

SHARPS REDMORE

ACOUSTIC CONSULTANTS



Report

Meadway Tilehurst, Reading

Redevelopment of Shopping
Parade

Environmental Noise Report

Prepared by

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Project No 1515151



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1.0 Introduction

- 1.1 Sharps Redmore (SR) has been instructed to undertake a noise assessment of proposed redevelopment of The Meadway, Shopping Parade in Tilehurst, Reading.
- 1.2 The proposed redevelopment will seek the demolition of garages and leisure unit located on the western part of the site, an enhancement of the remaining existing residential and retail units and construction of 6 new retail units with a new leisure unit at first floor level. Access to the site for customers will be via the existing access, shared with Asda to the south of the site, with access for delivery vehicles via the existing access road which runs along the northern boundary of the site which will lead to a service yard area at the rear of the retail stores.
- 1.3 The site is located off Honey End Lane, immediately to the south of the site is an Asda superstore, with the nearest noise sensitive properties being the three storey apartments located to the north east of the site, the residential bungalows to the west in Stoneham Close and the existing first floor flats with the site.
- 1.4 The purpose of this assessment is to assess the impact of redevelopment of the shopping centre on the amenity of surrounding properties. Based on experience of similar sites the main noise impacts will be as follows:
 - Noise from mechanical services plant;
 - Noise from servicing activity;
 - Noise from increased traffic.
- 1.5 Section 2.0 contains a discussion of the available methods of assessment and assessment criteria.
- 1.6 Section 3.0 of this report contains details of the environmental noise survey.
- 1.7 The impact of noise from the redevelopment of the site is considered in section 4.0 with the assessment conclusions are contained in section 5.0 of the report.
- 1.8 A guide to the acoustic terminology used within the report is included in Appendix A.

2.0 Assessment Criteria

2.1 The National Planning Policy Framework (NPPF) sets out the Government's economic, environmental and social planning policies for England and "these policies articulate the Government's vision of sustainable development." In respect of noise, Paragraph 123 of the NPPF states the following:

"Planning policies and decisions should aim to:

- *avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development*
- *mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions, while recognising that many developments will create some noise; and*
- *identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason"*

2.2 Guidance on the interpretation of the policy aims contained within the NPPF is contained within National Planning Policy Guidance (NPPG). The NPPG introduces the concept of a noise exposure hierarchy based on likely average response. The guidance contained in the NPPG is summarised in the table below:

Table 2.1: Noise Exposure Hierarchy

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
		Lowest Observed Adverse Effect Level	
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
		Significant Observed Adverse Effect Level	
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty	Significant Observed Adverse Effect	Avoid

Perception	Examples of Outcomes	Increasing Effect Level	Action
	in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.		
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

- 2.3 The NPPF and NPPG reinforce the March 2010 DEFRA publication, “Noise Policy Statement for England” (NPSE), which states three policy aims, as follows:

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

avoid significant adverse impacts on health and quality of life;

mitigate and minimise adverse impacts on health and quality of life; and

where possible, contribute to the improvement of health and quality of life.”

- 2.4 Together, the first two aims require that no significant adverse impact should occur and that, where a noise level which falls between a level which represents the lowest observable adverse effect and a level which represents a significant observed adverse effect, then according to the explanatory notes in the statement:

“... all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into consideration the guiding principles of sustainable development. This does not mean that such effects cannot occur.”

- 2.5 Therefore taking an overview of national policy aims and guidance it is clear that when considering the impact of noise from a development one must consider the significance of any impact.

- 2.6 It is possible to apply objective standards to the assessment of noise and the effect produced by the introduction of a certain noise source may be determined by several methods, as follows:

- i) The effect may be determined by reference to guideline noise values. British Standard (BS) 8233:1999 and World Health Organisation “Guidelines for Community Noise” contain such guidelines.
- ii) Alternatively, the impact may be determined by considering the change in noise level that would result from the proposal, in an appropriate noise index for the characteristic of the noise in question. There are various criteria linking change in noise level to effect. This is the method that is suited to, for example, the assessment of noise from road traffic because it is capable of displaying impact to all properties adjacent to a road link irrespective of their distance from the road.

- iii) Another method is to compare the resultant noise level against the background noise level (L_{A90}) of the area. This is the method employed by BS 4142:2014 to determine the likelihood of complaint from noise of an industrial or industrial type nature. It is best suited to the assessment of steady or pseudo-steady noise and is commonly used for the assessment of mechanical plant.

Guideline noise values

- 2.7 There are a number of guidance documents that contain recommended guideline noise values. These are discussed below.
- 2.8 British Standard 8233:2014 is principally intended to assist in the design of new dwellings; however, the Standard does state that it may be used in the assessment of noise from new sources being brought to existing dwellings.
- 2.9 The original BS 8233 published in 1999, was based on the advice contained in a draft of World Health Organisation document “Guidelines for Community Noise”. This document was released in final form in 2000. World Health Organisation guidance is referenced in the NPSE.
- 2.10 The WHO advice is the most useful, comprehensive, and pertinent advice in this case, because it is not specific to the circumstances of the assessment. Instead, it provides guidance on acceptable limits in, for example, schools, dwellings and offices.
- 2.11 The WHO guideline values are appropriate to what are termed “critical health effects”. This means that the limits are at the lowest noise level that would result in any psychological or physiological effect. The WHO guidelines are, as defined by NPSE, set at the Lowest Observed Adverse Effect Level (LOAEL), but do not define the level above which effects are significant (the SOAEL). Compliance with the LOAEL should, therefore, be seen as a robust aim.
- 2.12 The World Health Organisation/BS 8233 guideline values are summarised in the following table:

Table 2.2: WHO/BS 8233 guideline noise values

Document	Level	Guidance
World Health Organisation “Community Noise 2000”	$L_{AeqT} = 55$ dB	Serious annoyance, daytime and evening. (Continuous noise, outdoor living areas)
	$L_{AeqT} = 50$ dB	Moderate annoyance, daytime and evening. (Continuous noise, outdoor living areas).
	$L_{AeqT} = 35$ dB	Moderate annoyance, daytime and evening. (Continuous noise, dwellings, indoors)
	$L_{AeqT} = 30$ dB	Sleep disturbance, night-time (indoors)
	$L_{AMAX} = 60$ dB	Sleep disturbance, windows open at night. (Noise peaks outside bedrooms, external level).
	$L_{AMAX} = 45$ dB	Sleep disturbance at night (Noise peaks inside bedrooms, internal level)
BS 8233:2014 “Sound”	$L_{AeqT} = 55$ dB	Upper limit for external steady noise. (Gardens and balconies).

