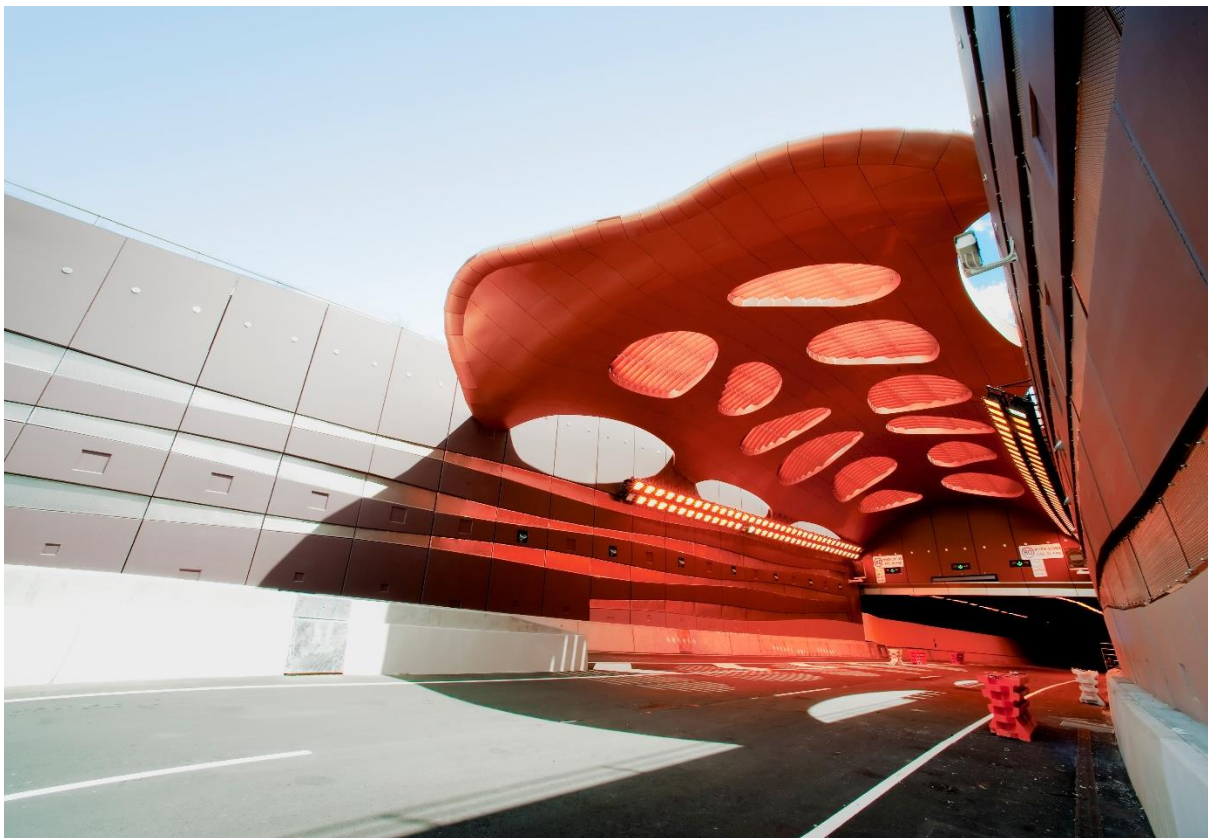


ST MARTIN'S CENTRE DEVELOPMENT, BLOCK A

NOISE IMPACT ASSESSMENT





ST MARTIN'S CENTRE DEVELOPMENT, BLOCK A NOISE IMPACT ASSESSMENT

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AUTHOR

PREPARED BY

Ellen Harrison, WSP Acoustics
Principal Consultant

REVIEWED BY

Robert Marriner, WSP Acoustics
Associate

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1 INTRODUCTION

This Noise Assessment has been prepared to inform the submission of a non-material amendment application (PP-06723552) pursuant to a series of alternations to Block A of planning permission 140997 associated with the regeneration of St Martin's Centre, Caversham.

The report should be reviewed alongside the Non-Material Amendment Brochure prepared by Latitude Architects. The Noise Assessment supports amendments to the scheme which include the incorporation of a plant room to meet the operational requirements of the proposed ground floor A3 unit which was omitted on the consented drawings and is required to ensure that the proposed development is deliverable.

Such amendments have been informed by a range of technical input which has evolved since planning permission was granted in 2015. This Report has also been prepared to discharge part i) of condition 31 of the extant permission in relation to Phase1A and has been submitted concurrently with the non-material amendment application.

This report is necessarily technical in nature and to assist the reader, a glossary of acoustic terminology is contained in Appendix A.

2 SITE DESCRIPTION

2.1 EXISTING SITE

The St Martin's Centre development is located within Caversham, Reading and is bound to the north by Church Street, to the east by Archway Road, and to the south and west by mixed use commercial and residential development.

The current site is mixed use with retail premises at ground floor level fronting Church Street, and residential apartments located above. There is a parking area located to the rear.

Block A to which this report relates is located in the northwest of the St Martins Centre. The site map and existing layout are shown in Appendix B.

2.2 PROPOSED DEVELOPMENT

The proposed development forms Block A of extant permission 140997 for the regeneration of St Martins Centre, Caversham which seeks to retain and extend the ground floor retail premises and provide new and refurbished residential units.

Block A is a new four storey building located in the north west corner of the site, with a ground floor restaurant and 17 residential units above.

Tenant plant items associated with the ground floor restaurant are proposed to be located externally on the fourth floor rooftop and internally on the ground floor level.

The proposed consolidated site plan of the St Martin's centre development is included in Appendix C.

3 ASSESSMENT METHODOLOGY

3.1 PLANNING CONDITION

Reading Borough Council (RBC) has granted planning consent for the development subject to a number of conditions, the following of which relates to the mechanical services scheme.

31. No air conditioning, refrigeration, or air extraction, plant shall be installed externally, or vented externally, until:

- i) a noise assessment to BS4142:2014 has been submitted to and approved in writing by the local planning authority demonstrating that the plant would not cause an exceedance of the 'good' internal noise level at the nearest residential premises, and detailing any noise attenuation measures necessary to achieve this.
- and
- ii) an odour control assessment in accordance with DEFRA Guidance on the Control of Odour and Noise from Commercial Kitchen Exhaust Systems (2005) has been submitted to and approved in writing by the local planning authority.

No plant shall be installed other than in accordance with the noise and odour control measures approved pursuant to this condition.

Reason: to minimise the effects of noise and odour arising from the development, in accordance with Policy CS34 of the Reading Borough LDF Core Strategy 2008 and Policy DM4 of the Sites and Detailed Policies Document 2012.

This report intends to discharge part (i) of this condition, and part (ii) will be discharged by a separate report to be prepared by an air quality specialist.

3.2 LOCAL AUTHORITY CONSULTATION

Further clarification was requested from the RBC with regards to the building services noise emission limits.

The Environmental Health Department confirmed that building services noise emissions should be designed such that the rating level does not exceed the measured background noise level (L_{A90}) at the nearest noise sensitive receptor.

This is in line with guidance within BS 4142: 2014 '*Methods for rating and assessing industrial and commercial sound*' which states that: '*Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context*'.

It was also confirmed that building services noise emissions should not exceed the 'good' internal noise levels for dwellings stated within BS 8233: 2014 '*Guidance on sound insulation and noise reduction for buildings*'. A summary of the criteria within BS 8233: 2014 is provided below.

3.3 BS 8233: 2014

Section 7 of this British Standard includes internal ambient noise levels for a variety of spaces. Internal ambient noise levels for dwellings are presented in Table 3-1 below.

Table 3-1: BS 8233: 2014 Internal ambient noise levels for dwellings

ACTIVITY	LOCATION	DAYTIME (07:00 TO 23:00 HRS)	NIGHT-TIME (23:00 TO 07:00 HRS)
Resting	Living room	35 dB $L_{Aeq,16hrs}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16hrs}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hrs}$	30 dB $L_{Aeq,8hrs}$

The above criteria have been adopted and are referred to in the following assessments.

4 ENVIRONMENTAL NOISE SURVEY

In order to inform the following noise impact assessment, it is necessary to obtain background noise levels representative of the nearest noise sensitive receptors. These are required to set appropriate building services noise emission limits relative to the background, in accordance the requirements of Reading Borough Council.

An environmental noise survey on the site was previously undertaken by Cundall to inform the planning application for the development.

The full details of the environmental noise survey are included within Cundall's 'Environmental Noise Report' ref. 1006081-RPT-00014, which is included in Appendix D of this report for reference. A summary of the survey and results are presented below.

4.1 CUNDALL ENVIRONMENTAL NOISE SURVEY

4.1.1 METHODOLOGY

Cundall undertook an environmental noise survey during the daytime on Thursday 7th November 2013, and during the night-time on Thursday 8th May 2014. The measurements are indicated on the site plan in Figure 4-1 below.

Figure 4-1: Cundall's environmental noise survey measurement positions



All measurements were made on a tripod, in free field locations, approximately 1.5 m above ground floor level. Weather conditions for the duration of the surveys were dry, with no precipitation and <3m/s wind speeds.

4.1.2 RESULTS

The following table has been extracted directly from Cundall's Environmental Noise Report.

Note 3 which relate to the measured background noise levels ($L_{A90,T}$) states that '*The typical background noise level is determined by taking the highest frequency density when plotted as a histogram. Where two distinct frequency ranges are evident [i.e. at positions 2 and 4, i.e. where daytime and evening background noise levels vary considerably], the lowest value is recorded.*'

It should be noted that the night-time measurements were conducted between approximately 01:00 and 04:00 hours.

Table 4-1: Cundall's environmental noise survey measurement results

Measurement Position / Period		Averaged ¹ $L_{Aeq,T}$	L_{AFmax} ²	$L_{A90,T}$ ³
1	Daytime	51.3	77.3 [53 - 77]	47
2	Daytime	68.8	92.3 [75-92]	60
	Night-time	54.3	77.5 [46-77]	37
3	Daytime	68.1	96.7 [74-96]	67
4	Daytime	59.5	80.3 [66-80]	49
	Night-time	46.6	71.3 [48-71]	42
5	Daytime	54.2	75.3 [61-75]	45
	Night-time	47.6	70.8 [45-70]	41

The background noise levels presented above have been used to determine the building services noise emission limits as discussed in Section 6.

5 PLANT DETAILS

The proposed tenant's plant items are detailed in Table 5-1 below.

Table 5-1: Details of the proposed tenant's plant items

LOCATION	NAME	REFERENCE	DESCRIPTION AND MODEL	QUANTITY
Fourth floor rooftop	AC VRF Condensers	VRF_CU01; VRF_CU02; VRF_CU03 and VRF_CU04.	Daikin Condensing outdoor unit model AZQS140B8V1	4
	Chiller Condenser	CH_CU01	Danfoss Optyma Plus Condenser model OP-MPHM015	1
	Freezer Condenser	FR_CU01	Danfoss Optyma Plus Condenser model OP-LPHM048	1
	Kitchen Extract Fan	KEF_01	Helios Gigabox Centrifugal fan 500mm ø GBW 500/4	1
Ground floor	Air Handling Unit	AHU_01	Unknown	1
	Toilet Extract Fan	TEF_01	Unknown	1

The proposed locations of the items above are indicated on the *Mechanical Services Ground Floor and Roof Level Duct Sketch* drawing by Building Services Design Consulting Engineers, which is included in Appendix E for reference.

All rooftop plant items are proposed to be surrounded by a standard non-acoustic weather louvre. AHU_01 and TEF_01 are both located internally within the ground floor, with external grilles ducted up to the south and west ground floor façades respectively.

Details of the case-radiated and in-duct sound power levels for the tenant's plant items have been provided by Workman LLP and the individual suppliers, and are reproduced in Table 5-2 and Table 5-3 below. Details of AHU_01 and TEF_01 were unavailable, so sound power level limits are provided for these items in Section 6.3.1.

Table 5-2: Case-radiated sound power levels for the tenant's plant items

REFERENCE	SOUND POWER LEVEL, L_w (dB) AT EACH OCTAVE BAND CENTRE FREQUENCY (Hz)							dB(A)
	125	250	500	1000	2000	4000	8000	
VRF_CU01, VRF_CU02, VRF_CU03 and VRF_CU04	56	63	67	64	64	61	48	69
KEF_01 ⁽¹⁾	75	71	60	56	46	40	34	65
CH_CU01	No spectrum data available							60
FR_CU01	No spectrum data available							69

Notes

(1) The sound power spectrum values provided for the kitchen extract fan were A-weighted. They have been corrected to linear values to be used in the following assessments.

Table 5-3: In-duct sound power levels of the kitchen extract fan exhaust

REFERENCE	SOUND POWER LEVEL, L_w (dB) AT EACH OCTAVE BAND CENTRE FREQUENCY (Hz)							dB(A)
	125	250	500	1000	2000	4000	8000	
KEF_01 ⁽¹⁾	77	82	77	74	72	68	61	80

Notes
(1) The sound power spectrum values provided for the kitchen extract fan were A-weighted. They have been corrected to linear values to be used in the following assessments.

5.1 OPERATIONAL PERIODS

It is understood that the opening hours of the ground floor restaurant could extend into the night-time period (which begins at 23:00 hrs), albeit for a short period at the beginning of the night until the restaurant closes.

The application is therefore being made based on a 24-hour operation, which all plant items operating simultaneously during the night-time periods.

6 PLANT NOISE ASSESSMENT

6.1 NEAREST NOISE SENSITIVE RECEPTORS

The nearest noise sensitive receptors and their associated windows closest to the proposed plant items have been identified to be:

- Noise Sensitive Receptor 1 (SR1): Fourth floor east-facing proposed apartment windows of Block A, directly below the rooftop plant items. These windows are approximately 4m from the proposed location of the VRF condensers, as shown below in Figure 6-1. There will be no line of sight between the windows and the plant items due to screening offered by the building itself.
- Noise Sensitive Receptor 2 (SR2): Fourth floor west-facing proposed apartment window of Block A, directly below the rooftop plant items. This window is approximately 7m from the proposed location of kitchen extract fan KEF_01, as shown below in Figure 6-1. There will be no line of sight between the window and the plant items due to screening offered by the building itself.
- Noise Sensitive Receptor 3 (SR3): Third floor north-facing existing windows of the residential premises on Abbottsmead Place. These windows are approximately 25m to the south-west of Block A, with a direct line of sight to the proposed rooftop plant items and external louvres of the ground floor plant items.
- Noise Sensitive Receptor 4 (SR4): First floor south-facing proposed apartment windows of Block A, within 5m of the external grilles of air handling unit AHU_01 and toilet extract fan TEF_01. As shown in Figure 6-2 overleaf.

The locations of all noise sensitive receptors are indicated on the proposed site plan within Appendix F.

