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D J McQueen

Assessment of External Plant Noise
for Proposed Food Retail Store at
the site of The Bridge Inn, Childwall
Valley Road, Liverpool

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1.0 SUMMARY

The predicted noise from typical external mechanical plant should be acceptable, day or night by any conceivably reasonable standard with no particular mitigation.

Daytime deliveries of all types should be acceptable during daytime hours with any realistic number of delivery vehicles. Vans and large rigid trucks should also be acceptable during the night.

A R Raymond

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2.0 INTRODUCTION

ADC was asked to carry out an independent assessment of potential impact of an approximately 1550m^2 food retail unit. The occupier is not known but we are advised it is likely to be a retailer such as Lidl, Aldi or Co-Op.

This report begins by discussing the various assessment criteria applicable to this situation. We follow by describing in simple terms our basic approach to calculations and modelling. After a short description of survey details, we discuss our results and present our conclusions and recommendations.

3.0 ASSESSMENT STANDARDS

3.1 NPPF

The National Planning Policy Framework provides nothing in the way of quantitative criteria. The main statement on noise is to be found in paragraph 123:-

123. 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;
- recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; 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.

The NPPF refers to the Noise Policy Statement for England (NPSE) which sets out the following aims:-

1. avoid significant adverse impacts on health and quality of life;
2. mitigate and minimise adverse impacts on health and quality of life; and
3. where possible, contribute to the improvement of health and quality of life.

It also introduces the concepts of:

- NOEL – No Observed Effect Level. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.
- LOAEL – Lowest Observed Adverse Effect Level. This is the level above which adverse effects on health and quality of life can be detected.

- SOAEL – Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life occur.

SOAEL is clearly something the policy seeks to avoid in aim 1. Aim 2 represents situations between SOAEL and LOAEL, and seeks to minimise and mitigate the effects.

3.2 BS8233

BS8233 was updated in March 2014. Quantitatively, however, the design criteria are little changed – just expressed differently to reduce ambiguity in certain situations.

Table 4 of BS8233 gives the desirable criteria for indoor ambient noise levels for dwellings as follows:-

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,16hour}$

Note that the standard accepts the widely used rule of thumb that, for a partly open window, the levels just outside will be 15dB higher than those just inside. This brings us to an external equivalent of the above table, as follows:-

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	50 dB $L_{Aeq,16hour}$	-
Dining	Dining room/area	55 dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	50 dB $L_{Aeq,16hour}$	45 dB $L_{Aeq,16hour}$

It goes on to state that, where necessary, the criteria can be relaxed by up to 5 dB and still achieve reasonable conditions. Note that the new version does not explicitly state criteria for bedroom noise in terms of dB L_{Amax}.

Garden area criteria are unchanged with 50 dB L_{Aeq} and 55 dB L_{Aeq} being considered desirable and reasonable respectively.

Note that the new version of BS8233 more explicitly specifies the assessment periods as 16 hour and 8 hour for daytime and night time respectively.

3.3 BS4142

BS 4142 was updated in November 2014. The standard is very complicated but, basically, it describes methods for rating and assessing sound of an industrial and/or commercial nature, which includes:

a) sound from industrial and manufacturing processes

b) sound from fixed installations which comprise mechanical and electrical plant and equipment

c) sound from the loading and unloading of goods and materials at industrial and/or commercial premises

d) sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and/or commercial site.

The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

Characteristics and Context

Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, we need to add a character correction to the specific sound level to obtain the rating level.

These features can include tonality, impulsivity and intermittency with corrections typically ranging potentially from 0dB to 9 dB. Corrections at the higher end would represent characteristics which are highly perceptible in the context of the ambient noise as a whole. Corrections at the lower end would represent characteristics which are just perceptible in the presence of the ambient noise as a whole,

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 source exceeds the background sound level and the context in which the sound occurs. An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context.

Assessment

We obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level from the rating level and considering the following.

a) Typically, the greater this difference, the greater the magnitude of the impact.

b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.

c) A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

d) The lower the rating level is relative to the measured background sound level, the less likely it 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 having a low impact, depending on the context.

Where the initial estimate of the impact needs to be modified due to the context, pertinent factors need to be taken into consideration, including the following.

1) The absolute level of sound.

   For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.

   Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.

   Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse.

2) The character and level of the residual sound compared to the character and level of the specific sound.

