ATTACHMENT 6.1

- NOISE & VIBRATION IMPACT ASSESSMENT -

noise & vibration solutions

Report Title: Noise & Vibration Impact Assessment

Client: Banagher Chilling Ltd

Site: Banagher, Co. Offaly

Issue Date: 18/04/2019

Level 2, Charlestown Centre, St. Margaret's Road, Dublin, D11 KXC7, Ireland

E info@enfonic.com W www.enfonic.com T 01 877 5088

Directors: G. Duffy, S. Duffy Registered in Ireland No. 360524

Document Control:

Prepared by:	Gary Duffy *Principle Consultant*
Contributor:	David Courtney *Consultant*
Reviewed by:	David Courtney *Consultant*

Issue	Date	Status:
1	06/04/2019	First Issue
2	18/04/2019	Clarification of impact assessment criteria
3	24/04/2019	Minor update to model screenshots
4	24/05/2019	Minor updates
5	05/06/2019	Formatting update

Table of Contents

Executive Summary 3
1.0 Introduction 3
2.0 Applicable Guidance 3
3.0 Assessment Criteria 4
4.0 Assessment Methodology 4
5.0 Noise Survey 5
6.0 Noise Modelling 7
7.0 Impact Assessment – Operational 9
8.0 Noise Model – Traffic 12
9.0 Impact Assessment – Traffic 14
10.0 Construction Noise and Vibration 15
11.0 Conclusions 18
APPENDIX A 19
APPENDIX B 21

Executive Summary

Enfonic have been commissioned by Panther Environmental to prepare a noise assessment in relation to the development by Banagher Chilling Limited at Banagher, Co. Offaly.

The assessment of the noise from the proposed development demonstrates that it is expected *not* to have an adverse impact during both construction and operational phases.

1.0 Introduction

From a noise perspective, the main noise sources considered in relation to the operational phase of the proposed development are on-site noise sources and noise related to the increase in traffic.

2.0 Applicable Guidance

BS:4142

Suitable guidance on environmental noise for planning purposes can be found in the standard *BS 4142:2014 Methods for rating and assessing industrial and commercial sound*.

This standard describes a method for assessing the impact of a proposed or existing industrial or commercial sound source. Its principal uses are to assess noise from new or changed industrial or commercial premises, to accompany a planning application, or to assess noise which may be giving rise to complaints.

The standard is basic in principle, but the details can be complex. In the simplest terms, the procedure rates the noise levels from an operation (the 'Specific' noise) and compares it with the 'Background' noise levels in the absence of the noise source(s) under investigation. The level difference is an indication of the impact that the operation might have.

If for example, if the 'Rated' noise level (the Specific noise + any penalties for particular noise characteristics) exceeds the Background noise by 10dB or more, it is likely to be an indication of a significant adverse impact. A difference of around 5dB indicates an adverse impact. If the level does not exceed the background, it is likely to have a low impact.

This however is dependent on the 'context' of the site and its environs e.g. time of day, nature of the neighbourhood, local attitudes to the development etc. There is also a degree of uncertainty applicable to the results e.g. for weather, instrumentation, measurement duration, calculation errors etc which ought to be considered.

ISO:1996

This standard defines the basic quantities to be used for the description of noise in community environments and describes basic assessment procedures. It also specifies methods to assess environmental noise and gives guidance on predicting the potential annoyance response of a community to long-term exposure from various types of environmental noises.

For example, it stipulates that noise measurements taken when it's raining are invalid†. It also advises on microphone positioning and other relevant procedures such as recording weather conditions.

ISO9613

Acoustics -- Attenuation of sound during propagation outdoors is used to predict the noise level from sources within the development.

CRTN

U.K. Department of Transport (Welsh Office) Document 'Calculation of Road Traffic Noise' (CRTN) 1988 is used for the prediction of road traffic noise following guidelines issued by Transport Infrastructure Ireland (TII)

BS5228

The impact of noise and vibration from construction activities can be assessed using this *Code of practice for noise and vibration control on construction and open sites.*

The guidance adopted in this standard designates noise sensitive locations into a specific category, based on the existing ambient noise levels i.e. in the absence of construction noise. This then sets threshold noise values for construction related noise that if exceeded, indicates a significant noise impact is associated with the construction activities.

3.0 Assessment Criteria

In order to assess the noise impact of any proposed development, the following methodology is adopted.

3.1 Baseline

The first stage is to assess and quantify the existing noise environment close to nearby sensitive receptors that may be affected by the proposed development.

3.2 Operational Phase

Operational noise levels are predicted, and the impact at the sensitive receptors assessed. Operational sources considered are;

- External noise sources associated with the operational of the development. These are primarily items of plant e.g. compressors, pumps etc and idling trailer and the Lairage Area.
- Road Traffic including changes to traffic flows on the existing road network as a result of the development.