Figure 6-1: Location of Sensitive Receptors 1 and 2 (fourth floor east- and west-facing windows of Block A)

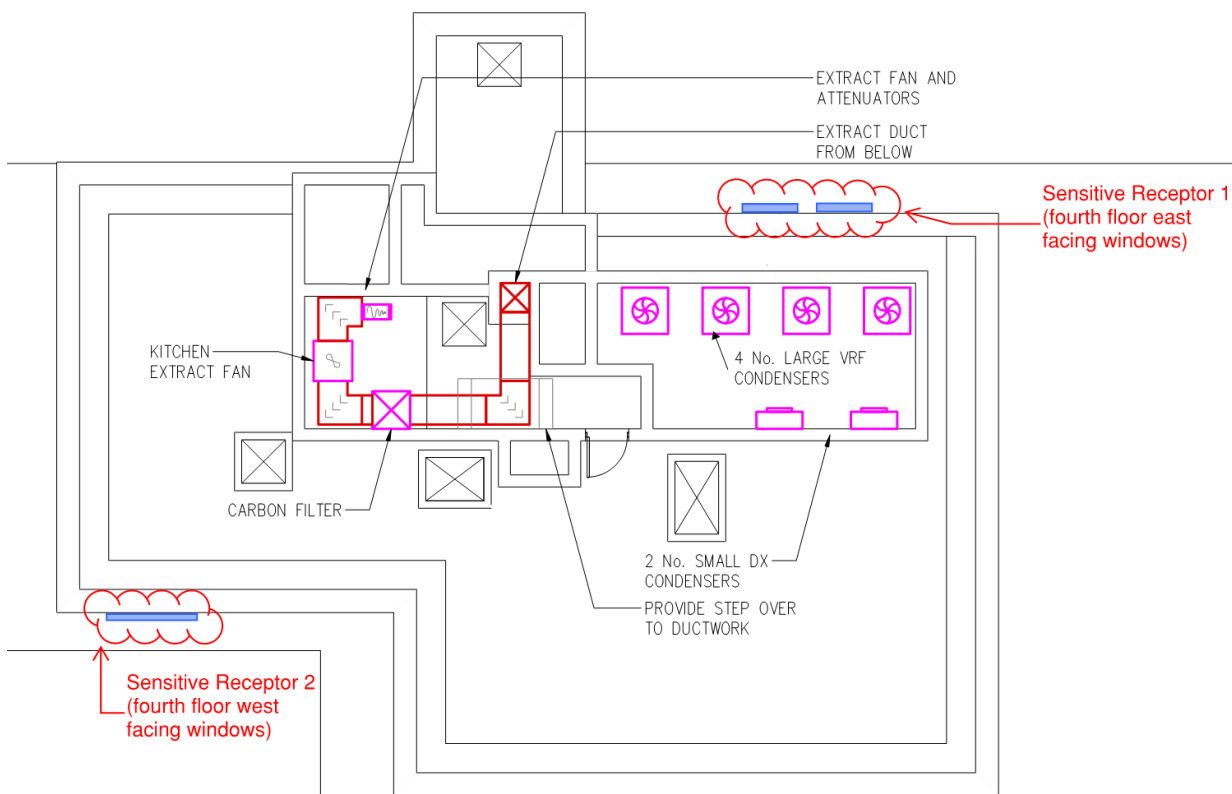
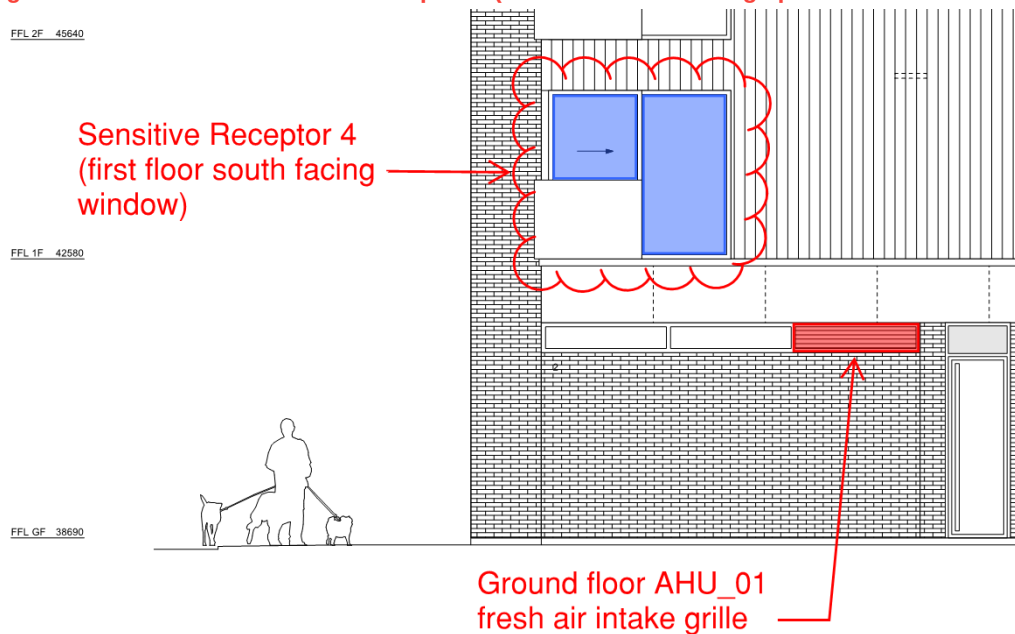


Figure 6-2: Location of Sensitive Receptor 4 (first floor south-facing apartment window of Block A)



6.2 NOISE EMISSION LIMITS

Noise emission limits for all new plant items are based on the requirements of Reading Borough Council, detailed in Section 3 of this report.

RBC requires the cumulative rating level ($L_{Ar,T}$) of all proposed plant to be equal to or lower than the measured background noise level at 1m from the nearest noise sensitive receptor.

This will be a combined noise level from all plant items associated with Block A, and should therefore include contributions from the tenant's plant items, as well as any plant associated with the residential accommodation.

It is therefore appropriate to set noise emission limits on the tenant's plant and on the residential accommodation plant to be 3 dB below the measured background noise level. This will ensure that if a nearby noise sensitive receptor is affected by plant noise from both the residential accommodation plant and the tenant's plant, the criteria set by RBC will still be achieved.

Based on the lowest measured daytime and night-time background noise levels (see Table 4-1), noise emission limits for the tenant's plant are presented below in Table 6-1.

Table 6-1: Tenant plant noise emission limits at 1m from the nearest noise sensitive receptors

PERIOD	LOWEST MEASURED BACKGROUND NOISE LEVELS	TENANT PLANT NOISE EMISSION LIMITS
Daytime (07:00 – 23:00 hrs)	45 dB L_{A90}	42 dB $L_{Ar,T}$
Night-time (23:00 – 07:00 hrs)	37 dB L_{A90}	34 dB $L_{Ar,T}$

Based on a typical sound level difference for an open window of 15 dB (in accordance with guidance in BS 8233), it can be seen that by designing to the above external rating levels at the nearest residential receptors, the resultant internal levels would be 27 dB(A) during the day and 19 dB(A) during the night. This is well below the BS 8233 internal ambient noise levels criteria for dwellings and therefore meets the additional requirement of RBC.

6.3 PREDICTED NOISE LEVELS

The following assessment assumes a worst-case scenario of all plant items operating simultaneously and at full duty during the night-time. As the night-time plant noise emission limit is more onerous than the daytime limit, designing to the night-time limit will ensure that the daytime limit is also achieved.

The ground floor tenant plant items are considered separately to the rooftop plant items below; as there is no data available for the ground floor plant items, and the distance between the two will result in noise emissions affecting different noise sensitive receptors.

6.3.1 GROUND FLOOR TENANT PLANT ITEMS

As details of the ground floor air handling unit AHU_01 and toilet extract fan TEF_01 are currently unavailable, it is considered appropriate to set individual noise emission limits for the external grilles, in order that the limits are achieved at the closest noise sensitive receptor (SR4).

Taking into account the distance between the external grilles and the window of SR4, and a nominal directivity loss based on the grille dimensions, the following limits have been set to achieve the night-time limit of 34 dB $L_{Aeq,T}$.

- Noise emissions associated with air handling unit AHU_01 must not exceed a sound pressure level of 45 dB(A) at 1m directly in front of the fresh-air inlet grille.
- Noise emissions associated with toilet extract fan TEF_01 must not exceed a sound pressure level of 45 dB(A) at 1m directly in front of the exhaust outlet grille.

The limits above assume that noise emissions from these plant items do not contain any tonal, intermittent or impulsive characteristics. If they do, these limits will need to be reduced in accordance with the penalties contained in BS 4142:2014.

It is likely that in-duct attenuators will be required in order to achieve the limits above, and attenuators are therefore recommended for these plant items within Section 5 of this report.

6.3.2 ROOFTOP TENANT PLANT ITEMS

The cumulative sound pressure level from all proposed tenant plant items has been predicted at noise sensitive receptors SR1, SR2 and SR3, which will be mainly affected by noise emissions from the rooftop plant items, due to their proximity. The predictions are based on the sound power data presented in Table 5-2 and Table 5-3, and take into account all ductwork systems, distance corrections and any screening from the existing and proposed buildings.

Prior to the recommendation of any mitigation measures such as in-duct acoustic attenuators or acoustic screens, a summary of the resultant noise levels are shown overleaf in Table 6-2.

Table 6-2: Calculated resultant noise level at each receptor prior to mitigation measures

RESULTANT NOISE LEVEL AT THE NEAREST NOISE SENSITIVE RECEPTORS			
PLANT ITEM REFERENCE	SR1 (4 th floor Block A east facing window)	SR2 (4 th floor Block A west facing window)	SR3 (3 rd floor window of residential premises on Abbottsmead Place)
VRF_CU01	34 dB	25 dB	29 dB
VRF_CU02	34 dB	24 dB	29 dB
VRF_CU03	34 dB	23 dB	28 dB
VRF_CU04	34 dB	22 dB	28 dB
KEF_01 case break-out	21 dB	29 dB	21 dB
KEF_01 exhaust	40 dB	43 dB	39 dB
CH_CU01	25 dB	15 dB	20 dB
FR_CU01	34 dB	24 dB	29 dB
AHU_01 fresh-air intake	1 dB	1 dB	21 dB
TEF_01 exhaust	1 dB	1 dB	18 dB
Cumulative Level	44 dB	44 dB	41 dB
Design Criterion	34 dB	34 dB	34 dB
Exceedance	10 dB	10 dB	7 dB

Comparison of the resultant cumulative sound pressure levels at the nearest noise sensitive windows to the plant noise emission limits indicates that the criteria would be exceeded at noise sensitive receptors SR1, SR2 and SR3.

The reasons for the exceedances are a predominantly a result of noise emissions from the kitchen extract fan and from the VRF condenser units at the SR1.

Mitigation measures will therefore be required to meet the criteria and satisfy the planning condition. All recommended mitigation measures are discussed in Section 7 of this report.

7 MITIGATION MEASURES

The detailed plant noise assessment undertaken in this report has demonstrated that mitigation measures are required to meet the plant noise criteria outlined in the planning conditions set by Reading Borough Council.

This section recommends appropriate mitigation measures to satisfy the planning condition.

7.1 ATTENUATOR SCHEDULE

In order to meet the plant noise emission limits at the nearest noise sensitive receptors, attenuators will be required on the following plant items:

- Kitchen extract fan KEF_01 exhaust ductwork;
- Air handling unit AHU_01 fresh air intake; and
- Toilet extract fan TEF_01 exhaust.

The specification of the attenuators for AHU_01 and TEF_01 will be required at a later date, when full details of these items are available.

The attenuator for the kitchen extract fan exhaust should achieve the following insertion losses.

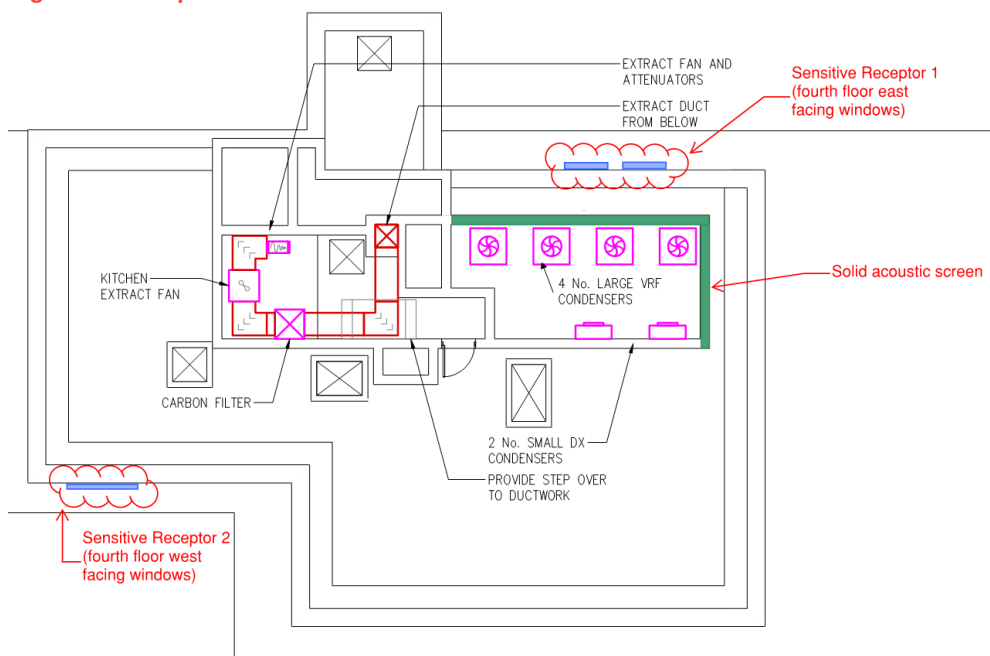
Table 7-1: Kitchen extract fan exhaust attenuator insertion loss requirements

REF.	MINIMUM DYNAMIC INSERTION LOSS (dB) AT EACH OCTAVE BAND (Hz)								APPROX. LENGTH (MM)
	63	125	250	500	1000	2000	4000	8000	
KEF_01 exhaust attenuator	5	11	19	29	36	37	28	18	1200

7.2 ACOUSTIC SCREEN DETAILS

It is recommended that a solid acoustic screen is installed to the east and south rooftop of the VRF condenser units, as shown in Figure 7-1 below. This screen will control noise emissions from these units to the location of SR1 and to the fourth floor south-facing proposed apartment windows of Block A, which are a similar distance to the rooftop condenser units.

Figure 7-1: Proposed location of solid acoustic screen



The solid acoustic screen must be as high as the current plant enclosure height, which is shown as 56790 AOD on the latest section drawings. This is based on the VRF condensers being 1.43m in height, if taller units are selected, the acoustic screen height must be increased in order that it is at least 0.3m above the height of the condensers.

The construction of the acoustic screen should have a minimum mass per unit surface area of 20 kg/m² and an acoustically absorbent inner face. Typically this could be achieved either with an acoustically absorbent builders work screen or with the use of proprietary acoustic panels. The acoustic screen shall comprise acoustically absorptive material, fixed in place with a non-obstructive fixing system. The absorptive treatment shall be a minimum of 50mm thick and be faced with an abrasion and fibre erosion protection layer such as a glass fibre scrim or glass fibre cloth and shall also be retained behind a perforated galvanised mild steel sheet with an open area of not less than 25%. The perforated face of the screen shall face towards the plant items. The absorptive face of the screen shall provide the following acoustic absorption co-efficients as a minimum.

Figure 7-2: Minimum acoustic absorption coefficients of the absorbent layer of the acoustic screen

MINIMUM ACOUSTIC ABSORPTION COEFFICIENTS (A) IN WHOLE OCTAVE BANDS (Hz)

125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
0.30	0.60	0.70	0.70	0.70	0.70

7.3 KITCHEN EXTRACT FAN NOISE CONTROL

To control case-radiated break-out noise from kitchen extract fan KEF_01 it is recommended that the unit and any flexible connectors are wrapped with a proprietary acoustic lagging product with a mass layer of surface mass of at least 5 kg/m².