Document	Level	Guidance
Insulation and noise reduction for buildings"	$L_{AeqT} = 50$ dB	Desirable limit for external steady noise. (Gardens and balconies).
	$L_{AeqT} = 35$ dB	Resting conditions for living rooms during the day. (Internal – steady noise)
	$L_{AeqT} = 40$ dB	Dining, dining room day. (Internal – steady noise)
	$L_{AeqT} = 35$ dB	Good resting/sleeping conditions for bedrooms, daytime (Internal – steady noise)
	$L_{Aeq} = 30$ dB	Sleeping, bedroom night (internal – steady noise)

- 2.13 For L_{AeqT} criteria the time base (T) given in the documents is 16 hours for daytime limits and 8 hours for night time limits. When assessing impact, this has the tendency to smooth out the hourly variations in noise level. As such, our calculations are carried out to a 1 hour time base, which is a more stringent assessment than is given in the guidance documents.

Changes in noise level

- 2.14 It is noted that changes in noise levels of less than 3 dBA are not perceptible under normal conditions and changes of 10 dBA are equivalent to a doubling of loudness. This guidance has been accepted by inspectors, at inquiry, to encompass changes in noise levels in the index L_{AeqT} .
- 2.15 The following table shows the response to changes in noise (known as a semantic scale):

Table 2.3: Change in noise level

Change in noise level L_{AeqT} dB	Response	Impact
<3	Imperceptible	None
3 – 5	Perceptible	Slight/moderate
6 – 10	Up to a doubling	Moderate/significant
11 – 15	More than a doubling	Substantial
>15	-	Severe

BS 4142:2014

- 2.16 As outlined, this British Standard enables the significance of sound impact to be determined in relation to industrial and commercial sources. The significance of sound impact is to be determined according to the following summary process:
- Determine the background sound levels, in terms of the index L_{A90} , at the receptor locations of interest.

- ii) Determine the specific sound level of the source being assessed, in terms of its L_{AeqT} level ($T = 1$ hour for day or 15 minutes for night), at the receptor location of interest.
- iii) Apply a rating level acoustic feature correction if the source sound has tonal, impulsive, intermittent, or other characteristics which attract attention.
- iv) Compare the rating sound level with the background sound level; the greater the difference between the two, the higher the likelihood of adverse impact.
- v) A difference (rating – background) of around +10 dB is an indication of significant adverse impact, depending on the context; a difference of +5 dB is an indication of an adverse impact, depending on the context. 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 upon context.
- vi) The general intent of the planning system is to ensure that a development does not result in “significant adverse impacts on health and quality of life.” BS 4142:2014 considers that the threshold of significant adverse impact is “a difference around +10 dB or more ... depending upon the context”. However the NPPF and NPPG state that where a noise level which falls between a level which represents the lowest observable adverse effect and a level which represents a significant observed adverse effect, then according to the explanatory notes in the statement “... *all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into consideration the guiding principles of sustainable development. This does not mean that such effects cannot occur*”.

2.17 As can be seen from above the significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound exceeds the background and the context in which it is placed. There are many contextual points to consider when assessing the impact of sound including the following:

- The absolute level of the sound;
- The character and level of the specific sound compared to existing noise climate;
- The sensitivity of receptors;
- The time and duration that the specific sound occurs;
- The conclusions of assessments undertaken using alternative assessment methods, for example WHO guideline noise values;
- The ability to mitigate the specific sound through various methods, for example by screening, the selection of quiet plant equipment;
- The form and scale of the development, for example does the proposed development involve new industrial/commercial premises or is the proposal for extension to existing premises?

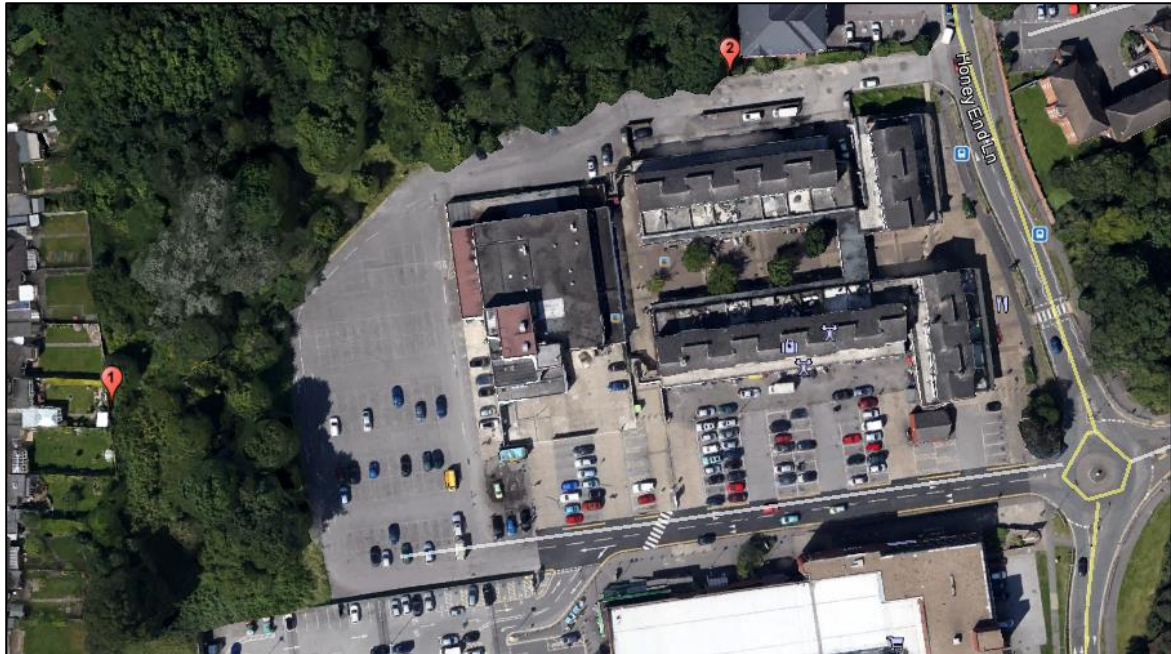
2.18 Taking into account the above comments in mind, the components of noise from the proposed redevelopment of the existing shopping centre has been assessed as follows:

- Fixed mechanical plant – BS 4142:2014
- Service Yard – BS 4142:2014/WHO Guidelines/Change in noise level
- Increased traffic – Change in noise level

3.0 Noise survey details

- 3.1 A noise survey was undertaken between Monday 22nd March and Tuesday 23rd March 2015 at two locations as shown in Fig 1 below. The measurement locations were chosen to represent the nearest noise sensitive properties to the development.