   We need to consider whether it would be beneficial to compare the frequency spectrum and temporal variation of the specific sound with that of the ambient or residual sound, to assess the degree to which the specific sound source is likely to be distinguishable and will represent an incongruous sound by comparison to the acoustic environment that would occur in the absence of the specific sound. Any sound parameters, sampling periods and averaging time periods used to undertake character comparisons should reflect the way in which sound of an industrial and/or commercial nature is likely to be perceived and how people react to it.

3) The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions.

4.0 BASIC APPROACH TO MODELLING

Calculations are summarised in Appendix 2.

4.1 Mechanical Equipment

1. We start with the manufacturers' noise data. The occupier is not yet known but we have used mechanical plant data from a 1800m^2 food

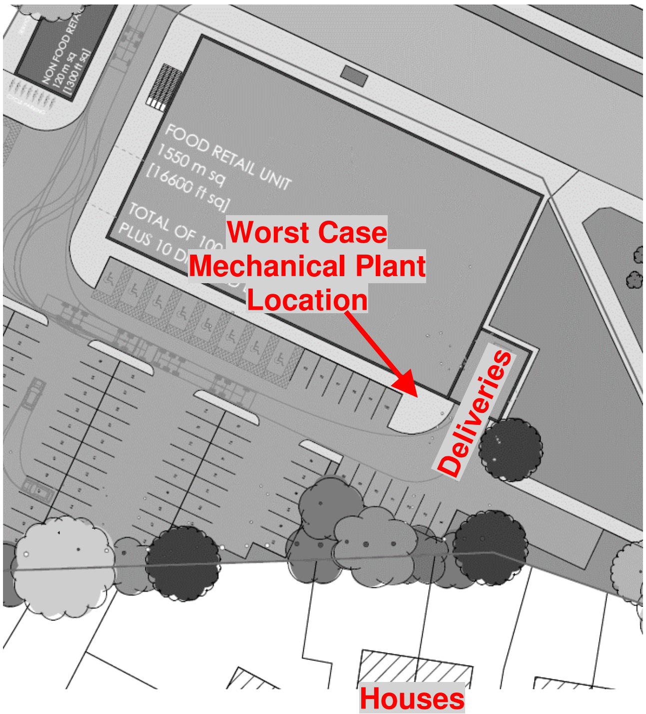
retail store we worked on recently (the store being considered here is 1550m^2)

2. We then adjust it for the number of items of each type, and convert it to a standardised 1m. Again we use the number of items used on our recent 1800m^2 food retail project.

3. The noise from each item, assumed to run continuously through the day and night, is totalled up.

4. The effect of barriers (acoustic fencing building edges, etc) is built in. Note that, at this stage no barrier is assumed but it can be added in as necessary.

5. Finally we adjust for distance to the nearest properties. Note that we have assumed the equipment will be in full view of the nearby houses, whereas in reality it is likely to be tucked away out of sight.



4.2 Deliveries

1. We start with our own data base of noise levels for various refrigerated delivery activities (arriving, reversing, unloading, etc) at 10m. This data is presented for small vans (supermarket home delivery size), larger rigid vans, and articulated HGVs.

2. The activities for each vehicle type are added up and compressed into a standardised time period of 1 second, an index called the SEL or LE.

3. These standardised figures can then be used to model any number of deliveries from any of the vehicle types at any distance.

4. Here we increase the number of deliveries of each type until the external equivalent of the BS8233 “Desirable” criterion is reached (45 dB L_{Aeq} night time or 50 dB L_{Aeq} daytime). This number of deliveries can then be considered against what is actually likely to occur.

5.0 SURVEY DETAILS

5.1 Site Times and Personnel

The measurements were carried out on 9th to 10 April 2015 by Mark Pickering of ADC Acoustics.

Measurements were carried out between approximately 23:00 hours and 07:00 hours to cover an entire weekday night.

5.2 Instrumentation

Instrumentation used was a Larson Davis 824. This is a precision grade sound level meter which holds a current calibration certificate and which was field-calibrated as required. It was set up to measure 5 minute[1] samples in terms of dB L_{eq}, L_{max} and L_{90} in overall dB(A) terms and in octave bands across the frequency range. See Definitions of Acoustic terms in Appendix 1.

5.3 Survey Conditions

The general noise climate was assumed to be normal and representative. Most of the noise was coming from local and distant traffic.