3.3 Construction Phase

The results of the baseline noise assessment are used for the initial impact assessment of construction noise and vibration. Details of the construction plant and processed to be used is not yet finalised, but typical best practice is discussed and recommendations to be included in the final plan offered.

4.0 Assessment Methodology

4.1 Baseline Conditions

Attended noise measurements were taken during the day at four locations close to the site of the proposed development. Being representative of the closest residential dwellings, the impact assessment at these locations will be greater than for other dwellings further from the site.

The following parameters were recorded during each monitoring period:

- **L_{Aeq}**

  The continuous equivalent A-weighted sound pressure level. This is an "average" of the sound pressure level.

- **L_{AF10}**

  This is the A-weighted sound level that is exceeded for noise for 10% of the sample period. Used as an indicator of traffic noise.

- **L_{AF90}**

  This is the A-weighted sound level that is exceeded for 90% of the sample period. Referred to the "background" noise level in some standards.

A glossary of Acoustic Terminology is in Appendix A

5.0 Noise Survey

Noise Survey Methodology

A series of three non-consecutive 15min noise measurements were taken in calm, dry conditions on Mar 8, 2019 using a B&K Type 2250 Sound Level Meter which was calibrated before and checked after the survey. A copy of the calibration certificates for the instruments are available on request.

Noise Monitoring Locations

The locations chosen were at the nearest sensitive receivers as follows:

Location	Description
1	At the entrance to a dwelling off the R438 SW of the proposed development
2	Outside a nursing home on the L7016 W of the proposed development
3	Adjacent to the entrance to the proposed development on the L7016
4	SE of the proposed development on the L7016

These are identified as green microphone symbols in Figure 5.1.

