

Acoustic Associates Sussex Ltd

Road Traffic Noise Assessment (B2259)

Site: Rising Sun, North Bersted, Bognor Regis. PO21 5AN

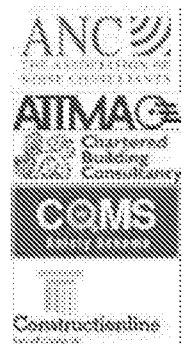
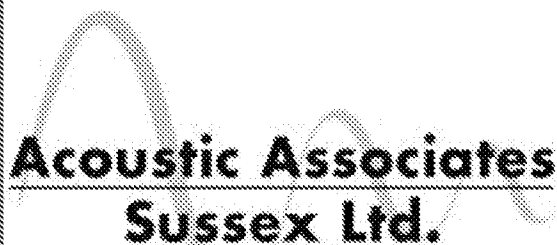
Client: Cactus Projects Limited

Report by: Scott Castle BSc (Hons) CEnv, MCIEH PGDip: Acoustics MIOA

Date: 17/06/2021

Project: J3170

Issue 1



Sound Insulation Testing - Acoustic Design of Buildings - BS4142 - PPG24 - Schools Acoustics B893 -
Vibration - Expert Witness Testimony - Noise at Work - Air Tightness Testing - Auditorium Acoustics

Part of the Acoustic Associates Group of companies:

DEVON HUMBERSIDE LEICESTERSHIRE NOTTINGHAMSHIRE PETERBOROUGH SUSSEX WESSEX WORCESTERSHIRE

Acoustic Associates Sussex Ltd, 8 Highdown House, Shoreham Airport, Shoreham-by-Sea, West Sussex BN43 5PB

Contents

1	Introduction	- 4 -
2	Context, Noise Criteria & Noise Assessment Methodology	- 5 -
2.1	Context	- 5 -
2.2	Site Location	- 5 -
2.3	Soundscape.....	- 6 -
2.4	ProPG Planning Guidance, June 2017.....	- 7 -
2.5	BS8233:2014 External Noise Criteria	- 7 -
2.6	BS8233:2014 Noise Criteria	- 7 -
2.7	COVID19	- 7 -
3	Sound Surveys	- 8 -
3.1	Position LT1 – B2259 Chichester Road.....	- 8 -
3.2	Position LT2 – Rear of Tesco Express	- 9 -
3.3	Anticipated Sound Sources.....	- 9 -
4	Methodology and Assessment Standards	- 10 -
4.1	Methodology.....	- 10 -
4.2	Applicable Assessment Standards	- 10 -
5	Results of the Sound Surveys	- 11 -
5.1	Position LT1 – B2259 Chichester Road.....	- 11 -
5.2	Position LT2 – Rear of Tesco Express	- 11 -
6	Noise Modelling Software	- 12 -
6.1	Noise Model Inputs	- 13 -
6.2	Noise Model Predictions	- 14 -
7	Discussion	- 16 -
7.1	General	- 16 -
7.2	External Amenity Areas.....	- 17 -
7.3	ProPG2017 Initial Site Risk Assessment.....	- 18 -
7.4	Façade Sound Reduction Index (SRI)	- 18 -
7.5	Example Construction and Rigorous Calculation.....	- 20 -
7.6	Ventilation and Windows	- 21 -
8	ProPG2017 Acoustic Design Statement.	- 22 -
8.1	Element 1 – Good Acoustic Design.....	- 22 -
8.2	Element 2 – Internal Noise Level Guidelines	- 22 -
8.3	Element 3 - External Amenity Area Noise Assessment.....	- 23 -
8.4	Element 4 – Assessment of other Relevant Issues	- 23 -
9	Recommended Mitigation Measures	- 23 -

10 Uncertainty	- 24 -
11 Conclusion	- 24 -

Tables

Table 1. BS8233:2014 Criteria	- 7 -
-------------------------------------	-------

Figures

Figure 1. Proposed Dwellings	- 5 -
Figure 2. Floor Plan - Block A	- 6 -
Figure 3. Floor Plan - Block B	- 6 -
Figure 4. Position LT1 Long Term Unattended Survey Details	- 8 -
Figure 5. Position LT1 Long Term Unattended Survey Location	- 8 -
Figure 6. Position LT2 Long Term Unattended Survey Details	- 9 -
Figure 7. Position LT2 Long Term Unattended Survey Location	- 9 -
Figure 8. Rear of Tesco Express Elevation	- 10 -
Figure 9. Two Rear Condensers and Roll Pallets/cages	- 10 -
Figure 10. LT1 Survey Data - External Freefield	- 11 -
Figure 11. Survey Data - LT2, External Freefield	- 11 -
Figure 12. Daytime Soundscape - L_{Aeq} , 5 minutes, 07:00-23:00 hours	- 12 -
Figure 13. Night Time Soundscape, L_{Aeq} , 5 minutes 23:00-07:00 hours	- 13 -
Figure 14. Blocks A and B	- 13 -
Figure 15. Predicted Daytime Noise Contour Map, Freefield, L_{Aeq} , 16 hour	- 15 -
Figure 16. Predicted Night Time-Noise Contour Map, L_{Aeq} , 8 hour	- 16 -
Figure 17. Block A and B Worst Case Facades (Adjusted)	- 17 -
Figure 18. Assessment of External Amenity Areas	- 17 -
Figure 19. ProPG2017 Initial Site Risk Assessment	- 18 -
Figure 20. Sound Reduction Index (SRI) to be achieved	- 19 -
Figure 21. Sound Reduction Index (SRI) Drivers for Worst Case Facades	- 19 -
Figure 22. Example Rigorous Calculation (Masonry Construction)	- 21 -
Figure 23. Assessment of Openable Windows	- 22 -

This report has been prepared by Acoustic Associates Sussex Limited with all reasonable skill, care and diligence and presents information included within the scope agreed with the client. If any third party whatsoever comes into possession of this report, they rely on it at their own risk and Acoustic Associates Sussex Ltd accepts no duty or responsibility (Including in negligence) to any such third party.

Report by: Scott Castle BSc (Hons) CEnvH, MCIEH PGDip: Acoustics MIOA

Checked by: Martyn Chambers BA (Hons), MSc PGDip: Acoustics. AMIOA

Issue 1	17/06/2021	Original Issue
---------	------------	----------------

1 Introduction

Acoustic Associates Sussex Ltd have been appointed to undertake an acoustic assessment to support planning permission for the erection of 7 new residential dwellings on land adjacent to the B2259 and Tesco Express at North Bersted, Bognor Regis.

Standards and guidance referenced for this assessment include:

- World Health Organisation (WHO) - Guidelines for Community Noise 1999
- BS8233 (Sound insulation and noise reduction for buildings) 2014
- ProPG Planning Guidance, June 2017
- Acoustics Ventilation and Overheating Residential Design Guide January 2020 Version 1.1

Noise levels were measured on site using two unattended class 1 sound level meters between 12th to 18th May 2021 when road traffic volumes were at representative levels. The assessment duration also deliberately included a weekend to ensure that any variation in the soundscape was captured.

The dominant noise source is that of the B2259 to the East of the site, and sounds are also generated by plant belonging to the Tesco Express store.

Noise modelling software (IMMI) was used to predict sound pressure levels around the two new building plots which will contain 3 and 4 dwellings respectively. As the report is in support of a detailed planning application, external sound pressure levels have been predicted for each façade of the proposed two plots to determine the relevant Sound Reduction Index (SRI) of the building envelope.

The highest predicted external sound pressure levels are those on the Eastern façade (67dB $L_{Aeq, 16 \text{ hour}}$) which are likely to overlook the B2259 at first floor level. The noise model showed a 21dB difference in the predicted sound pressure levels at the building façade between the Eastern and Western elements of Block A. Whilst the wall construction/specification is not yet known, it is still possible to demonstrate that the site is capable of being developed using an example rigorous calculation based on finalised floor plans using a worst case, mid terrace first floor bedroom overlooking the B2259.

An assessment was also undertaken of external amenity/garden spaces which all achieve under the BS8233:2014 criterion (55 dB $L_{Aeq, 16 \text{ hour}}$).

The assessment has applied British Standard BS8233:2014 as well as ProPG2017. The ProPG2017 assessment has included:

- A ProPG2017 stage 1 (Initial Site Risk Assessment).
- An Acoustic Design Statement (ADS) to inform decision makers and stakeholders of the good acoustic design principles that could be incorporated at the application site.
- An assessment of the predicted number of L_{Amax} events internally inside a bedroom during the night time periods

The report demonstrates that the site is capable of being developed and that the required internal sound pressure levels are capable of being achieved for the future occupants.

The application should not therefore be withheld planning consent on noise grounds.

2 Context, Noise Criteria & Noise Assessment Methodology

2.1 Context

This assessment supports a planning application being made for the erection of 7 new residential dwellings. The dwellings will be split into two plots, with three terraced properties overlooking the B2259 and four terraced properties behind the Tesco Express building. The report identifies the acoustic impact of the adjacent B2259 road network as well as any specific sounds generated from the rear of the Tesco store and provides suitable mitigation measures to protect the future occupants of the properties.

The build type is a modular build system and the wall construction/specification has not yet been finalised at the time of the report being written.

2.2 Site Location

The Tesco Express is located on the former site of the Rising Sun Public House.