Weather conditions were as follows :-

Rain	:	none, dry roads
Wind	:	negligible
Cloud	:	0 to 10%
Temperature	:	4 to 8 Celsius

5.5 Measurement Positions

The main measurement position was as shown by the star on the following plan.

[1] Note that, to make the results more digestible, we have converted the 5 minute samples to 15 minute samples.

The microphone was 1.5 m above ground and well away from other reflecting surfaces.

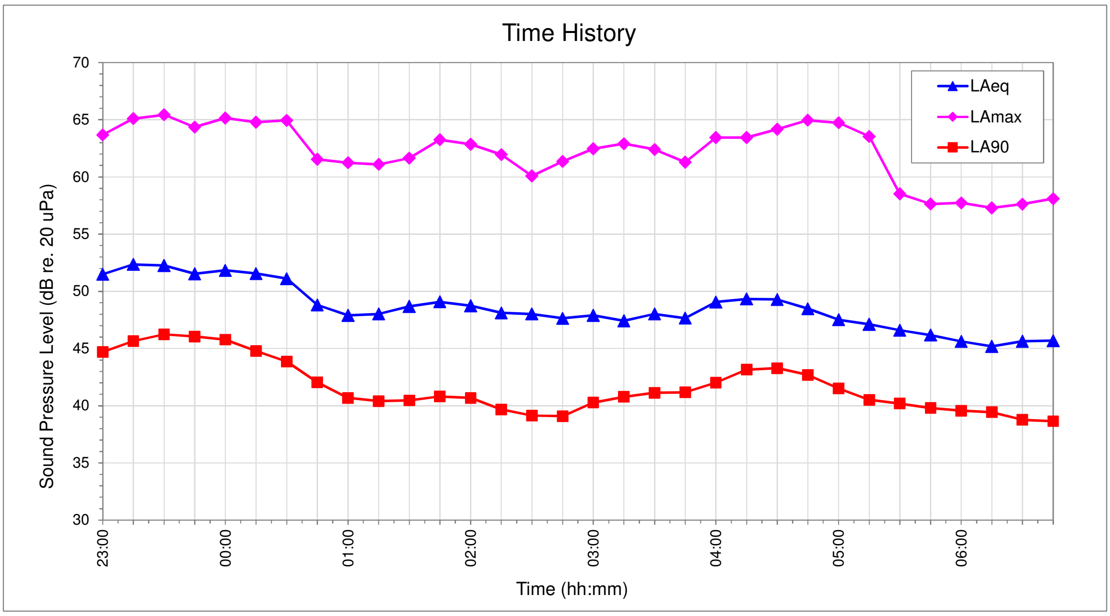
Note that the measurement position was chosen to represent the noise at the rear of the residential properties which are closest to the proposed delivery area.

6.0 <u>RESULTS AND DISCUSSIONS</u>

Most of this section concerns the mechanical equipment. Section 6.4 covers deliveries.

6.1 <u>Background Noise and Design Targets</u>

Full results are shown in Appendix 2. A summary is best displayed graphically as follows:-



The lowest 15 minute background noise level is 39 dB L_{A90}. We will use this as our design target (although BS4142 does not require the lowest level to be used, we do so here as a worst case).

6.2 Manufacturer's Noise Data

The following data was provided for a recent 1800m² food retail store (the store under consideration here being approximately 1550m²):-

Manufacturers' Data	*No.*	*Dist (m)*	*dB(A)*
Drycooler GFV 080.3A/3-L(S)-F6/4P	1	10	37
MIH FDC250VS A/C unit	2	1	58

For calculation purposes we have assumed a spectral shape (noise levels across the frequency range) based on similar units and these can be viewed in Appendix 2.

6.3 Predicted Noise Levels, Assessments and Discussions

Appendix 2 shows the calculation details and an explanation of the process is described in 4.1 above.

The predicted levels at the houses from the proposed equipment all running continuously is 33 dB L_{Aeq}. This is significantly below the lowest level of background noise and the impact will be negligible. Note that this prediction assumes that there is a clear line of sight between the plant and the nearest bedroom window and that it is located where shown in the sketch in 4.1 above. In reality it is likely to be located out of sight and/or within plant enclosure fencing.

6.4 Deliveries

Appendix 2 shows the calculation details and an explanation of the process is described in 4.2 above.

In order to meet the night time (23:00 to 07:00) external equivalent criterion for BS8233 "Desirable" conditions, the following delivery activities can take place.

