Chapter 9: Noise and Vibration

NOISE AND VIBRATION	
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SUPPORTING APPENDIX	***ES Volume 3, Appendix: Noise and Vibration***: Annex 1: Glossary; Annex 2: Legislative, Planning Policy Context and Other Relevant Standard and Guidance; Annex 3: Environmental Noise and Vibration Report; Annex 4: Construction Plant Assumptions; Annex 5: Crowd dispersion and breakout assessments; Annex 6: Baseline Conditions Noise Survey.
KEY CONSIDERATIONS	The following are the key acoustic issues which have been assessed: • Construction noise - airborne noise from machinery and the works themselves; • Construction vibration - ground-borne vibration from machinery and the works themselves; • Construction traffic - noise from construction vehicles; • Completed Proposed Development road traffic noise; • Completed Proposed Development road vibration; • Completed Proposed Development crowd dispersion and stadium noise; • Completed Proposed Development building services noise.
CONSULTATION	An EIA Scoping Report was formally issued to Woking Borough Council (WBC); following this, a meeting with WBC was undertaken to discuss the EIA and scope of the ES. The EIA Scoping Report and WBC's EIA Scoping Opinion is presented in ***ES Volume 3, Appendix: EIA Methodology (Annex 1).*** WBC agreed with the proposed approach to the assessment of noise and vibration and no further or specific comments were made on the scope of assessment.

ASSESSMENT METHODOLOGY

Defining the Baseline

Baseline Conditions

9.1 Environmental noise and vibration surveys were conducted in 2019 to establish the baseline noise climate at the site and at key receptor locations surrounding the site. The surveys have been used to establish the noise emissions associated with the existing football stadium (crowd dispersion and stadium breakout), assess the suitability of the site for residential development and set limiting noise emission criteria for sources associated with the Proposed Development i.e. new building services plant and systems.

9.2 The nearest receptors that have been identified to inform the positioning of the baseline noise monitoring and that are considered to be potentially sensitive to noise associated with the Proposed Development are listed in Table 9.1 with the zones highlighted in Figure 9.1.

9.3 These receptors are considered representative of other potential receptors further away from the site, as if noise levels are not deemed significant at these receptors, the receptors further afield will also not be significantly affected. Receptors further afield will be assessed if significant effects are identified.

9.4 In addition, receptors along the pedestrian routes have been considered when assessing potential impact from supporters entering and leaving the stadium. These receptors have been summarised by the routes taken and represent multiple individual receptors. These receptors are referred to as:

- Guildford Avenue;
- Guildford Avenue/Claremont Avenue (receptors at the junction and north section of Claremont Avenue);
- Wych Hill Lane/Claremont Avenue (receptors at the junction and south section of Claremont Avenue);
- Kingfield Avenue;
- White Rose Lane (receptors along White Rose Lane and adjacent roads); and
- Woking Park.

Table 9.1 Nearest noise sensitive receptors

Zone	Receptor
Kingfield Road and Kingfield Drive	Cobbles The Dell The Haven Cotwolds Chinthurst 7 Kingfield Drive
Westfield Avenue and Westfield Grove	Hazel House Beech House 62-66 Westfield Avenue 54-60 Westfield Avenue 51-63a Westfield Avenue 1 & 3 Westfield Grove
Kingfield Close	Pond House Kingfield Cottage The Cedars Nut Cottage Penlan.
Granville Road	67 & 78 Granville Road
Proposed Development	Block A Block B Block C Block D

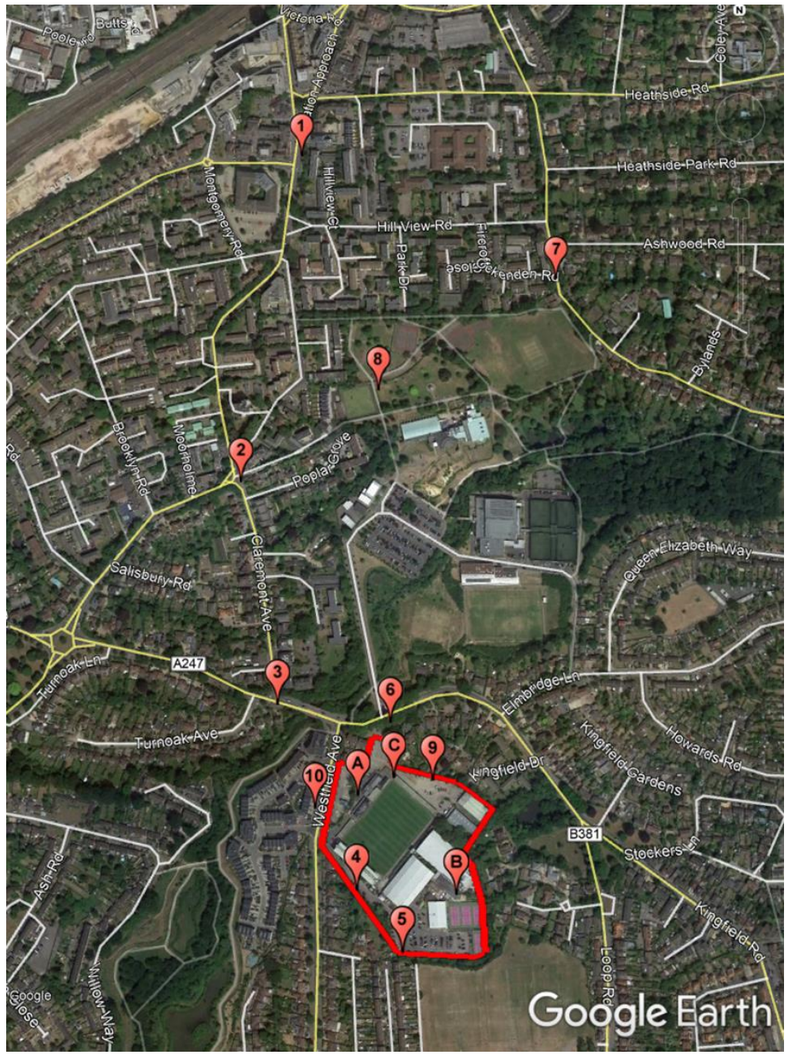
Figure 9.1 Existing Nearby Receptors (image courtesy of Google Earth Pro)

Noise Logging Survey

9.5 Long-term environmental noise surveys were conducted between 6 April 2019 and 13 April 2019. A continuous noise survey was undertaken at three positions to determine the existing noise levels across the site. The noise monitoring locations are shown in Figure 9.2 with an 'A', 'B' and 'C'. The dominant noise sources noted during the baseline surveys include road traffic, building services plant and the operation of the stadium during match days.

9.6 A summary of the long-term environmental noise results is provided in Table 9.1 in ***ES Volume 3, Appendix: Noise and Vibration (Annex 6)***. Full details of the methodology and results of the environmental noise surveys are presented in ***ES Volume 3, Appendix: Noise and Vibration (Annex 3)***.

Figure 9.2 Noise Monitoring Location (image courtesy of Google Earth Pro)



Sample Noise Measurements

9.7 Sample noise measurements were also carried out on 6 April 2019 and 13 April 2019 to supplement the long-term monitoring undertaken and completed, or to assess the baseline noise levels at receptor locations where leaving secure monitoring equipment was not possible. The measurement locations are presented as 1 to 10 in Figure 9.2. Measurements were made using a hand-held Brüel & Kjær 2250 sound level meter which was calibrated both before and after the measurements with no observable calibration drift. The results of the sample noise measurements are summarised in Table 9.2 to Table 9.21 in ***ES Volume 3, Appendix: Noise and Vibration (Annex 6)***.

Future Baseline Conditions

9.8 Future baseline noise levels have been assessed for the year of opening 2025 although this has been based on future traffic predictions in the year 2024. A computer model of the site and surrounding roads has been developed using CadnaA software, taking into account reflections from the Proposed Development, road geometry and average traffic speed. The results from the model have been used to assess the likely change in ambient noise levels at receptor locations surrounding the site.

9.9 The 2025 Future Baseline contains an uplift in the traffic road volumes expected in the area (see ***ES Volume 1, Chapter 7: Highways and Transport***). There are no cumulative schemes to consider in this assessment.

9.10 The 2024 traffic data is deemed suitable for use as for there to be a significant increase in noise resulting from an increase in traffic flows would require the traffic flows to double which is deemed highly unlikely without major changes to the roads in the surrounding area.

Likely Evolution of the Baseline Conditions

9.11 The evolution of the baseline condition has been determined through review of road traffic forecasts for future baseline assessment years and professional experience and judgement. The outline of the evolution of the future baseline is described qualitatively.

Impact Assessment

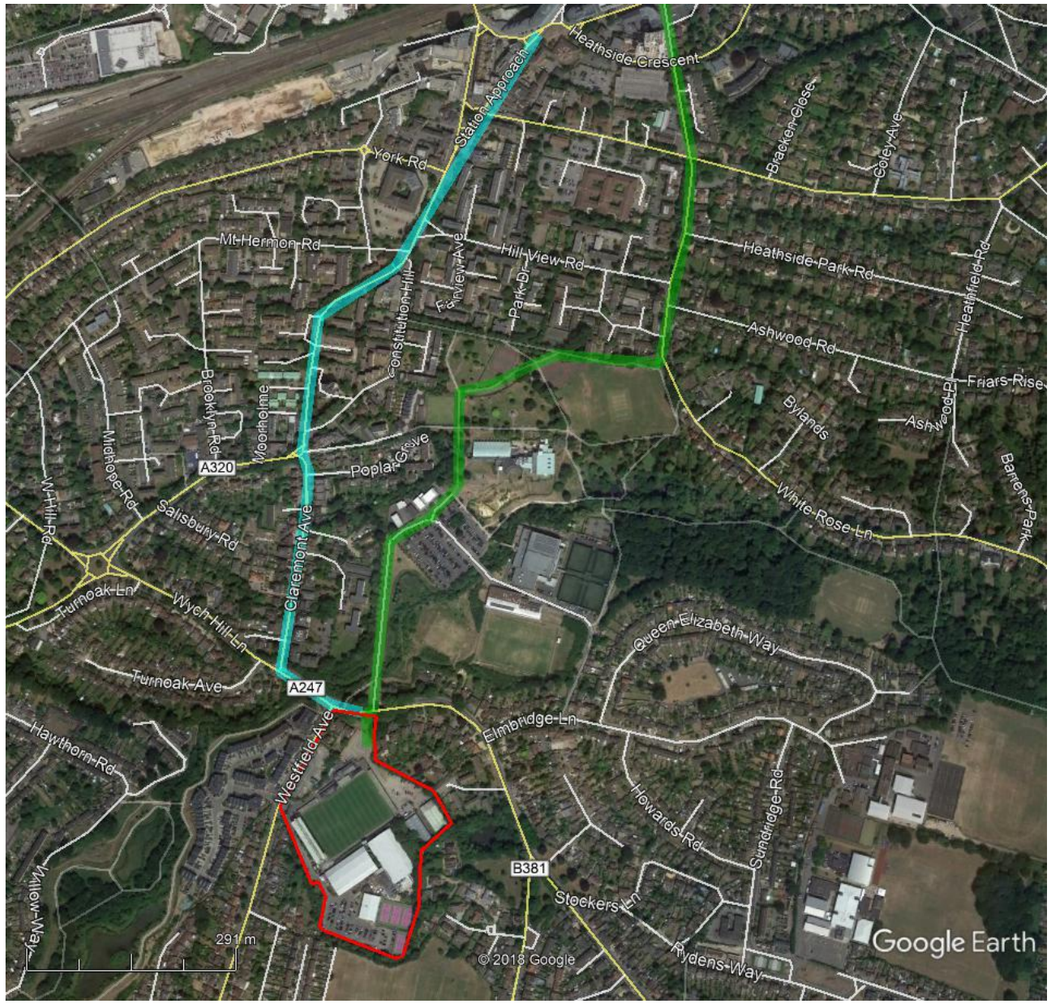
9.12 The study area for the assessment is defined by the location of the sensitive receptors identified (Figure 9.1 and Figure 9.3) and the proposed end use of the site.

9.13 This section presents the methodology used to assess each type of noise and vibration impact, in terms of the application of relevant standards and guidance, along with the types of data and analyses carried out.

9.14 The assessment considers the following sources of noise and vibration:

- Demolition and construction noise - airborne noise from machinery and the works themselves;
- Demolition and construction vibration - ground-borne vibration from machinery and the works themselves;
- Demolition and construction traffic - noise from demolition and construction vehicles;
- Completed development road traffic noise;
- Completed development noise generated by crowd dispersion;
- Completed development noise generated by spectators within the stadium;
- Completed development building services noise; and
- Site suitability for the proposed residential development purposes.

Figure 9.3 Pedestrian Routes from Town Centre to Stadium (image courtesy of Google Earth Pro)



Demolition and Construction Activities

9.15 The demolition and construction programme is anticipated to be undertaken over the course of approximately 6 years. Further details can be found in ***ES Volume 1, Chapter 5: Demolition and Construction***.

9.16 Assessments have been undertaken for the demolition, groundworks and substructure construction stages of work. Noise egress has been calculated based on the methodology outlined in British Standards (BS) 5228-1:2009 'Code of practice for noise and vibration control on construction and open sites - Part 1 Noise'[1]. Where specific sound power levels have not been provided, reference has been made to the operational noise levels for various items of plant that are included within this standard. The operational plant noise levels have been used to determine a representative equivalent continuous sound level (L_{Aeq}) associated with each stage of the demolition and construction programme.

9.17 A 3D noise model has been created to determine the predicted operational noise level associated with demolition and construction works themselves, at the surrounding noise sensitive receptors.

9.18 Noise levels associated within the demolition and construction of the Proposed Development have been predicted at each of the noise sensitive locations and these levels have been compared with the guidelines highlighted in BS 5228, in order to determine the magnitude of impact. This has been referenced against the sensitivity of each receptor to determine the scale of effect.