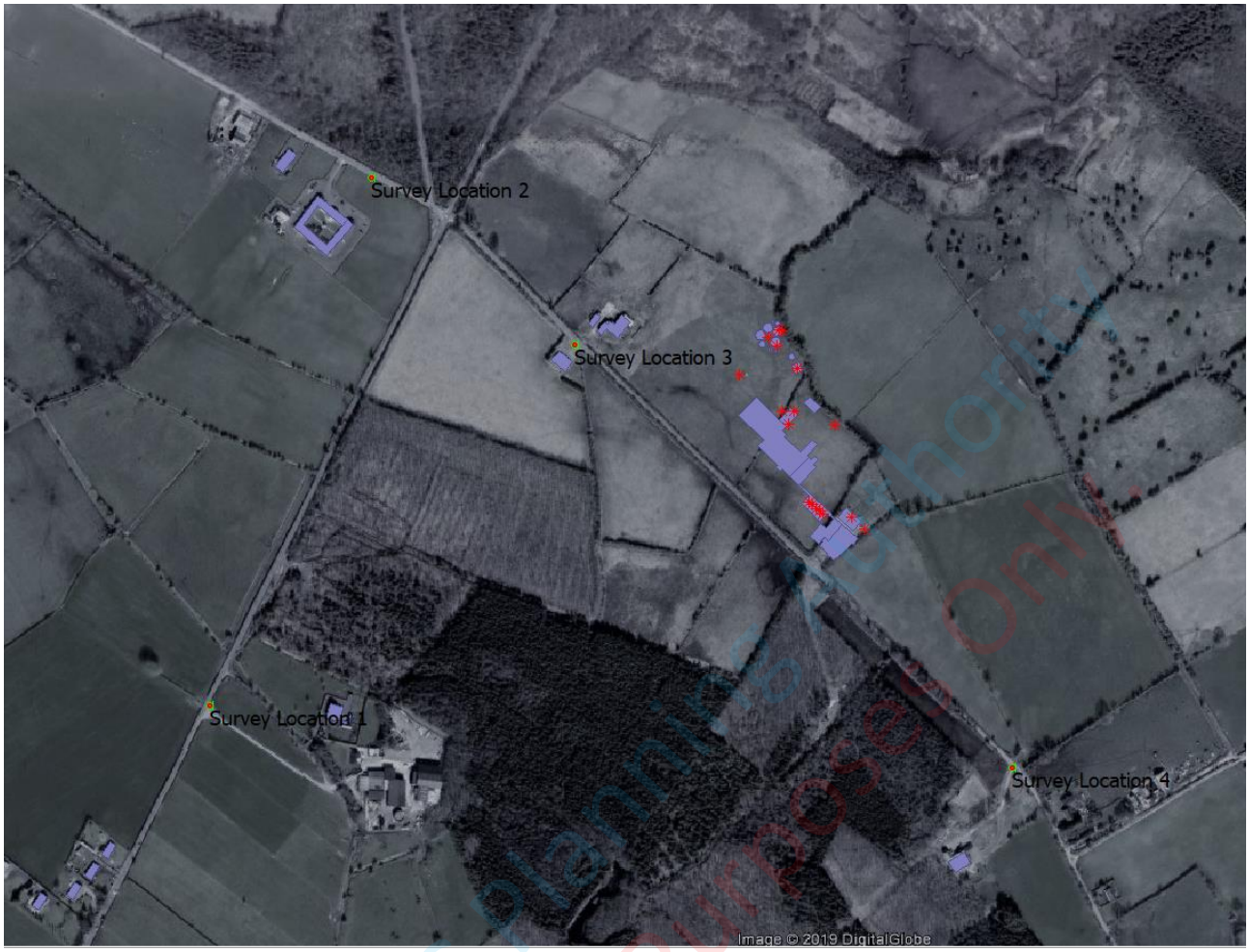


FIGURE 5.1: ATTENDED NOISE SURVEY LOCATIONS. OTHER MODEL ELEMENTS INCLUDE: BUILDINGS (PURPLE FEATURES) AND NOISE SOURCES (RED ASTERISKS).

Noise Survey Results

The results of the noise measurement are presented in Table 5.1 below.

TABLE 5.1: NOISE SURVEY RESULTS

Day-time		**dB (re. $2x10^{-5}$Pa)**			
Survey Location	**Start Time**	**L_{Aeq}**	**$L_{AF10.0}$**	**$L_{AF90.0}$**	**Main Noise Sources (ranked in significance)**
1a	08/03/2019 11:15	69.9	61.7	41.0	Local Road Traffic Noise (RTN) from R438, Bird Song, Farm activity to east, HGV X4, Distant RTN
1b	08/03/2019 12:24	72.9	70.8	45.8	Local RTN from R438, Bird Song, Farm activity to east, Farm machinery, HGV X6, Distant RTN
1c	08/03/2019 13:34	71.2	66.9	44.0	Local RTN from R438, Bird Song, Farm activity to east, HGV X5, Distant RTN
	Average:	**71.3**	**66.5**	**43.6**	
2a	08/03/2019 11:32	63.1	58.2	42.6	Bird Song, occasional local RTN, occasional HGV, RTN from R438
2b	08/03/2019 12:42	57.2	55.9	39.9	Bird Song, Local RTN, HGV

Survey Location	Start Time	L_{Aeq}	$L_{AF10.0}$	$L_{AF90.0}$	Main Noise Sources (ranked in significance)
2c	08/03/2019 13:51	55.7	56.5	45.4	Bird Song, Local RTN, HGV
	Average:	**58.6**	**56.9**	**42.6**	
	08/03/2019 11:49	56.9	51.3	39.2	Bird Song, occasional local RTN, Farm machinery noise to south, Wind Turbine
3a	08/03/2019 12:58	56.7	49.4	37.9	Bird Song, Wind Turbines, occasional local RTN
3b	08/03/2019 14:09	57.2	56.9	42.8	Bird Song, Wind Turbines, occasional local RTN
3c	**Average:**	**56.9**	**52.5**	**39.9**	
4a	08/03/2019 12:07	57.4	47.5	41.0	Bird Song, Wind Turbines, occasional local RTN
4b	08/03/2019 13:17	54.3	50.2	41.5	Bird Song, Wind Turbines, occasional local RTN
4c	08/03/2019 14:28	60.2	59.6	44.7	Bird Song, Wind Turbines, occasional local RTN
	Average:	**57.3**	**52.4**	**42.4**	

The Mean Value of the L_{Aeq} parameter is considered representative of the Ambient noise level under the measurement conditions.

The Mean Value of the L_{AF90} parameter is considered representative of the Background noise level under the measurement conditions.

The Mean Value of the L_{AF10} parameter is considered representative of the Traffic noise level under the measurement conditions.

An evening-time or night-time survey was not required as significant operational activities will not occur outside of 07:00-19:00hrs.

6.0 Noise Modelling

Following the guidelines of BS4142, the 'Specific' noise at sensitive receptor as a result of the operations of the proposed development must first be calculated.

6.1 Noise Model

A computer-based prediction model has been prepared in order to quantify the noise level associated with the operation of the proposed development. This section discusses the methodology behind the noise modelling process and presents the results of the modelling exercise.

6.2 Noise Prediction Software

Proprietary noise calculation software was used for the purposes of this impact assessment. The selected software, Brüel & Kjær Type 7810 Predictor, calculates traffic noise levels in accordance with *ISO 9613-*

2:1996 Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation.

The software predicts noise levels in different ways depending on the selected prediction standard. In general, however, the resultant noise level is calculated taking into account a range of factors affecting the propagation of sound, including:

- the magnitude of the noise source in terms of sound power;
- the distance between the source and receiver;
- the presence of obstacles such as screens or barriers in the propagation path;
- the presence of reflecting surfaces, and;
- the hardness of the ground between the source and receiver.