Small refrigerated vans	:	46 per 8 hour night, or 1 every 10 minutes or so (effectively no limit)
Large refrigerated rigid vans	:	3 per 8 hour night, or 1 every 2 to 3 hours
Articulated refrigerated HGVs	:	1 per 8 hour night would exceed BS8233 equivalent external criteria for "Desirable" night time conditions by 2 dB, although still less than existing levels without the development.

Apart from night time HGVs, deliveries can, to all intents and purposes, be unrestricted, in that it is highly unlikely that more than 3 large rigids would be required during the night and certainly nowhere near 46 vans.

For daytime, at least six times the delivery numbers can be used before criteria are exceeded[2]. The figures for the number of deliveries are clearly going to be substantially in excess of anything that is remotely likely to occur but, for the record, they are as follows:-

Small refrigerated vans	:	295 per 16 hour day, or 1 every 1 to 2 minutes.
Large refrigerated rigid vans	:	19 per 16 hour day, or 1 every 25 minutes or so.
Articulated refrigerated HGVs	:	4 per 16 hour day, or 1 every 2 hours.

7.0 CONCLUSIONS/RECOMMENDATIONS

The predicted noise from typical external mechanical plant should be acceptable, day or night by any conceivably reasonable standard with no particular mitigation.

There should be no significant risk of noise from mechanical plant but the LPA may wish to impose a condition asking for details to be submitted and approved before the development is put into use.

Daytime deliveries of all types should be acceptable during daytime hours with any realistic number of delivery vehicles. Vans and large rigid trucks should also be acceptable during the night but articulated HGVs may be more difficult on the current design.

It would not be practicable to impose conditions on the numbers and types of delivery vehicles but it would also be unreasonable to impose a blanket restriction on night time deliveries as all but large articulated HGVs would be perfectly acceptable. At the outline planning stage a condition requesting details to be submitted and approved would seem the most appropriate route. This will enable the end user to present the finer details of their modus operandi, and the LPA to exercise appropriate control.

[2] The daytime is 16 hours rather than the 8 hour night time so clearly double the deliveries can occur for the same rate. Also the daytime criteria are 5 dB higher, equivalent to a 3-fold increase in activity. The combined effect is therefore a 6-fold increase.

Appendix 1

Definition of Acoustic Terms

The Decibel

The decibel is the basic unit of noise measurement and is denoted dB. Technically, it is a means of expressing the difference in noise level between the measured noise and a standard level of noise. Most often the threshold of human hearing is used as the standard reference but is really should be stated. The threshold of human hearing is a sound pressure of 20µPa or a sound power of 1pW.

A sound pressure level or SPL should be expressed in dB(re. 20µPa). A sound power level or SWL should be expressed in dB(re. 1pW). If the reference levels are omitted, it will often (but not always) be safe to assume that they are referenced to the threshold of human hearing.

A-Weighting and dB(A)

The human hearing system responds differently to different frequencies. The A-weighting system takes account of this by emphasising mid and high frequencies more than low frequencies to give an overall level. An A-Weighted noise level, therefore, reflects the way normal, healthy hearing would perceive the overall level of the noise. The basic unit is dB(A), although other systems of expressing an A-weighted levels are discussed below.

Other weighting systems, such as C-Weighting, denoted dB(C), reflect the human hearing system's response at higher noise levels.

NR and NC Levels

NR curves and NC curves are a series of curves representing noise levels across the frequency range. A given noise climate has an NR level or NC level if it equals a point on the curve at any frequency. They are particularly, although by no means exclusively, used as a means of specifying noise limits in an indoor environment, for instance from mechanical services or traffic noise break-in from the outside. They are typically expressed as NR or NC followed by a number, e.g. NR40, NC55, etc.

Equivalent Continuous Sound Level, L_{eq}

This can be simplistically described as a way of expressing the average noise level.

The unit is dB L_{eq}. For A-weighted levels the unit is dB(A) L_{eq} or, in more modern units, dB L_{Aeq}.

Maximum Level, L_{max}

This is the maximum level reached (usually for a fraction of a second) in the measurement period.

The unit is dB L_{max}. For A-weighted levels the unit is dB(A) L_{max} or, in more modern units, dB L_{Amax}.

Statistical (Percentile) Levels, L_n

During a measurement of fluctuating noise, it is often useful to establish the levels exceed for a percentage of the time. L_n is the index representing the level exceeded for n% of the measurement period.