Demolition and Construction Traffic Noise

9.19 The assessment of demolition and construction traffic noise effects is based on the Department of Transport Welsh Office Calculation of Road Traffic Noise 1988 (CRTN)[2] and Volume 11 of the Design Manual for Roads and Bridges (DMRB)[3] using traffic data generated by the Applicant's Quantity Surveyor (Quartz Project Services) and Transport Consultant (Vectos).

9.20 Changes in road traffic noise levels associated with the demolition and construction works have been calculated following the principles detailed within the CRTN, which provide guidance and procedures for how to calculate noise from road traffic.

9.21 A computer model of the site and surrounding roads has been developed using CadnaA software taking into account reflections from the Proposed Development, road geometry and average traffic speed.

9.22 The results from the model have been used to assess the likely change in ambient noise levels at the location of receptors off- site, when compared to the baseline noise measurements.

Demolition and Construction Vibration

9.23 The assessment of demolition and construction vibration effects considers absolute levels experienced within the site's adjacent buildings, in general accordance with BS 5228-2:2009 Code of Practice for Noise and Vibration Control on Construction and Open Sites - Vibration[4].

9.24 Vibration levels have been predicted within each of the nearby sensitive receptors using historical data and the methodology provided in BS 5228-2.

9.25 Predictions of vibration levels within the receptors have been made in terms of the Peak Particle Velocity (PPV) experienced within the working day during the piling operations.

Assumptions and Limitations

9.26 It is assumed that trade contractors will comply with all legislation relevant to the control of noise and vibration from construction works.

9.27 The predictions of potential demolition and construction noise and vibration effects have assumed the following:

- The adoption of a minimum 2.4m high, solid perimeter hoarding around the site;
- Demolition and construction plant that is compliant with the sound and vibration levels published within BS 5288;
- Stationary demolition and construction plant such as concrete crushers, will be positioned behind screens and positioned away from the receptors;
- The use of hand-held tools when used for a prolonged period will be adequately screened;
- The two piling rigs will be positioned at opposing sides of the site when used; and
- Mobile plant will move across the site equally during the demolition and construction period.

9.28 The selected equipment and precise demolition and construction methodology would be dependent on the trade contractor selected for the work. Conservative, reasonable worst-case assumptions have, therefore, been made with regards to operations and activities, and the associated plant and equipment to be used, as presented within ***ES Volume 1, Chapter 5: Demolition and Construction***. As such, the predicted demolition and construction noise and vibration levels represent an upper estimate or worst-case scenario of emissions from the site during the works.

[1] *British Standard BS 5228:2009 – Code of practice for noise and vibration control on construction and open Sites*
[2] *Department for Transport Welsh Office (1988) Calculation of Road Traffic Noise (CRTN)*
[3] *Department for Transport Highways Agency Design Manual for Roads and Bridges: Volume 11 Environmental Assessment, August 2008*
[4] *British Standards (BS) 5228-2:2009 Code of Practice for Noise and Vibration Control on Construction and Open Sites - Vibration, December 2008*

9.29 The emphasis of the demolition and construction assessment is on the noisiest phases of work, which are likely to arise from the use of plant such as excavators, crushers and piling rigs.

9.30 For the purposes of this assessment, predictions have been generally made for the demolition and construction plant located at ground level to represent the worst-case scenario.

9.31 Furthermore, the month with the highest number of demolition and construction vehicle movements (months 25-30 during excavation) has been adopted in the assessment of potential increases in traffic noise, as a worst case scenario.

9.32 The equipment and operating hours assumed for the assessments contained herein are provided in ***ES Volume 3, Appendix: Noise and Vibration (Annex 4)***.

Building Services (Plant) Noise

9.33 Noise levels from building services plant associated with the Proposed Development will be controlled to ensure that it would not have an effect on nearby noise sensitive premises. Criteria for the assessment are set in accordance with BS 4142[5].

9.34 The baseline noise levels recorded at positions representative of the locations of sensitive receptors surrounding the Proposed Development have been used to set noise limits for the building services plant.

Operational Traffic Noise

9.35 The assessment of operational traffic noise effects is based on the Department of Transport Welsh Office Calculation of Road Traffic Noise 1988 (CRTN) and Volume 11 of the Design Manual for Roads and Bridges (DMRB), using traffic data generated by the Applicant's Transport Consultants (Vectos).

9.36 Changes in road traffic noise levels associated with the completed and operational Proposed Development have been calculated following the principles detailed within the CRTN, which provide guidance and procedures for how to calculate noise from road traffic.

9.37 For the completed and operational Proposed Development's road traffic effects, consideration is given to the $L_{Aeq,16hr}$ and hourly traffic flows. The following scenarios have been modelled:

- Future without Proposed Development (Likely Evolution of the Baseline Conditions); and
- Future with Proposed Development.

9.38 A computer model of the site and surrounding roads has been developed using CadnaA software taking into account reflections from the Proposed Development, road geometry and average traffic speed.

9.39 The results from the model have been used to assess the likely change in ambient noise levels at the locations of receptors off-site.

Site Suitability

9.40 The assessment of the site suitability for residential use consists of the following:

- Noise and vibration measurements completed on-site and detailed in ***ES Volume 3, Appendix: Noise and Vibration (Annex 3)***; and
- Computer modelling of the Proposed Development, including spectators within the stadium.

9.41 Results from the noise monitoring have been used to assess the suitability of the site for residential development, in terms of the meeting the recommendations made in BS 8233[6], as repeated in Table 9.2.

Table 9.2 BS8233 Indoor Ambient Noise Level Criteria for the Proposed Development

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	$L_{Aeq,16hr}$ 35 dB	-
Dining	Dining room	$L_{Aeq,16hr}$ 40 dB	-
Sleeping	Bedroom	$L_{Aeq,16hr}$ 35 dB	$L_{Aeq,8hr}$ 30 dB and L_{AFmax} 45 dB for regularly occurring events

9.42 An assessment of the noise levels experienced within external residential amenity areas created by the Proposed Development has been included. The assessment is based on achieving the recommended noise levels contained in BS 8223 which indicates that levels of $L_{Aeq,16hr}$ 55 dB or lower are considered desirable for residential amenity.

Crowd Dispersion and Stadium Noise

9.43 Crowd dispersion and Stadium noise has been included in the noise model.

9.44 The crowd dispersion noise assessments are based on measurements completed during a match day at positions along the crowd routes. A crowd flow survey was completed at the same time as the noise measurements. The crowd flow survey has been used to calibrate the noise levels to a known flow rate of people.

9.45 The anticipated crowd routes associated with the Proposed Development and calibrated sound levels are included in the computer model, with the resultant sound pressure levels assessed with respect to the relative short-term change in the 2019 ambient baseline noise levels, at the identified receptors and along the survey routes.

9.46 ***ES Volume 3, Appendix: Noise and Vibration (Annex 5)*** includes the full list of assumptions applied to the calculations, including the routes, number of people, sound level produced per person and walking speed.

9.47 Crowd stadium noise breakout has been based on the unattended and attended noise measurements completed in and around the stadium during a match day. The measurements have been used to establish a sound level contribution from spectators within the stadium, which has been applied to the Proposed Development.

9.48 ***ES Volume 3, Appendix: Noise and Vibration (Annex 6)*** includes the full list of assumptions applied to the calculations.

Assumptions and Limitations

9.49 It is assumed that for the purpose of the assessment, the ambient noise levels (measured as part of the baseline conditions) will be the same as when the Proposed Development operates, e.g. will not increase in line with traffic volumes predictions.

9.50 Crowds entering the stadium will be encouraged into the concourse areas, which will serve food and beverages prior to the match and at half time. There will be no confectionary or temporary food and beverage facilities outside the stadium. Supporters will not be re-admitted to the stadium once they leave.

9.51 For the assessment of site suitability, it is assumed that during a non-match day that the prevailing ambient noise climate will be determined by road traffic. During a match day it is assumed that the facades adjacent to the stadium will be dominated by stadium noise, which is predominately mid-high frequency content.

9.52 Noise breakout via the football stadium associated with the use of the hospitality areas and bar has been assessed.

Defining Significance

Receptor Sensitivity

9.53 The receptors relevant to this assessment are all residential and, based on information within the Woking Borough Council's (WBC's) Local Plan, of high sensitivity.

9.54 Although there are other noise sensitive receptors located at greater distance, it is considered that controlling noise egress at the closest properties will result in acceptable noise levels at all other noise sensitive premises.

9.55 In any instances where the noise impact cannot be mitigated to an acceptable level at the nearest noise sensitive receptors, consideration will be given to the impact on receptors at greater separation distance.

Magnitude of Impact

Demolition and Construction Noise and Vibration

9.56 The criteria for assessing the likely magnitude of impact from demolition and construction plant noise and vibration have been based on the 'ABC' method set out BS 5228-1&2:2009, which is a technique for assessing significance based on the change in existing ambient noise level in the vicinity of the Proposed Development.

[5] *British Standards (BS) 4142:2014 Method for rating and assessing industrial and commercial sound, October 2014*

[6] *British Standard BS 8233:2014 – Guidance on sound insulation and noise reduction for buildings.*

9.57 The criteria are provided relative to the ambient noise level, which changes around the site. The criteria presented in Table 9.3 is for receptor facades not adjacent to Westfield Avenue. This applies to most receptors.

Table 9.3 Magnitude of Impact - Demolition and Construction Noise and Vibration

Magnitude of Impact	Daytime Noise Levels	Vibration Levels
Very Low	Lower than ambient [1] L_{Aeq},or less or equal to L_{Aeq} 65 dB	Peak particle velocity (PPV) less than 0.3 mm/s
Low	Higher than ambient L_{Aeq} less than L_{Aeq} 65 dB	PPV regularly exceeding 0.3 mm/s, but less than 1.0 mm/s.
Medium	Higher than ambient and between L_{Aeq} 66-70 dB	PPV regularly exceeding 1.0 mm/s, but less than 10.0 mm/s.
High	Higher than ambient and greater than L_{Aeq} 70 dB	PPV regularly exceeding 10.0 mm/s.

9.58 The criteria presented in Table 9.4 is for receptor facades that face Westfield Avenue and opposite the site. This applies to the eastern facades of Hazel House, Beech House, 62-60 Westfield Avenue and 54-60 Westfield Avenue, where the ambient noise levels during a usual day are greater than L_{Aeq} 65 dB.

Table 9.4 Magnitude of Impact - Demolition and Construction Noise and Vibration at Westfield Avenue receptors

Magnitude of Impact	Daytime Noise Levels	Vibration Levels
Very Low	Lower than ambient L_{Aeq},or greater than the ambient L_{Aeq} but less or equal to L_{Aeq} 65 dB	Peak particle velocity (PPV) less than 0.3 mm/s
Low	Greater than ambient L_{Aeq} and between L_{Aeq} 66-70 dB	PPV regularly exceeding 0.3 mm/s, but less than 1.0 mm/s.
Medium	Higher than ambient and between L_{Aeq} 71-75 dB	PPV regularly exceeding 1.0 mm/s, but less than 10.0 mm/s.
High	Higher than ambient and greater than L_{Aeq} 75 dB	PPV regularly exceeding 10.0 mm/s.

Building Services Plant Noise

9.59 Noise levels from building services plant associated with the completed and operational Proposed Development would need to be controlled to ensure that it would not have an effect on nearby noise sensitive receptors relative to the background sound level. Criteria for the assessment are set in accordance with BS 4142 and the Institute of Acoustics (IOA) / Institute of Environmental Management and Assessment (IEMA) 'Guidelines for Noise Impact Assessment'[7], as identified in Table 9.5.

Table 9.5 Description of the Magnitude of Impact Rating for Assessing the Likely and Residual Effects of Building Services Plant Noise

Magnitude of Impact	Increase in Noise Level (dBA)	Description
Very low	<1.0	Noise increase is unlikely to be discernible
Low	1.0-2.9	A slight increase in noise levels may be perceived in affected buildings and outdoor recreational areas
Medium	3.0-4.9	Increase in noise levels is likely to be noticeable in affected buildings and outdoor recreational areas
High	>5.0	Increase in noise levels is likely to be clearly perceptible and could have a significant effect on the continued use of a building

Demolition and Construction, and Operational Road Traffic Noise

9.60 The road traffic effects (of the demolition and construction, and operation of the Proposed Development on nearby noise sensitive receptors) can be categorised as noise associated with changes in road traffic movements around the site, as a result of the Proposed Development.

9.61 Significance criteria for assessing the road traffic effects of the demolition and construction, and completion and operation of the Proposed Development are presented in Table 9.6. The criteria are based on the IOA / IEMA 'Guidelines for Noise Impact Assessment.'

Table 9.6 Description of the Magnitude of Impact Rating for Assessing the Effect of Increases in Road Traffic Noise

Magnitude of Impact	Increase in Noise Level (dBA)	Description
Very low	<1.0	Noise increase is unlikely to be discernible
Low	1.0-2.9	A slight increase in noise levels may be perceived in affected buildings and outdoor recreational areas
Medium	3.0-4.9	Increase in noise levels is likely to be noticeable in affected buildings and outdoor recreational areas
High	>5.0	Increase in noise levels is likely to be clearly perceptible and could have a significant effect on the continued use of a building

9.62 The assessment of road traffic noise reflections from the Proposed Development buildings to the existing receptors are inherently included within the calculation models and will be assessed by the magnitude of impact criteria presented in Table 9.6.

Site Suitability

9.63 The overall aim in determining whether a site is suitable for a development containing residential accommodation is whether appropriate internal noise levels are achieved within the apartments for sleeping and relaxing. The magnitude of impact category for site suitability have been developed, relative to increases from BS 8233 internal noise levels.