6.3 Input to the Noise Model

The noise model was prepared using the following data:

- Scaled map of the area around the site.
  - This was taken from Google Earth;
- Buildings on the proposed development.
  - These were provided in dwg format files by Panther Environmental
- Buildings associated with sensitive receptors.
  - These were identified during the noise survey and located on the Google Earth image.
- Sound power data of the major noise sources expected during the operational phase of the proposed development.
  - A list of the major noise sources and their associated Sound Power values was provided by Panther Environmental. It is understood that these were derived from measurements from a similar operation to the proposed development.

It has been assumed that for the purposes of the noise model that all sources are operational simultaneously. While this might not be the case for the true operation of the site, it represents a 'worse-case' in terms of the impact assessment.

The details of the items of plant used in the model which are presented in Table 6.1.

TABLE 6.1. NOISE SOURCE ACOUSTIC DATA.

		Octave Bands dB (re. 2x10-5Pa)									dB (re. $2x10^{-5}$Pa)	dB (re 10^{-12}W)
Ref	**Source**	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**Lp**	**Lw**
1	Drum Screen	67	65	67	64	67	70	71	71	70	77	85
2	DAF Unit	76	73	74	75	75	72	69	64	58	77	85
3	Blood Tank Refrigeration	72	77	74	75	74	73	69	65	60	77	85
4	Lairage Area	68	75	74	71	69	70	69	67	60	75	83

		Octave Bands dB (re. 2x10-5Pa)									dB (re. $2x10^{-5}$Pa)	dB (re 10^{-12}W)
5	General Waste Compactor	69	72	71	85	74	69	69	61	56	79	87
6	Boiler Room (external @2m)	74	76	78	79	77	77	75	69	64	81	92
7	Water Softener Shed (external @2m)	68	85	76	74	71	68	66	65	58	74	85
8	Refrigeration Room	73	93	81	84	88	80	74	69	61	88	96
9	Aeration Blowers (2 x 24kW)	-	69	58	59	60	63	65	59	56	72	80
10	Condenser Unit (Top)	75	80	74	77	74	73	77	78	74	83	91
11	Chiller Units (x5)	-	72	79	77	77	69	64	60	54	76	84
12	Trailer	79	75	79	77	75	71	66	61	56	76	84

Figure 5.1 also shows the buildings associated with the proposed development as input to the noise model in purple colour and sensitive receptors in green colour. The location of noise sources are shown as red asterixis.

6.4 Output of the Noise Model

Noise levels in terms of $L_{day\ (07:00\text{-}19:00)}$ are calculated to same noise survey locations and presented in Table 6.2. The impact assessment can then be made for these locations.

TABLE 6.2. PREDICTED DAY-TIME NOISE LEVELS FROM THE PROPOSED DEVELOPMENT.

Description	dBA
Survey Location 1	22.8
Survey Location 2	29.8
Survey Location 3	35.4
Survey Location 4	32.9

7.0 Impact Assessment – Operational

7.1 Legislative Context

There is no statutory Irish guidance relating to the maximum permissible noise level that may be generated by such a development. Local authorities may control operations by imposing limits on the hours of operation and/or may consider noise limits at their discretion. In the absence of specific noise limits, appropriate criteria relating to permissible operational noise levels for a development of this scale may be found in the following guidance:

- **Environmental Protection Agency (EPA) – Noise Guidance (NG4)**
    - This guidance is only applicable to industrial operations which full within the remit of the EPA and so cannot be directly applied to this development.

      However, typical limits set would likely be 55dBA for day-time operations and 45dBA for night-time which may, nonetheless be useful in this context.

- **World Health Organisation (WHO) - Environmental Noise Guideline**
    - This sets health-based recommendations on average environmental noise exposure of five relevant sources of environmental noise.

      There are no prescribed limits set but rather a comparative assessment is recommended, based on noise levels of the existing receiving environment. This approach is also followed in the BS4142 methodology used in this assessment.

      The WHO guidelines use established concepts from toxicology as follows:

      NOEL – No Observed Effect Level
      This is the level below which no effect can be detected. 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.

      UOAEL – Unacceptable Observed Adverse Effect Level
      This is the level above which unacceptable adverse effects on health and quality of life occur.

Table 7.0 presents a hierarchy of these terms, related examples, impact in terms of noise levels and recommended actions.

TABLE 7.0. NOISE EXPOSURE HIERARCHY (BASED ON WHO GUIDANCE)

Perception	Examples of Outcomes	Noise Level Criteria	Action
No Observed Effect Level (NOEL):			
Not noticeable	No Effect	Noise Rating Level ($L_{Aeq,T}$) is below background noise level ($L_{A90,T}$)	No specific measures required
Lowest Observed Adverse Effect Level (LOAEL):			
Noticeable and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life	Noise Rating Level ($L_{Aeq,T}$) between 0-5 dB above the background noise level ($L_{A90,T}$). LOAEL is equivalent to background noise level	No specific measures required
Significant Observed Adverse Effect Level (SOAEL):			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. having to keep windows closed most of the time, avoiding certain activities during periods of intrusion. 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	Noise Rating Level ($L_{Aeq,T}$) 10 dB or greater above the background noise level ($L_{A90,T}$).	Avoid
Unacceptable Observed Adverse Effect Level (UOAEL):			
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and nonauditory	Noise Rating Level ($L_{Aeq,T}$) 15 dB or greater above the background noise level ($L_{A90,T}$).	Prevent

7.2 Impact Assessment

Following the procedures of BS4142:2014, penalties/adjustments to the predicted 'Specific' noise levels may be applied. These include penalties for Tonal and Impulsive characteristics of the site noise and its intermittency. The noise is not expected to exhibit any of these characteristics, so no penalties have been applied.