The unit is dB L_n. For A-weighted levels, the unit is dB(A) L_n or, in more modern units, dB L_{An}.

Common examples are as follows :-

dB L_{A90} is the A-weighted level exceeded for 90% of the time and is often used to describe the underlying background noise.

dB L_{A50} is the A-weighted level exceed for 50% of the time. Mathematically, it is the median, another kind of average.

dB L_{A10} is the A-weighted level exceeded for 10% of the time and has traditionally been used to describe the intermittent highs in the noise climate such as passing cars or aircraft.

Frequency Analysis

Here the audible frequency range is divided up into bands and the noise level is expressed in each frequency band from low pitches to high pitches.

Octave Band analysis is where the frequency range is divided into 8 bands from 63 Hz to 8kHz, or sometimes into 10 bands from 31.5 Hz to 16kHz.

1/3 Octave Band analysis provides more detailed subdivision into 24 bands from 50 Hz to 10kHz, or sometimes into 30 bands from 20Hz to 20kHz.

Narrow Band analysis takes this further with the possibility of many thousands of bands, possibly only 1Hz wide, or even less.

In all types of frequency analysis, the level in each band can be expressed in terms of L_{eq}, L_{max}, L_n, etc. as defined above.

Sound Insulation

Sound insulation is best expressed across the frequency range in octave bands or third octave bands. Often, however, in known environments such as domestic sound insulation and speech privacy, it is simpler to express the sound insulation as a single figure. A higher value means better sound insulation.

The most common ways are dB D_{nTw}, dB R_w and $dB_{(mean\ 100\text{-}3150Hz)}$. The first two are ways of expressing average sound insulation, weighted to account for speech frequencies. The third is simply an un-weighted mean value.

The Building Regulations Approved Document E (ADE) routinely refer to D_{nTw} $+C_{tr}$ The C_{tr} term is a negative number which is used to modify the D_{nTw} value for the insulation properties at lower frequencies.

ADE also uses the L_{nTw} index for impact sound transmission. It is a measure of the level of noise in the room below a room in which a standard tapping machine is being used. It represents the impact sound transfer such as footfall noise, scraping chairs, washing machines, etc. A lower value means better insulation.

Reverberation Time

The most common measure of Reverberation Time is, effectively the time taken for sound from a steady source to decay by 60 dB after it has been abruptly cut off. In practice it is often difficult to measure a 60 dB decay and so decays of 30 dB, 20 dB, or even 10 dB are often used and adjusted pro rata, although the exact measure is not quite the same.

Reverberation Time is generally expressed as RT in seconds. We may, if we are being precise, add subscripts 60, 30, etc to show whether the basis of the measure is 60 dB decay, 30 dB decay, etc. E.g. the RT_{60} = 0.52s, the RT_{30} = 0.49s, etc.

RT can be expressed in octave bands or 1/3 octave bands across the frequency range, or at central frequencies such as 500 Hz or 1kHz.