If this proves impractical for maintenance or weather-proofing purposes an alternative design option would be to enclose the fan (and flexible connectors) with an acoustic enclosure, or to construct an acoustic screen between the location of the fan and sensitive receptor 2.

7.4 MITIGATED PLANT NOISE LEVELS

The resultant noise level from each plant item has been calculated at the nearest noise sensitive receptors, with the above mitigation measures in place. The contribution from each element of plant is presented below in Table 7-2 below for the night-time assessment, with the cumulative noise level compared against the design criterion.

Table 7-2: Resultant noise levels at the nearest sensitive receptors post mitigation measures

RESULTANT NOISE LEVEL AT THE NEAREST NOISE SENSITIVE RECEPTORS

PLANT ITEM REFERENCE	SR1 (4th floor Block A east facing window)	SR2 (4th floor Block A west facing window)	SR3 (3rd floor window of residential premises on Abbottsmead Place)
VRF_CU01	25 dB	25 dB	19 dB
VRF_CU02	25 dB	24 dB	19 dB
VRF_CU03	25 dB	23 dB	18 dB
VRF_CU04	25 dB	22 dB	18 dB
KEF_01 case break-out	16 dB	24 dB	16 dB
KEF_01 exhaust	14 dB	17 dB	8 dB
CH_CU01	16 dB	15 dB	10 dB
FR_CU01	25 dB	24 dB	19 dB
AHU_01 fresh-air intake	1 dB	1 dB	21 dB
TEF_01 exhaust	1 dB	1 dB	18 dB
Cumulative Level	33 dB	32 dB	28 dB
Design Criterion	34 dB	34 dB	34 dB
Exceedance	0 dB	0 dB	0 dB

The table above demonstrates that, with the mitigation measures in place, the cumulative noise levels at the noise sensitive receptors comply with the requirements of part (i) of planning conditions 31 set by Reading Borough Council.

8 CONCLUSION

WSP Acoustics has undertaken a noise impact assessment of the plant items proposed to be installed on Block A of the St Martin's Centre Development, which will serve the tenants of the ground floor restaurant of Block A.

The purpose of the noise impact assessment is to discharge part (i) of planning condition 31, set by Reading Borough Council (RBC), relating to mechanical plant noise.

An environmental noise survey previously undertaken by Cundall has been used to establish the background noise levels on site and set plant noise emission limits in accordance with RBC's requirements.

Details of the noise emission levels of all the proposed plant items have been provided by Workman LLP and have been used in a detailed assessment to calculate the resultant cumulative plant noise levels at the nearest noise sensitive receptors.

The assessments have demonstrated that mitigation measures are required to meet the plant noise criteria outlined in the planning conditions.

Section 7 of this report presents the recommended mitigation measures to meet the criteria and satisfy the planning conditions.

With these mitigation measures, plant noise levels are predicted to comply with the planning requirements.

Limitations to this report can be found in Appendix G.

APPENDIX

A ACOUSTIC GLOSSARY



ACOUSTIC TERMINOLOGY

Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 20 Hz (deep bass) to 20,000 Hz (high treble) and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude, but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear.

Furthermore, the perception of noise may be determined by a number of other factors, which may not necessarily be acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time. In some cases, the time of day and other acoustic features such as tonality or impulsiveness may be important, as may the disposition of the affected individual. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source.

The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq} , L_{A90} etc., according to the parameter being measured.

The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10 dB(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB(A) is generally regarded as the minimum difference needed to perceive a change under normal listening conditions.

An indication of the range of sound levels commonly found in the environment is given in the following table.

Table A-1: Typical sound levels found in the environment

SOUND LEVEL	LOCATION
0 dB(A)	Threshold of hearing
20 to 30 dB(A)	Quiet bedroom at night
30 to 40 dB(A)	Living room during the day
40 to 50 dB(A)	Typical office
50 to 60 dB(A)	Inside a car
60 to 70 dB(A)	Typical high street
70 to 90 dB(A)	Inside factory
100 to 110 dB(A)	Burglar alarm at 1m away
110 to 130 dB(A)	Jet aircraft on take off
140 dB(A)	Threshold of pain

APPENDIX

Table A-2: Terminology relating to noise

TERMINOLOGY	DESCRIPTION
Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level (Sound Level)	The sound level is the sound pressure relative to a standard reference pressure of $20\mu\text{Pa}$ (20×10^{-6} Pascals) on a decibel scale.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s_1 and s_2 is given by $20 \log_{10} (s_1 / s_2)$. The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is $20\mu\text{Pa}$.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
$L_{eq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level during the period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{90,T}$	A noise level index. The noise level exceeded for 90% of the time over the period T. L_{90} can be considered to be the "average minimum" noise level and is often used to describe the background noise.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m.
Façade	At a distance of 1m in front of a large sound reflecting object such as a building façade.
Fast/Slow Time Weighting	Averaging times used in sound level meters.
Octave Band	A range of frequencies whose upper limit is twice the frequency of the lower limit.

APPENDIX

B EXISTING SITE PLAN



APPENDIX

C PROPOSED CONSOLIDATED SITE PLAN

A large, white, stylized chevron graphic pointing downwards, located in the bottom left corner of the page. It is composed of two overlapping triangular shapes.

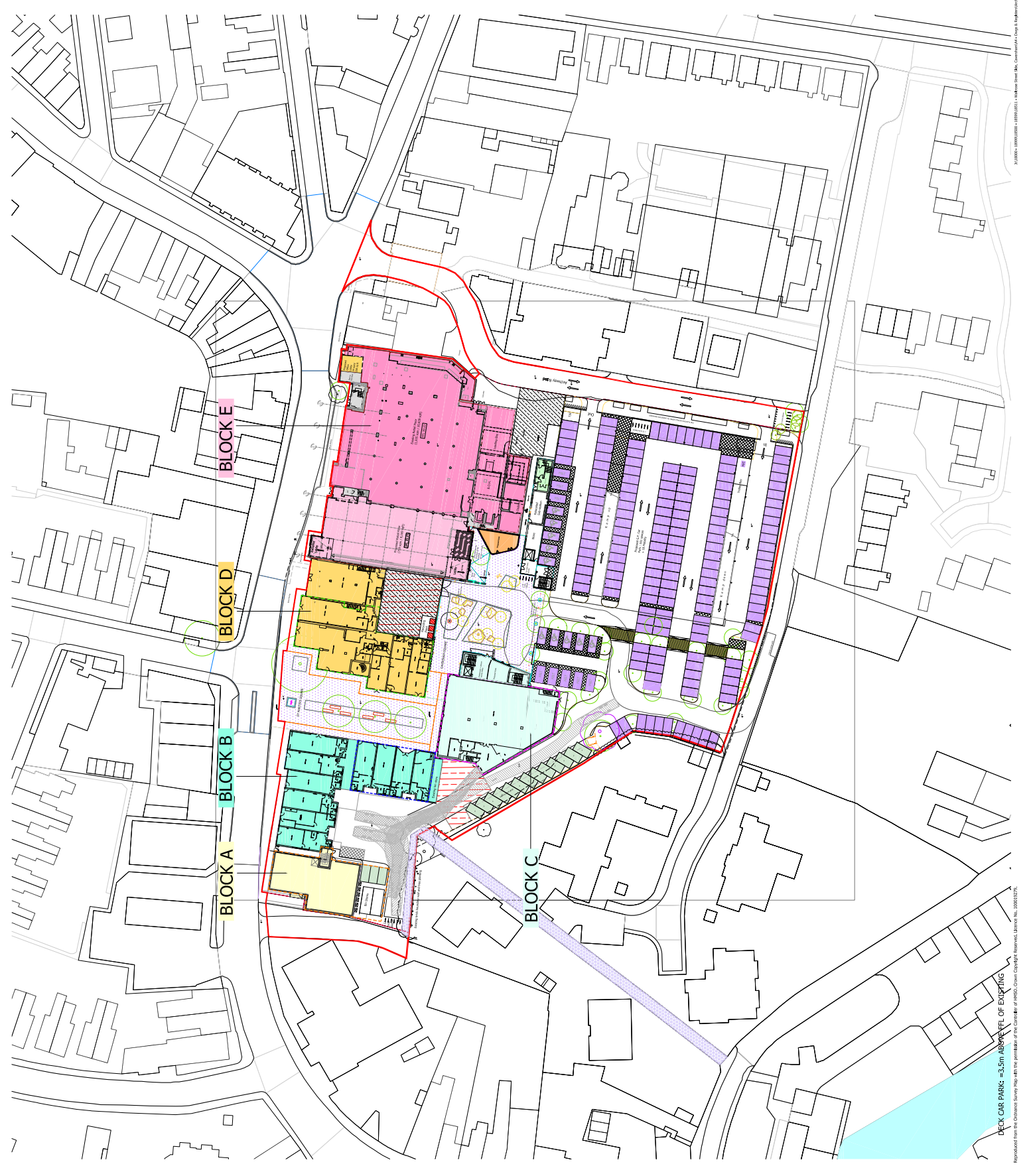
- | | |
|--|-------------|
| RETAIL PARKING AT GRADE: 179 | CYCLE ROUTE |
| CONSISTING OF: | |
| 152 STANDARD | |
| RETAIL CAR PARKING ON DECK: | |
| 129 STD BAYS | |
| RESIDENTIAL/STAFF PARKING: 16 | |
| PROPOSED RESTAURANT/ GROUND FLOOR | |
| FOR AREAS PLEASE REFER TO PLANS AND | |
| ELEVATIONS | |
| PROPOSED RESIDENTIAL FLOORS (17 UNITS) | |
| FOR AREAS PLEASE REFER TO PLANS AND | |
| ELEVATIONS | |
| EXISTING RETAIL GROUND FLOOR | |
| FOR AREAS PLEASE REFER TO PLANS AND | |
| ELEVATIONS | |
| PROPOSED RESTAURANT & CINEMA FLOORS | |
| FOR AREAS PLEASE REFER TO PLANS AND | |
| ELEVATIONS | |
| EXISTING RETAIL GROUND FLOOR : | |
| FOR AREAS PLEASE REFER TO PLANS | |
| AND ELEVATIONS | |
| PROPOSED RESIDENTIAL FLOORS (19 UNITS) | |
| FOR AREAS PLEASE REFER TO PLANS AND | |
| ELEVATIONS | |
| EXISTING WAITROSE | |
| FOR AREAS PLEASE REFER TO PLANS AND | |
| ELEVATIONS | |
| PROPOSED WAITROSE | |
| FOR AREAS PLEASE REFER TO PLANS AND | |
| ELEVATIONS | |
| UNITS TO BE DEMOLISHED: | |
| 316 SQ M/3,401 SQ FT | |
| LISTED BUILDINGS - LIBRARY | |
| EXISTING TREES | |
| SERVICE YARD | |
| RETAIL ACCESS AND KIOSKS | |
| RECYCLING POINT | |

PLANNING

Project: St Martin's Centre, Church Street
Caversham
Proposed Consolidated Site Plan
& Car Park
Drawn by: 15000/BA1
Date: 2013
Project No: 18511
Drawing No: PP-APP-02
Revision: P2

Other: Ready to be used for planning and building control purposes only. All area shown to be checked on site or against full building survey. The boundary shown is for information only and is not a legal boundary. The boundary shown is for information only and is not a legal boundary. The boundary shown is for information only and is not a legal boundary.

3/18/2013 - 18511/0001 - 18511/0001 - 18511/0001 - 18511/0001 - 18511/0001 - 18511/0001 - 18511/0001 - 18511/0001 - 18511/0001 - 18511/0001



DECK CAR PARK: ~3.5m ABOVE LEVEL OF EXISTING

APPENDIX

D CUNDALL ENVIRONMENTAL NOISE REPORT



Hermes Property Limited Trust

St Martin's Centre Caversham

Environmental Noise Report

Job No: 1006081

Doc No: 1006081-RPT-00014

Latest Revision: A

Date: 17/06/2014

Project name	St Martin's Centre, Caversham	Job Number
Report Name	Environmental Noise Report	1006081

Document Revision History

Revision Ref	Issue Date	Purpose of issue / description of revision
-	23/05/2014	Client comments

Document Validation (latest issue)

Revision A	Issue Date 17/06/2014	Purpose of issue / description of revision / version			
		Outline Planning			
			Prepared by	Checked by	Verified by
		Initials	JW	MRE	MRE
		Signature			

Executive Summary

Reading Borough Council have requested a noise assessment be carried out as part of the proposed regeneration of the St Martin's Centre in Caversham.

The assessment has been made to address issues raised by Jodie Wilson, Senior Environmental Health Office at Reading Borough Council. This included an assessment of the potential noise impact that the development may have on existing noise sensitive premises, in addition to an assessment for mitigation measures required for proposed residential dwellings.

A 3D noise model of the site has been created to accurately predict noise propagation across the site. Using the model, a comparison of traffic flows for the years 2014 and 2019, with and without the development has been made. Both the natural increase in traffic flow and the anticipated increase due to the development result in either 'No change' or 'Negligible' significance criteria, when compared to the classification of magnitude of noise impact set out in the DMRB.

Based on measured noise data, recommended limiting noise levels for breakout noise for A1/A3 units and the cinema have been set, in addition to limiting noise levels for any new items of services plant.

Using the 3D model, and the 2019 With Development scenario, the noise impact on proposed residential dwellings has been assessed. Recommended mitigation measures for glazing and ventilation have been made. On the most exposed façade, overlooking Church Street, the glazing attenuation requirements to achieve an internal noise level of 30 dBA $L_{Aeq,T}$ are 40 dB $R_w + C_{tr}$, with fresh air requirements to be met through mechanical ventilation.

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1. Introduction

Cundall has been instructed by Hermes Property Limited Trust to carry out an assessment of the potential noise issues that may arise from the proposed re-development of the St Martin's Centre in Caversham.

The development site is split into five separate blocks as follows:

- Block A – comprising ground floor restaurant with 17 residential units above
- Block B – comprising existing retail at ground floor with 4 residential units above existing residential
- Block C – comprising existing retail at ground floor with proposals for restaurant and cinema above
- Block D – comprising existing retail at ground floor with 19 residential units above
- Block E – proposed extension to existing Waitrose Store

In addition to the above, proposals are to redevelop the existing car parking to the rear of the site, to include a single deck car park.

