



**Frank Roberts & Sons Ltd**  
**Roberts Bakery & Little Treats, Northwich**

Noise Impact Assessment

9379042-01 – August 2020

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## Document Control Sheet

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## Executive Summary

Bureau Veritas was instructed by Frank Roberts & Sons Limited to undertake an environmental noise impact assessment of their bakery site at Gadbrook Park, Northwich to support their Environmental Permit application.

An assessment of the operational noise impacts has been carried out in accordance with the standard best practice and technical guidance.

A survey of individual sound sources, including: fixed mechanical plant/processes; vent exhaust points and process building openings, was conducted on 6<sup>th</sup> July 2020.

A detailed noise propagation model was developed for the site and surrounding areas, including all factors that influence the propagation of sound, such as objects that screen, reflect or absorb sound. The physical parameters of each identified sound source, including size, relative height and derived sound power levels were incorporated and calibrated within the model.

Standard noise propagation calculations were used to predict noise from the operation of the bakery site during both day- and night-time periods at the nearest residential receptors. This includes consideration of the variation in cooling requirements, in particular between winter and summer periods.

The assessment concludes that daytime operations at the bakery site, including tanker discharge operations, are not significant during the daytime as noise from road traffic on the A556 dual-carriageway immediately to the north of the site is dominant.

Similarly, the noise impacts to the nearby pre-school/nursery and primary school are not significant given the dominance of road traffic noise during the day.

At night, potential adverse noise impacts are indicated at residential properties on Shurlach Road and East Avenue in Rudheath due to operation of ventilation plant (intakes and vents) on the roof of Bread Plant 1/2, and at the nearest residential properties in Broken Cross due to operation of Bread Plant 3 chiller house. However, no complaints have been received relating to operation of these plant items.

Potential adverse and significant adverse noise impacts at night are also indicated at residential properties on Shurlach Road and East Avenue, respectively, due to tanker discharge operations at the silo bay to Bread Plant 1/2.

As a priority, noise mitigation measures should be considered to reduce the potential impacts of night-time tanker discharge operations at the silo bay to Bread Plant 1/2. This may include provision of an acoustic barrier or restrictions on delivery times.

It is also recommended that possible noise mitigation measures are considered for the Bread Plant 3 chiller house vent stacks (e.g acoustic baffles) and Bread Plant 1/2 ventilation plant (intakes and vents).

## 1 Introduction

- 1.1 Bureau Veritas was instructed by Frank Roberts & Sons Limited to undertake an environmental noise impact assessment of their bakery site at Gadbrook Park, Northwich to support their Environmental Permit application.
- 1.2 Frank Roberts & Sons operate both the Roberts Bakery (bread) and Little Treats (baked snacks) businesses at their site in Northwich. The family-run business has operated for 68 years at its current site, and now employs 900 people, producing and distributing bread and other baked goods for the UK and International markets.
- 1.3 A glossary of acoustic terminology is included in Appendix One.

## 2 The Effect of Noise on People

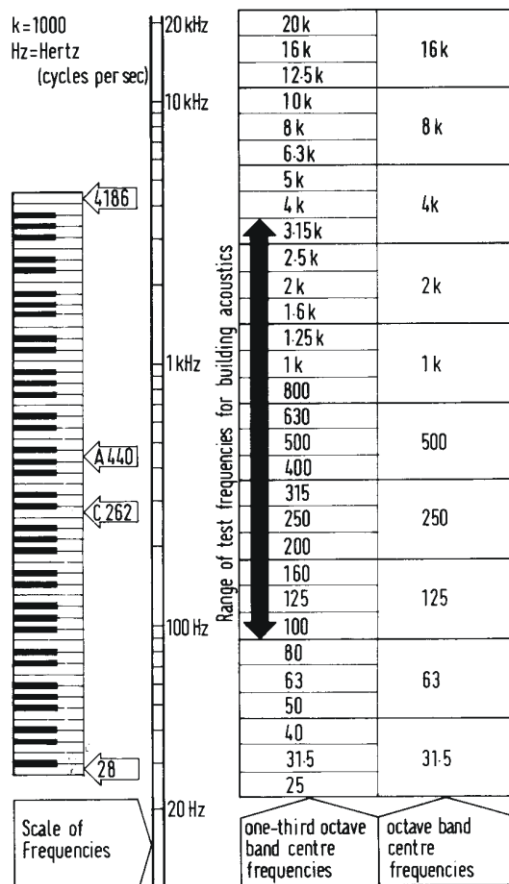
- 2.1 Although the effects of noise on man can be divided into two categories, physiological damage and annoyance, it is only the annoyance impacts that need to be considered in detail when addressing environmental noise impacts. The annoyance aspects of noise include the immediate effects of activity interference, for example sleep disturbance and speech interference.
- 2.2 It has become practice to measure sound levels in decibels (dB). The decibel scale is logarithmic rather than linear. It is helpful to remember that a noise level change of 3dB would be just perceptible to the ear, and that an increase of 10 dB is perceived, subjectively, as a doubling of loudness. The human ear responds differently to sounds of different frequencies. The ear "hears" high frequency sound of a given level more loudly than low frequency sound of the same level. The A-weighted sound level, dB(A), takes this response into consideration and is commonly used for measurement of environmental noise in UK. It indicates the subjective human response to sound.
- 2.3 Table 2.1 below, reproduced from the EA Horizontal Guidance Note H3, presents a semantic scale of decibel levels.

**Table 2.1: Typical sound levels in everyday situation**

Situation/noise source	Sound pressure level in dBA	Sound pressure in $\mu$ Pa	Average subjective description
30m from a military jet aircraft take off	140	200,000,000	Painful, intolerable
Pop concert	105	3,500,000	
Night club	100	2,000,000	
Pop concert at mixer desk	98	1,600,000	
Passing heavy goods vehicle at 7m	90	630,000	Very noisy
Ringling alarm clock at 1m	80	200,000	
Domestic vacuum cleaner at 3m	70	63,000	Noisy
Business office	60	20,000	
Normal conversation at 1m	55	11,000	
The reading room at the British Museum	35	1,100	
Bedroom in a quiet area with the windows shut	30	630	Very quiet
Remote country location without any identifiable sound	20	200	
Theoretical threshold of hearing	0	20	Uncanny silence

- 2.4 For the majority of most environmental noise impact assessments it is necessary only to refer to the overall A-weighted noise level of the source (road traffic noise, aircraft, pumps, motors etc.). However, certain noise sources or investigations require the use of frequency analysis to identify the particular tones that comprise the overall A-weighted level.
- 2.5 Frequency is the rate at which the air particles vibrate. The more rapid the vibrations, the higher the frequency and perceived pitch. Frequency is measured in Hertz (Hz).
- 2.6 A young person with average hearing can generally detect sounds in the range 20 Hz to 20,000 Hz (20 kHz). Figure 1 below illustrates the range of frequencies on a scale where it is noted, for example, that the lowest note on a full scale piano, 'A', has a fundamental at 28 Hz, and the highest, 'G', a fundamental at 4186 Hz (there will be higher order harmonics). Human speech is predominantly in the range 250 Hz - 3000 Hz. For building acoustics assessment noise levels in the frequency range 100 Hz to 3150 Hz are normally used.
- 2.7 The musical term 'octave' is the interval between the first and eighth note in a scale and represents a doubling of frequency. A series of octave and one-third octave bands have been derived, as shown on Figure 1 below, and these are commonly used in noise measurements where it is necessary to describe not only the level of the source noise but also the frequency content.

**Figure 2.1: Octave Scale**





- 2.8 Environmental noise levels vary continuously thus a means of time averaging is required. In practice, human response has been related to various units which include an allowance for the fluctuating nature of sound with time. For the purpose of this report these include:
- $L_{Aeq,T}$  : the equivalent A-weighted continuous sound level.
- 2.9 This unit relates to the equivalent level of continuous sound for a specific time period T. It contains all the energy of the varying sound levels over the same time period, and expresses it as a continuous level over that period. This unit is used to describe the specific noise level caused by traffic, transportation and industrial noise sources in the BS4142 assessment method.
- $L_{A90,T}$  : the A-weighted level of sound exceeded for 90% of the time period T.
- 2.10 This unit is commonly used to represent the background noise, and is used in assessing the effects of industrial noise in UK.
- 2.11 Other descriptors used in this report include :-
- $L_{Amax}$  : the maximum A-weighted level of sound over a period of measurement.
  - $L_{Amin}$  : the minimum A-weighted level of sound over a period of measurement.

### 3 Site Description

- 3.1 The Frank Roberts & Sons site is situated immediately to the south of the A556 dual-carriageway, approximately 2.2km to the southeast of Northwich Town Centre. Figure 3.1 shows the site location.

**Figure 3.1: Site Location**



- 3.2 The nearest noise sensitive receptors to the site include Rudheath Primary Academy and Little Owls pre-school nursery to the north, beyond the A556, and residential properties in Rudheath and Broken Cross.
- 3.3 The bakery operates 24 hours a day, seven days a week, whilst Little Treats currently operates 24 hours a day, Monday to Friday.
- 3.4 Figure 3.2 shows the different operations at the bakery site.

**Figure 3.2: Bakery Operations**





## 4 Criteria for Assessment

### Assessment Methodology

- 4.1 The measured noise levels have been assessed with reference to the following guidelines.

#### Environment Agency: Horizontal Guidance Note H3

- 4.2 The Environment Agency : Horizontal Guidance Note H3 (Part 2) Noise Assessment and Control (June 2004) provides an over-arching guide to the requirement of a compliant noise impact assessment. The guidance supports and highlights the methodology required by British Standard BS4142 and ISO Standard 9613-2 (see below).

- 4.3 All measurement procedures, equipment and methodologies were in accordance with these Guidance Notes.

#### British Standard 4142:2014+A1:2019 - Methods for rating and assessing industrial and commercial sound

- 4.4 BS 4142 provides a method for assessing whether a sound from industrial or commercial premises (e.g. fixed mechanical and electrical (M&E) plant, loading activities etc.) is likely to cause a disturbance to occupants of residential premises in the vicinity of the site.

- 4.5 BS4142 assesses potential significance of effect by comparing the 'specific sound level' of an industrial or commercial source with the typically representative background sound level ( $L_{A90}$ ). Certain acoustic features can increase the potential for a sound to attract attention, and therefore increase its relative significance than that expected from a simple comparison between the specific sound level and the background sound level.

- 4.6 In particular, BS 4142 identifies noise that contains discrete impulses and/or audible tonal qualities and in these cases recommends that a correction be added to the specific sound level. Further corrections are also possible should the sound be intermittent in nature, or if the sound is neither tonal nor impulsive but is readily distinguished against the residual acoustic environment. The specific sound level along with any applicable correction is referred to as the 'rating level'.

- 4.7 The greater the difference between the rating level and the background sound level; the greater the potential impact. The assessment criteria given by BS 4142 are as follows:

- A difference of +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of +5 dB could be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background sound level, the less likely it is that there will be an adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source.

- 4.8 As the bakery has been in operation at this site since 1952 (more than 70 years), and there are no recent records of complaints relating to its operation, it is reasonable to conclude that noise from the site is generally considered to be part of the acoustic character of the area.

- 4.9 It is therefore proposed that the threshold for the indication of potential adverse significance, with reference to the criteria above, is more than 5 dB above the prevailing background level.

**British Standard 8233: 2014 Guidance on Sound Insulation and Noise Reduction for Buildings**

- 4.10 BS 8233:2014 provides guidance for the control of noise in and around buildings. It is applicable to the design of new buildings, or refurbished buildings undergoing a change of use.
- 4.11 With regards to external sound sources affecting habitable residential spaces, Table 4 of BS 8233:2014 provides guideline values that it is desirable to not exceed during daytime and night time periods. These guideline values are reproduced in Table 4.5.

**Table 4.5: Indoor ambient sound levels for dwellings**

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living Room	35 dB L <sub>Aeq,16hour</sub>	-
Dining	Dining room/area	40 dB L <sub>Aeq,16hour</sub>	-
Sleeping (daytime resting)	Bedroom	35 dB L <sub>Aeq,16hour</sub>	30 dB L <sub>Aeq,8hour</sub>

- 4.12 For traditional external areas that are used for amenity space, such as gardens and patios, BS8233 states that it is desirable that the external sound level does not exceed 50 dB L<sub>Aeq,T</sub>, with an upper guideline value of 55 dB L<sub>Aeq,T</sub> which would be acceptable in noisier environments.

**ISO 9613-2:1996 ‘Acoustics – Attenuation of Sound during Propagation Outdoors – Part 2: General Method of Calculation’**

- 4.13 ISO 9613-2:1996 specifies methods for the description of sound outdoors in community environments. ISO 9613 can be applied to a wide variety of sound sources and includes methods to determine most of the major mechanisms of sound attenuation, such as:
- Geometric divergence ( $A_{div}$ ) – spherical spreading of sound energy;
  - Atmospheric absorption ( $A_{atm}$ ) – attenuation of sound due to interaction with the air (dependant on frequency of sound and negligible at short distances);
  - Ground effect ( $A_{gr}$ ) – sound reflecting by the ground surface interfacing with the sound propagating directly from source to receiver;
  - Reflection from surfaces (image source method, included in  $A_{gr}$  calculation) – sound is reflected from hard surfaces such as building facades due to atmospheric impedance of the surface. This effect increases the sound level when compared to a location free of buildings (i.e. free field); and
  - Screening by obstacles ( $A_{bar}$ ) – Hard obstacles such as close boarded timber fences and varying topography, including hills attenuate the sound from a source due to the insertion loss properties of the obstacle. However, there is an element of the sound which will diffract around the obstacle, especially at lower frequencies. The diffraction effect is determined using the path differences between the direct and diffracted sound. It should be noted that the screening effect provided by trees and foliage is negligible in the majority of cases; the exception is large areas of dense forest or plantations.

