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It's All In The Image

Assessment of noise impact for
Retrospective Planning.

Prepared for:-

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CONTENTS

1.0 SUMMARY

2.0 INTRODUCTION

3.0 ASSESSMENT STANDARDS

- 3.1 NPPF, NPSE and NPPG
- 3.2 BS 8233 and WHO
- 3.3 BS 4142
- 3.4 Local Authority

4.0 GUIDE TO MODELLING

5.0 SURVEY DETAILS

- 5.1 Site Times and Personnel
- 5.2 Instrumentation
- 5.3 Measurement Positions
- 5.4 Survey Conditions

6.0 RESULTS AND DISCUSSIONS

- 6.1 Background Sound Levels
- 6.2 Discussion of Sources
- 6.3 Results of Modelling
- 6.4 Mitigation
- 6.5 Overall Assessment
- 6.6 Discussion of Uncertainty

7.0 CONCLUSIONS/RECOMMENDATIONS

Appendix 1: Definition of Acoustic Terms

Appendix 2: Measurements in Full

1.0 SUMMARY

At the measurement position, the internal factory noise from the factory was audible, mainly through the open door, as well as other and sources around the western end of the building. The CNC and Edging roof areas were also just perceptible. These, and other less important sources were built into the modelling.

The impact is just above what a BS 4142 *“initial estimate”* rates as *“low impact depending on the context”*, but well below what it rates as *“adverse impact depending on the context”*.

The context of course is a well establish industrial area with the site itself a previous industrial use. We understand that there have been no complaints about the factory operational noise. We would suggest that the impact is low.



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2.0 INTRODUCTION

ADC was asked to carry out an independent assessment of the above site with regards to the impact of proposed mechanical equipment.

This report begins by summarising assessment standards and, where appropriate, discusses alternative interpretations.

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 life⁶⁵;
 - 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 BS8233 and WHO

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} but the WHO Guidelines for Community Noise (or similar) are widely used with a recommendation that the noise inside bedrooms should not typically exceed 45 dB L_{Amax} , for instance no more than 10 to 15 times a night.

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 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:

- sound from industrial and manufacturing processes
- 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 other criteria associated with this project.

4.0 GUIDE 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 key ones are:-

1. The ground is a mixture of absorptive and reflective (coefficient of 0.2 pessimistically 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.
6. The source data is based on site measurements of the factory in normal production. Measurements of individual sources were made at known distances, such as 1 m, or over a surface, such as an open door. They are entered into the model in terms of sound power and tested within the model to ensure the on-site levels are faithfully reproduced.
7. All units are assumed to run continuously on full load.

5.0 SURVEY DETAILS

5.1 Site times and Personnel

The survey on the proposed site was carried out by Andrew Raymond and Mark Pimlett of ADC Acoustics on the morning of 28th August 2023. The period was chosen to be outside of rush hour during the normal working day. The site does not normally work into the evening.

5.2 Instrumentation

Instrumentation used was two Rion NL-52. These are Class I sound level meters which hold current calibration certificates and which were field-calibrated as necessary. One was set up to measure continuous 5 minute samples of the noise climate near the boundary and the other was used for sample measurements of individual sources.

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

The position was chosen to represent the nearby housing in terms of background noise (factory not operating). For the factory noise itself, some modelling was required due to the different land levels and presence of fencing, etc.

In addition, sample measurements were made at short distances from the various sources.