Uncertainty in the predicted noise levels is a factor that ought also to be considered. A value of +3dB has been determined which includes uncertainties for:

- Instrumentation used;
- Complexity of the noise environment;
- Duration, times, number of measurement locations;
- Noise levels at existing site being 'contaminated' by other industrial/commercial sounds & traffic;
- Sound Power calculation errors;
- Modelling assumptions (some of which reduce uncertainty).

The penalties and uncertainties are added to the predicted noise level to give the Rating Level, Lr.

The results from the noise survey alongside the predicted Rating Levels, rounded to the nearest 0.5 dB are given in Table 7.1.

TABLE 7.1. IMPACT RESULTS FOR OPERATIONAL NOISE SOURCES.

Description	Specific Noise	Penalties	Uncertainty	Rated Level (Lr)	Background L_{AF90}	Impact Level Difference
Survey Location 1	22.8	0	3	26	44	-18
Survey Location 2	29.8	0	3	33	43	-10
Survey Location 3	35.4	0	3	38	40	-2
Survey Location 4	32.9	0	3	36	42	-6

All values are sound pressure levels in dB re: $2x10^{-5}$Pa

As can be seen from the results, the predicted noise levels are likely to be below the existing background levels at all Survey Locations. These would therefore fall into the **No Observed Effect Level (NOEL)** criteria and no specific measures (of noise control) need apply.

Therefore, no adverse impact identified by BS4142 at any location due to the operational noise sources is likely.

The predicted noise levels are also well below a typical limit of 55dBA that may apply were this an EPA scheduled activity.

8.0 Noise Model – Traffic

A noise model was developed for the associated increase in traffic from the proposed development. The applicable guidance as recommended by Transport Infrastructure Ireland (TII) is the CRTN standard. This uses traffic flow data including quantity of vehicles, velocity and percentage of heavy goods vehicles (HGVs). For best results, hourly long-term annual values are used.

8.1 Traffic Flow Data

For the purposes of the CRTN methodology, hourly values of the total number of vehicles and the percentage of heavy goods vehicle is required for each of the roads close to the site.

Figures for Annual Average Daily Traffic (AADT) for two scenarios were provided by Panther Environmental. These were for *Opening Year Without Development* and *Opening Year With Development* as presented in figures 8.1 and 8.2 below.

