PO Box 1030, Warrington, Cheshire WA4 9FJ
t. 01925 723333 www.adcacoustics.co.uk

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One Stop

Assessment of External Plant Noise for
Proposed Store at Larkhill, SP4 8PZ

Prepared for :-

One Stop
Apex Road
Brownhills,
Walsall
WS8 7TS

Prepared by :-

Andrew Raymond

ADC Acoustics is a trading name of Acoustic Design & Control Limited
Registered Office: One City Place, Queens Road, Chester, CH1 3BQ Registered in England and Wales 5117653

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1.0 SUMMARY

During the evening period the noise was mainly local traffic on the Packway which was a constant flow with the occasional break when more distant traffic noise was audible, as well as occasional live firing.

During the night, there was very little local road traffic, mainly HGVs. Distant traffic was faintly audible.

Based on an assumption of all equipment running on full load throughout the night, the predicted noise from the external mechanical plant in the proposed positions is likely to have negligible impact at the most affected residential positions. This is based on a small increase in height and specification to part of the fence around the northern yard area.



A R Raymond



P J Durell

2.0 INTRODUCTION

ADC was asked to carry out an independent assessment of the plant area of the proposed new One Stop store and predict the overall impact at the nearest noise-sensitive positions.

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 brief statement of survey details we discuss basic results and the resulting assessment. The impact is discussed along with any recommendations for mitigation.

3.0 ASSESSMENT STANDARDS

3.1 NPPF, NPSE and NPPG

The National Planning Policy Framework (NPPF), the Noise Policy Statement for England (NPSE) and the National Planning Practice Guidance (NPPG) provide nothing in the way of quantitative criteria but instead provide general policy aims and statements and some guidance on how certain situations can be interpreted.

The NPPF's main statement on noise is to be found in paragraph 185:-

> 185. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:
>
> a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life[65];
>
> b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and
>
> c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.

Paragraph 187 is also relevant:-

187. Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed.

The NPPF refers to the 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.

The NPPG section on noise adds some further detail, much of it reproducing the NPPF and NPSE, but some useful qualitative guidance is provided Noise Exposure Hierarchy, as follows:-

Response	***Examples of outcomes***	***Increasing effect level***	***Action***
No Observed Effect Level			
Not present	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, 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 small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, 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 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.	Significant Observed Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

It also makes the point that the subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation, including the level of the noise in absolute terms and how it might compare with the underlying background noise, the impulsiveness or intermittence pattern of the noise, its spectral content, and the time of day. It discusses in very general terms the issues to consider when introducing noise sources to existing noise sensitive area, new residential development in areas affected by existing noise sources (most of which have their own specific guidance, such as BS 4142, BS 8233, etc.) and the potential impact on wildlife.

3.2 BS 8233

BS 8233 was updated in March 2014. Quantitatively, however, the design criteria are little changed – just expressed differently to reduce ambiguity in certain situations. Its guidance is primarily intended for new buildings, but the criteria are routinely referred to for putting general noise climates into context.

The criteria in Table 4 of BS 8233 are based on WHO guidance and give 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 $L_{Aeq,8hour}$	30 dB $L_{Aeq,8hour}$

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 $L_{Aeq,8hour}$	45 dB $L_{Aeq,8hour}$

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 BS 8233 more explicitly specifies the assessment periods as 16 hour and 8 hour for daytime and night time respectively.

3.3 BS 4142

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.

3.4 Local Authority

We are not aware of any criteria proposed by the Local Authority

4.0 BASIC APPROACH TO MODELLING

We have used the well-established CadnaA modelling software which calculates noise propagation based on the processes of *ISO 9613 : Acoustics – Attenuation of sound during propagation outdoors*. Obviously, modelling software is reliant on the inputs and assumptions. The keys ones are:-

1. The ground is mainly reflective (coefficient of 0.11 assumed).

2. Calculations are based on two orders of reflections.

3. The proposed site buildings and the surrounding buildings are assumed to be mainly reflective (0.5 dB loss on reflection assumed).

4. The surrounding trees and vegetation will provide a small degree of absorption but this has been neglected.

5. Where acoustic fences are used, they are also assumed to be reflective the same as the buildings, unless specified otherwise.

6. The source data is based on manufacturers' literature. This is entered into the model along with the conditions under which the data was established (eg. free field, over hard ground, etc.) and tested to ensure the manufacturers' figure are faithfully reproduced in the model. When enclosures or silencers are specified, these are built into the figures.