## 5 Baseline Sound Levels

- 5.1 A baseline sound level survey was conducted at the site, comprising of short-term attended daytime and night-time measurements undertaken on the 19th and 23rd of June and 3rd and 17<sup>th</sup> July 2020, Measurements were undertaken at a number of positions considered the closest receptor locations during the day and night periods when the plant will be operating.
- 5.2 The nearest residential properties to the Roberts bakery location are:
- P1 – Malam Drive - approximately 210m to the west;
  - P2 – Shurlach Road - approximately 80m to the west;
  - P3 – East Avenue - approximately 100m to the northwest;
  - P4 – Central Road - approximately 240m to the north;
  - P5 – Elizabethan Way / School Road North - approximately 100m – 180m to the northeast; and
  - P6 - Waterside View - approximately 190m to the northeast.
- 5.3 The existing ambient noise climate at the residential properties is dominated by road traffic traveling on the A556 located to the north of the Bakery site.
- 5.4 The survey locations were representative of the background sound level, as shown on the site plan in Figure 5.1 below. Sets of 15-minute measurements were made at each of the representative receptor locations, including the day-time and night period.
- 5.5 During the survey, the sound level meter was mounted vertically on a tripod or pole 1.5 m above the ground and more than 3.5 m from any other reflecting surface.
- 5.6 The weather conditions throughout the daytime monitoring period (8<sup>th</sup> July 2020, 11:30 - 14:00) were: 15°C, <1 m/s wind speed from the northeast and 8/8 Okta cloud cover.
- 5.7 During the night time, the sound level surveys that were conducted on the 17<sup>th</sup> July 2020 between 23:45 – 02:00 the weather conditions were: 16°C, 2 m/s wind speed from the west and 7/8 Okta cloud cover.

**Figure 5.1: Background sound level survey measurement locations**



**Table 5.1: Summary of Measured Sound Levels**

ID	Location	Period	Start Time	Sound Pressure Level, dB re: 20µPa			
				$L_{Aeq,T}$	$L_{AFMax,T}$	$L_{A10,T}$	$L_{A90,T}$
P1	Malam Drive	Day (08/07/20)	11:39	52	76	54	46
		Night (17/07/20)	23:47	39	50	43	29
P2	Shurlach Road	Day (08/07/20)	11:58	68	82	72	59
		Night (17/07/20)	00:08	59	81	58	32
P3	East Avenue	Day (08/07/20)	12:34	59	68	62	55
		Night (17/07/20)	00:31	42	63	44	35
P4	Central Road	Day (08/07/20)	12:16	52	63	54	49
		Night (17/07/20)	00:53	43	57	46	38
P5	Elizabethan Way / School Road North	Day (08/07/20)	13:13	57	66	60	51
		Night (17/07/20)	01:43	40	56	42	37
P6	Waterside View	Day (08/07/20)	12:53	58	67	60	54

Note: measurement period, T, was 15min



- 5.8 The assessment of the noise impact from the bakery operations on the nearest noise sensitive properties is based on predicted source sound levels ( $L_{Aeq,T}$ ) (see Section 7) and the measured background sound levels ( $L_{A90,T}$ ).

#### Comments on Sound Climate

- 5.9 The dominant environmental sound source during the day and night-time periods is road traffic on the A556. Other notable sound sources includes intermittent aircraft overhead (approach to/departure from Manchester Airport).
- 5.10 At P1 Malam Drive, birdsong was dominant with traffic noise on the A556 significantly screened by residential properties. Birdsong was also significant during the day at P5 Elizabethan Way and P6 canal bridge (representative of School Road North and Waterside View).
- 5.11 At P4 Central Road, noise from children playing outside at Rudheath Primary School was clearly audible, although the dominant sound source remained to be road traffic on the A556.
- 5.12 In the very occasional lulls in traffic flow during the day, plant noise from the Roberts site was just audible at P3 East Avenue.
- 5.13 During the night-time hours, the notable sound sources affecting P1, P2 and P3 was predominantly from vehicles travelling along the A556 and this noise was still the dominant source at P4 and P5 albeit at a lower level.

#### Effects of Covid-19 Pandemic

- 5.14 The background sound level survey above was undertaken when the UK Government restrictions on movements due to the Covid-19 pandemic were beginning to ease. However, noise due to road traffic, particularly on less busy routes may not have been representative of 'normal' conditions. Furthermore, the area lies beneath the approach/departure flight path for Manchester Airport, and flight numbers were considerably lower than normal and were not audible at night.
- 5.15 Table 5.2 provides a comparison of the measured background sound levels with those obtained by Environmental Essentials (UK) Ltd (EEUK) during their surveys conducted in May and July 2018 (see Appendix Two), when conditions are considered to be representative.

**Table 5.2: Comparison of Background Sound Level Data**

ID	Location	Period	Background Sound Pressure Level, dB $L_{A90,T}$	
			May/July 2018 (EEUK)	July 2020 (BV)
P1	Malam Drive	Day	48	46
		Night	30	29
P2	Shurlach Road	Day	59	59
		Night	Nd	32
P3	East Avenue	Day	Nd	55
		Night	Nd	35
P4	Central Road	Day	48	49
		Night	39 <sup>a</sup>	38
P5	Elizabethan Way	Day	52	51
		Night	Nd	37



ID	Location	Period	Background Sound Pressure Level, dB $L_{A90,T}$	
			May/July 2018 (EEUK)	July 2020 (BV)
P6	Waterside View / School Road North	Day	Nd	54

Notes: a – Measured at Lavender Drive  
 Nd – No data

- 5.16** The comparison in Table 5.2 presents a strong correlation between the two surveys, indicating that the movement restriction due to the Covid-19 pandemic did not significantly affect the background noise climate. Primary reason for this is that road traffic on the A556 is the dominant sound source at all receptor locations. The A556 is a highly trafficked route, and the relative change in traffic flow was not sufficient to significantly affect the general noise climate at that stage.

## 6 Sound Source Emission Survey

6.1 Short-term attended sound pressure level measurements were undertaken on 6<sup>th</sup> July 2020 at locations around the site where, in each case, the sound emissions from the individual source under investigation was dominant.

### Sound Sources

6.2 The identified sound sources and the respective measured sound emission level are presented in Table 6.1 below. Full 1/3<sup>rd</sup> octave (25Hz – 10kHz) sound pressure measurement data is presented in Appendix Four.

**Table 6.1: Summary of Measured Sound Levels around the Site**

Ref	Source	Distance from Source	Sound Pressure Level dB L <sub>Aeq,T</sub>
FR1	Bread Plant 1/2 - Compressor House - louvered door	1m	96
FR2	Bread Plant 1/2 - Compressor House - removed louver	0 (at opening)	85
FR3	Bread Plant 1/2 - Compressor House - front roller shutter door	1m	82
FR4	Little Treats - Refrigeration unit (south)	1m	91
FR5	Little Treats - Refrigeration unit (north)	1m	90
FR6	Bread Plant 1/2 - Upper vent to compressor house	1.5m	93
FR7	Bread Plant 1/2 - Door to compressor house with louveres	1m	82
FR8	Bread Plant 1/2 - Open door to compressor house	0 (at opening)	81
FR9	Bread Plant 1/2 - depanner dust capture	2m	98
FR10	Bread Plant 1/2 - compressor to operate chiller system (door)	0 (at opening)	88
FR11	Bread Plant 1/2 - horizontal cooling fans	2.5m	100
FR12	Bread Plant 1/2 - pumps at ground level	0.5m (above)	84
FR13	Bread Plant 1/2 - bins jetwash	1m	86
FR14	Bread Plant 3 - Basket wash - dust extract enclosure	1m	89
FR15	Bread Plant 3 - Slicing - open shutter door	0 (at opening)	76
FR16	Bread Plant 3 - Basket wash - Large façade louveres	0.5m	81
FR17	Bread Plant 3 - Whitworths discharge tanker to silo	1m	99
FR18	Bread Plant 3 - Yellow HPC Kaeser EB421C Omega compressors	0.5m	78
FR19	Bread Plant 3 - Chiller House louver (north)	0.5m	75
FR20	Bread Plant 3 - Chiller House louver (south)	0.5m	81.3
FR21	Bread Plant 3 - Chiller House louver (stacks)	7m	91.2
FR22	Bread Plant 3 - South door (open)	1m	91.3
FR23	Bread Plant 3 - Robotic tin store - South door (open)	1m	84.4
FR24	Bread Plant 3 - Slicing & bagging area - South door (open)	1m	85.1
FR25	Little Treats - Refrigeration unit (northeast corner)	3m	92
FR26	Bread Plant 1/2 - Roof - Air intakes for internal cooling	0.5m	80.7
FR27	Bread Plant 1/2 - Roof - hot vent stack	1m	86.8

FR28	Bread Plant 1/2 - Roof - Large vent outlets	1m	84
FR29	Bread Plant 1/2 - Roof - Refrigeration system to coolers	1m	83.6
FR30	Bread Plant 1/2 - Roof - "mushroom" air vents	3m	92.2
FR31	Bread Plant 1/2 - Roof - Air intakes	2m	87
FR32	Bread Plant 1/2 - Tanker discharge to silo	11m	103.9
FR33	Little Treats - DCE unit*	2m	79.2

Notes: Measurement period, T, was 6 - 25 seconds

\* DCE plant not operating during survey. Assumed data from similar plant at a surrogate site

- 6.3 Based on the measurements described in Table 6.1, the assumed sound power data for each source is presented in Appendix Five.

#### Comments on Plant Sound Emissions

- 6.4 The bakery operates 24 hours a day, seven days a week, whilst Little Treats currently operates 24 hours a day, Monday to Friday. During operational hours, plant items operate either continuously (during batch production) or intermittently based on cooling demand in the bakery buildings. Operational 'on-times' have therefore been included within the noise propagation modelling in order to predict typical worst-case (summer day/night) noise generation over a 1-hour (daytime) and 15-minute (night-time) period. The assumed on-times are shown in Appendix Five.
- 6.5 In addition to fixed plant noise sources, the site also regularly receives deliveries of ingredients by road tanker, which discharge to the respective silos at Bread Plant 1/2, Bread Plant 3 and Little Treats. Deliveries occur 24/7, during respective production hours, and can last for up to 1-hour to fully discharge the tanker.
- 6.6 Measurements of sound emissions from tanker discharges of flour at Bread Plant 1/2 (FR32 in Table 6.1) and at Bread Plant 3 (FR17 in Table 6.1) were made. No deliveries to Little Treats were observed during the site survey, and therefore the sound emission from FR32 was assumed as a worst case. Appendix Three presents the tanker delivery schedule for a typical month (20<sup>th</sup> June – 20<sup>th</sup> July 2020) to Bread Plant 1/2 and Bread Plant 3. In addition, Little Treats receives a further 6 daytime deliveries per month (1no. syrup, 1no. chocolate and 4no. flour). That amounts to 186 deliveries in total per month, comprising 155 during the day (07:00-23:00) and 31 during the night (23:00-07:00). Simultaneous deliveries (tanker discharge) are unlikely to occur.
- 6.7 The assessment therefore considers the noise impacts from intermittent tanker discharge operations (6no. in any given daytime period, and 1no. at night) separately.

## 7 Noise Propagation Modelling

- 7.1 A sound propagation model of the site has been prepared using the CadnaA proprietary software package. The sound sources in the model were calibrated based on the measured sound level survey data, from which the propagation of sound across the site, and to the nearest residential receptors, can be calculated.
- 7.2 Noise propagation was predicted using algorithms described in ISO 9613-2:1996 'Acoustics - Attenuation of Sound during Propagation Outdoors - Part 2: General Method of Calculation', as incorporated within the noise modelling software.
- 7.3 Ground absorption was assumed to be 0 (i.e. acoustically reflective) for hard surfaces and 1 (i.e. acoustically absorbing) for green areas; 2 orders of reflection were assumed. The existing hard surfaces where located were also incorporated into the model. The project site was therefore accurately represented within the model.
- 7.4 The heights of the noise sources are assumed as the centre of each noise source. The directivity of door/louvre sound sources are all set as "opening" (directional away from the façade element).
- 7.5 3-dimensional images of the model are presented in Appendix Six.
- 7.6 Figures 7.1 and 7.2 show the predicted sound propagation grids at 1.5m (day) and 4m (night) above grade.
- 7.7 The partial sound level contribution from each sound source at each residential receptor location is presented in Appendix Seven.

**Figure 7.1: Predicted daytime noise propagation (1.5m height) –  $L_{Aeq}$**



**Figure 7.2: Predicted night-time noise propagation (4m height) –  $L_{Aeq}$**



7.8 The predicted noise levels at the six off-site receptor locations are presented in Table 7.1 below. For context, measured ambient and background survey data is also summarised in the table.

**Table 7.1: Predicted noise levels at offsite receptor locations**

Receptor Location	Predicted (industrial only)		Measured*			
	Specific Noise Level, dB $L_{Aeq,T}$ (free-field)		Ambient Sound Level, dB $L_{Aeq,15min}$ (free-field)		Background Sound Level, dB $L_{A90,15min}$ (free-field)	
	Day	Night	Day	Night	Day	Night
P1 – Malam Drive	35	37	52	39	46	29
P2 – Shurlach Road	46	45	68	59	59	32
P3 – East Avenue	47	46	59	42	55	35
P4 – Central Road	41	40	52	43	49	38
P5 – Elizabethan Way	43	43	57	40	51	37
P6 – Lavender Drive / School Road North	44	43	58	40	54	37



- 7.10 Predictions are based on all plant operating either continuously or intermittently as shown in Appendix Four.
- 7.11 The sound propagation algorithm assumes a positive wind vector from each individual sound source to each receptor. The measured data was obtained under low wind speeds (1-2m/s) from the northeast (day) and west (night).
- 7.12 Tables A7.1 – A7.12 in Appendix Seven present the partial sound level contributions of the 'top ten' most significant sound sources at each receptor location (day and night), including predicted octave band levels.
- 7.13 At location P1 and P2 to the west of the site, the dominant noise sources associated with the bakery are the cooling air intakes and vent extracts (mushroom-style vents) on the roof of Bread Plant 1/2, as well as the horizontal cooling fans.
- 7.14 The horizontal cooling fans are also the dominant sound source associated with the bakery site at receptor locations P3 and P4 to the north of the site during the day. At night at these locations, noise from the depanner DCE unit and the cooling air intakes and vent extracts (mushroom-style vents) on the roof of Bread Plant 1/2 are the most significant sound sources.
- 7.15 At receptor locations to the north and northeast of Bread Plant 3 (P5 and P6), noise from the two vent stack to the chiller house (east façade of Bread Plant 3) is significant during both day and night time periods. However, noise from the Bread Plant 1/2 horizontal cooling fans (daytime only) and depanner DCE unit is also significant.