The roadside plot (Block A) is impacted by road traffic noise as well as a bus stop in front of the site. The Chichester Road (B2259) is 30mph single carriageway and traffic remained relatively constant at the time of setting up and collection of the survey equipment. Vehicles also regularly turned into and departed from the adjacent Tesco Express site.

The plot to the rear is very overgrown and whilst traffic noise can still be heard, it is reduced from the roadside plot. Bird song was particularly noticeable. The Tesco express store is separated by an 2metre timber fence. The site location is shown in Figure 1 below with Figures 2 and 3 below detailing the proposed internal layout.

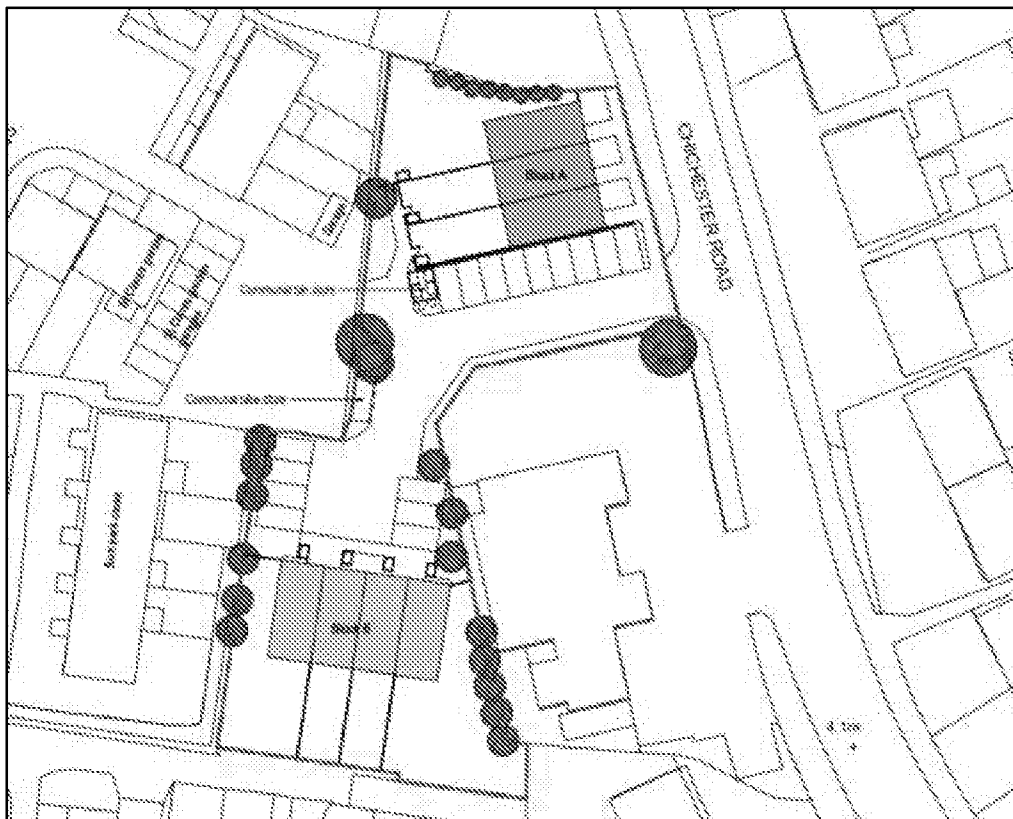


Figure 1. Proposed Dwellings

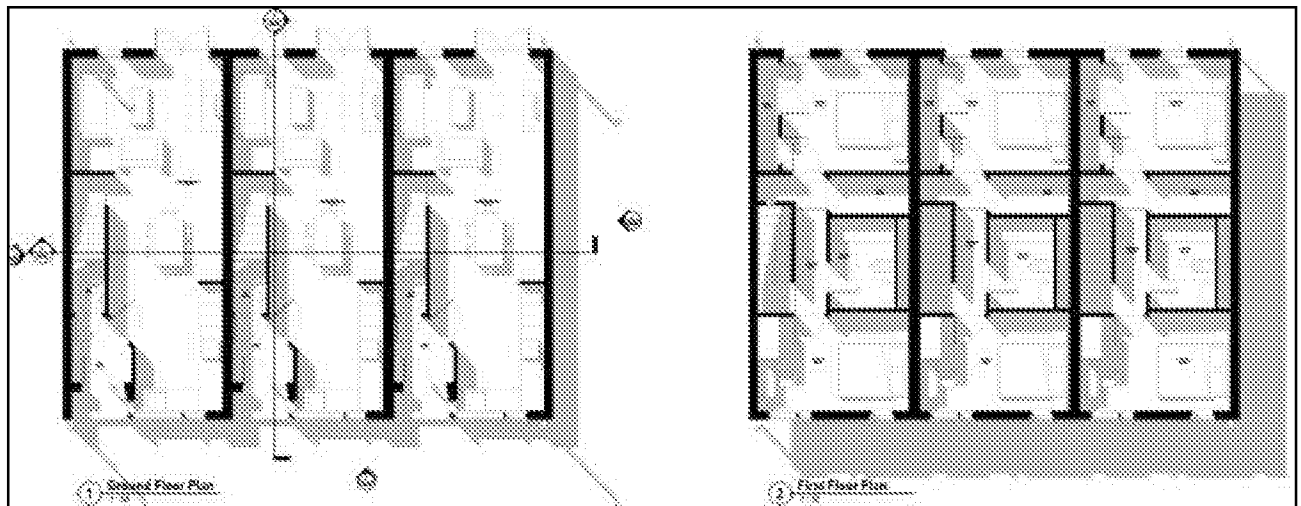


Figure 2. Floor Plan - Block A

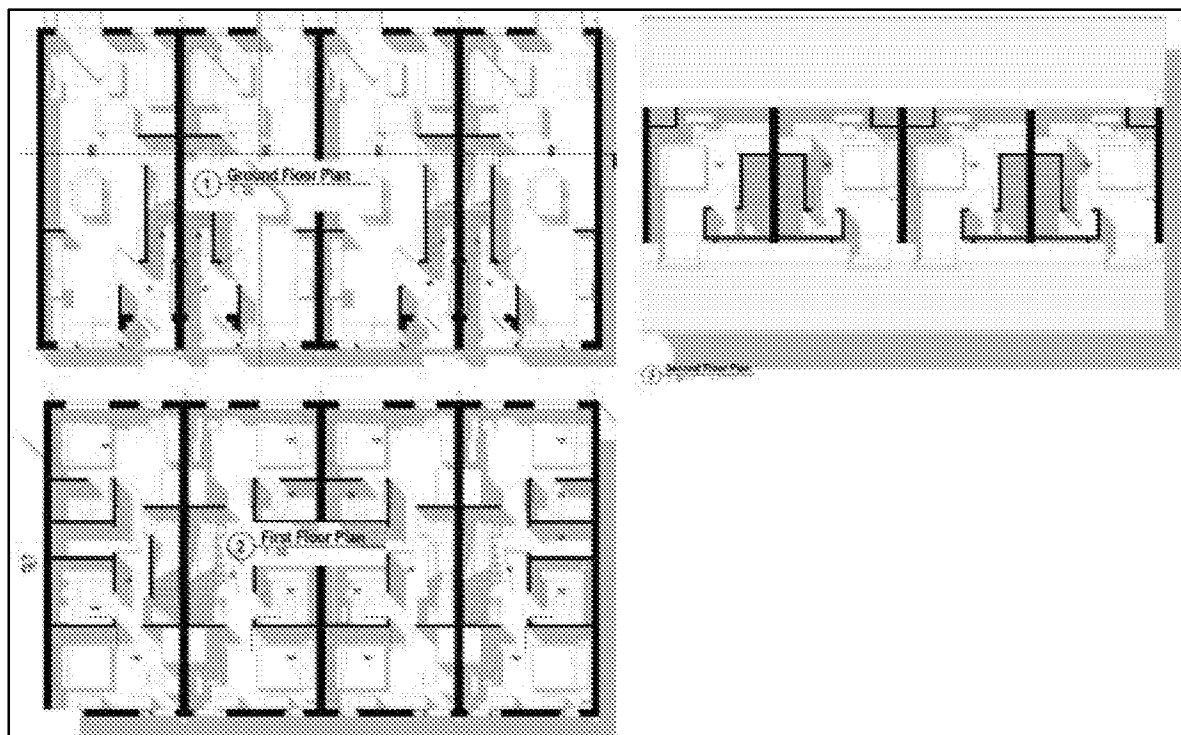


Figure 3. Floor Plan - Block B

It is noted that the more sheltered Block B to the rear of Tesco Express has rooms at ground, First and Second floors, with the latter being in the roof void. Neither Block A or Block B have windows on the side facades.

2.3 Soundscape

The site soundscape was dominated by road traffic noise from the B2259, with birdsong also more noticeable to the rear. Some plant noise from Tesco Express was also evident.

2.4 ProPG Planning Guidance, June 2017

Recent planning guidance (ProPG2017) relates to new residential development and airborne transportation noise, which includes exposure to road traffic, railway and aviation noise. Whilst ProPG, 2017 generally mirrors the requirements of BS8233:2014 and the World Health Organisation Guidelines, 1999, it goes further in setting a limit for inside bedrooms for L_{Amax} events and specifically, no more than 10 L_{Amax} events per night time period above 45dB(A).

The internal bedroom L_{Amax} values will be used in accordance with ProPG2017, and an initial site risk assessment will also be presented. Integral to ProPG2017, good acoustic design will also be discussed.