Table 9.7 Description of the Magnitude of Impact Rating for Assessing the Effects on Internal Noise Levels Within Dwellings

Magnitude of Impact	Increase in Noise Level (dBA)	Description
Very low	<1.0	Complies with Table 9.1
Low	1.0-5.0	Internal noise limits comply with 'reasonable' standard set out in BS 8233
Medium	6-10	Internal noise limits up to 5 dB higher than 'reasonable' standard set out in BS 8233
High	>10.0	Internal noise limits 10 dB higher than 'reasonable' standard set out in BS 8233

9.64 There are no generally adopted magnitude of impact criteria for noise levels in external spaces. The criteria in Table 9.8 are, therefore, applied.

Table 9.8 Magnitude of Impact - Noise in Designated Residential Amenity Spaces (other than private balconies)

Magnitude of Impact	Noise Level (dBA)	Description
Very low	≤50	Meets the lower recommended value in BS 8233
Low	51-55	Meets the upper guideline value in BS 8233
Medium	56-60	Noise levels that are just noticeable above the upper guideline value in BS 8233
High	≥61	Would be noticeably above the upper guideline value in BS 8233

9.65 As noted in BS 8233, not achieving the recommended levels in external spaces should not prohibit amenity space being provided, e.g. private residential balconies. However, it is acknowledged that residents should have access to external spaces (private or public), where appropriate noise levels for relaxation are achieved.

[7] *Institute of Environmental Management and Assessment (IEMA) and Institute of Acoustics (IOA) Guidelines for Noise Impact Assessment, October 2014*

9.66 The magnitude of impact criteria presented in Table 9.8 are intended to be used as part of the assessment of effects to other residential amenity spaces, such as specific areas that are intended to be used for relaxation by the future residents e.g. terraces and other areas specifically designated as external residential amenity.

Crowd Dispersion and Breakout from the Stadium

9.67 Assessment of crowd dispersion noise levels and breakout from the stadium is conducted on a proposed semantic scale included in the scoping report. The semantic scale assesses the noise level produced by a crowd, relative to the short-term change in noise level in the area, as per Table 9.9.

Table 9.9 Magnitude of Impact - Short-Term Noise Sources

Magnitude of Impact	Increase in Noise Level	Description
Very Low	Decrease of 6 dBA or more	Significant decrease
Very Low	Decrease of less than 6 dBA	Noticeable decrease
Low	Increase of less than 6 dBA	No significant change
Low	Increase of 6 to 10 dBA	Slight increase
Medium	Increase of 10 to 15 dBA	Moderate increase
High	Increase of 15 to 20 dBA	Substantial increase
High	Increase of more than 20 dBA	Severe increase

Noise Emissions from Bar and Hospitality Spaces

9.68 The event spaces have the potential to be occupied throughout the daytime and into the evening periods.

9.69 The IOA's Good Practice Guide on the Control of Noise from Pubs and Clubs provides discussion of the need for adequate control of noise impact on residential demises. It does not, however, provide quantitative criteria against which an assessment should be undertaken.

9.70 A separate IOA article was published in the IOA Acoustics Bulletin Nov/Dec 2003. This article does provide an assessment methodology for impact of pubs and clubs on residential premises, the relevant guidance from which is as follows:

9.71 The bar and hospitality spaces are understood to operate up to 23:00, with the potential to operate more than once a week. Venues where entertainment takes place more than once per week are recommended to comply with the following:

- The L_{Aeq} of the entertainment noise should not exceed the representative background noise level L_{A90} (without entertainment noise); and,
- The L_{10} of the entertainment noise should not exceed the representative background noise level L_{90} (without entertainment noise) in any 1/3 octave band between 40 Hz and 160 Hz'

9.72 On the basis of the above, the magnitude of impact criteria for the event spaces are given in Table 9.10

Table 9.10 Magnitude of Impact Criteria Relating to the Use of the Bar and Hospitality Spaces

Noise level	Magnitude of impact	Description
L_{Aeq} does not exceed the background L_{A90} level, L_{A10} does not exceed the background L_{A90} level in any 1/3 octave band between 40 Hz and 160 Hz	Very Low	Entertainment noise barely audible
L_{Aeq} does not exceed the background L_{A90} level	Low	Low frequency noise audible, but noise sources are not identifiable
L_{Aeq} does not exceed the background L_{A90} level by more than 5 dB	Medium	Entertainment noise generally audible
L_{Aeq} does not exceed the background L_{A90} level by more than 10 dB	High	Entertainment noise clearly audible

Scale and Nature of Effect

9.73 Table 9.11 determines the scale of effects based on the sensitivity of the receptor and the magnitude of the impact, as per the IOA / IEMA 'Guidelines for Noise Impact Assessment'.

9.74 A significant effect is an effect that is classified as being moderate or major in scale. Effects that are minor or negligible in scale are not considered to be significant effects.

Table 9.11 Scale of Effects

Sensitivity of Receptor	Magnitude of Impact			
	High	Medium	Low	Very Low
High	Major	Moderate	Minor	Negligible
Medium	Moderate	Minor	Negligible	Negligible
Low	Minor	Negligible	Negligible	Negligible

Categorising Likely Significant Effects

9.75 Table 9.12 puts the scale of effect into context, in relation to the effects experienced by the receptors and their likely acceptance of the effect. This is based on the IEMA Guidelines for Environmental Noise Impact Assessment and the Planning Practice Guidance (PPG)[8]. Table 9.12 also relates the scale of effect with the LOAEL (Lowest Observed Adverse Effect Level) and SOAEL (Significant Observed Adverse Effect Level) rating. The NOAEL (No Observed Adverse Effect Level) is equivalent to a Negligible effect rating.

Table 9.12 Classification of Noise Effects Relative to LOAEL and SOAEL

Scale of Effect	Description of Effect	Exceeds SOAEL?	Exceeds LOAEL?	Acceptable for occupants of assessed receptors?
Major	Disruptive, causes a material change in behaviour and/or attitude. Potential for sleep disturbance. Quality of life diminished due to change in character of the area.	Yes	Yes	No
Moderate	Intrusive, noise can be heard and causes small changes in behaviour and/or attitude. Potential for non-awakening sleep disturbance. Affects the character of an area such that there is a perceived change in the quality of life.	No	Yes	No
Minor	Non-intrusive, can be heard but does not cause any change in behaviour or attitude. Can slightly affect the character of an area but not such that there is a perceived change in the quality of life.	No	No	Yes
Negligible	No discernible effect on the receptor	No	No	Yes

9.76 All noise and vibration effects are typically either Adverse or Negligible. An Adverse effect is anything that can cause a change in behaviour, attitude or changes the character of a place. A Negligible effect is used to

[8] Department of Communities and Local Government (2014) Planning Practice Guidance

describe the effect when there is no discernible impact on the receptors. Whilst Beneficial noise effects can occur, in reality they are highly unlikely.

Geographic Extent of Effect

9.77 The geographic extent of the effects is identified. At a spatial level, 'site' or 'local' effects are those affecting the site and neighbouring receptors, while effects upon receptors in the borough or beyond the vicinity of the site and its neighbours are at a 'district / borough' level. Effects affecting the south-east of England are at a 'regional' level, whilst those which affect different parts of the country, or England, are considered being at a 'national' level.

Effect Duration

9.78 For the purposes of the ES, effects that are generated as a result of the demolition and construction works (i.e. those that last for this set period of time) are classed as 'temporary'; these may be further classified as either 'short term' or 'medium-term' effects depending on the duration of the demolition and construction works that generate the effect in question. Effects that result from the operational Proposed Development are classed as 'permanent' or 'long-term' effects.

Direct and Indirect, Reversible or Irreversible Effects

9.79 The assessment also identifies whether the effect is 'direct' (i.e. resulting without any intervening factors) or 'indirect' or 'secondary' (i.e. not directly caused or resulting from something else).

9.80 Whether the effect is 'reversible' or 'irreversible' is also identified.

BASELINE CONDITIONS

Baseline Conditions

9.81 The noise climate around the site is mainly affected by road traffic, building services plant and the operation of the stadium.

9.82 A noise survey of the Baseline Conditions has been undertaken and the results are summarised in ***ES Volume 3, Appendix: Noise and Vibration (Annex 6)***.

IDENTIFICATION OF RECEPTORS AND RECEPTOR SENSITIVITY

Existing

9.83 The receptors taken into consideration in the impact assessment have been identified in Figure 9.1 and listed with their sensitivity in Table 9.13.

Table 9.13 Receptors and Receptor Sensitivity

Receptor	Receptor Sensitivity
Kingfield Road (Cobbles, The Dell and The Haven)	High
Kingfield Drive (Cotwolds, Chinthurst and 7 Kingfield Drive)	High
Westfield Avenue (Hazel House, Beech House, 62-66 Westfield Avenue, 54-60 Westfield Avenue and 51-63a Westfield Avenue)	High
1 & 3 Westfield Grove	High
Kingfield Close (Pond House, Kingfield Cottage, The Cedars, Nut Cottage and Penlan	High
67 & 74 Granville Road	High

Introduced

9.84 Residential uses will form part of the Proposed Development. The residential receptors are of high sensitivity. An assessment on the suitability of the site for a residential development and any relevant mitigation measures have been included.

POTENTIAL EFFECTS

9.85 This section discusses noise and vibration effects to sensitive receptors arising from the Proposed Development during the demolition and construction phase and during the operational phase.

9.86 Where significant adverse effects are predicted to occur, mitigation measures have been identified in order to reduce the magnitude of these effects to an acceptable level.

Demolition and Construction

9.87 A summary of the predicted noise levels during the demolition and construction works is presented in Table 9.14. The noise levels presented are the maximum predicted at each building (receptor) identified in the table. Table 9.14 also presents the receptor sensitivity, the magnitude of impact and the resultant scale and nature of noise effect. The effects are defined pre-mitigation but account for the 2.4m high perimeter site hoarding and construction plant that is compliant with the sound and vibration levels published within BS 5228 (as detailed above at Paragraph 9.27).

9.88 The noise levels indicated in Table 9.14 represent those at a distance of 1m from the sensitive receptors and include reflections from the building's facades. Free-field noise levels would be approximately 3 dB lower than those presented.

Table 9.14 Summary of Predicted Noise Levels during Demolition and Construction

Activity	Predicted Noise Level ($L_{Aeq,10hr}$ dB)	Magnitude of Impact	Scale and Nature of Effect (significance)
Cobbles (*Receptor Sensitivity – High)*			
Demolition of Block 1	66	Medium	Moderate (significant)
Construction of Block 1	73	High	Major (significant)
Demolition of David Lloyd Leisure Centre and Stadium	63	Low	Minor (not significant)
Demolition of David Lloyd Leisure Centre and Stadium, and excavation of Blocks 2 to 5	69	Medium	Moderate (significant)
Construction of basement, Stadium and Block 2	64	Low	Minor (not significant)
Construction of Blocks 2 to 4	44	Very Low	Negligible (not significant)
Construction of Blocks 3 to 5	44	Very Low	Negligible (not significant)
Kingfield Drive (all receptors) (*Receptor Sensitivity – High)*			
Demolition of Block 1	53	Very Low	Negligible (not significant)
Construction of Block 1	60	Low	Minor (not significant)
Demolition of David Lloyd Leisure Centre and Stadium	60	Low	Minor (not significant)
Demolition of David Lloyd Leisure Centre and Stadium, and excavation of Blocks 2 to 5	66	Medium	Moderate (significant)
Construction of basement, Stadium and Block 2	64	Low	Minor (not significant)
Construction of Blocks 2 to 4	45	Very Low	Negligible (not significant)
Construction of Blocks 3 to 5	52	Very Low	Negligible (not significant)
Hazel House, Beech House, 62-66 Westfield Avenue and 54-60 Westfield Avenue (*Receptor Sensitivity – High)*			
Demolition of Block 1	67	Low	Minor (not significant)
Construction of Block 1	78	High	Major (significant)
Demolition of David Lloyd Leisure Centre and Stadium	65	Very Low	Negligible (not significant)
Demolition of David Lloyd Leisure Centre and Stadium, and excavation of Blocks 2 to 5	74	Medium	Moderate (significant)
Construction of basement, Stadium and Block 2	60	Very Low	Negligible (not significant)
Construction of Blocks 2 to 4	54	Very Low	Negligible (not significant)
Construction of Blocks 3 to 5	47	Very Low	Negligible (not significant)

Activity	Predicted Noise Level ($L_{Aeq,10hr}$ dB)	Magnitude of Impact	Scale and Nature of Effect (significance)
51 – 63 Westfield Avenue (*Receptor Sensitivity – High)*			
Demolition of Block 1	57	Low	Minor (not significant)
Construction of Block 1	64	Low	Minor (not significant)
Demolition of David Lloyd Leisure Centre and Stadium	61	Low	Minor (not significant)
Demolition of David Lloyd Leisure Centre and Stadium, and excavation of Blocks 2 to 5	71	High	Major (significant)
Construction of basement, Stadium and Block 2	67	Medium	Moderate (significant)
Construction of Blocks 2 to 4	63	Low	Minor (not significant)
Construction of Blocks 3 to 5	60	Low	Minor (not significant)
1 & 3 Westfield Grove (*Receptor Sensitivity – High)*			
Demolition of Block 1	48	Very Low	Negligible (not significant)
Construction of Block 1	56	Low	Minor (not significant)
Demolition of David Lloyd Leisure Centre and Stadium	65	Low	Minor (not significant)
Demolition of David Lloyd Leisure Centre and Stadium, and excavation of Blocks 2 to 5	73	High	Major (significant)
Construction of basement, Stadium and Block 2	65	Low	Minor (not significant)
Construction of Blocks 2 to 4	70	Medium	Moderate (significant)
Construction of Blocks 3 to 5	66	Medium	Moderate (significant)
Kingfield Close (Pond House, Kingfield Cottage, The Cedars, Nut Cottage and Penlan (*Receptor Sensitivity – High)*			
Demolition of Block 1	51	Very Low	Negligible (not significant)
Construction of Block 1	59	Low	Minor (not significant)
Demolition of David Lloyd Leisure Centre and Stadium	63	Low	Minor (not significant)
Demolition of David Lloyd Leisure Centre and Stadium, and excavation of Blocks 2 to 5	67	Medium	Moderate (significant)
Construction of basement, Stadium and Block 2	66	Medium	Moderate (significant)
Construction of Blocks 2 to 4	63	Low	Minor (not significant)
Construction of Blocks 3 to 5	67	Medium	Moderate (significant)
67 & 78 Granville Road (*Receptor Sensitivity – High)*			
Demolition of Block 1	43	Very Low	Negligible (not significant)
Construction of Block 1	56	Low	Minor (not significant)
Demolition of David Lloyd Leisure Centre and Stadium	66	Medium	Moderate (significant)
Demolition of David Lloyd Leisure Centre and Stadium, and excavation of Blocks 2 to 5	75	High	Major (significant)
Construction of basement, Stadium and Block 2	65	Low	Minor (not significant)
Construction of Blocks 2 to 4	68	Medium	Moderate (significant)
Construction of Blocks 3 to 5	60	Low	Minor (not significant)

