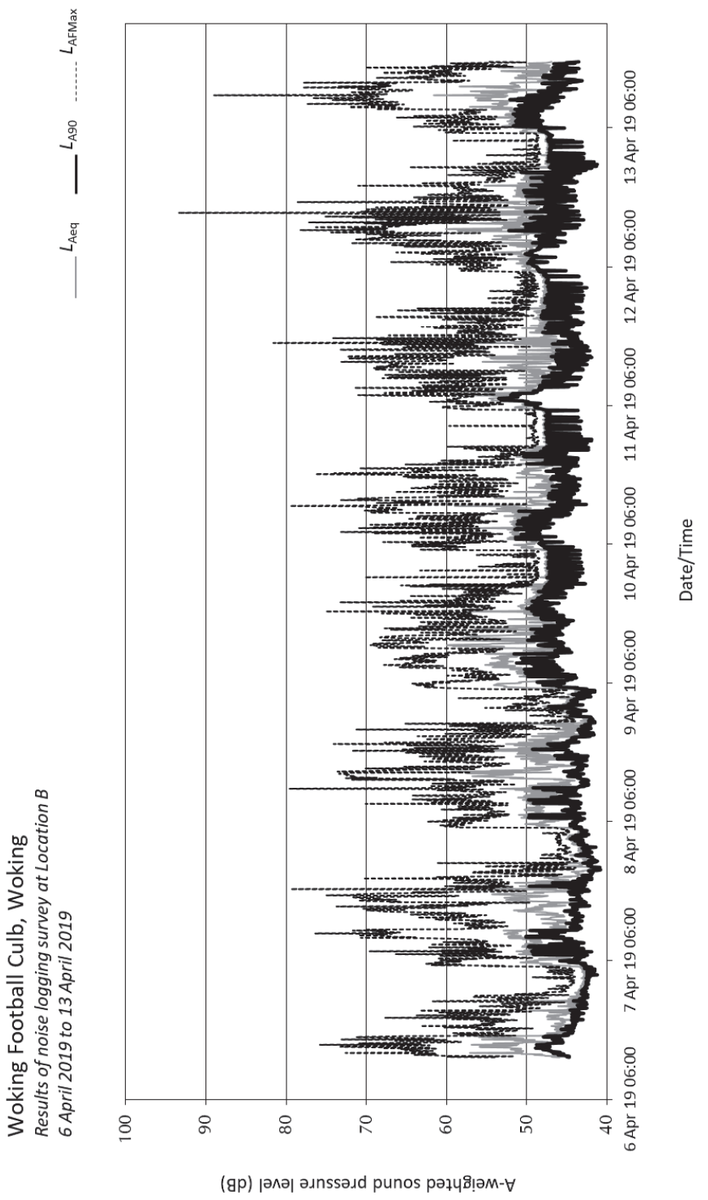

Results of unattended measurements at Location C

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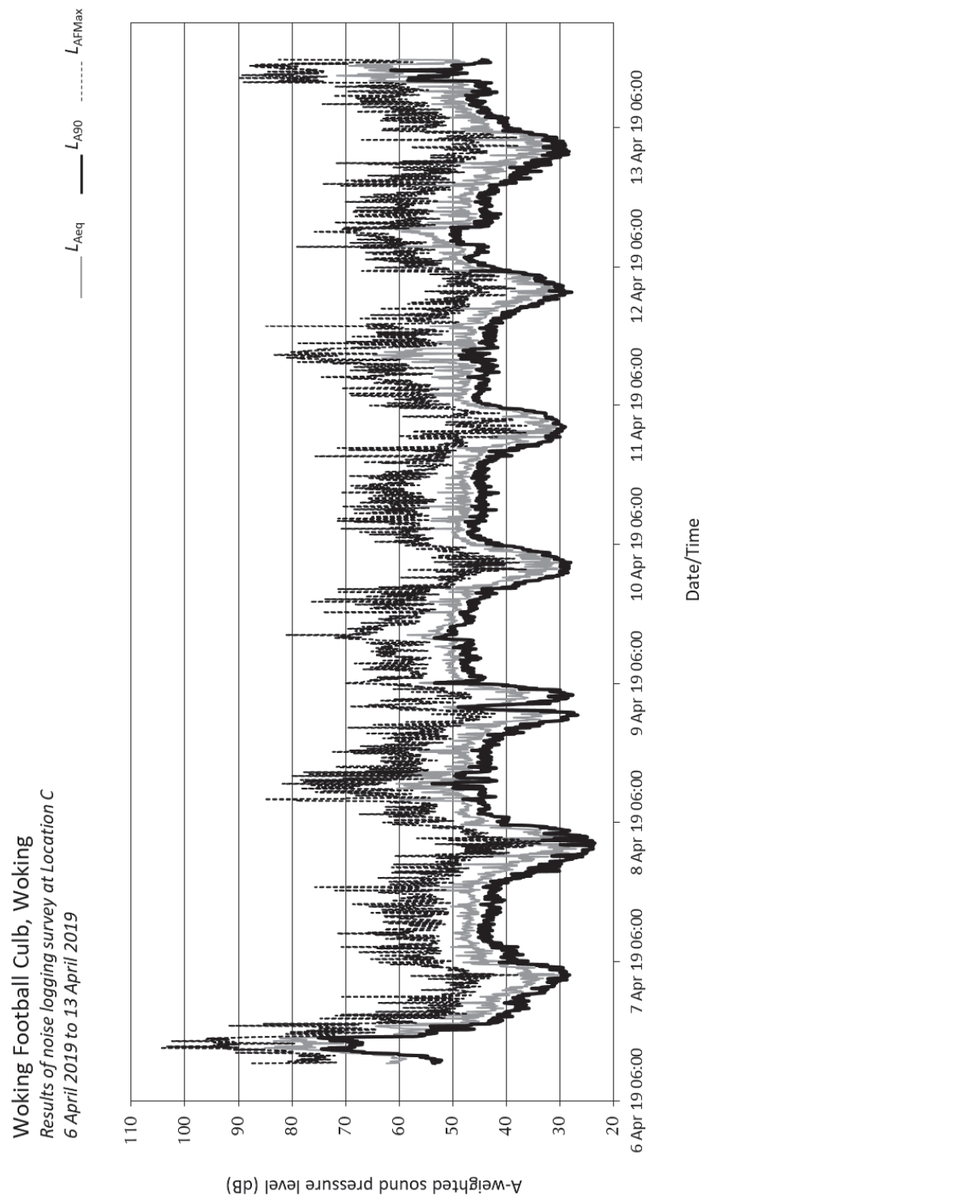

