

NOISE IMPACT ASSESSMENT

NEW SUBSTATION - EASTLANDS

REPORT NO. J004470-7177-RDC-02

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This report has been prepared based upon a scope of works and associated resources agreed between the client and Philip Dunbavin Acoustics Ltd (PDA). This report has been prepared with all reasonable skill, care and diligence and has been based upon the interpretation of data collected. This has been accepted in good faith as being accurate and valid at the time of the collection. This report has been based solely on the specific design assumptions and criteria stated herein.

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1.0 SUMMARY

At the request of Electricity North West, PDA has carried out a noise impact assessment for the proposed new substation at Eastlands, Manchester.

A survey was conducted of the background sound levels at the nearest noise sensitive properties to the proposed substation off Orme Close. Typical daytime background sound levels were found to be 56 dB L_{A90} . Typical night-time background sound levels were found to be 42 dB L_{A90} .

The Rating Level of the transformer at the nearest noise sensitive residence during normal operation was calculated as 7dB(A) and during occasional transformer outage conditions, where the cooling pumps and cooling fans were operating the Rating Level of the transformer was calculated as 29 dB(A).

The Rating Level of the transformer is 35 dB below the night-time Background Sound Level during normal operation and 13 dB below background during occasional outage conditions. Hence the criterion of Planning Condition 13 a) will be met by the proposed transformer at all times without additional mitigation.

2.0 BRIEF FOR CONSULTANCY

PDA Ltd. was engaged to carry out the following:

A. Noise Survey

We will travel to the site and carry out an ambient noise survey in the vicinity of the nearest noise sensitive property to the site. The measurement will include an assessment of the range of typical night-time L_{A90} background sound levels.

We would propose to undertake measurements to include representative night-time periods in accordance with BS 4142:2014, which are likely to be the worst case in terms of the assessment of the noise impact of the transformer.

We will carry out all noise surveys in accordance with the provisions of BS7445 “Description and Measurement of Environmental Noise”. The measurements made will include both dBA and octave band noise levels including L_{eq} , L_{max} , and L_{90} parameters..

B. Survey Processing and Report

The results of the noise survey will be assessed in line with the requirements of Planning Condition 13 and BS 4142:2014 to establish the propagation from the proposed substation to the nearest noise sensitive property.

The calculated rating level of the proposed substation will be compared with the pre-existing background level measured in part A and compared to the criterion of Planning Condition 13. Where the rating level is predicted to exceed the criterion we will propose suitable remedial works such that the criterion may be achieved. These are likely to be limited to the installation of noise barriers for an outdoor source such as a substation.

We will produce a report detailing all survey procedure, measurements and results suitable for submission to the Local Authority in support of your application to discharge part a) of the Planning Condition.

3.0 SITE DESCRIPTION

The proposed development is to install a new additional transformer and associated switch house adjacent to the existing electricity substation located off Rowsley Steet to the east of the Manchester Regional Arena and the Etihad football stadium. This report assesses the noise impact of the proposed development on nearby noise sensitive properties, in accordance with Planning Condition 13 a) of the Manchester City Council Planning Permission reference 135348/FO/2022.

The proposed transformer is to be located adjacent to the existing substation. To the immediate north and east of the development are sports training facilities and stadia which are not considered to be noise sensitive. To the immediate west and south are industrial and retail uses which are also not considered to be noise sensitive. The closest noise sensitive properties are the houses on Orme Close approximately 313m south of the proposed transformer.

4.0 ASSESSMENT CRITERIA

4.1 Local Authority Planning Condition 13 a)

Planning Condition 13 a) of the development's planning permission states the following:

13) a) Prior to first use of the development hereby approved, a scheme for the acoustic treatment of externally mounted plant, equipment and servicing shall be submitted for approval in writing by the City Council, as local planning authority. The scheme shall be designed to achieve a rating level of 5dB (LAeq) below the typical background (LA90) level at the nearest noise sensitive location. The approved scheme shall be implemented in full before first use commences.

It is noted that the above condition specifies the required criterion in terms of Rating Level and Background Level (LA90) which suggests that the proposed assessed is to be carried out in accordance with the methodology of BS 4142:2014+A1:2019.

