Bubney Solar Farm

ACOUSTIC ASSESSMENT

On Behalf Of Renewable Connections Developments Limited

March 2021 | P20-1083

BUBNEY SOLAR FARM

NOISE ASSESSMENT FOR PLANNING

Acoustics Report A1722 R01A

16th March 2021

Report for:	Bubney Solar Farm Ltd
Issued to:	Pegasus Group Ltd
	Attention: Gareth Roberts
Prepared by: Mark Harrison BSc (Hons) MIOA Senior Consultant	Checked by: Gavin Irvine BSc(Hons) MIOA Director
Issue/Revision number A1722 R01A	Date 16/03/2021

Ion Acoustics Ltd
Georges House
9 – 10 Bath Street
BRISTOL
BS1 6HL

www.ionacoustics.co.uk

0117 911 3765
mail@ionacoustics.co.uk

Consultants in Acoustics Noise & Vibration
Registered in England & Wales No. 5920418

Contents

1 Introduction

Ion Acoustics is appointed by Pegasus Planning Group Ltd to provide advice on operational noise associated with a proposed solar farm on land at Bubney farm, to the west of Whitchurch, Shropshire. The proposed facility would generate up to 30MW.

Solar farms are not normally noisy. Nevertheless, various electrical components, such as inverters and transformers, can emit low levels of noise. As such, a desktop assessment (this report) has been carried out to determine operational noise levels at the nearest residential receptors. The predicted noise levels are assessed against absolute noise limits specified to protect amenity. Computer modelling has been used to predict noise levels. This report sets out the assessment and demonstrates that the impact of noise from the solar farm will not result in any loss of amenity for nearby residential receptors.

2 Scheme Details

2.1 Site Location

The proposed site is located on farm land to the west of Whitchurch, between the A41 Bypass and the Welsh border. Major roads are located to the north (A41), east (A41) and south (A525) of the site.

The site is in a semi-rural area, with fields in all directions. That said, to the north of the site boundary lies Bubney Farm and to the south is a sewage treatment works. The nearest noise sensitive residential receptors are detailed in Table 1 below. This includes an approximate OS grid Co-ordinate and a distance to the site boundary.

Table 1: Noise Assessment Locations

Assessment Location	Approximate OS Grid Co-ordinates, (E, N)	Distance to site boundary (m)
AL01 – Rising Sun Cottages	351346, 341342	220
AL02 – Hadley Farm	351919, 341343	340
AL03 - Stoneleigh	352573, 341909	720
AL04 – Western Farm	352575, 342584	800
AL05 – Canal Cottages	352413, 342853	780
AL06 – Brightwater Lodge	351983, 343273	850
AL07 – Wolvesacre Mill	350999, 343226	560
AL08 – Llethr Mill	350832, 343118	600
AL09 – Gate House	350469, 342340	550
AL10 – Iscoyd Park	350467, 341975	610
AL11 – Moor Cottage	350929, 341353	390

The site is adjacent to the English / Welsh border, being approximately 40m at the closest approach. A number of the identified receptor locations lie within Wales, specifically; AL07, AL08, AL09, AL10 and AL10. The receptors in Table 1 are identified in more detailed in Figure 1 below:

Figure 1 – Site location showing site and nearest receptor locations © Google

The English / Welsh border is identified as the light blue line running up from AL11 to AL07.

2.2 Proposed Solar Farm

The proposed development is for a solar farm including the following:

- 10 No. power inverter units;
- A single Distribution Network Operator (DNO) transformer station.

The nature of solar farms is such that electricity is only generated during daylight hours. This may extend into times considered to be part of the night (that is early mornings before 07:00 hours) and during evenings (after 19:00 hours) during the summer. An outline plan of the proposed facility is presented in Figure 2 below.