Annex 4: Construction Plant Assumptions

Annex 4 Construction Plant Assumptions

The Construction Methodology for the Proposed Development has been reviewed by Sandy Brown to assess the potential noise and vibration affects associated with the construction phases of the project.

The construction programme indicates 12 phases, namely:

1. Demolition - Block 1
2. Construction - Block 1
3. Demolition - David Lloyd Centre
4. Demolition - Stadium
5. Excavation - Blocks 2 to 5
6. Construction - Infrastructure and Basements
7. Construction - Stadium
8. Construction – Block 2
9. Construction – Block 3
10. Construction – Block 4
11. Construction – Block 5
12. Completion.

The development will be phased, with many of the above listed phases to be carried out simultaneously. To represent the worst case in terms of impact the construction phases have been grouped into eight worst-case scenarios, as indicated below:

- Demolition – Block 1
- Construction – Block 1
- Demolition – David Lloyd Centre, Demolition - Stadium and Construction – Block 1
- Demolition – David Lloyd Centre and Stadium and Excavation – Blocks 2 to 5
- Construction – Infrastructure and Basement, Construction – New Stadium and Construction Block 2
- Construction – New Stadium, Construction – Block 2 and Construction – Block 3
- Construction – Block 2, Construction – Block 3 and Construction – Block 4
- Construction – Block 3, Construction - Block 4 and Construction - Block 5.

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These represent the worst case for potential noise impacts at the nearby noise sensitive receptors. It is noted that residential Blocks are expected to be progressively occupied during the construction programme and therefore have also been include in the assessments.

Details of the different construction plant, number, the percentage of time they will be operational and their associated sound pressure level, as set in BS 5228:2009, are provided.

Demolition – Block 1

The demolition of Block 1 is expected to last up to three months. The works will involve the demolition of the existing houses to the north-east of the site. The construction plant assumptions for the assessment scenario are listed in Table 1.

Table 1 Demolition plant assumptions – Block 1

Construction plant	Number	% activity	BS5228-1 reference	L_{Aeq} at 10 m (dB)
Mobile crane (35t)	1	50	C.4-43	70
Tracked crusher	1	20	C.1-14	82
Tracked excavators	1	50	C.2-2	77
Truck – waste removal (idling)	1	20	C.4-5	63
Water pump for wheel washing	1	10	C.2-45	65

Construction – Block 1

There is a period of a year where the Block 1 construction will be the only activities undertaken. The construction statement describes the activities as including the installation of contiguous bored piles to form a retaining wall and the excavation of the basement. The superstructure is to be built from the foundations, negating the use of piled foundations.

The perimeter bore piling activity and excavation activities have been assessed as they represent the worst-case activities. The construction plant assumptions for this assessment scenario are listed in Table 2.

Table 2 Construction plant assumptions – Block 1

Construction plant	Number	% activity	BS5228-1 reference	L_{Aeq} at 10 m (dB)
Tracked excavators	2	25	C.2-2	77
CFA piling rig	2	70	C.3-21	79
Mobile crane (35t)	2	50	C.4-43	70
Concrete pump and concrete mixer truck	2	25	C.4-28	75
Truck – waste removal (idling)	1	10	C.4-5	63
Tipper lorry	1	10	C.8-20	79

Demolition – David Lloyd Centre, Demolition - Stadium and Construction – Block 1

The David Lloyd Centre and Stadium demolition will occur simultaneously with the construction of Block 1 for a period up to three months.

The David Lloyd Centre is situated to the south west of the site, with the stadium occupying the centre and north -east of the site. The plant assumed for demolition of the David Lloyd centre and Stadium are listed in Table 3.

Table 3 Demolition plant assumptions – David Lloyd Centre and Stadium

Construction plant	Number	% activity	BS5228-1 reference	L_{Aeq} at 10 m (dB)
Mobile crane (35t)	4	50	C.4-43	70
Tracked crusher	4	20	C.1-14	82
Tracked excavators	4	40	C.2-2	77
Truck – waste removal (idling)	2	20	C.4-5	63
Water pump for wheel washing	2	10	C.2-45	65

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The Block 1 construction phase will be approaching completion, and as such it is expected that all works will be contained within the building envelope of the building. On this basis no additional construction plant has been assumed.

Demolition – David Lloyd Centre and Stadium and Excavation – Blocks 2 to 5

The plant and activities described in Table 3 will be applied to represent the demolition of David Lloyd Centre and Stadium during this assessment scenario.