4.2 BS 4142:2014 + A1:2019

The effect of industrial noise on the nearest noise sensitive residences will be assessed in accordance with BS4142:2014+A1:2019 – 'Methods for rating and assessing industrial and commercial sound'. This will include sound break-out from the mechanical services and deliveries to the proposed convenience store.

The standard describes a method of determining the level of sound of a commercial nature, together with procedures for assessing the impact of such a sound outside nearby noise sensitive areas.

The standard may be thought of as a procedure for comparing the sound from commercial sources with background sound levels in the absence of the commercial sound and determining the likely impact of the sound on noise sensitive residences.

In accordance with BS 4142 the background sound level is the typical A-weighted sound pressure level at the assessment position that is exceeded for 90% of a given time interval (LA90). The specific sound level is the equivalent continuous (LAeq) sound pressure level at the assessment position produced by the commercial source over a given time interval.

Certain acoustic features can increase the impact over that expected from a simple comparison between the specific sound level and the background level. Where such features are present, these are taken into account by adding corrections to the specific sound level.

This correction is applied based on whether the following features occur, or are expected to be present. The correction values can either be determined subjectively, or by various objective measurement procedures.

- The sound contains a distinguishable, discrete, continuous tone (whine, hiss, screech, hum, etc.). 0 – 6 dB penalty
- The sound contains distinct impulses (bangs, clicks, clatters, or thumps). 0 – 9 dB penalty.
- The sound is irregular enough to attract attention. 0 – 3 dB penalty.
- Where the specific sound features characteristics that are neither tonal nor impulsive, nor intermittent, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.

From the addition of the above penalties where appropriate the rating level is established, this being the value that is compared with the background noise. Note that corrections for impulsivity and tonality may be added arithmetically where both are present and likely to affect perception within the same reference period. However, if any single feature is dominant to the exclusion of the others then it might be appropriate to apply a reduced or even zero correction for the minor characteristics.

According to BS 4142 an initial estimate of the impact is given based on the rating level value as follows:

- a rating level 10 dB(A) or more above the background is an indication of significant adverse impact, depending on the context.
- a rating level 5 dB(A) above the background is an indication of an adverse impact, depending on the context.
- where the rating level does not exceed the background level, this is an indication of the specific sound source having a low impact, depending on the context.

BS4142 indicates that the noise source should be evaluated over the appropriate time interval which is as follows:

- 1h during the day (07:00 – 23:00)
- 15 min during the night (23:00 – 07:00)

The above initial assessment may then be modified depending on the context, to take into account;

- The absolute level of the sound.
- The character and level of the residual sound compared to the character and level of the specific sound.
- The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as:
 - o Façade insulation treatment
 - o Ventilation and / or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation; and
 - o Acoustic screening

5.0 SURVEY DETAILS

The assessment method of BS 4142:2014+A1:2019 requires an environmental noise survey to be carried out to establish the Background Sound Level at the nearest noise sensitive residences prior to the installation of the new source to be assessed (i.e. prior to the development).

An environmental noise survey was carried out immediately to the north of the houses on Orme Close, in the direction of the proposed substation between 18:30 on 12/06/2023 and 08:30 on 13/06/2023, thereby encompassing the whole night time period and the likely quietest part of the daytime period (the evening period prior to 23:00).

5.1 Site Description

The survey of Background Sound Levels at the nearest noise sensitive residences was carried out to the north of the nearest noise sensitive properties to the proposed development on Orme Close. See Figure 1 below.

