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# Proposed Substation Development Noise Assessment

East Limerick Substation Development, Co. Limerick

## CLIENT

Harmony Solar  
East Limerick Ltd

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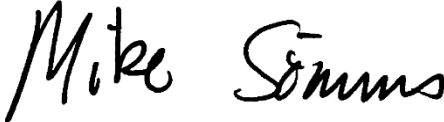
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# 1. INTRODUCTION

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Harmony Solar East Limerick Limited is seeking planning permission for a substation development within the townland of Gotoon, Coolscart, and Kilfrush in County Limerick. The Proposed Substation Development comprises a 220kV Loop In Loop Out (LILO) substation and associated works within a site of 17.02 hectares, including Battery Energy Storage System (BESS), transformer and substation.

The Proposed Substation Development forms part of a wider "Overall Project". The Overall Project extends to the townlands of Ballyhaukish, Millfarm, Coolscart, Gotoon, Coolalough, Ballycahill, Newtown, Kilfrush and Knocklong. The Overall Project comprises the following components:

- ▶ A new 220kV substation development, Battery Energy Storage System (BESS) and associated grid infrastructure (hereafter referred to as the Proposed Substation Development), for which planning consent will be sought from An Coimisiún Pleanála (ACP) as a Strategic Infrastructure Development (SID) under Section 182A of the Planning and Development Act 2000 (as amended).
- ▶ A solar farm and associated cable route (the Proposed Solar Farm Development), for which planning consent is sought from Limerick City and County Council under Section 34 of the Planning and Development Act 2000 (as amended).

The 'Overall Project' has been considered for the purposes of this assessment.

This Noise Impact Assessment has been prepared by AWN Consulting on behalf of Harmony Solar East Limerick Limited, to accompany an application for the Proposed Substation Development.

Noise criteria for the site have been derived with reference to the Environmental Protection Agency (EPA) Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities NG4 (EPA, 2016). Due to the low background noise measurements in the evening and night-time, a precautionary approach has been adopted, applying criteria representative of an 'area of low background noise' as defined in NG4.

A computer-based noise model has been developed to assess operational noise from the Overall Project, taking account of the site layout and location of key plant. Sound power levels for the BESS units, BESS transformer and the substation transformer have been supplied by the client and have been included in the noise modelling. In addition, noise data for the solar inverters and transformer modules forming part of the Overall Project have been supplied by the client and have been included in the noise modelling results.

The construction phase have also been considered, with appropriate assessment criteria applied.

For a glossary of acoustic terms used in this report please refer to Appendix A.

## 1.1 Statements of Authority

This report has been prepared by Alex Clark of AWN Consulting and reviewed by Mike Simms of AWN Consulting.

Alex Clark (Senior Acoustic Consultant) holds a BEng in Acoustical Engineering and is a full corporate member of the Institute of Acoustics (MIOA). Alex has worked in the field of acoustics for over 9 years. He has extensive experience in all aspects of environmental surveying, noise modelling and impact assessment for various sectors including, solar, BESS, industrial, commercial, and residential.

Mike Simms (Principal Acoustic Consultant) holds a BE and MEngSc in Mechanical Engineering and is a corporate member of the Institute of Acoustics. Mike has worked in the field of acoustics for over 20

years. He has extensive experience in all aspects of environmental surveying, noise modelling and impact assessment for various sectors including, wind energy, industrial, commercial and residential.

## **1.2 Fundamentals of Acoustics**

A sound wave travelling through the air is a regular disturbance of the atmospheric pressure. These pressure fluctuations are detected by the human ear, producing the sensation of hearing. To take account of the enormous range of pressure levels that can be detected by the ear, it is widely accepted that sound levels are measured and expressed using a decibel scale i.e., a logarithmic ratio of sound pressures. These values are expressed as Sound Pressure Levels (SPL) in decibels (dB).

The audible range of sounds expressed in terms of Sound Pressure Levels is 0 dB (for the threshold of hearing) to 120 dB (for the threshold of pain). In general, a subjective impression of a doubling of loudness corresponds to a tenfold increase in sound energy, which equates to a 10 dB increase in SPL. It should be noted that a doubling in sound energy, such as may be caused by a doubling of traffic flows, will increase the SPL by 3 dB. This results in the subjective impression of a slight increase in noise level.

The frequency of sound is the rate at which a sound wave oscillates is expressed in Hertz (Hz). The sensitivity of the human ear to different frequencies in the audible range is not uniform. For example, hearing sensitivity decreases markedly as frequency falls below 250 Hz. To rank the SPL of various noise sources, the measured level must be adjusted to give comparatively more weight to the frequencies that are readily detected by the human ear. The 'A-weighting' system defined in the international standard, BS ISO 226:2003 Acoustics. Normal Equal-loudness Level Contours has been found to provide the best correlations with human response to perceived loudness. SPLs measured using 'A-weighting' are expressed in terms of dB(A).

An indication of the level of some common sounds on the dB(A) scale is presented in Figure 1-1 below:

**Figure 1-1. dB(A) Scale & Indicative Noise Levels**

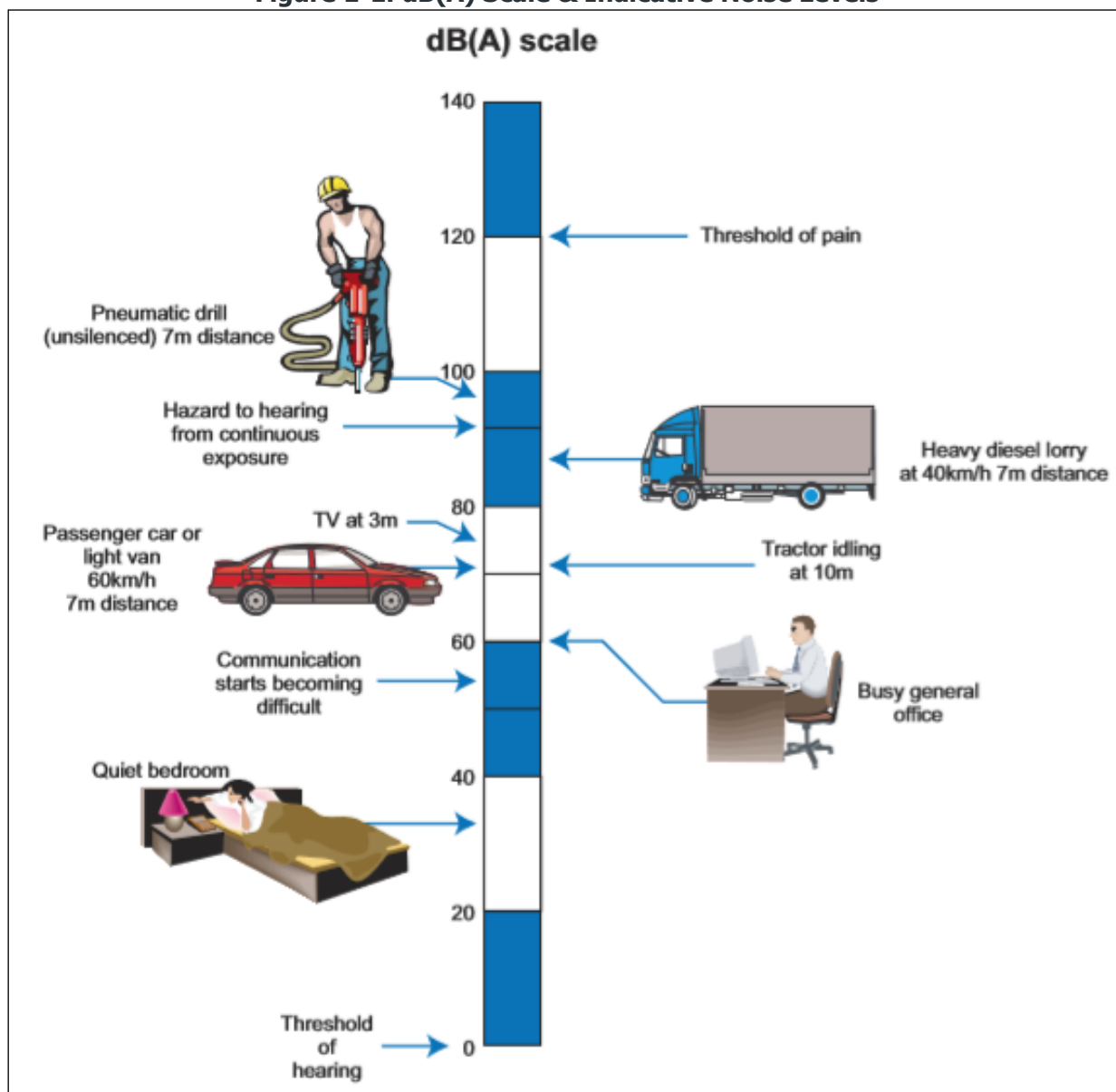


Figure 1-2 The level of typical common sounds on the dB(A) scale (NRA Guidelines for the Treatment of Noise and Vibration in National Road Schemes, 2004)

## 2. METHODOLOGY

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The following outline methodology has been adopted for this assessment:

- ▶ Review of the relevant guidance to identify appropriate criteria for elements of the Overall Project.
- ▶ Predict the typical levels of noise emissions at the nearest NSLs for the construction phase.
- ▶ Assess the potential impact by comparing the calculated levels against the relevant criteria.
- ▶ Where necessary to achieve the relevant criteria, present mitigation measures to control noise and vibration impacts.
- ▶ Present the predicted impact of the Proposed Substation Development considering any adopted mitigation measures.
- ▶ Describe the significance of the residual noise and vibration effects associated with the Proposed Substation Development and the Overall Project.

This outline methodology is described in further detail in the following sections.

### 3. RELEVANT GUIDANCE

The assessment of noise and vibration effects for the Proposed Substation Development has been undertaken with reference to the following guidance documents relating to environmental noise and vibration.

- ▶ EPA Guidelines on the Information to be contained in Environmental Impact Statements, Environmental Protection Agency, 2022 (Hereafter EPA 2022);
- ▶ British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise (Hereafter BS5228-1)
- ▶ British Standard BS 5228-2:2009+A1:2014 Code of practice for vibration control on construction and open sites – Vibration (Hereafter BS5228-2);
- ▶ British Standard BS 7385 – Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration BSI, 1993 (Hereafter BS7385);
- ▶ Guidelines for the Treatment of Noise and Vibration in National Road Schemes, Transport Infrastructure Ireland (TII) (formerly National Roads Authority 2004 (Hereafter TII 2004).
- ▶ Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes, Transport Infrastructure Ireland (TII) (formerly National Roads Authority (NRA) 2014 (Hereafter TII 2014);
- ▶ Design Manual for Roads and Bridges Sustainability & Environment Appraisal LA 111 Noise and Vibration Revision 2 (National England (now National Highways)) 2020 (Hereafter DMRB);

The following sections review best practice guidance that is commonly adopted in relation to environment and noise assessments and confirms the proposed criteria and assessment thresholds for the noise and vibration.

#### 3.1 Construction Phase – Noise

##### 3.1.1 General Construction Noise

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. Local authorities typically control construction activities by restricting the hours during which construction activities can take place and may consider noise limits at their discretion.

In the absence of specific noise limits, appropriate criteria relating to permissible construction noise levels can be found in the BS5528-1. This standard is commonly accepted and used in Ireland.

An approach in BS5528-1 calls for the designation of receptors into a specific category (A, B or C) based on the existing ambient noise levels at the receptor in the absence of construction noise. A threshold noise value is applied to each category. An exceedance of the construction noise threshold (CNT) at the façade of a noise sensitive location (NSL) during construction may indicate a potentially significant noise impact associated with the construction activities. The CNT values recommended by BS5228-1 are depicted in Table 3.1. This assessment method is proposed for residential receptors only.

**Table 3.1. Example Threshold of Potential Significant Effect at Dwellings**

| Assessment category and threshold value period (T)          | Threshold value, in $L_{Aeq,T}$ dB |                         |                         |
|-------------------------------------------------------------|------------------------------------|-------------------------|-------------------------|
|                                                             | Category A <sup>a</sup>            | Category B <sup>b</sup> | Category C <sup>c</sup> |
| Night-time (23:00 to 07:00hrs)                              | 45                                 | 50                      | 55                      |
| Evenings and weekends Note D                                | 55                                 | 60                      | 65                      |
| Daytime (07:00 – 19:00hrs) and Saturdays (07:00 – 13:00hrs) | 65                                 | 70                      | 75                      |

- 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. 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sunday

The following steps are applied to implement the A B C method from BS5228-1:

For each period (e.g., daytime) the ambient noise level is determined and rounded to the nearest 5 dB. At some NSLs, particularly those located close to a busy road network, the existing ambient noise levels are expected to be relatively high. However, given the rural nature of the site in general, the existing daytime ambient noise levels are generally expected in the range of 30 to 55 dB  $L_{Aeq,1hr}$ . Therefore, for the purposes of this assessment and to adopt a conservative approach, all properties will be assigned a Category A designation setting the initial CNT for daytime periods at 65 dB  $L_{Aeq,T}$ .