5.4 Survey Conditions

Weather conditions were as follows :-

Rain	:	none, dry roads
Cloud	:	80%
Temperature	:	17 to 18 Celsius
Wind	:	negligible

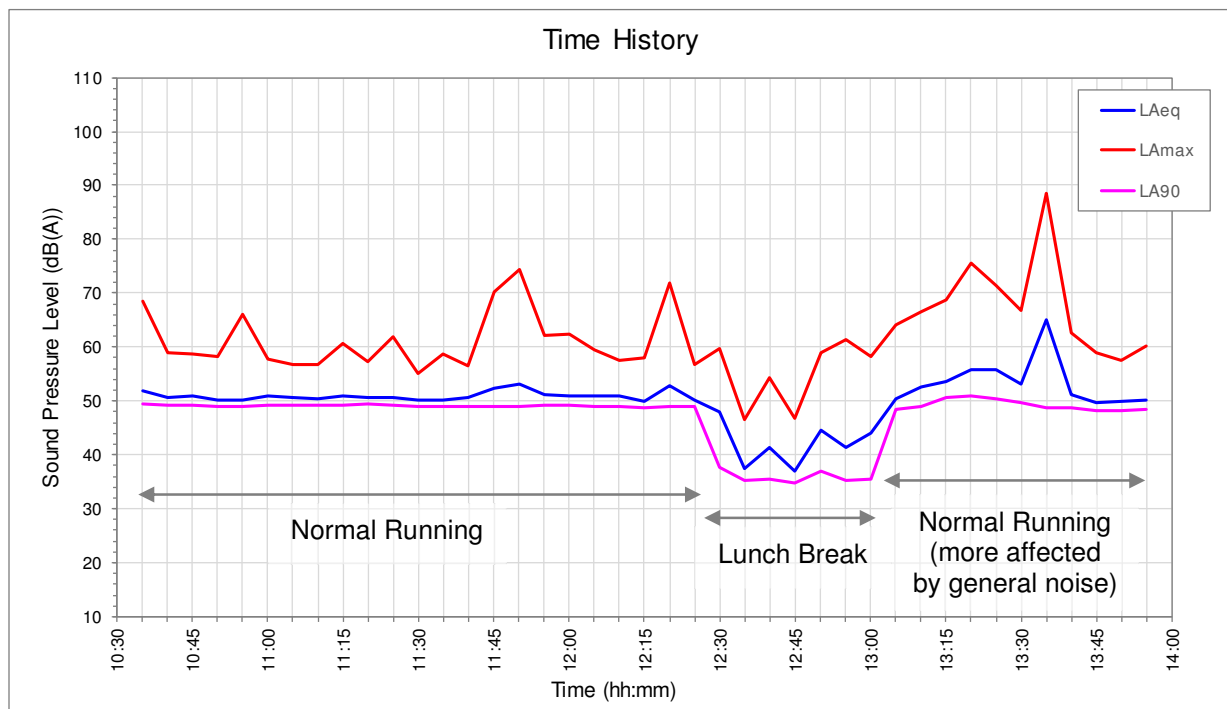
The general noise climate appeared to be normal and representative. We were advised that the factory was in a busy period of production and so representative of a typical worst case. Any processes not being used were set running for us.

6.0 RESULTS AND DISCUSSIONS

6.1 Basic Results

At the measurement position, the internal factory noise from the factory was audible, mainly through the open door, as well as other and sources around the western end of the building. The CNC and Edging roof areas were also just perceptible. These, and other less important sources were built into the modelling.

Full results of the main measurements are shown in Appendix 2. They are summarised graphically below.



We have used the overall first Normal Running period levels and the Lunch Break levels when the factory was effectively shut down, to derive the Factory noise on its own. This is summarised as follows:-

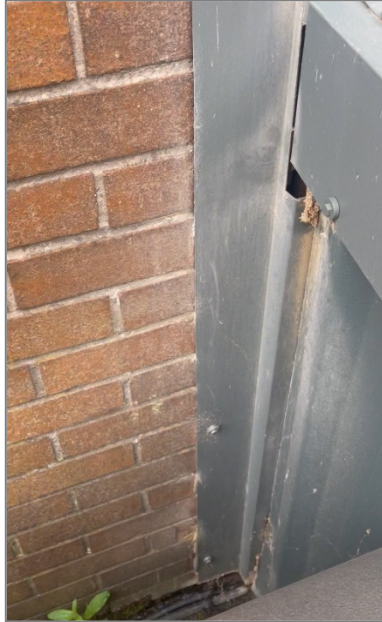
Operating Conditions	Index	dB(A)	63
Factory Running Normally	Leq	51	63
	Lmax	65	70
	L90	49	61
Lunch Break	Leq	43	55
	Lmax	58	69
	L90	36	46
Factory Only	Leq	50	63
	Lmax	n/a	-
	L90	49	61

6.2 Discussion of Sources

The following sources were identified and entered into the modelling.