Fig 1 – Measurement Locations



- 3.2 Noise measurements were taken using a Norsonic 118 sound level meter fitted with an environmental microphone kit. The sound level meter was calibrated at the start and end of the survey and no variation in level noted.
- 3.3 The survey was carried out between 1700 hours to 0800 hours to represent the most noise sensitive periods during which activity may take place. The sound level meter was set up to continuously store 15 minute samples over the duration of the survey. The sound level meter microphone was positioned at 1.5 metres above the ground in free field conditions. Weather conditions during the survey were dry, cool with light winds.
- 3.4 Noise levels are dominated by road traffic on Honey End Lane and from cars arriving and leaving the existing car park areas. At monitoring location 2, noise level was influenced during the evening period by noise from the ventilation system at the rear of the Indian Restaurant which is located within the existing shopping centre.
- 3.5 The results of the noise survey are summarised in table 3.1 below and presented in full in Appendix B.

Table 3.1 – Survey Results

Location	Noise level dB						
	Evening ¹		Night time ²			Morning ³	
	L _{Aeq15min}	L _{A90,15min}	L _{Aeq15min}	L _{A90,15min}	L _{Amax}	L _{Aeq15min}	L _{A90,15min}
ML1	44 - 50	39 - 46	37 - 52	35 - 48	64	51 - 52	48 - 49
ML2	46 - 55	37 - 52	40 - 54	35 - 46	71	53 - 55	46 - 48

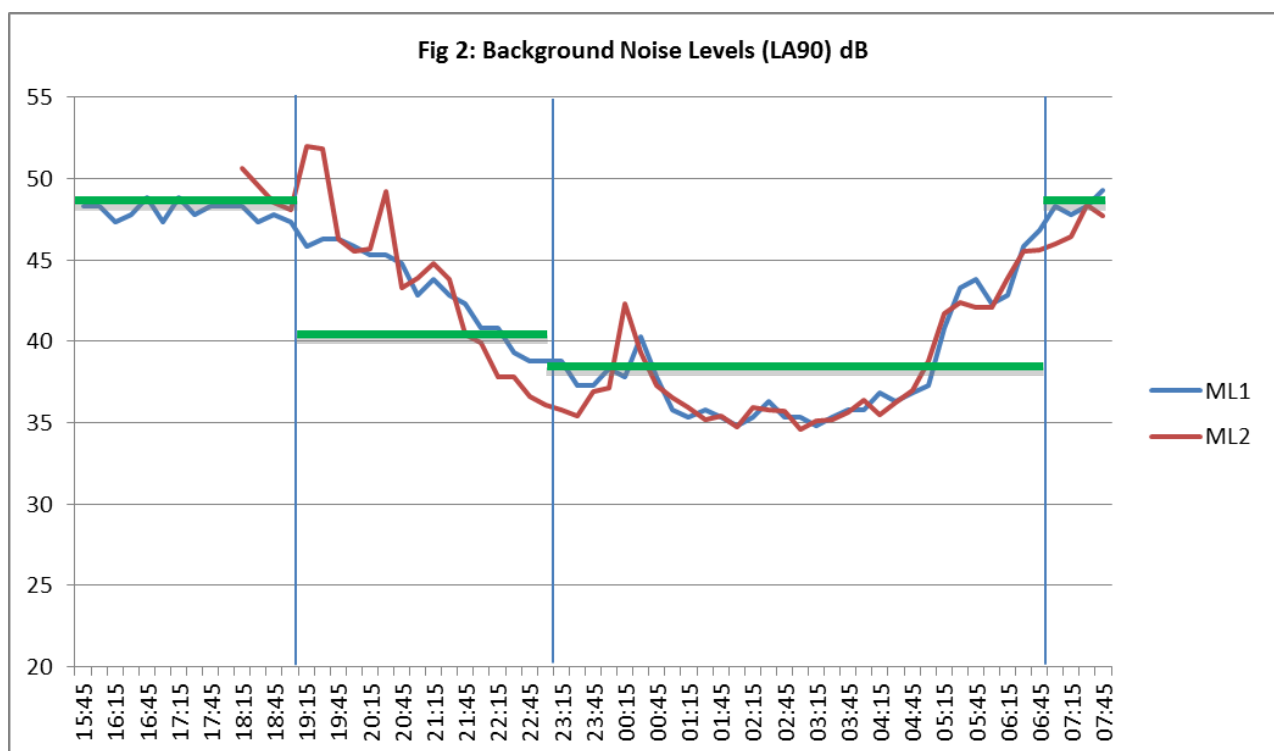
¹Based on period 1900 – 2300 hrs

²Based on period 2300 – 0700 hrs

³Based on period 0700 – 0800 hrs

3.6 To determine a baseline against which calculations in accordance with BS 4142:2014 could be undertaken Fig 2 below shows the background noise levels (L_{A90,5min}) measured during the survey period. Based on measurements recorded the following typical background noise levels have been determined.

- Daytime (0700 – 1900 hrs) – 48 dB L_{A90,15mins}
- Evening (1900 – 2300 hrs) – 40 dB L_{A90,15mins}
- Night time (2300 – 0700 hrs) – 38 dB L_{A90,15mins}



4.0 Noise Assessment

- 4.1 Based on experience of similar sites and as outlined in section 1.0 the main noise impacts from the proposed development will be as follows:

- Noise from mechanical services plant;
- Noise from servicing activity;
- Noise from increased traffic.