The excavation of Blocks 2 and 5 will coincide with the demolition activities for approximately three months. The excavation of the basement will last approximately nine months. The activities will include perimeter bore piling and bulk excavation of the basement area. The construction plant assumptions are listed in Table 4.

Table 4 Excavation plant assumptions – Blocks 2 to 5

Construction plant	Number	% activity	BS5228-1 reference	L_{Aeq} at 10 m (dB)
Tracked excavators	2	25	C.2-2	77
CFA piling rig	2	70	C.3-21	79
Mobile crane (35t)	4	50	C.4-43	70
Concrete pump and concrete mixer truck	2	25	C.4-28	75
Truck – waste removal (idling)	1	10	C.4-5	63
Tipper lorry	1	10	C.8-20	79

Construction – Infrastructure and Basement, Construction – New Stadium and Construction Block 2

The initial construction phases will comprise superstructure works only.

The residential concrete frames will be constructed using in-situ concrete.

The stadium will be formed using a hot rolled steel members that will be fabricated off site and fitted together using bolted connections. There will be no site welding. Seated areas will be formed using pre-cast concrete slabs and profiled metal formwork.

The construction plant assumptions are listed in Table 5.

Table 5 Superstructure - construction plant assumptions (Basement and infrastructure, Stadium and Block 2)

Construction plant	Number	% activity	BS5228-1 reference	L_{Aeq} at 10 m (dB)
Tracked excavators	2	10	C.2-2	77
Mobile cranes (35t)	8	50	C.4-43	70
Concrete pump and concrete mixer truck	2	50	C.4-28	75
Tower Cranes	2	50	C.4-47	76
Deliveries	4	10	D7-121	70

Construction – Block 2, Construction – Block 3 and Construction – Block 4

The Construction – Block 2, Construction – Block 3 and Construction – Block 4 assessment scenario is expected to comprise internal fit-out works in Block 2, envelope installation on Block 3 and superstructure work on Block 4.

As the Block 2 fit-out work will be contained within the building envelope no construction plant assumptions have been made.

The construction plant assumptions for the envelope installation are listed in Table 6.

Table 6 Envelope construction plant assumptions

Construction plant	Number	% activity	BS5228-1 reference	L_{Aeq} at 10 m (dB)
Cement mixer truck	2	40	C.4-19	71
Handheld nail gun	2	10	C.4-95	73
Tower Cranes	2	50	C.4-47	76

The construction plant assumptions for the Block 4 substructure construction works are listed in Table 7.

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Table 7 Superstructure construction plant assumptions (Block 4)

Construction plant	Number	% activity	BS5228-1 reference	L_{Aeq} at 10 m (dB)
Tracked excavators	1	10	C.2-2	77
Mobile cranes (35t)	2	50	C.4-43	70
Concrete pump and concrete mixer truck	1	50	C.4-28	75
Tower Cranes	1	50	C.4-47	76
Deliveries	2	10	D7-121	70

Construction – Block 3, Construction - Block 4 and Construction - Block 5

The Construction – Block 3, Construction – Block 4 and Construction – Block 5 scenario is expected to comprise internal fit-out works in Block 3, envelope installation on Block 4 and superstructure work on Block 5.

On the above basis, the assumptions outlined in Table 5, Table 6 and Table 7 respectively will be applied.

Annex 5:Crowd Dispersion and Breakout Assessments

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Memo:	M001-A	**Date:**	27 September 2019
Project:	19108	**Pages:**	12
From:	Philip Owen	**Reviewer:**	Edward Farrer

Woking FC
Crowd noise assessments

Executive summary

The noise generated by spectators in the new stadium, and entering and leaving has been predicted to assess the effects at the nearby sensitive properties.

The assessments are based on noise measurements made during a match day. The noise measurements have been calibrated with simultaneous footfall counts and stadium attendance figures to estimate an equivalent sound power level per person along the routes and within the crowd.

Information on the pedestrian routes for a maximum capacity match have been provided by Vectos. The crowd route information and sound power level per person have been used to predict the noise levels at the nearby receptors.

The predicted crowd noise levels have been compared with the criteria proposed within the scoping report to assess short-term increases in noise level at the existing receptors.

The assessment of pedestrian routes indicates that there will be a slight increase in ambient noise level at worst-case locations. The slight increases will not result in adverse effects.

The assessment of stadium noise indicates that some receptors will experience less noise, similar noise levels or increases in noise level from those currently experienced. The increases in noise level are slight, so will not result in adverse effects at the existing receptors.

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Modelling of spectator noise entering and leaving the stadium

Establishing a sound power level per person

Noise and simultaneous footfall count measurements were completed on 6 April 2019 along the route taken by supporters.

Measurement Position 8 (as described in 19180-R02-A *Environmental noise report*), located in Woking Park has been used to assess the noise produced by the spectators as it was the dominant source of noise at this location.

The measurements at the position were taken at approximately 5 m from the pedestrian route.

Table 1 presents the noise levels and the pedestrian foot count measurements.

Table 1 Measured noise levels and corresponding footfall counts

Measurement time	Measured sound pressure level (dB)		Footfall count
	$L_{Aeq,15min}$[1]	$L_{AFmax,15min}$	
14:00-14:15	62	88	1185
17:05-17:20	60	82	1131

[1] taken from 5 minute measurements

Using the above data, a sound power level for a single person within a moving crowd has been derived. The sound power level has been calculated on the basis that each person is a point source moving at 5 km/hr.