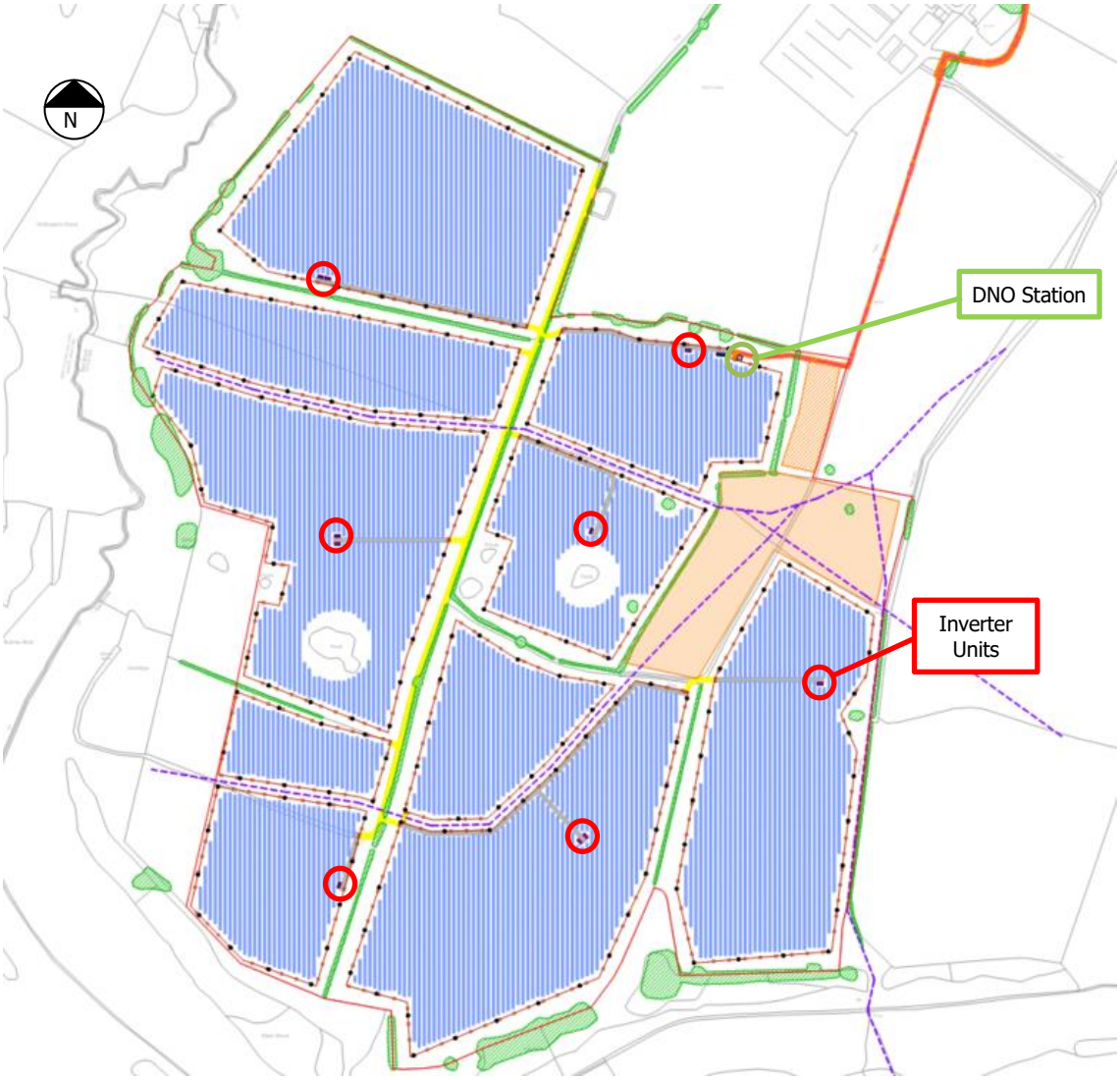

Figure 2 – Proposed Site Layout (Conversion locations circled in red)

The solar farm is to use tracker panels: solar panels which move on their mountings to track the sun throughout the day to maximise the collection of solar energy. The tracking mechanism uses a small, 24V DC motor to move the panels and typically operates for 5 to 10 seconds every few minutes throughout the day. The motors are located to the rear of the panels and generate a low level of noise.