Noise from mechanical services plant

- 4.2 The precise details of the mechanical services and refrigeration equipment (type and noise signature) are not known at this stage, however it is likely that the retail units will have mechanical plant such as air condensers and refrigeration plant, which may operate twenty four hours a day.
- 4.3 The closest residential properties to the proposed plant area are the three storey apartments located at the entrance to the service access road and the bungalows to the west of the site in Stoneham Close.
- 4.4 With regard to the assessment of industrial noise sources in commercial premises (i.e. fixed mechanical plant associated with a retail development), British Standard 4142:2014 'Method for Rating industrial noise affecting mixed residential and industrial areas' enables the resultant noise level from new equipment to be compared against the existing background noise level (L_{A90}) of an area to assess the impact.
- 4.5 In terms of seeking to set appropriate plant rating sound limits, the advice in BS 4142:2014 is *"The lower the rating level is relative to the measured background sound level, the less likely is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source of having a low impact, depending on context"* (clause 11 note'd').
- 4.6 Hence in relation to the guidance above there is a technical case to set the plant sound limits that match the current background sound climate. This approach would result in a following plant rating levels:
- Daytime (0700 – 1900 hrs) – 48 dB $L_{Aeq,1hr}$
 - Evening (1900 – 2300 hrs) – 40 dB $L_{Aeq,1hr}$
 - Night time (2300 – 0700 hrs) – 38 dB $L_{Aeq,15mins}$
- 4.7 Based on experience of similar commercial developments it is considered that the above levels are achievable and reasonable in context of the existing noise climate and character of the area. The above limits can be secured by means of a planning condition.

Noise from servicing activity

- 4.8 Service vehicles will enter the site via the access road which runs along the northern boundary of the site before turning into a service yard area which is located behind the new retail units.

- 4.9 The closest residential properties to the new service area are the bungalows in Stoneham Close and the flats above the existing retail units. The properties in Stoneham Close are approximately 55 metres from the nearest loading bay (Unit 6) and centre of the turning circle. The existing residential flats are approximately 15 metres from the nearest loading bay (Unit 1).
- 4.10 Delivery event activity noise has been measured at a large number of food retail stores; the following maximum noise level and event duration has been recorded:

Table 4.1: Delivery event noise levels

Event Noise Level (at 10 metres)						Overall L_{Amax} dB
Arrival		Unloading		Departure		
Duration (mins)	L _{Aeq T} (dB)	Duration (mins)	L _{Aeq T} (dB)	Duration (mins)	L _{Aeq T} (dB)	
2	69	30	66	0.5	67	
						75-79

- 4.11 The noise levels in the table above encompass all typical delivery activity noise sources; such hydraulic tailgate lift noise, the removal of secure straps, noise associated with the lowering of tailgate flaps and the movement of roll cages.
- 4.12 Table 4.2 below summarises the predicted ambient (L_{AeqT}) and peak (L_{Amax}) delivery activity noise levels at first floor level both the residential properties in Stoneham Close and flats above the shops. The full delivery event activity noise calculations are included in Appendix D1; in relation to the properties in Stoneham Close screening attenuation in is based on a 1.8 metre high close boarded fence at the boundary of the residential properties. Details of the screening calculations are shown in Appendix C1 and C2.

Table 4.2: Predicted delivery activity noise levels

Receptor	Predicted noise level dB	
	L _{Aeq 1 hour}	L _{Amax}
		Arrival-Departure/Unloading
Stoneham Close	27	39/43
The Meadway	56	71/70

- 4.13 An assessment of delivery activity noise levels using the methodology in BS 4142:2014 are presented in Appendices D1 to D4. Appendices D1 to D2 assesses the noise impact at Stoneham Close, whereby the calculations in Appendices D3 – D4 seek to assess delivery noise at the existing properties in the Meadway Parade.

The results of the assessment are shown in Table 4.3 below

Table 4.3: BS 4142: Noise Assessment

Receptor	Time period	Rating level dB	BS 4142 guidance
Stoneham Close ¹	Daytime (0700 to 2300 hrs)	-18 dB	Indicative of no impact*
	Night time (2300 to 0700 hrs)	-11 dB	Indicative of no impact*
The Meadway ²	Daytime (0700 to 2300 hrs)	+14 dB	Indicative of significant adverse impact*
	Night time (2300 to 0700 hrs)	+24 dB	Indicative of significant adverse impact*

¹Assessment based on deliveries to units 6, 5 and 4

²Assessment based on deliveries to units 1

- 4.14 Based on the above the above noise from servicing activity will have no impact at Stoneham Close, however the noise from deliveries to the new units has the potential to cause a significant adverse impact to at the residential units which form part of the existing shopping centre. In terms impact on existing residential properties which form part of the Meadway Parade, such a result is not unexpected taking into account the close proximity to the commercial premises.
- 4.15 The main emphasis of the BS 4142:2014 is that any noise impact should be considered in context of the existing noise climate. It is therefore entirely possible that whilst the numerical outcome of a BS 4142 assessment is indicative of adverse or significant adverse impact, when the proposal is considered in context the significance of the impact is reduced to an acceptable level. This point is emphasised by noise from deliveries to existing commercial premises, which if assessed under the new version of BS 4142, would result in a similar rating level or higher to those detailed above but regularly take place without causing significant harm to local residents to the flats above.
- 4.16 The BS 4142 assessment at Appendices D3 and D4 summarises the key contextual considerations at the Meadway residential properties in this instance. In addition to these considerations regard is also had to existing character of the area.
- 4.17 The area is already a mixed use development and it is noted that deliveries to the commercial units would take place at the rear of the stores. The noise impact from deliveries to the proposed units will be similar from deliveries to existing commercial units which form part of the shopping parade. Therefore it is recommended that deliveries to the new units are restricted in line with the extant planning consent for the site.

Noise from increased traffic

- 4.18 The increase in road traffic noise as a result of the development can be determined by comparing the base traffic flows, with the base + development flows, by means of the formula found in "Calculation of Road Traffic Noise":

$$\text{Increase in noise level} = 10 \log_{10} (\text{future total traffic flow} \div \text{existing traffic flow}) \text{ dB}$$

- 4.19 To increase the noise level by 3 dBA, the minimum perceptible, the future traffic flow would need to be at least twice the existing traffic flow.

- 4.20 Existing traffic levels along the Honey End Lane are relatively high and the increase in road traffic resulting from the new stores will be small compared to the existing traffic levels. As a result the impact of noise from any increased traffic on local residents will be negligible.