A sound power level of L_{wA} 77 dB has been calculated per person in a moving crowd, which is approximately equal to a raised vocal effort (as per ANSI 3.5).

Crowd route information

The crowd route information, provided by Vectos, is summarised in Table 2 and shown in Figure 1.

Figure 1 illustrates the routes and identifies the locations where baseline noise measurements were completed, as detailed in 19108-R02-A *Environmental noise survey*.

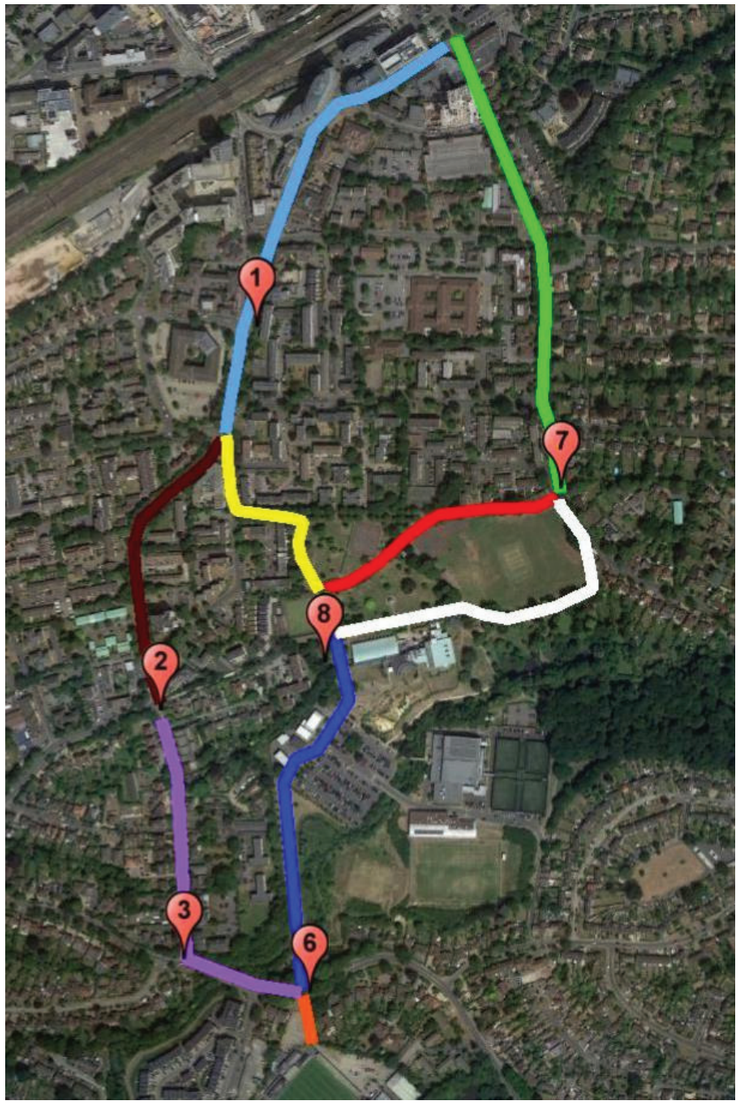

Figure 1 Pedestrian routes to and from Woking FC

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Table 2 crowd route information

Route	2019 number along route		2024 number along route	
	Before match	After match	Before match	After match
Site Access (orange)	2556	1621	5564	3341
Claremont Avenue (mauve)	520	720	1149	1518
Guildford Road (burgundy)	142	167	285	339
Guildford Road (light blue)	915	767	1793	1507
Woking Park (dark blue)	1253	1181	2694	2510
Woking Park (green)	1185	1131	2464	2384
Woking Park (white)	497	520	996	1082
Woking Park (red)	706	705	1342	1379
Woking Park (yellow)	746	481	1549	964
White Rose Lane (pink)	556	481	1131	1206

Predicted noise levels

The sound power levels per person and crowd route information have been included within the environmental noise model to calculate the noise levels at the nearby receptors. The predictions from the model are summarised in Table 3 and shown in Figure 2.

Table 3 Predicted ambient noise levels at receptors along crowd routes

Measurement position	Existing noise level on a match day ($L_{Aeq,15mins}$ dB)	Existing noise level on a non-match day ($L_{Aeq,15mins}$ dB)	Predicted 2024 match day noise level ($L_{Aeq,15min}$ dB)
1	72	72	72
2	69	69	71
3	66	69	66
6	67	61	68

Measurement position	Existing noise level on a match day ($L_{Aeq,15mins}$ dB)	Existing noise level on a non-match day ($L_{Aeq,15mins}$ dB)	Predicted 2024 match day noise level ($L_{Aeq,15min}$ dB)
7	59	59	63
8	62	48	65

