Report VA4807.240112.NIA2

Shell Waterloo, Crosby Road North, Waterloo, Liverpool

Noise Impact Assessment

12 January 2024

JMS Planning

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Contents

Attachments

Report Version	Author	Approved	Changes	Date
NIA	Jamie Duncan	Steven Liddell	-	14/7/23
NIA2	Jamie Duncan	Steven Liddell	Updated layout	12/1/24

The interpretations and conclusions summarised in this report represent Venta Acoustics' best technical interpretation of the data available to us at the time of assessment. Any information provided by third parties and referred to in this report has not been checked or verified by Venta Acoustics, unless otherwise expressly stated in the document. Venta Acoustics cannot accept any liability for the correctness or validity of the information provided. Due to a degree of uncertainty inherent in the prediction of all parameters, we cannot, and do not guarantee the accuracy or correctness of any interpretation and we shall not, except in the case of gross or wilful negligence on our part, be liable for any loss, cost, damages or expenses incurred or sustained by anyone resulting from any interpretations, predictions of conclusions made by the company or employees. The findings and conclusions are relevant to the period of the site survey works, and should not be relied upon to represent site conditions at later dates. Where additional information becomes available which may affect the findings of our assessment, the author reserves the right to review the information, reassess the findings and modify the conclusions accordingly.

1. Introduction

It is proposed to refurbish and reconfigure the fuel station at Shell Waterloo, Crosby Road North, Waterloo, Liverpool. As part of the works, eight new EV chargers will be installed, along with their associated inverter units and a new substation.

Venta Acoustics has been commissioned by JMS Planning to undertake an assessment the potential noise impact on the nearby noise sensitive receivers, as requested by Sefton Council.

An environmental noise survey was undertaken to determine the background noise levels at the site as well as the sound levels generated by the surrounding premises. These levels were then used to undertake an assessment of the likely impact with reference to the methodology in BS4142:2014 *Methods for rating and assessing industrial and commercial sound.*

All staff at Venta Acoustics are fully qualified and members of the Institute of Acoustics, the recognised UK professional body for acoustics, noise and vibration professionals and are fully competent to undertake BS4142 assessments.

2. Site Description

As illustrated on attached site plan VA4807/SP1, the fuel station is located in a mixed residential and retail area. The site is bordered by houses on Hougoumont Grove to the west, and retail premises on South Road, and Backs Road to the north. To the south is Heron House, an office building, with Burlington House on the opposite side of Crosby Road North to the east.

The most affected noise sensitive receivers are expected to be the overlooking houses to the west on Hougoumount Grove.

3. Design Criterion and Assessment Methodology

3.1 Sefton Council Requirements

Sefton Council Environmental Health have provided the following comment on the application.

> *I am aware that PKM150 (150kW) Ultra-Fast DC chargers are proposed to be installed at another Shell site within Sefton that does not have residential property in close proximity to them. The applicant for the current application has identified residential properties to the west of the site and in view of the noise data for the abovementioned chargers, I would have expected a noise impact assessment (NIA) to have accompanied this application, particularly if the chargers are to be available for use throughout the night and/or early morning.*
>
> *A decision regarding this application should be deferred until the applicant can demonstrate there will not be an adverse impact on the residential properties to the west of the site.*

3.2 BS4142:2014+A1:2019

British Standard BS4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound* describes a method for rating and assessing sound of an industrial and/or commercial nature, which includes:

- Sound from industrial and manufacturing processes;
- Sound from fixed installations which comprise mechanical and electrical plant and equipment;
- Sound from the loading and unloading of goods and materials at industrial and/or commercial premises, and;
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes.

The Standard is therefore suited to this assessment.

The assessment methodology considers the Specific Sound Level, as measured or calculated at a potential noise sensitive receptor, due to the source under investigation in terms of a L_{Aeq} value over a one-hour period during daytime operation (07:00-23:00 hours) and a fifteen-minute period during night-time operation (23:00-07:00 hours).

A correction factor is added to this level to account for the acoustic character of the sound. This is determined as follows when using the subjective assessment methodology:

Tonality - For sound ranging from not tonal to prominently tonal, the Joint Nordic Method gives a correction of between 0 dB and +6 dB for tonality. Subjectively, this can be allocated as a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible and 6 dB where it is highly perceptible.