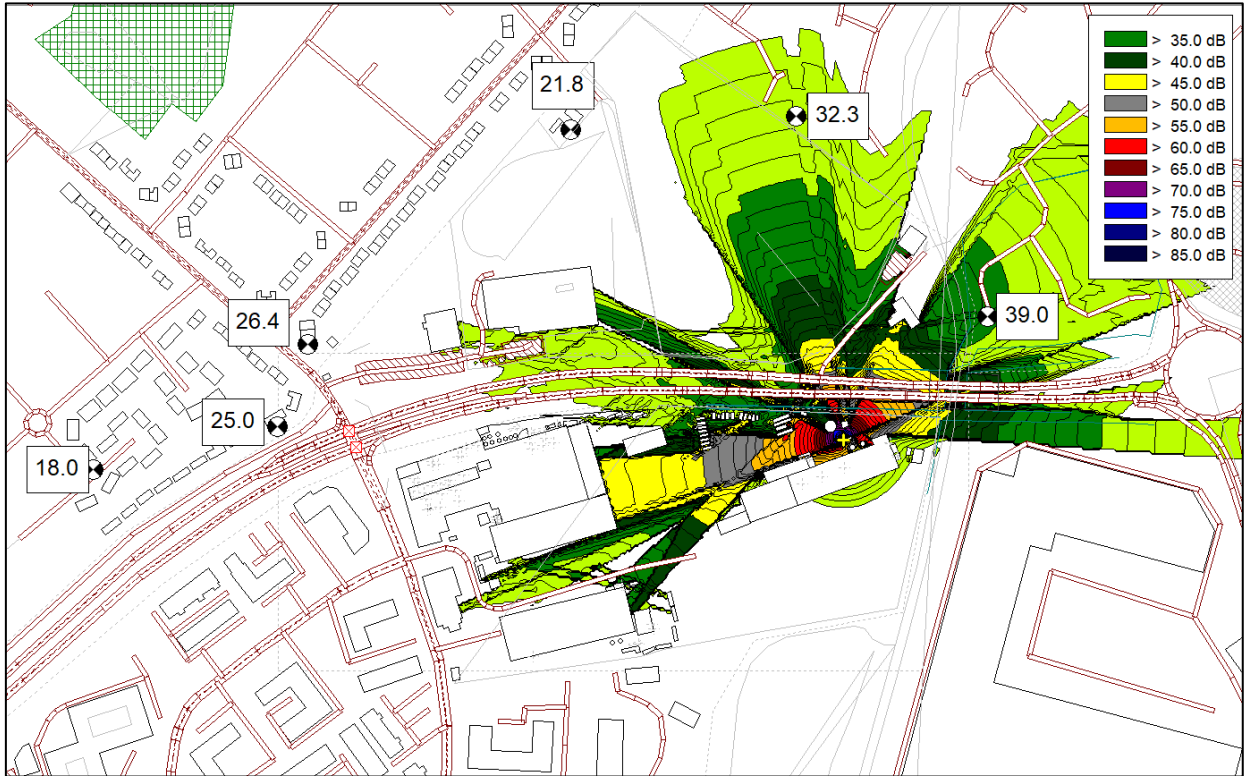
#### **Tanker Discharge Operations**

- 7.16 The site regularly receives deliveries of ingredients by road tanker, which discharge to the respective silos at Bread Plant 1/2, Bread Plant 3 and Little Treats. Deliveries occur 24/7, during respective production hours, and can last for up to 1-hour to fully discharge the tanker.
- 7.17 During the day, noise from tankers discharging is below the background sound level at receptor locations. The noise impact is therefore low during the day.
- 7.18 Typically there are 30no. tanker deliveries at night over a one month period, comprising 18no. at Bread Plant 1/2 and 12no. at Bread Plant 3.
- 7.19 Figures 7.3 and 7.4 show the predicted sound propagation grids at 4m (night) above grade for tanker discharge operations at each silo bay – Bread Plant 1/2 and Bread Plant 3.

**Figure 7.3: Bread Plant 1/2 Tanker Discharge - Predicted noise propagation (4m height)**  
–  $L_{Aeq}$



**Figure 7.4: Bread Plant 3 Tanker Discharge - Predicted noise propagation (4m height)**  
–  $L_{Aeq}$



## 8 Noise Impact Assessment

- 8.1 Tables 8.1 – 8.6 assess the impact of the current Frank Roberts & Sons operational noise at each receptor location in context of BS4142.

**Table 8.1 – BS4142 assessment – P1 Malam Drive**

Results	Level	Commentary
Specific Sound Level ( $L_{Aeq,1h}$ )	35 dB day 37 dB night	Predicted in CadnaA model (1.5m and 4m above ground level for day and night periods)
Character Correction	0 dB	Broadband sound, with no perceptible tones or other distinguishing acoustic features
Rating Level ( $L_{Aeq,1h}$ )	35 dB day 37 dB night	
Background Sound Level ( $L_{A90,1h}$ )	46 dB day 29 dB night	From Table 5.1
Assessment Level (Rating Level minus Background Level)	-11 dB day +8 dB night	No impact during the day. Assessment indicates likelihood of adverse impact at night, depending on context.
Context	<p>At night the noise-sensitive location is indoors with open windows. Assuming 10 dB reduction through an open window, and lack of distinctive acoustic features, the site operation is unlikely to be perceptible within bedrooms above the ambient noise associated with road traffic on the A556.</p> <p>Although some plant items operate intermittently based on cooling demand, the broadband sound from the site is generally continuous.</p> <p>The bakery has been in operation since 1952 (&gt;70 years) at the site and noise from it may therefore be considered an established characteristic of the area.</p> <p>There have not been any recent complaints relating to noise from operation of fixed plant at the bakery.</p>	
Assessment	Assessment level is not more than 5 dB above the background and therefore the impact is low.	

**Table 8.2 – BS4142 assessment – P2 Shurlach Road**

Results	Level	Commentary
Specific Sound Level ( $L_{Aeq,1h}$ )	46 dB day 45 dB night	Predicted in CadnaA model (1.5m and 4m above ground level for day and night periods)
Character Correction	0 dB	Broadband sound, with no perceptible tones or other distinguishing acoustic features
Rating Level ( $L_{Aeq,1h}$ )	46 dB day 45 dB night	Typical worst case 1-hour (day) / 15-minute (night) period during the summer
Background Sound Level ( $L_{A90,1h}$ )	59 dB day 32 dB night	From Table 5.1
Assessment Level (Rating Level minus Background Level)	-13 dB day +13 dB night	No impact during the day. Assessment indicates likelihood of significant adverse impact at night, depending on context.
Context		<p>At night the noise-sensitive location is indoors with open windows. Assuming 10 dB reduction through an open window, and lack of distinctive acoustic features, the site operation is unlikely to be perceptible within bedrooms above the ambient noise associated with road traffic on the A556 (59 dB <math>L_{Aeq,T}</math> and <math>L_{AFmax}</math> levels &gt;80 dB). It is likely windows facing the A556 would be closed to prevent sleep disturbance due to road traffic noise.</p> <p>Although some plant items operate intermittently based on cooling demand, the broadband sound from the site is generally continuous.</p> <p>The bakery has been in operation since 1952 (&gt;70 years) at the site and noise from it may therefore be considered an established characteristic of the area.</p> <p>There have not been any recent complaints relating to noise from operation of fixed plant at the bakery.</p>
Assessment		Assessment level is more than 5 dB above the background and therefore the impact is assessed as moderate adverse.



**Table 8.3 – BS4142 assessment – P3 East Avenue**

Results	Level	Commentary
Specific Sound Level ( $L_{Aeq,1h}$ )	47 dB day 46 dB night	Predicted in CadnaA model (1.5m and 4m above ground level for day and night periods)
Character Correction	0 dB	Broadband sound, with no perceptible tones or other distinguishing acoustic features
Rating Level ( $L_{Aeq,1h}$ )	47 dB day 46 dB night	Typical worst case 1-hour (day) / 15-minute (night) period during the summer
Background Sound Level ( $L_{A90,1h}$ )	55 dB day 35 dB night	From Table 5.1
Assessment Level (Rating Level minus Background Level)	-8 dB day +11 dB night	No impact during the day. Assessment indicates likelihood of significant adverse impact at night, depending on context.
Context		<p>At night the noise-sensitive location is indoors with open windows. Assuming 10 dB reduction through an open window, and lack of distinctive acoustic features, the site operation is unlikely to be perceptible within bedrooms above the ambient noise associated with road traffic on the A556 (52 dB <math>L_{Aeq,T}</math>).</p> <p>Although some plant items operate intermittently based on cooling demand, the broadband sound from the site is generally continuous.</p> <p>The bakery has been in operation since 1952 (&gt;70 years) at the site and noise from it may therefore be considered an established characteristic of the area.</p> <p>There have not been any recent complaints relating to noise from operation of fixed plant at the bakery.</p>
Assessment		Assessment level is more than 5 dB above the background and therefore the impact is assessed as moderate adverse.

**Table 8.4 – BS4142 assessment – P4 Central Road**

Results	Level	Commentary
Specific Sound Level ( $L_{Aeq,1h}$ )	41 dB day 40 dB night	Predicted in CadnaA model (1.5m above ground level for day and night periods - bungalow)
Character Correction	0 dB	Broadband sound, with no perceptible tones or other distinguishing acoustic features
Rating Level ( $L_{Aeq,1h}$ )	41 dB day 40 dB night	Typical worst case 1-hour (day) / 15-minute (night) period during the summer
Background Sound Level ( $L_{A90,1h}$ )	49 dB day 38 dB night	From Table 5.1
Assessment Level (Rating Level minus Background Level)	-8 dB day +2 dB night	No impact during the day. Assessment indicates likelihood of adverse impact at night, depending on context.
Context	<p>At night the noise-sensitive location is indoors with open windows. Assuming 10 dB reduction through an open window, and lack of distinctive acoustic features, the site operation is unlikely to be perceptible within bedrooms above the ambient noise associated with road traffic on the A556.</p> <p>Although some plant items operate intermittently based on cooling demand, the broadband sound from the site is generally continuous.</p> <p>The bakery has been in operation since 1952 (&gt;70 years) at the site and noise from it may therefore be considered an established characteristic of the area.</p> <p>There have not been any recent complaints relating to noise from operation of fixed plant at the bakery.</p>	
Assessment	Assessment level is not more than 5 dB above the background and therefore the impact is low.	

**Table 8.5– BS4142 assessment – P5 Elizabethan Way**

Results	Level	Commentary
Specific Sound Level ( $L_{Aeq,1h}$ )	44 dB day 43 dB night	Predicted in CadnaA model (1.5m and 4m above ground level for day and night periods)
Character Correction	0 dB	Broadband sound, with no perceptible tones or other distinguishing acoustic features
Rating Level ( $L_{Aeq,1h}$ )	44 dB day 43 dB night	Typical worst case 1-hour (day) / 15-minute (night) period during the summer
Background Sound Level ( $L_{A90,1h}$ )	51 dB day 37 dB night	From Table 5.1
Assessment Level (Rating Level minus Background Level)	-7 dB day +6 dB night	No impact during the day. Assessment indicates likelihood of adverse impact at night, depending on context.
Context	<p>At night the noise-sensitive location is indoors with open windows. Assuming 10 dB reduction through an open window, and lack of distinctive acoustic features, the site operation is unlikely to be perceptible within bedrooms above the ambient noise associated with road traffic on the A556.</p> <p>Although some plant items operate intermittently based on cooling demand, the broadband sound from the site is generally continuous.</p> <p>The bakery has been in operation since 1952 (&gt;70 years) at the site and noise from it may therefore be considered an established characteristic of the area.</p> <p>There have not been any recent complaints relating to noise from operation of fixed plant at the bakery.</p>	
Assessment	Assessment level is more than 5 dB above the background and therefore the impact is assessed as moderate adverse.	

**Table 8.6 – BS4142 assessment – P6 Lavender Drive / School Road North**

Results	Level	Commentary
Specific Sound Level ( $L_{Aeq,1h}$ )	43 dB day 43 dB night	Predicted in CadnaA model (1.5m and 4m above ground level for day and night periods)
Character Correction	0 dB	Broadband sound, with no perceptible tones or other distinguishing acoustic features
Rating Level ( $L_{Aeq,1h}$ )	43 dB day 43 dB night	Typical worst case 1-hour (day) / 15-minute (night) period during the summer
Background Sound Level ( $L_{A90,1h}$ )	54 dB day 37 dB night	From Table 5.1
Assessment Level (Rating Level minus Background Level)	-11 dB day +7 dB night	No impact during the day. Assessment indicates likelihood of adverse impact at night, depending on context.
Context	<p>At night the noise-sensitive location is indoors with open windows. Assuming 10 dB reduction through an open window, and lack of distinctive acoustic features, the site operation is unlikely to be perceptible within bedrooms above the ambient noise associated with road traffic on the A556. Although some plant items operate intermittently based on cooling demand, the broadband sound from the site is generally continuous.</p> <p>The bakery has been in operation since 1952 (&gt;70 years) at the site and noise from it may therefore be considered an established characteristic of the area.</p> <p>There have not been any recent complaints relating to noise from operation of fixed plant at the bakery.</p>	
Assessment	Assessment level is more than 5 dB above the background and therefore the impact is assessed as moderate adverse.	