7. All units are assumed to run continuously on full load.

5.0 SURVEY DETAILS

5.1 Site Times and Personnel

The site surveys were carried out by Mark Pimlett of ADC Acoustics from approximately 21:00 until shortly after 23:00 on 13th June 2023, and from shortly before 02:00 to shortly after 04:00 the following night. The times were chosen to represent evening opening times of the store, and through the quietest times of the night.

5.2 Instrumentation

Instrumentation used was a Rion NL-52. This is a Class I sound level meter which holds a current calibration certificate and which was field-calibrated as necessary. The meter was set up to measure continuous 5 minute samples of the noise climate.

All measurements have been gathered in terms of dB L_{eq}, dB L_{max} and dB L_{90} in overall A-weighted terms, and in octave bands across the frequency range. See Definition of Acoustic Terms in Appendix 1.

5.3 Measurement Positions

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



The position was chosen to represent the nearest residential area.

The microphone was 1.3 m above ground and well away from other reflecting surfaces.

5.4 Survey Conditions

Weather conditions were as follows :-

Rain	:	none, dry roads
Cloud	:	0%
Temperature	:	15 to 25 Celsius
Wind	:	negligible

The general noise climate appeared to be normal and representative.

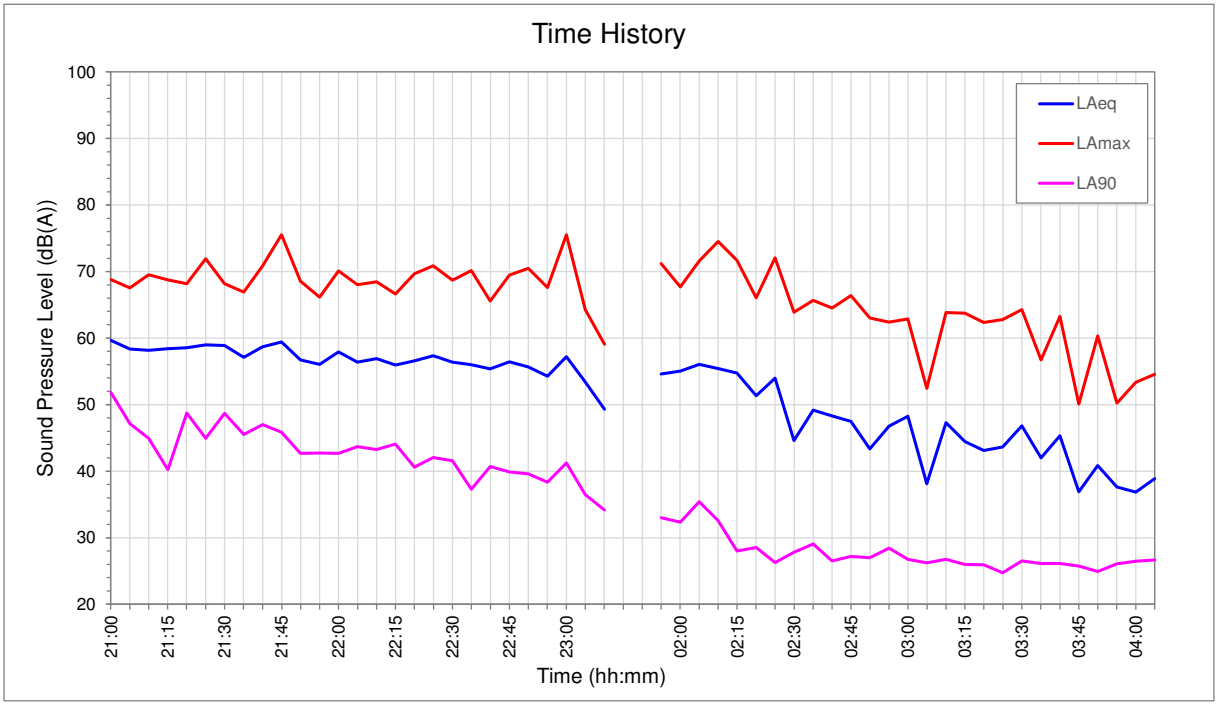
6.0 RESULTS AND DISCUSSIONS

6.1 Background Sound Levels

During the evening period the noise was mainly local traffic on the Packway which was a constant flow with the occasional break when more distant traffic noise was audible, as well as occasional live firing.