Appendix 2

Measurement and Calculation Details

15 Minute Samples

Position	*Time*	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
1	23:00	Leq	**51**	64	52	49	47	48	42	35	28
		Lmax	**64**	74	64	67	63	57	48	39	30
		L90	**45**	52	43	39	38	43	35	24	23
	23:15	Leq	**52**	65	53	50	50	49	43	35	28
		Lmax	**65**	71	60	58	67	58	49	38	30
		L90	**46**	53	44	40	39	44	36	25	23
	23:30	Leq	**52**	64	53	50	49	49	42	34	27
		Lmax	**65**	74	65	63	67	58	48	39	32
		L90	**46**	52	44	40	39	45	37	25	23
	23:45	Leq	**52**	63	53	48	48	48	42	34	26
		Lmax	**64**	73	64	62	65	58	50	39	30
		L90	**46**	52	44	41	39	44	37	25	23
1	00:00	Leq	**52**	65	55	52	46	48	43	35	27
		Lmax	**65**	75	69	71	60	58	52	43	34
		L90	**46**	52	44	40	39	44	36	25	23
	00:15	Leq	**52**	65	54	52	46	48	43	35	26
		Lmax	**65**	73	68	70	59	59	53	43	32
		L90	**45**	52	43	39	38	43	35	25	23
	00:30	Leq	**51**	64	54	52	45	47	43	35	27
		Lmax	**65**	73	70	70	60	58	53	46	36
		L90	**44**	51	43	38	37	42	35	25	23
	00:45	Leq	**49**	59	49	45	42	46	41	34	27
		Lmax	**62**	65	66	59	58	58	53	48	36
		L90	**42**	50	41	37	35	40	33	24	23
1	01:00	Leq	**48**	58	49	44	42	44	41	34	26
		Lmax	**61**	65	66	59	58	57	53	48	36
		L90	**41**	50	41	36	34	38	32	24	23
	01:15	Leq	**48**	60	48	44	41	45	41	35	26
		Lmax	**61**	63	56	58	57	58	53	46	32
		L90	**40**	51	41	36	34	38	31	24	23
	01:30	Leq	**49**	63	51	49	43	44	41	36	28
		Lmax	**62**	66	57	66	57	57	51	40	29
		L90	**40**	51	41	37	34	38	31	24	23
	01:45	Leq	**49**	63	51	49	43	45	41	36	28
		Lmax	**63**	67	63	66	57	60	54	42	31
		L90	**41**	51	42	37	35	38	32	25	23
1	02:00	Leq	**49**	63	52	50	44	44	40	33	28
		Lmax	**63**	70	63	66	59	58	53	43	33
		L90	**41**	51	42	37	35	38	32	25	23
	02:15	Leq	**48**	62	52	48	43	44	40	32	26
		Lmax	**62**	77	69	61	57	57	53	43	33
		L90	**40**	50	41	36	34	37	30	24	23
	02:30	Leq	**48**	62	52	48	43	44	40	32	26
		Lmax	**60**	77	69	63	57	52	47	41	31
		L90	**39**	51	41	36	34	36	29	24	23
	02:45	Leq	**48**	59	51	47	42	44	39	31	25
		Lmax	**61**	77	69	62	59	55	50	43	32
		L90	**39**	51	41	35	33	37	29	24	23

15 Minute Samples (continued)

1	03:00	Leq	**48**	60	51	46	44	44	39	32	26
		Lmax	**62**	78	68	61	61	57	51	45	40
		L90	**40**	50	41	36	34	38	30	24	23
	03:15	Leq	**47**	60	50	45	43	44	39	31	26
		Lmax	**63**	78	66	59	61	59	52	44	40
		L90	**41**	49	40	36	34	39	30	24	23
	03:30	Leq	**48**	61	50	45	43	45	39	32	27
		Lmax	**62**	78	66	59	59	59	52	46	41
		L90	**41**	48	40	36	35	39	30	24	23
	03:45	Leq	**48**	59	48	45	42	45	39	31	25
		Lmax	**61**	74	60	64	56	57	51	45	36
		L90	**41**	47	40	35	35	39	31	24	23
1	04:00	Leq	**49**	60	50	46	43	46	41	32	26
		Lmax	**63**	73	61	64	57	60	55	46	36
		L90	**42**	47	40	35	35	40	32	24	23
	04:15	Leq	**49**	59	50	46	43	47	41	33	25
		Lmax	**63**	74	65	64	57	60	55	45	33
		L90	**43**	48	41	37	36	41	34	24	23
	04:30	Leq	**49**	59	51	46	43	47	41	33	25
		Lmax	**64**	65	64	57	57	62	56	48	38
		L90	**43**	47	41	36	37	42	34	24	23
	04:45	Leq	**48**	58	50	46	43	46	40	32	25
		Lmax	**65**	64	64	57	59	63	56	48	39
		L90	**43**	47	40	36	36	41	33	24	23
1	05:00	Leq	**48**	57	49	45	42	45	39	32	26
		Lmax	**65**	64	58	52	58	63	57	48	40
		L90	**42**	46	39	35	35	40	31	24	23
	05:15	Leq	**47**	57	47	44	41	44	39	32	26
		Lmax	**64**	62	57	52	57	62	56	45	38
		L90	**41**	46	38	34	34	39	30	24	23
	05:30	Leq	**47**	57	47	43	40	44	39	31	26
		Lmax	**59**	63	57	53	50	55	53	45	38
		L90	**40**	46	38	34	34	39	30	24	23
	05:45	Leq	**46**	58	49	43	40	43	37	30	25
		Lmax	**58**	62	57	50	49	55	51	39	28
		L90	**40**	45	38	34	34	38	29	24	23
1	06:00	Leq	**46**	57	49	42	39	43	37	29	25
		Lmax	**58**	64	57	51	50	55	51	39	29
		L90	**40**	45	37	33	34	38	28	24	23
	06:15	Leq	**45**	56	48	41	39	43	36	29	24
		Lmax	**57**	65	57	50	52	55	48	38	27
		L90	**39**	45	38	34	34	38	28	23	23
	06:30	Leq	**46**	57	46	42	39	43	37	29	25
		Lmax	**58**	64	52	51	52	56	49	39	28
		L90	**39**	46	37	33	33	37	28	24	23
	06:45	Leq	**46**	58	47	42	39	43	37	29	25
		Lmax	**58**	61	51	51	51	56	49	39	28
		L90	**39**	46	37	33	33	37	28	24	23