Impulsivity - A correction of up to +9dB can be applied for sound that is highly impulsive considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be allocated as a penalty of 3 dB for impulsivity which is just perceptible at the receiver, 6 dB where it is clearly perceptible and 9 dB where it is highly perceptible.

Other sound characteristics - Where the specific sound contains characteristics that are neither tonal nor impulsive, but are otherwise startling, disturbing or incongruous with the residual acoustic environment, a penalty of +3 dB can be applied.

Intermittency - When the specific sound has identifiable on/off conditions, if the intermittency is readily distinctive against the residual acoustic environment, a penalty of +3 dB can be applied.

An initial estimate of the impact of the source is then obtained by subtracting the typical background noise level, in terms of a LA90 value over the relevant period of operation, from the corrected Specific Sound Level.

- Typically, the greater this difference, the greater the magnitude of the impact.
- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +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 having a low impact, depending on the context.

The initial estimate of the impact may then be modified by taking consideration of the context in which the sound occurs.

4. Environmental Noise Survey

4.1 Survey Procedure & Equipment

In order to establish the existing background noise levels at the site, a noise survey was carried out between Wednesday 12th and Thursday 13th July 2023 at the location shown in site plan VA4807/SP1. This location was chosen to be representative of the background noise level at the most affected noise sensitive receivers.

Continuous 5-minute samples of the L_{Aeq}, L_{Amax}, L_{A10} and L_{A90} sound pressure levels were undertaken at the measurement location.

The weather during the survey period was generally dry with light winds. The background noise data is not considered to have been compromised by these conditions.

Measurements were made generally in accordance with ISO 1996 2:2017 *Acoustics - Description, measurement and assessment of environmental noise – Part 2: Determination of sound pressure levels*.

The following equipment was used in the course of the survey:

Manufacturer	Model Type	Serial No	Calibration	
			Certificate No.	Date
NTi Class 1 Integrating SLM	XL2	A2A-15892-E0	150497-1	28/3/23
Larson Davis calibrator	CAL200	13049	1504971-3	28/3/23

Table 4.1 – Equipment used for the survey

The calibration of the sound level meter was verified before and after use with no significant calibration drift observed.

5. Results

The measured sound levels are shown as a time-history plot on the attached chart VA4807/TH1.

The background noise level is determined by road traffic noise in the surrounding area.

The typical background noise levels measured were:

Monitoring Period	Typical[1] $L_{A90,5min}$
07:00 – 23:00 hours	48 dB
23:00 – 07:00 hours	36 dB

Table 5.1 – Typical background noise levels **[dB ref. 20 µPa]**

[1] The typical L_{A90} value is taken as the 10th percentile of all L_{A90} values measured during the relevant period.

6. BS4142 Noise Impact Assessment

Eight Tritium electric car chargers will be installed in the centre of the site, with the associated inverter units and substation located to the west of the shop. The GRP unit and chargers are understood to generate negligible amounts of noise, with the inverters being the main noise sources associated with the new plant. The substation is also housed in a GRP unit, and generates relatively low levels of noise.

The noise levels measured for the loudest element of the works are shown in Table 6.1.

Noise Source	Measurement Distance	L_{Aeq}	Notes
Tritium inverter	1m	71 dB	Advised by Tritium. 4 units (1 unit per 2 chargers)
Substation	Sound Power	57 dB	Typical substation manufacturer noise data from similar sites. Tonal at 63/125Hz
Car charging on charger	1m	65 dB	Site Measurement

Table 6.1 – Noise sources used for assessment

6.1 Acoustic Character Correction

The subjective method of allocating corrections to the sound sources has been used following the methodology provided in BS4142:2014 and summarised in section 3.2. These corrections apply to the noise as it is perceived at the receivers.

Noise Source	Subjective Description	Allocated Corrections
Power Inverter	Slight tonal content at source, not tonal at receiver	Tonality: 0 dB Impulsivity: 0 dB Intermittency: 0 dB
Car Charger + Car Fans	Intermittent operation of charger	Tonality: 0 dB Impulsivity: 0 dB Intermittency: +3 dB
Substation	Constant operation with a potential faint low frequency tone at source. Tone not present at receiver. Housed in a GRP enclosure.	Tonality: 0 dB Impulsivity: 0 dB Intermittency: 0dB

Table 6.2 – Acoustic character corrections

These penalties are applied to the specific noise level in section 6.2 to obtain the rating noise level.