5.0 Summary and Conclusions

- 5.1 Sharps Redmore has undertaken an environmental noise assessment for redevelopment of The Meadway, Shopping Centre in Tilehurst, Reading including the erection of new retail units. In terms of noise the following activities have been assessed.
- Fixed mechanical plant
 - Noise from deliveries
 - Change in road traffic noise
- 5.2 Comprehensive surveys have been carried out at one location representative of the existing noise sensitive properties.
- 5.3 Taking into account the above and having assessed the main noise impacts from the development against national standards, taking into account the existing noise climate and extant use of the site, it is concluded that the site can be redeveloped as proposed without causing significant impact or disturbance to local residents as advised by the National Planning Policy Framework.
- 5.4 If granted the proposed development will not compromise the Governments' noise policy vision, as stated in the Noise Policy Statement for England.

APPENDIX A

ACOUSTIC TERMINOLOGY

Acoustic Terminology

- A1 Noise, defined as unwanted sound, is measured in units of decibels, dB. The range of audible sounds is from 0 dB to 140 dB. Two equal sources of sound, if added together will result in an increase in level of 3 dB, i.e. $50 \text{ dB} + 50 \text{ dB} = 53 \text{ dB}$. Increases in continuous sound are perceived in the following manner:

1 dB increase - barely perceptible

3 dB increase - just noticeable

10 dB increase - perceived as twice as loud

- A2 Frequency (or pitch) of sound is measured in units of Hertz. 1 Hertz (Hz) = 1 cycle/second. The range of frequencies audible to the human ear is around 20Hz to 18000Hz (or 18kHz). The capability of a person to hear higher frequencies will reduce with age. The ear is more sensitive to medium frequency than high or low frequencies.

- A3 To take account of the varying sensitivity of people to different frequencies a weighting scale has been universally adopted called "A-weighting". The measuring equipment has the ability automatically to weight (or filter) a sound to this A scale so that the sound level it measures best correlates to the subjective response of a person. The unit of measurement thus becomes dBA (decibel, A-weighted).

- A4 The second important characteristic of sound is amplitude or level. Two units are used to express level, a) sound power level - L_w and b) sound pressure level - L_p . Sound power level is an inherent property of a source whilst sound pressure level is dependent on surroundings/distance/directivity, etc. The sound level that is measured on a meter is the sound pressure level, L_p .

- A5 External sound levels are rarely steady but rise or fall in response to the activity in the area - cars, voices, planes, birdsong, etc. A person's subjective response to different noises has been found to vary dependent on the type and temporal distribution of a particular type of noise. A set of statistical indices have been developed for the subjective response to these different noise sources.

- A6 The main noise indices in use in the UK are:

L_{A90} : The sound level (in dBA) exceeded for 90% of the time. This level gives an indication of the sound level during the quieter periods of time in any given sample. It is used to describe the "background sound level" of an area.

L_{Aeq} : The equivalent continuous sound level in dBA. This unit may be described as "the notional steady noise level that would provide, over a period, the same energy as the intermittent noise". In other words, the energy average level. This unit is now used to measure a wide variety of different types of noise of an industrial or commercial nature, as well as aircraft and trains.

L_{A10} : The sound level (in dBA) exceeded for 10% of the time. This level gives an indication of the sound level during the noisier periods of time in any given sample. It has been used over many years to measure and assess road traffic noise.

L_{AMAX} The maximum level of sound measured in any given period. This unit is used to measure and assess transient noises, i.e. gun shots, individual vehicles, etc.

- A7 The sound energy of a transient event may be described by a term SEL - Sound Exposure Level. This is the L_{Aeq} level normalised to one second. That is the constant level in dBA which lasting for one second has the same amount of acoustic energy as a given A weighted noise event lasting for a period of time. The use of this unit allows the prediction of the L_{Aeq} level over any period and for any number of events using the equation;

$$L_{AeqT} = SEL + 10 \log n - 10 \log T \text{ dB.}$$

Where

n = Number of events in time period T.

T = Total sample period in seconds.

- A8 In the open, known as free field, sound attenuates at a rate of 6 dB per each doubling of distance. This is known as geometric spreading or sometimes referred to as the Inverse Square Law. As noise is measured on a Logarithmic scale, this attenuation in distance = $20 \log$ (ratio of distances), e.g. for a noise level of 60 dB at ten metres, the corresponding level at 160 metres is:

$$60 - 20 \log \frac{160}{10} = 60 - 24 = 36 \text{ dB.}$$

APPENDIX B

NOISE SURVEY RESULTS

Appendix B – Survey Results

Time	Noise Level dB(A)							
	ML1				ML1			
	L _{Aeq}	L _{Amax}	L _{Amin}	L _{A90}	L _{Aeq}	L _{Amax}	L _{Amin}	L _{A90}
(2015/03/23 15:45:00.00)	51.5	72.8	45.1	48.3				
(2015/03/23 16:00:00.00)	52.7	73.6	45.1	48.3				
(2015/03/23 16:15:00.00)	50.9	64.9	43.1	47.3				
(2015/03/23 16:30:00.00)	50.3	60.5	44.7	47.8				
(2015/03/23 16:45:00.00)	53.1	68.1	45.9	48.8				
(2015/03/23 17:00:00.00)	50	59.1	43.9	47.3				
(2015/03/23 17:15:00.00)	53.2	67.4	44.8	48.8				
(2015/03/23 17:30:00.00)	51.5	63.5	44.5	47.8				
(2015/03/23 17:45:00.00)	54	73.2	45.5	48.3				
(2015/03/23 18:00:00.00)	51.4	70.8	44.3	48.3				
(2015/03/23 18:15:00.00)	51.9	72.4	45.9	48.3	55	76.7	41.4	50.6
(2015/03/23 18:30:00.00)	51.2	69.3	44.1	47.3	54	67.1	44.5	49.6
(2015/03/23 18:45:00.00)	50.5	62.3	43.9	47.8	53.2	71.2	44.8	48.5
(2015/03/23 19:00:00.00)	49.1	66.9	43.8	47.3	54.7	72.8	44.3	48.1
(2015/03/23 19:15:00.00)	48.3	69.2	42.8	45.8	54.8	70.3	49.6	52
(2015/03/23 19:30:00.00)	48.5	56.1	43.5	46.3	54.8	69.3	47.6	51.8
(2015/03/23 19:45:00.00)	49.4	69.5	44	46.3	52.9	73.9	42.3	46.3
(2015/03/23 20:00:00.00)	48.3	58.1	43.2	45.8	51.8	65.6	41.7	45.5
(2015/03/23 20:15:00.00)	48	60.9	42.1	45.3	52.8	65.3	41.5	45.7
(2015/03/23 20:30:00.00)	49.7	71.9	42.2	45.3	53.7	69.7	41.3	49.2
(2015/03/23 20:45:00.00)	49.9	70.6	41.5	44.8	50.8	70.1	40.3	43.3
(2015/03/23 21:00:00.00)	46.7	63.7	39.4	42.8	48.9	62.7	40.4	43.9
(2015/03/23 21:15:00.00)	46.7	56.7	41.1	43.8	52	67.3	39.4	44.8
(2015/03/23 21:30:00.00)	46.2	54.8	39.3	42.8	50.8	59.7	39.7	43.8
(2015/03/23 21:44:59.00)	45.5	62.2	38.9	42.3	47.2	64.5	37.2	40.4
(2015/03/23 22:00:00.00)	45.3	57.7	38.1	40.8	51.2	72.3	36.9	39.9
(2015/03/23 22:15:00.00)	46.2	67.4	37.4	40.8	46.6	59.7	35.6	37.8
(2015/03/23 22:30:00.00)	48	68.3	36.7	39.3	50.3	63.6	34.8	37.8
(2015/03/23 22:45:00.00)	44.2	56.2	36.1	38.8	46.1	64	34.4	36.6
(2015/03/23 23:00:00.00)	44.5	60.4	36.5	38.8	43.9	54.6	34.2	36.1
(2015/03/23 23:15:00.00)	42.8	53.7	36.1	38.8	45.7	71.2	32.8	35.8
(2015/03/23 23:30:00.00)	41.8	57.5	34.5	37.3	44	69.6	33.4	35.4
(2015/03/23 23:45:00.00)	41.9	50.2	34.6	37.3	42.2	55.5	35.3	36.9
(2015/03/24 00:00:00.00)	41.4	50.8	36.7	38.3	42.8	54.8	35.5	37.1
(2015/03/24 00:15:00.00)	41.7	51.3	36	37.8	45.7	65	40	42.3
(2015/03/24 00:30:00.00)	42.6	52.3	39.1	40.3	44.8	56.6	36.6	39.3
(2015/03/24 00:44:59.00)	42.9	57	36.4	37.8	45	68.7	35.3	37.3
(2015/03/24 01:00:00.00)	39.3	50.7	34.1	35.8	45.9	63.9	34.8	36.5
(2015/03/24 01:15:00.00)	40.4	53.9	34.1	35.3	44.9	62.6	34.3	35.9
(2015/03/24 01:30:00.00)	39.3	49.8	34.4	35.8	39.9	53.2	33.8	35.2

Time	Noise Level dB(A)							
	ML1				ML1			
	L _{Aeq}	L _{Amax}	L _{Amin}	L _{A90}	L _{Aeq}	L _{Amax}	L _{Amin}	L _{A90}
(2015/03/24 01:45:00.00)	37.7	48.1	34.2	35.3	40.5	56.3	33.6	35.4
(2015/03/24 02:00:00.00)	38	50.2	33.8	34.8	40.4	57.5	33.5	34.7
(2015/03/24 02:15:00.00)	39.1	54	33.7	35.3	40.2	53.7	33.9	35.9
(2015/03/24 02:30:00.00)	39.1	49.2	35	36.3	40.2	53.5	34	35.8
(2015/03/24 02:45:00.00)	36.5	46.6	34.4	35.3	42	57.1	34.2	35.7
(2015/03/24 03:00:00.00)	39.2	53.6	33.9	35.3	42.3	55.6	33.3	34.6
(2015/03/24 03:15:00.00)	41.3	58.7	33.6	34.8	42.7	57.3	33.4	35.1
(2015/03/24 03:30:00.00)	43.9	59.9	33.8	35.3	41.7	54.4	33.6	35.2
(2015/03/24 03:45:00.00)	43.6	58.6	34.2	35.8	42.8	62.7	33.5	35.6
(2015/03/24 04:00:00.00)	44.1	59.2	34	35.8	45.8	64.4	34.1	36.4
(2015/03/24 04:15:00.00)	45.4	58.9	34.3	36.8	43.3	56.8	33.9	35.5
(2015/03/24 04:30:00.00)	45.6	58.5	34.5	36.3	46.3	66.2	33.8	36.2
(2015/03/24 04:45:00.00)	46	58.9	34.8	36.8	44.7	56.9	34.6	37
(2015/03/24 05:00:00.00)	45.4	61.3	34.7	37.3	51.1	68.8	34.8	38.8
(2015/03/24 05:15:00.00)	47.5	60.3	36.1	40.8	52.2	68.5	36.4	41.7
(2015/03/24 05:30:00.00)	52.3	64.5	38.9	43.3	50.5	66.3	38.2	42.4
(2015/03/24 05:45:00.00)	48.2	58.4	39.6	43.8	51.4	66.1	37.6	42.1
(2015/03/24 06:00:00.00)	46.2	64.2	38.9	42.3	51.2	68.2	37.6	42.1
(2015/03/24 06:15:00.00)	46.8	57.8	39.8	42.8	52.4	74.9	40.1	43.9
(2015/03/24 06:30:00.00)	49.5	64	41.6	45.8	53	73	41.4	45.5
(2015/03/24 06:45:00.00)	51.2	69.4	43.3	46.8	54	73.9	40.8	45.6
(2015/03/24 07:00:00.00)	51.7	68.9	44.9	48.3	53.3	71.2	41.2	46
(2015/03/24 07:15:00.00)	50.9	61.3	45.4	47.8	53.1	70.5	41.9	46.4
(2015/03/24 07:30:00.00)	51.4	60	44.9	48.3	55	75.5	44.1	48.4
(2015/03/24 07:45:00.00)	51.7	63.2	45.7	49.3	53.3	64.8	43.2	47.7