Activity	Predicted Noise Level ($L_{Aeq,10hr}$ dB)	Magnitude of Impact	Scale and Nature of Effect (significance)
Block 1 (*Receptor Sensitivity – High)*			
Demolition of Block 1	N/A	N/A	N/A
Construction of Block 1	N/A	N/A	N/A
Demolition of David Lloyd Leisure Centre and Stadium	N/A	N/A	N/A
Demolition of David Lloyd Leisure Centre and Stadium, and excavation of Blocks 2 to 5	N/A	N/A	N/A
Construction of basement, Stadium and Block 2	65	Low	Minor (not significant)
Construction of Blocks 2 to 4	55	Very Low	Negligible (not significant)
Construction of Blocks 3 to 5	53	Very Low	Negligible (not significant)
Block 2 (*Receptor Sensitivity – High)*			
Demolition of Block 1	N/A	N/A	N/A
Construction of Block 1	N/A	N/A	N/A
Demolition of David Lloyd Leisure Centre and Stadium	N/A	N/A	N/A
Demolition of David Lloyd Leisure Centre and Stadium, and excavation of Blocks 2 to 5	N/A	N/A	N/A
Construction of basement, Stadium and Block 2	N/A	N/A	N/A
Construction of Blocks 2 to 4	N/A	N/A	N/A
Construction of Blocks 3 to 5	52	Very Low	Negligible (not significant)

9.89 Figure 9.4 to Figure 9.10 show the corresponding noise contour plots of predicted noise levels at specific intervals within the construction period where construction activities are considered likely to be noisier. The plots are presented at a grid height of 1.5m above the existing ground level in all instances.

Figure 9.4 Demolition of Block 1

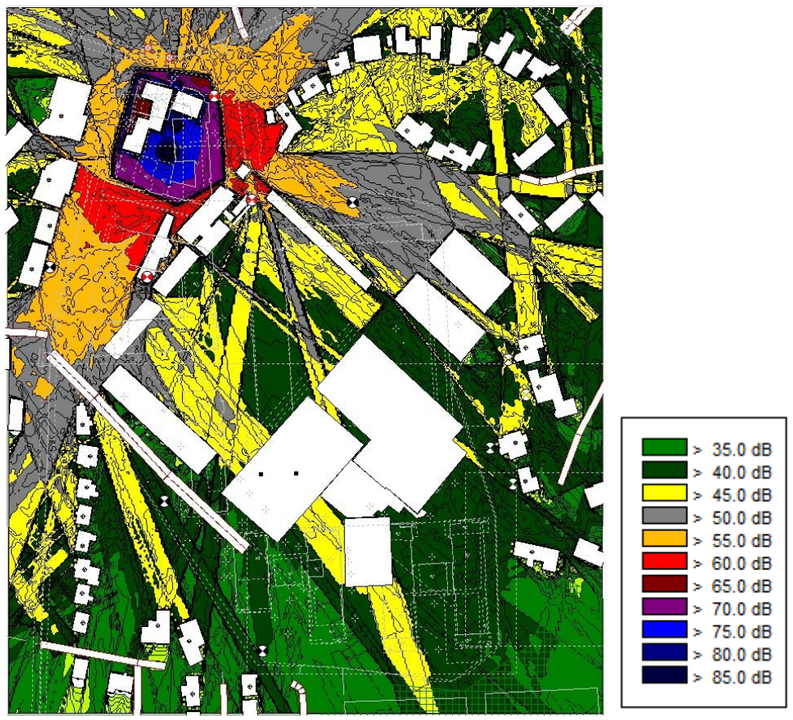


Figure 9.5 Construction of Block 1

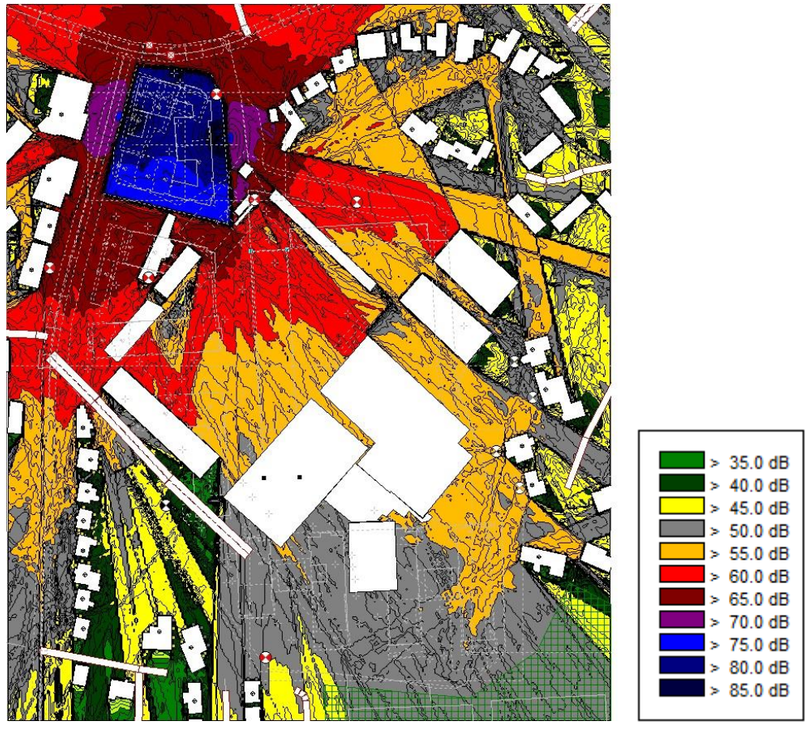


Figure 9.6 Demolition of David Lloyd Leisure Centre and Stadium

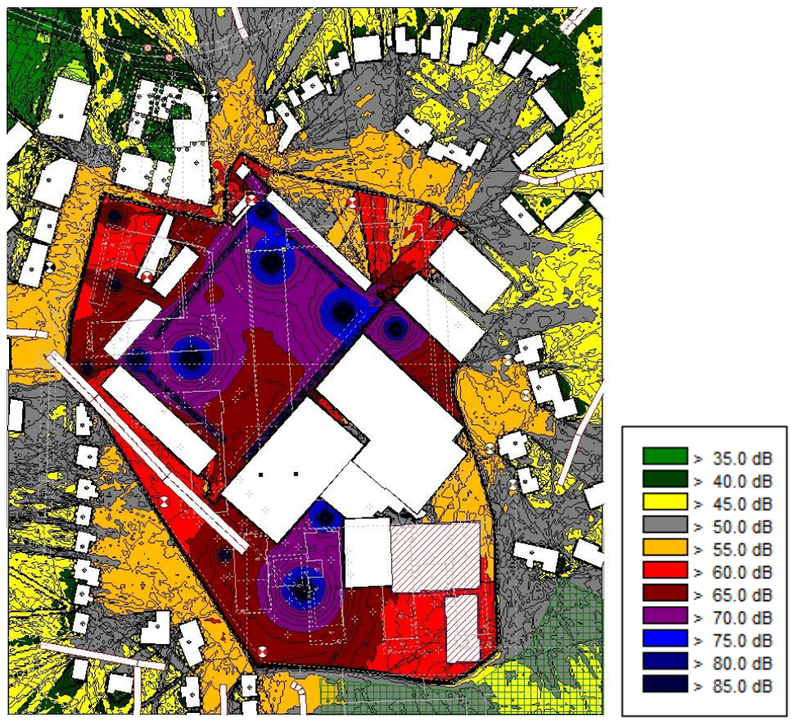


Figure 9.7 Demolition of David Lloyd Leisure Centre and Stadium, and excavation of Blocks 2 to 5

