Lidl Foodstore Development, Milford Haven

Noise Assessment for Planning Application

28th February 2024

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1. INTRODUCTION

1.1. Overview

inacoustic has been commissioned to assess the impact of potential noise arising from a proposed foodstore redevelopment at a site off Great North Road, Milford Haven.

The following technical noise assessment has been produced to accompany a Planning Application to Pembrokeshire County Council and is based upon environmental noise measurements undertaken at the site and a subsequent 3-dimensional noise modelling exercise.

This noise assessment is necessarily technical in nature; therefore, a glossary of terms is included in Appendix A to assist the reader.

1.2. Scope and Objectives

The scope of the noise assessment can be summarised as follows:

- A sound monitoring survey was undertaken at a discrete location adjacent to the closest noise-sensitive receptors to the Site;
- A 3-dimensional noise modelling exercise, in order to quantify the potential noise generation of the proposed site uses;
- An assessment of potential noise impacts with respect to the prevailing acoustic conditions at existing off-site receptors; and
- Recommendation of mitigation measures, where necessary, to comply with the requirements of BS4142:2014+A1:2019[1].

[1] British Standard 4142: 2014+A1:2019 *Method for rating and assessing commercial sound*. BSI

2. Policy Context

2.1. National Policy

2.1.1. Planning Policy Wales

The Government's planning policies for Wales are contained in Planning Policy Wales (Edition 12, February 2024). The policy provides overarching requirements for developments to adequately control noise pollution, to provide appropriate soundscapes and to incorporate good acoustic design.

The policy is supplemented by the Noise and Soundscape Action Plan 2018-2023, which provides more detailed guidance on planning for a new development, but does not set out specific assessment methods or criteria. The guidance in this document has been used to inform a qualitative assessment of the effect the proposed development could have on the local soundscape.

2.1.2. Technical Advice Note (Wales) 11

This note provides advice on how the planning system in Wales can be used to minimise the adverse impact of noise without placing unreasonable restrictions on development or adding unduly to the costs and administrative burdens of business.

It outlines some of the main considerations which local planning authorities should take into account in drawing-up development plan policies and when determining planning applications for development which will either generate noise or be exposed to existing noise sources.

2.2. Assessment Criteria

2.2.1. BS4142:2014+A1:2019

BS4142:2014+A1:2019 sets out a method to assess the likely effect of sound from factories, industrial premises or fixed installations and sources of an industrial nature in commercial premises, on people who might be inside or outside a dwelling or premises used for residential purposes in the vicinity.

The procedure contained in BS4142:2014+A1:2019 for assessing the effect of sound on residential receptors is to compare the measured or predicted sound level from the source in question, the $L_{Aeq,T}$ *specific sound level*, immediately outside the dwelling with the $L_{A90,T}$ background sound level.

Where the sound contains a tonality, impulsivity, intermittency and other sound characteristics, then a correction depending on the grade of the aforementioned characteristics of the sound is added to the specific sound level to obtain the $L_{Ar,Tr}$ *rating sound level*. The effect of uncertainty in sound measurements, data and calculations should also be considered when necessary.

BS4142:2014+A1:2019 states: *"The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs"*. An estimation of the impact of the specific sound can be obtained by the difference of the rating sound level and the background sound level and considering the following:

- *"Typically, the greater this difference, the greater the magnitude of the impact."*
- *"A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context."*
- *"A difference of around +5dB is likely to 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 the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context."*

During the daytime, the assessment is carried out over a reference time period of 1-hour, with a reference period of 15-minutes used for the night-time assessment. The periods associated with day or night, for the purposes of the Standard, are considered to be 07.00 to 23.00 and 23.00 to 07.00, respectively.

Rating Penalty Principle

Section 9 of BS4142:2014+A1:2019 describes how the rating sound level should be derived from the specific sound level, by determining a rating penalty.

BS4142:2014+A1:2019 states:

"Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, add a character correction to the specific sound level to obtain the rating level. This can be approached in three ways:

a) subjective method;
b) objective method for tonality;
c) reference method."

Given that the Proposed Development is not operational, the subjective method has been adopted to derive the rating sound level from the specific sound level. This is discussed in Section 9.2 of BS4142:2014+A1:2019, which states:

"Where appropriate, establish a rating penalty for sound based on a subjective assessment of its characteristics. This would also be appropriate where a new source cannot be measured because it is only proposed at that time, but the characteristics of similar sources can subjectively be assessed.

Correct the specific sound level if a tone, impulse or other characteristics occurs, or is expected to be present, for new or modified sound sources."

BS4142:2014+A1:2019 defines four characteristics that should be considered when deriving a rating penalty, namely; tonality; impulsivity; intermittency; and other sound characteristics, which are defined as:

Tonality

A rating penalty of +2 dB is applicable for a tone which is *"just perceptible"*, +4 dB where a tone is *"clearly perceptible"*, and +6 dB where a tone is *"highly perceptible"*.

Impulsivity

A rating penalty of +3 dB is applicable for impulsivity which is *"just perceptible"*, +6 dB where it is *"clearly perceptible"*, and +9 dB where it is *"highly perceptible"*.

Intermittency

BS4142:2014+A1:2019 states that when the *"specific sound has identifiable on/off conditions, the specific sound level ought to be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time … if the intermittency is readily distinctive against the residual acoustic environment, a penalty of +3 dB can be applied."*

Other Sound Characteristics

BS4142:2014+A1:2019 states that where *"the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distance against the residual acoustic environment, a penalty of +3 dB can be applied."*

Uncertainty in Calculations

BS4142:2014+A1:2019 requires that the level of uncertainty in the measured data and associated calculations is considered in the assessment. The Standard recommends that steps should be taken to reduce the level of uncertainty.