The following Figure [extract from Barton Willmore drawing PA-102 shows the extent of the proposed development and location of each block]:

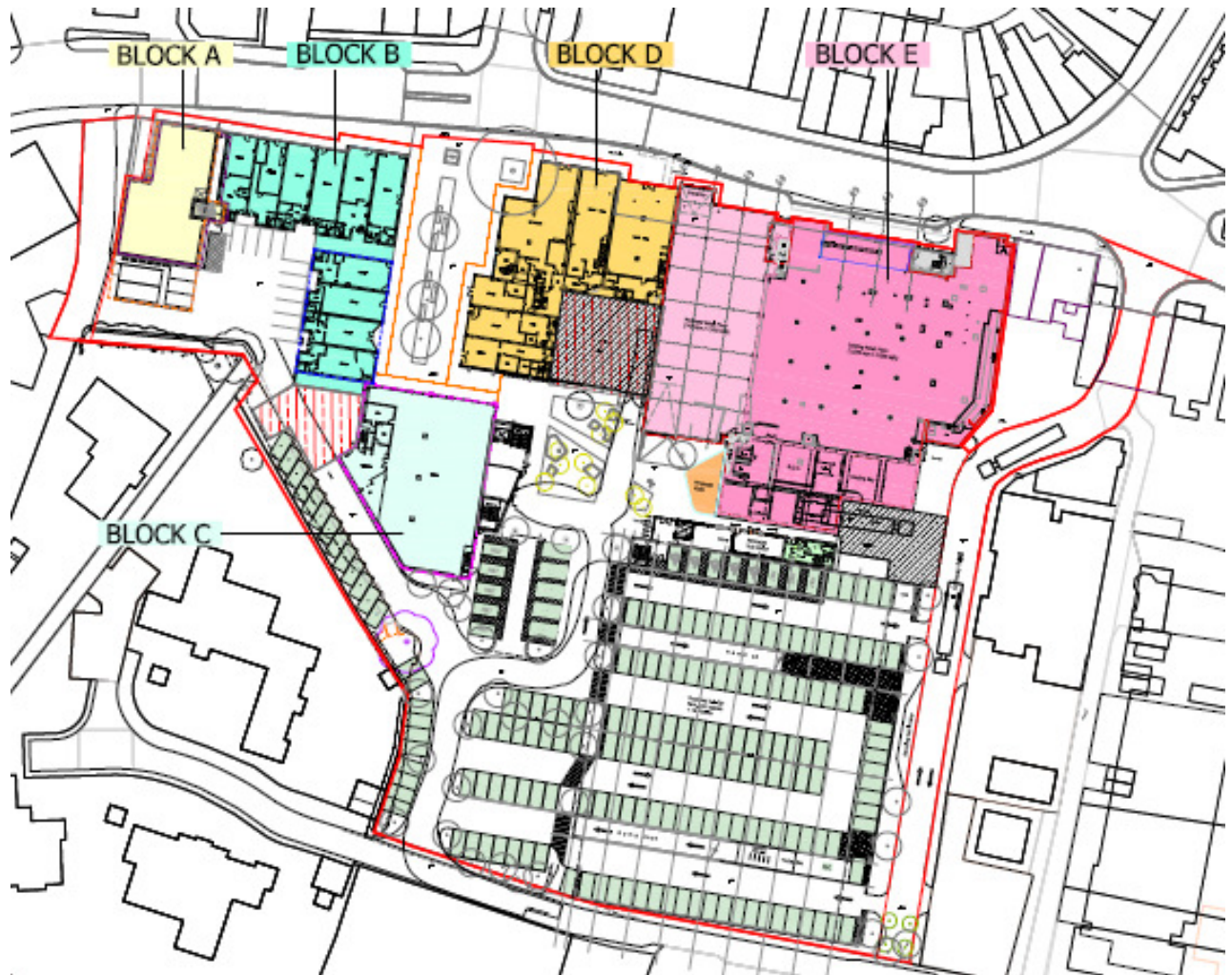


Figure 1 - Proposed layout showing each Block

The purpose of this Report is to as follows:

- to document existing ambient and background noise levels around the site;
- to provide a summary of good practice measures for the control of construction noise
- to assess the potential noise impact from the proposed development on existing noise sensitive premises
- to assess the noise impact on proposed residential dwellings from existing noise sources
- to set limiting noise levels for new items of services plant associated with the development.

2. Design Criteria

2.1 Local Authority Planning Requirements

The requirements of Reading Borough Council [RBC] for the noise assessment are set out in an internal memo from Jodie Wilson, Senior Environmental Health Office, to Stephen Vigar, dated 24th December 2013 [appended to this Report in Section 9]. In addition, the noise impact assessment requirements were discussed with Jodie on 23rd May 2014 and set out in an email [copy appended to this report in Section 9] from the author to Jodie on 27th May 2014.

2.1.1 Noise impact on residential development

Reading Borough Council's noise policy for new build residential development is for internal ambient noise levels to be designed to meet the 'good' criteria within the 1999 version of British Standard 8233 [BS 8233]. These are summarised in the following Table:

Room	Design criteria ['good']
Bedrooms	$\leq 30 \text{ dB } L_{Aeq,T}$
Living rooms	$\leq 30 \text{ dB } L_{Aeq,T}$
Gardens and balconies	$\leq 50 \text{ dB } L_{Aeq,T}$

Table 1 - Internal noise criteria for new build residential development

Received correspondence from RBC confirms that the above requirements are based on British Standard 8233:1999 and the World Health Organisation Community Guidelines. BS 8233: 1999 has been superseded in February 2014. The 2014 version retains the 'good' criteria for residential developments, but removes the upper 'reasonable' range. There is also no reference to a maximum criteria is either RBCs correspondence or the new BS 8233: 2014.

Glazing will be specified to provide appropriate sound insulation properties to see that the above internal noise levels can be achieved, in addition to comments made on the anticipated maximum noise impact [in line with BS 8233:1999].

With regards ventilation, it is understood that "*Ventilation measures should be selected which do not allow unacceptable noise ingress and should provide sufficient ventilation to avoid the need to open windows in hot weather, however non-openable windows are not considered an acceptable solution due to the impact on living standards.*"

2.1.2 Noise arising from commercial / industrial development

Any new items of services plant associated with the development should be designed and installed such that the rating level is no greater than 10 dB below the existing background [$L_{A90,T}$] noise level. The assessment is based on the methodology set out in BS 4142: 1977.

2.1.3 Noise arising from ‘other’ sources

No specific guidance is given in respect of specific noise sources, such as from the car park or service yards. However, it is considered that the principles set out above [Sections 2.1.1 & 0] can be used. ‘Typical’ noise data for services yards and anticipated car park usage will be input into a 3D noise model to provide the average noise impact from such activities.

Similarly, no specific guidance has been provided for noise from the proposed cinema / restaurants, and therefore best practice measures have been included for within this report. It was noted by Jodie Wilson that opposite the site, there is an existing restaurant which opens its frontage during hot weather and at the time of writing no complaints of noise have been received.

3. Noise climate

Noise surveys have been carried out to establish the existing ambient and background noise levels around the site and to determine the noise impact on proposed residential dwellings. The measured noise levels have also been used to calibrate and verify a 3D noise map of the site that can more accurately assess noise propagation from multiple existing and proposed noise sources. The following sub-sections provide details on the noise surveys and 3D noise modelling.

3.1 Noise surveys

The following noise surveys were carried out:

- Daytime noise surveys were carried out between approximately 14:10 and 20:00 hours on 7th November 2013
- Night-time noise surveys were carried out between approximately 01:00 and 04:00 hours on 8th May 2014

Measurements were made with two CEL 633 Class 1 sound level meters [serial numbers 1211404 and 1211405]. Meters were field calibrated prior to, and immediately following measurements with no significant drift noted. Copies of relevant calibration certification can be supplied upon request.

All measurements were made on a tripod, in free field locations, approximately 1.5 m above ground floor level. Weather conditions for the duration of the surveys were dry, with no precipitation and <3m/s wind speeds.

Measurements were made concurrently of numerous noise descriptors, but the key factors used in this assessment are as follows:

- $L_{Aeq,T}$ – the average A-weighted noise level exposure over a given time period, T;
- $L_{A90,T}$ – the A-weighted noise level exceeded for 90% of the measurement period, T, commonly accepted as being the 'background' noise level;
- L_{Amax} – the maximum A-weighted noise level within a particular measurement period.

Figure 2 shows the red line site boundary with the indicative measurement locations marked.

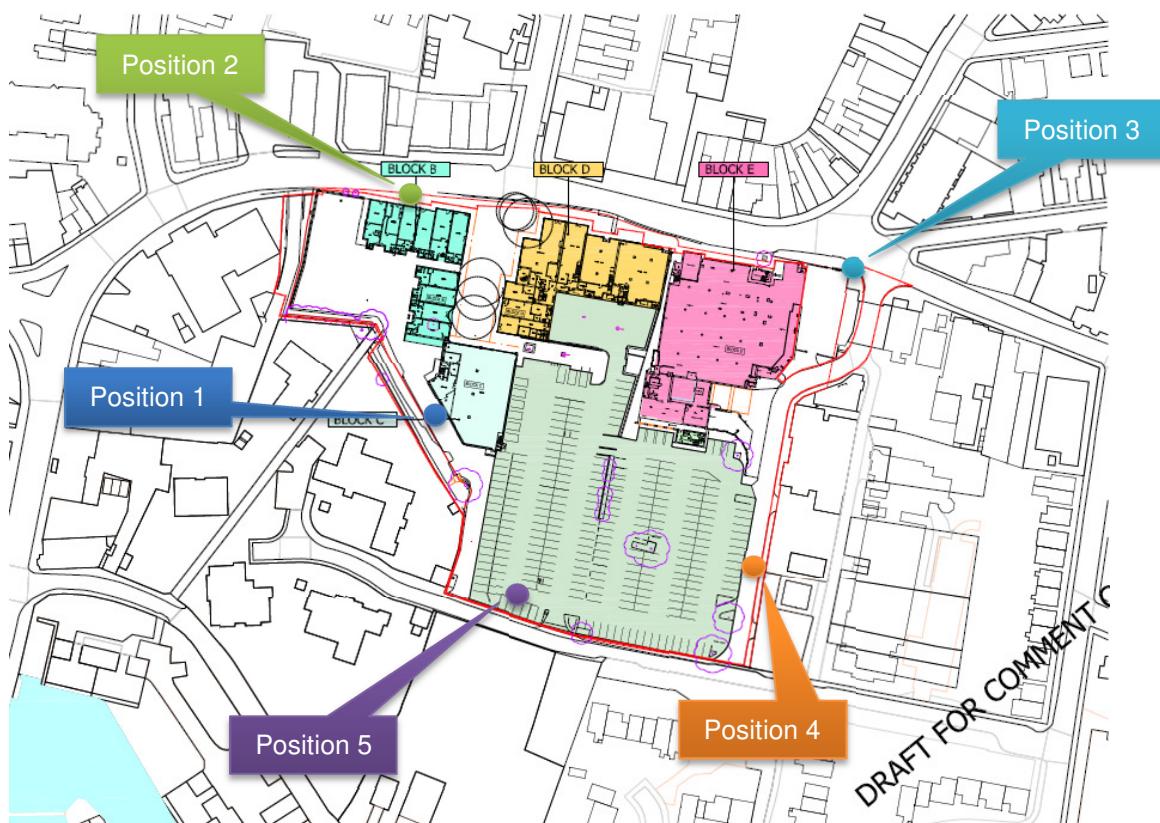


Figure 2 - Site plan showing indicative location of measurement positions

The following Table shows a summary of measurement results for each position. All values are in dBA. Detailed measurement results are shown in Section 8 below. All values shown are in dBA.

Measurement Position / Period		Averaged ¹ $L_{Aeq,T}$	L_{AFmax} ²	$L_{A90,T}$ ³
1	Daytime	51.3	77.3 [53 - 77]	47
2	Daytime	68.8	92.3 [75-92]	60
	Night-time	54.3	77.5 [46-77]	37
3	Daytime	68.1	96.7 [74-96]	67
4	Daytime	59.5	80.3 [66-80]	49
	Night-time	46.6	71.3 [48-71]	42
5	Daytime	54.2	75.3 [61-75]	45
	Night-time	47.6	70.8 [45-70]	41

Table 2 - Summary of measured noise levels

3.2 3D noise model

In order to accurately assess noise propagation across the site, a 3D noise model has been created, using SoundPlan [version 7.2]. The model has been calibrated using measured noise data around the site and also road traffic data provided by WYG. For service yards and car parks, typical activity noise levels have been used in the assessment.

Road traffic data has been provided by WYG in the form of Annual Average Daily Traffic figures for the following scenarios:

- 2014 Base – existing traffic levels around the site
- 2019 Base – projected traffic levels around the site with no development
- 2019 With development – projected traffic levels around the site with the development

¹ The logarithmically averaged noise measured during the period

² Highest L_{Amax} is shown with the range in brackets below

³ The typical background noise level is determined by taking the highest frequency density when plotted as a histogram. Where two distinct frequency ranges are evident [i.e. at positions 2 and 4, i.e. where daytime and evening background noise levels vary considerably], the lowest value is recorded.

4. Construction noise

During the construction period, some disturbance to noise sensitive properties is inevitable. The level of disturbance is however likely to reduce, particularly towards the end of the construction phase as internal works and fit-out would inherently be less obtrusive.

The contractor will be required to comply with the requirements of BS 5228-1:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites – Part 1: Noise' and provide Reading Borough Council with a Construction Management Plan.

The following is good practice guidance for the management of construction noise and vibration, in addition to the guidance given and required by Reading Borough Council:

- Effective communication between the main contractor and nearby noise sensitive receptors (residential and commercial) outlining current and forthcoming activities, including timescales. For a development of this scale, a 'point of contact' with dedicated phone number and email address should be made available for queries and complaints. Effective communication is important in controlling adverse community reaction to noise
- Appropriate hours of noisy work adjacent to residential dwellings should be restricted to 08:00 to 18:00 hours Monday to Friday and 08:00 to 13:00 hours on Saturday, with no noise activities taking place on Sundays or Bank Holidays. Maximum permitted noise levels are 72 dBA $L_{Aeq,10hr}$ Monday to Friday and 72 dBA $L_{Aeq,5hr}$ Saturdays adjacent to residential dwellings
- Site vehicles should not be left idling, particularly when in close proximity to residential dwellings. This is also applicable to other site machinery, such as pumps, generators etc, which, if not in use, should be shut down
- Over-revving of works vehicles should be avoided and site access should be configured to minimise disruption
- Site hoarding should be installed to provide barrier attenuation against noise. To be effective, the barrier should block the line of sight between the noise source and receptor, and screens are more effective closer to the noise source. Site hoarding can also be used as an effective communication tool if details of the construction programme and activities are placed on the hoarding. Transparent screens can be used to allow a visual appreciation of on-going works
- Careful selection of plant and machinery should be made to minimise noise impact and all items of plant and machinery should be well maintained in accordance with the manufacturer's instructions. Where feasible, appropriate silencers should be used to reduce noise levels at source
- Constant monitoring of activities and noise levels around the site will be required to identify areas where any additional mitigation measures could be employed.