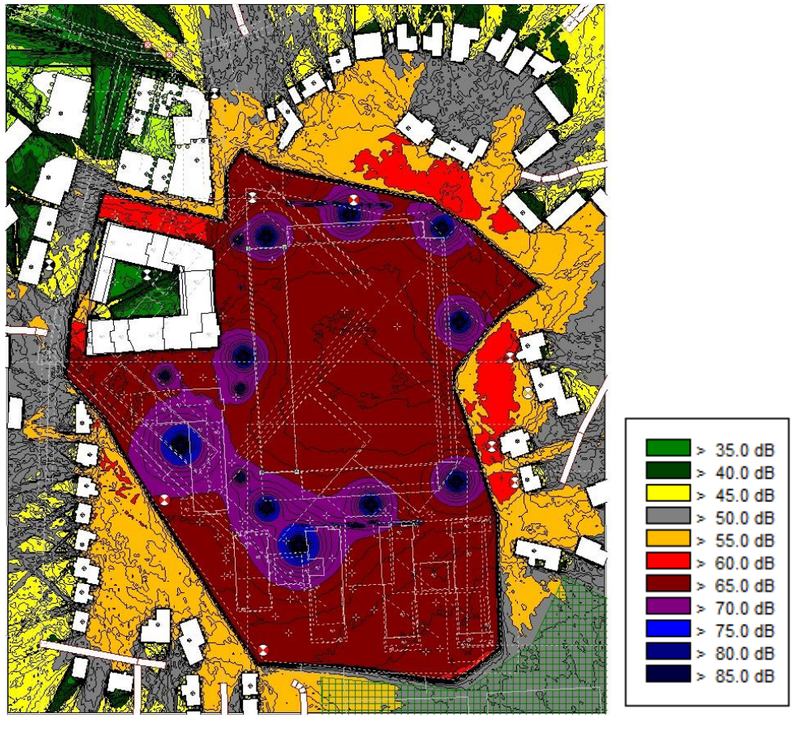


Figure 9.8 Construction of basement, Stadium and Block 2

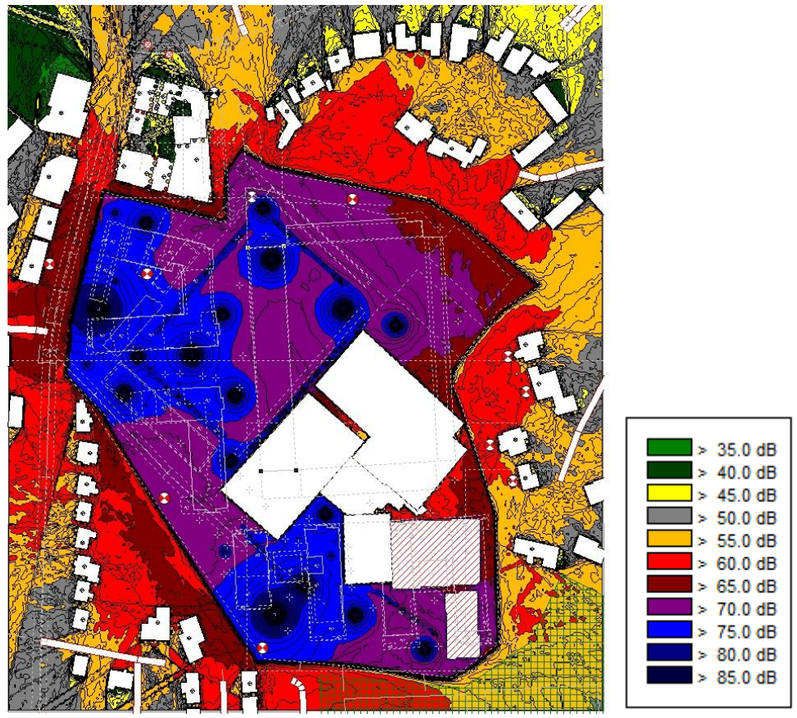


Figure 9.9 Construction of Blocks 2 to 4

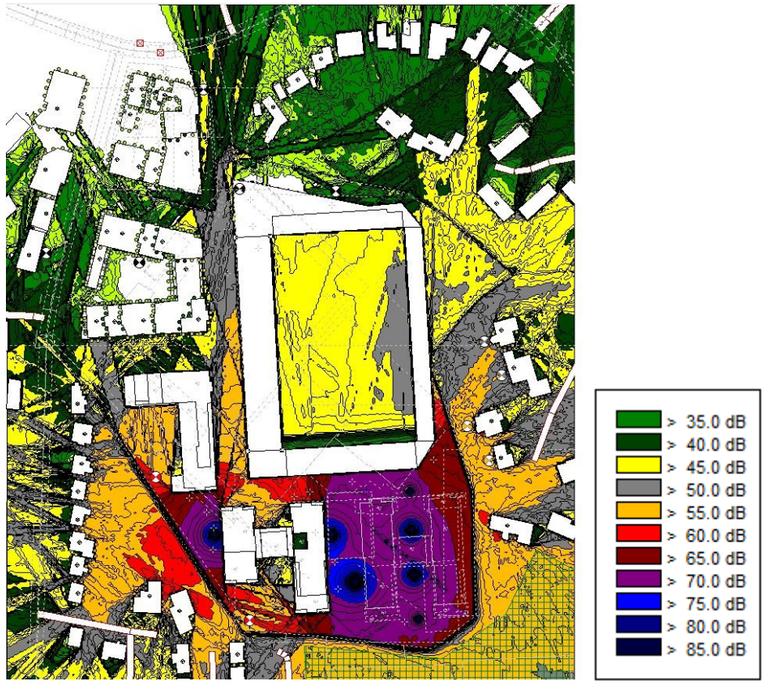
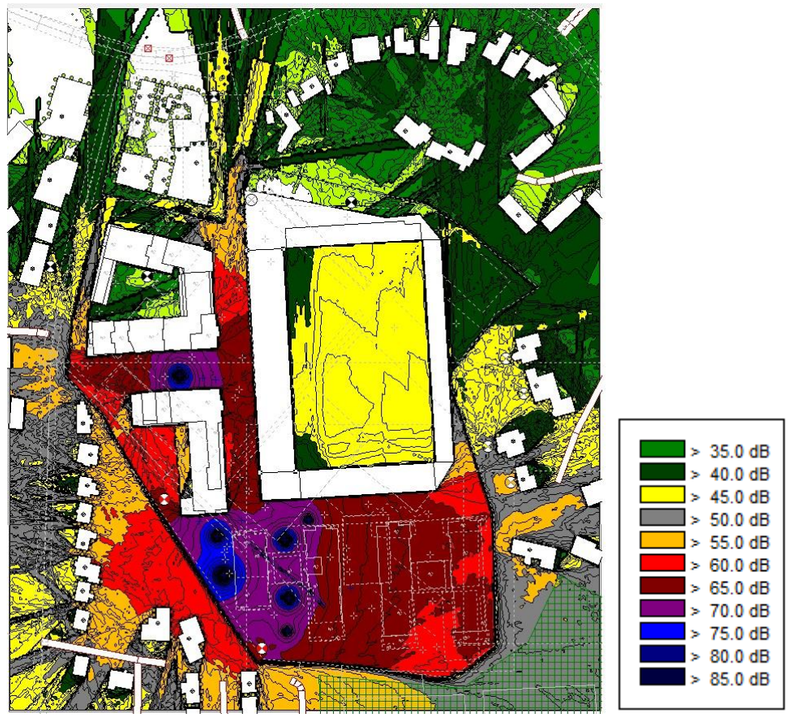


Figure 9.10 Construction of Blocks 3 to 5



9.90 All assessed intervals in the programme are predicted to result in either a **Major Adverse** or **Moderate Adverse** effect (significant) to at least one receptor. However, the assessments indicate that these adverse effects will be limited in their geographical extent and will not occur across the entire demolition and construction period. As such, the effects are **local, temporary (short-term), direct and reversible**.

9.91 The predictions presented are based on reasonable worst-case assumptions and it is considered that there will be opportunities for the contractor to reduce the magnitude of impact experienced at the nearest noise sensitive properties through the implementation of Best Practicable Means (BPM) and associated mitigation measures. An outline of the noise mitigation that could be applied, to reduce the magnitude of impact and so resultant scale of effects experienced, is provided within ***ES Volume 1, Chapter 5: Demolition and Construction***.

Construction Traffic

9.92 The demolition and construction traffic programme shows a peak of 68 vehicle movements per day entering and leaving the site. Based on the change in traffic flow the overall effect on changes to A-weighted 16 hour noise levels would be less than 1.0 dB.

9.93 On this basis the potential magnitude of impact would be Very Low and the likely effect to all receptors (including those located along the road network) is assessed to be **Negligible (not significant)**, **local, temporary (short-term), direct and reversible**.

Construction Vibration

9.94 BS 5228 indicates that construction activities (particularly piling) generally only generate vibration impacts when they are located less than 20m from sensitive locations. The magnitude of impact depends on the type of piling, ground conditions, and receptor distance.

9.95 It is not possible to estimate the levels of vibration with any certainty. Instead, it is proposed that limits are placed on the vibration at sensitive buildings (receptors) and therefore vibration levels will need to be monitored during construction. BS 5228-2 states that vibration PPV levels are tolerable within residential properties when they do not exceed 1.0mm/s and prior warning is given.

9.96 Annex C and D of BS 5228-2 provide summaries of case histories of vibration measured during piling operations. Data from works carried out in East London indicate that peak particle velocities of between 0.05

to 0.23mm/s at 20m from a site have been recorded during auger boring of 1.05m diameter piles, with soil conditions described as 'fill / dense ballast / clay'. During the removal of pile casings PPV's (at 25 Hz) of between 0.8 to 1.5mm/s at 30m and 25m from piling locations have been recorded in the same general area. These historical data suggest that vibration levels are unlikely to affect any buildings outside of the site, and that at reasonable distances from the Proposed Development the vibration levels would be expected to be substantially lower than the vibration levels stated above.

9.97 The majority of receptors are further away from the proposed piling positions along the site perimeter. In these instances, vibration levels below 1 mm/s would be expected within the properties. On this basis the effects have been assessed as **Minor Adverse** (not significant), **local, temporary (short-term), direct and reversible**.

9.98 The properties that are within 20m of the site perimeter are namely, Hazel House, 63a and 63 Westfield Avenue, 1 Westfield Grove, 67 Granville Road, Penlan, Nutt Cottage and The Cedars, may experience vibration levels in the region of 1mm/s - 3mm/s. The effects at these receptors have been assessed as **Minor Adverse (not significant), local, temporary (short-term), direct and reversible.**

Completed Development

Road Traffic

9.99 A computer model of the site and surrounding roads has been developed using CadnaA software. The computer model takes into account road geometry, gradients and average traffic speed and accounts for the existing noise from surrounding train lines and road traffic.

9.100 Road traffic noise contour maps for the 2025 future baseline and 2025 future baseline with the Proposed Development have been generated and are shown in Figure 9.11 and Figure 9.12. These take into account the 2024 18 hour AADT road traffic data, percentage of heavy vehicles and average assumed speed of the vehicles. The contour maps indicate predicted noise levels at 1.5m above ground level, approximately ear height, in the vicinity of the Proposed Development.

9.101 A noise contour plot has been generated to assess the magnitude of noise impact that changes to road traffic volumes and composition in the 2025 Future Baseline scenarios for both with and without the Proposed Development. The noise contour plot is shown in Figure 9.13 and indicates the change in noise levels at a height of 1.5m.

9.102 The use of the retail units within the stadium has not been considered, as they will operate as retail without significant noise emissions. Car parking associated with the retail and other uses is assumed to be of a similar magnitude to the existing operations

9.103 The 16-hour noise levels detailed in Table 9.15 are the highest change in noise level predicted between the 2025 "with" and "without" development scenarios for each receptor. The predictions include road traffic and on-site traffic.

Table 9.15 Predicted 16-hour Noise Levels at 1m from Receptors

Receptor	Predicted noise level ($L_{Aeq,10hr}$ dB)			Receptor Sensitivity	Magnitude of Impact	Scale and Nature of Effect and Significance
	2024 without Proposed Development	2024 with Proposed Development	Change with Proposed Development			
Kingfield Road (Cobbles)	60	62	2	High	Low	Minor (not significant)
Kingfield Road (The Dell and The Haven)	61	61	<1	High	Very Low	Negligible (not significant)
Kingfield Drive (Cotwolds, Chinthurst and 7 Kingfield Drive)	55	55	<1	High	Very Low	Negligible (not significant)
Westfield Avenue (Hazel House, Beech House, 62-66 Westfield Avenue, 54-60 Westfield Avenue and 51-63a Westfield Avenue)	67	68	1	High	Low	Minor (not significant)
1 & 3 Westfield Grove	56	56	<1	High	Very Low	Negligible (not significant)
Kingfield Close (Pond House, Kingfield Cottage, The Cedars, Nut Cottage and Penlan	54	56	2	High	Low	Minor (not significant)
67 & 74 Granville Road	56	56	<1	High	Very Low	Negligible (not significant)

Figure 9.11 Noise Contour Plot of the 2025 Future Road Traffic

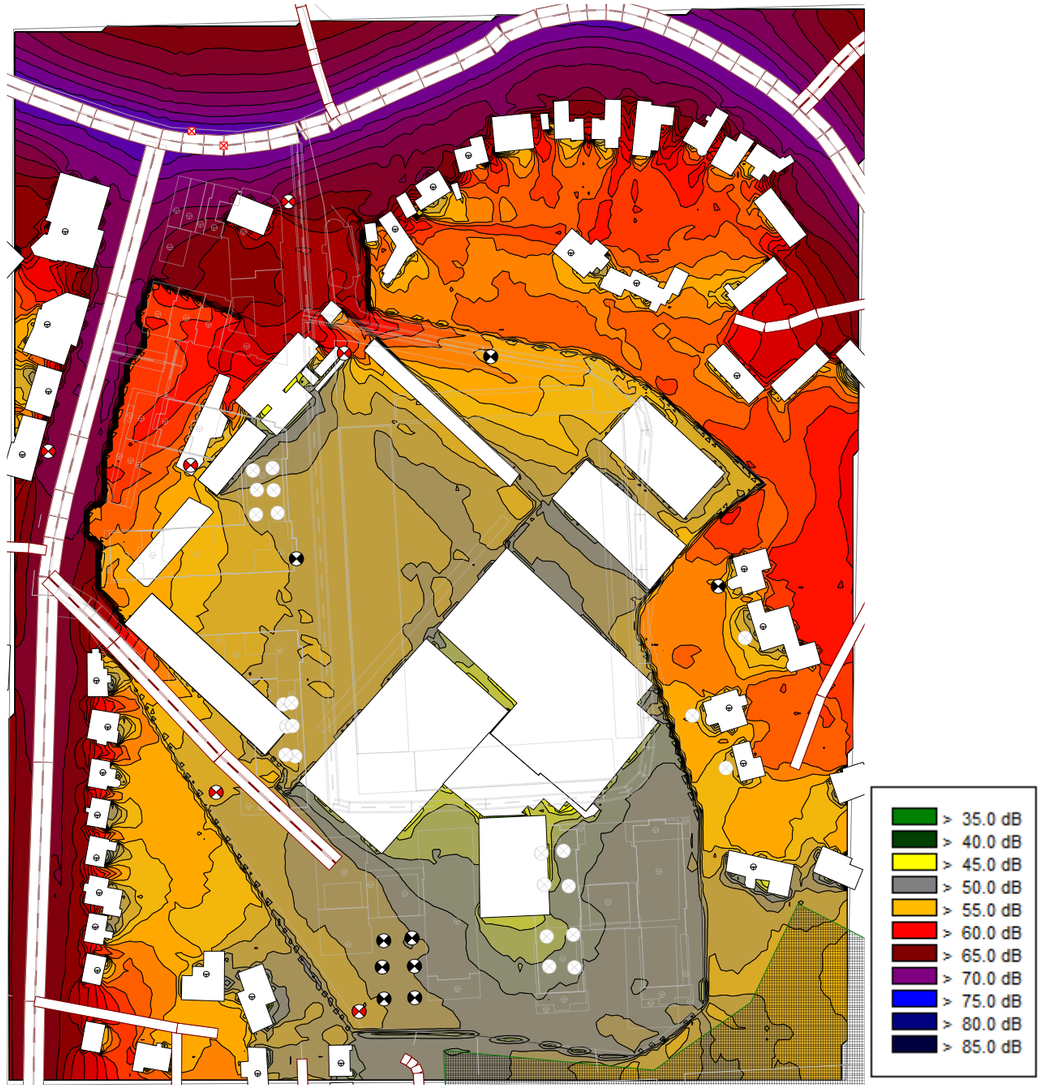
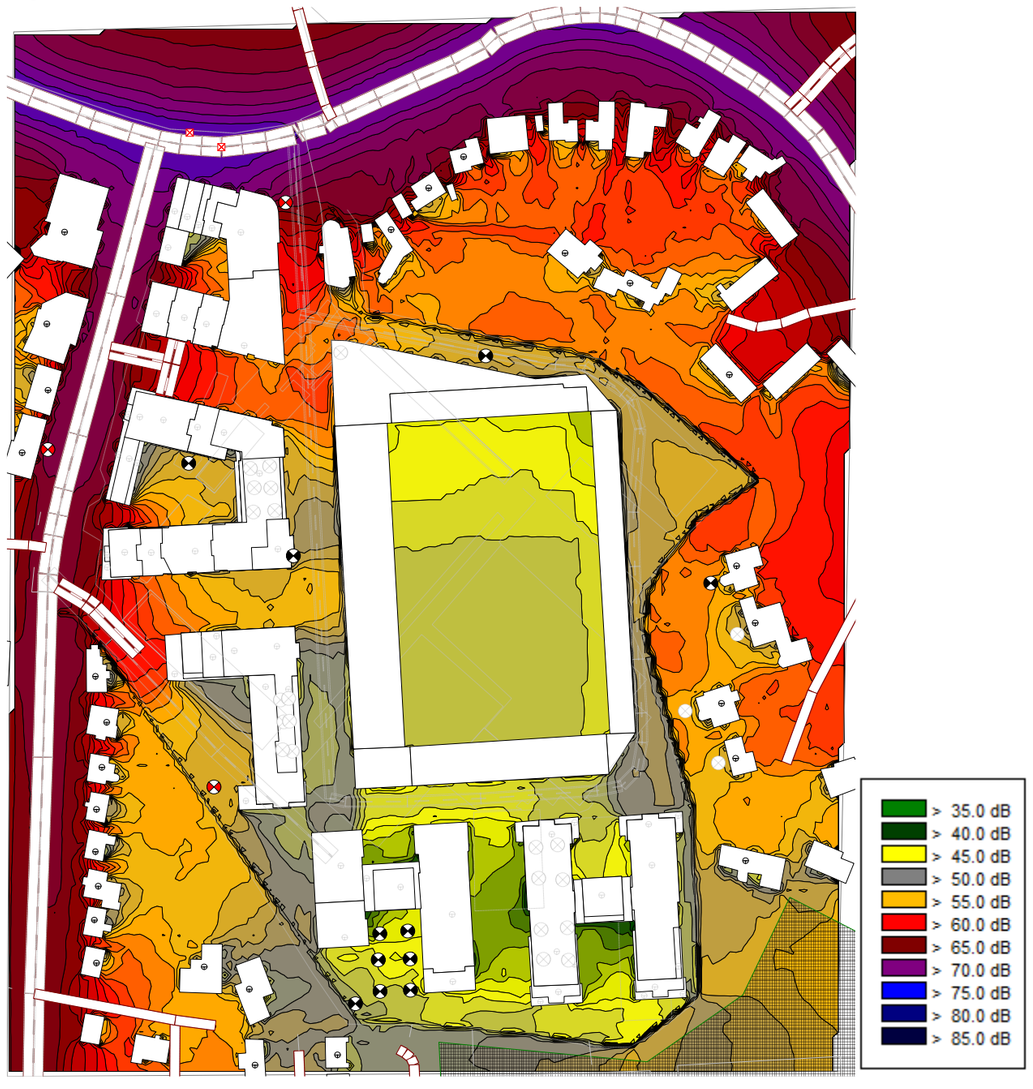


Figure 9.12 Noise Contour Plot of the 2025 Future Road Traffic with the Proposed Development



9.104 Figure 9.13 illustrates the predicted change in ambient noise levels due to increases in traffic. The areas in green indicate a negligible change in noise level to those that would exist in the future without the Proposed Development taking place.