Measurement Uncertainty

BS4142:2014+A1:2019 states that measurement uncertainty depends on a number of factors, including the following, which are applicable to the Proposed Development:

"
…
b) the complexity and level of variability of the residual acoustic environment;
…
d) the location(s) selected for taking the measurements;
…
g) the measurement time intervals;
h) the range of times when the measurements have been taken;
i) the range of suitable weather conditions during which measurements have been taken;
…
k) the level of rounding of each measurement recorded; and
l) the instrumentation used."

Calculation Uncertainty

BS4142:2014+A1:2019 states that calculation uncertainty depends on a number of factors, including the following, which are applicable to the Proposed Development:

"
…
b) uncertainty in the operation or sound emission characteristics of the specific sound source and any assumed sound power levels;
c) uncertainty in the calculation method;
d) simplifying the real situation to "fit" the model (user influence on modelling); and
e) error in the calculation process."

2.2.2. Relative Change in Ambient Noise Level

In circumstances where a noise environment may be altered by addition or removal of a noise source, considered to be largely anonymous or within the prevailing acoustic character of an area, for example, changes to traffic quantum or patterns, it is normal to consider the relative change in ambient noise level. The assessment, therefore, considers this phenomenon to add context.

The impact scale adopted in this assessment is shown in Table 1 below, which relates to established human responses to noise, in line with 'Table 7-12 Effect Descriptors' of the IEMA Guidelines.

TABLE 1: IMPACT SCALE FOR COMPARISON OF FUTURE NOISE AGAINST EXISTING NOISE

Noise Level Change dB(A)	Subjective Response	Significance
Less than 1.0	Not perceptible	Negligible
1.0 – 2.9	Barely perceptible	Minor impact
3.0 – 4.9	Noticeable	Moderate impact
5.0 – 9.9	Up to a doubling or halving of loudness	Substantial impact
10.0 or more	More than a doubling or halving of loudness	Major impact

The criteria above reflect the key benchmarks that relate to human perception of sound. A change of 3 dB(A) is generally considered to be the smallest change in environmental noise that is perceptible to the human ear. A 10 dB(A) change in noise represents a doubling or halving of the subjective perception of loudness. The difference between the minimum perceptible change and the doubling or halving of the loudness is split to provide greater definition to the assessment of changes in noise level. It is considered that the criteria specified in Table 1 provide a good indication as to the likely significance of changes in noise levels in this case and can be used to inform the context in which the sound occurs in order to assess the impact of noise from the proposed development.

3. Site Description

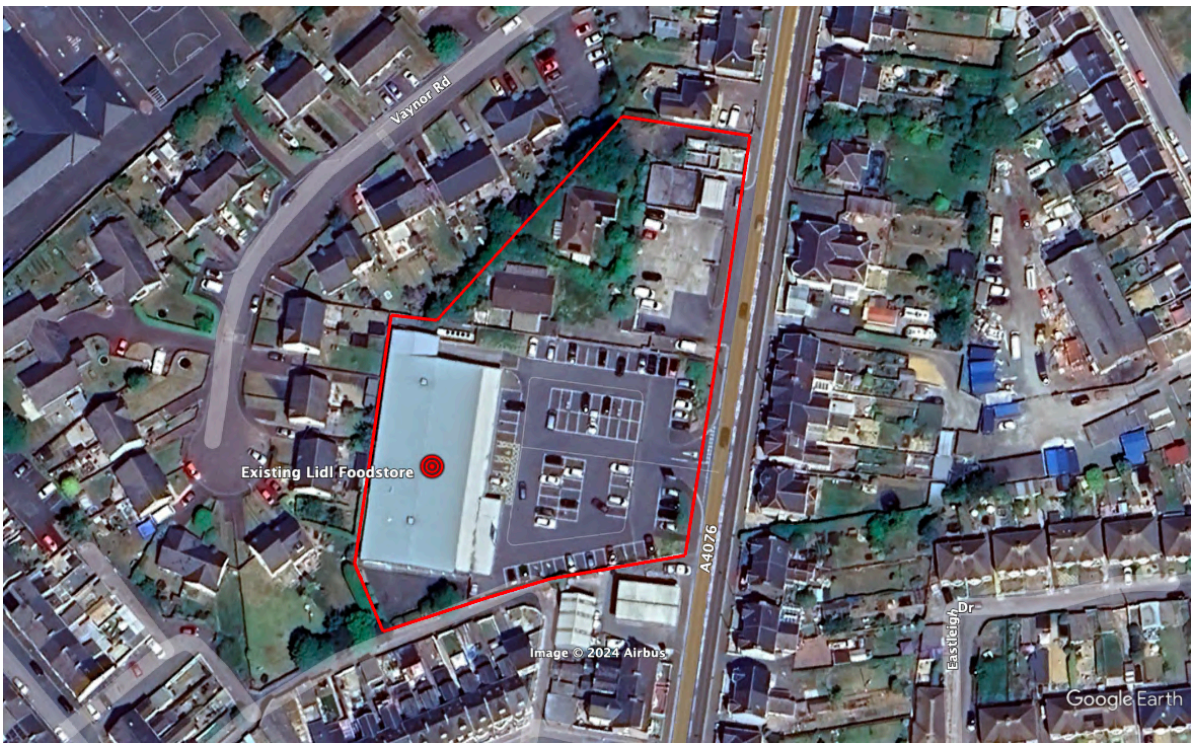
3.1. Site and Surrounding Area

The Proposed Development currently comprises the existing Lidl foodstore, a car hire depot and two residential properties, as shown on Figure 1.

Figure 1, below, shows the location of the site relative to the closest residential receptors, being the rear of the residential dwellings on Vaynor Road, to the west/north-west and Greville Street, to the south.

The ambient sound environment across the area was influenced by road traffic noise and general activity associated with the foodstore.