1 Hour Samples

Position	*Time*	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
1	23:00	Leq	**52**	64	52	49	49	48	43	35	27
		Lmax	**65**	73	64	64	66	58	49	39	31
		L90	**46**	52	44	40	39	44	36	25	23
	00:00	Leq	**51**	64	54	51	45	47	42	35	27
		Lmax	**64**	73	68	69	59	58	53	46	35
		L90	**44**	51	43	39	38	42	35	25	23
	01:00	Leq	**48**	62	50	47	42	44	41	35	27
		Lmax	**62**	66	62	64	57	58	53	45	33
		L90	**41**	51	41	36	34	38	31	24	23
	02:00	Leq	**48**	62	52	48	43	44	40	32	27
		Lmax	**62**	76	68	64	58	56	51	42	32
		L90	**40**	51	41	36	34	37	30	24	23
	03:00	Leq	**48**	60	50	45	43	44	39	32	26
		Lmax	**62**	77	66	61	60	58	52	45	39
		L90	**41**	49	40	36	35	39	30	24	23
	04:00	Leq	**49**	59	50	46	43	46	41	32	25
		Lmax	**64**	71	64	62	58	62	55	47	37
		L90	**43**	47	41	36	36	41	33	24	23
	05:00	Leq	**47**	57	48	44	41	44	38	31	26
		Lmax	**62**	63	57	52	55	60	55	46	38
		L90	**41**	46	38	34	34	39	30	24	23
	06:00	Leq	**46**	57	47	42	39	43	36	29	25
		Lmax	**58**	64	55	51	51	56	49	39	28
		L90	**39**	46	37	34	33	37	28	24	23

8 Hour Samples

Position	*Time*	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
1	23:00 - 07:00	Leq	**49**	61	51	47	44	46	40	33	26
		Lmax	**63**	73	65	64	60	59	53	44	35
		L90	**42**	50	41	37	36	40	33	24	23

Mechanical Plant

Manufacturers' Data	*No.*	*Dist (m)*	*dB(A)*
Drycooler GFV 080.3A/3-L(S)-F6/4P	1	10	37
MIH FDC250VS A/C unit	2	1	58

Predicted at Nearest Residential	*No.*	*Dist (m)*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Assumed Spectrum Shape	-	-	**-**	10	4	1	-4	-6	-10	-13	-20
Drycooler GFV 080.3A/3-L(S)-F6/4P	1	1	**57**	67	61	58	53	51	47	44	37
MIH FDC250VS A/C unit	2	1	**61**	71	65	62	57	55	51	48	41
Barrier Effect (none assumed)	-	-	**-**	0	0	0	0	0	0	0	0
Distance Correction (worst case)	-	30	**-**	-30	-30	-30	-30	-30	-30	-30	-30
Total	3	30	**33**	43	37	34	29	27	23	20	13

Deliveries

Basic Data

Dilivery Van with Chiller, eg Supermarket Home Delivery	*Duration (s)*	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Unloading @ 10m from centre of vehicle	600	Leq	**55**	56	62	57	55	43	39	32	25
		SEL	**82**	84	89	85	83	70	67	60	53
		Lmax	**68**	63	68	67	70	55	51	41	28
Reverse @ 10m from centre of vehicle	10	Leq	**59**	70	61	57	53	56	51	47	41
		SEL	**69**	80	71	67	63	66	61	57	51
		Lmax	**62**	73	64	60	55	59	53	49	42
Start up and Pull-away @ 10m from centre of vehicle	10	Leq	**62**	69	60	58	54	58	55	49	45
		SEL	**72**	79	70	68	64	68	65	59	55
		Lmax	**65**	70	62	60	57	61	58	55	48
All Activities	1	SEL	**83**	86	89	85	83	73	70	63	58
		Lmax	**66**	70	65	63	66	59	55	51	44