9.105 The increases in ambient noise levels predicted at receptors, at all surrounding the Proposed Development have been assessed to be **Negligible (not significant), local, permanent, direct and irreversible** at Kingfield Road (The Dell and The Haven), Kingfield Drive (Cotswolds, Chinthurst and 7 Kingfield Drive) and 1&3 Westfield Grove.

9.106 The increases in ambient noise levels predicted at receptors at all surrounding the Proposed Development have been assessed to be **Minor Adverse (not significant), local, permanent, direct and irreversible** at Kingfield Road (Cobbles), Westfield Avenue (Hazel House, Beech House, 62-66 Westfield Avenue, 54-60 Westfield Avenue and 51-63a Westfield Avenue) and Kingfield Close (Pond House, Kingfield Cottage, The Cedars, Nut Cottage and Penlan).

Figure 9.13 Comparison of 2025 Future Road with the Proposed Development and Without the Proposed Development (light green = no increase in noise level dB, white = buildings demolished, existing or proposed)

Match Day Operations – Stadium Noise

9.107 The site currently operates with a football stadium, with the Proposed Development to also include a football stadium. An assessment has been completed to evaluate the likely change in ambient noise levels experienced at the nearby receptors during a football match.

9.108 Details on the predicted noise levels from the stadium can be found in ***ES Volume 3, Appendix: Noise and Vibration (Annex 5)*** and are summarised in Table 9.16**.**

Table 9.16 Football Stadium Operation – Maximum Capacity

Receptor	2019 Football Match Noise Level ($L_{Aeq,T}$ dB)	Predicted Noise Level ($L_{Aeq,T}$ dB)	Increase in ambient noise level (dB)	Receptor Sensitivity	Magnitude of Impact	Scale and Nature of Effect and Significance
Cobbles	67	55	-12	High	Very Low	Negligible (not significant)
The Dell	61	48	-13	High	Very Low	Negligible (not significant)
The Haven	59	47	-12	High	Very Low	Negligible (not significant)
Cotswolds	63	50	-13	High	Very Low	Negligible (not significant)
Chinthurst	63	52	-11	High	Very Low	Negligible (not significant)
11-12 Kingfield Drive	59	53	-6	High	Very Low	Negligible (not significant)
Pond House	47	53	+6	High	Low	Minor (not significant)
Kingfield Cottage	46	52	+6	High	Low	Minor (not significant)
The Cedars	46	52	+6	High	Low	Minor (not significant)
Nut Cottage	49	52	+3	High	Low	Minor (not significant)
Penlan	46	52	+8	High	Low	Minor (not significant)
67 Granville Road	45	47	+2	High	Low	Minor (not significant)
78 Granville Road	43	48	+5	High	Low	Minor (not significant)
1 Westfield Grove	46	50	+4	High	Low	Minor (not significant)
3 Westfield Grove	47	51	+4	High	Low	Minor (not significant)
51 Westfield Avenue	45	47	+2	High	Low	Minor (not significant)
53 Westfield Avenue	44	49	+5	High	Low	Minor (not significant)
55 Westfield Avenue	48	51	+3	High	Low	Minor (not significant)
57 Westfield Avenue	49	49	0	High	Very Low	Negligible (not significant)
59 Westfield Avenue	49	49	0	High	Very Low	Negligible (not significant)
61 Westfield Avenue	49	48	-1	High	Very Low	Negligible (not significant)
63 Westfield Avenue	51	48	-3	High	Very Low	Negligible (not significant)

Receptor	2019 Football Match Noise Level ($L_{Aeq,T}$ dB)	Predicted Noise Level ($L_{Aeq,T}$ dB)	Increase in ambient noise level (dB)	Receptor Sensitivity	Magnitude of Impact	Scale and Nature of Effect and Significance
63a Westfield Avenue	53	50	-3	High	Very Low	Negligible (not significant)
54-66 Westfield Avenue	49	48	-1	High	Very Low	Negligible (not significant)
1 to 12 Beech House	47	50	+3	High	Low	Negligible (not significant)
1 to 26 Hazel House	53	46	-7	High	Very Low	Negligible (not significant)
Block 1	55[1]	67	12	High	Medium	Moderate (significant)
Block 2	53[1]	73	18	High	High	Major (significant)
Block 3	53[1]	63	13	High	Medium	Moderate (significant)
Block 4	51[1]	74	23	High	High	Major (significant)
Block 5	49[1]	73	24	High	High	Major (significant)

[1] Predicted without a football match taking place.

9.109 As shown in Table 9.16, the likely stadium noise has been assessed to be at worst result in a **Minor Adverse (not significant) local, permanent, direct and irreversible** effect at all existing receptors.

9.110 The introduced receptors will be subjected to higher changes in ambient noise level than their predicted non-match day condition. The effects in change in ambient noise level have been assessed to be **Major or Moderate Adverse (significant) local, permanent, direct and irreversible.** However, it is recognised that the introduced receptors will be aware of the football stadium prior to moving and if "satisfactory" internal noise levels are still achieved during a football match (e.g. a Very Low or Low Magnitude of Impact) could be deemed a reasonable approach. A further assessment has therefore been included in Paragraph 9.119.

Crowd Dispersion

9.111 Details on the predicted noise levels from crowds leaving the venue after an event finish can be found in **Volume 3: Appendix Noise and Vibration – Annex 5**.

9.112 The ambient noise level assessment has been based on a capacity match, so represents a worst-case in terms of potential adverse effects.

9.113 The assessment has been based on the worst-case 15 minutes, with the assessment completed with respect to the existing ambient noise levels measured or predicted along the pedestrian routes presented in Figure 9.14

9.114 The predicted results from the analysis are provided in Table 9.17.

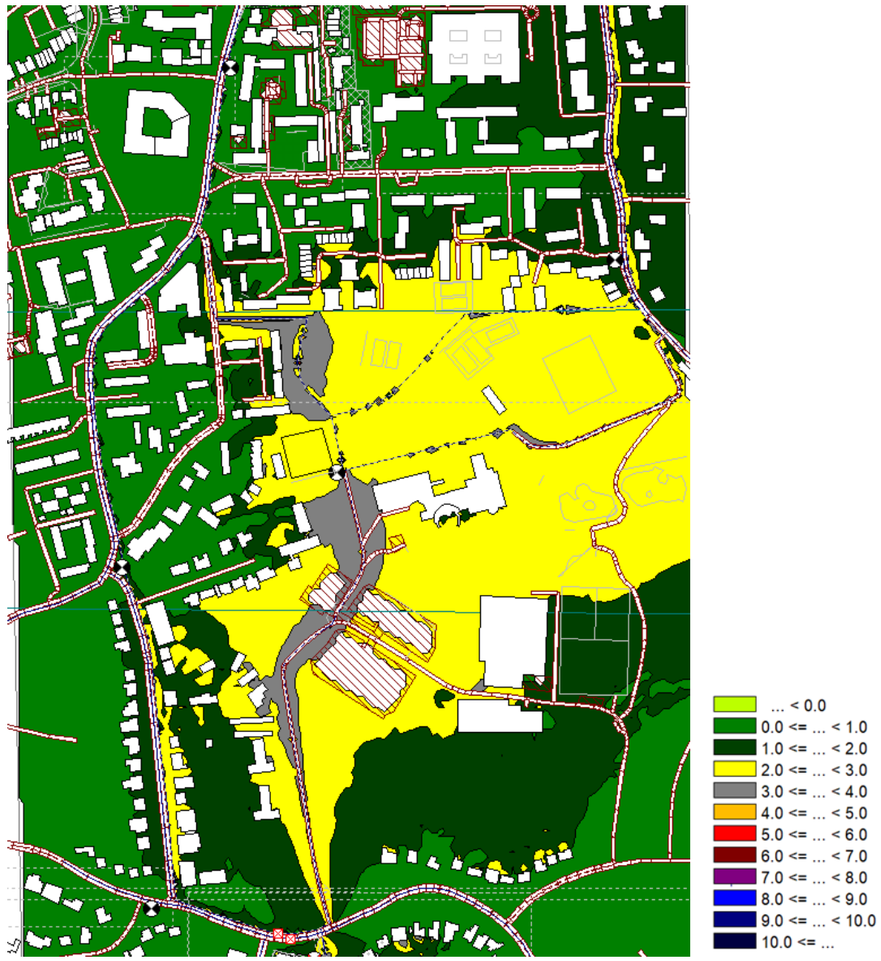
Figure 9.14 Pedestrian Routes to and from Woking Football Club

Table 9.17 Crowd Ambient Noise Dispersion Summary

Receptor	Measurement position	Existing noise levels ($L_{Aeq,15min}$ dB)	Predicted crowd noise levels ($L_{Aeq,15min}$ dB)	Increase in ambient noise level ($L_{Aeq,15min}$ dB)	Receptor Sensitivity	Magnitude of Impact	Scale and Nature of Effect and Significance
1 – Guildford Avenue	1	72	72	0	High	Very Low	Negligible (not significant)
2 – Guildford Avenue/ Claremont Avenue	2	69	71	2	High	Low	Minor (not significant)
3 – Wych Hill Lane/ Claremont Avenue	3	66	66	0	High	Very Low	Negligible (not significant)
6 – Kingfield Avenue	6	67	68	1	High	Low	Minor (not significant)
7 – White Rose Lane	7	59	63	4	High	Low	Minor (not significant)
8 – Woking Park	8	62	65	5	High	Low	Minor (not significant)

9.115 The assessment of maximum noise levels associated with crowd dispersion indicates a **Minor Adverse (not significant), local, permanent, direct and irreversible** effect along Guildford Avenue/Claremont Avenue, Kingfield Avenue, White Rose Lane and within Woking Park. **Negligible (not significant), local, permanent, direct and irreversible** effects are described at the remaining nearby residential receptors.

Figure 9.15 Increase in Ambient Noise Level - Crowd Dispersion (Grid 1.5m Above Ground)



Site Suitability for Residential Development

9.116 Computer modelling (CadnaA) has been completed to evaluate the sound pressure levels incident on each of the proposed residential façades. Two models were produced, one to represent the non-match day ambient noise levels and the other to represent the match day ambient noise levels. The models were calibrated from the survey information and reflect the proposed building massing.

9.117 Figure 9.16 and Figure 9.17 show images from the modelling completed that illustrate the façade noise levels expected across the Proposed Development during a non-match day.

9.118 Figure 9.18 and Figure 9.19 show images from the modelling completed that illustrate the façade noise levels expected across the Proposed Development during a match. Without appropriate mitigation, the residents of the introduced receptors may experience unacceptably high internal noise levels during a match day. This would likely result in either **Major or Moderate Adverse (significant)** effects, as described in Paragraph 9.110.

9.119 The predicted façade pressure levels for a non-match day and during a match, and the required sound insulation performance across the facades (the reduction in noise that the façade needs to provide) are presented in Table 9.18. The façade sound insulation requirements have been provided based on achieving a "Very Low" magnitude of impact during a non-match day and the night time (e.g. meets BS 8233:2014 recommendations), and to provide a "Low" magnitude of impact during a match (e.g. meets *satisfactory* internal noise levels as described in BS 8233:2014).