Figure 1: Proposed Development Site and Surrounding Area



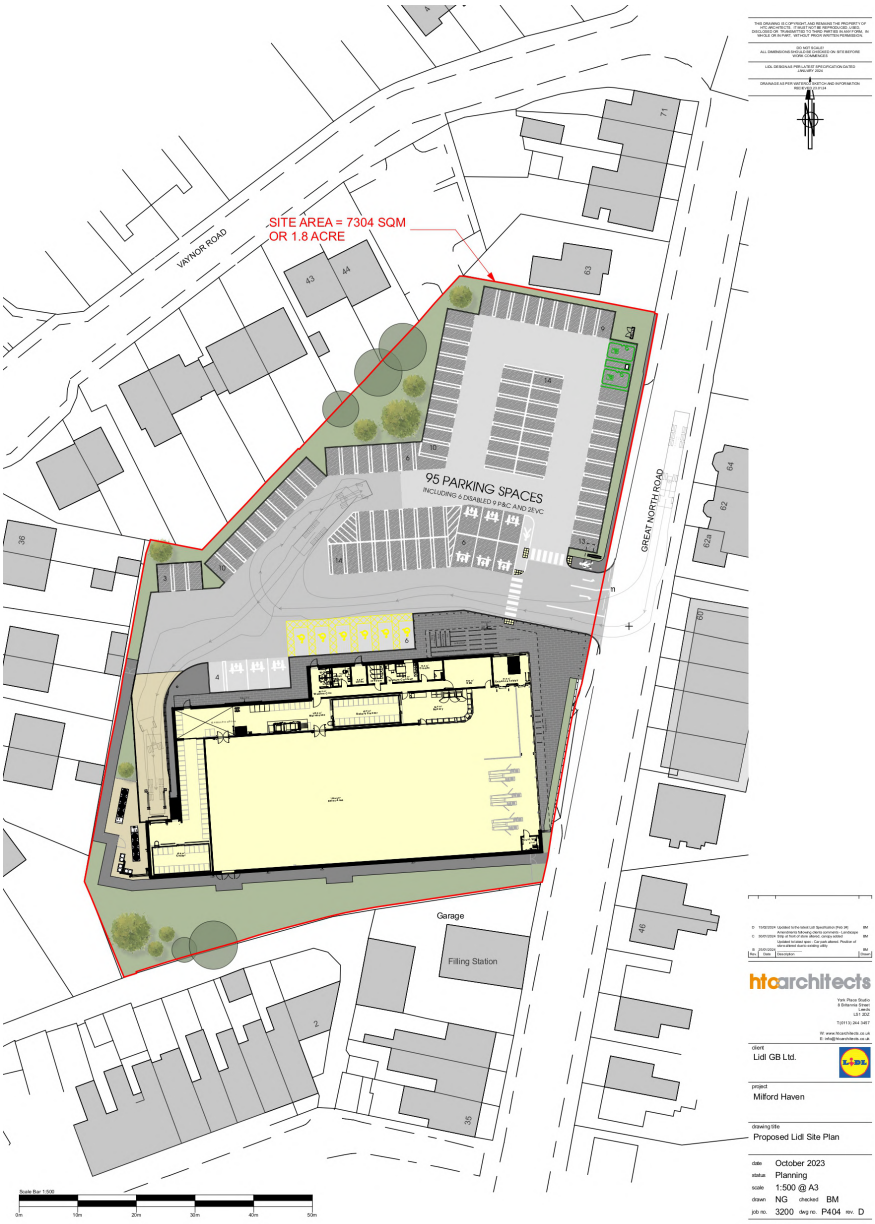
3.2. Proposed Development Overview

The proposals comprise the demolition of the existing foodstore, car hire depot and two residential properties, and construction of a new foodstore (full application), with associated car parking spaces, including a car park extension to the north, a delivery bay and external plant. The layout of the proposed development is shown in Figure 2, below.

The provision of a 2.4-metre high solid barrier has been considered along the northern side of the loading bay ramp, extending to parking bay 3; mounted on top of the concrete retaining structure to maximise effective path difference.

The retail facility is proposed to open between the hours of 08:00 and 22:00 Monday to Saturday and 10:00 to 16:00 on Sundays and to receive deliveries between 07:00-23:00.

FIGURE 2: PROPOSED DEVELOPMENT LAYOUT



The proposals also incorporate a new suite of external plant, comprising 2 No. refrigeration dry coolers with pumps and 3 No. VRF air handling units, within a plant compound bound by a 4-metre high acoustically absorbent barrier., which has been included to mitigate the 1st floor, night-time impacts on residents of Vaynor Road.

4. Measurement Methodology

4.1. General

The prevailing noise conditions in the area have been determined by an environmental noise survey conducted between Wednesday 17th and Thursday 18th January 2024.

4.2. Measurement Details

All noise measurements were undertaken by a consultant certified as competent in environmental noise monitoring, and, in accordance with the principles of BS 7445[2].

All acoustic measurement equipment used during the noise survey conformed to Type 1 specification of British Standard 61672[3]. A full inventory of this equipment is shown in Table 2 below.

Table 2: Inventory of Sound Measurement Equipment

Measurement Position	Make, Model & Description	Serial Number	Calibration Certificate Number	Calibration Due Date
MP1	Brüel & Kjær 2238 Sound Level Meter	2328256	1123444	11/02/2024
	Brüel & Kjær ZC 0030 Preamplifier	-		
	Brüel & Kjær 4188 Microphone	171603		
	Cirrus CR:515 Acoustic Calibrator	72886	1141301	07/03/2024

The sound measurement equipment used during the survey was field calibrated at the start and end of the measurement period. A calibration laboratory has calibrated the field calibrator used within the twelve months preceding the measurements. A drift of less than 0.2 dB in the field calibration was found to have occurred on the sound level meter.

The weather conditions during the survey were monitored locally and conducive to noise measurement, it being dry, with low wind speeds.