Specific noise data for the tracker motors is not available however, but indicative information provided gives a sound power level for the motors of less than 50dB L_{WA}. This noise level, calculated to the nearest receptor (AL01 Rising Sun Cottage at 220m from the site boundary) would give a sound pressure level of less than 10dB L_{pA}. Even if multiple motor units are considered, noise from the tracker motors are unlikely to be audible at any of the identified receptor locations. To that end, no further consideration of noise from the tracking panels is provided in this assessment.

3 Planning Policy and Other Guidance on Noise

3.1 Shropshire Council Environmental Health Officer Consultation

Prior to undertaking this assessment, a telephone call was placed to Shropshire Council Environmental Health team on the 26th February 2021. The aim of the call was to discuss the proposed assessment and agree an appropriate assessment methodology in light of the anticipated low noise levels from the solar farm. At the time of writing no response has been received from the Council.

Previous discussions with the Council for a separate, unrelated project indicate that the Council would typically expect an assessment to be undertaken in line with BS4142. Furthermore, the Council look for a relative noise limit to be set at 5dB below the typical background sound level for each assessment period. If the background sound levels measured are very low (typically taken as below L_{A90} 30dB) then an assessment against absolute noise limits would be acceptable.

3.2 National Planning Policy Framework (NPPF)

In March 2012 the National Planning Policy Framework (NPPF) replaced a number of Planning Policy Statements with a single document which is intended to promote sustainable development. The document was revised in June 2019[1]. The document is generally not prescriptive and does not provide noise criteria. Instead, it places the onus on local authorities to develop their own local plans and policies as follows:

"170 Planning policies and decisions should contribute to and enhance the natural and local environment by: ……..

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability……."

The document further states that:

"180. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;

b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason…"

3.3 Noise Policy Statement for England (NPSE)

The Noise Policy Statement for England (NPSE)[2] sets out the Government's policy on environmental, neighbourhood and neighbour noise for England. The policy has three aims:

1 https://www.gov.uk/government/publications/national-planning-policy-framework--2
2 Noise Policy Statement for England (DEFRA) available at:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69533/pb13750-noise-policy.pdf

- *"avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life.*

The NPSE introduces the following terms which are also used in the NPPF:

"NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected.

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur."

However, neither the NPSE nor the NPPF Planning Practice Guidance defines numeric bounds for NOEL, LOAEL or SOAEL. The boundary of each effect level should be defined for each situation and location.

Further Government planning advice is available online[3]. The online guidance refers to the NPPF and NPSE and presents a noise assessment hierarchy table to provide further information on the boundaries between NOEL, LOAEL and SOAEL. This is shown below in Table 1.

[3] See https://www.gov.uk/guidance/noise--2

Table 2: Noise Assessment Hierarchy Table

Perception	Examples of Outcomes	Increasing Effect Level	Action
No Observed Effect Level			
Not noticeable	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

3.4 BS4142: 2014 +A1: 2019 – Assessment Principles

The standard method for assessing noise of an industrial nature affecting housing, is British Standard BS 4142 "Method for rating and assessing industrial and commercial sound". A BS 4142 assessment is typically made by determining the difference between the industrial noise under consideration and the background sound level as represented by the L_{A90} parameter, determined in the absence of the industrial noise. The L_{A90} parameter is defined as the level exceeded for 90% of the measurement time, representing the underlying noise in the absence of short duration noise events such as dog barks or individual cars passing.

The industrial noise under consideration is assessed in terms of the ambient noise level, L_{Aeq}, but a character correction penalty can be applied where the noise exhibits certain characteristics such as distinguishable tones, impulsiveness or, if the noise is distinctively intermittent. The ambient noise level, L_{Aeq} is defined as the steady-state noise level with the same energy as the actual fluctuating sound over the same time period. It is effectively the average noise level during the period. The industrial noise level (L_{Aeq}) with the character correction (if necessary) is known as rating level, L_{Ar}, and the difference between the background noise and the rating level is determined to make the BS 4142 assessment. The standard then states:

a) *"Typically, the greater the difference, the greater the magnitude of the impact.*

b) *A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.*

c) *A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context.*

d) *The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound 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."*

The standard outlines a number of methods for defining appropriate 'character corrections' to determine the rating levels to account for tonal qualities, impulsive qualities, other sound characteristics and/or intermittency.