Figure 9.16 Predicted Façade Noise Levels with the Development Completed (Non-match Day)

Figure 9.17 Predicted Façade Noise Levels with the Development Completed (Non-match Day)

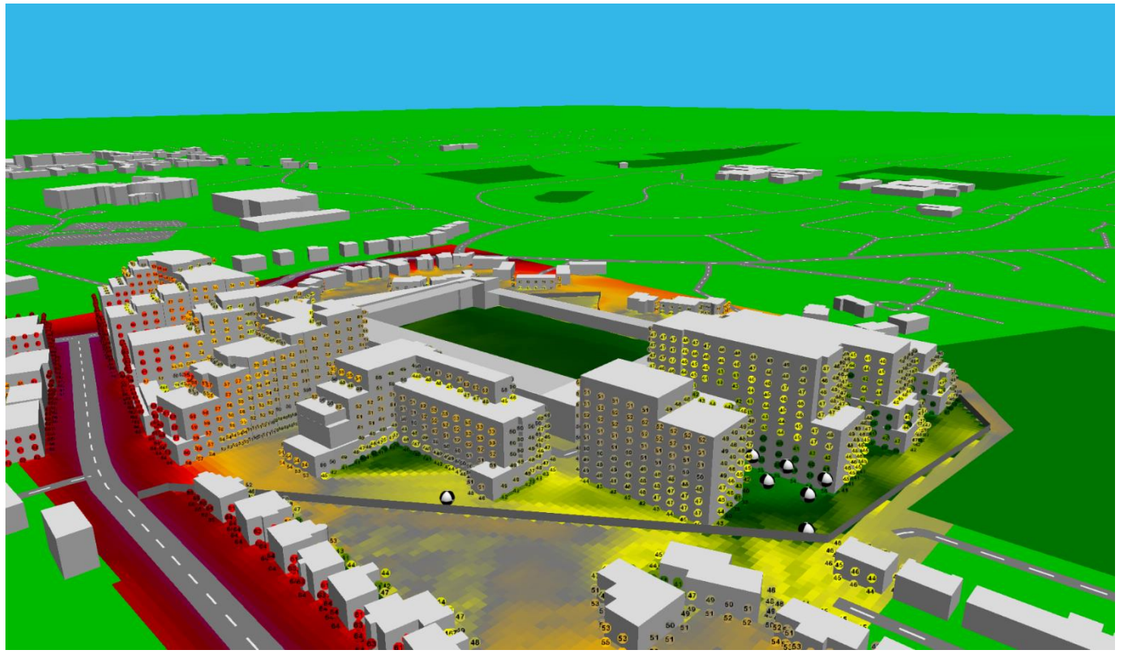


Figure 9.18 Predicted Façade Noise Levels with the Development Completed (Match Day)

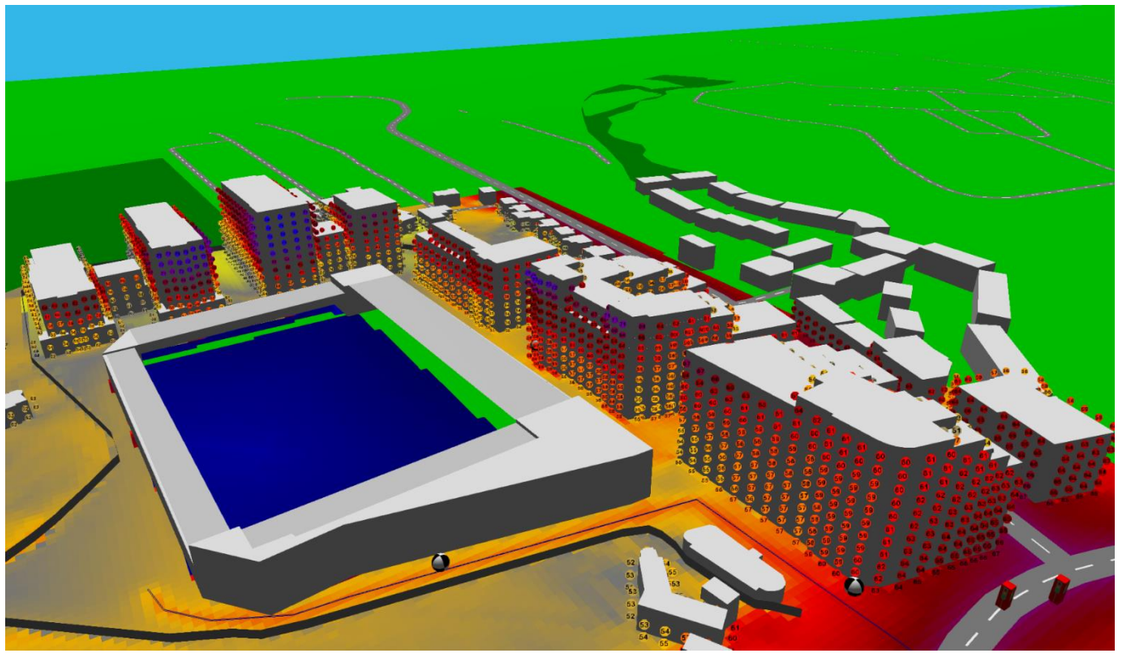


Figure 9.19 Predicted Façade Noise Levels with the Development (Match day)

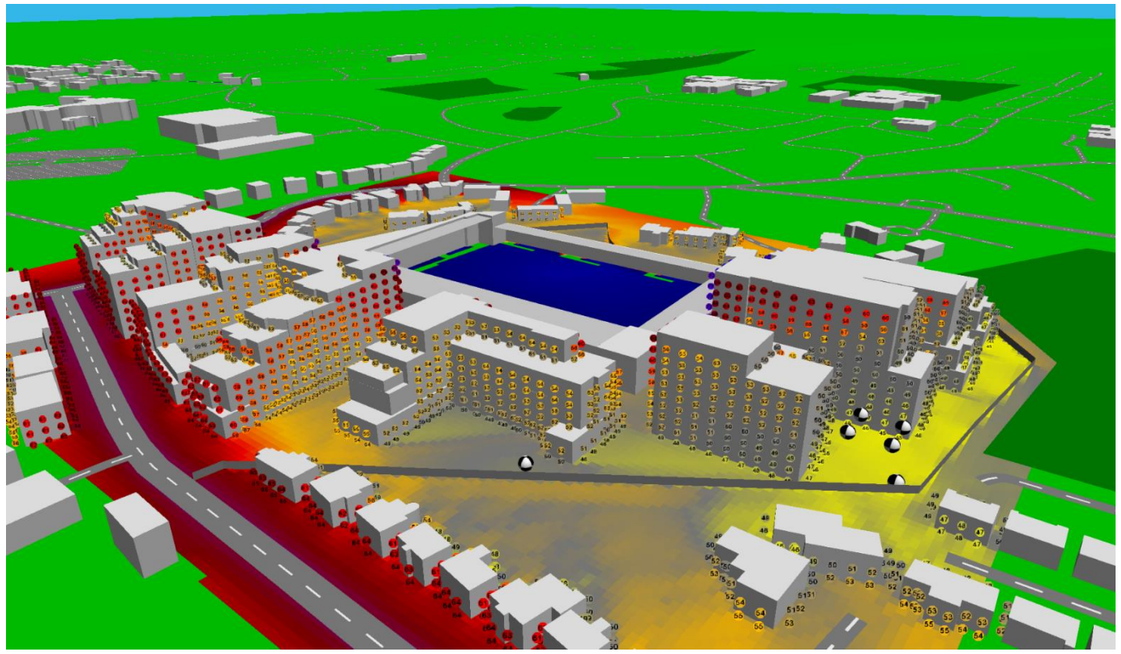


Table 9.18 Predicted Façade Sound Pressure Levels and Façade Sound Insulation Requirements

Block	Façade	Highest daytime sound pressure level ($L_{Aeq,16hr}$ dB)	Highest night-time sound pressure level ($L_{Aeq,8hr}$ dB)	Highest match sound pressure level ($L_{Aeq,2hr}$ dB)	Highest façade sound insulation requirement – (R'_w+C_{tr} dB)	Highest façade sound insulation requirement – (R'_w dB)	Glass type reference (Table 9.40)
1	North	66	58	67	33	29	2
	East	61	53	67	28	29	2
	South	63	54	66	30	28	3
	West	67	57	67	34	29	4
	Courtyard	60	50	60	27	22	1
2	North	63	52	65	30	27	3
	East	53	45	72	20	34	2
	South	60	52	69	27	31	1
	West	66	55	66	33	28	4
	Courtyard	58	50	58	25	20	1
3	North	54	46	63	21	25	1
	East	51	43	65	18	27	1
	South	52	44	57	19	19	1
	West	55	47	54	22	16	1
4	North	52	46	74	19	36	3
	East	51	45	71	18	33	2
	South	49	41	60	16	22	1
	West	52	46	56	19	18	1
5	North	53	45	73	20	35	3
	East	53	45	68	20	30	1
	South	50	42	51	17	13	1
	West	47	39	71	14	33	3

9.120 Detailed calculations based on the proposed layouts, ratio of window to non-window area and the build-up of the non-windows indicates that the glazing (and frame) sound insulation performance can be 3-5 dB less than the overall requirements listed in Table 9.18. Example glazing types that can provide the necessary acoustic losses are presented in Table 9.19.

9.121 Should ratio of glazing to non-glazing change during detailed design stages then this will need to re-assessed.

Table 9.19 Example Glazing Configuration and Ventilation Strategies for Overall Façade Sound Insulation

Glass type reference	Sound Insulation ($R'_w + C_{tr}$ dB)	Sound Insulation (R'_w dB)	Example Double Glazing Configurations (Glass / Airspace /Glass)	Ventilation Strategy
1	15-27	20-32	6 mm glass/16 mm cavity/6 mm glass	Acoustically attenuated passive ventilation (eg, trickle vents)
2	28-29	33-34	6.8 mm acoustic laminate/16 mm cavity /6 mm glass	Acoustically attenuated passive ventilation (eg, trickle vents)
3	30-32	35-37	8.8 mm acoustic laminate /16 mm cavity/6 mm glass	Acoustically attenuated passive ventilation (eg, trickle vents)
4	33-35	38-40	8.8 mm acoustic laminate/16 mm/10 mm glass	High performance acoustically attenuated passive ventilation
5	36-38	41-43	8.8 mm acoustic laminate/16 mm/10 mm glass	Mechanical ventilation
6	39-42	44-47	12.8 mm acoustic laminate/20 mm/10 mm glass	Mechanical ventilation

9.122 The precise design details of the façade and the ventilation provisions will be finalised as the design progresses. However, Table 9.19 demonstrates that appropriate glazing specifications are available and that these coupled with an appropriate ventilation strategy, can meet the required internal noise criteria.

9.123 On the basis that suitable internal noise levels for apartments can be achieved through appropriate glazing configurations and ventilation provisions a very low magnitude of impact and so a resultant **Negligible (not significant), local, permanent, direct and irreversible effect** has been assessed for during a non-match day.

9.124 On the basis that acceptable internal noise levels for apartments can be achieved through appropriate glazing configurations and ventilation provisions a low magnitude of impact and so a resultant **Minor Adverse (not significant), local, permanent, direct and irreversible effect** has been assessed for during a match day.

Residential Amenity Noise Levels (Non-Match Day)

9.125 Computer modelling has been completed to assess the noise levels in the external residential amenity spaces within the Proposed Development during non-match days. Match days have not been considered as they are short-term and temporary occurrences. In addition, other suitable locations close to the site exist, i.e. Woking Park.

9.126 Assessments of suitable amenity spaces have been completed with respect to the shared spaces at ground and roof levels of each residential blocks only. However, it is noted that many private amenity spaces (i.e. balconies) would also comply with the relevant guidance.

9.127 The calculated external noise levels have been assessed with respect to guidance provided in BS 8223, which states that for traditional amenity spaces, such as gardens and patios, it is desirable for noise levels to be within the $L_{Aeq,16hr}$ 50-55 dB range.

Table 9.20 Ambient Noise Levels in Residential Amenity Spaces

Receptor	Predicted Noise Level ($L_{Aeq,T}$ dB)	Receptor Sensitivity	Magnitude of Impact	Scale and Nature of Effect and Significance
Block 1 – ground floor	45-60	Low	Low	Negligible (not significant)
Block 1 – roof	47-52	Low	Low	Negligible (not significant)
Block 2 – ground floor	45-60	Low	Low	Negligible (not significant)
Block 2 – roof	47-51	Low	Low	Negligible (not significant)
Block 3 – ground floor	41-48	Low	Very Low	Negligible (not significant)
Block 3 – roof	50-51	Low	Low	Negligible (not significant)
Block 4 – ground floor	36-44	Low	Very Low	Negligible (not significant)
Block 4 – roof	48-50	Low	Very Low	Negligible (not significant)
Block 5 – ground floor	38-41	Low	Very Low	Negligible (not significant)
Block 5 – roof	48-50	Low	Very Low	Negligible (not significant)

9.128 The noise levels predicted in the shared external residential amenity space ranged between $L_{Aeq,16hr}$ 36-60 dB.

9.129 In addition, there are also numerous instances, where appropriate conditions are achieved on private balconies i.e. those screened from the existing roads.

9.130 On this basis that all residents have access to external amenity where appropriate noise levels are achieved for amenity, a low magnitude of impact and **Negligible (not significant), local, permanent, direct and irreversible effect** has been assessed.

Bar and Hospitality Spaces

9.131 The bar and hospitality spaces are to be able to operate multiple times a week and simultaneously. Their uses are to remain flexible, so assessment of their impact is based on them using amplified music within their operation. The assessments have been contained to break-out noise from the building envelope, as it is assumed that patron noise (smoking areas) will be appropriately managed by members of staff, and vehicles will access from the carpark or Kingfield Road, as per the existing operation of the bar.

9.132 The bar and hospitality spaces will be mechanically ventilated and comfort cooled, so that the façade will remain closed when it is occupied.

9.133 Music noise levels within the spaces are to be controlled so that they do not exceed L_{Aeq} 90 dB, and 90 dB and 85 dB at 63 Hz and 125 Hz (bass frequencies) respectively.

9.134 The most affected receptors will be Cobbles, Block 1 and Block 2, which are approximately 20m away from the stadium façade. The lowest background noise level measured at Position C, the closest monitoring position to these receptors, between the likely proposed hours of operation (17:00 and 23:00) was $L_{A90,5min}$ 30 dB.

9.135 The façade of the bar and hospitality spaces are to achieve $R_w + C_{tr}$ 42 dB. With this level of sound insulation provided the predicted music noise emissions will be below the background noise levels, which would correspond with a Very Low magnitude of impact. The façade sound insulation requirement corresponds with Glass Type 6 referenced in Table 9.40.

9.136 On the basis that music and other event generated noise will be managed and suitable designs included, the magnitude of impact will be Very Low and the effect will be **Negligible (not significant), local, permanent, direct and reversible effect** at all receptors.