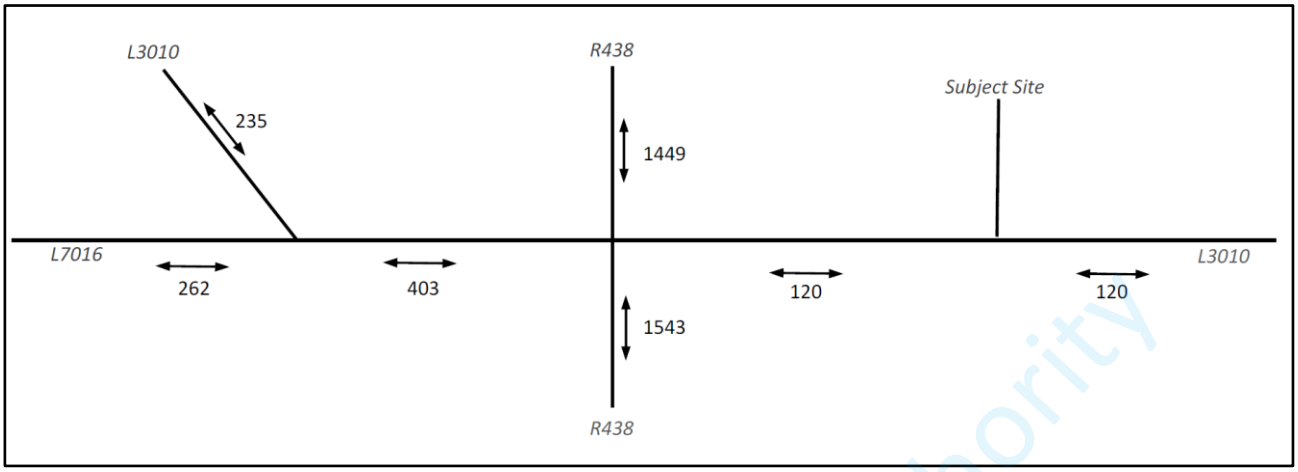


FIGURE 8.1. AADT FIGURES FOR OPENING YEAR WITHOUT DEVELOPMENT

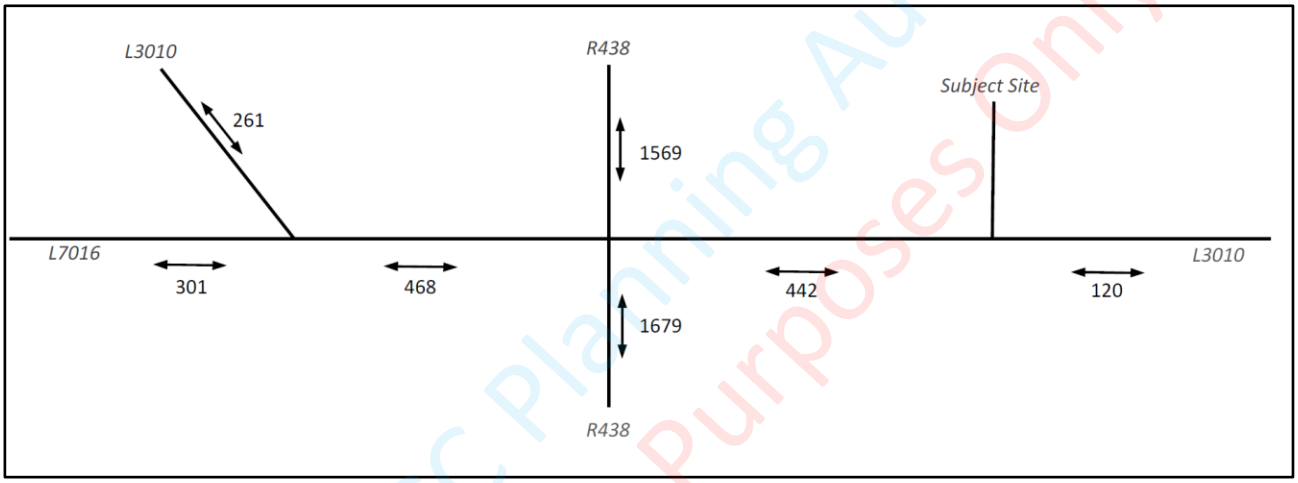


FIGURE 8.2. AADT FIGURES FOR OPENING YEAR WITH DEVELOPMENT

The speeds for each road was set as follows:

Road Section	Speed set in model (k/h)
L7017 (west of the L3010 junction)	80
L3010 (short section west of the R438)	30
R438	100
L3010 (between R438 and Subject Site)	30
L3010 (east of Subject Site)	100

The roads as modelled are illustrated in Figure 8.3

FIGURE 8.3. MODELLED ROADS SHOWN AS DASHED RED LINES.

To provide hourly input data to the models, which would allow the L_{day} parameter to be calculated as required, each AADT value was distributed using TII's Diurnal Profile as set out in Table 8.1.

TABLE 8.1. TII DIURNAL PROFILE FOR NON HCV TRAFFIC.

Hour	%	Hour	%	Hour	%
1	0.84	9	5.83	17	8.02
2	0.53	10	5.26	18	8.54
3	0.38	11	5.17	19	7.34
4	0.33	12	5.72	20	5.68
5	0.37	13	6.33	21	4.35
6	0.73	14	6.63	22	3.23
7	2.20	15	6.82	23	2.25
8	4.68	16	7.32	24	1.45

The percentage of HGVs was set as 8% for the Do Nothing scenario i.e. opening year without the development. For the Do Something scenario i.e. with the Development in operation, a figure of 12% HGVs was used.

9.0 Impact Assessment – Traffic

Traffic is predicted to increase in the area regardless of whether the proposed development proceeds.

Both scenarios were modelled and the difference between the two compared.

As all other inputs are fixed e.g. traffic speed, road surface type etc, the result differences are attributable solely the change in traffic volume and mix of HGVs. The difference in the results is therefore the important consideration rather than the respective predicated levels

Table 9.1 presents the results of the noise models.

TABLE 9.1. PREDICTED TRAFFIC NOISE LEVELS.

Location	Do Nothing	Do Something	Difference
Survey Location 1	65.7	66.3	0.6
Survey Location 2	55.6	65.6	10.0
Survey Location 3	44.5	51.6	7.1
Survey Location 4	36.6	38.1	1.5

In terms of traffic noise impact; Location 2, which is outside the nursing home close to the junction of all roads in this assessment, exhibits a large increase in noise of 10dB.

Survey Location 2 (Nursing home)

The Survey Location 2 is set beside the L7016 road with the building approximately 50m back. To better represent the impact at this building, the noise level outside the Nursing home has also been predicted.