2.5 BS8233:2014 External Noise Criteria

BS8233:2014 states as follows with regards to external amenity spaces

“For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal external amenity space might be limited or not available, i.e. in flats, apartment blocks, etc. In these locations, specification of noise limits is not necessarily appropriate. Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses. However, the general guidance on noise in amenity space is still appropriate for larger balconies, roof gardens and terraces, which might be intended to be used for relaxation. In high-noise areas, consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels. Achieving levels of 55 dB $L_{Aeq,T}$ or less might not be possible at the outer edge of these areas, but should be achievable in some areas of the space.”

2.6 BS8233:2014 Noise Criteria

Table 4 of BS8233:2014 provides the following guideline values:

Activity	Location	Time period of day	
		07:00-23:00	23:00-07:00
Resting	Living Rooms	35dB $L_{Aeq,16hour}$	-
Dining	Dining Room/Area	40dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35dB $L_{Aeq,16hour}$	30dB $L_{Aeq,8hour}$

Table 1. BS8233:2014 Criteria

2.7 COVID19

The survey data was recorded when road traffic use and conditions were considered to be normal and representative and after the national lockdown had been lifted (March 29th 2021). Subjectively, the B2259 was seen to be busy.

3 Sound Surveys

A sound survey was carried out using two unattended survey positions at representative locations to establish how the soundscape is impacted by road traffic noise and any noise from Tesco Express. As shown from Figure 1, the B2259 runs in a North to South direction to the East of the site.

3.1 Position LT1 – B2259 Chichester Road

A 01dB SIP95 class 1 sound level meter was mounted on a monopole in freefield conditions on the application site. The 01dB SIP95 measures every single second with data post processed in dBTrait software to determine 5-minute readings of both L_{Aeq} , and L_{AMax} values suitable for deriving 16-hour and 8-hour values. The data obtained is Fast time weighted and A Weighted and the sound level meter was calibrated at the beginning and end of the survey without any significant drift having occurred.

Position LT1 Unattended Survey – B2259	
Survey(s) carried out by	Scott Castle BSc (Hons) Env Health, MCIEH CEnvH PGDip Acoustics MIOA
Equipment Used	01dB SIP 95, Class 1 sound level meter. Serial No. 10492
Equipment Used	CAL21 Calibrator. Serial No. 50241778
Location of Microphone	SU92252/00790. Freefield
Duration of Survey	12 th May 2021 to 18 th May 2021
Height	1.9m above ground level

Figure 4. Position LT1 Long Term Unattended Survey Details

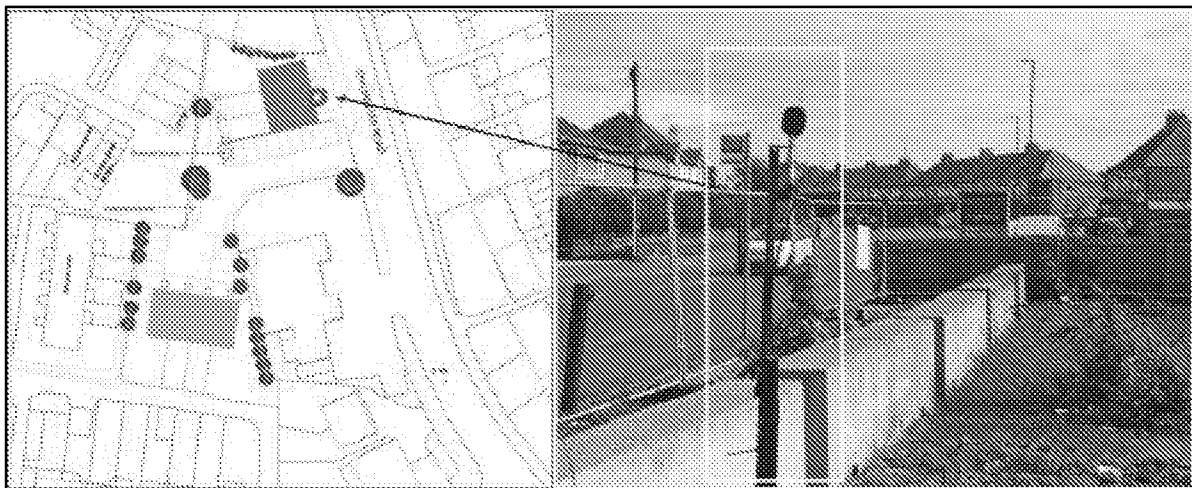


Figure 5. Position LT1 Long Term Unattended Survey Location

3.2 Position LT2 – Rear of Tesco Express

A long-term survey position was also chosen positioning the sound level meter in a clearing in the plot to the rear of the Tesco Express store.

The measurement conditions were 7.6m from the rear Tesco fence line and are considered to be freefield. The survey details can be seen in Figures 4 and 5 below.

The 01dB Black Solo sound level meter was set to record data every second and the data was also post processed through dBTrait software to determine 5-minute readings of both L_{Aeq} and L_{AMax} values suitable for deriving 16-hour and 8-hour values. The data obtained is Fast time weighted and A Weighted and the sound level meter was calibrated at the beginning and end of the survey without any significant drift having occurred.

Unattended Survey Site (LT2)- Rear of Tesco Express	
Survey(s) carried out by	Scott Castle BSc (Hons) Env Health, MCIEH CEnvH PGDip Acoustics MIOA
Equipment Used	01dB Black Solo- Class 1 Sound Level Meter. Serial No. 60673
Equipment Used	CAL21 Calibrator. Serial No. 50241778
Location of Microphone	SU92220/00755. Freefield
Duration of Survey	12 th May 2021 to 18 th May 2021
Height	1.9m above ground level

Figure 6. Position LT2 Long Term Unattended Survey Details

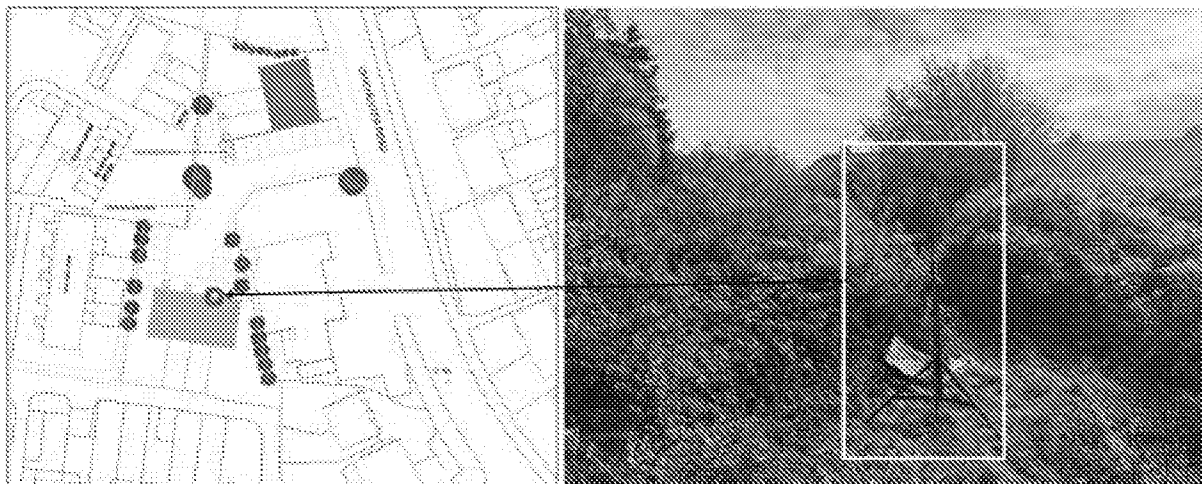


Figure 7. Position LT2 Long Term Unattended Survey Location

3.3 Anticipated Sound Sources

The B2259 was noted to be relatively continuous and is the dominant sound source on the site. Customers accessing the Tesco Express were also noted. Plant noise could also be detected from the Tesco Express at the LT2 position which was consistent with the 2 condensers noted at the rear of the Tesco façade. These are consistent with the planning application BE/37/12 on the Adur Planning website.

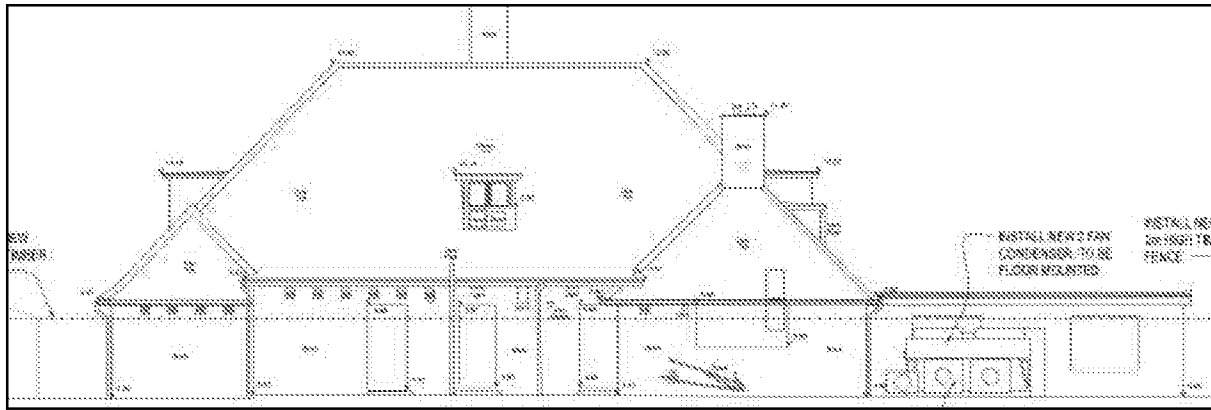


Figure 8. Rear of Tesco Express Elevation

Having spoken to the Tesco Express store manager it was understood that the plant was replaced approximately a year ago. Aside from the plant, movement of metallic roll cages would also be likely, as seen in Figure 7 below.