- Careful consideration will be required for the use of heavy equipment, particularly piling equipment to reduce vibration impact on nearby persons, such as auger driven piling as opposed to impact piling, where feasible

5. New development near existing dwellings

The following sub-sections detail the mitigation measures to be employed to control noise breakout from the proposed development. This section is split into the following Sections:

- Predicted noise impact from road traffic [roads, deliveries and car parks]
- Control of noise breakout from A1/A3 units and Cinema
- Control of noise from fixed services plant

5.1 Existing noise sensitive properties

The site is within an established commercial / residential area. The following Figure highlights the existing residential areas surrounding the site in green:

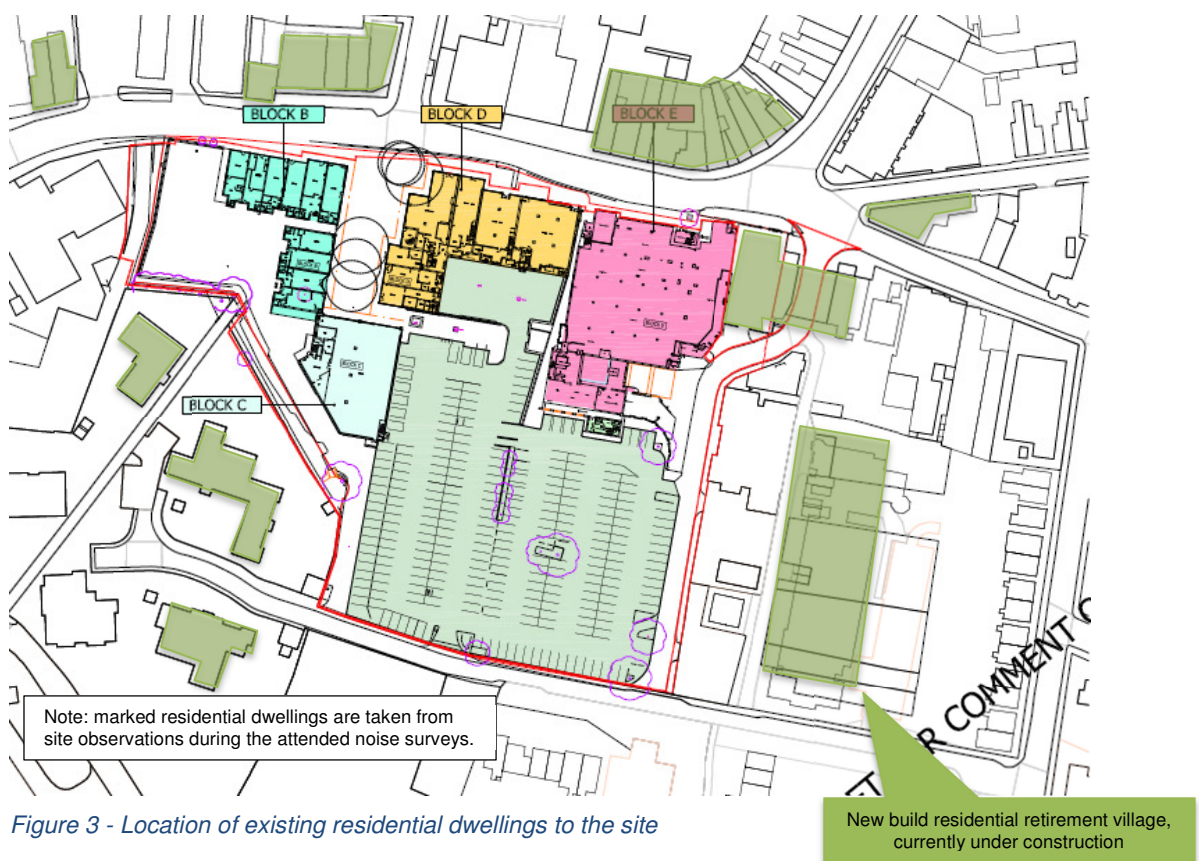


Figure 3 - Location of existing residential dwellings to the site

5.2 Predicted noise impact from road traffic

WYG have provided traffic flow data for the major roads surrounding the site. Data has been provided in the form of Annual Average Daily Traffic [AADT] figures for the following scenarios:

- 2014 Base – existing traffic levels around the site

- 2019 Base – projected traffic levels around the site with no development [based on natural increase in road traffic]
- 2019 With development – projected traffic levels around the site with the development [based on anticipated traffic flows due to natural increases in road traffic plus additional traffic attributable to the proposed development⁴]

In order to assess the potential noise impact from road traffic noise, four residential receptors have been assessed along the major routes into the precinct. These receptors are shown in the following Figure in green:

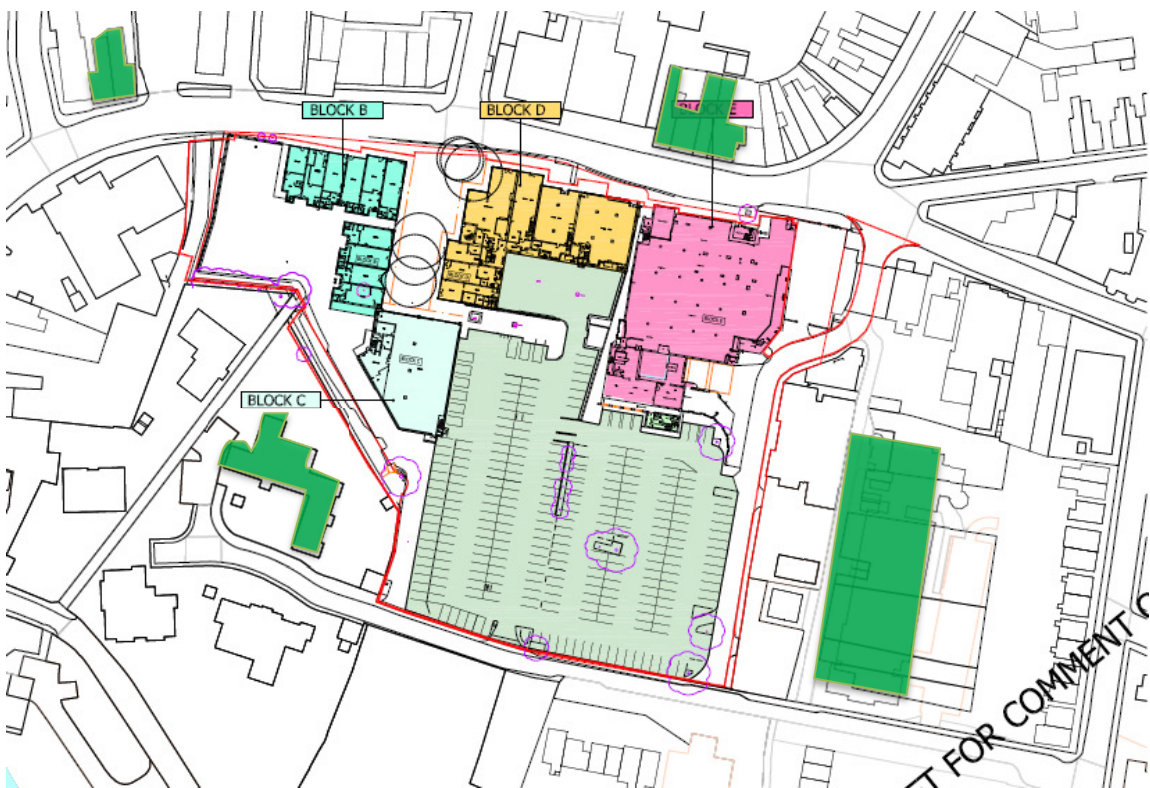


Figure 4 - Location of receivers for road traffic assessment

For each receptor highlighted above, the change in noise level has been assessed and these levels compared to the suggested significance criteria as set out in the Design Manual for Roads and Bridges [DMRB], Volume 11 Section 3.

For each receptor, the noise impact was assessed at each floor level, however, only the worst case change in noise level is shown. Usually, noise levels from a 3D noise model would be rounded to the nearest integer, however, for the purposes of comparing noise levels for a DMRB assessment, values to 0.1 dB are used.

⁴ This includes increase in deliveries/collections associated with service yards [see Section 6.1.2 for details]

The following Table summarises the results from the assessment. In addition to the predicted noise impact, the magnitude of change in noise level is also shown in brackets. For ease of reference, the magnitude of change in noise level is also colour coded, as follows:

Change in noise level	Significance criteria ⁵
0	No change
0.1 – 0.9	Negligible
1.0 – 2.9	Minor
3.0 – 4.9	Moderate
5.0 +	Major

Figure 5 - Classification of magnitude of noise impact [short term]

Receptor	2014 Base [existing traffic levels around the site]		2019 Base [projected traffic levels around the site with NO development]		2019 With development [projected traffic levels around the site with the development]	
	Day	Night	Day	Night	Day	Night
Abbotsmead Place	67.9	61.0	68.1 [0.2]	61.5 [0.5]	68.1 [0.0]	61.5 [0.0]
14-16 Church Street	69.8	62.9	70.0 [0.2]	63.4 [0.5]	70.0 [0.0]	63.5 [0.1]
36a-40 Church Street	50.6	41.9	50.7 [0.1]	42.3 [0.4]	50.6 [0.0]	42.3 [0.0]
Crayshaw Court Retirement Village	50.6	43.0	50.7 [0.1]	43.3 [0.3]	52.1 [1.4]	43.6 [0.3]

Table 3 - Predicted increase in road traffic flow noise

The change in noise levels shown equate to:

- the difference between the 2014 and 2019 traffic levels, assuming natural increases in traffic around the site [No Development].
- the difference between the 2019 'No Development' and 2019 'With development' traffic levels

As can be seen from the above Table, the majority of receptor points show that the potential noise impact from increased traffic flows will be 'Negligible' or 'No change'. A 'Minor' change [+1.4 dB] is

⁵ Table 3.1 from DMRB

noted between the 2019 Base data [No Development] and the 2019 With Development data for Crayshaw Court Retirement Village. The predominant reason for this is the proposed changes to the car park to the rear of the development.

It is noted, with reference to the Grid Noise Maps below, that the noise impact on some residential dwellings will reduce due to the proposed Block A providing a barrier between Church Street and residential blocks to the south.

To put the change in noise levels above into context, traffic levels would have to double for a 3 dB increase in noise levels to be noted.

The following Figures show the predicted noise impact from changes in traffic flows from the 3D noise model. Each grid noise map is for daytime periods and at 1.5 m above ground level.

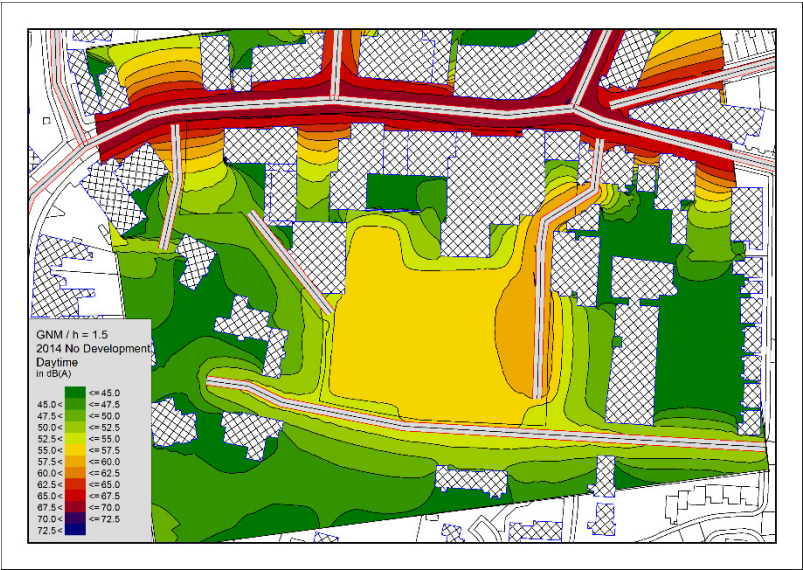


Figure 6 - Grid Noise Map showing noise propagation for 2014 No Development scenario



Figure 7 - Grid Noise Map showing noise propagation for 2019 No Development scenario

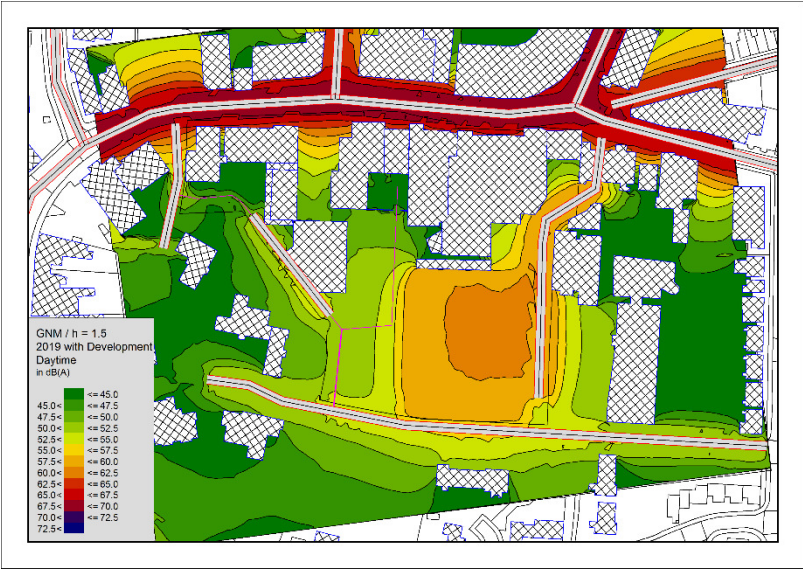


Figure 8 - Grid Noise Map showing noise propagation for 2019 With Development scenario

5.3 Control of noise breakout from A1/A3 units and Cinema

5.3.1 Cinema

At the time of writing, the cinema operator is unknown [Block C]. Experience has shown however, that most cinema operators have stringent requirements for the control of noise break-in to such an extent that noise break-out is adequately controlled. For example, typical noise intrusion into an auditorium would be $< \text{NR30 } L_{10}/L_{\text{max}}$ ⁶.

To see that noise breakout is adequately controlled however, the following Tables show:

- Typical internal noise level within auditoria [amplified film sound track⁷]

Octave band frequency, Hz	31	63	125	250	500	1000	2000	4000	8000
$L_{\text{Max,fast}}$	105	110	105	100	100	100	100	95	90
$L_{\text{eq,1hr}}$	85	95	85	85	85	85	80	80	75

Table 4 - Typical internal noise levels within Cinema Auditoria

- Noise level not to be exceeded [low frequency octave band and broad band values] at 1 m from the nearest residential dwelling [values based on measured background noise levels, refer to Table 2]

Octave band frequency, Hz	50	63	80	100	125	160	Broad band
Daytime $L_{90,5\text{min}}$	51	51	50	49	49	46	45
Night-time $L_{90,5\text{min}}$	47	47	46	45	45	42	41

Table 5 - Limiting noise levels for breakout noise from the cinema

5.3.2 A1 / A3 units

Further to discussions with Jodie Wilson, it is understood that there are few concerns for noise breakout from A1 / A3 units. This is based on the site currently in use with both A1 and A3 units, including other such units in the immediate vicinity.

It is recommended that a tiered approach to noise mitigation be adopted by future tenants, to see that the noise impact is adequately controlled. The following Table shows suggested mitigation measures, depending on the use and likely internal activity noise levels:

⁶ Example taken from two commercial cinema operators

⁷ Values taken from commercial cinema operator

A1 / A3 Internal activities	Mitigation measures
A1 or A3 units with no amplified music / background music, including patron noise	Any new glazing to shop frontages, including doors, to provide ≥ 25 dB R_w
A1 or A3 units with [louder] amplified music Amplified music limited to 90 dB $L_{Aeq,10mins}$ and 105 dB L_{Amax} during normal operation	Internal noise limiter for amplified music calibrated to the limits set Glazing and doors to shop frontages to provide ≥ 40 dB R_w
External seating areas	No amplified music Time restrictions from 08:00 to 23:00 hours Management policy per tenancy on the control of 'noisy/rowdy' behaviour

Table 6 - Suggested mitigation measures for control of noise breakout from A1/A3 units

5.4 Control of noise from fixed services plant

There will be a number of dedicated services plant rooms/locations associated with the development to serve the retail units and cinema, in addition to smaller plant to service the residential areas of the development.