BS 5228-1 states that:

*"If the site noise level exceeds the appropriate category value [the CNT], then a potential significant effect is indicated. The assessor then needs to consider other project-specific factors, such as the number of receptors affected and the duration and character of the impact, to determine if there is a significant effect."*

If the specific construction noise level exceeds the CNT, then a potential significant impact is identified. To determine the significance of effects, it is important to consider the duration and magnitude of the impacts as described in Section 3.1.4.

### 3.1.2 Linear Construction Works

Linear construction works in the context of the Proposed Substation Development refers to the local road widening along the L1509 within the public road boundary.

A fixed noise limit is proposed for these elements of the construction phase. This approach is deemed appropriate as noise from these activities is variable, typically short in duration, and only at its highest when closest to the NSL. As the works progress, the distance between the construction activities and the NSL increases, resulting in reduced noise levels and a shorter duration of exposure to noise impacts. To set an appropriate fixed noise limit, reference is made to paragraph E.2, BS 5228-1.

*General Principle:*

*"Noise from construction and demolition sites should not exceed the level at which conversation in the nearest building would be difficult with the windows shut."*

Recommended Daytime Limits (07.00 and 19.00 hours):

*"...outside the nearest window of the occupied room closest to the site boundary should not exceed:*

- *70 decibels (dBA) in rural, suburban areas away from main road traffic and industrial noise; and*
- *75 decibels (dBA) in urban areas near main roads in heavy industrial areas."*

Guidance in the Transport Infrastructure Ireland (formerly NRA) (TII) document *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes* (TII, 2014) proposes a daytime period (Monday to Friday 0700 – 1900 hrs) with a construction noise limit of 70 dB  $L_{Aeq,1hr}$ .

Considering the above guidance, a CNT of 70 dB  $L_{Aeq,16hr}$  is proposed for linear construction activities. Noise levels above 70 dB  $L_{Aeq,16hr}$  may indicate a significant impact depending on the duration and frequency of occurrence.

### 3.1.3 Construction Traffic

There are no specific guidelines or limits relating to traffic related sources along the local or surrounding roads. Given that traffic from the construction of the Proposed Substation Development will make use of existing roads already carrying traffic volumes, it is appropriate to assess the calculated increase in traffic noise levels that will arise because of vehicular movements associated with the development.

In the absence of any national guidelines in Ireland, for the assessment of potential noise impacts from construction related traffic along public roads it is proposed to adopt guidance from DMRB. Table 3.2 taken from DMRB offers guidance as to the likely short-term impact associated with any change in traffic noise level.

**Table 3.2. Likely Impacts Associated with Change in Traffic Noise Level (Source: DMRB).**

| <b>Change in Sound Level (dB<br/><math>L_{A10, 18hr}</math>)</b> | <b>Magnitude of Impact</b> | <b>Initial Significance Rating</b> |
|------------------------------------------------------------------|----------------------------|------------------------------------|
| Less than 1.0                                                    | Negligible                 | Not significant                    |
| 1 – 2.9                                                          | Minor                      |                                    |
| 3 – 4.9                                                          | Moderate                   | Significant                        |
| Greater than or equal to 5.0                                     | Major                      |                                    |

The DMRB guidance will be used to assess the predicted increases in traffic levels on public roads associated with the Proposed Substation Development and comment on the likely 'short-term' impacts during the construction phase.

### 3.1.4 Construction Phase Vibration

With respect to this development, the range of relevant criteria used for building protection is expressed in terms of Peak Particle Velocity (PPV) in mm/s.

Guidance relevant to acceptable vibration within buildings is contained in the following standards:

- ▶ BS 7385
- ▶ BS 5228-2

BS7385 states that there should typically be no cosmetic damage if transient vibration does not exceed 15 mm/s at 4 Hz rising to 20 mm/s at 15 Hz and 50 mm/s at 40 Hz and above. These guidelines relate to relatively modern buildings and should be reduced to 50% or less for more critical buildings.

BS5228-2 recommends that, for soundly constructed residential properties and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e., non-structural) damage should be taken as a peak particle velocity of 15 mm/s for transient vibration at frequencies below 15 Hz and 20 mm/s at frequencies above 15 Hz. Below these vibration magnitudes minor damage is unlikely, although the standard notes that where there is existing damage these limits may be reduced by up to 50%. In addition, where continuous vibration is such that resonances are excited within structures the limits discussed above may need to be reduced by 50%.

TII 2004 also contains information on the permissible construction vibration levels during the construction phase as shown in Table 3.3.

**Table 3.3. Allowable Vibration at Sensitive Properties (TII 2004)**

| <b>Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of:</b> |                   |                                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|--------------------------------|
| <b>Less than 10Hz</b>                                                                                                                                    | <b>10 to 50Hz</b> | <b>50 to 100Hz (and above)</b> |
| 8 mm/s                                                                                                                                                   | 12.5 mm/s         | 20 mm/s                        |

Following review of the suggested vibration criteria discussed above from BS7385, BS5228-2 and TII 2004, the values in Table 3-3 are considered appropriate for this assessment of impact.

### 3.1.5 Factors to Consider when Assessing Construction Noise Impacts

To assist with interpretation of a predicted construction noise level (CNL), relative to the CNT, reference is made to Table 3.16 in DMRB which forms the basis of and been adapted by AWN to include the relevant significance effects from EPA 2022. The adapted guidance to assess the likely magnitude of impact associated with construction activities is presented in Table 3.4.

**Table 3.4. Description of the magnitude of impacts. Adapted from DMRB Table 3.16**

| <b>Construction Noise Level (CNL)</b>     | <b>Magnitude of Impact (DMRB)</b> | <b>Determined EPA Significance of Effect</b> | <b>Determination</b>                                                                   |
|-------------------------------------------|-----------------------------------|----------------------------------------------|----------------------------------------------------------------------------------------|
| Below or equal Baseline Noise Level       | Negligible                        | Not Significant                              | Depending on range of the CNL, the baseline noise level and the duration of the effect |
| Above Baseline and below or equal to CNT  | Minor                             | Not Significant to Slight                    |                                                                                        |
| Above CNT and below or equal to CNT + 5dB | Moderate                          | Moderate to Significant                      |                                                                                        |
| Above CNT + 5dB                           | Major                             | Significant to Very Significant              |                                                                                        |

The adapted DMRB guidance outlined will be used to assess the predicted construction noise levels at NSLs and comment on the likely effects during the construction stage.