Open Door. This was measured over its surface and entered as a vertical area source.

Dust Collector Leak. This can be identified by ear and was entered as a very small area source based on close-to measurements.



Production Area Roofs. These calculated from the internal levels, with sound insulation data for Roof panels and thin polycarbonate roof lights. There were entered as large area sources.

Gaps and holes in and around the Cladding. These were detected by ear (and eyes where inaccessible) and included small holes and unsealed gaps along cladding edges. They were entered as small and/or thin vertical area sources.



Areas of Exposed Duct. Four such points were found on the underside of the stretch of ground level ducting along the wester side of the factory. Each is entered as point source.



Open Vents. Two vents were making a small contribution and are entered as area sources.



6.3 Results of Modelling

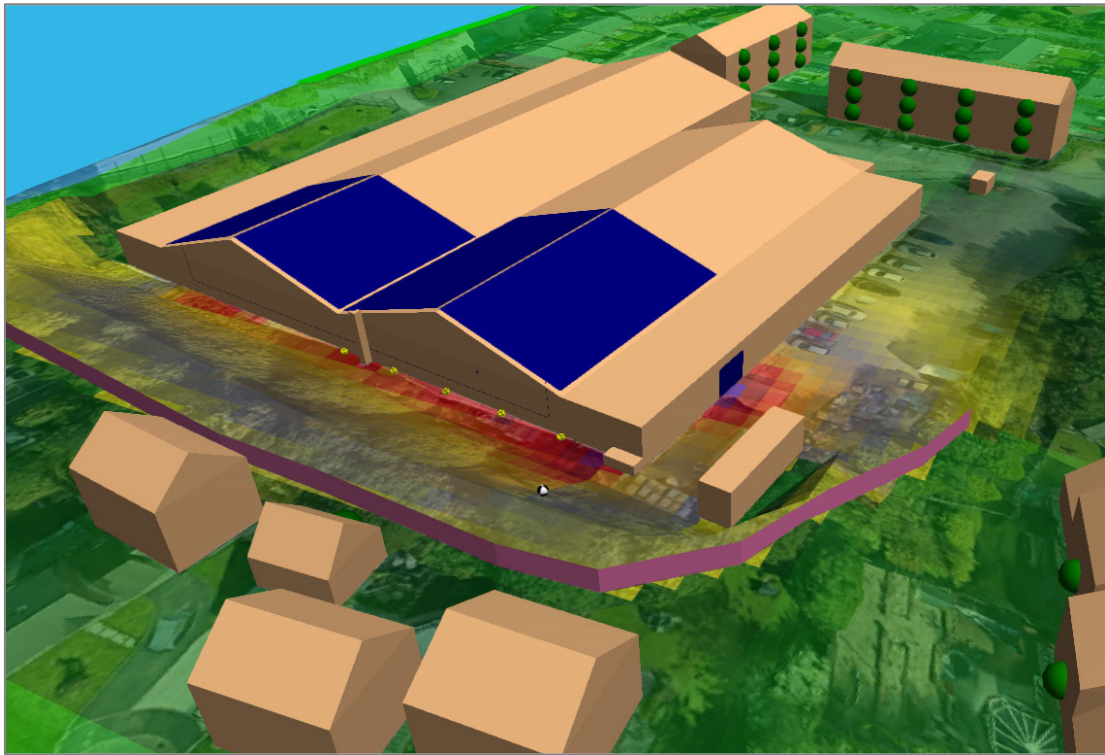
Full details of methods and assumptions described in Section 4.0 above. The result of the modelling is shown below.