Figure 9. Two Rear Condensers and Roll Pallets/cages

4 Methodology and Assessment Standards

4.1 Methodology

Using data from the survey periods, noise modelling software will be used to construct a noise model detailing road traffic noise, and how this impacts the proposed dwellings.

4.2 Applicable Assessment Standards

Whilst Table 4 of BS8233:2014 will be used for continuous anonymous sound levels, ProPG2017 will be used in respect of L_{Amax} levels at night inside the bedrooms.

The rigorous calculation methodology as described in G2 of BS8233:2014 will be applied to determine the glazing required to protect the future occupants.

5 Results of the Sound Surveys

The daytime ($L_{Aeq,16 \text{ hour}}$) and night time ($L_{Aeq,8 \text{ hour}}$) measured external sound pressure levels are detailed below. These are for complete periods only and show freefield external, A weighted and Fast data at the survey positions.

5.1 Position LT1 – B2259 Chichester Road

Logarithmically Averaged Day and Night time Periods (External - Freefield)-dB(A)			
$L_{Aeq, 16 \text{ hour } 07:00-23:00}$		$L_{Aeq, 8 \text{ hour } 23:00-07:00}$	
Day 1	65.7	Night 1	60.3
Day 2	65.8	Night 2	60.1
Day 3	66.1	Night 3	60.8
Day 4	66.6	Night 4	58.6
Day 5	65.6	Night 5	60.8
Arithmetic Average	66.0	Night 6	60.9
		Arithmetic Average	60.3

Figure 10. LT1 Survey Data - External Freefield

It is noted that the measured daytime and night time sound pressure levels are consistent with only a 1dB variation on the daytime levels and 2dB for the night time measured sound pressure levels.

5.2 Position LT2 – Rear of Tesco Express

Logarithmically Averaged Day and Night time Periods (External - Freefield)-dB(A)			
$L_{Aeq, 16 \text{ hour } 07:00-23:00}$		$L_{Aeq, 8 \text{ hour } 23:00-07:00}$	
Day 1	52.1	Night 1	49.6
Day 2	51.7	Night 2	49.5
Day 3	51.2	Night 3	49.5
Day 4	50.8	Night 4	48.8
Day 5	52.0	Night 5	48.0
Arithmetic Average	51.6	Night 6	47.9
		Arithmetic Average	48.9

Figure 11. Survey Data - LT2, External Freefield

It is noted that the measured daytime and night time sound pressure levels are consistent with only a 1dB variation on the daytime levels and 2dB for the night time measured sound pressure levels.

6 Noise Modelling Software

In order to see how noise varies at different positions around the proposed development it is possible to produce a noise contour map. A computer noise model has been completed using the computer package IMMI. Drawings of the area have been used to complete the noise models and the topography of the location recreated. IMMI faithfully implements the propagation method of ISO-9613:1996; Acoustics – Attenuation of sound during propagation outdoors.

IMMI Wolfel Noise modelling software has been used to plot the road traffic noise impacts from the B2259 as the dominant sound source on the site.

A model is created of the application site as it is at the time of the survey. The B2259 as a line source was then added into the model and received sound pressure levels at the LT1 position adjusted until they match the measured sound pressure levels at the survey position. The model is then considered to be calibrated. Please note that to present a robust report, the calibration of the model was undertaken using the highest daytime and night time measured values (ie 67dB $L_{Aeq, 16 \text{ hour}}$ and 61dB $L_{Aeq, 8 \text{ hour}}$).

Whilst the roadside LT1 position was relatively straight forward to calibrate with direct line of sight of the road, when plotting only the road source in the noise model the model prediction for the LT2 position is under estimated by 5.3dB in the daytime and 8.3dB at the night time, ie predicted position at the LT2 for the daytime is 46dB $L_{Aeq, 16 \text{ hour}}$. The measured daytime sound pressure levels, as per Figure 9 above are 52dB $L_{Aeq, 16 \text{ hour}}$. Similarly, 40dB $L_{Aeq, 8 \text{ hour}}$ was predicted for night, but 49dB $L_{Aeq, 8 \text{ hour}}$ was measured at LT2. This suggests that the Tesco site does have an influence on the rear soundscape.

In revisiting both the daytime and night time soundscapes, plant is likely to have switched in and out of service and is apparent in the measured soundscape. However, customer vehicles, birdsong and other road traffic noise, potentially Bedford Avenue will also form a part of the soundscape.

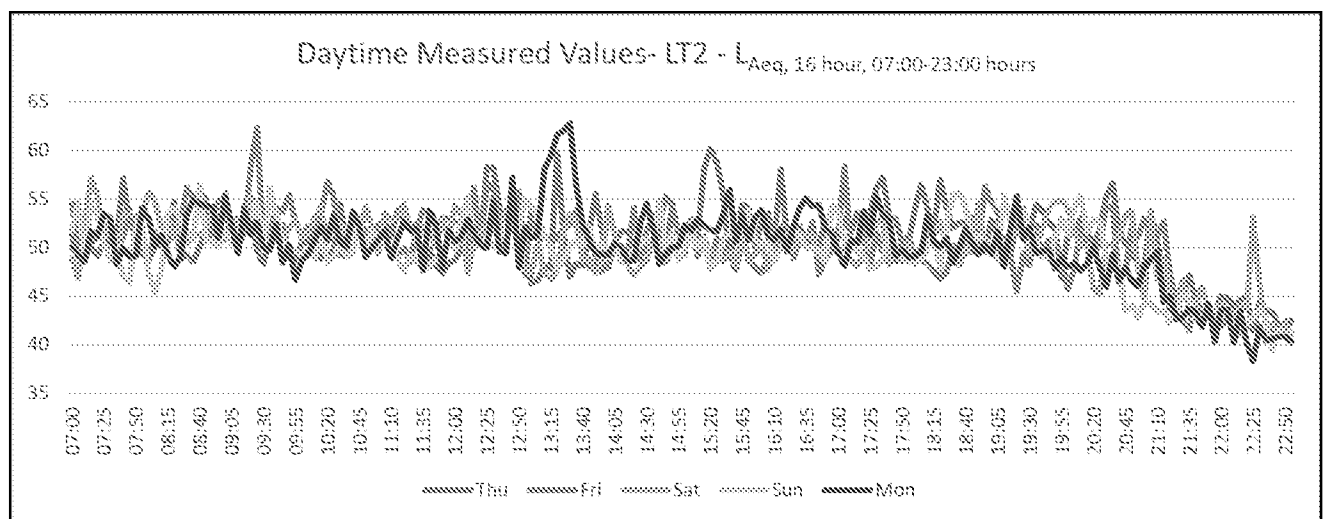


Figure 12. Daytime Soundscape - $L_{Aeq, 5 \text{ minutes}}$, 07:00-23:00 hours

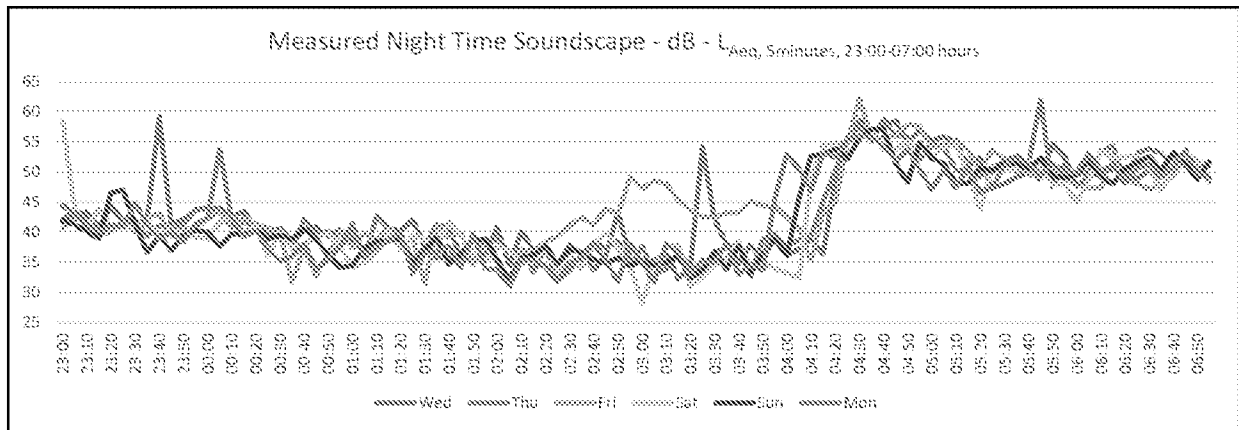


Figure 13. Night Time Soundscape, L_{Aeq} , 5 minutes 23:00-07:00 hours

Given the complexity of the sound sources, the noise model will be used to predict sound pressure levels around Block A, however, for Block B, the measured LT2 values will be applied to all facades.