Section 3.19 of DMRB states that construction noise and construction traffic noise shall constitute a significant effect where it is determined that a major or moderate magnitude of impact will occur for a duration exceeding:

- ▶ 10 or more days or nights in any 15 consecutive days or nights; or
- ▶ A total number of days exceeding 40 in any 6 consecutive months.

## 3.2 Operational Phase Noise

### 3.2.1 EPA NG4

Although not strictly applicable, (an EPA licence is not being sought in this instance) to the Proposed Development, reference is made to guidance relevant to determination of appropriate operational noise levels set out in Environmental Protection Agency (EPA) Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities NG4 (EPA, 2016).

Under this guidance, for a noise-sensitive location in the vicinity of the site to be considered an 'area of low background noise', the noise levels measured at that location during the environmental noise survey need to satisfy all three of the following criteria:

- ▶ Arithmetic Average of  $L_{A90}$  During Daytime Period  $\leq 40$  dB  $L_{A90}$ , and;
- ▶ Arithmetic Average of  $L_{A90}$  During Evening Period  $\leq 35$  dB  $L_{A90}$ , and;
- ▶ Arithmetic Average of  $L_{A90}$  During Night-time Period  $\leq 30$  dB  $L_{A90}$ .

Depending on whether each location is considered an 'area of low background noise', Table 3.5 below outlines the noise emission limit criteria detailed in the NG4 document.

**Table 3.5. NG4 Approach for Determining Appropriate Noise Criteria**

| <b>Scenario</b>                  | <b>Daytime<br/>Noise Criterion,<br/>dB L<sub>Ar,T</sub><br/>(07:00 to 19:00hrs)</b> | <b>Evening<br/>Noise Criterion,<br/>dB L<sub>Ar,T</sub><br/>(19:00 to 23:00hrs)</b> | <b>Night-time<br/>Noise Criterion,<br/>dB L<sub>Aeq,T</sub><br/>(23:00 to 07:00hrs)</b> |
|----------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Areas of Low<br>Background Noise | 45 dB                                                                               | 40 dB                                                                               | 35 dB                                                                                   |
| All Other Areas                  | 55 dB                                                                               | 50 dB                                                                               | 45 dB                                                                                   |

## 4. RECEIVING ENVIRONMENT

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The site is shown in Figure 4-1 in the context of the surrounding environment. The Proposed Substation Development is within a site of 17.02 hectares in the townlands of Gotoon, Coolscart and Kilfrush in County Limerick.

The Red Line Boundary for the Proposed Substation Development overlaps with, and is located within, the Red Line Boundary for the Proposed Solar Farm Development and therefore forms part of the wider Overall Project lands.

The project lands are in a rural, agricultural area, and are of generally flat topography. All are in agricultural use at present.

Local existing noise sources are traffic along the R513 and R516 roads, along with local roads including the L1509. The Dublin to Cork Railway line also lies approximately 3 km to the south of the site. In addition, farm activity is anticipated in the noise environment. The approximate boundary of the site is shown in Figure 4-1.

**Figure 4-1. Site Boundary in context of surrounding area**



Background Imagery © Google Earth

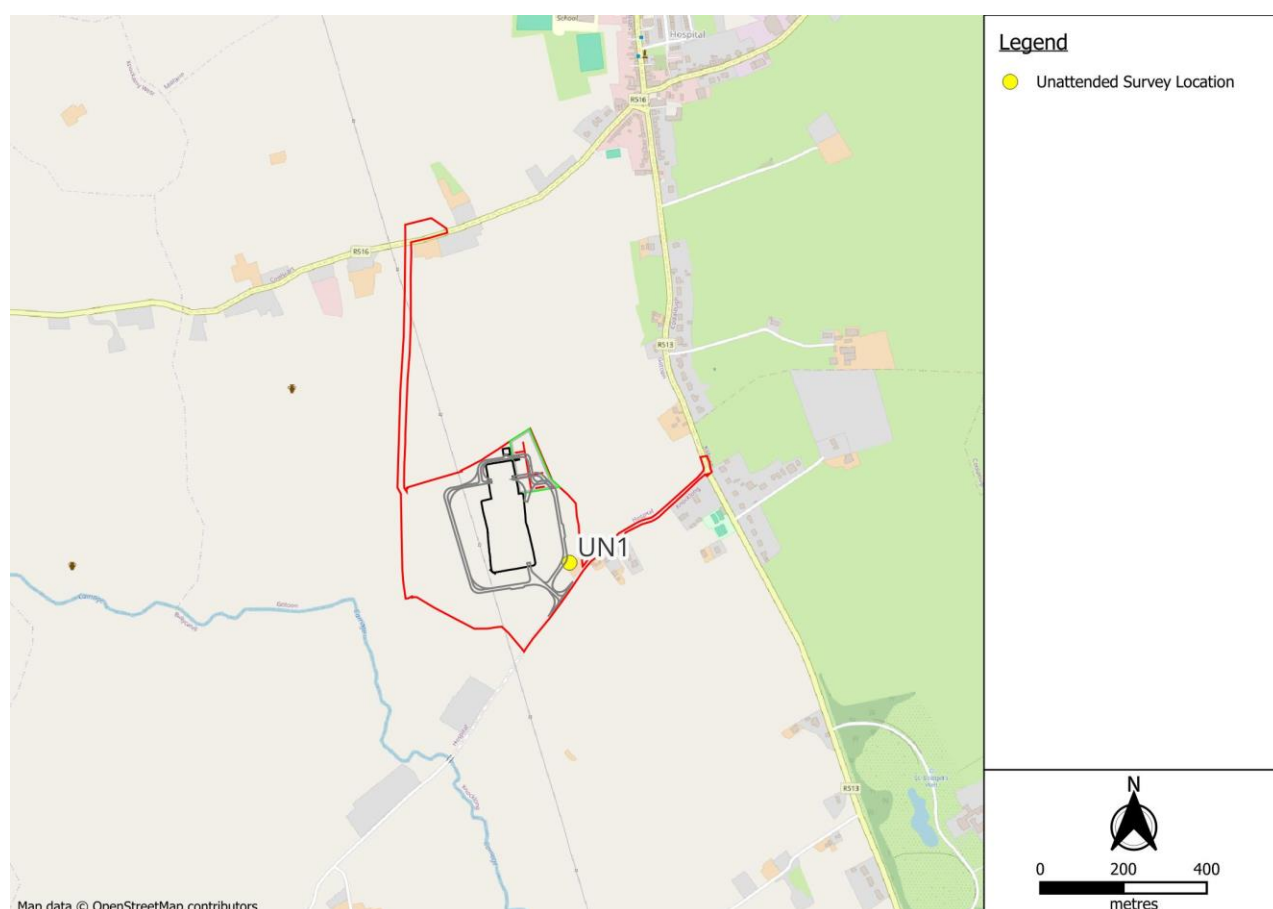
## 4.1 Baseline Noise Survey Locations

An environmental noise survey has been conducted at the site in order to quantify the existing noise environment. The survey was conducted in general accordance with ISO 1996: 2017: Acoustics – Description, measurement and assessment of environmental noise.