- 8.2** Given the context, taking into account the absolute level and the absence of distinctive acoustic features, the noise impact at Malam Drive and Central Road in Rudheath is unlikely to lead to justifiable complaint from residents. This is provided that equipment is well maintained to ensure acoustic features do not develop.
- 8.3** At Shurlach Road and East Avenue in Rudheath, and at the nearest residential receptors in Broken Cross, the noise impact is assessed as moderate at night, despite the existing noise from road traffic on the A556. Considering this, and that the noise has a broadband characteristic without any acoustic feature (e.g. tonality, intermittency, impulsivity) the noise might be present but not intrusive. However, measures should be considered to reduce noise generation and/or propagation from the identified dominant sound sources. These are the cooling vents (mushroom-type) and cooling air intakes that are situated on the roof of Bread Plant 1/2, and the chiller house vent stacks east of Bread Plant 3.

## Tanker Discharge Operations

### Bread Plant 1/2

- 8.4 Table 8.7 assesses the impact of tanker discharge operations at Bread Plant 1/2 silo bay at night at each receptor location in context of BS4142.

**Table 8.7: Bread Plant 1/2 Tanker Discharge – BS4142 Assessment (night)**

Receptor	Specific Noise Level, dB L <sub>Aeq,T</sub> (free-field)	Character Correction	Rating Level (L <sub>Aeq,1h</sub> )	Background Sound Level, dB L <sub>A90,15min</sub> (free-field)	Assessment Level
P1 – Malam Drive	28	0	28	29	-1
P2 – Shurlach Road	39	3*	42	32	+10
P3 – East Avenue	48	3*	51	35	+16
P4 – Central Road	37	0	37	38	-1
P5 – Elizabethan Way	35	0	35	37	-2
P6 – Lavender Drive / School Road North	39	3*	42	37	+5

Notes: \* Intermittency is readily distinctive against the residual acoustic environment.

- 8.5 Based on the predicted noise levels from the tanker discharge operation at Bread Plant 1/2, and the context, the noise impact at the nearest noise sensitive receptors is assessed as low at Malam Drive and Central Road in Rudheath, and at the nearest residential receptors in Broken Cross.
- 8.6 At night the noise-sensitive location is indoors with open windows. Assuming 10 dB reduction through an open window, and lack of distinctive acoustic features, tanker discharge operation at Bread Plant 1/2 silo bay is unlikely to be perceptible within bedrooms above the ambient noise associated with road traffic on the A556. The bakery has been in operation since 1952 (>70 years) at the site and noise from it may therefore be considered an established characteristic of the area.
- 8.7 At receptor properties at Shurlach Road the noise impact is assessed as moderate at night, despite the existing noise from road traffic on the A556.
- 8.8 At receptor properties at East Avenue, nearest to Bread Plant 1/2 silos, the noise impact is assessed as significant adverse at night, and has the potential to be intrusive and cause sleep disturbance.
- 8.9 At these locations (and at Lavender Drive / School Road North), the on/off condition of the tanker discharge operation is likely to be readily distinctive and therefore a 3 dB penalty has been applied.
- 8.10 Measures should be considered to reduce noise generation and/or propagation from the tanker discharge operation at Bread Plant 1/2 at night.
- 8.11 In February 2019, a complaint was received from a local resident (near to receptor P6 location) who described a “howling” noise from the bakery. After investigation by Frank Roberts & Sons, it was identified that the source was associated with tanker discharge operation (approximately 23:30 hrs). However, it is believed that this related to a short period when additional actions are required to dislodge flour. Physical and procedural measures are being considered to improve this process and reduce noise propagation.



8.12 In August 2019, a complaint was received from the same local resident (near to receptor P6 location) who described a ‘banging’ noise in the early hours of the morning. An investigation by Frank Roberts & Sons identified that a tanker driver had not followed the site policy forbidding the use of hammering to dislodge residual materials. This was fed back to the contracted company and no repeats have occurred.

8.13 No further complaints have been received since.

### Bread Plant 3

8.14 Table 8.8 assesses the impact of tanker discharge operations at Bread Plant 3 silo bay at night at each receptor location in context of BS4142.

**Table 8.8: Bread Plant 3 Tanker Discharge – BS4142 Assessment (night)**

Receptor	Specific Noise Level, dB L <sub>Aeq,T</sub> (free-field)	Character Correction	Rating Level (L <sub>Aeq,1h</sub> )	Background Sound Level, dB L <sub>A90,15min</sub> (free-field)	Assessment Level
P1 – Malam Drive	18	0	18	29	-11
P2 – Shurlach Road	25	0	25	32	-7
P3 – East Avenue	26	0	26	35	-9
P4 – Central Road	22	0	22	38	-16
P5 – Elizabethan Way	39	3*	42	37	+5
P6 – Lavender Drive / School Road North	32	0	32	37	-5

Notes: \* Intermittency is readily distinctive against the residual acoustic environment.

8.15 Based on the predicted noise levels from the tanker discharge operation at Bread Plant 3, and the context, the noise impact at the nearest noise sensitive receptors is assessed as low.

8.16 At night the noise-sensitive location is indoors with open windows. Assuming 10 dB reduction through an open window, and lack of distinctive acoustic features, the site operation is unlikely to be perceptible within bedrooms above the ambient noise associated with road traffic on the A556.

8.17 Although some plant items operate intermittently based on cooling demand, the broadband sound from the site is generally continuous.

8.18 The bakery has been in operation since 1952 (>70 years) at the site and noise from it may therefore be considered an established characteristic of the area.

8.19 There have not been any recent complaints relating to noise from tanker discharge operations at the Bread Plant 3 silo.

## 9 Impacts to Other Noise Sensitive Receptors

- 9.1 The Little Owls pre-school and nursery (at The Venue) and Rudheath Primary School are situated approximately 70m north of the bakery site.
- 9.2 Whilst these are relatively close to the bakery, road traffic on the A556 is the dominant sound source, with ambient noise levels at the southern façade of these establishments being similar to those measured at P2 (Shurlach Road) in Table 4.1. Ambient daytime noise levels are therefore in the region of 65 – 68 dB  $L_{Aeq}$  due to road traffic during the day when they are open.
- 9.3 The predicted specific sound pressure levels from operation at the bakery site are up to 56 dB  $L_{Aeq,T}$  at the southern façade of the primary school due to fixed plant operation (summer period). The specific level from a tanker discharging at the silos to Bread Plant 3 is predicted to be 52 dB  $L_{Aeq,T}$ , and therefore this operation is unlikely to be discernible from the residual acoustic climate.
- 9.4 The noise impact of the bakery's operations are therefore assessed as not significant and that provisions in place (i.e. mechanical ventilation so that windows can remain closed) to ensure suitable internal teaching spaces at the primary school with respect to road traffic noise are likely to be sufficient to control noise intrusion.

## 10 Conclusions

- 10.1 Bureau Veritas was instructed by Frank Roberts & Sons Limited to undertake an environmental noise impact assessment of their bakery site at Gadbrook Park, Northwich to support their Environmental Permit application.
- 10.2 A background sound level survey was conducted at representative locations for the nearest residential receptors during the day and night-time period. Despite slightly reduced road traffic and significantly reduced air traffic due to the Covid-19 pandemic, the obtained background sound level data compares favourably with data obtained in 2018 and are therefore considered to be representative.
- 10.3 A survey of sound emissions from on-site sound sources was conducted, and the data obtained was used to calibrate a 3D sound propagation model for the site.
- 10.4 The assessment considers the typical worst case summer operation which includes operation of all cooling/ventilation plant items, as well as doors and windows to Bread Plants 1/2 and 3 being open.
- 10.5 A separate assessment has been carried out for tanker discharge operation which occurs intermittently 24 hours per day, 7 days per week, with roughly one delivery per night. Tanker discharge operation typically lasts approximately one hour.
- 10.6 The assessment concludes that daytime operations at the bakery site, including tanker discharge operations, are not significant during the daytime as noise from road traffic on the A556 dual-carriageway immediately to the north of the site is dominant.
- 10.7 Similarly, the noise impacts to the nearby pre-school/nursery and primary school are not significant given the dominance of road traffic noise during the day.
- 10.8 At night, potential adverse noise impacts are indicated at residential properties on Shurlach Road and East Avenue in Rudheath due to operation of ventilation plant (intakes and vents) on the roof of Bread Plant 1/2, and at the nearest residential properties in Broken Cross due to operation of Bread Plant 3 chiller house.
- 10.9 Potential adverse and significant adverse noise impacts at night are also indicated at residential properties on Shurlach Road and East Avenue, respectively, due to tanker discharge operations at the silo bay to Bread Plant 1/2.
- 10.10 As a priority, noise mitigation measures should be considered to reduce the potential impacts of night-time tanker discharge operations at the silo bay to Bread Plant 1/2. This may include provision of an acoustic barrier or restrictions on delivery times.
- 10.11 It is also recommended that possible noise mitigation measures are considered for the Bread Plant 3 chiller house vent stacks (e.g acoustic baffles) and Bread Plant 1/2 ventilation plant (intakes and vents).

## Appendix One – Glossary of Acoustic Terminology

<b>Sound power level</b>	A logarithmic measure of the power of a sound relative to a reference value.
<b>"A" Weighting (dB(A))</b>	The human ear does not respond uniformly to different frequencies. "A" weighting is commonly used to simulate the frequency response of the ear. It is used in the assessment of the risk of damage to hearing due to noise.
<b>Decibel (dB)</b>	The range of audible sound pressures is approximately $2 \times 10^{-5}$ Pa to 200 Pa. Using decibel notation presents this range in a more manageable form, 0 dB to 140 dB.
<b>Ambient sound level, <math>L_{Aeq,T}</math></b>	equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time, usually from many sources near and far, at the assessment location over a given time interval, T. NOTE The ambient sound level is a measure of the residual sound and the specific sound when present.
<b>Background sound level, <math>L_{90,T}</math></b>	A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels.
<b>Maximum sound level, <math>L_{Amax,T}</math></b>	The maximum RMS A-weighted sound pressure level occurring within a specified time period.
<b>Noise</b>	Unwanted sound.
<b>Ambient sound</b>	Totally encompassing sound in a given situation at any given time composed of noise from many sources, near and far.
<b>Residual sound</b>	Ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound.
<b>Rating level</b>	Specific sound level plus any adjustment for the characteristic features of the sound.

## Appendix Two – Baseline Noise Survey by EEUK Ltd (May/July 2018)

**Table 2**  
*Off-site Background (daytime), dB*

	Date	Time	Duration	L <sub>Aeq</sub>	L <sub>A90</sub>	L <sub>Amax</sub>	L <sub>Amin</sub>
Bridge over canal leading to school road north	16/05/2018	10:39	15:00	57	<b>52</b>	73	49
No 56-lavender drive	16/05/2018	11:05	15:00	58	<b>46</b>	77	43
No 56-central road	16/05/2018	11:26	15:00	53	<b>48</b>	68	45
No 38 & 36 malam drive	16/05/2018	11:48	15:00	58	<b>48</b>	71	42
No 14 shurlach road	16/05/2018	15:32	15:00	68	<b>59</b>	81	52

**Table 4**  
*Off-site Background (night time), dB*

	Date	Time	Duration	L <sub>Aeq</sub>	L <sub>A90</sub>	L <sub>Amax</sub>	L <sub>Amin</sub>
No 56-Lavender Drive	17/05/2018	00:13	10:00	53	<b>39</b>	69	37
Sovereign Close	17/05/2018	01:03	10:00	42	<b>33</b>	61	30
Nos 38 & 36 Malam Drive	13/07/2018	01:59	15:00	45	<b>30</b>	63	28
Sovereign Close	13/07/2018	02:28	15:00	48	<b>31</b>	68	26

## Appendix Three – Typical Tanker Delivery Schedule (20<sup>th</sup> June – 20<sup>th</sup> July 2020)

**Table A3.1: Deliveries to Bread Plant 1/2**

Time	Material	Conf.deliv
15:30:00	51435	20/06/2020
20:00:00	51733	20/06/2020
01:00:00	51435	21/06/2020
14:00:00	51584	21/06/2020
11:30:00	51733	21/06/2020
22:00:00	51733	21/06/2020
11:30:00	51435	22/06/2020
13:00:00	51584	22/06/2020
07:30:00	51733	22/06/2020
11:30:00	51435	23/06/2020
20:00:00	51435	23/06/2020
16:45:00	51584	23/06/2020
07:30:00	51733	23/06/2020
15:30:00	51733	23/06/2020
08:45:00	50550	24/06/2020
07:30:00	51435	24/06/2020
02:30:00	51733	24/06/2020
11:30:00	51733	24/06/2020
22:00:00	51733	24/06/2020
02:30:00	51435	25/06/2020
07:30:00	51435	25/06/2020
13:00:00	51584	25/06/2020
11:30:00	51733	25/06/2020
16:45:00	51733	25/06/2020
11:30:00	51435	26/06/2020
20:00:00	51435	26/06/2020
07:30:00	51733	26/06/2020
15:30:00	51733	26/06/2020
22:00:00	51733	26/06/2020
22:00:00	51435	27/06/2020
15:30:00	51435	28/06/2020
13:00:00	51584	28/06/2020
02:30:00	51733	28/06/2020
11:30:00	51733	28/06/2020
20:00:00	51733	28/06/2020
01:00:00	51435	29/06/2020