[9] *British Standards (BS) 5839-8:2008 Fire detection and fire alarm systems for buildings – Part 8: Code of practice for the design, installation, commissioning and maintenance of voice alarm systems (2008)*

Public Address for Emergency Announcements

9.137 The external Public Address System will be used purely for emergency announcements. On this basis its use during regular testing has been considered. The precise details of the arrangement are unknown, though it will only be tested during the daytime, with the level high enough to comply with the relevant standards[9].

9.138 The public address systems will be tested above the ambient noise levels and will contribute and increase the existing ambient conditions at the receptors closest to the stadium. The increase in noise levels will likely be **Minor Adverse (not significant), local, permanent and irreversible**.

Building Service Plant Noise

9.139 Based on the baseline background noise levels, the total noise from building services plant will be limited in line with the noise levels detailed in Table 9.21 at a position 1m from all nearby facades.

9.140 Limits have only been determined for the closest receptors on the basis that the control of noise emissions from building services plant at these receptors will inherently result in lower noise levels at receptors further away.

Table 9.21 Building Services Plant Noise Limits

Receptor	Building Services Noise Limits, 1m from Facade (dB)		Representative Background Sound Level (dB)		Increase in Background Sound Level	Receptor Sensitivity	Magnitude of Impact	Scale and Nature of Effect and Significance
	Daytime (07:00 to 23:00 hours)	Night-time (23:00 to 07:00 hours)	Daytime (07:00 to 23:00 hours)	Night time (23:00 to 07:00 hours)				
Kingfield Road (Cobbles, The Dell and The Haven)	33	19	43	29	<1	High	Negligible	Negligible (not significant)
Kingfield Drive (Cotwolds, Chinthurst and 7 Kingfield Drive)	33	19	43	29	<1	High	Negligible	Negligible (not significant)
Westfield Avenue (Hazel House, Beech House, 62-66 Westfield Avenue, 54-60 Westfield Avenue and 51-63a Westfield Avenue)	38	23	45[1]	30[1]	<1	High	Negligible	Negligible (not significant)
1 & 3 Westfield Grove	38	23	45[1]	30[1]	<1	High	Negligible	Negligible (not significant)
Kingfield Close (Pond House, Kingfield Cottage, The Cedars, Nut Cottage and Penlan	33	19	43	29	<1	High	Negligible	Negligible (not significant)
67 & 74 Granville Road	33	19	43	29	<1	High	Negligible	Negligible (not significant)

[1] Free-field measurements taken >3m from vertical reflective surfaces

9.141 The building services plant strategy will be developed to ensure that the limits detailed in Table 9.21 are achieved. On this basis a **Negligible (not significant), local, permanent, direct and irreversible effect** has been assessed at all receptors.

MITIGATION AND MONITORING MEASURES

Demolition and Construction

9.142 As noted, the predicted noise levels are based on reasonable worst-case assumptions and there will be additional mitigation options available to the contractor to reduce noise associated with demolition and construction activities. Additional mitigation measures that the contractor/s shall be required to explore and implement include:

- The production of a construction noise and vibration report that evaluates the construction activities and provides specific BPM to reduce noise and vibration;
- Limiting high impact activities (e.g. piling) to specific times during the day, e.g. 1 hour on – 1 hour off, or 09:00-12:00 and 14:00-17:00;
- Plant is to be properly maintained and operated in accordance with manufacturer's recommendations. Electrically powered plant is preferred, where practicable, to mechanically powered alternatives;
- Where feasible, all stationary plant would be located so that the noise effect at all occupied residential and commercial properties is minimised and, if practicable, every item of static plant when in operation is to be sound attenuated using methods based on the guidance and advice given in BS 5228;
- Trade contractors would at all times apply the principle of Best Practicable Means as defined in Section 72 of the COPA and carry out all work in such a manner as to reduce any disturbance from noise and vibration to a minimum; and
- The timing of building operations will be critical in avoiding noise and vibration nuisance to surrounding areas and premises. The contractor would identify particularly sensitive periods in the works so that the potential problems can be minimised and that early and good public relations with the adjacent occupants of buildings are maintained.

9.143 The assessment of potential construction noise and vibration effects does not include prescriptive measures, as these are not appropriate for this stage of the development. During detailed construction programme stage and preparation of the Construction Environmental Management Plan (CEMP), measures to mitigate potential noise and vibration effects on nearby noise sensitive premises will be defined and agreed with WBC. The primary method for the control of noise and vibration being a Section 61 agreement under the Control of Pollution Act 1974 (COPA) with WBC being established.

9.144 A Section 61 agreement under the COPA will contain appropriate noise and vibration limits at the nearby properties. These limits are recommended to be monitored and reported. The reports and monitoring will highlight when it is likely that the construction limits will be exceeded, so that construction activities can be effectively altered.

9.145 In addition, a Section 61 agreement also sets out a dispensation and variation procedure under which consent can be applied for to carry out works which would potentially exceed the agreed noise and vibration limits or must occur at times when such work is otherwise not approved. Such dispensation/variations would be applied for where there are good engineering, safety or practical reasons for undertaking the works at these times. The selected contractor should adopt measures, including site supervision arrangements, to reduce noise and vibration to a minimum in accordance with Best Practicable Means (BPM), as defined in Section 72 of the COPA.

9.146 With the measures outlined above adopted, the likely residual effects from demolition construction activities are expected to reduce to be less than those presented. However, some construction activities, notably piling around the perimeter, may not result in a similar outcome. In these temporary instances, the effects will remain as **Major Adverse (significant), local, temporary (short-term), direct and reversible effect** at Cobbles, Hazel House et al, 51-63 Westfield Avenue, 1 & 3 Westfield Avenue and 67 & 78 Granville Road.

Construction Traffic Noise

9.147 No mitigation is required. The residual effects would remain Negligible to Minor Adverse (not significant), local, temporary (medium-term), direct and reversible.

Vibration Effects from Construction Activities

9.148 With regards to the effects of construction generated vibration on nearby sensitive receptors, the effect is considered to be **Minor to Negligible (not significant), local, temporary, direct and reversible** pre-mitigation. In addition, vibration limits would-be set-in accordance with BS5228-2 to minimise the risk of complaints or building damage. These limits would be controlled through the implementation of the construction method statement (CMS), in addition to vibration monitoring.

9.149 The likely residual vibration effects from construction activities is expected to remain as **Minor Adverse or Negligible (not significant), local, temporary, direct and reversible**. No further mitigation is required.

Completed Development

Road Traffic

9.150 No mitigation is required. The residual effects would remain Negligible (not significant), local, permanent, direct and irreversible.

Match Day Operations – Stadium Noise

9.151 No mitigation is required for the existing receptors. The residual effects would remain **Minor Adverse (not significant) local, permanent, direct and irreversible.**

9.152 Mitigation, in the form of appropriately specified facades, is to be adopted for the introduced receptors, such that the residual effects will be **Minor Adverse (not significant) local, permanent, direct and irreversible.**

Crowd Dispersion

9.153 No mitigation is required. The residual effects would remain **Minor Adverse (not significant) local, permanent, direct and irreversibl**e along Guildford Avenue/Claremont Avenue, Kingfield Avenue, White Rose Lane and Woking Park, and **Negligible (not significant) local, permanent, direct and irreversible** along the remaining routes.

9.154 Additional crowd management measures, as required, will be identified through monitoring of crowd dispersion when in operation.

Site Suitability for Residential Development

9.155 No further mitigation measures are required. Residual effects are Negligible (not significant), local, permanent, direct and irreversible during a non-match day and Minor (not significant), local, permanent, direct and irreversible during a match.

Bar and Hospitality Spaces

9.156 No further mitigation measures are required. Residual effects are **Negligible (not significant), local, permanent, direct and reversible**.

9.157 Ancillary activities, such as smoking areas and taxi pickups, will need to be appropriately positioned and managed so that noise emissions to the existing and introduced receptors are controlled.

Public-Address for Event Management and Site Security

9.158 The public address system, when tested, is assumed to achieve the limits listed – this is likely to be secured through a planning condition by WBC. On this basis no further mitigation measures are proposed. The residual effects are **Minor Adverse (not significant), local, permanent, direct and irreversible**

Building Service Plant Noise

9.159 The building services plant will be designed to the limits listed. Reviews of the expected building services plant indicates that the proposed building services plant noise limits are achievable, and, on this basis, no further mitigation measures are currently proposed. Residual effects are **Negligible (not significant), local, permanent, direct and irreversible.**

RESIDUAL EFFECTS

9.160 The residual effects resulting from the Proposed Development are summarised in Table 9.22.

Table 9.22 Summary of Residual Effects

Activity	Receptor Sensitivity	Residual Effect (Nature and Scale)	Geo	DI	PT	RIR	St Mt Lt
Demolition and Construction							
Noise and Vibration							
Demolition of Block 1	High	Negligible (not significant) to Moderate (significant)	L	D	T	R	St
Construction of Block 1	High	Minor (not significant) to Major (significant)	L	D	T	R	St
Demolition of David Lloyd Leisure Centre and Stadium	High	Negligible (not significant) to Moderate (significant)	L	D	T	R	St
Demolition of David Lloyd Leisure Centre and Stadium, and excavation of Blocks 2 and 3	High	Negligible (not significant) to Major (significant)	L	D	T	R	St
Construction of basement, Stadium and Block 2	High	Negligible (not significant) to Major (significant)	L	D	T	R	St
Construction of Blocks 2 to 4	High	Negligible (not significant) to Moderate (significant)	L	D	T	R	St
Construction of Blocks 3 to 5	High	Negligible (not significant) to Moderate (significant)	L	D	T	R	St
Construction Vibration (during piling)	High	Negligible (not significant) to Minor (not significant)	L	D	T	R	St
Construction traffic	High	Negligible (not significant) to Minor (not significant)	L	D	T	R	St
Completed Development							
Noise							
Road traffic	High	Negligible to Minor Adverse (not significant)	L	D	P	IR	Lt
Crowd dispersion	High	Negligible to Minor Adverse (not significant)	L	D	P	IR	Lt
Stadium noise	High	Negligible to Minor Adverse (not significant)	L	D	P	IR	Lt
Site suitability (internal noise levels during non-match days)	High	Negligible (not significant)	L	D	P	IR	Lt
Site suitability (internal noise levels during match days)	High	Minor adverse (not significant)	L	D	P	IR	Lt
Site suitability (shared external amenity	Low	Negligible (not significant)	L	D	P	IR	Lt
Music noise emissions from Bar and Hospitality	High	Negligible (not significant)	L	D	P	R	Lt
Public Address for Emergency Announcements	High	Minor adverse (not significant)	L	D	P	IR	Lt
Building services noise	High	Negligible (not significant)	L	D	P	IR	Lt

Notes:

Residual Effect

- Scale = Negligible / Minor / Moderate / Major
- Nature = Beneficial or Adverse

Geo (Geographic Extent) = Local (L), Borough (B), Regional (R), National (N)

D = Direct / I = Indirect

P = Permanent / T = Temporary

R = Reversible / IR= Irreversible

St = Short Term / Mt = Medium Term / Lt = Long Term

N/A = not applicable / not assessed

LIKELY SIGNIFICANT EFFECTS

9.161 With mitigation adopted, the Proposed Development will result in temporary residual effects that are **Major Adverse** or **Moderate Adverse** in scale and nature at the closest receptors during different phases of the demolition and construction programme at all surrounding receptors. The periods of these effects will be limited and will not occur at an individual receptor for the duration of the demolition and construction programme.

9.162 During other construction phases either **Minor Adverse** or **Negligible** residual effects are expected.

9.163 The worst-case assessment of noise emissions from the stadium indicate permanent (operational) residual noise effects could be **Moderate or Major Adverse** at the introduced. The underlining assumptions used for the worst-case assessment are not expected to eventuate in practice. However, mitigation, in the form of appropriately specification of the facades, is to be adopted so that satisfactory internal noise levels are achieved. With this mitigation adopted the residual effects will be **Minor Adverse**.

9.164 Apart from stadium noise emissions, with mitigation adopted, the Proposed Development will not result in permanent (operational) residual noise or vibration effects that are major or moderate scale and so significant.

CLIMATE CHANGE

9.165 There are no climate change variables that would directly affect the assessments detailed within this noise and vibration assessment. Changes to the temperature, or other variables may inadvertently increase/decrease the noise and vibration climate. However, these changes are not quantifiable.

9.166 The residential receptors within and surrounding the Proposed Development are moderately vulnerable due to their sensitivity to changes in external temperature.

9.167 The noise climate is predominately determined by road and rail traffic. To significantly increase the noise produced by these sources requires the future volume of road or rail journeys to double. Given the existing road and rail traffic volumes are high, it is unlikely that this scenario will eventuate. As it is unlikely that the external noise levels will rise, the magnitude of impacts presented within this assessment will remain unchanged.

9.168 The vibration levels on site are predominantly due to the nearby railway line. However, the current vibration levels measured on site are unlikely to change significantly in the future and certainly not as a result of climatic changes. No change in the magnitude of impacts currently assessed is therefore anticipated.

9.169 Given the magnitude of impacts are not expected to change when considering climate change variables there is no requirement to provide additional mitigation.

ASSESSMENT OF FUTURE ENVIRONMENT

Evolution of the Baseline Scenario

9.170 Without the Proposed Development taking place it is likely that surveyed environmental noise conditions (baseline) will remain broadly the same. This is considered on the basis that Woking FC will not significantly change their operations and any road traffic increases will be less than 20% than the existing conditions.

Cumulative Effects Assessment

9.171 As set out in ***ES Volume 1, Chapter 2: EIA Methodology***, no cumulative schemes were identified within the surrounding area of the site; therefore, a cumulative effects assessment (i.e. an assessment of the effects of the Proposed Development in combination with the effects of other cumulative schemes within the surrounding area) has not been undertaken.