Services will be split between general landlord's plant and tenant plant. At the time of writing, the plant selection is unknown, and therefore this report sets out the criteria to be achieved.

In accordance with Reading Borough Council's noise policy, services plant should be designed such that the 'rating'⁸ noise level is at least 10 dB below the existing ambient background noise levels when measured at the nearest noise sensitive receptors.

The background noise level [$L_{A90,T}$] was measured around the site at five locations, for both daytime and night-time periods. For each position, the 'typical' background noise level has been determined as the highest frequency density from plotting a histogram of measured noise levels.

The background noise levels around the site varied considerably. The following Figure therefore shows proposed limiting noise levels for services plant around the site, depending on the measured noise data.

The limiting noise levels should apply to all new items of service plant running simultaneously, including both landlord's and tenant's. More detailed calculations / division of noise limits will be applied when services plant locations and likely noise levels are determined.

⁸ The rating level, as described in BS 4142: 1997, is the specific noise level plus any adjustment for the characteristic features of the noise.

	Daytime	Night-time
Measured noise level	60 dBA	37 dBA
Limiting noise level	50 dBA	27 dBA

	Daytime	Night-time
Measured noise level	67 dBA	37 dBA
Limiting noise level	57 dBA	27 dBA



	Daytime	Night-time
Measured noise level	45 dBA	41 dBA
Limiting noise level	35 dBA	31 dBA

	Daytime	Night-time
Measured noise level	49	42
Limiting noise level	39	32

6. New dwellings proposed near existing noise sources

An assessment has been made of the required sound reduction properties for glazing and ventilation for proposed new build residential elements of the development.

The following Figure shows the proposed site plan with residential areas marked on.

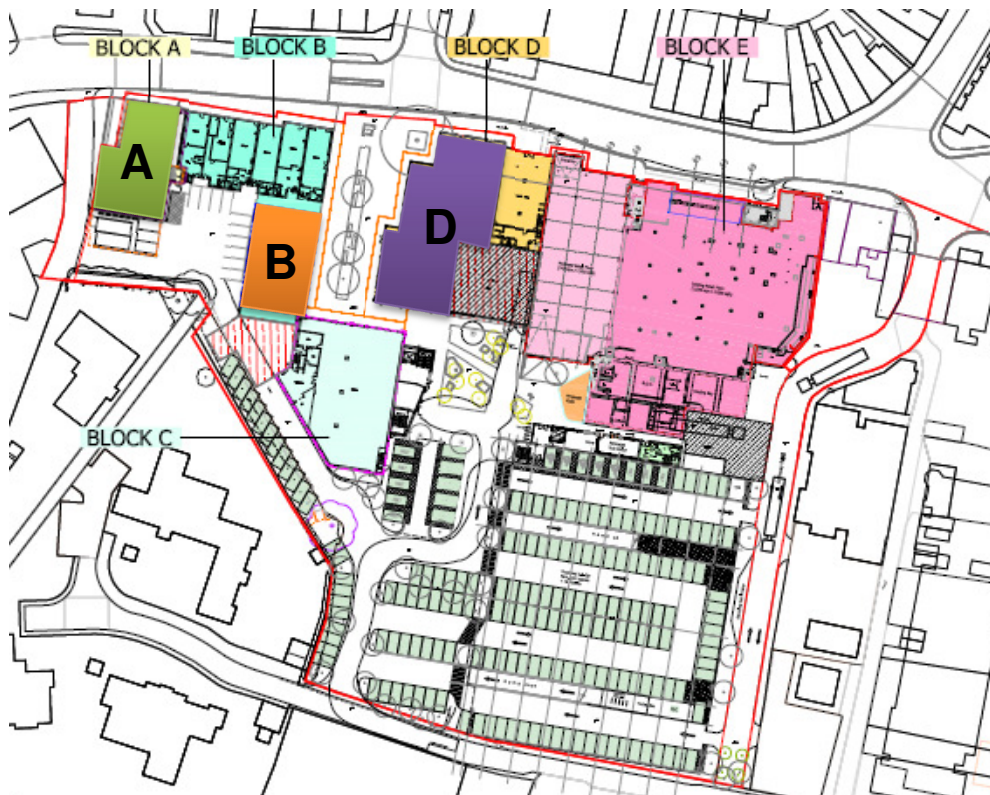


Figure 9 - Site plan showing location of proposed residential

6.1 Noise sources affecting proposed residential dwellings

The potential noise sources that will impact on the proposed residential elements of the development are road traffic [on the surrounding road network and within the car parks] and from service yard noise. These will be discussed below:

6.1.1 Vehicular noise

The predicted noise impact on proposed residential dwellings attributable to vehicular traffic has been assessed using the 3D noise model. Traffic data for the 2019 With Development scenario has been used, which will provide the worst case noise impact [i.e. the natural increase in road traffic over the next 5 years and the increase in traffic levels attributable to the development].

6.1.2 Service yards

The following Figure shows existing and proposed service yards associated with the development:

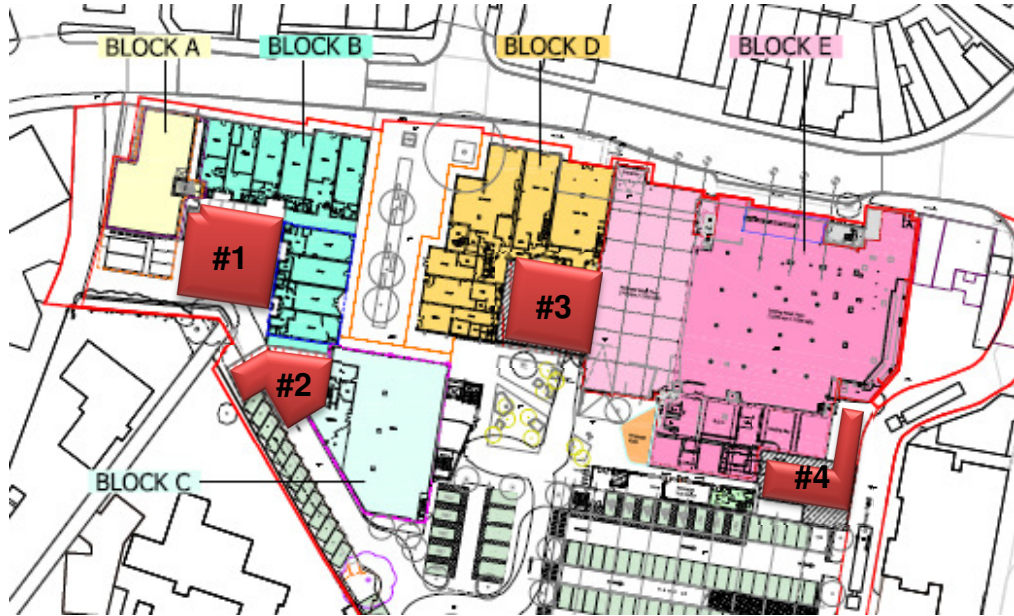


Figure 10 - Service yard locations

All of the above service yards are existing. As part of the development proposals, the following changes are proposed:

- **Service Yard #1** – this area is currently a car park and will predominantly be used as such under the proposed scheme. However, to service the proposed Pizza Express it is understood that a number of deliveries are required, including the following:
 - Fresh Food, 3 times per week, Mon-Sat, 18t vehicle, contractual delivery hours are Midnight to Noon but the majority of deliveries take place between Midnight and 6am.
 - Frozen/Drinks , twice per week, Mon-Sat, between the hours of 8am to 7pm, 18/26t vehicle
 - Waste Collection - 6 days per week, 10 am to 2 pm, 18t vehicle
 - Non Food, fortnightly, Mon-Fri, 8am to 6pm, 7.5t vehicle

This service yard will be accessed from Abbotsmead Place to the south, with egress onto Church Street to the north, as shown in the following Figure:



Figure 11 - Swept path analysis for Service Yard #1 [proposed Pizza Express]

Other items within service yard #1 would include bins and condenser units⁹.

- **Service Yard #2** – this area is currently used to service Block C and includes deliveries and bins. The number of deliveries may increase due to the increase in commercial demises, however, as above, this is anticipated to be no greater than two vans or a single 7.5t lorry per day.
- **Service Yard #3** – this service yard is existing and currently enclosed by a 3 m solid boundary enclosure. It is understood¹⁰ that the existing equipment is to be retained, although rearranged as part of the development works. The anticipated number of vehicular deliveries is one fresh food 18t HGV three times a week (Mon-Sat), one 18/26t HGV twice a week (Mon-Sat) for frozen/drinks, one 18t waste collection lorry six days a week and one non-food 7.5t lorry fortnightly (Mon-Fri)¹¹.
- **Service Yard #4** – this service area is existing and will not undergo any known changes. There is potential for increased deliveries due to the increase in net area for the Waitrose Store, although due to its well shielded nature, this is not anticipated to have any impact on proposed residential dwellings.

6.2 Predicted noise impact

Since the daytime noise impact is considerably greater than the night-time impact, and the daytime and night-time noise criteria are the same, the glazing and ventilation attenuation requirements will be dictated by the daytime noise impact. The following Figures therefore show the predicted daytime noise impact on proposed residential elevations.

⁹ Refer to Section 5.4 for control of noise from fixed services plant

¹⁰ Based on discussion with the Highways Consultant

¹¹ Delivery durations have been modelled as taking up to 1 hour.

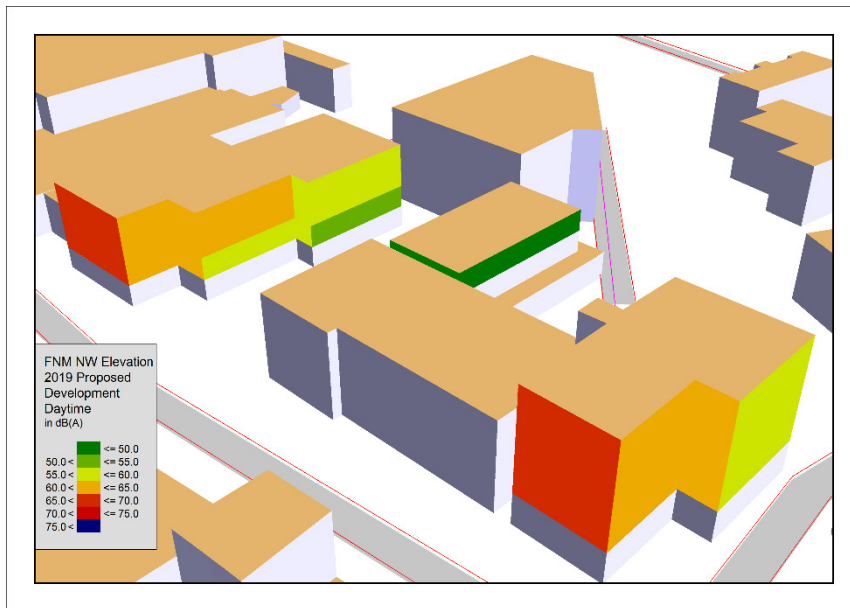


Figure 12 – Façade Noise Map showing predicted noise impact on proposed residential dwellings [view from north west]

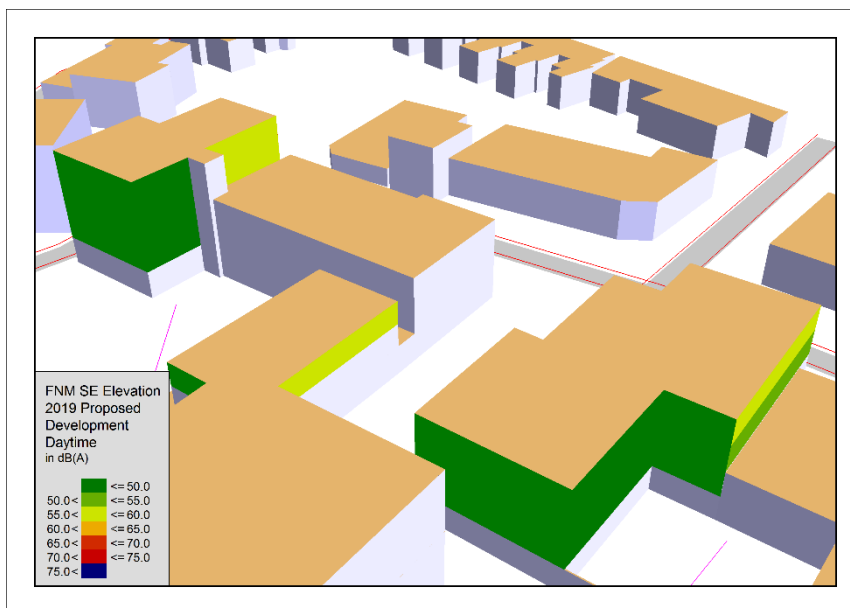


Figure 13 – Façade Noise Map showing predicted noise impact on proposed residential dwellings [view from south east]

The predicted noise impact shown in the above Figures is the daytime average [$L_{Aeq,18\text{hour}}$] noise level. As noted, this includes the projected 2019 With Development traffic flows and anticipated deliveries.

6.3 Glazing and ventilation attenuation requirements

Based on the predicted noise impacts above, the following Table shows the required glazing and ventilation sound attenuation requirements to achieve the 'good' internal noise criteria, as per BS 8233:1999. The glazing sound attenuation requirements are quoted in terms of $R_w + C_{tr}$, the C_{tr} providing a correction for road traffic noise which is the dominant noise source to affect façades. Ventilation attenuation requirements apply to all penetrations through the façade and are denoted $D_{n,e,w} + C_{tr}$.

Predicted noise impact on façade	Glazing sound attenuation	Suggested configuration	Ventilation
< 55 dB	$\geq 25 \text{ dB } R_w + C_{tr}$	Standard thermal double glazing	No acoustic rating
> 55 to $\leq 60 \text{ dB}$	$\geq 30 \text{ dB } R_w + C_{tr}$	10 mm pane 16 mm air gap 4 mm pane	36 dB $D_{n,e,w} + C_{tr}$
> 60 to $\leq 65 \text{ dB}$	$\geq 35 \text{ dB } R_w + C_{tr}$	6 mm pane 16 mm air gap 10.8 mm Pilkington Optiphon	41 dB $D_{n,e,w} + C_{tr}$
> 65 to $\leq 70 \text{ dB}$	$\geq 40 \text{ dB } R_w + C_{tr}$	8.8 mm Pilkington Optiphon 16 mm air gap 12.8 mm Pilkington Optiphon	46 dB $D_{n,e,w} + C_{tr}$

Table 7 - Glazing attenuation figures, based on noise impact

It is considered that if new build residential areas are provided with the above mitigation measures, internal noise levels in line with RBCs requirements will be achieved.

The proposed glazing and ventilation is discussed in more detail below.