During the night, there was very little local road, mainly HGVs. Distant traffic was faintly audible.

Full results are shown in Appendix 2. They are summarised graphically below.



We have used the lowest 15 minute periods for the evening and night time measurements in the assessments. BS 4142 does not require us to use the lowest periods but it is a means mitigating against potential uncertainty of varying conditions, for instance on different days of the week. The levels for these periods are as follows:-

Time Period	*Index*	***dB(A)***
Lowest Evening	Leq	**56**
	Lmax	**69**
	L90	**39**
Lowest Night Time	Leq	**44**
	Lmax	**63**
	L90	**26**

6.2 Manufacturer's Noise Data

The following data was provided:-

Unit A - Danfoss OP-MPAM005COP04G (Size h834mm x w1350mm x d480mm) : Noise - 56dB(A) @ 1m
Unit B - Fijitsu AOYG45KBTB (Size h998mm x w940mm x d320mm) : Noise - 57dB(A) @ 1m
Unit C - Fijitsu AOYG45KBTB (Size h998mm x w940mm x d320mm) : Noise - 57dB(A) @ 1m
Unit D - Fijitsu AOYG45KBTB (Size h998mm x w940mm x d320mm) : Noise - 57dB(A) @ 1m
Unit E - Fijitsu AOYG54KBTB (Size h998mm x w940mm x d320mm) : Noise - 59dB(A) @ 1m

Where only the single figure (dB(A) or dB L_A) are available but no octave band data (spectral shape or noise levels across the frequency range), for calculation purposes we have assumed a spectral shape based on similar units. In all cases the manufacturers' datasheets were used to enter sound power levels.

6.3 Predicted Noise Levels

Based on all items operating on full load throughout the night[1], the predicted levels at the residential windows are as shown below:-

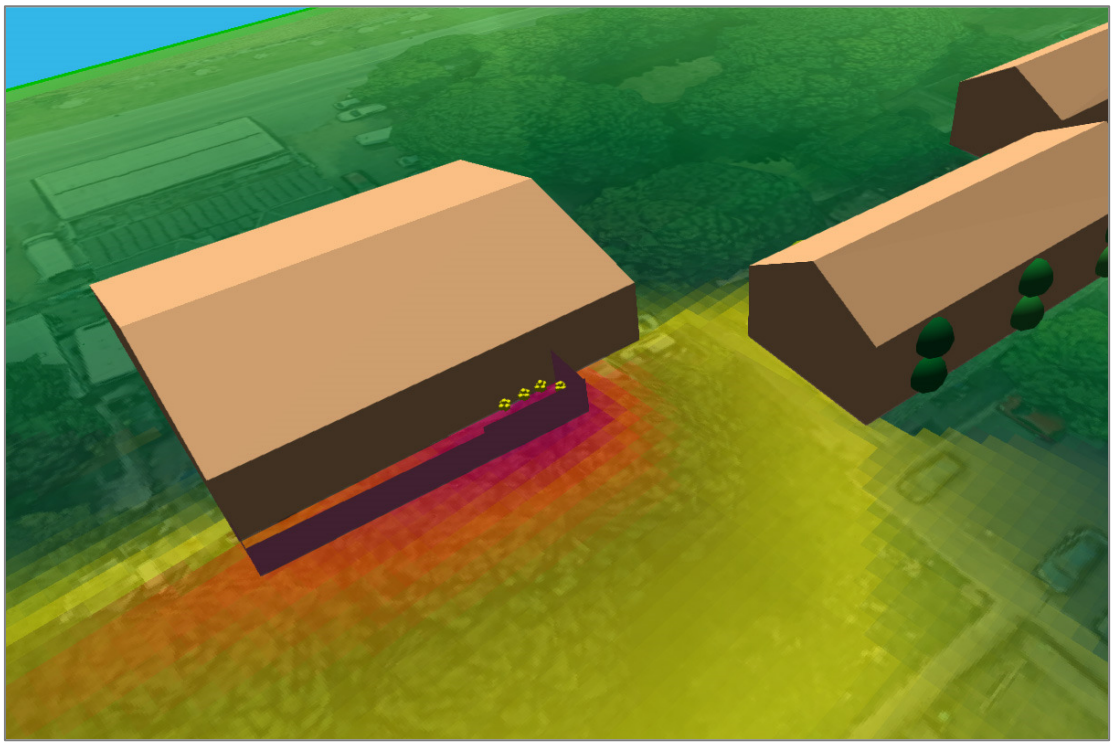


Note that:-

- The beige shapes are surrounding buildings and the application site building in its proposed form.
- The magenta lines are fences.
- The yellow crosses are the mechanical equipment point sources.
- The coloured numbers are the noise levels at the residential facades. Note that the software is set up to present the noisiest floor level.
- Note that the noise contours are shown for guidance as to how the noise propagates. The contours are at a height of 4 m.