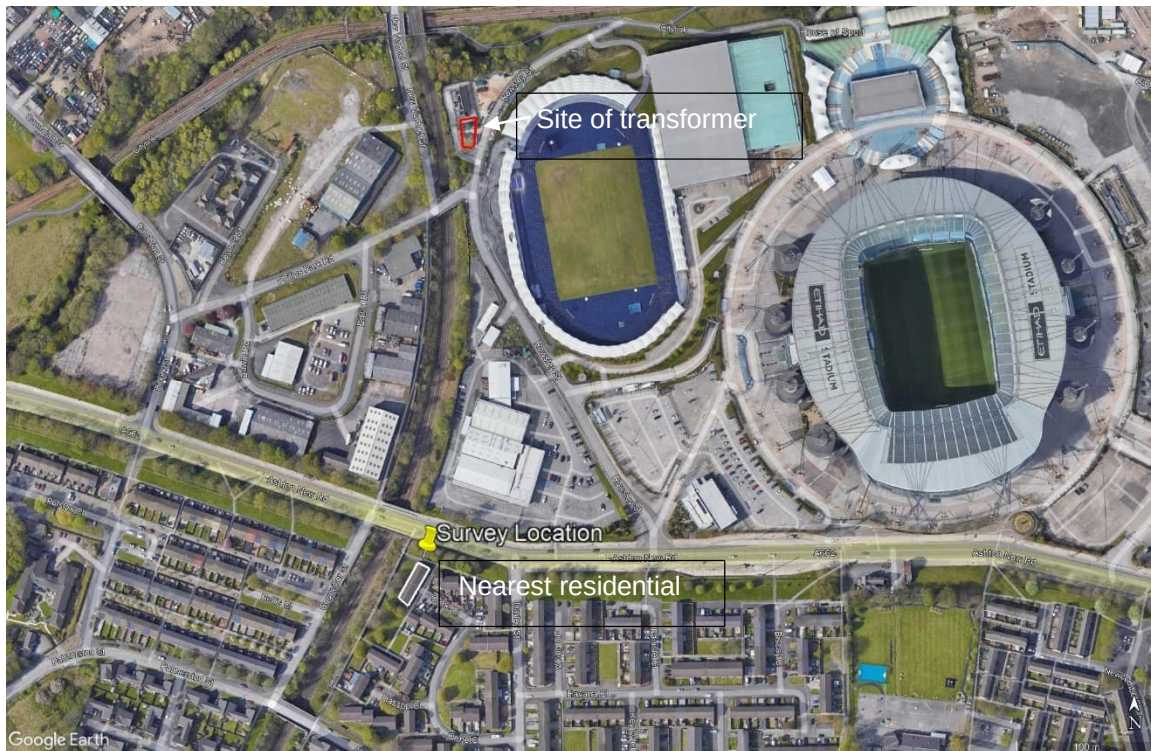


Figure 1 – Proposed site of transformer, nearest residential properties and survey measurement location

5.2 Survey Times and Personnel

The survey was conducted between 18:30 on 12/06/2023 and 08:30 on 13/06/2023. All measurements were made a partially attended by Mr Sam Iles and Mr Joe Meadows of PDA Ltd.

5.3 Equipment

The survey was conducted with a RION NL-52 sound level meter. In accordance with IEC 61672-1:2002 the meter has a class 1 frequency response and can operate as an integrating sound level meter with statistical functions. The meter was set to measure 'A' weighted, broadband sound pressure levels and various statistical parameters. The meter was field calibrated to 1KHz at 94dB both before and after the measurement, during which time no significant deviation from the calibrated level was observed. In addition to this a valid calibration certificate is held for the meter and the calibrator. The sound level meter was fitted with an all weather windshield and housed in a weatherproof enclosure for the duration of the survey period.

5.4 Weather

During the survey period the weather was observed to be mainly dry, temperature 19 - 27 °C, and wind speeds from 0 to 4 m/s. A short thunderstorm with heavy rain and some thunder occurred between approximately 18:30 and 19:00 on 12/06/2023, however the remainder of the survey was dry. Weather observations have been taken from the nearby Weather Underground IMANCH115 weather station

5.5 Measured Noise Results

The results of the survey are reproduced in Figure 2 below;