6.1 Noise Model Inputs

The following noise model inputs have been derived from the site plans, including site plans for the adjacent Tesco Express. As stated, it was necessary to derive an existing model for calibration purposes and without the influence of the proposed new dwellings which reflect the measurement conditions for the survey. Noise mapping was then introduced into the model to reflect the proposed two new blocks of 7 dwellings.

The proposed plan has used two separate two storey dwellings which have been labelled as Block A and Block B. Block A is the northern most on the site with Block B located to the rear of Tesco Express.

Two story properties have been modelled as 7m in height.

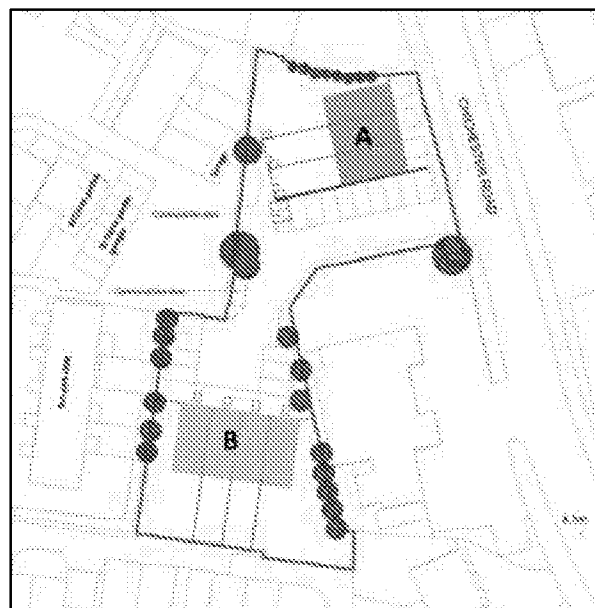


Figure 14. Blocks A and B

Receptor positions have been placed on all building facades at ground and first floor levels (labelled North, East, South and West) to provide as much detail as possible. Ground floor receptors, representing windows, have been placed at 1.5m above ground level and first floor windows at 4m above ground level.

For the purposes of assessing external amenity areas, receptor positions were placed at 1.5m in the rear gardens at Block A separated by a 1.8m privacy fence and also to the South of Block B.

6.2 Noise Model Predictions

The predictions below are freefield and A Weighted. It is noted that the legend is not clear or legible in detailing the predictions made at the receptor locations and for this purpose, a more clearly annotated presentation of the worst-case values is presented below in Figure 15. Both daytime and night time noise contours are presented.

It is also noted that whilst there are clearly activities from Tesco Express, due to the uncertainty of how these are being generated, these have not been included into the model. Instead, the façade outputs for Block B will utilise the data measured at LT2.

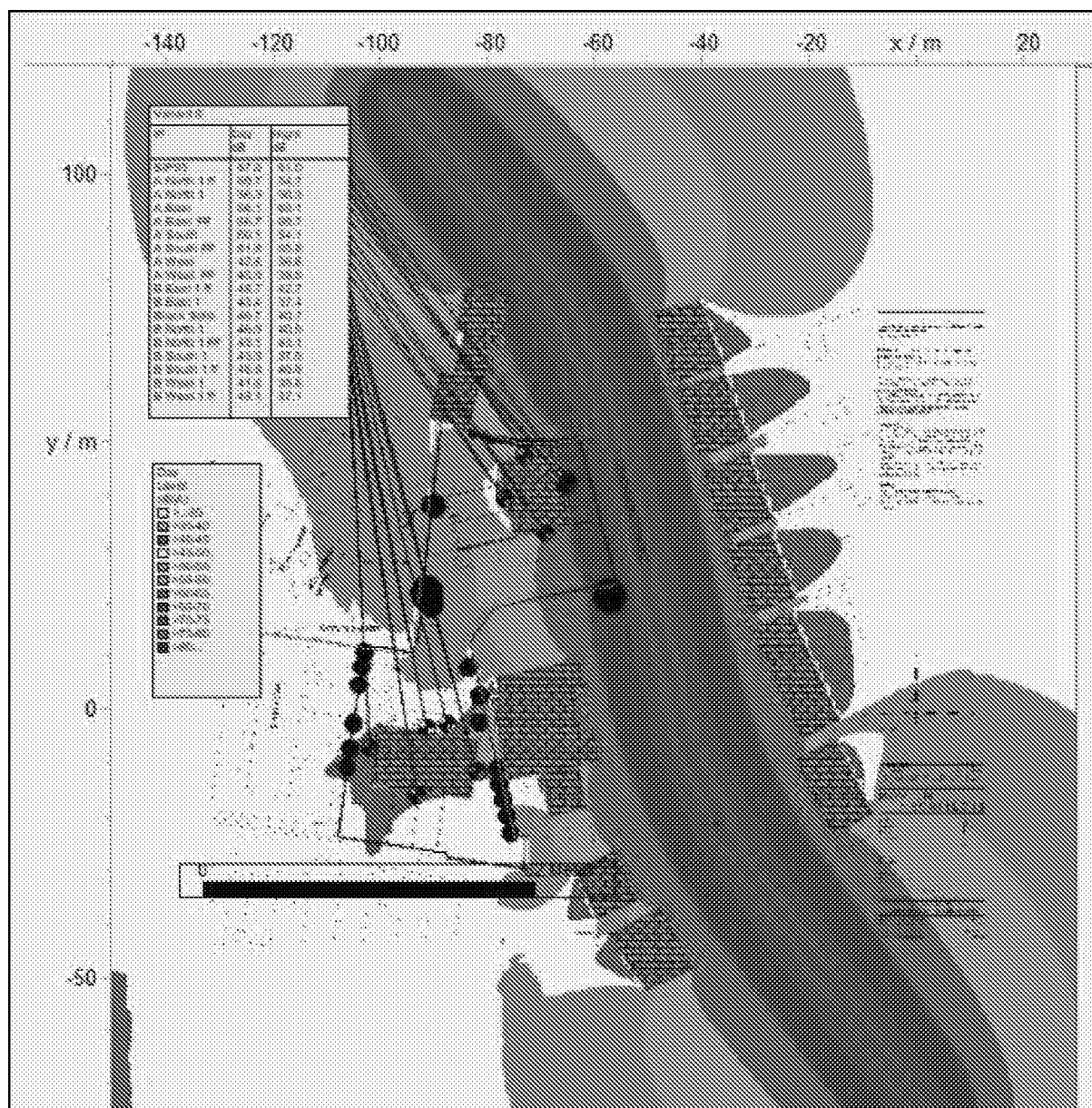


Figure 15. Predicted Daytime Noise Contour Map, Freefield, LAeq, 16 hour

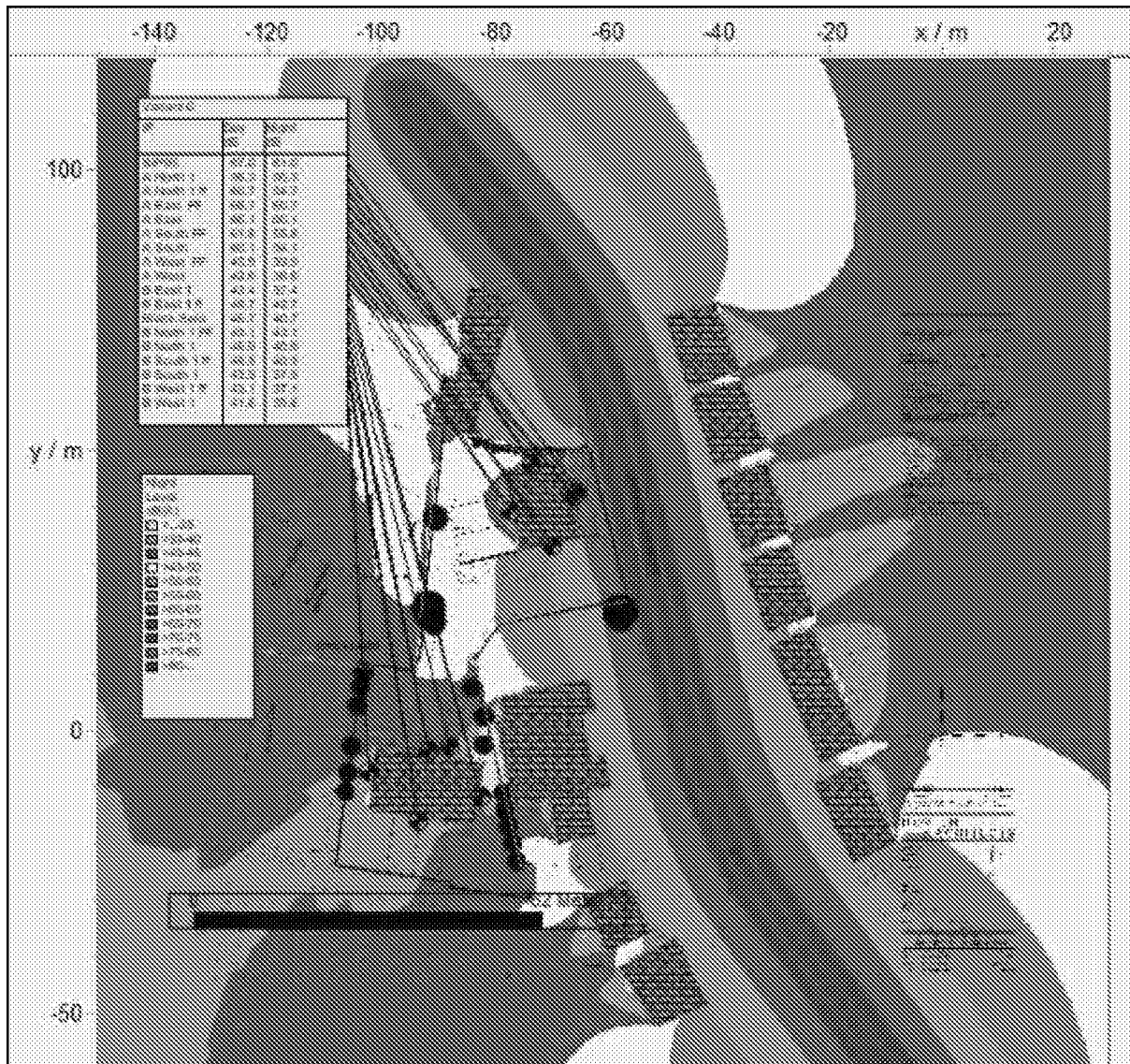


Figure 16. Predicted Night Time-Noise Contour Map, L_{Aeq} , 8 hour

Whilst the receptor positions were also plotted for Block B, it is apparent from the legend in Figures 15 and 16 above that there is a disparity between what is being predicted versus what was actually measured, as previously stated in 6.2 above. Therefore, LT2 values have been applied to Block B facades allowing a worst-case presentation.