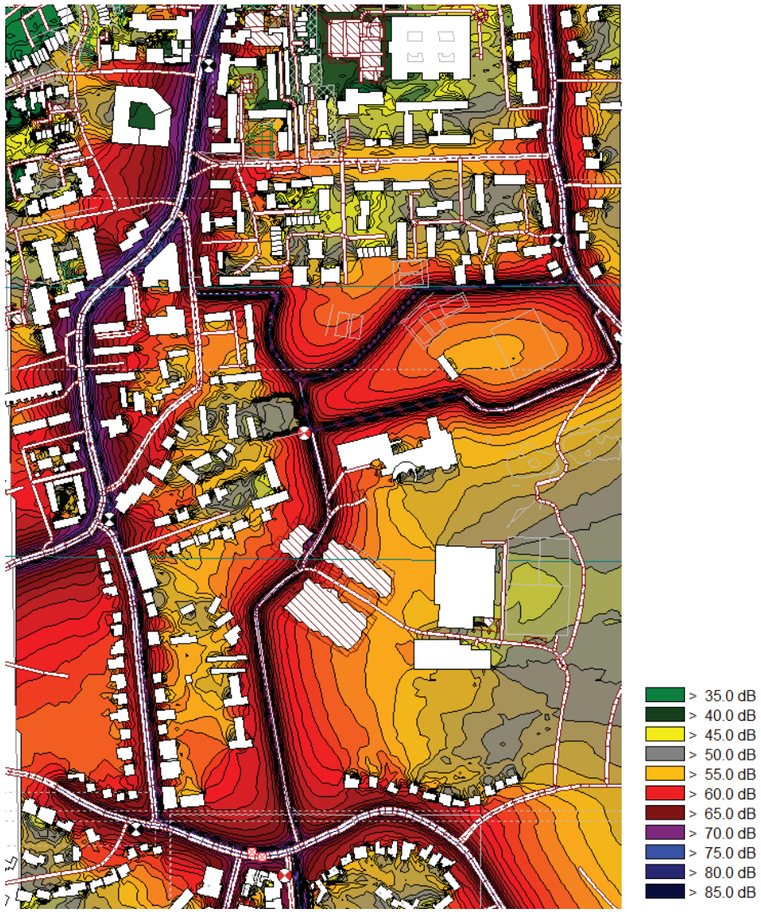

Figure 2 Predicted crowd noise levels around Woking FC (grid 1.5 m above ground)

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Stadium noise

Establishing a sound power level

Noise monitoring was completed within and surrounding the existing stadium during a match day, as reported in 19108-R01-A *Environmental noise survey report*. These results have been used with the reported final capacity of 4,538 spectators to calculate an equivalent sound power levels per unit area of stadium.

The analysis indicates that the existing stadium operates with sound power levels of L_{wA} 79-87 dB per unit area of spectator. The highest sound power levels were attributed to the west stand, the current position of the home standing section.

The west standing section unit sound power level has been applied to each of the proposed stands and seating areas. This is considered to represent a worst-case assessment on the following basis:

- The standing home section of supporters are typically the loudest in the ground
- The existing north-east stand is mainly enclosed, typical of the proposed condition.

Predicted noise levels

The drawings of the proposed stadium, along with the proposed capacity of each of the stands have been provided. The drawings indicate the total capacity will be 9,500.

The model has been adopted to include the A-weighted sound power level per unit area assessed from the existing north-west stand, ie L_{wA} 87 dB.

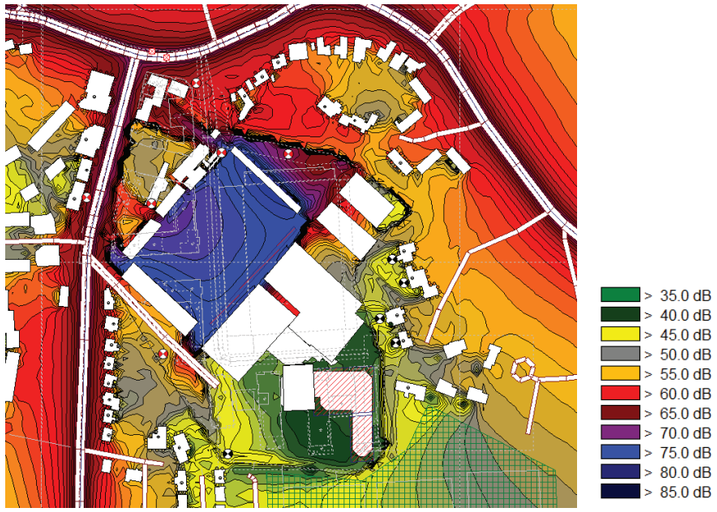

Figure 3 Existing stadium noise levels during a match (grid 1.5 m above ground)

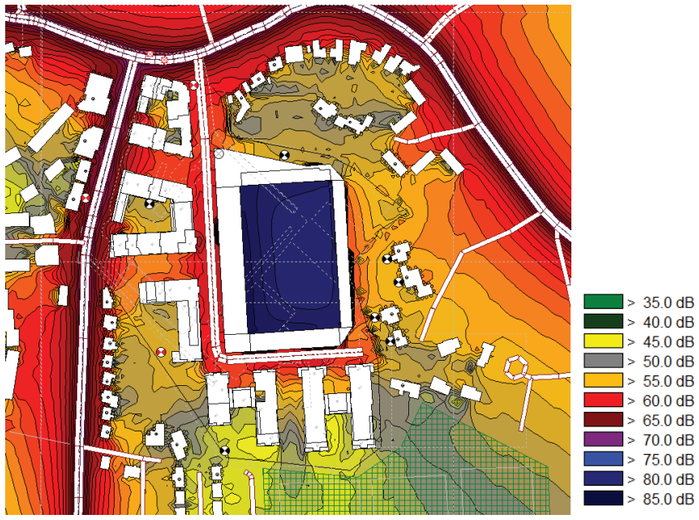

Figure 4 Predicted stadium noise levels during a match (grid 1.5 m above ground)

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Assessment

Criteria

The criteria proposed within the scoping report for the assessment of pedestrian and stadium noise levels is provided in Table 4.