6.2 Mitigation

It is recommended that a barrier be introduced between the inverter plant installation and the noise sensitive receivers, with a cantilevered roof extending over the top of all the units. The screen should be at least 0.3m higher than the top of the inverter, i.e., nominally 2.7m high, and formed from a continuous and imperforate material with a minimum mass per unit area of 14kg/m^2.

The approximate location of the screen is shown on the noise maps, VA4807/NM1-NM2, in blue.

6.3 Rating Noise Level and Assessment

The rating noise levels at the assessment locations are compared against the relevant background noise levels to assess the notional significance of the noise impact as follows. Operations are adjusted to the appropriate on times.

For the assessment of the noise, it has been assumed that all the units will operate constantly during the daytime, with only four chargers, and two of the associated inverter units and the substation, in use during a single 15 minute night-time assessment period.

It is considered that this is a robust and pessimistic assessment with it being unlikely that multiple chargers would be in use during the quieter parts of the night.

Due to the complexity of the building interaction in this locale and the likelihood of noise both reflecting off and being screened by the surrounding building and screens, 3D noise mapping was implemented to ensure the most accurate prediction of plant noise levels at the nearest noise sensitive receivers.

This process uses several different calculation protocols to derive accurate noise analysis predictions. Noise propagation and barrier attenuation are calculated in accordance with ISO 9613-1:1993 *Acoustics - Attenuation of sound during propagation outdoors - Part 1: Calculation of the absorption of sound by the atmosphere* and ISO 9613-2:1996 *Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation*.

The assessments at the most affected receiver are summarised below.

Results		Relevant Clause	Commentary
Specific Sound Level	L_{Aeq} 40 dB		All car charging plant & substation, calculated in VA4430/NM1
Assume 100% on time	0 dB	7.2	
Acoustic feature correction	+3 dB	9.2	+3dB for intermittency
Rating level	L_{Ar} 43 dB	9.2	
Background sound level	L_{A90} 48 dB	8	Daytime background
Excess of rating over background sound level	-5 dB	11	
Indication of a low impact		11	Depending on context

Table 6.3 – BS4142 Assessment – Car Charging Plant Noise (Daytime)

Results		Relevant Clause	Commentary
Specific Sound Level	L_{Aeq} 36 dB		2 car chargers and 1 inverter, calculated in VA4430/NM2
Assume 100% on time	0 dB	7.2	
Acoustic feature correction	+3 dB	9.2	+3dB for intermittency
Rating level	L_{Ar} 39 dB	9.2	
Background sound level	L_{A90} 36 dB	8	Night-time background
Excess of rating over background sound level	+3 dB	11	
Indication of a low to marginal impact		11	Depending on context

Table 6.4 – BS4142 Assessment – Car Charging Plant Noise (Night-time)

6.4 Context

The site is already a 24 hour fuel station and so forms part of the existing noise climate in the area, including neighbouring receptors.

At a greater distance, there are multiple businesses including takeaways and a comedy club.

Within this context, the estimated impact of the sound sources is expected to remain valid or be slightly reduced.

6.5 Uncertainty

This section considers the variable in the assessment that may cause variations within the final results and describes how these have been addressed.

- Use of a Class 1 sound level meter is considered to reduce instrument error to insignificant levels as compared with environmental variations. The calibration of the instrumentation was confirmed before and after the noise surveys.
- The background measurements were undertaken under suitable weather conditions over a period designed to include reasonable temporal variations in background noise levels. The monitoring location was selected to be representative of the background noise levels

expected to be experienced by the nearby dwellings without being unduly influenced by extraneous noise sources.

- Where library data has been used, propagation calculations have been used to correct noise levels to the relevant distance at the receiver.

Overall, the uncertainty is considered to have been minimised to a suitable range so as not to risk significant variations in the impact assessment of typical operations.

7. Conclusion

A baseline noise survey has been undertaken by Venta Acoustics to establish the background noise climate in the locality of Shell Waterloo, Crosby Road North, Waterloo, Liverpool.

The measured noise levels have been assessed against BS4142:2014 *Methods for rating and assessing industrial and commercial sound*.

When assessed using BS4142, and assuming the recommended mitigation measures for the inverter units, noise from the new EV charging equipment on site has been shown to have a low impact during the daytime and a low/marginal impact during the night-time.