The predicted level at this location was 58.8dBA, some 6.8dB less than for the position of Survey Location 2. The measured background level from Survey Location 2 is likely to be similar at the Nursing home, therefore the impact is 3.2dB.

This impact falls with the **Lowest Observed Adverse Effect Level (LOAEL)** criteria and no specific measures (of noise control) need apply.

In addition, it is understood that the design of the Nursing home is such that only offices face the roads and a quiet courtyard exists within the building envelope.

10.0 Construction Noise and Vibration

10.1 Noise

The guidance adopted in the BS5228 standard designates noise sensitive locations into a specific category; A, B or C as presented in Table 10.1, based on existing ambient noise levels i.e. in the absence of construction noise. This then sets threshold noise values for construction related noise that if exceeded, indicates a significant noise impact is associated with the construction activities.

Table 10.1 also sets out the values which, when exceeded, indicate a significant effect at the facades of residential receptors as recommended by the above standard. Please note that these are cumulative levels, i.e. the sum of both ambient and construction noise levels.

TABLE 10.1. EXAMPLE THRESHOLD OF SIGNIFICANT EFFECT AT DWELLINGS

Assessment category and threshold value period (L_{Aeq})	Threshold value, in decibels (dB)		
	Category A	Category B	Category C
Night-time (23.00−07.00)	45	50	55
Evenings and weekends [D)]	55	60	65
Daytime (07.00−19.00) and Saturdays (07.00−13.00)	65	70	75
NOTE 1 A significant effect has been deemed to occur if the total L_{Aeq} noise level, including construction, exceeds the threshold level for the Category appropriate to the ambient noise level. *NOTE 2 If the ambient noise level exceeds the threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a significant effect is deemed to occur if the total L_{Aeq} noise level for the period increases by more than 3 dB due to construction activity.* *NOTE 3 Applied to residential receptors only.*			
A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values. **B)** Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values. **C)** Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values. **D)** Category D: 19.00–23.00 weekdays, 13.00–23.00 Saturdays and 07.00–23.00 Sundays.			

Construction for the proposed development will only take place from 07:00 – 19:00 Mon-Fri, 08:00 to 14:00 Sat. The L_{Aeq} Ambient noise levels at the Survey Locations are presented in Table 5.1 and following the guidelines, the resultant limits are shown in Table 10.2

TABLE 10.2. APPLICABLE CONSTRUCTION NOISE LIMIT

Survey Location	Ambient Noise Level	Rounded to nearest 5dB	Applicable Category (Day-time)	Applicable L_{Aeq} Limit
1	71.3	70	B	70
2	58.6	60	A	65
3	56.1	60	A	65
4	57.3	60	A	65

10.3 Vibration

There are no habitable dwellings close to the proposed development and the expected vibration levels from the construction site are expected to be undetectable at the closest sensitive receptors.

10.4 Construction Management Plan

Based on information in the Construction Details document provided and given the likely requirements of a site of this scale, it is considered that there is little likelihood of a significant adverse impact from the construction works. Nonetheless, a comprehensive Construction Environmental Management Plan which includes adopting appropriate mitigation measures will manage the risk of noise impacting the community. The following is a broad outline of recommended actions to include in the plan.

The contract documents should clearly specify that the Contractor undertaking the construction of the works will be obliged to take specific noise abatement measures and comply with the recommendations of BS5228-1 2009. These measures will typically include:

- No plant used on site will be permitted to cause an ongoing public nuisance due to noise;
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations;
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract;
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers;
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use;
- Any plant, such as generators or pumps, which is required to operate before 07:00hrs or after 19:00hrs will be surrounded by an acoustic enclosure or portable screen;
- Location of plant shall consider the likely noise propagation to nearby sensitive receptors;
- During the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Table 2 using methods outlined in BS5228:2009 Part 1.

Working Hours

Normal working times will be 07:00 to 19:00hrs Monday to Friday, 08:00 to 14:00 Saturdays. Works other than the pumping out of excavations, security and emergency works will not be undertaken outside these working hours without the written permission of the Contracting Authority.

Works other than the pumping out of excavations, security and emergency works will not be undertaken at night and on Sundays without the written permission of the Contracting Authority.

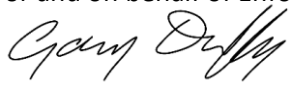
Emergency Work

The emergency work referred to above may include the replacement of warning lights, signs and other safety items on public roads, the repair of damaged fences, repair of water supplies and other services which have been interrupted, repair to any damaged temporary works and all repairs associated with working on public roads.

11.0 Conclusions

Noise levels from the site operations and associated traffic in the area have been considered. The associated noise impact assessment has demonstrated a low adverse impact is likely, therefore the proposed development should not be restricted on noise grounds.