Table 4 Description of the Magnitude of Impact Rating for Assessing the Residual and Likely Effect of crowd noise

Magnitude of impact	Temporary increase in noise level ($L_{Aeq,T}$ dB)	Description
Very Low	Decrease of 6 dB or more	Significant decrease
Very Low	Decrease of less than 6 dB	No significate change
Low	Increase of less than 6 dB	No significant change
Low	Increase of 6 to 10 dB	Slight increase
Medium	Increase of 10 to 15 dB	Moderate increase
High	Increase of 15 to 20 dB	Substantial increase
High	Increase of more than 20 dB	Severe increase

Assessing the increase in ambient noise level due to crowds entering and leaving the stadium

Table 5 and Figure 5 present the assessed increases in ambient noise due to crowds and the associated impact category.

Table 5 Assessed increases in ambient noise level and Magnitude of Impact category

Receptor	Measured noise levels ($L_{Aeq,15min}$ dB) [1]	Predicted noise levels ($L_{Aeq,15min}$ dB)	Increase in ambient noise level ($L_{Aeq,15min}$ dB)	Magnitude of impact
1 – Guildford Avenue	72	72	0	Very Low
2 – Guildford Avenue/ Claremont Avenue	69	71	2	Low
3 – Wych Hill Lane/ Claremont Avenue	66	66	0	Very Low
6 – Kingfield Avenue	67	68	1	Low
7 – White Rose Lane	59	63	4	Low

Receptor	Measured noise levels ($L_{Aeq,15min}$ dB) [1]	Predicted noise levels ($L_{Aeq,15min}$ dB)	Increase in ambient noise level ($L_{Aeq,15min}$ dB)	Magnitude of impact
8 – Woking Park	62	65	5	Low

[1] Measurements as documented for existing match days in 19108-R02-A *Environmental noise and vibration survey report*.

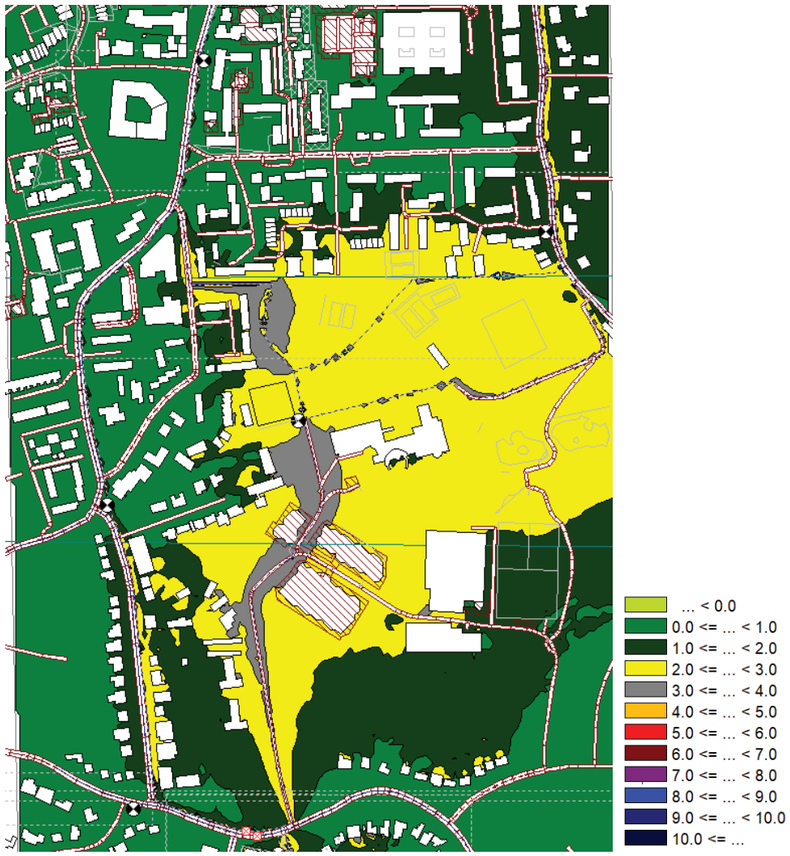

Figure 5 Increase in ambient noise level with crowd dispersion noise (grid 1.5 m above ground)

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Figure 5 illustrates that increases in the existing ambient noise level are only predicted close to the routes, most notably those through Woking Park. The increases in ambient noise level fall within the "Low" impact category. The "Low" impact would result in a Minor (not significant) adverse effect.

Assessing the increase in ambient noise level from stadium

Table 5 and Figure 5 present the assessed increases in ambient noise due to crowds and the associated Magnitude of Impact category.

Table 6 Assessed increases in ambient noise level and Magnitude of Impact category

Receptor	Existing crowd facade noise levels ($L_{Aeq,15min}$ dB)[1]	Predicted crowd facade noise levels ($L_{Aeq,15min}$ dB) [2]	Change in crowd noise level ($L_{Aeq,15min}$ dB)	Magnitude of Impact
Cobbles	67	55	-12	Very Low
The Dell	61	48	-13	Very Low
The Haven	59	47	-12	Very Low
Cotswolds	63	50	-13	Very Low
Chinthurst	63	52	-11	Very Low
11-12 Kingfield Drive	59	53	-6	Very Low
Pond House	47	53	+6	Low
Kingfield Cottage	46	52	+6	Low
The Cedars	46	52	+6	Low
Nut Cottage	49	52	+3	Low
Penian	46	52	+8	Low
67 Granville Road	45	47	+2	Low
78 Granville Road	43	48	+5	Low
1 Westfield Grove	46	50	+4	Low
3 Westfield Grove	47	51	+4	Low
51 Westfield Avenue	45	47	+2	Low