The night-time assessment is considered to be robust and pessimistic, assuming that 50% of the chargers would be in use at the same time during the quieter parts of the night, which is considered unlikely. Considering the low predicted noise level of 36dB(A) outside the nearby houses, the internal noise levels inside would be very low, even with open windows, and would be at a level that would be unlikely to negatively impact the residents in Hougoumont Grove.

Taking the above into consideration, and the fact that the premises is already a 24 hour fuel station, it is offered that the overall impact of these proposals would be low on the existing residents.

Jamie Duncan MIOA

VA4807/SP1 Site Plan showing measurement locations

Shell Waterloo, Crosby Road North, Waterloo, Liverpool

Environmental Noise Time History: 1

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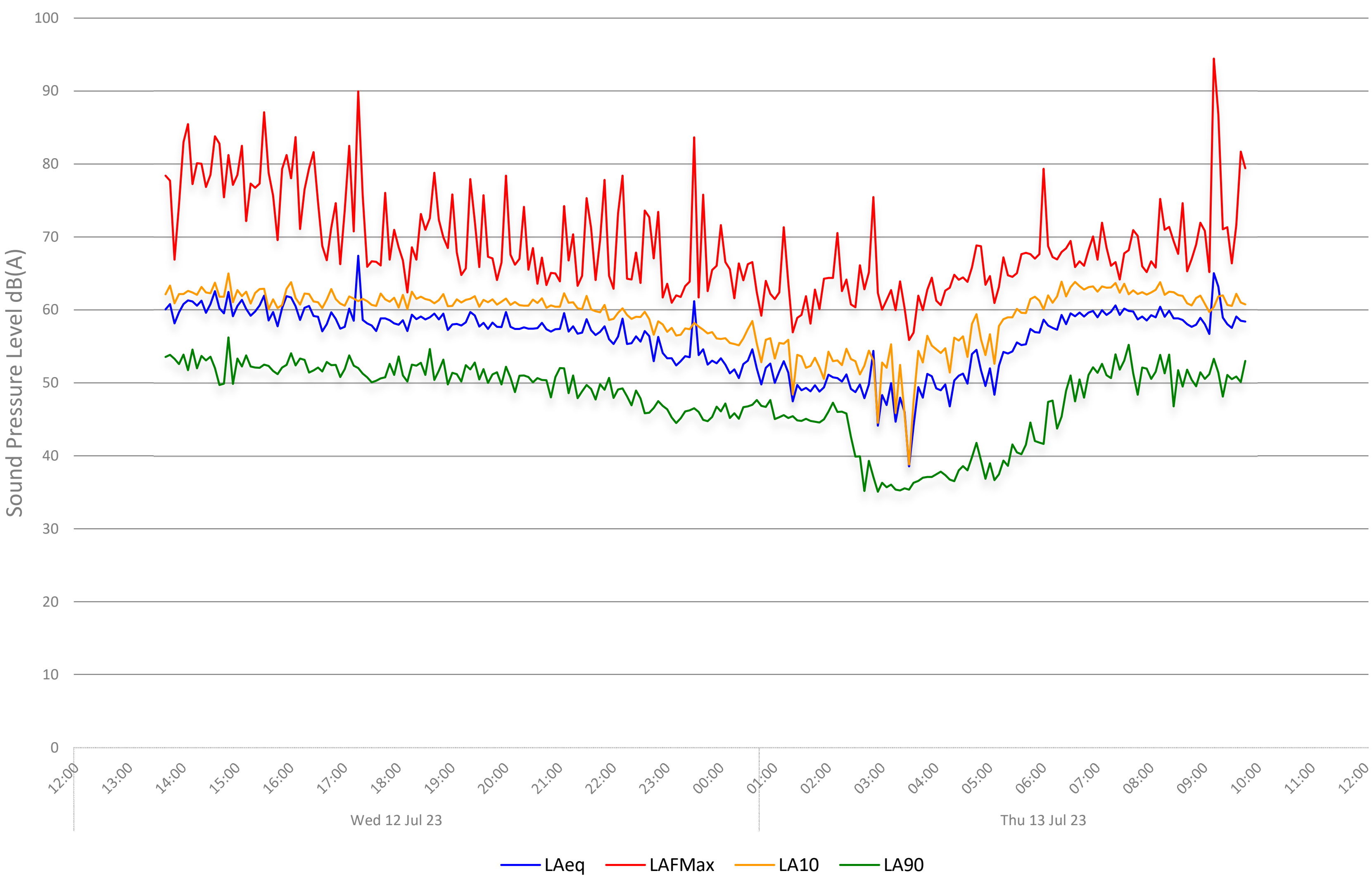
Figure VA4807/TH1