The following 3D view should help to visualise the model.

[1]This is an extremely unlikely scenario, with most items rarely running beyond 70% for night time and rarely all items at the same time.



6.4 Assessments

For the assessment of proposed noise, BS 4142 requires us to assess the predicted industrial noise against the "background sound level" which is the noise climate without development described in terms of the underlying dB L_{A90} index.

The proposed equipment can potentially run 24 hour and so only the night time BS 4142 assessment is presented as follows:-

Specific Sound Level:	30 dB L_{Aeq}
Feature Corrections[2]	
tonality:	0 dB
impulsivity:	0 dB
intermittency:	0 dB
other:	0 dB
Rating Level:	30 dB L_{Ar}
Background Sound Level:	26 dB L_{A90}
Rating Level Excess re. Background	+4 dB

[2] The units are extremely unlikely to be tonal or impulsive. They will be intermittent to a degree at source but, at the receiver position, the intermittency is extremely unlikely to be *"readily distinctive against the residual acoustic environment"*, as BS 4142 describes it. Also the equipment tends to ramp up and down rather than abruptly cut in and out, and of course all the units will do so at different times, each masking the effect of the others. In any case, the noise is likely to be barely audible at the receiver positions and so no character corrections apply.

This is above what a BS 4142 *"Initial estimate"* rates as *"low impact depending on the context".*

The context of course is an established commercial site with the previous use as garage forecourt and car repair service. The context is especially crucial here due to the low predicted noise levels. BS 4142 states:-

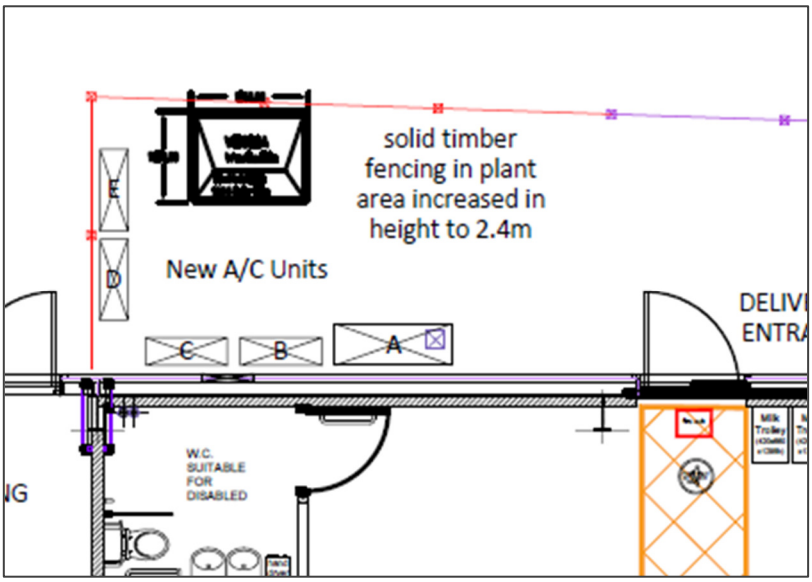
> Where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration, including the following.
>
> 1) The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall 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.

The current version of BS 4142 does not define what is "low", but previous versions defined it as a background level below 30 dB L_{A90} and a rating level below 35 dB L_{Aeq}. Here, levels are significantly below these figures and it is unlikely that the units will be audible inside bedrooms at all. We would suggest that the impact will be negligible.

Also important to the context is that we assume that all units run at full load at the same time, which is very unlikely ever to occur. The impact, even under the somewhat extreme assumption of all equipment running on full load at the same time is likely to be negligible.

6.5 Mitigation

The above modelling assumes a small increase in height and specification to part of the fence around the northern yard area. Most of the fence is specified as 2.0 m, but the 5 panels surrounding the equipment should be increased in height to 2.4 m. The following is an extract from the main planning drawing.