11:30:00	51435	29/06/2020
16:45:00	51584	29/06/2020
07:30:00	51733	29/06/2020
20:00:00	51733	29/06/2020
11:30:00	51435	30/06/2020
16:45:00	51584	30/06/2020
07:30:00	51733	30/06/2020
15:30:00	51733	30/06/2020
16:45:00	50550	01/07/2020
11:30:00	51435	01/07/2020
20:00:00	51435	01/07/2020
01:00:00	51733	01/07/2020
07:30:00	51733	01/07/2020
09:15:00	51435	02/07/2020
07:30:00	51584	02/07/2020
01:00:00	51733	02/07/2020
11:30:00	51733	02/07/2020
22:00:00	51733	02/07/2020
01:00:00	51435	03/07/2020
16:45:00	51584	03/07/2020
11:30:00	51733	03/07/2020
22:00:00	51733	03/07/2020
01:00:00	51435	04/07/2020
11:30:00	51435	04/07/2020
22:00:00	51733	04/07/2020
15:30:00	51435	05/07/2020
13:00:00	51584	05/07/2020
11:30:00	51733	05/07/2020
22:00:00	51733	05/07/2020
02:30:00	51435	06/07/2020
11:30:00	51435	06/07/2020
07:30:00	51733	06/07/2020
02:30:00	51435	07/07/2020
07:30:00	51435	07/07/2020
13:00:00	51584	07/07/2020
11:30:00	51733	07/07/2020
22:00:00	51733	07/07/2020
13:00:00	50550	08/07/2020
15:30:00	51435	08/07/2020
07:30:00	51733	08/07/2020
21:00:00	51733	08/07/2020

01:00:00	51435	09/07/2020
15:30:00	51435	09/07/2020
16:45:00	51584	09/07/2020
07:30:00	51733	09/07/2020
20:00:00	51733	09/07/2020
11:30:00	51435	10/07/2020
07:30:00	51733	10/07/2020
20:00:00	51733	10/07/2020
20:00:00	51435	11/07/2020
13:00:00	51584	11/07/2020
01:00:00	51733	11/07/2020
13:00:00	51435	12/07/2020
01:00:00	51733	12/07/2020
07:30:00	51733	12/07/2020
11:00:00	51733	12/07/2020
20:00:00	51733	12/07/2020
01:00:00	51435	13/07/2020
11:30:00	51435	13/07/2020
13:00:00	51584	13/07/2020
07:30:00	51733	13/07/2020
20:00:00	51733	13/07/2020
11:30:00	51435	14/07/2020
20:00:00	51435	14/07/2020
13:00:00	51584	14/07/2020
07:30:00	51733	14/07/2020
07:30:00	51435	15/07/2020
16:45:00	51584	15/07/2020
11:30:00	51733	15/07/2020
20:00:00	51733	15/07/2020
00:30:00	51435	16/07/2020
13:00:00	51435	16/07/2020
07:30:00	51733	16/07/2020
16:00:00	51733	16/07/2020
16:00:00	50550	17/07/2020
09:15:00	51435	17/07/2020
21:30:00	51435	17/07/2020
13:00:00	51584	17/07/2020
01:00:00	51733	17/07/2020
07:30:00	51733	17/07/2020
20:00:00	51733	17/07/2020
20:00:00	51435	18/07/2020

11:30:00	51733	18/07/2020
11:30:00	51435	19/07/2020
20:00:00	51435	19/07/2020
13:00:00	51584	19/07/2020
01:00:00	51733	19/07/2020
09:45:00	51733	19/07/2020
15:30:00	51733	19/07/2020
11:30:00	51435	20/07/2020
14:00:00	51584	20/07/2020
07:30:00	51733	20/07/2020
21:00:00	51733	20/07/2020

**Table A3.2: Deliveries to Bread Plant 3**

Time	Material	Conf.deliv
02:30:00	51733	20/06/2020
09:45:00	51733	21/06/2020
12:00:00	51435	21/06/2020
02:30:00	51733	22/06/2020
12:00:00	51733	22/06/2020
14:15:00	51435	22/06/2020
02:30:00	51733	23/06/2020
12:00:00	51435	23/06/2020
07:15:00	51733	24/06/2020
16:00:00	51733	24/06/2020
12:00:00	51435	25/06/2020
07:15:00	51733	26/06/2020
16:00:00	51435	26/06/2020
20:00:00	51733	27/06/2020
12:00:00	51733	28/06/2020
02:30:00	51733	29/06/2020
10:15:00	51435	29/06/2020
12:00:00	51733	29/06/2020
08:45:00	51733	01/07/2020
14:15:00	51733	01/07/2020
02:30:00	51733	02/07/2020
12:00:00	51435	02/07/2020
02:30:00	51733	03/07/2020
14:15:00	51435	03/07/2020
02:30:00	51733	04/07/2020
11:00:00	51733	05/07/2020

12:00:00	51733	06/07/2020
14:15:00	51435	06/07/2020
17:00:00	51733	07/07/2020
02:30:00	51733	08/07/2020
11:00:00	51733	08/07/2020
14:15:00	51435	08/07/2020
20:00:00	51733	08/07/2020
21:00:00	51733	09/07/2020
12:00:00	51435	10/07/2020
16:00:00	51733	10/07/2020
12:00:00	51733	11/07/2020
12:00:00	51733	12/07/2020
02:30:00	51733	13/07/2020
12:00:00	51435	13/07/2020
02:30:00	51733	14/07/2020
02:30:00	51733	15/07/2020
12:00:00	51435	15/07/2020
02:30:00	51733	16/07/2020
20:00:00	51733	16/07/2020
11:00:00	51435	17/07/2020
14:15:00	51733	17/07/2020
02:30:00	51733	19/07/2020
12:00:00	51435	19/07/2020
07:15:00	51733	20/07/2020
20:00:00	51733	20/07/2020

## Appendix Four – Sound Pressure Levels

Table A4.1: Measured Sound Pressure Levels

ID	Source	dB LAeq	Unweighted 1/3 <sup>rd</sup> Octave Band Sound Pressure Level*, dBz re: 20µPa																											
			25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	6.3 kHz	8 kHz	10 kHz	
<b>Bread Plant 1/2</b>																														
707	Compressor House - approx 5m from stacks	72	63.5	60.2	62.1	63.7	59.9	59.1	58.7	62.3	64.8	63.5	61.5	63.6	60.3	58.7	60.7	58.5	61.5	58.3	58.5	58.6	57	58.9	59.1	65.9	58.1	57.6	57.4	
708	Compressor House - louvred door	90.8	67.7	68.8	72.3	76.8	71.6	68.3	73.3	72.1	68.5	70.4	73.4	77	68.8	73.9	80	71.5	76.2	73.6	75.3	76.7	75.3	77.5	79.3	86	78.9	79.6	80.6	
709	Compressor House - removed louvre	85.3	69.7	69.2	70.7	74.2	67.3	68.4	77.7	72.6	75.1	73.8	73.8	73.1	73.3	76.1	77.8	77.1	73	74	75	72.6	72	73.5	70	73.6	69.2	69	68.5	
710	Compressor House - front roller shutter door (dominated by 708)	77.2	66.2	64.2	64.6	68.5	68.7	68.2	74.9	70	69.2	69.2	70.2	68.9	68.9	69.8	67.7	69	64.9	63.5	65.5	62.1	61.1	62.4	63.6	68.7	61.1	61.2	59.5	
714	Upper vent to compressor house	81.1	69.5	74.1	68.1	66.9	70.1	67.3	67.7	80.4	71.3	68.8	69.8	70	73.4	76.8	76.9	73.1	72.3	68.1	66.6	65.8	64.2	62	59.3	57.2	54.7	52.6	50.5	
715	Door to compressor house with louvres	77.3	70.7	71.1	66.5	71.5	67	67	69	73.3	68	70.8	64.5	73.7	68.7	71.3	69.1	66.2	68.1	65.3	66	62	62.1	64.8	62.8	61.1	55.5	53.1	51.1	
717	Open door to compressor house	81.2	66.3	71.4	65.6	73.1	67	67.1	72.2	76.4	70.7	72.7	66.7	72.7	70.7	77.2	70.6	69.5	72.1	69.9	68.7	66.5	66.2	68.8	67.8	67.8	64.4	62.3	59.9	
718	depanner dust capture	84.2	66	64.5	66.6	81.7	67.9	67.9	74.7	67.1	68.6	71.1	75.5	77.2	75.3	76.6	74.8	76.4	76.2	69.9	67.5	66.6	66.9	68.3	70.7	71.5	71.5	70.5	71.3	
719	compressor to operate chiller system (door)	87.8	71	65.8	71.6	76.7	77.3	74.8	75	79	77.4	75.9	77.7	82.7	81.5	81.2	77.3	82.1	79.3	72.4	72	72.1	72.6	73.3	73.2	72.4	71.6	69.6	68.1	
720	horizontal cooling fans	83.7	70.9	71.8	72.1	74.7	79.6	80.8	82.2	81.4	78.2	76.7	75	75.1	74.6	75.9	74.5	74.3	74.3	72	70.8	70.8	70.8	70.8	70.8	70.8	68.5	66.3	64.7	63.7
721	pumps at ground level	82.3	70.5	70.1	68.2	73.2	70.1	66.1	71.2	72.9	72.1	72	72	75.7	72.6	73	71.7	74.3	70.6	70.8	70.8	70.2	68.3	67.9	68.2	69.6	69	68.9	65.8	
722	bins jetwash	77.5	67.9	70.8	78.5	86.5	92.8	91.5	74.9	72.8	70.9	63.5	64.3	67.2	70.6	68.1	64.7	65.1	62.4	63.4	61.5	62.1	63.1	64	65.6	65	64.2	64.7	63.4	
735	Roof - Air intakes for internal cooling	78.8	76.9	70.7	69.3	70.3	68.4	70.8	78.9	82.6	75.1	71	72.1	72.6	69.9	72.9	73.4	70.9	68.5	67.6	64.3	63.5	61.3	59.3	56.6	53.7	51.7	45.4	42.2	
736	Roof - hot vent stack	78.8	67.3	68.3	68.5	68.7	67.8	70.8	73.1	74.1	77.2	75.2	64.2	66.1	67.6	72.4	71.7	72.2	69	67.7	67.4	67.5	65.8	58.3	54.7	51.2	44.2	41.7	39.7	
737	Roof - Large vent outlets	76.1	78.1	74.6	78	76.4	78.9	76.2	74.7	73.3	74	74.5	75.7	73.3	71.9	69.6	67.8	65	64.4	64	62.1	59.1	54.4	52.6	49.1	46.1	42.7	40.3	38.1	
738	Roof - Refrigeration system to coolers	75.6	71.4	66.6	65.6	65.9	65.4	67.4	71.7	78	73.6	67.3	63.9	63.4	64	60.9	61.9	60.4	61.4	65.9	67.7	67.9	63.3	61.4	57.9	58.3	57.2	56.7	55.4	
739	Roof - "mushroom" air vents	74.6	80.2	78	76.4	74.9	73	72.5	76	74.2	81.8	71.9	71.2	70.7	68.9	62.8	63	64.8	64.9	60.3	59.3	56.9	56.1	54.9	53.9	52.3	52.1	51.8	51	
740	Roof - Air intakes	72.9	76.7	73.9	71.7	69.3	66.5	68.1	72.6	77.3	75	65.9	65.6	65.8	63.6	66.2	66.5	63.8	62.2	61.9	60.6	59.1	57.1	55.4	52.4	49.7	47	43.3	40.1	