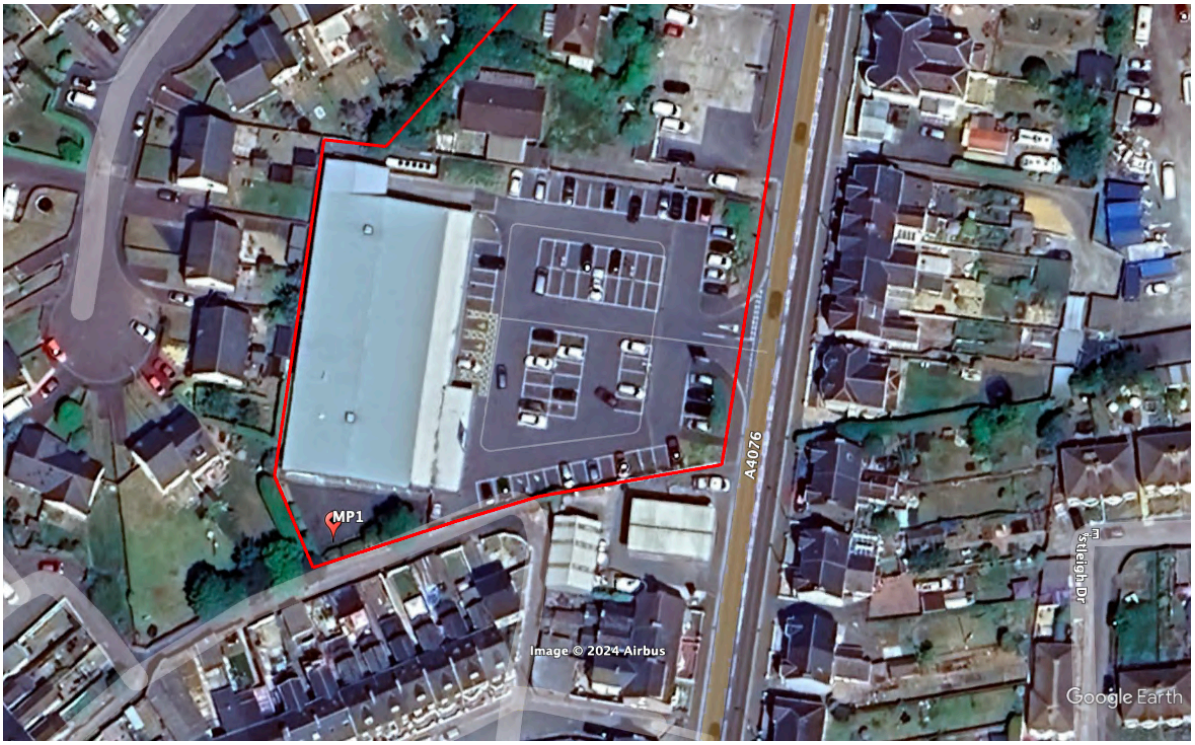
The microphone was fitted with a protective windshield for the measurement, which is described in Table 3, with an aerial photograph indicating its location shown in Figure 3.

Table 3: Measurement Position Description

Measurement Position	Description
MP1	A largely unattended daytime and night-time measurement of sound under free-field conditions, at a height of 1.5 metres above local ground level, close to the south-western site boundary with the closest off-site noise-sensitive receptors. The sound environment at this location was influenced by road traffic noise arising from vehicles on the A4076.

[2] British Standard 7445: 2003: Description and measurement of environmental noise. BSI
[3] British Standard 61672: 2013: Electroacoustics. Sound level meters. Part 1 Specifications. BSI.

Figure 3: Measurement Position



4.3. Summary Measurement Results

4.3.1. Background

The summarised results of the environmental noise measurements are presented in Table 4, with full, measured time histories and statistical analyses presented under Appendix B.

Table 4: Summary of Noise Measurement Results

Measurement Position	Period	Noise Level, dB			
		$L_{Aeq,T}$	Typical L_{A90}	Mean L_{A10}	L_{AFmax}
MP1	Daytime	48.4	**42**	49	73
	Night-Time	36.6	**25**	37	56

4.3.2. Source

In addition to the measurement of existing noise levels at the closest receptor location to the store, a series of source noise measurements have been utilised, which were carried out during a normal delivery to similar store. That store is similar in operational configuration to the food store forming the subject of this assessment.

Source noise measurements were carried out for the following elements of the delivery:

- HGV arriving;
- HGV reversing;
- HGV starting and departing;
- HGV door opening;
- HGV door slam;
- service bay door opening;
- dock levelling process;
- HGV unloading/loading;
- return dock process; and
- service bay door closing.

The noise parameters of sound exposure level (SEL), and maxima (L_{AFmax}) were measured for each discreet noise source as appropriate. In the case of the HGV unloading/loading process, where 33 pallets were offloaded and 9 pallets on-loaded, the recorded L_{AFmax} levels have been presented. The results of these measurements are presented in Table 5.

TABLE 5: SUMMARY OF SOURCE NOISE MEASUREMENT RESULTS

Source	Distance	Noise Level – dB	
		L_{AFMax}	SEL
HGV arriving	10 metres	-	77.0
HGV reversing (inc reverse alarm)	10 metres	-	82.0
HGV starting and departing	10 metres	-	76.0
HGV door closing	5 metres	87.6	80.6
Service bay door operation	5 metres	60.9	61.7
Dock levelling process	5 metres	89.2	83.2
HGV pallet unloading (worst)*	2 metres	89.4	98.8
Return dock process	5 metres	86.0	84.4

The entire delivery process took approximately 1-hour, from start to finish.

5. Operational Noise Assessment

5.1. Noise Modelling

5.1.1. Noise Source Data

The following sources of noise associated with the Proposed Development have been identified and are considered in this assessment:

- Mechanical services plant;
- Delivery vehicles; and
- Customer vehicles in the car park.

5.1.2. Source Data

The A-weighted sound source information, associated with the various items of external mechanical plant at the foodstore can be seen below in Table 6.