A noise measurement location was selected to be representative of the noise environment experienced by nearby noise-sensitive locations (NSLs) to the Proposed Development. Note that the substation will operate continuously on a 24-hour basis with consistent noise emissions, unlike the equipment from the rest of the 'Overall Project', which do not operate continuously.

The monitoring location is shown in Figure 4-2:

**Figure 4-2. Noise Measurement Location**



## 4.2 Noise Measurement Parameters

The noise survey results are presented in terms of the following parameters.

- |           |                                                                                                                                                                        |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $L_{Aeq}$ | is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period. |
| $L_{A90}$ | is the sound level that is exceeded for 90% of the sample period. It is typically used as a descriptor for background noise.                                           |

The “A” suffix for the noise parameters denotes the fact that the sound levels have been “A-weighted” in order to account for the non-linear nature of human hearing. All sound levels in this report are expressed in terms of decibels (dB) relative to  $2 \times 10^{-5}$  Pa.

Another parameter that will be commented upon in this report is the rating level,  $L_{Ar,T}$ .

$L_{Ar,T}$  The  $L_{Aeq}$  during a specified time interval, plus specified adjustments for tonal character and impulsiveness of the sound.

### 4.3 Personnel and Instrumentation

AWN carried out the noise surveys. The following instrumentation was used in conducting the noise and surveys:

**Table 4-1. Instrumentation Details**

| Equipment | Type  | Serial Number | Calibration Date |
|-----------|-------|---------------|------------------|
| Rion      | NL-52 | 1076330       | Nov 2024         |

### 4.4 Survey Results

The survey results for the unattended noise monitoring are given in Table 4-2.

**Table 4-2. Summary of Measured Noise Levels**

| Time and Date | Period  | Measured Noise Levels<br>(dB re. $2 \times 10^{-5}$ Pa) |           |
|---------------|---------|---------------------------------------------------------|-----------|
|               |         | $L_{Aeq}$                                               | $L_{A90}$ |
| 18 March 2026 | Day     | 47                                                      | 42        |
| 18 March 2026 | Evening | 41                                                      | 31        |
| 18 March 2026 | Night   | 40                                                      | 25        |
| 19 March 2026 | Day     | 47                                                      | 38        |

### 4.5 Selection of Noise Criteria

Table 4-3 presents the measured noise levels and compares them to the thresholds in the NG4 guidance for a ‘low background noise area’. The daytime range of measured levels is 38 to 42 dB  $L_{A90}$ ; in the context of the evening and night-time noise levels it is considered that the location is in an area of low background noise.

**Table 4-3. Measured Noise Levels**

| Period     | dB $L_{A90,15min}$ | NG4 Screening<br>(dB $L_{A90,15min}$ ) | Satisfies All Criteria<br>for Low Background<br>Noise Area? |
|------------|--------------------|----------------------------------------|-------------------------------------------------------------|
| Daytime    | 38-42              | $\leq 40$                              | Yes                                                         |
| Evening    | 31                 | $\leq 35$                              |                                                             |
| Night-time | 25                 | $\leq 30$                              |                                                             |

The criteria for noise from the development at noise-sensitive locations are therefore:

- ▶ Daytime periods (07:00hrs to 19:00hrs): 45 dB  $L_{Ar,T}$ ;
- ▶ Evening periods (19:00hrs to 23:00hrs): 40 dB  $L_{Ar,T}$ ;
- ▶ Night-time periods (23:00 to 07:00hrs): 35 dB  $L_{Aeq,T}$ .

Section 5-2 of this report presents the predicted noise contours and compares them to the adopted criteria.

## 5. POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT

### 5.1 Construction Phase

#### 5.1.1 General Construction

The largest noise and vibration impact of the Proposed Development will occur during the construction phase due to the operation of various plant machinery and HGV movement to, from and around the site. It is anticipated that cable works will not be significant in terms of construction noise, will be done with standard machinery and will not include intensive activities e.g. rock breaking.

Thresholds for significant noise from construction have been determined in Section 3.1. The daytime significance threshold for construction noise at NSLs in proximity to the site is set at 65 dB  $L_{Aeq,T}$ . The evening and night-time thresholds have not been considered as construction activities are expected to take place during daytime hours. Any requirement for works outside these hours would be subject to prior agreement with the Limerick County Council and appropriate noise management measures.

BS 5228-1 contains noise level data for various construction machinery. The noise levels relating to site clearance, ground excavation and loading lorries (dozers, tracked excavators and wheeled loaders) reach a maximum of 81 dB  $L_{Aeq,T}$  at a distance of 10 m. For this assessment, a worst-case scenario is assumed of 3 no. such items with a sound pressure level (SPL) of 81 dB at 10 m operating simultaneously along the closest works boundary, resulting in a total noise level of 86 dB at 10 m from the plant. This conservative scenario is the typical assumption made for developments of this size, on the basis that it is unlikely that more than 3 no. items of such plant/equipment would be operating simultaneously in such close proximity to each other.

For the calculated values in Table 5-1 below it is assumed that the ground between the construction plant and the NSL is 'soft', but no screening due to site hoarding is assumed. It is also noted that an 'on-time' activity of 66% applies to construction plant.

For the purposes of the calculation, the closest residential NSL is at a distance of 45 m from the location of construction works of the proposed development, though most NSLs are at greater distances, and any works would not take place near the 'worst-case' NSL for extended periods of time.

**Table 5-1. Indicative noise calculations for varying distances**

| Plant Item (BS 5228 Ref.)                                           | Plant Noise Level at 10m Distance (dB $L_{Aeq,1hr}$ ) | Calculated Construction Noise Levels dB $L_{Aeq,1hr}$ at reference distance from works |       |       |       |
|---------------------------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------------------------------------|-------|-------|-------|
|                                                                     |                                                       | 50 m                                                                                   | 100 m | 200 m | 300 m |
| 3 no. items each with SPL of 81 dB at 10 m operating simultaneously | 86                                                    | 65                                                                                     | 57    | 49    | 45    |

Based on the guidance in Section 3.1.4, at distances of 50 m or more predicted noise levels are below the threshold of 65 dB  $L_{Aeq,T}$  and therefore the likely noise impacts are considered not significant

At distances of less than 50 m, predicted noise levels are in excess of the threshold of 65 dB  $L_{Aeq,T}$ . However, activity will progress around the site and as a result take place at varying distances to the offsite NSLs. On this basis it is not anticipated to affect any individual NSL for more than the timeframes referred to in Section 3.1.4. Taking this into account, the construction noise effects are not considered significant and no specific mitigation measures are required.