Bread Plant 3																													
723	Basket wash - dust extract enclosure	80.7	70.4	70.5	73.2	81.2	75.1	78.7	78.9	78.4	80.3	74.4	83.2	77.3	76.1	71.3	69.5	70.5	67.5	64.4	64	63	64	62.5	67.1	62.4	64.4	64.1	61.1
724	Slicing - open shutter door	76	69.7	68.9	67.2	71.1	67.7	70.9	69.1	67.6	70.3	70	70.4	68.5	68.6	68.8	67.9	66.6	65	63.2	62.1	62	62.1	62.1	62.4	63.1	61.6	60.6	57.3
725	Basket wash - Large façade louvres	79	70.7	66.9	66.8	76.3	68.3	68.9	66.8	67.3	70.3	67.5	68.1	71.3	68.7	70.9	71.9	71.6	71.7	69.9	64.7	63.2	63.2	63.7	63.5	60.9	57.4	56.5	54.6
726	Whitworths discharge tanker to silo	91.6	86.3	79.3	67.4	80.8	75	69.3	65.5	65.4	65.9	70.2	67	73.1	70.7	71.1	80.9	76.9	78.1	77.3	78.3	77.6	80.2	84.7	80.5	80.3	79.4	78.7	78.6
727	Yellow HPC Kaeser EB421C Omega compressors	76.2	76.6	72.5	68.6	70.1	68.9	65.8	71.7	69	74	75.8	72.6	67.9	66.9	70.2	73.8	66.4	63.1	62.5	58.5	58.8	55.6	55.7	53.3	49.6	50	47.6	46.3
728	Chiller House louvre (north)	72.7	68	62.6	62.8	69.8	64.5	65.5	67.1	68.3	65.3	69.3	65.6	65.1	64.6	67.2	65	64.4	63.7	61.9	61.3	58.7	55.7	53.6	54.6	53.7	50.3	45.1	42.6
729	Chiller House louvre (south)	79.3	64.8	61.3	62.3	73	67.2	66.8	74.7	73.8	76.6	76.6	74.7	72.6	71.5	73.1	71.3	71.4	70.4	68.3	65.7	64.8	62.6	60.8	61.9	60.6	57.1	52.3	52.6
730	Chiller House louvre (stacks)	66.3	67.2	62.5	64	68.9	63.7	66.1	71.4	65.9	61.5	62.9	61.5	62.9	60	58.8	57.8	57.5	56.9	55.2	52.6	50.6	48.4	47.3	46.3	45.3	43.1	39.9	37.4
731	South door (open)	83.3	67.7	65.1	66.6	72.1	71	68.2	69.6	73	73.3	74.7	75.8	71.8	75.9	73.3	74.2	76.9	75.6	73.2	70.9	70.1	69.4	67.7	66.6	63.3	61.5	60.1	59.2
732	Robotic tin store - South door (open)	76.4	70.7	69.3	67.4	72.2	67.8	70.8	67.3	66.7	72.5	70.6	68.2	69.4	70.7	67.7	67.1	67.1	66.7	63.8	62.7	63.4	66.6	62.3	60.4	59.3	58.2	55.9	53.4
733	Slicing & bagging area - South door (open)	77.2	64	61.9	62.3	62.9	63.8	67.2	68.7	68.1	70.2	69	66.3	64.4	67.7	67.4	66.3	66.1	65.1	63.5	63	63.8	65.3	66.1	65.9	66.1	65.2	64.8	63.6
Little Treats																													
711	Refrigeration unit (south)	83.3	68	63.3	71.2	87.8	70.2	71.4	81.4	83.8	78.2	80.4	81.4	77.5	76.6	76.2	74.9	75	74.9	72.4	70.4	68.2	65.2	62.5	59.2	56.2	54	50.4	46.7
713	Refrigeration unit (north)	81.9	64.9	60.7	67.3	81.1	70.1	71.2	79.7	81.3	78.2	83.2	85.7	77.1	77.4	71.9	70.9	69.7	69.7	67	64.7	66	62.1	58.4	56.8	55.3	56.2	56.6	53
734	Refrigeration unit (northeast corner)	74.5	75.2	67.6	63.8	65.2	59.6	64.6	68.3	65.4	71.1	77.6	65.9	64.2	66.7	72.4	66.5	64.3	62.7	59.4	57.2	58.3	59.3	54.1	52.4	50.9	49.2	48.3	46.1
735	Bread Plant 1/2 - Roof - Air intakes for internal cooling	78.8	76.9	70.7	69.3	70.3	68.4	70.8	78.9	82.6	75.1	71	72.1	72.6	69.9	72.9	73.4	70.9	68.5	67.6	64.3	63.5	61.3	59.3	56.6	53.7	51.7	45.4	42.2
736	Bread Plant 1/2 - Roof - hot vent stack	78.8	67.3	68.3	68.5	68.7	67.8	70.8	73.1	74.1	77.2	75.2	64.2	66.1	67.6	72.4	71.7	72.2	69	67.7	67.4	67.5	65.8	58.3	54.7	51.2	44.2	41.7	39.7
737	Bread Plant 1/2 - Roof - Large vent outlets	76.1	78.1	74.6	78	76.4	78.9	76.2	74.7	73.3	74	74.5	75.7	73.3	71.9	69.6	67.8	65	64.4	64	62.1	59.1	54.4	52.6	49.1	46.1	42.7	40.3	38.1
738	Bread Plant 1/2 - Roof - Refrigeration system to coolers	75.6	71.4	66.6	65.6	65.9	65.4	67.4	71.7	78	73.6	67.3	63.9	63.4	64	60.9	61.9	60.4	61.4	65.9	67.7	67.9	63.3	61.4	57.9	58.3	57.2	56.7	55.4
739	Bread Plant 1/2 - Roof - "mushroom" air vents	74.6	80.2	78	76.4	74.9	73	72.5	76	74.2	81.8	71.9	71.2	70.7	68.9	62.8	63	64.8	64.9	60.3	59.3	56.9	56.1	54.9	53.9	52.3	52.1	51.8	51
740	Bread Plant 1/2 - Roof - Air intakes	72.9	76.7	73.9	71.7	69.3	66.5	68.1	72.6	77.3	75	65.9	65.6	65.8	63.6	66.2	66.5	63.8	62.2	61.9	60.6	59.1	57.1	55.4	52.4	49.7	47	43.3	40.1

Notes: \* Refer to Table 6.1 for distance from source.



## Appendix Five - Derived Sound Power Data

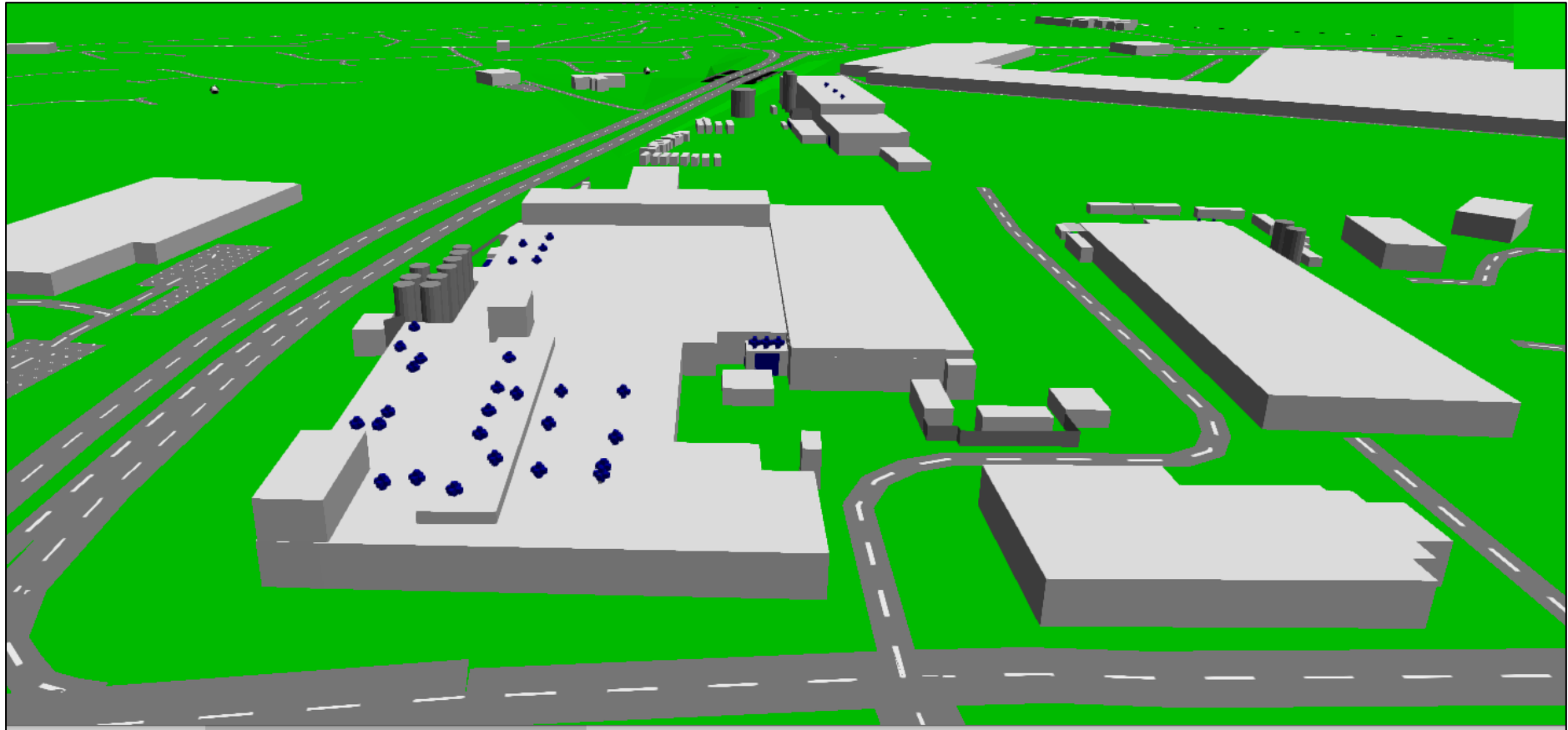
Table A5.1: Assumed Sound Power Levels

Source	ID	Octave Band Sound Power Level, dB LwA									Sound Power Level		% On-Time (of 1-hour day and 15-min night)	
		31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	dB LwA	dB LwZ	Day	Night
<b>Bread Plant 1/2</b>														
Compressor House - louvred door	FR1	73.8	76.6	77.1	78.4	78.9	81.2	81.7	84.3	84.6	95.6	96.4	100	100
Compressor House - removed louvre	FR2	69.2	67.3	72.6	73.8	76.1	73	72.6	70	69	85.3	87.8	100	100
Compressor House - front roller shutter door	FR3	69.2	73.7	75	75.2	74.8	69.9	67.1	68.6	66.2	82.2	87.1	100	100
Upper vent to compressor house	FR6	85.6	81.6	91.9	81.3	88.3	83.8	77.3	70.8	64.1	92.6	97.5	100	100
Door to compressor house with louvres	FR7	76.1	72	78.3	69.5	76.3	73.1	67	67.8	58.1	82.2	87.6	100	100
Open door to compressor house	FR8	71.4	67	76.4	66.7	77.2	72.1	66.5	67.8	62.3	81.1	85	100	100
Depanner dust capture	FR9	78.5	81.9	81.1	89.5	90.6	90.2	80.6	84.7	84.5	98	101.8	100	100
Compressor to operate chiller system (door)	FR10	65.8	77.3	79	77.7	81.2	79.3	72.1	73.2	69.6	87.8	91.3	100	100
Horizontal cooling fans	FR11	87.7	95.5	97.3	90.9	91.8	90.2	86.7	86.7	80.6	99.6	106	50	0
Pumps at ground level	FR12	72.1	72.1	74.9	74	75	72.6	72.2	70.2	70.9	84.2	87.5	100	100
Bins jetwash	FR13	78.8	100.8	80.8	72.3	76.1	70.4	70.1	73.6	72.7	85.5	104	50	20
Roof - Air intakes for internal cooling	FR26	72.7	70.4	84.6	74.1	74.9	70.5	65.5	58.6	47.4	80.7	89.1	100	100
Roof - Hot vent stack	FR27	76.3	75.8	82.1	72.2	80.4	77	75.5	62.7	49.7	86.8	92.3	100	0
Roof - Large vent outlets	FR28	82.6	86.9	81.3	83.7	77.6	72.4	67.1	57.1	48.3	84	95.2	100	100
Roof - Refrigeration system to coolers	FR29	74.6	73.4	86	71.9	68.9	69.4	75.9	65.9	64.7	83.6	90.4	100	100
Roof - "mushroom" air vents	FR30	95.5	90.5	91.7	88.7	80.3	82.4	74.4	71.4	69.3	92.2	105	100	100
Roof - Air intakes	FR31	87.9	80.5	91.3	79.6	80.2	76.2	73.1	66.4	57.3	87	97.8	100	100
Tanker discharge to silo	FR32	111.6	101.7	97.3	96.1	100.3	95	90	84.4	79	103.9	115.1	100	100

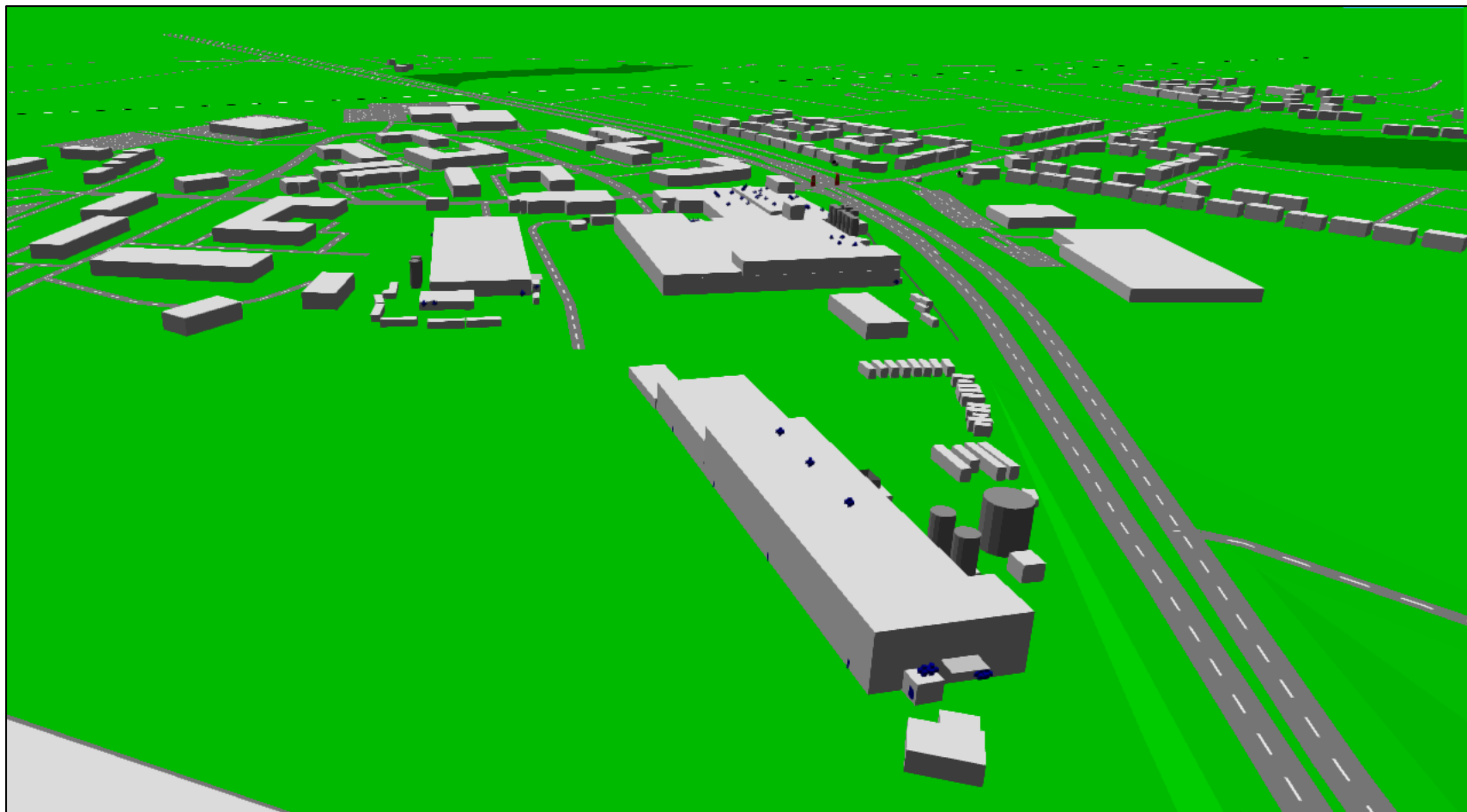
<b>Bread Plant 3</b>														
Basket wash - dust extract enclosure	FR14	78.5	83.1	86.4	91.2	79.3	75.5	71	75.1	72.1	88.8	97.7	100	100
Slicing - open shutter door	FR15	68.9	67.7	67.6	70.4	68.8	65	62	62.4	60.6	76	81.8	8	0
Basket wash - Large façade louvres	FR16	68.9	70.3	69.3	70.1	72.9	73.7	65.2	65.5	58.5	80.9	85.3	100	100
Whitworths discharge tanker to silo	FR17	87.3	83	73.4	75	79.1	86.1	85.6	88.5	86.7	99.4	101	100	100
Yellow HPC Kaeser EB421C Omega compressors	FR18	74.5	70.9	71	74.6	72.2	65.1	60.8	55.3	49.6	78.2	86	50	100
Chiller House louvre (north)	FR19	64.6	66.5	70.3	67.6	69.2	65.7	60.7	56.6	47.1	74.6	80.9	100	100
Chiller House louvre (south)	FR20	63.3	69.2	75.8	76.7	75.1	72.4	66.8	63.9	54.3	81.3	87	100	100
Chiller House louvre (stacks)	FR21	87.4	88.6	90.8	86.4	83.7	81.8	75.5	71.2	64.8	91.2	102.1	100	100
South door (open)	FR22	73.1	79	81	83.8	81.3	83.6	78.1	74.6	68.1	91.3	94.2	100	100
Robotic tin store - South door (open)	FR23	77.3	75.8	74.7	76.2	75.7	74.7	71.4	68.4	63.9	84.4	90.1	100	100
Slicing & bagging area - South door (open)	FR24	69.9	71.8	76.1	74.3	75.4	73.1	71.8	73.9	72.8	85.1	88.3	100	100
<b>Little Treats</b>														
Refrigeration unit (south)	FR4	71.3	78.2	91.8	89.4	84.2	82.9	76.2	67.2	58.4	91.3	100.1	100	100
Refrigeration unit (north)	FR5	68.7	78.1	89.3	93.7	79.9	77.7	74	64.8	64.6	90	98.8	100	100
Refrigeration unit (northeast corner)	FR25	85.1	77.1	82.9	83.4	89.9	80.2	75.8	69.9	65.8	92	99.8	100	100
DCE unit ( <i>assumed</i> )	FR33	76.7	71.3	72.1	76.9	64.1	65.5	67.6	70.9	61.1	79.2	87.2	100	0