7 Discussion

7.1 General

The difference in predicted noise levels is illustrated well in Figure 17 below which details that room orientation can account for up to a 21dB(A) (rounded) reduction in predicted freefield sound pressure levels as shown with the noise mapping results for Block A.

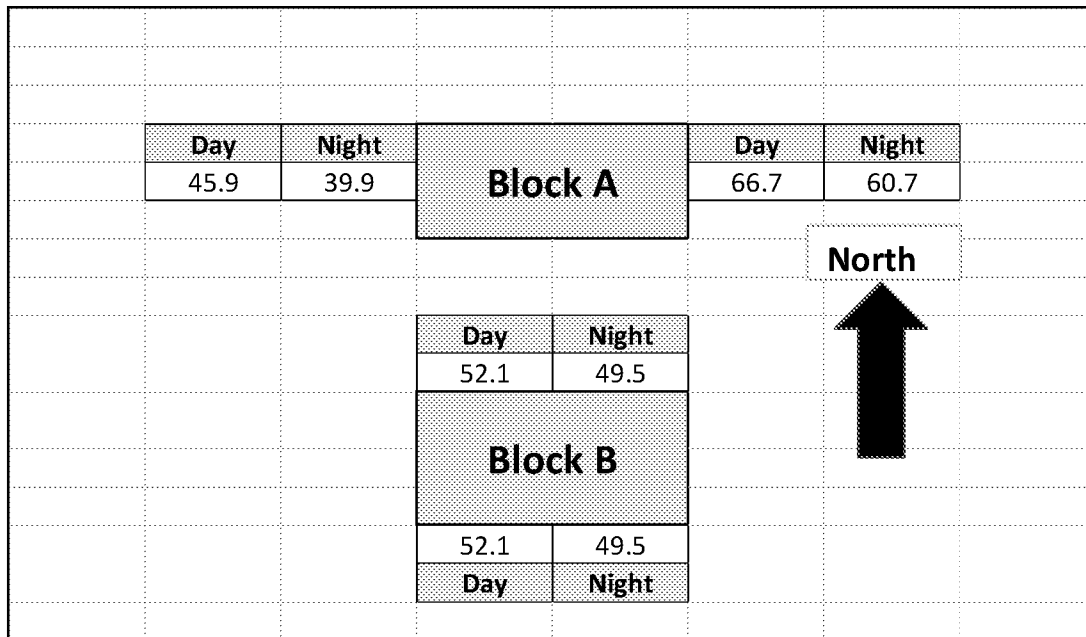


Figure 17. Block A and B Worst Case Facades (Adjusted)

Please note that Figure 17 has applied worst case measured data from LT2 for Block B rather than relying on the noise modelling software to make accurate predictions.

7.2 External Amenity Areas

For simplicity, receptor positions (at 1.5m above ground level) were placed to the West of Block A. Block B, as stated above has had the worst case $L_{Aeq, 16 \text{ hour}}$ values from LT2 applied. The predicted (and measured for Block B) sound pressure levels are shown in Figure 16 below.

Block	Location	External Freefield Value-dB $L_{Aeq, 16 \text{ hour}}$
Block A	Garden 1	51.1
Block A	Garden 2	49.7
Block A	Garden 3	53.5
Block B	Garden 4	52.1
Block B	Garden 5	52.1
Block B	Garden 6	52.1
Block B	Garden 7	52.1

Figure 18. Assessment of External Amenity Areas

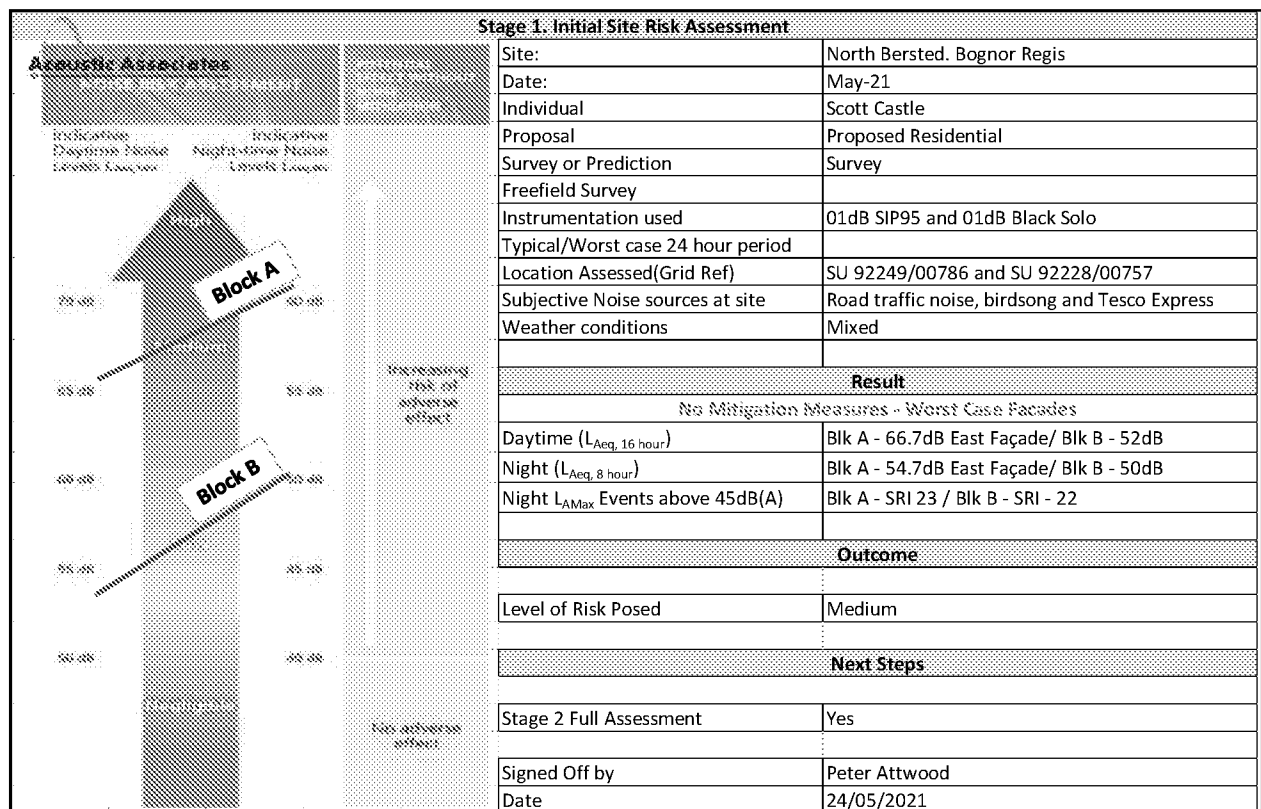
All external amenity area predictions are below the BS8233:2014 requirement of 55 dB $L_{Aeq, 16 \text{ hour}}$.

7.3 ProPG2017 Initial Site Risk Assessment

In line with the requirements of ProPG2017, an initial site risk assessment is presented to detail to stakeholders and decision makers the level of risk associated with external freefield noise levels at the site. Please note that this presents a worst-case illustration without any mitigation measures applied. The Initial site risk assessment (see Figure 19 below) is also based on the highest values in the measured survey dataset for daytime and night time periods.

Figure 19 presents worst case data for both Blocks A and B, as clearly whilst Block B is more shielded from road traffic noise, it does receive sounds generated from Tesco Express.

The initial site risk assessment demonstrates a low to medium outcome indicating that as the risk increases, there will be a reliance on good acoustic design and relevant mitigation measures to protect the future occupants from noise. Further details regarding the ProPG2017 Acoustic Design Statement are seen in Section 8 below.



Given that the wall construction techniques/materials are not yet known, it is instead possible to provide a SRI or Sound Reduction Index required to protect the end residents. Whilst good acoustic design suggests that there is a 21dB difference between the front and rear facades of Block A, the room layouts are already proposed. Figure 20 below details the minimum SRI to be achieved for the different facades.