The standard also highlights the importance of considering the context in which a sound occurs. The standard indicates that factors including the absolute sound level, the character of the sound, the sensitivity of the receptor and the existing acoustic character of the area should be considered when assessing the noise impact. The absolute sound level is of particular importance where the measured background sound levels are low, which is typically taken as L_{A90} 30dB and below. In regard to low sound levels, the standard states:

"Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night."

3.5 BS 8233: 2014 and WHO criteria

British Standard BS 8233: 2014[4] and the World Health Organisation (WHO) also provide external noise criteria to protect residential amenity. These are detailed in Table 3 below.

Table 3: WHO / BS 8233: 2014 Guideline Noise Levels

Location	Critical Health Effect	07:00 to 23:00	23:00 to 07:00
Outside Bedroom Windows	Sleep Disturbance (Windows Open)	--	45dB $L_{Aeq,\ 8hours}$ (1)
Amenity Spaces (Gardens / Patios)	Moderate Annoyance Serious Annoyance	50dB $L_{Aeq,\ 16\ hours}$ (2) 55dB $L_{Aeq,\ 16\ hours}$ (2)	--
Notes: From WHO Community Noise Guidelines (1999) BS 8233: 2014 and WHO Community Noise Guidelines			

The WHO guideline of 45 dB $L_{Aeq,\ 8hr}$ represents an 8-hour L_{Aeq} outside noise-sensitive rooms to prevent sleep disturbance. The WHO limit is a level at 1m from the façade. Therefore, equivalent free field level would be approximately 3dB lower, that is 42 dB L_{Aeq}.

The daytime limits apply to relatively anonymous noises without character and are commonly applied to traffic noise.

3.6 Absolute Noise Level Assessment

In instances of low rating noise levels, BS4142 indicates that assessment in line with absolute noise limits might be as, or more, appropriate than a relative assessment.

To ensure the proposed development is not a significant or prohibiting factor in achieving the relevant WHO guideline values at sensitive residential receptors, noise generated by the development would need to be approximately 10dB below the guidance levels in Table 2.

As such, a limit of 32 dB L_{Aeq} (free field) is proposed for noise from the solar farm at residential receptors. This is set on the basis of the night-time noise limit to ensure that sleep is protected during early morning periods during the summer when sunrise could be at 5am. During the daytime, even in rural areas, occasions when the background noise would be less than 32 dB L_{Aeq} would be rare and therefore a target of 32 dB L_{Ar} in the daytime is also likely to be consistent with a rating of a low impact in accordance with BS 4142.

4 Noise Predictions

A noise model has been constructed using IMMI[5] noise modelling software to predict noise levels to the nearest noise-sensitive receptor locations. Within the modelling software, propagation of noise has been calculated in accordance with ISO 9613-2[6] with the following input parameters:

- Downwind propagation (noise levels under crosswind and upwind conditions will be less);
- Soft ground between the noise source and the receiver locations (G = 1.0),
- Ambient air temperature of 10°C and 70% Relative Humidity; and,
- Barriers and screening influence calculated in accordance with ISO 9613-2.

[4] British Standards Institution (2014) BS 8233:2014: Guidance on sound insulation and noise reduction for buildings
[5] IMMI noise mapping https://www.immi.eu/en/noise-mapping-with-immi.html
[6] ISO 9613-2: Acoustics – Attenuation of sound during propagation outdoors: Part 2: General method of calculation

The input source data for the model is described below. The exact equipment for use on the site has not yet been identified, therefore example noise data for typical equipment used on other solar projects has been used here to show the likely noise levels the scheme may generate. In the event that different equipment is specified, it will be designed to the same noise limits.