Table 6: Sound Power Level Source Data

Plant Type	Quantity	Manufacturer Sound Pressure Level (dB)	Distance from Source (m)
Food Refrigeration Pump Station & Dry Cooler	2	44	5
VRF Air Handling Units*	3	62	1
*denotes daytime operation, only			

Any alternative plant should have an equal or lower sound emission level (dB) in a hemispherical free-field.

It should be noted that the air-conditioning, heating and cooling plant operates only during daytime hours (07:00 hours to 23:00 hours). Only the mechanical plant associated with refrigeration operates during all periods of the day and night, according to demand.

In terms of delivery frequency to the store, it is understood that there is likely to be up to two heavy goods vehicles deliveries per day and two to three light goods vehicle deliveries per day, with no more than one HGV delivery being undertaken in any single hour.

Typical source noise levels for delivery vehicles have been taken from historical measurements, unrelated to this development (as stated earlier in this report). The sources measured include a heavy goods vehicle (HGV) performing manoeuvres that are replicated at this site. The source noise levels are presented as sound exposure levels, or SELs in Table 5 of this report.

To control the potential impact of noise breakout during unloading activities, the proposals include a level dock, within which the vehicle unloading will be undertaken.

Typical source noise levels for car park vehicle activities have been taken from historical measurements, from similar developments. The source noise levels are presented as sound exposure levels, or SELs. The distance between the activity and the measurement position was 10 metres in each case.

- Car passby 71 dB(A)
- Reversing Manoeuvre 71 dB(A)
- Door Closure 63 dB(A)

5.1.3. Calculation Process

Calculations were carried out using Cadna/A, which undertakes its calculations in accordance with guidance given in ISO9613-1:1993 and ISO9613-2:1996.

5.1.4. Sound Data Assumptions

Given that the land between Proposed Development and nearest receptors is mixed, the ground factor has been set to 0.5 in the calculation software. Furthermore, two orders of reflection have been considered.

5.2. Static Plant

A BS4142 assessment has been carried out for fixed items of plant to determine the potential noise impact on the existing sensitive receivers, on the basis of the input parameters detailed above.

The prediction has been undertaken using the Cadna/A computer noise-modelling package, which utilises the ISO9613[4] prediction methodology. The program was set to consider light, downwind propagation, air temperature of 10°C and 70% relative humidity.

Due to the broadband and continuous nature of the sound associated with the static plant and the habituation of the neighbouring receptors to the presence of a foodstore, no correction is considered necessary for tonality, intermittency or impulsivity.

The results of the BS4142 noise assessment are shown in Table 7. To represent worst case, the assessment has been carried out at the closest noise sensitive receptors, being the closest façade of the adjacent properties on Vaynor Road, to the west and Greville Road, to the south, with reference to the measured $L_{A90,T}$ background noise levels. The assessment considers the ground floor of the receptors during the daytime and the first floor at night.

[4] ISO 9613-2: 1996 *Acoustics – Attenuation of sound during propagation outdoors* – Part 2: *General method of calculation*

TABLE 7: PLANT NOISE ASSESSMENT

Assessment Period	Sound Level – dB			
	Specific Sound Level: $L_{Aeq,T}$	Rating Level: L_{ArTr}	Background Sound Level: $L_{A90,T}$	Excess of L_{ArTr} above $L_{A90,T}$
Closest Property on Vaynor Road (No. 31/32)				
Day (Grd Floor)	25.4	25	42	-17
Night (1st Floor)	24.9	25	25	0
Closest Property on Greville Road (No. 10/12)				
Day (Grd Floor)	18.6	19	42	-23
Night (1st Floor)	16.4	16	25	-9

Table 7 identifies that the proposed external plant complement would give rise to a *"low impact"* at the closest noise-sensitive receptor to the site, in the context of BS4142:2014+A1:2019 assessment criteria.

5.3. Relative Change in Ambient Sound Level

The potential increase in ambient noise level as a result of delivery vehicles accessing the Proposed Development has also been considered in conjunction with the predicted plant noise levels, set out in Table 7. It is understood that deliveries may occur during the daytime only at the foodstore. The driver will unload the goods via the level dock in the service bay.

The period considered is one hour during the day and the scenario considered is:

- Daytime – One HGV arriving and performing an entire delivery cycle at the foodstore in any one-hour period.

The likely increase in ambient noise level and assessment of impact, associated with the combination of the scenarios described above with the contribution from static plant is presented in Table 8. To represent worst case, these predictions again consider the closest residential receptors; considering the ground floor during the daytime. The prediction has again been undertaken using the Cadna/A computer noise-modelling package, with the above-quoted SELs being adjusted to and considered as 1-hour sound power levels.

TABLE 8: CUMULATIVE NOISE ASSESSMENT

Assessment Period	Sound Level – dB			
	Specific Sound Level: $L_{Aeq,T}$	Existing Ambient Level: $L_{Aeq,T}$	Future Ambient Level: $L_{Aeq,T}$	Change in Ambient Level
Closest Property on Vaynor Road (No. 31/32)				
Day	35.5	48.4	48.6	+0.2
Closest Property on Greville Road (No. 10/12)				
Day	23.1	48.4	48.4	0.0

The assessment identifies that noise from deliveries, added to the noise generated by the static plant, during the day would equate to an imperceptible increase in ambient sound level, of negligible significance.

5.4. Cumulative BS4142 Assessment

A BS4142 assessment has been carried out for fixed items of plant and the delivery vehicle movements detailed above, to determine the potential noise impact on the existing noise-sensitive receivers in the area.

In terms of acoustic character, it is considered that the delivery activity may give rise to a just perceptible level of impulsivity at off-site receptors, so a +3 dB correction has been added to the specific noise level, to account for this phenomenon.

The results of the BS4142 noise assessment are shown in Table 9. To represent worst case, the assessment has been carried out at the closest noise sensitive receptors, being the closest façade of the adjacent properties on Yaynor Road and Greville Road, with reference to the measured $L_{A90,T}$ background noise levels.