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VENTA ACOUSTICS
VA4807/NM1
Daytime
> 35.0 dB
> 40.0 dB
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> 50.0 dB
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VENTA ACOUSTICS
VA4807/NM2
Night-time
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> 85.0 dB

APPENDIX A

Acoustic Terminology & Human Response to Broadband Sound

1.1 Acoustic Terminology

The human impact of sounds is dependent upon many complex interrelated factors such as 'loudness', its frequency (or pitch) and variation in level. In order to have some objective measure of the annoyance, scales have been derived to allow for these subjective factors.

Sound	Vibrations propagating through a medium (air, water, etc.) that are detectable by the auditory system.
Noise	Sound that is unwanted by or disturbing to the perceiver.
Frequency	The rate per second of vibration constituting a wave, measured in Hertz (Hz), where 1Hz = 1 vibration cycle per second. The human hearing can generally detect sound having frequencies in the range 20Hz to 20kHz. Frequency corresponds to the perception of 'pitch', with low frequencies producing low 'notes' and higher frequencies producing high 'notes'.
dB(A):	Human hearing is more susceptible to mid-frequency sounds than those at high and low frequencies. To take account of this in measurements and predictions, the 'A' weighting scale is used so that the level of sound corresponds roughly to the level as it is typically discerned by humans. The measured or calculated 'A' weighted sound level is designated as dB(A) or L_A.
L_{eq} :	A notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the actual, fluctuating sound measured over that period (e.g. 8 hour, 1 hour, etc). The concept of L_{eq} (equivalent continuous sound level) has primarily been used in assessing noise from industry, although its use is becoming more widespread in defining many other types of sounds, such as from amplified music and environmental sources such as aircraft and construction. Because L_{eq} is effectively a summation of a number of events, it does not in itself limit the magnitude of any individual event, and this is frequently used in conjunction with an absolute sound limit.
L_{10} & L_{90} :	Statistical L_n indices are used to describe the level and the degree of fluctuation of non-steady sound. The term refers to the level exceeded for n% of the time. Hence, L_{10} is the level exceeded for 10% of the time and as such can be regarded as a typical maximum level. Similarly, L_{90} is the typical minimum level and is often used to describe background noise. It is common practice to use the L_{10} index to describe noise from traffic as, being a high average, it takes into account the increased annoyance that results from the non-steady nature of traffic flow.
L_{max} :	The maximum sound pressure level recorded over a given period. L_{max} is sometimes used in assessing environmental noise, where occasional loud events occur which might not be adequately represented by a time-averaged L_{eq} value.

1.2 Octave Band Frequencies

In order to determine the way in which the energy of sound is distributed across the frequency range, the International Standards Organisation has agreed on "preferred" bands of frequency for sound measurement and analysis. The widest and most commonly used band for frequency measurement and analysis is the Octave Band. In these bands, the upper frequency limit is twice the lower frequency limit, with the band being described by its "centre frequency" which is the average (geometric mean) of the upper and lower limits, e.g. 250 Hz octave band extends from 176 Hz to 353 Hz. The most commonly used octave bands are:

Octave Band Centre Frequency Hz	63	125	250	500	1000	2000	4000	8000

APPENDIX A

1.3 Human Perception of Broadband Noise

Because of the logarithmic nature of the decibel scale, it should be borne in mind that sound levels in dB(A) do not have a simple linear relationship. For example, 100dB(A) sound level is not twice as loud as 50dB(A). It has been found experimentally that changes in the average level of fluctuating sound, such as from traffic, need to be of the order of 3dB before becoming definitely perceptible to the human ear. Data from other experiments have indicated that a change in sound level of 10dB is perceived by the average listener as a doubling or halving of loudness. Using this information, a guide to the subjective interpretation of changes in environmental sound level can be given.

Change in Sound Level dB	Subjective Impression	Human Response
0 to 2	Imperceptible change in loudness	Marginal
3 to 5	Perceptible change in loudness	Noticeable
6 to 10	Up to a doubling or halving of loudness	Significant
11 to 15	More than a doubling or halving of loudness	Substantial
16 to 20	Up to a quadrupling or quartering of loudness	Substantial
21 or more	More than a quadrupling or quartering of loudness	Very Substantial