### 5.1.2 Linear Works along the L1509

Localised widening of the L1509 within the public road boundary will be undertaken where required to accommodate the transformer delivery vehicle, together with localised works at its junction with the R513.

Noise effects due to these localised works will be short in duration at therefore the time period during which construction plant is close to individual noise-sensitive location will be limited. Taking into account the factors discussed in Section 3.1.5, the construction noise effects are not considered significant and no specific mitigation measures are required.

### 5.1.3 Vibration

There are no vibration impacts anticipated at sensitive locations during the Construction Phase. Notwithstanding the above, any construction activities undertaken on the site will be required to operate below the recommended vibration criteria set out in Table 3.3.

### 5.1.4 Construction Traffic

In terms of the additional construction traffic on local roads that will be generated as a result of the Proposed Development, the following comment is presented: Based on guidance in DMRB Noise and Vibration (UKHE, 2020) in order to increase traffic noise levels by 1 dB, traffic volumes would need to increase by the order of 25%. It is considered that additional traffic introduced onto the local road network due to the construction phase associated with various phases of the development, as outlined in the relevant sections of the Construction Traffic Management Plan, will not result in a significant noise impact.

## 5.2 Operational Phase

### 5.2.1 Noise Modelling Software

Proprietary noise calculation software has been used for the purposes of this modelling exercise. The selected software, DGMR iNoise, calculates noise levels in accordance with ISO 9613: Acoustics – Attenuation of sound during propagation outdoors, Part 2: Engineering method for the prediction of sound pressure levels outdoors, 2024.

DGMR iNoise is a proprietary noise calculation package for computing noise levels in the vicinity of noise sources. iNoise calculates 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 A-weighted sound power levels ( $L_{WA}$ );
- ▶ 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;
- ▶ the hardness of the ground between the source and receiver, and
- ▶ attenuation due to atmospheric absorption.

Noise propagation has been calculated in accordance with ISO 9613-2:2024, which predicts sound levels under meteorological conditions favourable to sound propagation, namely downwind conditions or a moderate ground-based temperature inversion.

## 5.2.2 Noise Sources

### 5.2.2.1 Substation Transformer

Noise from the substation transformer is included in the noise contours presented in Figure 5-1 and 5-2. As the closest noise-sensitive dwellings to the site are to the southeast of the substation compound, specific reference to predicted noise levels is made here. The noise source on the substation is the transformer, with sound power levels given in Table 5-2, as provided by Harmony Solar. The transformer is surrounded on three sides by a concrete wall, 8.5 m high. The open side faces away from the NSLs.

The substation will have the same noise emissions for daytime, evening time and night-time periods.

### 5.2.2.2 Battery Energy Storage System (BESS) Facility

The BESS facility is comprised of multiple noise sources including: BESS units, a BESS transformer and Power Conversion System (PCS) units. The noise levels from these sources, provided by Harmony Solar, are given in Table 5-2 below and have been included in the noise modelling.

### 5.2.2.3 Solar Farm Noise Sources

The Proposed Solar Farm Development is part of a separate planning application; for a robust cumulative assessment it is included in the noise predictions and the assessment of the Overall Project.

The principal noise sources associated with a solar farm are the inverters which are distributed around the solar farm site. Based on information provided by Harmony Solar, the sound power level of each inverter is as presented in Table 5-2, for daytime, evening time and early morning time conditions.

**Table 5-2. Noise Emission Data**

| Operating Point                                                  | Sound Power Level, $L_w$ (dB) at Octave-band Centre Frequency, (Hz) |     |     |     |      |      |      |      | dB(A) |
|------------------------------------------------------------------|---------------------------------------------------------------------|-----|-----|-----|------|------|------|------|-------|
|                                                                  | 63                                                                  | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |       |
| Substation Transformer                                           | 100                                                                 | 102 | 97  | 97  | 91   | 86   | 81   | 74   | 97    |
| BESS Unit                                                        | 49                                                                  | 51  | 58  | 62  | 67   | 64   | 59   | 50   | 70    |
| BESS Transformer                                                 | -                                                                   | 96  | -   | -   | -    | -    | -    | -    | 80    |
| PCS Unit                                                         | 60                                                                  | 62  | 70  | 74  | 78   | 75   | 70   | 61   | 81    |
| Inverter and transformers: Daytime                               | 85                                                                  | 85  | 94  | 92  | 88   | 85   | 82   | 88   | 98    |
| Inverter and transformers Evening and Night-time (early morning) | 70                                                                  | 70  | 79  | 77  | 73   | 70   | 67   | 73   | 83    |

## 5.2.3 Predicted Noise Levels

The adopted noise criteria at noise sensitive locations are presented in Section 4.5. To inform the noise assessment it is considered appropriate to examine the extent of the noise contours.

For daytime periods, making reference to Figure 5-1, there are no noise-sensitive locations within the 45 dB  $L_{Aeq}$  contour. Similarly, for evening and night-time periods, as shown in Figure 5-2, there are no noise-sensitive locations calculated to exceed the 35 dB  $L_{Aeq}$  noise level criteria.

As there are no noise-sensitive locations where predicted noise levels exceed 35 dB  $L_{Aeq}$ , the Proposed Development is considered to comply with the adopted criteria for all periods. Application of these criteria does not result in any mitigation being required.