Note that:-

- The beige shapes are buildings
- The yellow crosses are point sources
- The area sources are shown as dark blue hatched area. For vertical area sources these are just thin blue lines which are easier to see in the 3D view.
- The magenta lines are fences.
- The numbers in the coloured octagons are the noise levels at the residential facades. Note that the software is set up to present the noisiest floor level.
- The number in the rectangle is the level at the main measurement position.
- Note that the noise contours are shown for guidance as to how the noise propagates. The contours are at a height of 1.5 m.

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



6.4 Mitigation

Boundary fencing is built into the modelling. Note that it is only relied upon to reduce noise by up to 6 dB at the most affected residential locations, so does not have to be a specialist acoustic fence. Theoretically, a barrier which is required to provide a 10 dB reduction only needs a density of 3 kg/m² which would be equivalent to around 6 mm thick timber. The important point is that there are no gaps and on inspection there appeared to be none and the fences were in generally good condition.

6.5 Overall Assessment

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 LA90 index.

The BS 4142 assessment is presented as follows:-

Specific Sound Level:	38 dB L _{Aeq}
Feature Corrections ¹	
tonality:	0 dB
impulsivity:	0 dB
intermittency:	0 dB
other:	0 dB
Rating Level:	38 dB L _{Ar}
Background Sound Level:	37 dB L _{A90}
Rating Level Excess re. Background	+1 dB

This is just above what a BS 4142 “*initial estimate*” rates as “*low impact depending on the context*”, but well below what it rates as “*adverse impact depending on the context*”.

The context of course is a well establish industrial area with the site itself a previous industrial use. We understand that there have been no complaints about the factory operational noise. We would suggest that the impact is low.

6.6 Discussion of Uncertainty

BS 4142 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”.

We have no reason to believe that the background conditions were anything other than representative of normal conditions. The factory noise measurements were made during a busy spell and so should represent a typical worst case.

Source data is should be reliable as it was all measured on-site (as opposed to the typical planning situation where we rely on manufacturers’ specification data). Where possible the model was “tested” to ensure that on-site measurements were reproduced. The roof areas are the only one where we could not measure directly over the external surfaces. However, these were subjectively and analytically not the main sources of noise at the various positions.

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.

¹ There was no evidence of tonality or impulsivity. The individual sources within the factory 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.

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

We would suggest that uncertainty is low and, where it may exist, it is mitigated for by the assumption of a busy period persisting all day every day.

Other sources such as Fork Lift Trucks and other vehicle movements have not been included. We are advised that these are very infrequent and we witnessed very little during our site survey.

7.0 CONCLUSIONS/RECOMMENDATIONS

The impact is just above what a BS 4142 *“initial estimate”* rates as *“low impact depending on the context”*, but well below what it rates as *“adverse impact depending on the context”*.

The context of course is a well establish industrial area with the site itself a previous industrial use. We understand that there have been no complaints about the factory operational noise. We would suggest that the impact is low.

Boundary fencing is built into the modelling. It is only relied upon to reduce noise by up 6 dB at the most affected residential locations, so does not have be a specialist acoustic fence. However it will need to be maintained in good condition (no gaps), particularly along the western boundary.

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 it really should be stated. The threshold of human hearing is a sound pressure of 20 μ Pa or a sound power of 1pW.

A sound pressure level or SPL should be expressed in dB(re. 20 μ Pa). 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 $L_{A\max}$.