Receptor	Existing crowd facade noise levels ($L_{Aeq,15min}$ dB)[1]	Predicted crowd facade noise levels ($L_{Aeq,15min}$ dB) [2]	Change in crowd noise level ($L_{Aeq,15min}$ dB)	Magnitude of Impact
53 Westfield Avenue	44	49	+5	Low
55 Westfield Avenue	48	51	+3	Low
57 Westfield Avenue	49	49	0	Very Low
59 Westfield Avenue	49	49	0	Very Low
61 Westfield Avenue	49	48	-1	Very Low
63 Westfield Avenue	51	48	-3	Very Low
63a Westfield Avenue	53	50	-3	Very Low
54-66 Westefield Avenue	49	48	-1	Very Low
1 to 12 Beech House	47	50	+3	Low
1 to 26 Hazel House	53	46	-7	Very Low

[1] Based on modelled results of existing ambient noise levels during a match day.
[2] Highest predicted facade noise level for each building.

The predicted crowd noise levels will increase most notably at the receptors to the east and south of the site. The increases in crowd noise are expected to be perceptible, though.

All other receptors are predicted to have a Low or Very Low impact, which would result in Minor or Negligible effects (not significant).

It is noted that the predictions are based on worst-case assumptions, such as a capacity event and the highest source noise levels in each part of the stadium.

Cumulative effects

The assessments consider increases and changes to the existing environmental noise level so inherently accounts for the cumulative effect from usual environmental noise sources.

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Conclusion

The crowd routes and increase in stadium noise associated with the Woking FC development have been analysed to predict the increase and change in noise climates at receptors along the pedestrian routes and at receptors surrounding the stadium. The predictions are based on measured noise levels and crowd flow information.

The predictions indicate that there will be at most a slight temporary increase in ambient noise level. The slight increases in ambient noise levels will not be significant and consequentially the impact will be “Low”. The Low category corresponds to a Minor (not significant) effect.

Annex 6: Baseline Conditions Noise Survey

Appendix 6: Baseline Conditions Noise Survey

9.1 The representative free-field recorded background sound levels during the unattended surveys are shown in Table 9.1.

Table 9.1 Representative Background Sound Levels

Location	Representative Background Sound Levels $L_{A90,5min}$ (dB)	
	Daytime (07:00 to 23:00)	Night-time (23:00 to 07:00)
A	45	30
B	44	43
C	43	29

9.2 The results of the sample noise measurements (over 5-minute periods) undertaken during a match day are summarised in Table 9.2 – 0.

Table 9.2 Summary of Sample Measurement Results at Position 1 (match-day)

Location	Date	Time	Sound pressure levels (dB)		
			$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$
1	6/4/19	13:40	71	79	64
1	6/4/19	13:50	84	111	62
1	6/4/19	13:55	69	71	69

Table 9.3 Summary of Sample Measurement Results at Position 2 (match-day)

Location	Date	Time	Sound pressure levels (dB)		
			$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$
2	6/4/19	14:10	68	84	65
2	6/4/19	14:15	68	78	63
2	6/4/19	14:20	69	78	66

Table 9.4 Summary of Sample Measurement Results at Position 3 (match-day)

Location	Date	Time	Sound pressure levels (dB)		
			$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$
3	6/4/19	14:35	65	75	58
3	6/4/19	14:40	66	74	60
3	6/4/19	14:45	66	75	59
3	6/4/19	14:50	65	77	58

Table 9.5 Summary of Sample Measurements Results at Position 4 (match-day)

Location	Date	Time	Sound pressure levels (dB)		
			$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$
4	6/4/19	15:15	57	70	50
4	6/4/19	15:20	60	74	49
4	6/4/19	15:25	61	72	57
4	6/4/19	15:50	57	71	49
4	6/4/19	16:00	59	75	49
4	6/4/19	16:05	64	95	49

Table 9.6 Summary of Sample Measurements Results at Position 5 (match-day)

Location	Date	Time	Sound pressure levels (dB)		
			$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$
5	6/4/19	15:35	58	73	54
5	6/4/19	15:40	55	65	48
5	6/4/19	15:45	54	68	46

Table 9.7 Summary of Sample Measurements Results at Position 6 (match-day)

Location	Date	Time	Sound pressure levels (dB)		
			$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$
6	6/4/19	14:25	62	79	58
6	6/4/19	14:30	63	82	57
6	6/4/19	14:35	64	77	58
6	6/4/19	14:40	73	91	61
6	6/4/19	14:45	66	78	61
6	6/4/19	14:50	64	77	60
6	6/4/19	16:20	65	82	58
6	6/4/19	16:25	63	71	58
6	6/4/19	16:30	69	90	59
6	6/4/19	16:35	67	77	59
6	6/4/19	16:40	64	75	59
6	6/4/19	16:45	67	85	61
6	6/4/19	16:50	66	76	62
6	6/4/19	16:55	64	76	60
6	6/4/19	17:00	70	84	61
6	6/4/19	17:05	63	76	60
6	6/4/19	17:10	69	87	60

Table 9.8 Summary of Sample Measurements Results at Position 7 (match-day)

Location	Date	Time	Sound pressure levels (dB)		
			$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$
7	6/4/19	13:40	60	73	45
7	6/4/19	13:45	60	74	47
7	6/4/19	13:50	58	74	44

Table 9.9 Summary of Sample Measurements Results at Position 8 (match-day)