At the closest NSL to the substation, at coordinates E570510, N634456, the predicted noise levels due to the substation and the rest of the solar farm are:

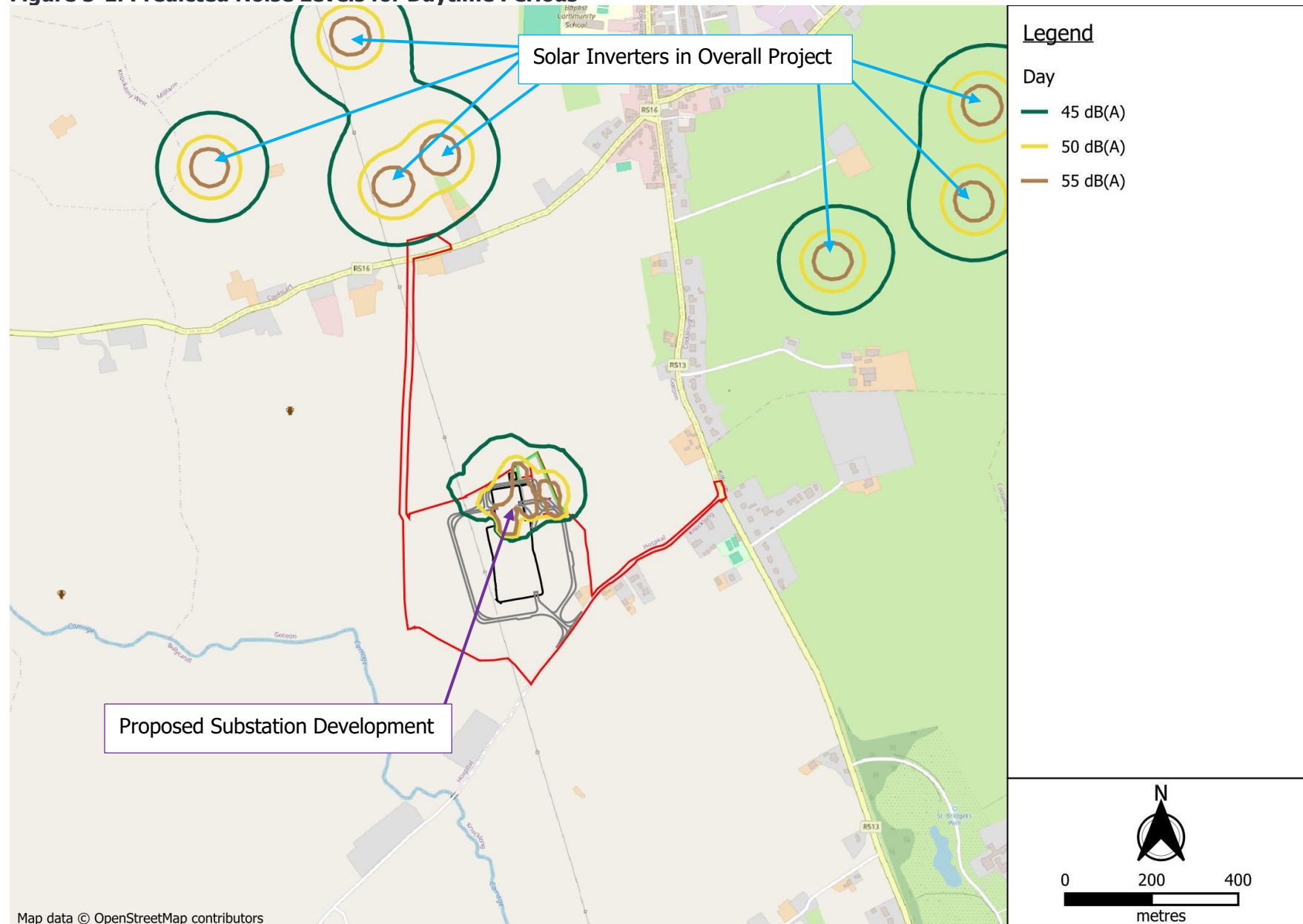
- ▶ 37 dB  $L_{Aeq,T}$  for daytime periods
- ▶ 35 dB  $L_{Aeq,T}$  for evening and night-time periods.

The predicted noise levels are within the noise criteria for all periods; therefore the noise effects are not significant and mitigation measures are not required.

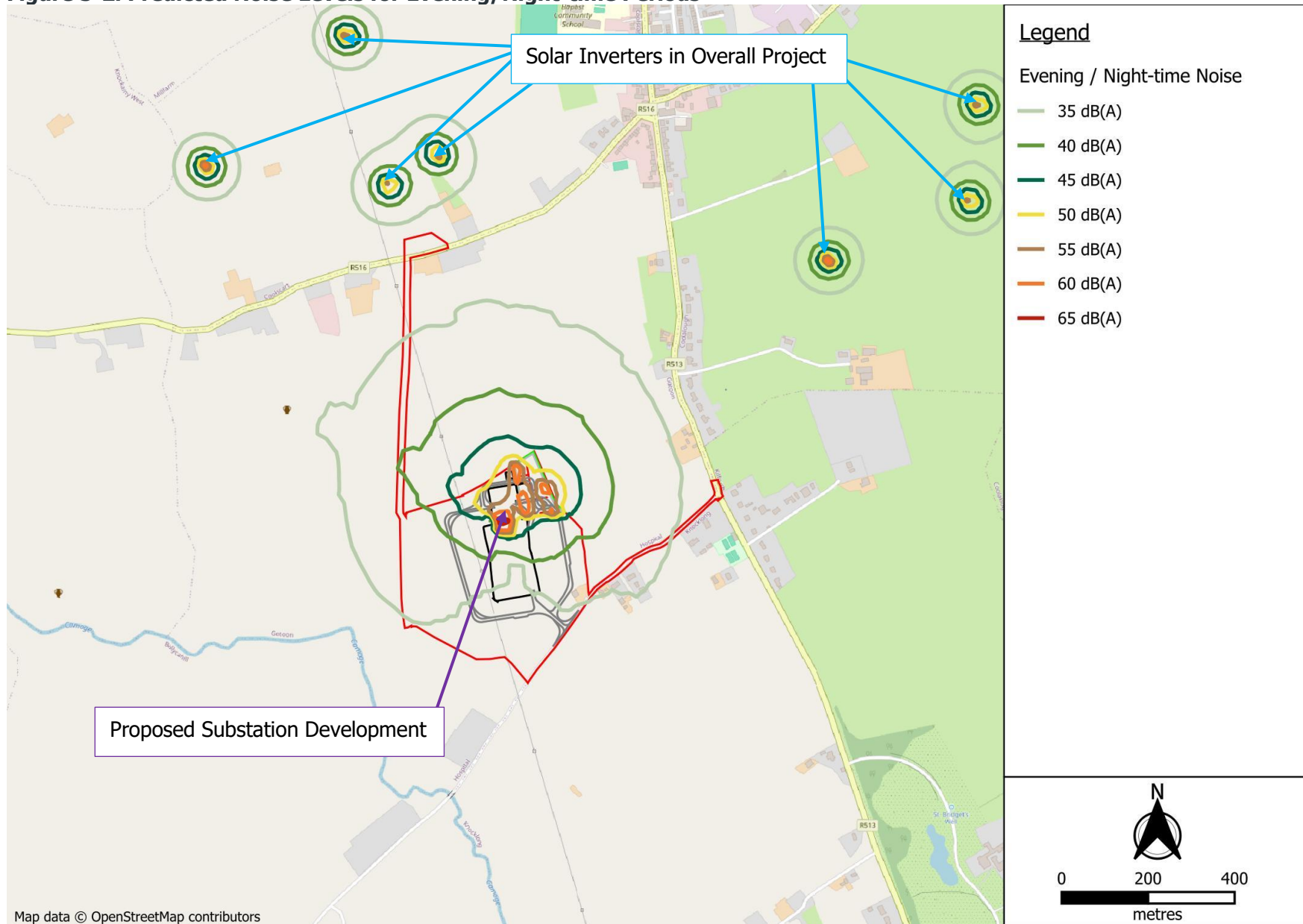
#### **5.2.4 Operational Vibration**

There is no significant source of vibration associated with the Proposed Substation Development or the Overall Project. There are therefore no significant vibration effects at off-site locations.