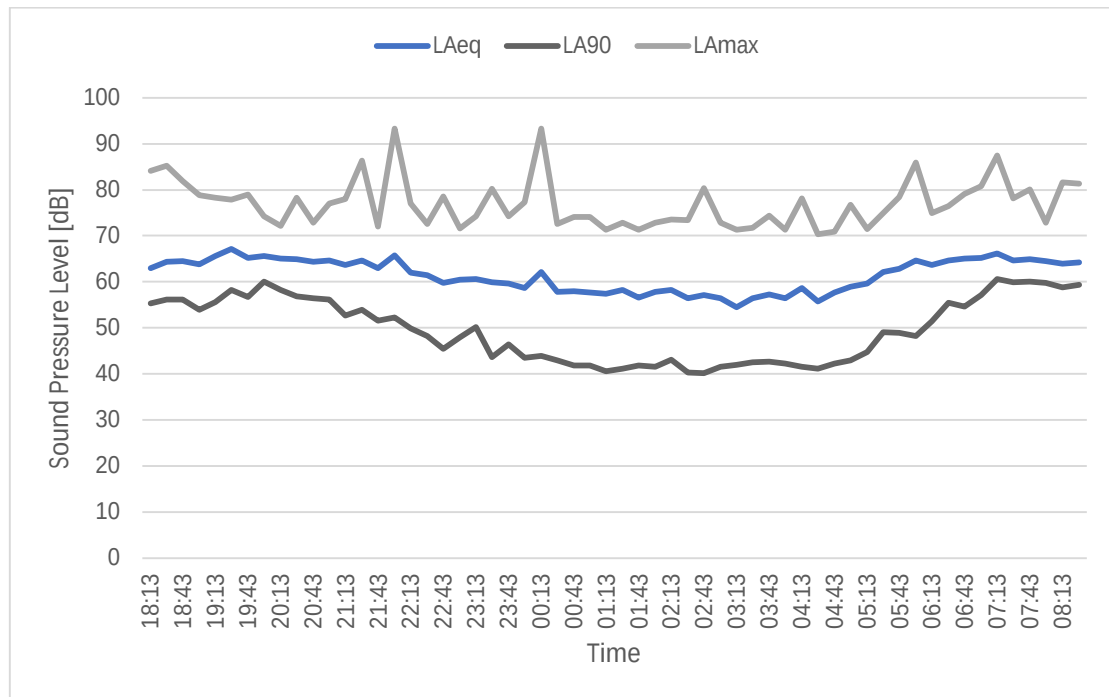


Figure 2 – Survey results

Typical background sound levels for daytime and night-time periods have been taken. For the day-time period both the mode and the median of the 15 minute L_{A90} measurements was 56 dB(A). For the night-time period the mode and the median of the 15 minute L_{A90} measurements were 42 dB(A) and 43 dB(A) respectively.

For the purposes of the assessment, as the transformer will operate over a 24 hour period, we have taken the 42 dB(A) night-time modal value as the typical Background Sound Level.

6.0 PROPOSED NOISE SOURCE

We are informed that the proposed 23 MVA transformers are supplied with a guaranteed maximum sound power level of 65 dB(A) in normal operation. In case of an outage on one of the other transformers, the cooling pumps and fans of the transformer would start to operate, and in this condition the maximum sound power level would increase to 83 dB(A).

7.0 IMPACT ASSESSMENT

The sound propagation from the transformer site to the nearest noise sensitive properties will be attenuated by a number of factors including distance (geometric spreading), ground absorption, air absorption and shielding. In this case, as the distance from the transformer to the nearest noise sensitive property is large, we have neglected all attenuation factors with the exception of distance (geometric spreading).

If we consider the transformer as a point source on a reflecting plane, the sound energy propagates out from the transformer hemispherically with the energy spread over the area of the hemisphere and reducing as a function of the square of the distance.

The sound attenuation by geometric spreading (considering the area of a hemisphere of radius r is $2\pi r^2$) is given by:

$$20 \times \log(r) + 10 \times \log(2\pi)$$

For the nearest property off Orme Close, 313m south of the proposed transformer, this results in a geometric attenuation of:

$$20 \times \log(313) + 10 \times \log(2\pi) = 49.9 + 8 = 57.9$$

Hence, the Specific Sound due to the transformer at the nearest residence in normal operation would be $65 - 57.9 = 7.1$ dB(A). The transformer sound is likely to be tonal with the sound generally dominated by the 100Hz tone related to the magnetostriction of the transformer coils, however, at the receiver the level is only 7.1 dB(A), hence at this location the tonality of the transformer sound will be masked by other environmental sounds and thus not audible. As such, the Rating Level at the nearest noise sensitive property is calculated to be no more than 7.1 dB(A).