Statistical (Percentile) Levels, L_n

During a measurement of fluctuating noise, it is often useful to establish the levels exceeded 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 exceeded 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 100-3150Hz). 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

<i>Time Period</i>	<i>Index</i>	<i>dB(A)</i>	63	125	250	500	1k	2k	4k	8k
10:35	Leq	52	65	61	52	47	45	43	41	32
	Lmax	68	74	72	67	63	62	61	61	50
	L90	49	62	59	50	45	43	39	37	30
10:40	Leq	51	64	61	51	46	45	40	38	32
	Lmax	59	68	65	55	52	52	50	51	53
	L90	49	62	59	50	44	43	39	37	30
10:45	Leq	51	64	60	51	46	45	40	37	31
	Lmax	59	71	65	59	55	53	49	44	44
	L90	49	62	59	50	44	43	39	36	30
10:50	Leq	50	64	60	51	45	44	39	37	31
	Lmax	58	69	65	56	53	51	50	51	47
	L90	49	62	59	50	44	42	39	36	29
10:55	Leq	50	63	60	51	45	44	39	37	30
	Lmax	66	73	65	68	63	61	56	48	42
	L90	49	62	59	50	43	43	38	36	29
11:00	Leq	51	63	61	52	46	45	40	37	31
	Lmax	58	67	66	54	52	54	47	42	38
	L90	49	61	59	51	45	43	39	36	30
11:05	Leq	51	63	61	51	46	45	40	37	31
	Lmax	57	68	66	55	53	52	46	40	35
	L90	49	62	59	50	44	43	39	36	30
11:10	Leq	50	64	60	51	45	44	40	37	31
	Lmax	57	68	65	56	53	51	48	44	37
	L90	49	62	59	50	44	42	39	36	29
11:15	Leq	51	63	60	53	46	44	40	37	30
	Lmax	61	68	65	62	59	56	48	43	36
	L90	49	62	59	50	44	43	39	36	29
11:20	Leq	51	63	60	51	46	45	40	38	31
	Lmax	57	70	65	55	54	52	47	45	41
	L90	49	61	59	50	45	43	39	37	30
11:25	Leq	51	64	60	51	46	44	40	37	31
	Lmax	62	69	66	57	53	60	52	52	43
	L90	49	62	59	50	44	43	39	36	30
11:30	Leq	50	63	60	51	45	44	40	37	30
	Lmax	55	68	66	54	51	49	45	40	36
	L90	49	62	59	50	44	43	39	36	29
11:35	Leq	50	63	60	51	45	43	39	37	30
	Lmax	59	68	65	56	53	55	49	46	42
	L90	49	61	59	50	44	42	39	36	29
11:40	Leq	51	63	60	51	45	45	40	37	31
	Lmax	57	67	65	54	51	52	47	42	36
	L90	49	61	59	50	44	43	39	36	29
11:45	Leq	52	64	61	51	47	45	45	44	32
	Lmax	70	72	65	60	66	63	65	63	50
	L90	49	61	59	49	44	42	39	36	29
11:50	Leq	53	63	60	51	47	46	47	43	34
	Lmax	74	70	64	60	72	69	68	64	57
	L90	49	61	59	50	44	42	39	36	29
11:55	Leq	51	64	61	51	46	46	41	38	31
	Lmax	62	69	65	54	58	58	56	50	40
	L90	49	61	59	50	45	43	39	36	30
12:00	Leq	51	63	60	51	45	44	42	39	31
	Lmax	62	68	65	55	58	54	59	50	42
	L90	49	61	59	50	44	43	39	36	30
12:05	Leq	51	63	61	52	45	45	40	38	34
	Lmax	59	68	66	64	52	53	48	44	49
	L90	49	61	59	50	44	42	39	36	30
12:10	Leq	51	63	60	52	46	45	40	38	32
	Lmax	58	68	64	59	52	53	47	42	38
	L90	49	61	59	50	44	42	39	36	30
12:15	Leq	50	63	61	51	46	43	39	36	30
	Lmax	58	72	65	58	56	53	47	41	37
	L90	49	61	59	49	45	42	38	36	29
12:20	Leq	53	63	61	56	50	46	40	37	31
	Lmax	72	68	69	79	69	60	51	43	37
	L90	49	61	59	48	45	42	38	36	30
12:25	Leq	50	64	60	51	45	43	39	37	31
	Lmax	57	75	65	54	52	51	46	44	38
	L90	49	62	59	50	44	42	38	36	29