Note that the fence is relied upon to reduce the noise by 15 dB. For that reason it does not have to be an especially high spec fence. Theoretically, a barrier which is required to provide a 15 dB reduction only needs a density of 7 kg/m^2 which would be equivalent to around 13 mm thick timber. The more important point, however, is that there are no gaps, including allowance for shrinkage and warping. An overlapping 15 to 18 mm fence would be a typical example of a simple, moderate-performance acoustic fence. Note that this applies only to the 5 panels shown. The rest of the fencing is not relied upon at all.

6.6 Discussion of Uncertainty

BS4142 requires us to

"Consider the level of uncertainty in the data and associated calculations. Where the level of uncertainty could affect the conclusion, take reasonably practicable steps to reduce the level of uncertainty".

The measurements of Background/Residual Sound were taken at times regarded as representing what are likely to be the worst case (quietest) parts of the opening times and through the night. We have no reason to believe that the conditions were anything other than representative of normal conditions. BS 4142 does not state what would be a representative background noise but there is certainly no suggestion that it should be the lowest, and indeed it states, *"…the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods"*. However, in order to allow for the possibility of variation in levels, we have used the lowest 15 minute period.

Source data is assumed to be reliable. Where uncertainty may exist for this we have mitigated it by assuming that all equipment is running on full load all of the time, which would in our experience would rarely occur, if ever.

Calculations are based on the processes of *ISO 9613 : Acoustics – Attenuation of sound during propagation outdoors*. We know of no

concerns within our industry as to the basic reliability of these methods and it is cited in BS 4142 as *"a validated method of calculating sound levels"*. The CadnaA software uses this standard and the input assumptions err on the side of caution and are stated in Section 4.

Varying meteorological conditions are unlikely to have a significant impact on results as the distances involved are small.

7.0 CONCLUSIONS/RECOMMENDATIONS

Based on an assumption of all equipment running on full load throughout the night, the predicted noise from the external mechanical plant in the proposed positions is likely to have negligible impact at the most affected residential positions. This is based on a small increase in height and specification to part of the fence around the northern yard area.

Our only recommendation is that you issues this report to planners and that Officers are encouraged to contact us directly with any queries.