APPENDIX C

SERVICE YARD CALCULATIONS

APPENDIX C1: Predicted delivery event noise at Stoneham Close

Activity	Resultant noise level (dB)
Arrival	
Baseline level	$L_{Aeq,2 \text{ mins}} = 69$
Distance attenuation to 55 metres = $20 \log^{10}_{55} = -15$	$L_{Aeq,2 \text{ mins}} = 54$
Screening loss = -21 dB (see Appendix C3)	$L_{Aeq,2 \text{ mins}} = 33$
Convert to 1 hour = $10 \log^2_{60} = -15$	$L_{Aeq,1 \text{ hour}} = 18$
Unloading	
Baseline level	$L_{Aeq,30 \text{ mins}} = 66$
Distance attenuation to 55 metres = $20 \log^{10}_{55} = -15$	$L_{Aeq,30 \text{ mins}} = 51$
Screening loss = -21 dB (see Appendix C3)	$L_{Aeq,30 \text{ mins}} = 30$
Convert to 1 hour = $10 \log^{30}_{60} = -3$	$L_{Aeq,1 \text{ hour}} = 27$
Departure	
Baseline level	$L_{Aeq,0.5 \text{ mins}} = 67$
Distance attenuation to 55 metres = $20 \log^{10}_{55} = -15$	$L_{Aeq,0.5 \text{ mins}} = 52$
Screening loss = -21 dB (see Appendix C3)	$L_{Aeq,0.5 \text{ mins}} = 31$
Convert to 1 hour = $10 \log^{0.5}_{60} = -21$	$L_{Aeq,1 \text{ hour}} = 10$
Overall 18+27+10	$L_{Aeq,1 \text{ hour}} = 27 \text{ dB}$
WHO DAYTIME CRITERION ($L_{Aeq,16hr}$)	55 dB
WHO NIGHT TIME CRITERION ($L_{Aeq,8hr}$)	45 dB
Peak noise – arrival and departure	
Baseline level	$L_{Amax} = 75$
Distance attenuation to 55 metres = $20 \log^{10}_{55} = -15$	$L_{Amax} = 60$
Screening loss = -21 dB (see Appendix C3)	$L_{Amax} = 39$
Peak noise – unloading	
Baseline level	$L_{Amax} = 79$
Distance attenuation to 55 metres = $20 \log^{10}_{34} = -15$	$L_{Amax} = 64$
Screening loss = -21 dB (see Appendix C3)	$L_{Amax} = 43$
WHO guideline night time criterion (L_{Amax})	$L_{Amax} = 60$

APPENDIX C2: Predicted delivery event noise at Flats above existing retail units

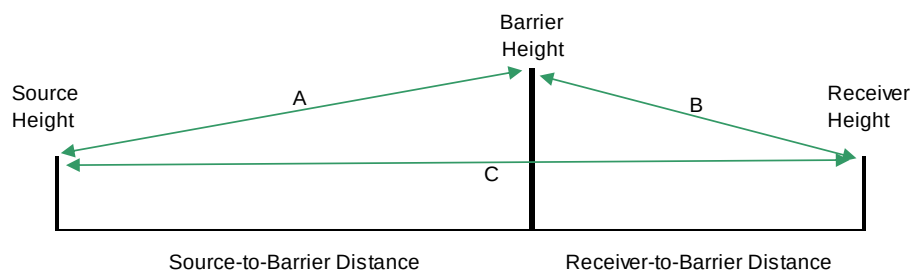
Activity	Resultant noise level (dB)
Arrival	
Baseline level	$L_{Aeq,2 \text{ mins}} = 69$
Distance attenuation to 15 metres = $20 \log^{10}/_{15} = -4$	$L_{Aeq,2 \text{ mins}} = 65$
Screening loss = nil	$L_{Aeq,2 \text{ mins}} = 65$
Convert to 1 hour = $10 \log^2/_{60} = -15$	$L_{Aeq,1 \text{ hour}} = 50$
Unloading	
Baseline level	$L_{Aeq,30 \text{ mins}} = 66$
Distance attenuation to 15 metres = $20 \log^{10}/_{15} = -4$	$L_{Aeq,30 \text{ mins}} = 62$
Screening loss = 5dB	$L_{Aeq,30 \text{ mins}} = 57$
Convert to 1 hour = $10 \log^{30}/_{60} = -3$	$L_{Aeq,1 \text{ hour}} = 54$
Departure	
Baseline level	$L_{Aeq,0.5 \text{ mins}} = 67$
Distance attenuation to 15 metres = $20 \log^{10}/_{15} = -4$	$L_{Aeq,0.5 \text{ mins}} = 63$
Screening loss = nil	$L_{Aeq,0.5 \text{ mins}} = 63$
Convert to 1 hour = $10 \log^{0.5}/_{60} = -21$	$L_{Aeq,1 \text{ hour}} = 42$
Overall 50+54+42	$L_{Aeq,1 \text{ hour}} = 56 \text{ dB}$
WHO DAYTIME CRITERION ($L_{Aeq,16hr}$)	55 dB
WHO NIGHT TIME CRITERION ($L_{Aeq,8hr}$)	45 dB
Peak noise – arrival and departure	
Baseline level	$L_{Amax} = 75$
Distance attenuation to 15 metres = $20 \log^{10}/_{15} = -4$	$L_{Amax} = 71$
Screening loss = nil	$L_{Amax} = 71$
Peak noise – unloading	
Baseline level	$L_{Amax} = 79$
Distance attenuation to 15 metres = $20 \log^{10}/_{15} = -4$	$L_{Amax} = 75$
Screening loss = -5dB	$L_{Amax} = 70$
WHO guideline night time criterion (L_{Amax})	$L_{Amax} = 60$

Appendix C3 – Stoneham Close – Arrival/Departure/Unloading

BASIC BARRIER ATTENUATION

Date:	27/03/2015
Project:	<u>The Meadway, Tilehurst</u>
Project No:	

Stoneham Close



Source-to-Barrier Distance	16.0 m
Receiver-to-Barrier Distance	39.0 m

Source Height	69.5 m
Receiver Height	84.3 m
Barrier Height	84.3 m

Path difference = 3.839 m
(a + b) - c

Frequency - Hz	63	125	250	500	1K	2K	4K	8K	CRTN
Attenuation - dB	15	18	21	24	27	30	33	36	21.3 dBA