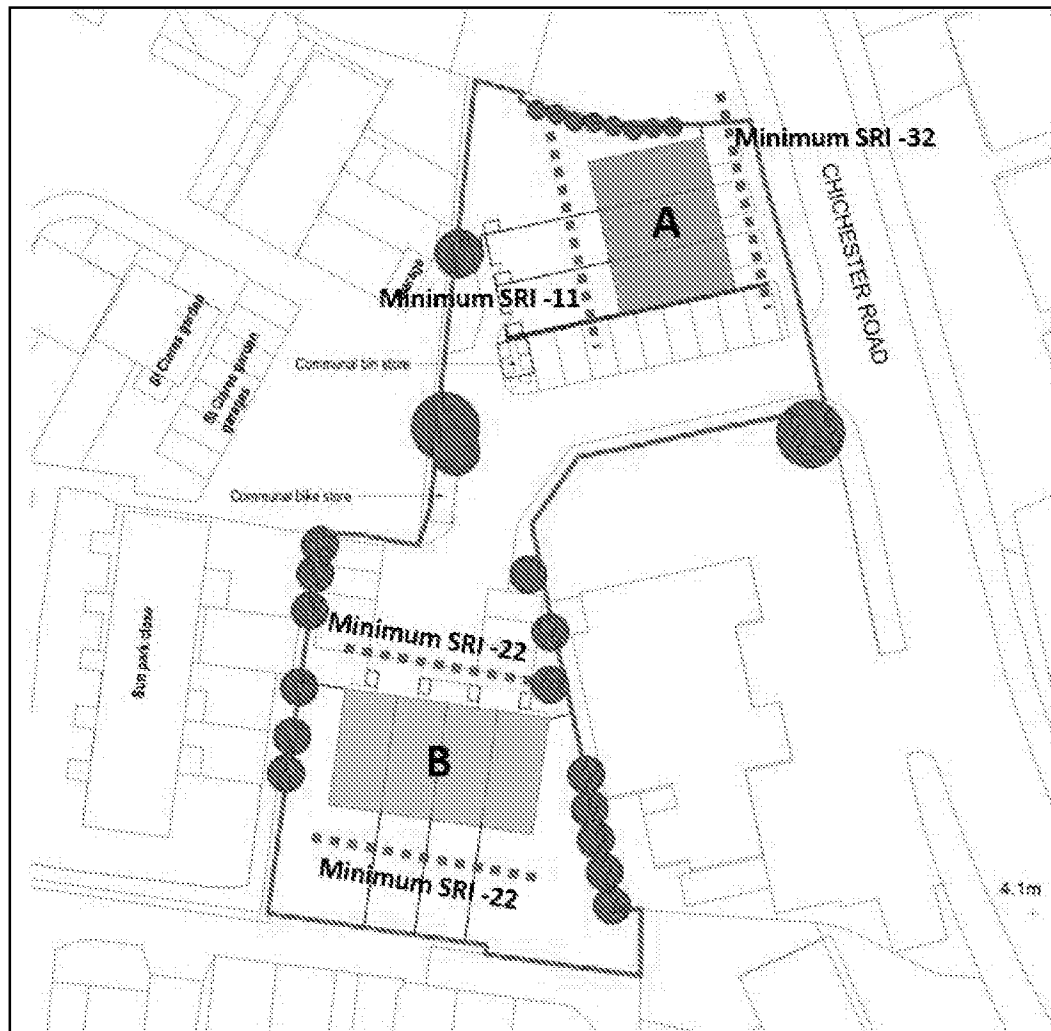


Figure 20. Sound Reduction Index (SRI) to be achieved

Location	Description	Highest Predicted Daytime External Sound Pressure Level (L _{Aeq} , 16 hour) - Rounded	BS8233:2014 Daytime Criterion	Daytime SRI	Highest Predicted Night Time External Sound Pressure Level (L _{Aeq} , 8 hour)	BS8233:2014 Night Time Criterion	Night Time SRI	SRI to ensure less than 10 LAmax events 45dB(A)	SRI to Apply
Block A	East Facing First Floor	67	35 dB L _{Aeq} , 16 hour	32	61	30 dB L _{Aeq} , 8 hour	31	23	32
Block B	East Facing First Floor	52	35 dB L _{Aeq} , 16 hour	17	50	30 dB L _{Aeq} , 8 hour	20	22	22

All data presented is dB(A) and Freefield

Figure 21. Sound Reduction Index (SRI) Drivers for Worst Case Facades

As detailed in Figure 21 above and predictably, the highest SRI is that of the East facing first floor windows which will overlook the B2259 (Block A).

7.5 Example Construction and Rigorous Calculation

As a detailed planning application, it is key to be able to demonstrate that the BS8233:2014 internal sound pressure levels are capable of being achieved. As previously stated, at the time of writing the report, the modular construction techniques and/or materials are not yet known. However, it is relevant to show that development of the site is achievable with residents afforded the relevant protection. A brick-built construction (cavity wall) has been provided as merely an example.

As a worst case, a first-floor mid terrace bedroom in Block A (with two windows) overlooking the B2259 has been selected with a daytime sound pressure level of 67dB $L_{Aeq, 16 \text{ hour}}$ and night time, 61dB $L_{Aeq, 8 \text{ hour}}$. The SRI required for the roadside facing façade of Block A is 32dB.

The following inputs are noted:

Window size – 2.7m²

Façade Size – 13.2m²

Remaining Wall Space – 10.5m²

Ceiling space – 11.6m²

The rigorous calculation shown in Figure 22 below details that with enhanced glazing (Pilkington 10/12/4) and a high performance commercially available Greenwood through the wall vent (2500mm²), the internal sound pressure level for the daytime is 33dB $L_{Aeq, 16 \text{ hour}}$. Importantly, the calculated SRI is 34dB, which provides sufficient protection for night time L_{Amax} requirements also. The Greenwood MA3015 through the wall passive ventilation has a $D_{n,e,w} + C_{tr}$ (A Weighted) of 52dB.

Non Frequency Dependent Variables			Key for Table Below					
Term	Derivation	Value	R _w	Sound Reduction of Window (Octave)				
A ₀	Given in BS EN 20140-10 = 10 (m ²)	10	R _{ew}	Sound Reduction Index of External Wall (Octave)				
S _t	Total Facade Area (m ²)	13.2	R _{rr}	Sound Reduction Index of Roof/Ceiling (Octave)				
S _w	Window Area (m ²)	2.7	A	Equivalent Absorption Area of Rx Room				
S _{ew}	External Wall Area (m ²)	10.5	D _{n,e}	Insulation of Trickle Vent (BS EN 20140-10)				
S _{rr}	Ceiling Area (m ²)	11.6						
S	Total Area sound enters the room (m ²)	24.8						

Frequency Dependent Variables							
Term	Description	Octave Band Centre Frequency					
		125	250	500	1000	2000	4000
L _{eq,ff}	Free-Field External Noise Level	69	65	63	63	60	53
D _{n,e}	MA3015	46.7	46.3	49	55.7	66.3	69.3
R _w	10_12_4	25	22	33	40	43	44
R _{ew}	Cavity Masonry (Brick Cavity with Insulation lightweight block)	41	39	44	52	60	65
R _{rr}	Tile on Felt, Pitched Roof, 100mm mineral wool on plasterboard ceiling	43	43	43	43	43	43
A	Equivalent Absorption Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00

BS8233 Calculation Details							
Term From Equation Below		Octave Band Centre Frequency					
		125	250	500	1000	2000	4000
L _{eq,ff}		69	65	63	63	60	53
A ₀ /S . 10 [^] (-D _{n,e} /10)		8.6208E-06	9.45E-06	5.08E-06	1.0853E-06	9.45254E-08	4.73749E-08
S _w /S . 10 [^] (-R _w /10)		0.00034428	0.000687	5.46E-05	1.08871E-05	5.45647E-06	4.33423E-06
S _{ew} /S . 10 [^] (-R _{ew} /10)		3.3631E-05	5.33E-05	1.69E-05	2.67139E-06	4.23387E-07	1.33887E-07
S _{rr} /S . 10 [^] (-R _{rr} /10)		2.3443E-05	2.34E-05	2.34E-05	2.34426E-05	2.34426E-05	2.34426E-05
10log10(S/A)+3		6.53058996	5.483236	4.903317	4.903316982	5.183604218	5.183604218
L _{eq,2}		41.6581585	39.36574	27.90067	23.71101779	19.86959024	12.64868412
A-Weighting		-16.1	-8.6	-3.2	0	1.2	1
A-Weighted L _{eq}		25.5581585	30.76574	24.70067	23.71101779	21.06959024	13.64868412

A-Weighted Level Outside	67
BS8233 Predicted Internal A-Weighted Level	33
Predicted Building Envelope SRI	34

BS8233 Calculation can be seen below:							
$L_{eq,2} = L_{eq,ff} + 10 \log_{10} \left(\frac{A_0}{S} 10^{-\frac{D_{n,e}}{10}} + \frac{S_w}{S} 10^{-\frac{R_w}{10}} + \frac{S_{ew}}{S} 10^{-\frac{R_{ew}}{10}} + \frac{S_{rr}}{S} 10^{-\frac{R_{rr}}{10}} \right) + 10 \log_{10} \left(\frac{S}{A} \right) + 3$							

Figure 22. Example Rigorous Calculation (Masonry Construction)

7.6 Ventilation and Windows

Using the worst-case façade data for Blocks A and B, an assessment may be made of whether residents are able to rely on open windows for ventilation purposes. As seen in Figure 22 below, this is not likely to be the case and alternative ventilation provision may be required. Whilst residents ultimately retain the choice and freedom to open windows, the internal soundscape as a result of the road traffic noise and or external commercially generated sounds will increase and be above the criteria stated within BS82233:2014. It is important to note that there is no performance criterion stated for short term purge ventilation.