TABLE 9: CUMULATIVE BS4142 ASSESSMENT

Assessment Period	Sound Level – dB			
	Specific Sound Level: $L_{Aeq,T}$	Rating Level: L_{ArTr}	Background Sound Level: $L_{A90,T}$	Excess of L_{ArTr} above $L_{A90,T}$
Closest Property on Vaynor Road (No. 31/32)				
Day	36	39	42	-3
Closest Property on Greville Road (No. 10/12)				
Day	23	26	42	-16

Comparison of the results presented in Table 9, above, with the criteria set out in BS4142:2014+A1:2019, identifies that the cumulative effects of the static plant and delivery vehicles, during the daytime period, would constitute a *"low impact"*.

It should also be noted that the results in Table 9 reinforce the conclusion of Section 5.3.

5.5. Uncertainty

As the assessment is based on statistically robust baseline noise measurements, measured source noise levels from similar developments and published plant noise data, coupled to an assessment of worst-case future conditions, no corrections are considered necessary to account for uncertainty in the assessment.

5.6. Customer Car Park

As the closest residential receptors to the car park will already be habituated to the sound of customer vehicles in the area, this phenomenon has been considered separately and with regard to the relative change in ambient sound level, only.

The receptor location considered is the rear facade of No. 39 to 44 Veynor Road; being the receptors not previously exposed to car park activity and being located further from the road traffic noise source of Great North Road. Receptors along Great North Road are considered to be sufficiently influenced by road traffic noise to not be affected by car park activity.

The potential increase in ambient noise level as a result of customer vehicles within the car park has therefore been assessed, based upon the measured baseline sound levels shown in Table 4. To represent a typical worst case, it is assumed that 80% of the car parking spaces will experience full usage cycle during one hour.

The period considered is the daytime. The night-time period has been excluded from the assessment as the store will not be open.

The likely increase in ambient noise levels and assessment of impact at the most affected receptor to the north of the site, associated with the worst-case daytime scenario described above is presented in Table 10.

TABLE 10: CAR PARK NOISE ASSESSMENT

Assessment Period	Sound Level – dB			
	Specific Sound Level: $L_{Aeq,T}$	Existing Ambient Level: $L_{Aeq,T}$	Future Ambient Level: $L_{Aeq,T}$	Change in Ambient Level
Closest Property on Veynor Road (No. 42)				
Day	43.9	48.4	49.7	+1.3

The assessment identifies that peak anticipated use of the car park, would have the potential to increase noise by up to 1.3 dB(A) at the closest and most-affected receptor, equating to an barely perceptible minor impact. It should also be noted, that the predicted specific noise level arising from proposed car park activity is also below the measured L_{A90} background sound level in the area.

6. CONCLUSION

inacoustic has been commissioned to assess the impact of potential noise arising from a proposed foodstore redevelopment at a site off Great North Road, Milford Haven.

The following technical noise assessment has been produced to accompany a Planning Application to Pembrokeshire County Council and is based upon environmental noise measurements undertaken at the site and a subsequent 3-dimensional noise modelling exercise.

The assessment methodology contained in British Standard 4142: 2014+A1: 2019 *Methods for rating and assessing industrial and commercial sound* has been used in conjunction with the basic principles of changes in noise exposure.

Accordingly, the assessment is based upon environmental noise measurements undertaken at locations representative of the closest noise-sensitive receptors in the vicinity of the site, the design specification for fixed external plant items and historical noise measurement results of deliveries to foodstores such as that planned for this site. The assessment has been undertaken for both daytime and night-time periods, as although the store will only be open during the daytime, some of the external plant units will operate 24-hours per day.

On the basis of the assessment, the installation of specified plant for the store will comprise a *"low impact"* in the context of the guidance set out in BS4142:2014+A1:2019, during both the daytime and night-time period, when mitigated in the manner described in Section 3.2 of this report.

The assessment identifies that noise from vehicle deliveries during the day is unlikely to significantly increase noise levels at the closest sensitive dwellings and as such, will result in no worse than a negligible impact.

On the basis of the assessment, the presence of a daytime delivery to the store will comprise a *"low impact"* in the context of the guidance set out in BS4142:2014+A1:2019, when mitigated in the manner described in Section 3.2 of this report.

The assessment identifies that noise from customer vehicles in the car park is unlikely to significantly increase noise levels at the closest sensitive dwellings and as such, will result in no worse than a minor impact.

In light of the above, it is considered that the potential noise impacts associated with the Proposed Development can be adequately controlled by appropriate engineering and design and that noise should not be considered a material constraint to the granting of planning permission for the proposals once mitigated as described in this report.

7. APPENDICES

7.1. Appendix A – Definition of Terms

Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level (Sound Level)	The sound level is the sound pressure relative to a standard reference pressure of 20μPa ($20x10^{-6}$ Pascals) on a decibel scale.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 log10 (s1 / s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20μPa.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
$L_{eq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level during the period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{90,T}$	A noise level index. The noise level exceeded for 90% of the time over the period T. L_{90} can be considered to be the "average minimum" noise level and is often used to describe the background noise.
$L_{10,T}$	A noise level index. The noise level exceeded for 10% of the time over the period T. L_{10} can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m
Facade	At a distance of 1m in front of a large sound reflecting object such as a building façade.
Fast Time Weighting	An averaging time used in sound level meters. Defined in BS 5969.

In order to assist the understanding of acoustic terminology and the relative change in noise, the following background information is provided.

The human ear can detect a very wide range of pressure fluctuations, which are perceived as sound. In order to express these fluctuations in a manageable way, a logarithmic scale called the decibel, or dB scale is used. The decibel scale typically ranges from 0 dB (the threshold of hearing) to over 120 dB. An indication of the range of sound levels commonly found in the environment is given in the following table.