## Appendix Six – Cadna Model Images

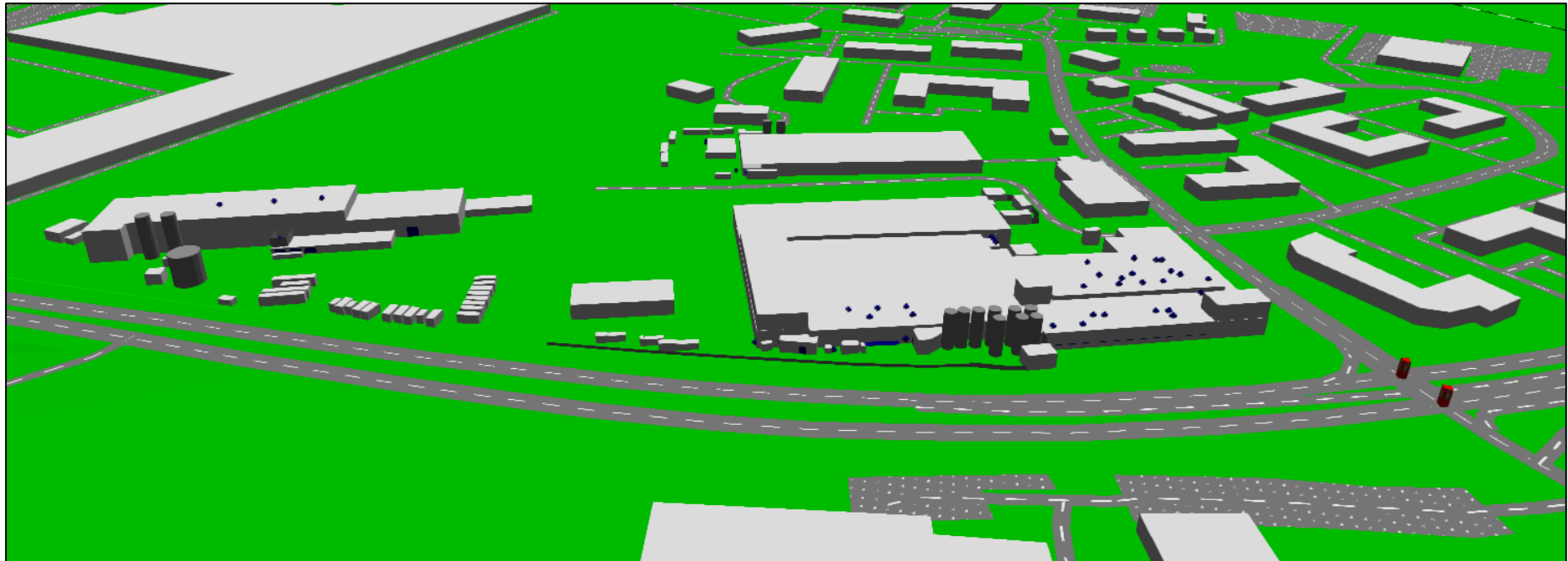
Figure A6.1: Cadna Model (view from East)



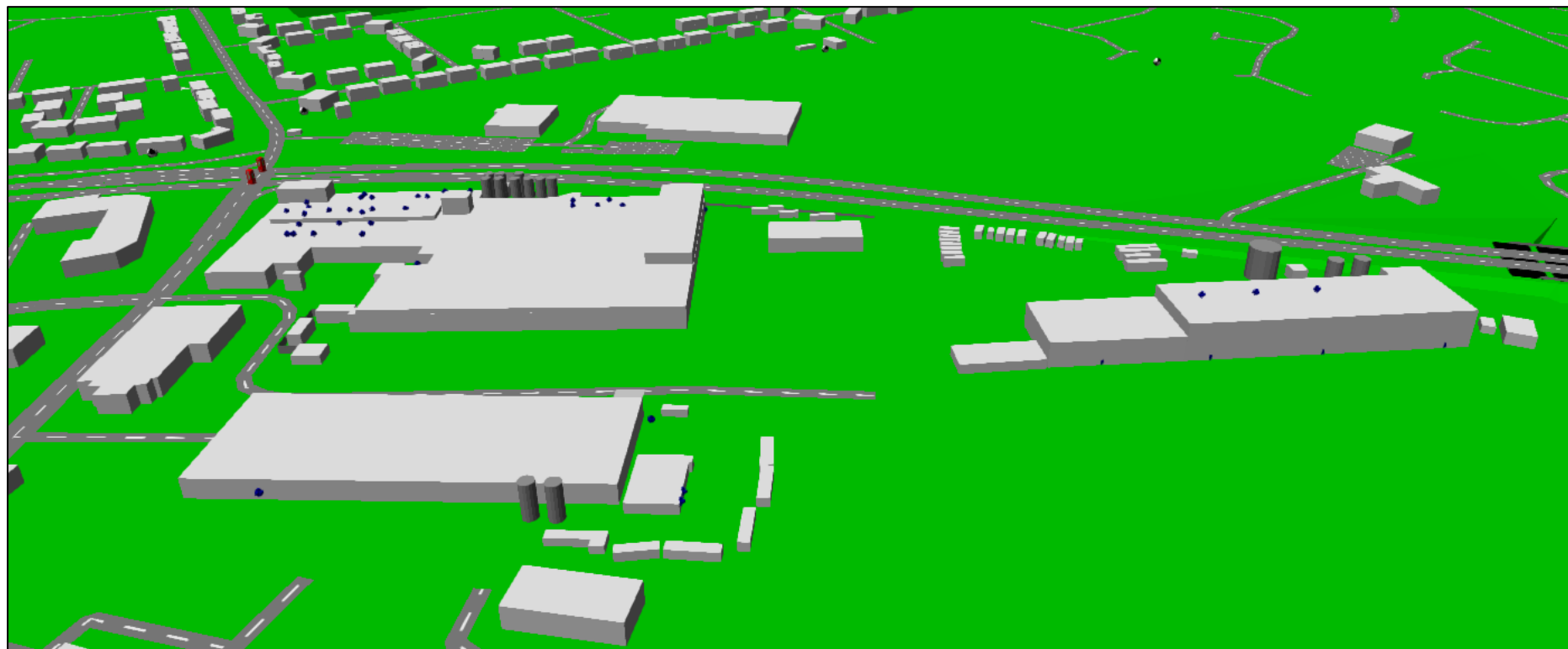
**Figure A6.2:** Cadna Model (view from West)



**Figure A6.3:** Cadna Model (view from North)



**Figure A6.4:** Cadna Model (view from South)





## Appendix Seven - Partial Sound Contributions

**Table A7.1:** Daytime Partial Sound Levels at P1 – Malam Drive (35 dB L<sub>Aeq,T</sub> Free-field)

Source	Broadband Sound Pressure Level, dB L <sub>Aeq</sub>	Octave Band Sound Pressure Level, dB L <sub>Aeq</sub>								
		31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
mushroom air vents	26.5	-2.8	5.2	19.8	21.5	20.3	19.5	11.2	-1	-29.6
mushroom air vents	26.1	-3.2	4.8	19.3	21	19.8	19.1	10.7	-1.8	-31.4
mushroom air vents	25.8	-3.5	4.5	19.1	20.8	19.6	18.9	10.5	-2.1	-32.3
air intakes	22	-12	-5.6	11.2	10.7	16.7	18.4	12.6	-3.1	-43.3
Horizontal fans	22	-17.6	0.5	9.7	9	16.7	18.7	12.4	0.6	-38.8
air intakes	21	-11.8	-5.4	11.3	10.8	16.8	16.2	10.3	-5.1	-43.8
mushroom air vents	20.6	-5.8	0.9	14	16.5	13.7	12.5	3.1	-11.2	-43.4
air intakes	20.3	-11.9	-5.5	11.3	10.7	15.9	15.4	9.5	-6.1	-45.1
air intakes	20.2	-11.2	-4.8	11.9	11.4	15.4	15.1	9.4	-5.7	-42.7
air intakes	20.2	-12.3	-5.8	11	10.7	15.9	15.3	9.3	-6.5	-46.4

**Table A7.2:** Night-time Partial Sound Levels at P1 – Malam Drive (37 dB L<sub>Aeq,T</sub> Free-field)

Source	Broadband Sound Pressure Level, dB L <sub>Aeq</sub>	Octave Band Sound Pressure Level, dB L <sub>Aeq</sub>								
		31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
mushroom air vents	28.9	-2.5	5.8	20.8	22.9	22.7	23.3	16.8	6.8	-19.1
mushroom air vents	28.4	-2.9	5.3	20.4	22.4	22.2	22.8	16.2	5.9	-21.2
mushroom air vents	28.2	-3.2	5.1	20.2	22.2	22	22.6	15.9	5.5	-22.1
air intakes	24.7	-11.7	-5	12.3	12	19	21.3	17	3.3	-33.9
air intakes	23.9	-11.5	-4.8	12.5	12.2	19.2	19.6	15.4	2.1	-33.8
mushroom air vents	23.6	-3.6	3.4	16.9	19.2	16.9	16	7.1	-6.8	-39.9
air intakes	23.3	-11.6	-4.9	12.4	12.1	18.5	18.9	14.9	1.4	-34.8
air intakes	23.1	-12	-5.3	12	12.1	18.4	18.7	14.4	0.7	-36.5
air intakes	23	-10.9	-4.2	13.1	12.9	17.9	18.5	14.4	1.6	-32.6
mushroom air vents	21.8	-4.3	3	16.8	17.1	14.6	12.6	3.8	-8.9	-40.6

**Table A7.3:** Daytime Partial Sound Levels at P2 – Shurlach Road (46 dB L<sub>Aeq,T</sub> Free-field)

Source	Broadband Sound Pressure Level, dB L <sub>Aeq</sub>	Octave Band Sound Pressure Level, dB L <sub>Aeq</sub>								
		31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Horizontal fans	38.5	-2.9	17.3	27.6	28.7	33.3	34	29.3	21.7	-4.9
mushroom air vents	37.6	4.1	12.5	29.6	30	30.3	32.4	29.4	22.7	8.1
mushroom air vents	36.1	6.7	15	30.2	29.5	29.1	29.8	23.8	17	-0.8
mushroom air vents	32.4	7.8	15.1	29	26.7	23.9	22.2	13.6	4.1	-13.8
air intakes	32	-4.3	2.5	21.9	20	25.5	26.7	26.4	17.2	-4.3
mushroom air vents	31.9	7.3	14.1	27.7	24.7	24.7	24.5	18.2	11.1	-3.5
air intakes	31.9	-5.8	1	18.4	18.6	24.4	27.9	26.6	16.6	-7.6
mushroom air vents	31.1	7.3	14.3	28	25.2	22.3	20.4	12.5	2.7	-16.2
air intakes	30.5	-6.3	0.5	17.9	18.3	24.6	25.8	24.6	14.5	-9.9
air intakes	30.1	-4.4	2.3	21.7	19.5	24.7	24.9	22.1	13.5	-6.5