4.1 Noise Data

The solar panels feed in to 10no power inverter units. The inverter units are distributed across the site as shown in Figure 2 above. The outputs of the localised inverters are then fed to a DNO substation for export to the National Grid. These items will be the only significant noise sources at the site. Typical sound power levels for these sources are given in the tables below.

Inverter Units

Information for the inverter units was provided by Pegasus and is considered to be a reasonable proxy for the type of units proposed at the Bubney site. The actual plant used is likely to differ from the example data below. Table 4 summarises the operational noise levels of the inverter. The source information is documented in Appendix A. This represents unit operating at 100% capacity during a sunny daytime period.

Table 4: Noise Data – Inverter Unit

Noise Source	Sound Power Level (dB) in Octave Bands, Hz							Overall, dB L_{WA}
	63	125	250	500	1000	2000	4000	
Inverter Units	80	86	93	86	83	86	93	97

The information provided is in octave bands and does not allow for analysis to identify tonal content. That being said, the distance between the noise sources and receptors is such that any tonal content will be masked by other environmental noise. Any high frequency peaks will tend to be dissipated readily with distance (and atmospheric absorption) such that these sources are not heard outside of the solar farm site.

DNO Station - Transformer

The DNO station includes a number of items of plant which facilitate the connection to the National Grid. The most significant noise source is the large power transformer.

No specific information has been provided for the DNO transformer, therefore typical noise data from a similar solar farm site has been used in this assessment. The sound power level used within this assessment is summarised in Table 5 below.

Table 5: Noise Data – DNO Transformer

Noise Source	Sound Power Level (dB) in Octave Bands, Hz							Overall, dB L_{WA}
	63	125	250	500	1000	2000	4000	
DNO Power Transformer	78.0	78.8	80.4	83.7	77.7	67.6	62.0	83.0

5 Operational Assessment

5.1 Noise Contours

The noise predictions are presented in the first instance as a noise contour plot in Figure 3 below, showing the predicted noise levels (dB L_{Aeq}) and the nearest houses. The contours assume that

all equipment is running at full capacity, which is only likely to occur in the middle of a sunny day when all plant is operating at 100%.