TABLE 11: TYPICAL SOUND LEVELS FOUND IN THE ENVIRONMENT

Sound Level	Location
0dB(A)	Threshold of hearing
20 to 30dB(A)	Quiet bedroom at night
30 to 40dB(A)	Living room during the day
40 to 50dB(A)	Typical office
50 to 60dB(A)	Inside a car
60 to 70dB(A)	Typical high street
70 to 90dB(A)	Inside factory
100 to 110dB(A)	Burglar alarm at 1m away
110 to 130dB(A)	Jet aircraft on take off
140dB(A)	Threshold of Pain

The ear is less sensitive to some frequencies than to others. The A-weighting scale is used to approximate the frequency response of the ear. Levels weighted using this scale are commonly identified by the notation dB(A).

In accordance with logarithmic addition, combining two sources with equal noise levels would result in an increase of 3 dB(A) in the noise level from a single source.

A change of 3 dB(A) is generally regarded as the smallest change in broadband continuous noise which the human ear can detect (although in certain controlled circumstances a change of 1 dB(A) is just perceptible). Therefore, a 2 dB(A) increase would not be normally be perceptible. A 10 dB(A) increase in noise represents a subjective doubling of loudness.

A noise impact on a community is deemed to occur when a new noise is introduced that is out of character with the area, or when a significant increase above the pre-existing ambient noise level occurs.

For levels of noise that vary with time, it is necessary to employ a statistical index that allows for this variation. These statistical indices are expressed as the sound level that is exceeded for a percentage of the time period of interest. In the UK, traffic noise is measured as the L_{A10}, the noise level exceeded for 10% of the measurement period. The L_{A90} is the level exceeded for 90% of the time and has been adopted to represent the background noise level in the absence of discrete events. An alternative way of assessing the time varying noise levels is to use the equivalent continuous sound level, L_{Aeq}.

This is a notional steady level that would, over a given period of time, deliver the same sound energy as the actual fluctuating sound.

To put these quantities into context, where a receiver is predominantly affected by continuous flows of road traffic, a doubling or halving of the flows would result in a just perceptible change of 3 dB, while an increase of more than 25%, or a decrease of more than 20%, in traffic flows represent changes of 1 dB in traffic noise levels (assuming no alteration in the mix of traffic or flow speeds).

Note that the time constant and the period of the noise measurement should be specified. For example, BS4142 specifies background noise measurement periods of 1 hour during the day and 15 minutes during the night. The noise levels are commonly symbolised as $L_{A90,1hour}$ dB and $L_{A90,15mins}$ dB. The noise measurement should be recorded using a 'FAST' time response equivalent to 0.125 ms.