Large Rigid with Chiller	*Duration (s)*	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Unloading @ 10m from centre of vehicle	1200	Leq	**64**	70	69	65	63	56	53	47	39
		SEL	**94**	100	100	96	94	87	84	77	70
		Lmax	**75**	78	77	75	76	67	64	56	46
Reverse @ 10m from centre of vehicle	15	Leq	**67**	76	69	65	62	62	59	54	47
		SEL	**78**	88	81	77	74	74	71	66	58
		Lmax	**73**	83	75	72	68	69	65	60	53
Start up and Pull-away @ 10m from centre of vehicle	15	Leq	**68**	76	69	65	63	64	61	55	49
		SEL	**80**	88	80	77	74	75	73	67	61
		Lmax	**74**	82	74	72	69	70	67	63	56
All Activities	1	SEL	**95**	101	100	96	94	87	84	78	71
		Lmax	**74**	82	76	73	72	69	65	60	53

Articulated HGV with Chiller	*Duration (s)*	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Unloading @ 10m from centre of vehicle	1800	Leq	**68**	80	74	70	65	62	57	53	45
		SEL	**100**	113	106	103	97	94	90	85	77
		Lmax	**79**	89	81	80	78	73	68	62	52
Reverse @ 10m from centre of vehicle	20	Leq	**74**	84	78	73	71	68	65	60	51
		SEL	**87**	97	91	86	84	81	78	73	64
		Lmax	**83**	95	87	84	81	78	74	68	62
Start up and Pull-away @ 10m from centre of vehicle	20	Leq	**75**	83	77	73	72	69	67	62	53
		SEL	**88**	96	90	86	85	82	80	75	66
		Lmax	**84**	93	86	84	82	79	76	71	65
All Activities	1	SEL	**101**	113	106	103	98	95	90	86	78
		Lmax	**83**	93	86	83	80	77	74	68	62

Models

Distance to Residential (m) 30
Model Time Period (Hours) 8

Mainly Small Vans
No. of Small Vans in period 46
No. of Larger Rigids in period 0
No. of Atriculated HGVs in period 0

Type of Vehicle	*Activity*	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Small Delivery Van	All	Leq	**45**	49	52	48	45	36	32	26	21
		Lmax	**56**	60	56	54	56	49	46	42	35
Larger Rigid	All	Leq	**0**	0	0	0	0	0	0	0	0
		Lmax	**0**	0	0	0	0	0	0	0	0
Articulated HGV	All	Leq	**0**	0	0	0	0	0	0	0	0
		Lmax	**0**	0	0	0	0	0	0	0	0
Overall Contribution	All	Leq	**45**	49	52	48	45	36	32	26	21
		Lmax	**56**	60	56	54	56	49	46	42	35

Mainly Large Rigids
No. of Small Deliveries in period 0
No. of Larger Rigids in period 3
No. of Atriculated HGVs in period 0

Type of Vehicle	*Activity*	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Small Delivery Van	All	Leq	**0**	0	0	0	0	0	0	0	0
		Lmax	**0**	0	0	0	0	0	0	0	0
Larger Rigid	All	Leq	**45**	52	51	47	45	38	35	29	21
		Lmax	**65**	72	66	64	63	59	56	51	44
Articulated HGV	All	Leq	**0**	0	0	0	0	0	0	0	0
		Lmax	**0**	0	0	0	0	0	0	0	0
Overall Contribution	All	Leq	**45**	52	51	47	45	38	35	29	21
		Lmax	**65**	72	66	64	63	59	56	51	44

Mainly Articulated HGVs
No. of Small Deliveries in period 0
No. of Larger Rigids in period 0
No. of Atriculated HGVs in period 1

Type of Vehicle	*Activity*	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Small Delivery Van	All	Leq	**0**	0	0	0	0	0	0	0	0
		Lmax	**0**	0	0	0	0	0	0	0	0
Larger Rigid	All	Leq	**0**	0	0	0	0	0	0	0	0
		Lmax	**0**	0	0	0	0	0	0	0	0
Articulated HGV	All	Leq	**47**	59	52	49	44	41	36	32	24
		Lmax	**73**	83	76	73	71	68	64	59	53
Overall Contribution	All	Leq	**47**	59	52	49	44	41	36	32	24
		Lmax	**73**	83	76	73	71	68	64	59	53