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

Measurements in Full

Time Period	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
21:00	Leq	**60**	65	57	54	53	57	52	44	32
	Lmax	**69**	79	71	66	65	65	60	57	49
	L90	**52**	55	46	43	45	50	44	33	21
21:05	Leq	**58**	62	56	52	50	56	51	42	29
	Lmax	**68**	75	73	61	62	65	59	54	41
	L90	**47**	50	43	38	40	45	40	29	18
21:10	Leq	**58**	62	60	52	50	56	51	43	31
	Lmax	**70**	76	78	68	64	65	61	55	47
	L90	**45**	49	40	36	39	43	37	26	16
21:15	Leq	**58**	62	56	52	51	56	51	43	31
	Lmax	**69**	77	70	67	63	66	61	54	44
	L90	**40**	46	39	34	36	38	30	21	15
21:20	Leq	**59**	63	59	53	50	56	51	42	30
	Lmax	**68**	77	77	69	62	63	59	52	44
	L90	**49**	52	45	40	41	46	42	31	19
21:25	Leq	**59**	64	56	53	52	57	52	44	34
	Lmax	**72**	82	72	67	67	68	65	59	53
	L90	**45**	50	42	38	39	43	37	25	16
21:30	Leq	**59**	63	55	52	51	57	52	42	30
	Lmax	**68**	77	73	61	66	64	60	52	40
	L90	**49**	48	42	39	42	47	41	30	17
21:35	Leq	**57**	62	53	50	50	55	50	42	30
	Lmax	**67**	73	70	61	62	64	59	54	46
	L90	**46**	50	40	36	39	44	37	27	15
21:40	Leq	**59**	65	62	52	50	56	51	43	32
	Lmax	**71**	83	84	68	61	64	59	59	50
	L90	**47**	49	42	37	41	45	39	27	15
21:45	Leq	**59**	63	67	60	51	56	51	43	31
	Lmax	**76**	78	87	80	68	65	62	57	46
	L90	**46**	51	42	37	39	44	38	25	14
21:50	Leq	**57**	66	55	51	50	54	49	42	30
	Lmax	**69**	85	71	65	64	65	59	54	48
	L90	**43**	47	37	35	37	41	34	22	14
21:55	Leq	**56**	64	52	49	48	54	49	41	28
	Lmax	**66**	82	65	63	61	63	58	52	42
	L90	**43**	48	38	34	36	41	35	21	14
22:00	Leq	**58**	65	57	53	52	55	50	43	32
	Lmax	**70**	80	71	67	67	65	63	60	49
	L90	**43**	48	40	34	38	41	33	20	13
22:05	Leq	**56**	59	53	51	48	54	49	41	30
	Lmax	**68**	77	71	66	61	63	58	61	54
	L90	**44**	47	38	34	37	42	35	23	14
22:10	Leq	**57**	62	54	51	50	54	50	43	31
	Lmax	**68**	75	68	64	64	65	61	59	49
	L90	**43**	47	38	35	38	41	36	20	13
22:15	Leq	**56**	59	52	50	48	54	49	40	28
	Lmax	**67**	72	68	67	59	64	58	51	40
	L90	**44**	46	38	35	37	42	36	21	13
22:20	Leq	**57**	62	55	50	50	54	49	42	30
	Lmax	**70**	76	71	64	66	67	60	54	46
	L90	**41**	46	38	33	35	39	32	18	13
22:25	Leq	**57**	63	57	52	50	55	50	41	30
	Lmax	**71**	79	77	72	65	67	60	52	44
	L90	**42**	48	38	33	36	40	34	19	13
22:30	Leq	**56**	60	52	50	49	54	49	40	28
	Lmax	**69**	73	68	65	64	65	62	54	43
	L90	**42**	47	37	33	36	40	33	19	13
22:35	Leq	**56**	60	53	49	50	54	49	40	29
	Lmax	**70**	74	68	62	69	66	62	53	42
	L90	**37**	45	36	31	34	35	27	16	13
22:40	Leq	**55**	56	50	48	47	53	48	39	27
	Lmax	**66**	70	61	60	59	63	58	53	42
	L90	**41**	45	37	32	34	39	33	19	13
22:45	Leq	**56**	60	52	49	48	54	49	41	28
	Lmax	**69**	75	68	61	62	68	59	56	46
	L90	**40**	45	38	32	33	38	32	20	14
22:50	Leq	**56**	59	57	49	48	53	48	41	30
	Lmax	**70**	77	77	64	65	67	62	57	48
	L90	**40**	45	38	33	34	38	31	17	13
22:55	Leq	**54**	61	53	49	47	52	47	38	28
	Lmax	**68**	78	67	65	63	64	60	53	45
	L90	**38**	47	37	31	32	36	30	17	13
23:00	Leq	**57**	64	56	52	51	54	50	44	33
	Lmax	**76**	81	71	66	64	68	72	68	56
	L90	**41**	47	37	33	35	39	33	19	13
23:05	Leq	**53**	55	48	46	45	51	46	37	26
	Lmax	**64**	68	60	57	54	62	56	50	42
	L90	**36**	41	33	30	32	34	28	16	13
23:10	Leq	**49**	50	45	42	41	47	43	33	21
	Lmax	**59**	61	54	53	51	57	51	42	31
	L90	**34**	42	34	28	31	32	24	15	13