**Table A7.4:** Night-time Partial Sound Levels at P2 – Shurlach Road (45 dB L<sub>Aeq,T</sub> Free-field)

Source	Broadband Sound Pressure Level, dB L <sub>Aeq</sub>	Octave Band Sound Pressure Level, dB L <sub>Aeq</sub>								
		31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
mushroom air vents	38.5	4.1	12.5	29.7	30.2	31	34.3	29.4	22.8	8.1
mushroom air vents	36.6	6.7	15	30.2	30	29.8	30.7	25.3	17.2	-0.8
mushroom air vents	32.8	7.4	14.3	27.9	25.3	25.4	26.2	21.8	14.2	-2.7
air intakes	32.8	-4.2	2.6	22.1	20.2	26.2	28.5	26.4	17.2	-4.3
mushroom air vents	32.7	7.9	15.2	29.2	27.1	24.4	22.4	13.8	4.6	-13.7
air intakes	32.7	-5.8	1	18.6	18.9	25	29.4	26.6	16.6	-7.6
mushroom air vents	31.5	7.3	14.5	28.2	25.9	22.9	20.9	13.3	3.5	-16.2
air intakes	31.2	-6.3	0.5	18	18.5	25.1	27.4	24.6	14.7	-9.8
air intakes	31	-4.4	2.4	21.8	19.7	25.1	25.7	24	17.1	-4.6
air intakes	30.6	-4.6	2.1	21.5	19.4	24.8	25.4	23.5	16.8	-5.2

**Table A7.5:** Daytime Partial Sound Levels at P3 – East Avenue (47 dB L<sub>Aeq,T</sub> Free-field)

Source	Broadband Sound Pressure Level, dB L <sub>Aeq</sub>	Octave Band Sound Pressure Level, dB L <sub>Aeq</sub>								
		31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
mushroom air vents	36.9	2.1	10.5	27.7	28.3	29.2	33.4	27.5	19.8	2.4
mushroom air vents	36.8	1.9	10.3	27.6	28.1	29.1	33.2	27.3	19.5	1.8
mushroom air vents	36.2	1.6	10	27.3	27.8	28.8	32.4	26.5	18.7	0.8
air intakes	33	-4.8	2.1	21.6	20	26.6	29.3	26.1	16.6	-6
air intakes	32.9	-5.7	1.2	18.9	20.8	28.1	28.6	25.3	15.5	-8.3
air intakes	32.2	-6	0.9	18.5	18.9	25.6	28.7	25.7	15.8	-8.8
Depanner dust capture (DCE unit) vent	32	-11.8	12.1	15	23.4	26.9	27	23.4	20.7	-0.5
air intakes	31.8	-5.2	1.6	21	20.5	25.9	26.9	25.4	16.7	-6.5
mushroom air vents	31.1	6.7	14	27.8	25.1	22.5	21.2	13.8	3.6	-16.4
air intakes	31.1	-5	1.7	21.1	19.1	24.6	26	25.3	16.3	-6.5

**Table A7.6:** Night-time Partial Sound Levels at P3 – East Avenue (46 dB L<sub>Aeq,T</sub> Free-field)

Source	Broadband Sound Pressure Level, dB L <sub>Aeq</sub>	Octave Band Sound Pressure Level, dB L <sub>Aeq</sub>								
		31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
mushroom air vents	37.1	2.1	10.6	27.9	28.5	29.9	33.4	27.5	19.8	2.4
mushroom air vents	36.9	1.9	10.4	27.7	28.4	29.8	33.2	27.3	19.5	1.8
mushroom air vents	36.4	1.6	10.1	27.4	28.1	29.6	32.4	26.5	18.7	0.8
air intakes	33.3	-4.7	2.1	21.8	20.4	27.7	29.3	26.1	16.6	-6
air intakes	33.1	-5.6	1.3	19.1	21.1	28.5	28.6	25.3	15.5	-8.3
air intakes	32.5	-5.1	1.6	21.1	20.7	26.3	28	26.4	16.7	-6.4
air intakes	32.5	-6	0.9	18.6	19.1	26.5	28.7	25.8	15.8	-8.7
Depanner dust capture (DCE unit) vent	32	-12.4	11.5	14.6	23.7	27.1	26.6	23.3	20.7	-0.5
air intakes	31.9	-5	1.8	21.2	19.3	25.1	27.5	25.9	16.3	-6.5
air intakes	31.7	-5.7	1.1	20.6	20.2	25.8	27	25.5	15.7	-7.9

**Table A7.7:** Daytime Partial Sound Levels at P4 – Central Road (41 dB L<sub>Aeq,T</sub> Free-field)

Source	Broadband Sound Pressure Level, dB L <sub>Aeq</sub>	Octave Band Sound Pressure Level, dB L <sub>Aeq</sub>								
		31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Depanner dust capture (DCE unit) vent	33.4	-18.3	8.3	12.4	23.2	28.2	30.4	21.4	16.8	-7.7
Louvres to basket wash	28.2	-13.8	4.3	9.5	16.8	22.8	25.3	17.8	7.9	-29.8
high level vent	27	-14.2	-4.3	13.4	13.5	24.4	21.8	14.9	3.5	-28.3
mushroom air vents	26.9	-3.9	4.4	19.4	19.4	21.1	21.7	14.9	4.9	-25.2
mushroom air vents	26.6	-3.7	4.6	19.6	19.6	19.3	21.7	15	5.9	-24.2
mushroom air vents	26.2	-3.5	4.8	19.8	19.8	19.6	20.2	13.5	5.3	-24.1
mushroom air vents	25.6	-4	4.3	19.3	19.3	19	19.6	12.9	3.3	-27
mushroom air vents	25.4	-4.3	4	19	19	18.8	19.3	12.5	1.3	-29.1
air intakes	22.5	-11.1	-4.3	12.9	12.5	17.5	17.7	13.5	1.7	-33.4
Refrig unit (Little Treats NE corner)	22.5	-25.9	1.9	10.4	16	16.9	17.9	11.5	-6.7	-51.3

**Table A7.8:** Night-time Partial Sound Levels at P4 – Central Road (40 dB  $L_{Aeq,T}$  Free-field)

Source	Broadband Sound Pressure Level, dB $L_{Aeq}$	Octave Band Sound Pressure Level, dB $L_{Aeq}$								
		31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Depanner dust capture (DCE unit) vent	33.4	-18.3	8.3	12.4	23.2	28.2	30.4	21.4	16.8	-7.7
Louvres to basket wash	28.2	-13.8	4.3	9.5	16.8	22.8	25.3	17.8	7.9	-29.8
high level vent	27	-14.2	-4.3	13.4	13.5	24.4	21.8	14.9	3.5	-28.3
mushroom air vents	26.9	-3.9	4.4	19.4	19.4	21.1	21.7	14.9	4.9	-25.2
mushroom air vents	26.6	-3.7	4.6	19.6	19.6	19.3	21.7	15	5.9	-24.2
mushroom air vents	26.2	-3.5	4.8	19.8	19.8	19.6	20.2	13.5	5.3	-24.1
mushroom air vents	25.6	-4	4.3	19.3	19.3	19	19.6	12.9	3.3	-27
mushroom air vents	25.4	-4.3	4	19	19	18.8	19.3	12.5	1.3	-29.1
air intakes	22.5	-11.1	-4.3	12.9	12.5	17.5	17.7	13.5	1.7	-33.4
Refrig unit (Little Treats SE corner)	22.5	-25.9	1.9	10.4	16	16.9	17.9	11.5	-6.7	-51.3

**Table A7.9:** Daytime Partial Sound Levels at P5 – Elizabethan Way (43 dB  $L_{Aeq,T}$  Free-field)

Source	Broadband Sound Pressure Level, dB $L_{Aeq}$	Octave Band Sound Pressure Level, dB $L_{Aeq}$								
		31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Chiller House stack	37.3	1.7	16.6	28	29.8	31.6	32.4	26.9	19	-0.1
Chiller House stack	37.3	1.7	16.6	27.9	29.8	31.5	32.3	26.9	18.9	-0.3
Depanner dust capture (DCE unit) vent	31	-17.2	7.4	11.3	21.3	26.2	27.7	18.3	12.6	-20.5
Basket wash DCE fan	27.3	-15	6.7	17.8	24.4	21.3	17	10.2	3.9	-16.9
Louvres to basket wash	25.7	-15.2	3.3	9	15.6	20.6	22.5	13.1	8.6	-19.9
Louvres to basket wash	24.4	-17.2	0.2	6	13.7	19.5	21.4	12.5	5.7	-19.9
Side door - open	23.7	-15.7	-1.8	6	10.8	15.5	21.5	15.6	7	-13.7
high level vent	23.5	-19.9	-9.7	8.3	8.9	20.4	18.9	12.7	-0.2	-35.9
Louvres to basket wash	23.3	-17.6	-0.4	5.3	12.7	18.1	20.4	11.6	5	-22.2
Refrig unit (Little Treats NE corner)	22.5	-12.6	-7.1	8	19.1	18.6	11.6	2.8	-14.7	-54.6

**Table A7.10:** Night-time Partial Sound Levels at P5 – Elizabethan Way (43 dB L<sub>Aeq,T</sub> Free-field)

Source	Broadband Sound Pressure Level, dB L <sub>Aeq</sub>	Octave Band Sound Pressure Level, dB L <sub>Aeq</sub>								
		31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Chiller House stack	37.8	1.7	16.7	28	30	31.8	32.9	28.1	21.6	5.1
Chiller House stack	37.7	1.7	16.6	28	29.9	31.8	32.9	28	21.5	5
Depanner dust capture (DCE unit) vent	32	-17.2	7.4	11.4	22.1	27.4	28.7	19.1	13.3	-19.7
Basket wash DCE fan	27.6	-14.9	6.7	17.9	24.6	21.6	17.4	10.6	4.4	-16.5
Louvres to basket wash	26.7	-12.2	5.5	9.9	16.2	21.5	23.7	15.1	10.2	-16.5
Louvres to basket wash	26.7	-16.1	1.3	7	14.8	21.2	24.1	16.1	9.7	-15.7
high level vent	25.5	-19.8	-9.6	8.6	9.4	21.6	21.6	16.8	3.1	-34.2
Louvres to basket wash	25.2	-15.6	1.6	6.7	13.8	19.7	22.4	14.2	8.3	-17.6
Side door - open	24.8	-16.2	-2.1	5.7	10.9	15.5	22.8	17.4	8.5	-13.6
HPC Kaeser compressor	23.5	-12.6	-4.6	8.9	17.3	20.5	16.3	9.1	-0.1	-20.3

**Table A7.11:** Daytime Partial Sound Levels at P6 – Lavender Drive / School Road North (43 dB L<sub>Aeq,T</sub> Free-field)

Source	Broadband Sound Pressure Level, dB L <sub>Aeq</sub>	Octave Band Sound Pressure Level, dB L <sub>Aeq</sub>								
		31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Horizontal fans	38.3	-9.9	10.7	24.1	26.2	31.8	34.7	31.4	22.9	-11.7
Refrig unit (Little Treats NE corner)	33.4	-3.6	4.1	17.2	27.6	29.9	26.6	21.3	6.3	-33.7
Chiller House stack	32.9	-5.7	11	24.1	25.8	27.5	27.8	21.6	10.5	-20.8
Chiller House stack	32.7	-6.3	9.3	22.6	25.8	27.4	27.8	21.5	10.4	-21
high level vent	30.4	-17	-5.1	14.5	15.6	27.2	25.9	20.1	7.3	-26.8
Louvres to basket wash	30.1	-13.8	4.7	9.8	17.8	24.2	27.5	20.1	14.2	-16.6
mushroom air vents	26.4	-1.7	6.5	21.2	20.2	19.5	19.5	11.1	-3.8	-43.9
mushroom air vents	24	-1.6	6.7	20.3	18.4	16.2	14.6	4.6	-11.4	-51.9
Louvres to basket wash	23.6	-18.8	0.5	5.2	12.5	18.2	20.8	12.8	6	-23.9
Basket wash DCE fan	23.2	-17.3	3.6	13	19.9	17.2	14.8	8	0	-29.2



**Table A7.12:** Night-time Partial Sound Levels at P6 – Lavender Drive / School Road North (43 dB L<sub>Aeq,T</sub> Free-field)

Source	Broadband Sound Pressure Level, dB L <sub>Aeq</sub>	Octave Band Sound Pressure Level, dB L <sub>Aeq</sub>								
		31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Depanner dust capture (DCE unit) vent	38.4	-20.5	4.6	13.7	27.3	33.5	35.5	26.7	22.3	-6.6
Refrig unit (Little Treats NE corner)	33.7	-4.1	3.5	16.6	28.1	30.5	26.3	20.9	5.8	-34.2
Chiller House stack	32.2	-6.7	8.4	20.2	23.2	27.5	27.8	21.6	10.5	-20.8
Chiller House stack	32.1	-6.8	8.4	20.2	23.1	27.4	27.8	21.5	10.4	-21
Louvres to basket wash	31.1	-13.6	5	10.2	18.2	24.8	28.5	22.5	15.2	-16.2
high level vent	30.5	-17	-5	14.9	15.7	27.3	26.1	20.1	7.3	-26.8
mushroom air vents	26.5	-1.7	6.5	20.9	20.7	20	19.4	10.8	-4.1	-44.2
Louvres to basket wash	24.3	-18.2	0.8	5.3	12.6	18.5	21.4	14.6	7.7	-23.5
mushroom air vents	24.1	-1.6	6.7	20	18.8	16.7	14.7	4.7	-11.3	-51.8
Basket wash DCE fan	23.4	-17.4	3.6	13.1	20.1	17.4	15.2	8.5	0.6	-28.6