6.3.1 Glazing – L_{AFmax} levels from road traffic on Church Street

Based on measured noise data at Position 2, the most representative for road traffic along Church Street, maximum noise levels typically ranged from 46 – 78 dBA L_{AFmax} , with the highest recorded value being 92 dBA. The following Graph shows range of measured L_{AFmax} noise levels:

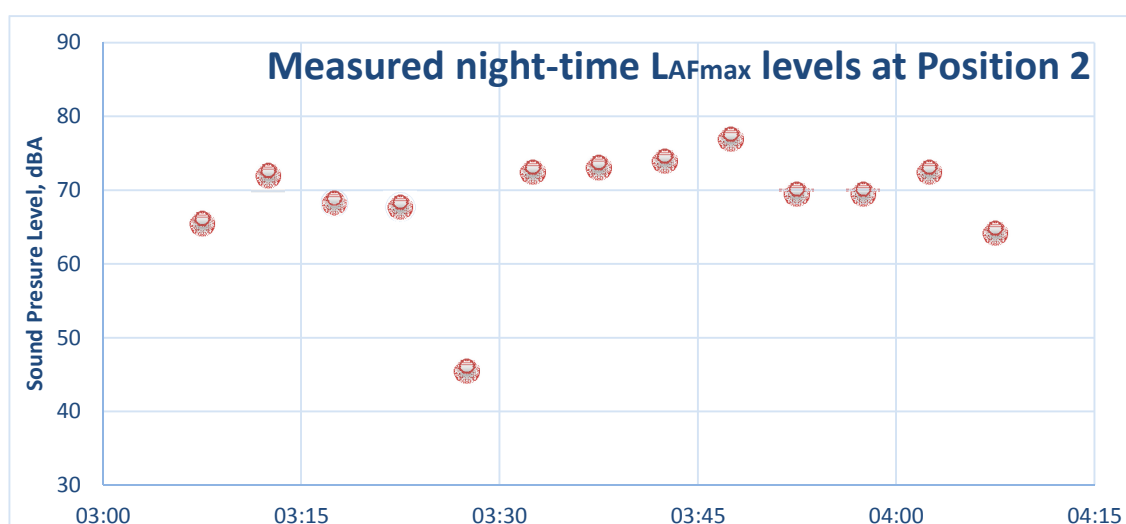


Figure 14 - Graph showing measured L_{AFmax} noise levels at Position 2

As can be seen, the maximum noise level measured at Position 2 are relatively high, which is to be expected adjacent to the very busy Church Street, which carries large volumes of traffic, including buses, HGVs etc.

Assuming the actual L_{AFmax} noise impact on the proposed residential façades will be between 3 dB lower than measured noise level, due to distance attenuation [measured noise levels were adjacent on the kerb adjacent to the road], it is anticipated that maximum noise levels, would be typically < 75 dBA. Based on the glazing attenuation above [40 dB $R_w + C_{tr}$], this would therefore result in L_{Amax} levels of < 35 dB within residential dwellings, which is significantly less than the 45 dB L_{AFmax} criteria set out in BS 8233:1999¹².

6.3.2 Glazing – L_{AFmax} levels from deliveries / collections

The predicted noise impact above included the anticipated number of deliveries and collections, as detailed in Section 6.1.2 above. The predicted noise impact however, is an average noise level, the $L_{Aeq,16hour}$. Based on only a few deliveries expected per day therefore, averaged over the 16-hour period, delivery noise should have no significant impact on the overall noise exposure.

However, each delivery will create a transient increase in the noise impact on nearby existing and proposed residential façades, as shown in the following Figure. Based on the information in Section 6.1.2, a worst case scenario may result in a maximum of five deliveries within a 24-hour period, although most days, this would only be 2-3 [up to one within the night-time period]. These instantaneous noise events would be limited to 20-30 second durations. To minimise the noise impact, it is recommended that vehicles making deliveries within Service Yard #1 do not have their engines idling during the loading/off-loading period.

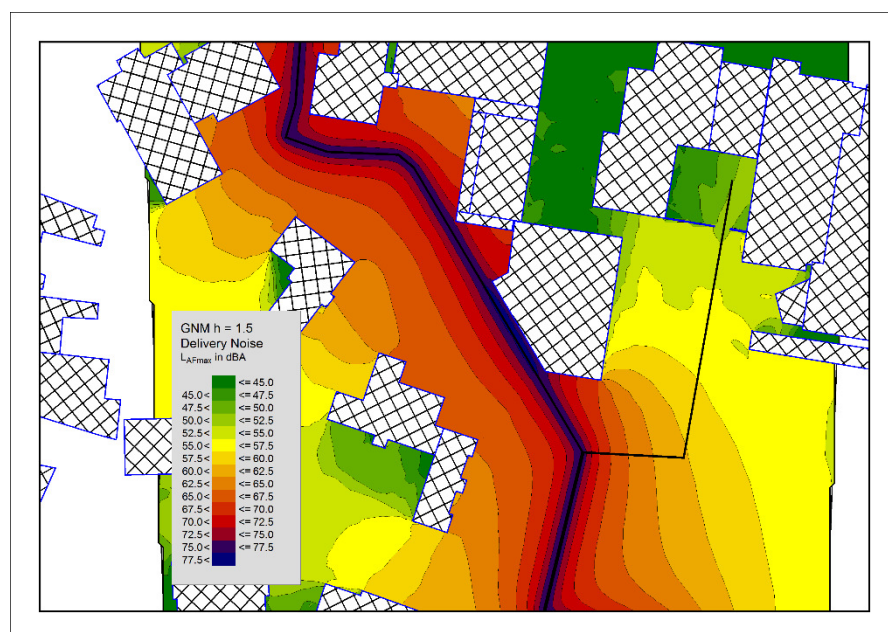


Figure 15 - Predicted L_{AFmax} noise level for delivery vehicles

¹² As noted above, BS 8233: 1999 has been superseded in February 2014. The 2014 version does not include a L_{AFmax} criteria for residential dwellings.

It is noted that a number of small van deliveries already use this route for loading/unloading Service Yard #2.

6.3.3 Ventilation details

In relation to meeting the requirements of Part F¹³ of the Building Regulations, proposals are for the minimum fresh air requirements [whole building / dwelling ventilation and extract ventilation from wet rooms] to be met through mechanical ventilation [e.g. Whole House Ventilation or Mechanical Ventilation Heat Recovery (MVHR)].

Purge ventilation¹⁴ and the control of summertime overheating would be met through openable windows.

¹³ Building Regulations Approved Document F: Means of Ventilation

¹⁴ Purge ventilation is described in AD-F as “...to aid the removal of high concentrations of pollutants and water vapour released from occasional activities such as painting and decorating or accidental releases such as smoke from burnt food or spillage of water. Purge ventilation is intermittent, i.e. required only when such occasional activities occur.”

7. Conclusions

An assessment has been carried out to assess the potential noise impact the proposed regeneration of the St Martin's Precinct will have on nearby noise sensitive premises. The assessment also addresses the noise impact on proposed new residential dwellings.

Noise levels have been measured around the site and these, in conjunction with traffic count data, have been used to create a 3D noise model of the site to accurately predict noise propagation across the complex site from numerous noise sources.

Based on anticipated increases in traffic flows for the year 2019, with and without the development, there are no significant increases in noise levels anticipated that would adversely affect existing nearby residential dwellings.

Glazing and ventilation attenuation requirements for new build residential dwellings have been set, with suggested glazing specifications and ventilation solutions.

Limiting noise levels for new items of services plant have been set, based on the 'typical' background noise levels measured around the site.

The noise assessment for the regeneration of the St Martin's precinct has not highlighted any significant new noise sources, and it is considered that the existing noise climate [and predicted future vehicular noise], does not preclude residential development within this areas, provided the appropriate mitigation measures set out herein are included.

8. Detailed measured noise data

The following Tables show detailed measurement results [L_{AFmax} , $L_{Aeq,5mins}$, $L_{A90,5mins}$] for each Position.

Position 1				Position 2			
Time	L_{AFmax}	$L_{Aeq,15mins}$	$L_{A90,5mins}$	Time	L_{AFmax}	$L_{Aeq,15mins}$	$L_{A90,5mins}$
14:12	63.2	48.3	47.0	14:46	81.6	69.2	66.5
14:17	59.4	47.6	47.0	14:51	86.7	68.0	65.5
14:22	68.1	49.8	46.5	14:56	87.0	71.0	67.5
14:27	53.9	46.6	46.5	15:01	83.8	71.0	68.0
14:32	63.3	47.6	46.5	15:06	87.7	69.8	66.0
14:37	68.9	47.9	46.0	15:11	92.3	71.0	67.0
15:23	71.1	54.0	50.0	15:58	81.3	65.4	58.5
15:28	66.1	52.3	50.0	16:03	90.6	67.1	57.0
15:33	77.3	54.8	50.0	16:08	75.2	64.7	58.0
15:38	64.6	52.4	50.5	16:13	76.7	64.4	58.0
15:43	76.1	57.4	50.0	16:18	84.1	67.4	60.0
15:48	56.1	47.0	44.5	16:23	83.4	67.4	59.5
17:04	70.6	52.0	49.0	17:36	81.3	69.3	68.0
17:09	58.8	48.5	48.0	17:41	78.0	68.7	67.5
17:14	76.0	55.7	47.0	17:46	86.4	70.0	66.5
17:19	59.9	49.0	47.0	17:51	89.1	70.1	68.0
17:24	65.1	48.9	48.0	17:56	84.9	69.4	68.0
17:29	69.1	53.0	48.0	18:01	80.2	68.8	67.5
18:26	58.1	49.1	45.5	18:59	80.4	67.7	61.0
18:31	64.9	47.8	45.5	19:04	78.1	68.1	57.0
18:36	61.4	47.1	45.5	19:09	78.5	67.7	59.5
18:41	60.4	48.6	46.5	19:14	75.1	67.5	61.5
18:46	65.2	48.5	47.0	19:19	89.4	70.5	60.5
18:51	58.4	48.9	45.5	19:24	79.1	67.8	60.5

Position 3				Position 4			
Time	L _{AFmax}	L _{Aeq,15mins}	L _{A90,5mins}	Time	L _{AFmax}	L _{Aeq,15mins}	L _{A90,5mins}
15:20	86.2	70.3	68.0	14:14	75.3	59.1	48.5
15:25	85.5	69.5	67.0	14:19	69.4	58.2	49.0
15:30	87.2	68.1	66.0	14:24	68.7	57.7	48.5
15:35	80.0	67.8	66.5	14:29	69.6	55.7	47.5
15:40	78.7	67.1	66.0	14:34	68.2	57.1	47.5
15:45	78.3	66.9	65.0	14:39	75.8	60.7	48.5
16:34	83.0	69.1	64.0	15:55	75.6	60.3	53.5
16:39	84.0	68.3	63.0	16:00	77.2	61.2	53.0
16:44	81.5	66.9	61.0	16:05	72.6	59.5	53.5
16:49	79.0	66.9	62.0	16:10	75.6	61.0	55.5
16:54	79.3	66.5	62.5	16:15	76.6	60.9	52.5
16:59	96.7	70.7	61.0	16:20	77.5	61.1	54.0
18:11	85.5	69.4	67.0	17:17	68.4	56.8	48.0
18:16	84.9	67.2	66.5	17:22	66.2	55.4	48.5
18:21	79.0	68.0	66.5	17:27	69.8	57.3	49.5
18:26	77.3	67.4	66.5	17:32	70.9	57.7	49.5
18:31	80.2	68.7	67.0	17:37	68.9	56.0	47.5
18:36	87.9	70.2	66.0	17:42	68.4	58.4	48.5
19:33	81.7	68.5	61.5	18:43	77.5	61.7	55.0
19:38	84.4	67.5	62.5	18:48	74.2	59.4	54.0
19:43	75.9	65.7	60.0	18:53	79.6	62.1	55.5
19:48	74.4	64.8	58.5	18:58	75.3	59.2	53.0
				19:03	76.4	61.6	55.0
				19:08	80.3	60.4	55.0

Position 5			
Time	L _{AFmax}	L _{Aeq,15mins}	L _{A90,5mins}
14:48	64.2	52.9	45
14:53	64	52.5	44.5
14:58	67.3	53.4	45
15:03	64.5	51.4	45
15:08	70.8	55.5	48
15:13	64.5	52.3	45.5
16:32	73.8	57.1	50.5
16:37	69.5	56.1	52.5
16:42	73.8	53.5	50.5
16:47	74.3	55.7	50.5
16:52	68.8	54.6	48.5
16:57	66.4	54.4	50
17:52	71.1	54.9	45.5
17:57	64.9	52.2	45.5
18:02	72.6	55.5	46.5
18:07	63.7	50.2	44
18:12	69.6	53.8	45
18:17	70.4	52.5	44.5
19:14	67.6	54.1	48.5
19:19	75.3	56.8	49
19:24	67.4	53.1	47.5
19:29	73.1	54.2	48
19:34	61.7	51.2	49
19:39	65.4	54.4	51.5

9. Local Authority Liaison

The following internal email has been received which sets out the requirements for the noise assessment.



INTERNAL MEMORANDUM

To:	Stephen Vigar	Your Ref:	131711
From:	Jodie Wilson - Senior Environmental Health Officer	My Ref:	EP /481074
Date consultation received:	Date: 24 December 2013		

Application Number: 131711

Premises Address: St Martins Precinct, Church Street, Caversham

Application For: A comprehensive package of development and improvements to St Martin's Centre

Environmental Protection concerns

- Noise impact on development
- Noise arising from development
- Delivery hours
- Air Quality impact - increased exposure / new receptors
- Contaminated Land
- Light - external
- Odour and noise - kitchen extraction
- Construction and Demolition phase

Noise impact on development

I have concerns about noise impact on residents of the proposed development and would recommend a noise assessment to predict the impact of the development and the external environment on residents. Applications for proposed residential developments where there are obvious noise sources, such as road, rail, industry, town centre location etc should be accompanied by a noise assessment of the external noise environment, identifying noise mitigation measures as necessary. The noise sources of concern include road traffic, pedestrians, extraction and ventilation plant, cinema, car park, recycling bins / refuse bins and deliveries.

The noise assessment should identify the external noise levels impacting on the façade of the proposed dwellings. The external noise levels can be used to ensure that the design, particularly in terms of glazing and ventilation would control noise levels sufficiently to provide a good quality living environment.

We refer to BS 8233:1999 and the WHO guidelines for community noise which provide guidance on acceptable noise levels. We look at noise levels within bedrooms at night (23:00hrs-07:00hrs) and living rooms during the

day (07:00hrs to 23:00hrs) and external amenity space (gardens / balconies, etc). For new build, we expect that the design will meet the 'good' standard. Where a building is being renovated and/or is listed, the 'reasonable' standard might be acceptable, where the 'good' standard cannot be met.

Room	Design criteria (good)	Upper limit (reasonable)
Bedrooms	<30dB	<35dB
Living rooms	<30dB	<40dB
Gardens & Balconies	<50dB	<55dB

Noise mitigation is likely to focus on the weak point in the structure; glazing. Given that the acoustic integrity would be compromised should the windows be opened, ventilation details must also be provided, where mitigation relies on closed windows. Ventilation measures should be selected which do not allow unacceptable noise ingress and should provide sufficient ventilation to avoid the need to open windows in hot weather, however non-openable windows are not considered an acceptable solution due to the impact on living standards.

The design should reflect the findings of the noise assessment and incorporate the recommendations of the noise assessment, or equivalent, in terms of glazing and ventilation.

Noise arising from development

I have concerns about the impact of noise from the proposed development on nearby noise sensitive receptors. Potential noise sources include, extraction and ventilation plant associated with the commercial uses, noise breakout from the cinema and other leisure uses, and delivery noise.