For and on behalf of Enfonic Ltd



Gary Duffy, BEng, MIOA
Managing Director

APPENDIX A

Acoustic Terminology

Ambient	Encompassing sound, at a given place. Usually a composite of sounds from many sources near and far.
A-weighting	Frequency weighting scale to account for non-linear response of the human ear. Used so that the measured noise corresponds roughly to the overall level of noise that is discerned by the average human. Denoted by suffix A in parameters such as L_{Aeq}, L_{AF10}, etc.
Background Level	A-weighted noise level of exceeded for 90% of the measurement time. Denoted L_{AF90}.
Broadband	Noise which contains roughly equal energy across the audible frequency spectrum with no tonal component.
Decibel (dB)	Unit of noise measurement scale relative to 20 µPa. The scale is logarithmic therefore dBs cannot be arithmetically added or subtracted.
Fast response	0.125 seconds response time of the Sound Level Meter to changing noise levels. Denoted by suffix F in parameters such as LAF10 T, LAF90 T, etc.
Free-field	Noise environment free from reflections from vertical surfaces.
Frequency	Number of cycles per second of a sound or vibration wave. The range of human hearing is c20-20,000 Hertz.
Hertz (Hz)	Unit of frequency measurement.
Impulse	A category of short duration, almost instantaneous sounds, typically less than one second.
$L_{Aeq, T}$	Equivalent continuous A-weighted sound pressure level. The value of the sound pressure level in decibels of continuous steady sound that, within a specified time interval, T = t2 – t1, has the same mean-squared sound pressure as a sound that varies with time
L_{AF}	The RMS (root mean square) of the instantaneous sound pressure over a given period of time (T). T is usually Fast (0.125sec) or Slow (1sec)
L_{AF10}	The noise level just exceeded for 10% of the measurement period, A-weighted and calculated by Statistical Analysis.
L_{AF90}	The noise level exceeded for 90% of the measurement period, A-weighted and calculated by Statistical Analysis.
$L_{Ar,T}$	The Rated noise level. The A-weighted, Leq, Sound Pressure Level of an industrial noise during a specified time period, adjusted for Tonal, Impulsiveness and other characteristics.
Masking	A noise that is intense enough to render inaudible or unintelligible another sound that is also present
Near Field	Sound field near a sound source, usually within about two wavelengths of the source noise.
Noise Monitoring Terminal (NMT)	A location where a noise measurement was taken using a Sound Level Meter.
Noise Sensitive Location	Any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or area of high amenity which for its proper enjoyment requires absence of noise at nuisance levels.
1/3 octave band	Frequency spectrum may be divided into octave bands. Upper limit of each octave is twice lower limit. Each octave may be subdivided into thirds, allowing greater analysis of tones.
Residual level	Noise level remaining when specific source is absent or does not contribute to ambient.
Reverberant Field	Sound field near reflecting surfaces where reflected waves contribute to the measured noise level.

Sound Level Meter	A sound level meter is commonly a hand-held instrument with a microphone used for acoustic measurements. The diaphragm of the microphone responds to changes in air pressure caused by sound waves and converted into an electrical signal measured by the instrument. The current international standard that specifies sound level meter functionality and performances is the IEC 61672-1:2013.
Specific level	Noise from the source under investigation as defined in BS 4142 Method for rating industrial noise affecting mixed residential and industrial areas. The specific noise is compared to the Background Noise for impact assessment.
Tone	Character of noise caused by dominance of one or more frequencies. The noise under investigation may be penalised when assessing industrial and environmental noise.
Z-weighting	Z for 'Zero' frequency weighting i.e. no frequency weighting applied to the measured noise level. Denoted by suffix Z in parameters such as L_{Zeq}, L_{ZF90}, etc.

APPENDIX B

Statement of qualifications, competency and experience.

Name	Responsibilities in this report	Professional Membership	Experience
Gary Duffy, B.Eng., Dip Acoustics	Principle consultant. Report author.	Corporate member of Institute of Acoustics (IOA) since 1994	Enfonic's managing director specialising in acoustics within sales, training and consultancy sectors for 27 years Product support specialist for B&K (UK & Ireland) Predictor software. Founder member of the Irish branch of the IOA and ex-chair. Currently member of IOA London and Irish branches and regularly attends and presents at CPD accredited meetings. Co-wrote the EPA's original guidance note on noise and has advised on its current form. Sat on the steering committee of current (2017) Part E Building Regulations (Noise). Produces regular reports for industries including BS4142 & BZ5228, IPPC & IE (EPA) and ETSU (Wind Turbine) impact & compliance assessments.
David Courtney, B.Eng	Consultant. Noise Survey and report reviewer.	Awaiting on application for Associated membership of IOA to be approved	Passed the IOA Certificate of Competence in Environmental Noise Assessment in 2017. Undertakes all types of noise and vibration measurements and assessments in relation to BS4142, BZ5228, IPPC & IE (EPA) and ETSU (Wind Turbine). Also manages our long-term monitoring sites and provides technical support for our hire services.