Location	Date	Time	Sound pressure levels (dB)		
			$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$
8	6/4/19	14:00	57	82	45
8	6/4/19	14:05	66	88	47
8	6/4/19	14:15	50	63	46
8	6/4/19	16:30	49	67	43
8	6/4/19	16:35	49	71	42
8	6/4/19	16:40	46	58	43
8	6/4/19	16:45	55	75	43
8	6/4/19	17:05	60	82	47
8	6/4/19	17:10	57	78	50
8	6/4/19	17:15	48	66	43
8	6/4/19	17:05	60	82	47
8	6/4/19	17:10	57	78	50
8	6/4/19	17:15	48	66	43

Table 9.10 Summary of Sample Measurement Results at Position 9 (match-day)

Location	Date	Time	Sound pressure levels (dB)		
			$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$
9	6/4/19	15:10	69	87	61
9	6/4/19	15:15	67	80	59
9	6/4/19	15:20	67	80	57
9	6/4/19	16:00	66	83	52
9	6/4/19	16:05	71	85	59
9	6/4/19	16:10	66	80	56

Table 9.11 Summary of Sample Measurement Results at Position 10 (match-day)

Location	Date	Time	Sound pressure levels (dB)		
			$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$
10	6/4/19	15:25	65	79	58
10	6/4/19	15:30	68	82	59
10	6/4/19	15:35	70	87	60
10	6/4/19	15:40	68	83	58
10	6/4/19	15:50	70	83	59
10	6/4/19	15:55	67	79	61

9.3 The results of the sample noise measurements (over 5 minute periods) undertaken during a non-match day are summarised in Table 9.12 – Table 9.21.

Table 9.12 Summary of Sample Measurement Results at Position 1 (non-match day)

Location	Date	Time	Sound pressure levels (dB)		
			$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$
1	13/4/19	13:40	73	85	63
1	13/4/19	13:45	72	82	59
1	13/4/19	13:50	72	89	63

Table 9.13 Summary of Sample Measurement Results at Position 2 (non-match day)

Location	Date	Time	Sound pressure levels (dB)		
			$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$
2	13/4/19	14:05	70	82	64
2	13/4/19	14:10	68	84	65
2	13/4/19	14:15	68	78	63

Table 9.14 Summary of Sample Measurement Results at Position 3 (non-match day)

Location	Date	Time	Sound pressure levels (dB)		
			$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$
3	13/4/19	14:25	69	84	60
3	13/4/19	14:30	68	82	60
3	13/4/19	14:35	69	91	60

Table 9.15 Summary of Sample Measurements Results at Position 4 (non-match day)

Location	Date	Time	Sound pressure levels (dB)		
			$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$
4	13/4/19	15:00	57	72	44
4	13/4/19	15:05	57	71	43
4	13/4/19	15:10	56	71	42
4	13/4/19	15:45	57	72	44
4	13/4/19	15:50	54	71	44

Table 9.16 Summary of Sample Measurements Results at Position 5 (non-match day)

Location	Date	Time	Sound pressure levels (dB)		
			$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$
5	13/4/19	15:20	48	64	41
5	13/4/19	15:25	49	65	41
5	13/4/19	15:30	49	66	43
5	13/4/19	16:05	48	66	41
5	13/4/19	16:10	43	57	40
5	13/4/19	16:15	54	68	40

Table 9.17 Summary of Sample Measurements Results at Position 6 (non-match day)

Location	Date	Time	Sound pressure levels (dB)		
			$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$
6	13/4/19	14:20	61	74	55
6	13/4/19	14:25	62	78	56
6	13/4/19	14:30	60	72	54
6	13/4/19	14:35	60	67	56
6	13/4/19	14:45	60	67	55
6	13/4/19	14:50	63	71	53
6	13/4/19	16:30	61	66	55
6	13/4/19	16:35	61	70	57
6	13/4/19	16:40	60	70	54

Table 9.18 Summary of Sample Measurements Results at Position 7 (non-match day)

Location	Date	Time	Sound pressure levels (dB)		
			$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$
7	13/4/19	13:35	62	79	50
7	13/4/19	13:40	57	70	46
7	13/4/19	13:45	57	73	45
7	13/4/19	13:35	62	79	50

Table 9.19 Summary of Sample Measurements Results at Position 8 (non-match day)

Location	Date	Time	Sound pressure levels (dB)		
			$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$
8	13/4/19	14:00	47	57	42
8	13/4/19	14:05	48	60	42
8	13/4/19	14:10	46	58	43
8	13/4/19	16:45	49	66	44
8	13/4/19	16:50	49	61	42
8	13/4/19	16:55	49	74	43

Table 9.20 Summary of Sample Measurement Results at Position 9 (non-match day)

Location	Date	Time	Sound pressure levels (dB)		
			$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$
9	13/4/19	14:55	63	75	46
9	13/4/19	15:00	52	63	45
9	13/4/19	15:05	53	76	43
9	13/4/19	15:50	56	81	50
9	13/4/19	15:55	53	62	48
9	13/4/19	16:00	51	68	44
9	13/4/19	16:25	51	69	43
9	13/4/19	16:30	52	69	42
9	13/4/19	16:35	57	74	43

Table 9.21 Summary of Sample Measurement Results at Position 10 (Non-match day)

Location	Date	Time	Sound pressure levels (dB)		
			$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$
10	13/4/19	15:15	65	79	50
10	13/4/19	15:20	64	76	50
10	13/4/19	15:25	64	77	50
10	13/4/19	15:30	66	83	50
10	13/4/19	15:35	65	79	51
10	13/4/19	15:40	67	88	51
10	13/4/19	16:05	63	78	46
10	13/4/19	16:10	65	79	49
10	13/4/19	16:15	65	79	49