We refer to BS4142:1997 when looking at the introduction of proposed noise generating equipment. BS4142:1997 is designed to assess the likelihood of noise complaints resulting from new plant, if permitted.

A noise assessment should be carried out following the methodology of BS4142:1997 and submitted with the application. The noise assessment would be carried out for the nearest noise sensitive receptor (usually a residential dwelling). In this case as there are potentially several potential receptor locations for several potential sources, the noise assessment should cover the worst affected resident for each location where noise sources are proposed to be placed.

The assessment provides the following classifications:

	Source 'rating' level (dB L _{dB})
Complaints likely	>10dB above background*
Marginal significance	5dB above background*
Complaints unlikely	>10dB below background*

'Background' refers to the background noise level without the noise source operating (dB L_{A90})

We would like to see the applicants demonstrate that complaints will be unlikely. In order to do this the applicants would have to ensure that the noise rating level was at least 10dB below the existing background level as measured at the nearest noise sensitive receptor.

Where the noise source is within 10dB of the existing background noise, the resulting background noise will increase. In a densely occupied area such as there in Caversham, it is important to ensure that new developments do not increase background noise levels. Increasing background noise levels results in an increasing benchmark against which new plant is introduced. Gradually the noise in an area could each time new plant is introduced. If all developments involving noise generating equipment achieve 'complaints unlikely', background noise levels would not be increased.

In order to meet the 'complaints unlikely' criteria, noise mitigation measures should be recommended and the noise assessment updated to reflect the mitigated noise source rating level.

A noise assessment should be submitted with the application to show that 'complaints unlikely' criteria will be met if the plant assessed is installed and detailing the mitigation measures required to achieve this.

The following confirmation email was sent from Tom Nightingale [Cundall] to Jodie Wilson, Senior Environmental Health Office at Reading Borough Council.

Nightingale, Tom

From: Nightingale, Tom
Sent: 27 May 2014 11:28
To: 'jodie.wilson@reading.gov.uk'
Cc: david.baker@workman.co.uk; Willcocks, Jake; Parkin, Andrew
Subject: St Martins Precinct, Caverham - Acoustic assessment

27/05/2014

Acoustic Report for St Martins Precinct, Caverham

Dear Jodie,

Thank you for the time last Friday to chat through the requirements for the acoustics report for the St Martins Precinct development.

We are in receipt of your comments to Stephen Vigar, dated 24/12/2013, which highlight the potential noise sources and your requirements for the assessment. In summary, please find below a schedule of our proposals, taking on board your comments to Stephen and our discussions.

We have completed the noise surveys at the site. The daytime noise surveys were carried out on 7th November [Thursday] 2013 approximately between 14:00 and 20:00 hours, i.e. daytime, rush-hour and early evening hours. The night-time survey was carried out more recently, on 9th May 2014, between approximately 01:00 and 04:15 hours.

With regards new build residential areas, the measured noise levels and traffic count data will be used in a 3D noise model of the site to predict the noise impact on each façade so that suitable glazing and ventilation can be proposed. The model will include 'typical' service yard activity noise to provide an average noise impact.

We note your criteria for new build residential as follows:

- Glazing to attenuate sound such that internal noise levels within bedrooms and living rooms are < 30 dBA $L_{Aeq,T}$
- Ventilation to be provided which does not compromise the external façade attenuation. Where the exposure dictates, ventilation to meet the minimum fresh air requirements of Part F [whole building/dwelling ventilation and extract ventilation to wet rooms] would be met through mechanical ventilation, such as MVHR. However, Purge ventilation and the control of summertime overheating would be met through openable windows.

New items of services plant will be designed to achieve 10 dB below existing typical background [$L_{A90,T}$] noise levels, as per your guidance.

With regards noise breakout from commercial/entertainment parts of the development, we note the following:

- Typically, cinema specifications require a high level of sound attenuation against noise break-in which conversely provides good protections against noise break-out, however, this will be addressed in the report.
- With regards noise breakout from retail/restaurant etc. we will address the potential for noise breakout in relation to the nearest noise sensitive receptors, control of amplified music and management control [music and patrons etc.].

We welcome any additional comments you may have and trust that the above accurately reflects our conversation.

Best regards,

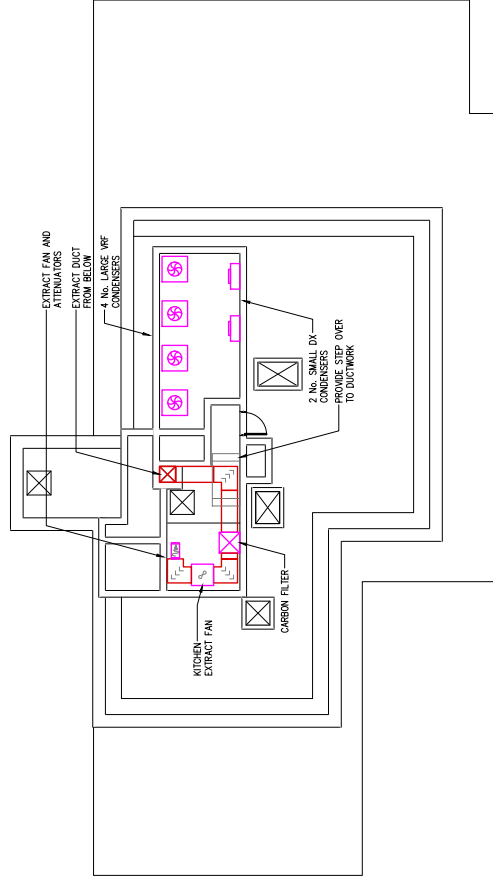
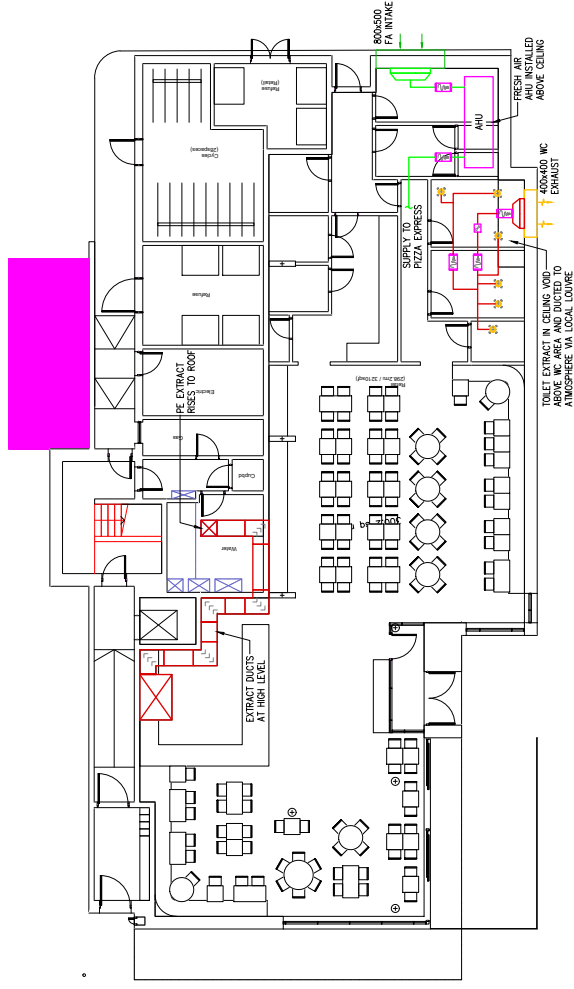
Tom

APPENDIX

E PROPOSED MECHANICAL SERVICES LAYOUTS

NOTES

1. DO NOT SCALE FROM THIS DRAWING. WORK TO MEASURED DIMENSIONS.
2. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.
3. BUILDING SERVICES DESIGN HAVE NO RESPONSIBILITY FOR ANY USE MADE OF THIS DRAWING OTHER THAN THAT FOR WHICH IT WAS PREPARED AND ISSUED.
4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OF THE MECHANICAL AND ELECTRICAL SERVICES DRAWINGS, AND ALL DRAWINGS AND DOCUMENTS WHICH FORM PART OF THE BUILDING SERVICES DESIGN TEAM.
5. THE INFORMATION ON THIS DRAWING IS INCLUSIVE OF THE DESIGNER'S DESIGN RESPONSIBILITY. YOU SHOULD USE THIS AS A BASIS ONLY FOR HIS/HER DESIGN DEVELOPMENT AND THE PRODUCTION OF FULLY DEVELOPED WORKING DRAWINGS. BUILDING SERVICES DESIGN DRAWINGS MUST NOT BE USED ON SITE FOR INSTALLATION PURPOSES.
6. ANY DISCREPANCIES, ERRORS OR OMISSIONS ARE TO BE CLARIFIED WITH THE RELEVANT ENGINEER AT THE EARLIEST OPPORTUNITY.
7. ALL WORKS ARE TO BE IN ACCORDANCE WITH THE CURRENT RELEVANT STATUTORY REGULATIONS, STANDARDS, CODES OF PRACTICE, AND TRADE ACCEPTED CODES OF PRACTICE AND TRADE REQUIREMENTS.
8. IT IS THE CONTRACTORS RESPONSIBILITY TO DEAL WITH THE MAIN CONTRACTOR AND ALL OTHER TRADES TO ENSURE THE CORRECT CO-ORDINATION OF WORKS TO SUIT PROGRAMME REQUIREMENTS, AND TO AVOID CLASHES.
9. DRAWING ISSUE STATUS/STATUS AS FOLLOWS:
PRELIMINARY STAGE ISSUE:- DRAWINGS ISSUED FOR INFORMATION PURPOSES ONLY, TO ASSIST OTHER DESIGNERS IN DEVELOPING THEIR DESIGNS.
DESIGN INTENT STAGE ISSUE:- DRAWINGS ISSUED FOR DESIGN INTENT PURPOSES FOR THE PURPOSE OF OBTAINING COMPETITIVE TENDER PRICES FOR THE WORKS SHOWN AND AS DESCRIBED IN THE CONSTRUCTION STAGE ISSUE:- DRAWINGS ISSUED TO DESIGN INTENT DRAWINGS UPDATED TO DESIGN INTENT DRAWINGS FOR THE PURPOSE OF DEVELOPMENT AND CO-ORDINATED WORKING DRAWING PRODUCTION. CONSTRUCTION STAGE ISSUE DRAWINGS MUST NOT BE USED ON SITE FOR INSTALLATION PURPOSES.



EH	INFORMATION	ISSUE	EH
REV	DATE		RY

BSD Building Services Design
Consulting Engineers
Website: www.bsd.co.uk

First Floor, Boundary House
74-77, Ainslie Road
Edinburgh EC3N 2EX
Tel: (0207) 377 9007 Fax: (0207) 377 9111
Email: jordan@bsd.co.uk

 **BSI** Registered
122, Market Street
Birmingham B3 3YF
Tel: 0121 717 0400
Fax: 0121 717 0401
Email: bsi@bsi.co.uk

Client: HERMES

Project:
CHURCH ROAD
CAVERSHAM

Title: MECHANICAL SERVICES
GROUND FLOOR AND ROOF LEVEL
DUCT SKETCH

Scale at At:	Date:	Designed:	Drawn:	Design:
1:100	Dec-16	EH	AJL	CAD:
Drawing No:				Rev:

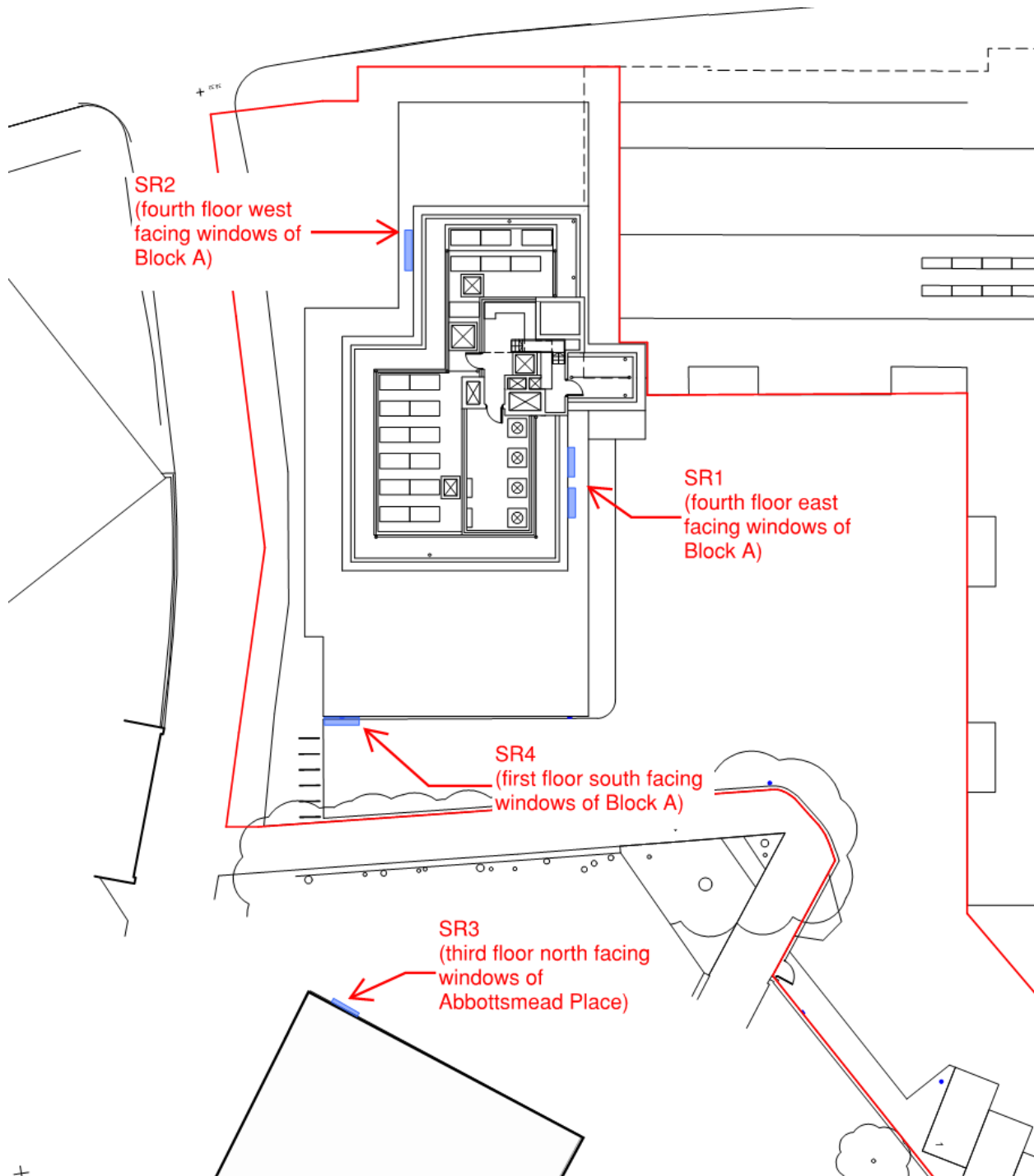
INFORMATION

APPENDIX

F SITE PLAN WITH PROPOSED SENSITIVE RECEPTORS

APPENDIX

Figure F-1: Proposed site plan with noise sensitive receptors highlighted



APPENDIX

G LIMITATIONS TO THIS REPORT



APPENDIX

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