Time Period	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
01:55	Leq	**55**	60	54	48	50	51	47	41	29
	Lmax	**71**	76	72	67	67	67	64	59	48
	L90	**33**	41	34	27	29	30	24	15	13
02:00	Leq	**55**	55	53	49	49	53	48	40	29
	Lmax	**68**	72	69	64	63	65	59	55	47
	L90	**32**	39	32	27	28	30	21	15	13
02:05	Leq	**56**	60	51	48	49	54	49	39	28
	Lmax	**72**	78	69	66	66	69	63	52	46
	L90	**35**	39	34	27	30	34	25	14	13
02:10	Leq	**55**	56	50	48	48	53	49	40	28
	Lmax	**74**	73	70	69	68	72	68	60	48
	L90	**33**	39	32	26	28	31	22	15	13
02:15	Leq	**55**	56	51	47	49	52	48	39	28
	Lmax	**72**	75	69	66	69	68	64	55	48
	L90	**28**	38	31	26	25	24	18	14	13
02:20	Leq	**51**	53	47	45	45	49	44	35	26
	Lmax	**66**	73	64	61	62	62	59	52	44
	L90	**29**	37	31	25	26	25	17	13	13
02:25	Leq	**54**	59	51	47	50	51	46	37	27
	Lmax	**72**	75	68	66	70	69	63	57	48
	L90	**26**	39	31	23	24	21	15	13	13
02:30	Leq	**45**	44	38	36	36	42	38	29	19
	Lmax	**64**	61	56	56	55	61	58	49	38
	L90	**28**	35	30	24	26	24	15	13	13
02:35	Leq	**49**	55	43	41	41	47	41	33	22
	Lmax	**66**	71	59	58	56	64	58	49	39
	L90	**29**	37	29	24	26	26	19	14	13
02:40	Leq	**48**	50	42	40	40	46	42	34	24
	Lmax	**65**	69	61	57	56	61	59	52	42
	L90	**27**	35	29	22	23	22	18	16	14
02:45	Leq	**48**	49	40	39	39	44	42	35	24
	Lmax	**66**	68	58	58	57	62	62	54	42
	L90	**27**	35	29	24	24	22	19	17	14
02:50	Leq	**43**	44	36	35	35	42	35	26	17
	Lmax	**63**	64	55	57	54	61	55	45	33
	L90	**27**	35	29	23	24	22	19	17	14
02:55	Leq	**47**	47	41	39	38	45	40	29	18
	Lmax	**62**	63	58	57	53	60	55	45	32
	L90	**28**	35	29	23	25	25	19	16	14
03:00	Leq	**48**	47	41	40	40	47	40	31	20
	Lmax	**63**	66	58	57	55	61	55	45	33
	L90	**27**	36	28	22	23	23	18	16	14
03:05	Leq	**38**	45	37	32	33	35	31	26	19
	Lmax	**52**	59	50	43	48	50	42	40	32
	L90	**26**	36	28	22	23	21	18	16	14
03:10	Leq	**47**	47	40	39	40	45	40	30	19
	Lmax	**64**	64	56	57	57	62	56	47	35
	L90	**27**	34	28	23	23	22	18	17	14
03:15	Leq	**44**	40	37	37	37	43	37	27	18
	Lmax	**64**	57	58	58	57	61	56	47	35
	L90	**26**	33	29	23	23	21	18	16	14
03:20	Leq	**43**	43	38	37	36	41	36	26	17
	Lmax	**62**	62	61	60	55	59	56	45	35
	L90	**26**	34	29	22	23	21	17	15	14
03:25	Leq	**44**	46	41	37	37	42	35	27	18
	Lmax	**63**	67	60	57	56	61	55	45	36
	L90	**25**	33	28	21	21	19	17	15	14
03:30	Leq	**47**	43	39	38	38	44	40	31	19
	Lmax	**64**	60	57	58	54	62	58	49	37
	L90	**26**	33	29	22	23	23	16	14	13
03:35	Leq	**42**	45	38	35	36	40	34	26	18
	Lmax	**57**	60	52	52	51	55	48	40	31
	L90	**26**	34	28	22	23	21	18	16	14
03:40	Leq	**45**	44	38	38	38	43	38	28	18
	Lmax	**63**	60	57	57	56	61	56	46	34
	L90	**26**	34	28	22	23	21	18	16	14
03:45	Leq	**37**	42	35	31	32	34	29	24	17
	Lmax	**50**	56	47	45	44	48	41	38	31
	L90	**26**	34	28	22	23	21	17	15	14
03:50	Leq	**41**	40	38	35	33	39	33	25	16
	Lmax	**60**	58	59	55	51	58	52	44	31
	L90	**25**	33	27	21	21	19	17	16	14
03:55	Leq	**38**	43	36	32	33	34	30	25	18
	Lmax	**50**	55	47	47	46	47	41	37	29
	L90	**26**	34	28	22	22	21	18	17	14
04:00	Leq	**37**	39	35	31	31	34	29	25	18
	Lmax	**53**	56	55	51	48	50	45	42	38
	L90	**26**	34	29	23	22	21	19	17	14
04:05	Leq	**39**	42	37	32	33	36	32	27	20
	Lmax	**55**	54	51	50	49	52	47	41	35
	L90	**27**	34	29	22	23	22	19	17	14

Time Period	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Lowest Evening	Leq	**56**	60	54	49	48	53	48	40	29
	Lmax	**69**	77	73	64	64	67	60	56	47
	L90	**39**	46	37	32	33	37	31	18	13
Lowest Night Time	Leq	**44**	44	39	37	37	42	36	27	17
	Lmax	**63**	64	60	59	56	61	56	46	35
	L90	**26**	33	28	22	22	20	17	15	14