For occasional periods during a transformer outage when the cooling pumps and fans might be operating the Specific Sound due to the transformer at the nearest residence would be $83 - 57.9 = 25.1$ dB(A). In this case there is a potential for the transformer sound to be tonal due to the blade passage frequency of the cooling fans, without being prominently tonal. In this case in accordance with the subjective method of BS 4142:2014+A1:2019 a 4 dB penalty is likely to be appropriate resulting in a Rating Level of 29.1 dB(A) at the noise sensitive residence. Note that the 25 dB(A) Specific Sound is still likely to be inaudible at the receiver given the measured residual and background noise levels, so arguably the tonal penalty should not be applied in this case either, however, for the avoidance of doubt it has been included.

7.1 BS 4142 Assessment

During normal operation of the transformer, in the worst case night-time period the Rating Level is calculated to be no more than 7 dB(A) which is 35 dB below the Background Sound Level of 42 dB(A). In accordance with BS 4142:2014, *"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."* In addition the Rating Level meets the Local Authority criterion of Planning Condition 13 a) in that the rating level is at least 5 dB below the background sound level.

For occasional times where there may be a transformer outage resulting in the cooling pumps and fans operating, the Rating Level is calculated to be no more than 29 dB(A) which is 13 dB below the Background Sound Level of 42 dB(A). In accordance with BS 4142:2014, *“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.”* In addition the Rating Level meets the Local Authority criterion of Planning Condition 13 a) in that the rating level is at least 5 dB below the background sound level.

8.0 CONCLUSION

At the request of Electricity North West, PDA has carried out a noise impact assessment for the proposed new substation at Eastlands, Manchester.

A survey was conducted of the background sound levels at the nearest noise sensitive properties to the proposed substation off Orme Close. Typical daytime background sound levels were found to be 56 dB LA90. Typical night-time background sound levels were found to be 42 dB LA90.

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The Rating Level of the transformer is 35 dB below the night-time Background Sound Level during normal operation and 13 dB below background during occasional outage conditions. Hence the criterion of Planning Condition 13 a) will be met by the proposed transformer at all times without additional mitigation.

APPENDIX A – DEFINITION OF ACOUSTIC TERMS

The decibel

This is the basic unit of noise, denoted dB.

A Weighting

This is a weighting process which simulates the human ear's different sensitivity at different frequencies. A weighting can be shown two typical ways, 50 dB(A) L_{eq} or 50 dB L_{Aeq} . Both mean the same thing. (See below for a definition of L_{eq}). The dB(A) level can be regarded as the overall level perceived by human beings.

L_{eq} and $L_{eq(s)}$

This is the equivalent continuous noise level which contains the same acoustic energy as the actual time-varying sound. In other words it is a kind of average noise level. It is denoted dB L_{eq} or, for A-weighted figures dB(A) L_{eq} or dB L_{Aeq} . It can also be expressed in terms of frequency analysis (see later). $L_{eq(s)}$ is the sample L_{eq} level.

L_n

This is the level exceeded for n% of the time. It is denoted dB L_n or, for A-weighted figures dB(A) L_n or dB L_{An} . It can be expressed in terms of frequency analysis (see later). L_{90} is the level exceeded for 90% of the time and is a measure of the lowest level typically reached. L_{10} is the level exceeded for 10% of the time and is the highest level typically reached. L_{50} is the level exceeded for 50% of the time and, mathematically, it is the median.

L_{max}

This is the maximum level reached during a measurement period. The "time constant", or the ability of the equipment to respond to impulses is usually expressed along with it, e.g. "Fast", "Slow", etc. It is denoted dB L_{max} or, for A-weighted figures dB(A) L_{max} , dB L_{Amax} , etc. It can also be expressed in terms of frequency analysis.

Frequency Analysis

Whereas dB(A) gives a very useful overall figure, it has its limitations in that it cannot be used to model or predict the effect of noise control and mitigation as this nearly always has radically different performance at different frequencies.

Frequency analysis expresses an overall noise level at each frequency or band of frequencies in the audible range. Octave band analysis divides the audible range into 10 bands from 31.5 Hz to 16 kHz and the noise level in each band can be expressed in any form e.g. L_{eq} , L_{90} , L_{max} etc. One third octave band analysis uses 30 bands.

Narrow band analysis takes the process to resolutions of less than 1 Hz. This is useful for identifying the existence of tones (whines, hums, etc.) and in pin-pointing the sources.