**Figure 5-1. Predicted Noise Levels for Daytime Periods**



**Figure 5-2. Predicted Noise Levels for Evening/Night-time Periods**



## 6. CONCLUSIONS

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The criteria for environmental noise from the Proposed Substation Development along with the Overall Project have been selected based on guidance in Environmental Protection Agency (EPA) Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities NG4 (EPA, 2016).

Criteria for the construction phase have been set with reference to BS5228-1. The significance threshold is set at 65 dB  $L_{Aeq,T}$ . Calculations of construction noise, based on distances to noise-sensitive locations and on the assumptions in Section 5.1, are within the criteria.

Sound power levels from manufacturer's data have been used in the noise model to prepare noise contours as shown in Figure 5-1 and Figure 5-2. It is assumed that the noise from the Proposed Development has no tonal or impulsive characteristics at noise-sensitive locations.

Based on the layouts and associated sound power levels information provided, there is no noise-sensitive location in excess of the day, evening or night-time / early morning criteria.

This noise assessment has concluded that there are no significant environmental noise or vibration effects associated with the operation of the Proposed Substation Development or the Overall Project.

## APPENDIX A. GLOSSARY OF ACOUSTIC TERMS

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|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ambient noise</b>            | The totally encompassing sound in a given situation at a given time, usually composed of sound from many sources, near and far.                                                                                                                                                                                                                                                                                                                                                               |
| <b>background noise</b>         | The steady existing noise level present without contribution from any intermittent sources. The A-weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90 per cent of a given time interval, T ( $L_{AF90,T}$ ).                                                                                                                                                                                                                               |
| <b>broadband</b>                | Sounds that contain energy distributed across a wide range of frequencies.                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>dB</b>                       | Decibel - The scale in which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the RMS pressure of the sound field and the reference pressure of 20 micro-pascals (20 $\mu$ Pa).                                                                                                                                                                                                                                                                |
| <b>dB L<sub>pA</sub></b>        | An 'A-weighted decibel' - a measure of the overall noise level of sound across the audible frequency range (20 Hz – 20 kHz) with A-frequency weighting (i.e. 'A'-weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.                                                                                                                                                                                                                     |
| <b>Hertz (Hz)</b>               | The unit of sound frequency in cycles per second.                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Impulsive noise</b>          | A noise that is of short duration (typically less than one second), the sound pressure level of which is significantly higher than the background.                                                                                                                                                                                                                                                                                                                                            |
| <b>L<sub>Aeq,T</sub></b>        | This is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period (T). The closer the L <sub>Aeq</sub> value is to either the L <sub>AF10</sub> or L <sub>AF90</sub> value indicates the relative impact of the intermittent sources and their contribution. The relative spread between the values determines the impact of intermittent sources such as traffic on the background. |
| <b>L<sub>AFN</sub></b>          | The A-weighted noise level exceeded for N% of the sampling interval. Measured using the "Fast" time weighting.                                                                                                                                                                                                                                                                                                                                                                                |
| <b>L<sub>A,T</sub></b>          | The Rated Noise Level, equal to the L <sub>Aeq</sub> during a specified time interval (T), plus specified adjustments for tonal character and impulsiveness of the sound.                                                                                                                                                                                                                                                                                                                     |
| <b>L<sub>AF90</sub></b>         | Refers to those A-weighted noise levels in the lower 90 percentile of the sampling interval; it is the level which is exceeded for 90% of the measurement period. It will therefore exclude the intermittent features of traffic and is used to estimate a background level. Measured using the "Fast" time weighting.                                                                                                                                                                        |
| <b>noise</b>                    | Any sound, that has the potential to cause disturbance, discomfort or psychological stress to a person exposed to it, or any sound that could cause actual physiological harm to a person exposed to it, or physical damage to any structure exposed to it, is known as noise.                                                                                                                                                                                                                |
| <b>noise sensitive location</b> | NSL – Any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or other area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels.                                                                                                                                                                                                                                |

|                                                  |                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>octave band</b>                               | A frequency interval, the upper limit of which is twice that of the lower limit. For example, the 1,000Hz octave band contains acoustical energy between 707Hz and 1,414Hz. The centre frequencies used for the designation of octave bands are defined in ISO and ANSI standards.                                                                                                     |
| <b>rating level</b>                              | See $L_{Ar,T}$ .                                                                                                                                                                                                                                                                                                                                                                       |
| <b>sound power level</b>                         | The logarithmic measure of sound power in comparison to a referenced sound intensity level of one picowatt (1pW) per m <sup>2</sup> where:<br><br>$L_w = 10 \log \frac{P}{P_0} \text{ dB}$ <p>Where: p is the rms value of sound power in pascals; and<br/> <math>P_0</math> is 1 pW.</p>                                                                                              |
| <b>sound pressure level</b>                      | The sound pressure level at a point is defined as:<br><br>$L_p = 20 \log \frac{P}{P_0} \text{ dB}$                                                                                                                                                                                                                                                                                     |
| <b>specific noise level</b>                      | A component of the ambient noise which can be specifically identified by acoustical means and may be associated with a specific source. In BS 4142, there is a more precise definition as follows: 'the equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source over a given reference time interval ( $L_{Aeq, T}$ )'. |
| <b>tonal</b>                                     | Sounds which cover a range of only a few Hz which contains a clearly audible tone i.e. distinguishable, discrete or continuous noise (whine, hiss, screech, or hum etc.) are referred to as being 'tonal'.                                                                                                                                                                             |
| <b><sup>1</sup>/<sub>3</sub> octave analysis</b> | Frequency analysis of sound such that the frequency spectrum is subdivided into bands of one-third of an octave each.                                                                                                                                                                                                                                                                  |