Figure 23 below uses an arbitrary figure of 30dB to represent a closed standard thermal double-glazed window, when set in a masonry façade. However, it is important to recognise that the size of the window, as well as the ratio of glazing to brickwork will dictate how much sound energy passes through the weakest part of the façade.

Assessment of whether windows may be opened for background ventilation							
Location	Description	Highest Predicted Daytime External Sound Pressure Level ($L_{Aeq, 16 \text{ hour}}$)	Open Window (-13dB)	Closed Window (-30dB)	BS8233:2014 Daytime Criterion	Openable Windows (Yes/No)	Rigorous Calculation Required - Yes/No
Block A	East Facing First Floor	67	54	37	35 dB $L_{Aeq, 16 \text{ hour}}$	No	Yes
Block B	East Facing First Floor	52	39	22	35 dB $L_{Aeq, 16 \text{ hour}}$	No	Yes
Location	Description	Highest Predicted Night Time External Sound Pressure Level ($L_{Aeq, 8 \text{ hour}}$)	Open Window (-13dB)	Closed Window (-30dB)	BS8233:2014 Night Time Criterion	Openable Windows (Yes/No)	Rigorous Calculation Required - Yes/No
Block A	East Facing First Floor	61	48	31	30 dB $L_{Aeq, 8 \text{ hour}}$	No	Yes
Block B	East Facing First Floor	50	37	20	30 dB $L_{Aeq, 8 \text{ hour}}$	No	Yes
All predicted External data presented is dB(A) and Freefield							

Figure 23. Assessment of Openable Windows

It is also important to recognise that Figure 23 uses the worst case predicted sound pressure levels and for Block A at the rear, it may well be possible to open windows during the daytime and night time period. With predicted daytime levels of 46dB $L_{Aeq, 16 \text{ hour}}$, with a partially open window (minus 13dB) this would achieve 33dB $L_{Aeq, 16 \text{ hour}}$ for the daytime and similarly, with 40dB $L_{Aeq, 8 \text{ hour}}$, this would equate to 27dB $L_{Aeq, 8 \text{ hour}}$, both of which are below the internal sound pressure level criteria from BS8233:2014.

8 ProPG2017 Acoustic Design Statement.

Given the medium scoring of the initial site risk assessment, it is necessary to provide a full assessment and there are four areas which are discussed as follows.

8.1 Element 1 – Good Acoustic Design

Having provided the difference in façade levels around the buildings, the architect can seek to place more sensitive spaces such as bedrooms on the quieter facades. Such an approach does not rely on the sound insulation of the building envelope but uses the massing and form of the building to provide a barrier and create facades with reduced exposure to sound levels.

As stated, there would be an approximate 21dB(A) difference in predicted noise levels on the Eastern and Western facades of Block A. It is also noted that Block A has been moved back from the roadside where practicable.

Sensible acoustic design has also been applied to both Blocks A and B to limit overlooking of the Tesco Express car park and rear yard area by not having side elevation windows.

8.2 Element 2 – Internal Noise Level Guidelines

The assessment undertaken has determined that even on the worst-case East facing façade that have the highest predicted sound pressure levels, that Table 4 (of BS8233:2014) criteria for internal sound pressure levels are capable of being achieved. The assessment has ensured that not only BS8233:2014 criteria have been met but also that the ProPG:2017 requirements for L_{Amax} events during the night time period have also been included.

The Sound Reduction Index (SRI) has been calculated to allow the planning application to proceed through the consent stage. A worst-case rigorous calculation example, albeit using a masonry cavity façade, demonstrated that a mid-terrace first floor bedroom on Block A overlooking the B2259 achieved Table 4 sound pressure levels from BS8233:2014 with through the wall passive ventilation and enhanced 10/12/4 Pilkington double glazing.

Future residents would also have the option and freedom to open windows for ventilation as they choose. As already stated, any ventilation strategy will need to take account of it not contributing significantly to the internal soundscape to avoid residents switching off such devices. The AVOG dated 2020 states : *“a more prudent limit for mechanical services noise around 24 – 26 dB(A) is likely to be required to prevent an adverse reaction from most occupants while falling asleep.”*

8.3 Element 3 - External Amenity Area Noise Assessment

An assessment of the external amenity spaces/gardens has been carried out and these are below the requirements of BS8233:2014, namely 55 dB $L_{Aeq, 16 \text{ hour}}$.

8.4 Element 4 – Assessment of other Relevant Issues

The four principal areas for discussion are as follows:

- (i) Compliance with relevant national and local policy
- (ii) Magnitude and extent of compliance with ProPG
- (iii) Likely occupants of the development
- (iv) Acoustic design v unintended adverse consequences
- (v) Acoustic design v wider planning objectives

It has been demonstrated that the site is capable of supporting a new residential development which meets national planning policy as well as standards such as BS8233:2014 and meets the local demand for housing need. The requirements and principal thread of good acoustic design within ProPG as well as the L_{Amax} events have also been incorporated into the assessment, as well as an initial site risk assessment and full acoustic design statement.

Unintended adverse consequences have been obviated by good acoustic design. Future occupants will be free to open windows and have a connection with the external environment and there is not a requirement for sealed facades. The acoustic design does not have any obvious conflicts that may arise for example where there are mixed tenures such as commercial and mixed residential within the same building demises, this application seeks a straightforward erection of 7 new two storey dwellings and windows which would allow direct overlooking of the rear Tesco yard have been avoided.

9 Recommended Mitigation Measures

As previously stated, whilst the floor plan has been completed, the construction materials and techniques are not yet finalised, however an example rigorous calculation does demonstrate that the development is capable of being built and that the future residents remain protected.

The relevant SRI for the facades has been calculated and are stated within the report which should not preclude the award of planning consent by the local planning authority.

It is likely that the facades overlooking the B2259 will require enhanced glazing and potentially passive through the wall ventilation, however, until such time that the façade construction is known it is difficult to estimate the exact specifications.

10 Uncertainty

The sound level meters used in the site survey work were calibrated before and after the survey in situ, without any significant drift having occurred, to ensure that the information and data being obtained was representative and that the sound level meter was operating correctly.

Data has also been measured over a number of days including a weekend to properly understand the soundscape.

With any calculations made, including the determination of background sound levels, there has not been any additional rounding of numbers to prevent double handling, this has only occurred once at the final part of the sum and is presented to the reader with an easy-to-understand reference level or single figure. Only complete data periods have been applied to the survey set.

Where it was likely that there were additional sound sources (ie to the rear of Tesco Express), a second sound level meter was deployed to ensure that the site soundscape was understood.

To remove uncertainty over the size of the Tesco Express building, the dimensions were scaled from plans on the Adur Planning website.

When using the noise modelling software, the B2559 was calibrated to the highest measured daytime and night time sound pressure levels to ensure a robust report.

Where it was evident that the model predictions for the B2559 alone under predicted for the Block B dwellings, the worst-case measured values from the LT2 survey position were applied to each façade to ensure that the impact of Tesco Express was in fact captured.

The lack of a specification for the wall construction also presents a small element of uncertainty, however this has been overcome by demonstrating that the site is in fact capable of being developed and provision of relevant SRI's to be achieved of the building envelope.

11 Conclusion

Noise levels were measured on site using two unattended class 1 sound level meters between 12th to 18th May 2021 when road traffic volumes were at representative levels. The assessment duration also deliberately included a weekend to ensure that any variation in the soundscape was captured.

The dominant noise source is that of the B2259 to the East of the site, and sounds are also generated by plant belonging to the Tesco Express store.

Noise modelling software (IMMI) was used to predict sound pressure levels around the two new building plots which will contain 3 and 4 dwellings respectively. As the report is in support of a detailed planning application, external sound pressure levels have been predicted for each façade of the proposed two plots to determine the relevant Sound Reduction Index (SRI) of the building envelope.

The highest predicted external sound pressure levels are those on the Eastern façade (67dB $L_{Aeq, 16 \text{ hour}}$) which are likely to overlook the B2259 at first floor level. The noise model showed a 21dB difference in the predicted sound pressure levels at the building façade between the Eastern and Western elements of Block A. Whilst the wall construction/specification is not yet known, it is still possible to demonstrate that the site is capable of being developed using an example rigorous calculation based on finalised floor plans using a worst case, mid terrace first floor bedroom overlooking the B2259.

An assessment was also undertaken of external amenity/garden spaces which all achieve under the BS8233:2014 criterion (55 dB $L_{Aeq, 16 \text{ hour}}$).

The assessment has applied British Standard BS8233:2014 as well as ProPG2017. The ProPG2017 assessment has included:

- A ProPG2017 stage 1 (Initial Site Risk Assessment).
- An Acoustic Design Statement (ADS) to inform decision makers and stakeholders of the good acoustic design principles that could be incorporated at the application site.
- An assessment of the predicted number of L_{Amax} events internally inside a bedroom during the night time periods

The report demonstrates that the site is capable of being developed and that the required internal sound pressure levels are capable of being achieved for the future occupants.

The application should not therefore be withheld planning consent on noise grounds.