Time Period	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
12:30	Leq	48	61	58	49	44	41	37	33	27
	Lmax	60	76	64	55	53	57	50	39	36
	L90	38	48	45	38	35	33	27	24	20
12:35	Leq	37	48	44	38	34	33	26	22	17
	Lmax	46	61	52	46	41	42	38	35	27
	L90	35	44	41	35	32	31	24	19	16
12:40	Leq	41	51	48	46	37	34	26	22	18
	Lmax	54	63	62	61	47	42	35	30	27
	L90	36	45	41	36	33	31	24	18	15
12:45	Leq	37	48	44	38	34	32	26	21	16
	Lmax	47	63	54	45	42	42	36	32	32
	L90	35	44	40	35	32	30	24	18	15
12:50	Leq	45	51	51	47	43	38	31	26	21
	Lmax	59	65	60	61	57	51	51	48	39
	L90	37	47	43	38	33	33	25	20	16
12:55	Leq	41	57	48	44	37	36	30	26	23
	Lmax	61	69	59	54	54	58	52	53	50
	L90	35	46	41	36	32	31	24	19	15
13:00	Leq	44	56	52	47	39	38	33	29	23
	Lmax	58	67	64	60	52	55	45	42	42
	L90	36	46	40	35	32	32	25	20	16

Time Period	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
13:05	Leq	50	64	61	51	46	44	40	36	29
	Lmax	64	69	69	64	59	61	54	51	39
	L90	48	62	59	49	44	41	37	33	26
13:10	Leq	53	63	61	52	48	47	44	41	32
	Lmax	67	74	66	62	62	59	61	60	44
	L90	49	62	59	50	44	42	38	35	29
13:15	Leq	54	64	61	52	49	47	46	44	32
	Lmax	69	69	67	60	63	63	63	61	51
	L90	51	62	59	51	47	45	41	37	29
13:20	Leq	56	66	63	54	52	51	47	45	32
	Lmax	76	88	81	73	71	72	65	65	44
	L90	51	62	60	51	47	45	41	37	30
13:25	Leq	56	66	62	55	52	51	47	44	33
	Lmax	71	80	76	73	68	66	61	58	50
	L90	50	63	59	51	46	44	41	37	30
13:30	Leq	53	65	61	52	48	47	45	44	32
	Lmax	67	73	67	60	63	57	60	61	47
	L90	50	63	59	50	45	44	40	37	30
13:35	Leq	65	69	67	65	61	61	58	52	40
	Lmax	88	95	93	90	84	83	80	76	64
	L90	49	63	59	50	45	41	37	35	28
13:40	Leq	51	64	61	51	48	45	38	36	30
	Lmax	63	72	66	61	61	59	50	47	37
	L90	49	62	59	50	45	41	37	35	29
13:45	Leq	50	64	61	50	45	42	37	36	29
	Lmax	59	68	66	57	57	52	50	42	37
	L90	48	62	59	49	44	40	36	35	29
13:50	Leq	50	63	61	50	45	43	38	36	30
	Lmax	58	68	65	54	53	54	47	44	35
	L90	48	62	59	49	43	40	37	35	29
13:55	Leq	50	64	61	50	45	43	38	37	32
	Lmax	60	69	66	53	50	52	49	52	57
	L90	48	62	59	49	44	41	37	35	29

Operating Conditions	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
Factory Running Normally	Leq	51	63	60	52	46	45	41	39	31
	Lmax	65	70	66	66	62	59	57	55	47
	L90	49	61	59	50	44	42	39	36	29
Lunch Break	Leq	43	55	52	46	40	37	32	28	22
	Lmax	58	69	61	58	52	54	48	46	43
	L90	36	46	42	36	33	32	25	20	16
Factory Only	Leq	50	63	60	50	45	44	40	38	31
	Lmax	n/a	-	-	-	-	-	-	-	-
	L90	49	61	59	50	44	42	39	36	29