APPENDIX D

BS 4142:2014 – NOISE ASSESSMENT

APPENDIX D1: Assessment of delivery activity noise using BS 4142:2014: Daytime

Results	Receptor location	Relevant clause	Commentary
	Stoneham Close		
Background sound level: daytime	48 dB $L_{A90\ 16\ hours}$	8.1 8.1.3	The typical daytime sound level was derived from the graph of background sound levels in Figure 2 of the report.
Specific sound level	27 dB		Predicted levels from delivery sound source measurements taken over 20 years of assessing retail noise and its characteristics
Acoustic feature correction	+3	9.2	Delivery activity noise is typically characterised by a series of short impulsive bangs, crashes and 'rattles' associated with the movement of produce roll cages. At these receptor locations the impulsivity associated with a delivery event is considered to be just perceptible in the context of the existing noise climate.
Rating level	30 dB	9.2	
Background level: daytime	48 dB	8.1 8.1.3	Based on daytime measurements
Excess of rating level over background level	30-48 = -18 dB	11	
Assessment indicates likelihood of no impact subject to context	Relevant clause 11 The context is: 1. Predicted delivery event noise levels are considerably below the WHO daytime guideline value to avoid moderate annoyance (50 dB $L_{Aeq\ 16\ hours}$). 2. How do the predicted delivery activity sound levels compare to the existing ambient ($L_{Aeq\ T}$) noise climate? Predicted delivery activity sound levels are below the existing daytime ambient noise climate. There will be no overall change in ambient noise level ($L_{Aeq\ 1\ hour}$). 3. The character of the existing noise climate. The existing noise climate is contributed to by local (and distant) road traffic. Noise from delivery activity during the day would not be out of context with the existing noise climate.		
Uncertainty of the assessment	Relevant clause 10 The excess of the rating level over the background sound level is -18 dB; the uncertainty of the measurement could have an influence to the outcome of the assessment.		

APPENDIX D2: Assessment of delivery activity noise using BS 4142:2014: Night time

Results	Receptor location	Relevant clause	Commentary
	Stoneham Close		
Background sound level: night time	38 dB L_{A90} 8 hours	8.1 8.1.3	The typical night time sound level was derived from the graph of background sound levels in Figure 2 of the report.
Specific sound level	27 dB		Predicted levels from delivery sound source measurements taken over 20 years of assessing retail noise and its characteristics
Acoustic feature correction	N/a	9.2	Delivery activity noise is typically characterised by a series of short impulsive bangs, crashes and 'rattles' associated with the movement of produce roll cages. At night noise sensitive location is inside with windows open. The impulsivity associated with a delivery event is considered imperceptible within the bedroom.
Rating level	27 dB	9.2	
Background level: night time	38 dB	8.1 8.1.3	Based on measurements recorded between 22 and 23 March 2015
Excess of rating level over background level	27 - 38 = -11 dB	11	
Assessment indicates likelihood of no impact subject to context	Relevant clause 11 The context is: 1. Predicted delivery event noise levels comply with the WHO night time guideline value to avoid sleep disturbance (45 dB L_{Aeq} 8 hours). 2. How do the predicted delivery activity sound levels compare to the existing ambient ($L_{Aeq T}$) noise climate? Predicted delivery activity sound are significantly below the existing noise levels measured during the night time period. There will no increase in existing noise levels. 3. The character of the existing noise climate. The existing noise climate during the night time period is dominated by distant road traffic on the A30. Noise levels are from localised activity would be out of character with existing noise climate.		
Uncertainty of the assessment	Relevant clause 10 The excess of the rating level over the background sound level is -11 dB; the uncertainty of the measurement could have an influence to the outcome of the assessment.		

APPENDIX D3: Assessment of delivery activity noise using BS 4142:2014 Day time

Results	Receptor location	Relevant clause	Commentary
	The Meadway		
Background sound level: daytime	48 dB $L_{A90\ 1\text{ hour}}$	8.1 8.1.3	The typical daytime sound level was derived from the graph of background sound levels in Figure 2 of the report.
Specific sound level	56 dB		Predicted levels from delivery sound source measurements taken over 20 years of assessing retail noise and its characteristics
Acoustic feature correction	+6 dB	9.2	Delivery activity noise is typically characterised by a series of short impulsive bangs, crashes and 'rattles' associated with the movement of produce roll cages. During the day noise levels will be clearly audible.
Rating level	62 dB	9.2	
Background level	48B	8.1 8.1.3	Based on daytime measurements
Excess of rating level over background level	48 - 62 = +14 dB	11	
Assessment indicates likelihood of significant adverse impact subject to context	Relevant clause 11 The context is: 1. Predicted delivery event noise levels just exceed the WHO night time guideline value for serious annoyance (55 dB $L_{Aeq\ 16\text{ hours}}$). 2. How do the predicted delivery activity sound levels compare to the existing ambient ($L_{Aeq\ T}$) noise climate? Predicted delivery activity sound levels are similar to the existing daytime ambient noise levels measured at ML2. 3. The character of the existing noise climate. The existing noise climate during the daytime is characterised by noise from the existing shopping centre and road traffic noise. Deliveries already take place to the existing units below the residential flats. Noise from deliveries to neighbouring retail units will not therefore be out of character with the existing noise climate experienced by residents.		
Uncertainty of the assessment	Relevant clause 10 The excess of the rating level over the background sound level is +14 dB; the uncertainty of the measurement could have an influence to the outcome of the assessment.		

APPENDIX D4: Assessment of delivery activity noise using BS 4142:2014 Night time

Results	Receptor location	Relevant clause	Commentary
	The Meadway		
Background sound level: night time	38 dB $L_{A90\ 1\text{ hour}}$	8.1 8.1.3	The typical night time sound level was derived from the graph of background sound levels in Figure 2 of the report.
Specific sound level	56 dB		Predicted levels from delivery sound source measurements taken over 20 years of assessing retail noise and its characteristics
Acoustic feature correction	+6 dB	9.2	Delivery activity noise is typically characterised by a series of short impulsive bangs, crashes and 'rattles' associated with the movement of produce roll cages. At night the receptor will be insider but noise from deliveries would still be clearly audible.
Rating level	62 dB	9.2	
Background level	38 dB	8.1 8.1.3	See above
Excess of rating level over background level	38 - 62 = +24 dB	11	
Assessment indicates likelihood of significant adverse impact subject to context	Relevant clause 11 The context is: 1. Predicted delivery event noise levels significantly exceeds the WHO night time guideline value for sleep disturbance (45 dB $L_{Aeq\ 16\text{ hours}}$). 2. How do the predicted delivery activity sound levels compare to the existing ambient ($L_{Aeq\ T}$) noise climate? Predicted delivery activity sound levels are significantly below the existing night time ambient noise levels measured at ML2. 3. The character of the existing noise climate. The existing noise climate during the night time is characterised by noise from distant traffic. There is little activity within the existing retail units during the night, although activity did start to increase from 0600 hours.		
Uncertainty of the assessment	Relevant clause 10 The excess of the rating level over the background sound level is +24 dB; the uncertainty of the measurement could have an influence to the outcome of the assessment.		