7.2. Appendix B – Measurement Results

FIGURE 4: MP1 MEASURED TIME HISTORY

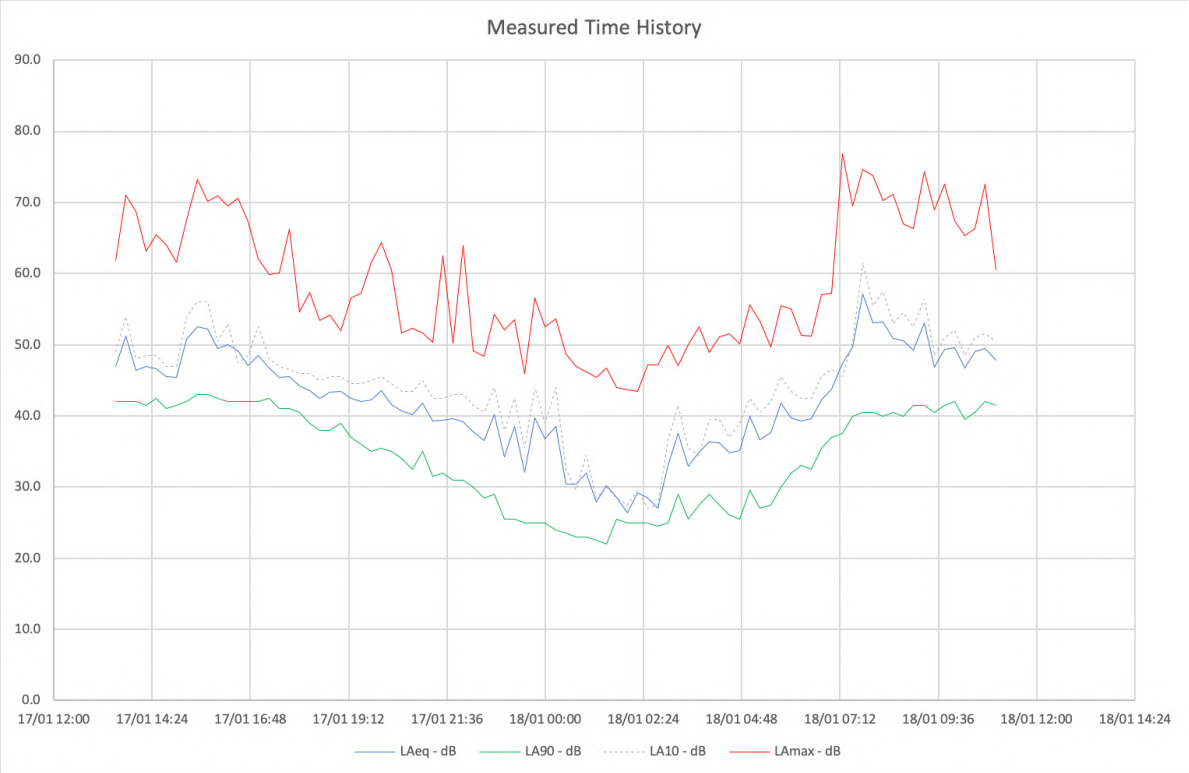


FIGURE 5: MP1 DAYTIME L_{90} ANALYSIS

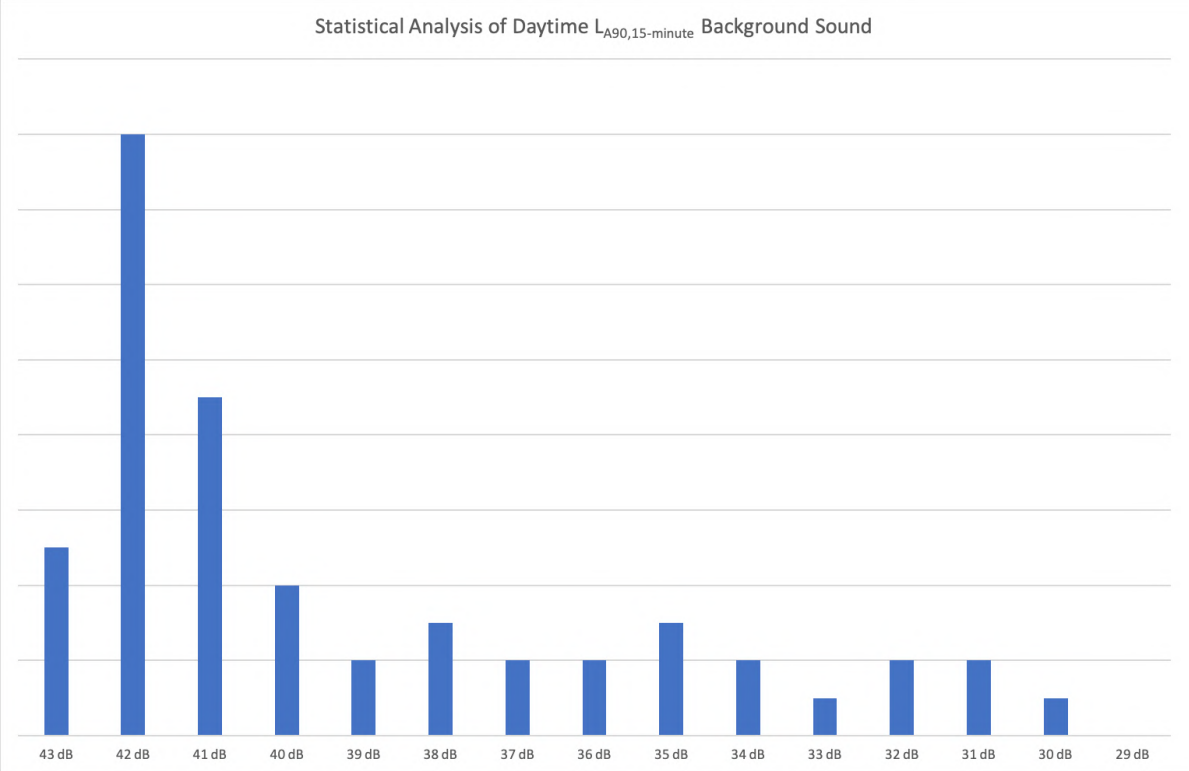
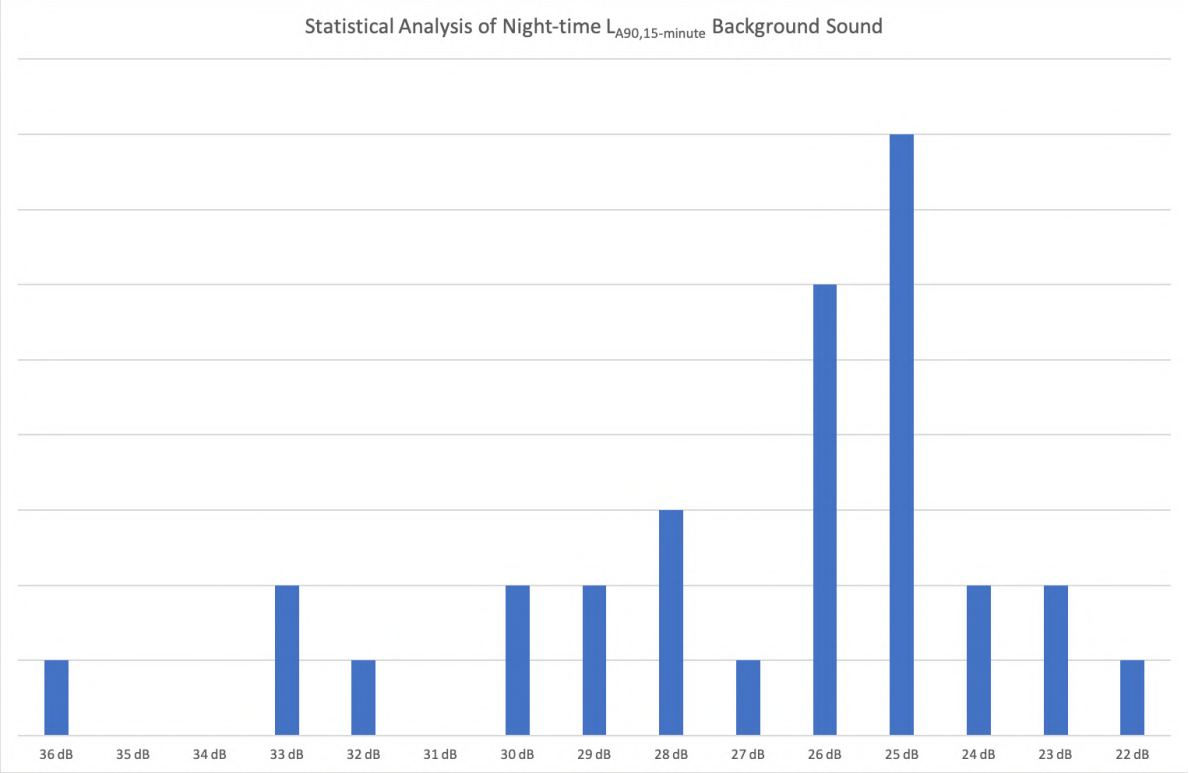


FIGURE 6: MP1 NIGHT-TIME L_{90} ANALYSIS



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