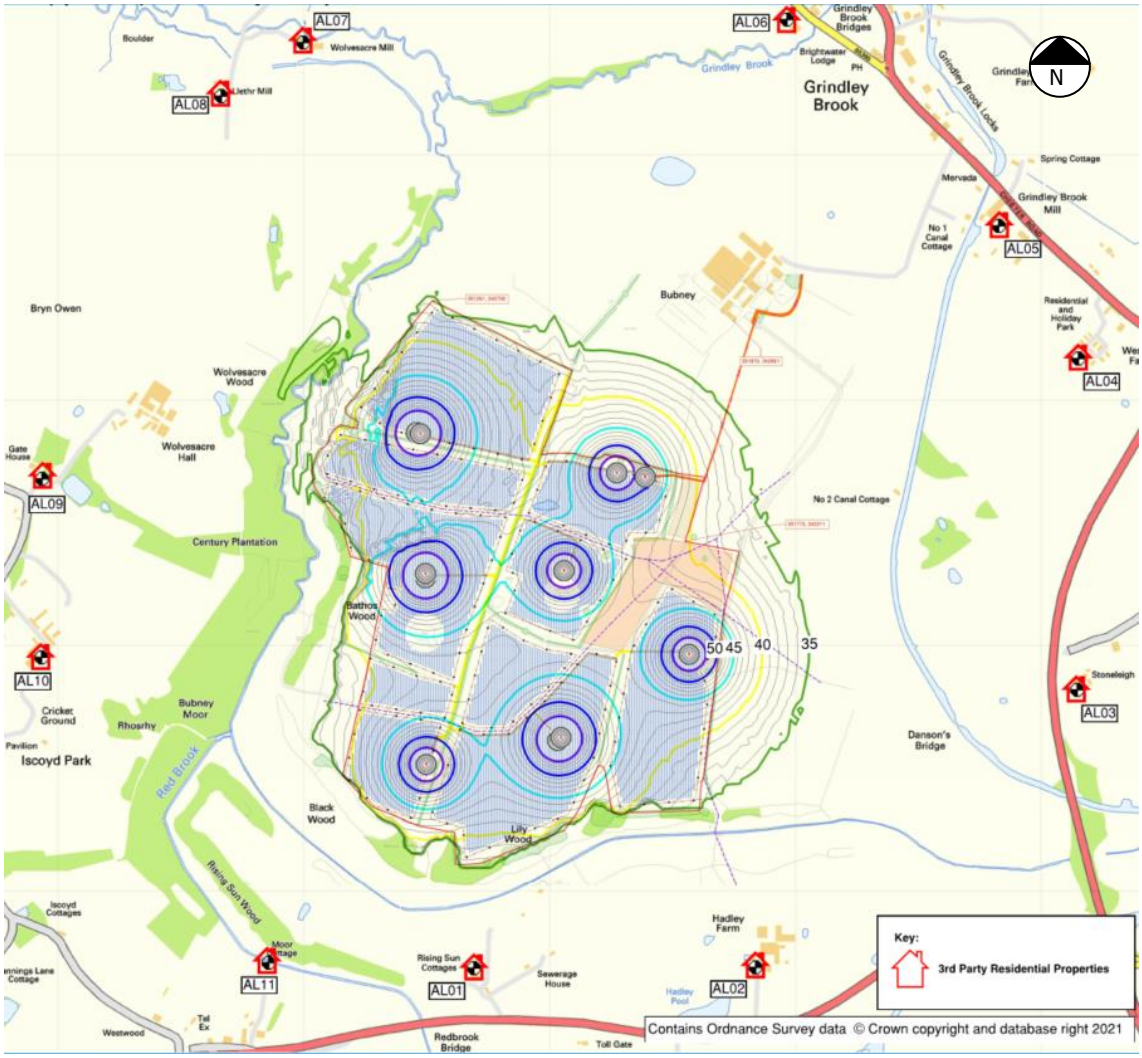

Figure 4 – Indicative Noise Contour Plot, dB L_{Aeq}

The noise contour plot above indicates that the propagation of noise is restricted to the immediate area surrounding the site and is largely contained within the site boundary. The lowest contour shown (light green) is the 35dB(A) contour.

In addition to the noise contours, the model has been used to calculate specific noise levels at the third-party receptor locations shown with red house symbols above. These predicted levels have been used to evaluate the noise impact in accordance with the methodology detailed in BS 4142.

The noise information provided for the inverter units does not include 1/3rd octave band data therefore it is not possible to identify any particular tonal elements. It is plausible that some tonal content is emitted from the inverters however, given the distance between the site and the receptor locations, it is not likely to be readily identifiable. To that end, no tonal correction is included in the derivation of the rating noise levels.

Noise generated by the DNO station transformer is generally taken as being broadband in nature, displaying no tonal elements.

In addition to the above, the solar farm does not generate any other identifiable characteristics i.e. intermittency, impulses and/or 'other' characteristics. To that end, no character corrections have been applied in the calculation of the rating noise level.

5.2 Predicted Noise Levels at Receptors

The solar scheme will only operate during daylight hours, with full capacity reached around the middle of the day on a sunny day. However, as indicated above, the Solar Farm could feasibly operate, during the summer months, before 07:00 hours. To that end, the noise limits detailed in Section 3.3 above, based on night-time sleep disturbance criteria from the WHO are used in the assessment below. The predicted noise levels are given in Table 6.

Table 6: Noise Impact Assessment

Receptor Location	Predicted (Specific) level, dB L_{Aeq}	Rating level, dB L_{Ar}	Rating Noise Limit (ref Section 3.3) dB L_{Ar}	Difference, dB
AL01 – Rising Sun Cottages	27.5	28	32	-4
AL02 – Hadley Farm	25.6	26		-6
AL03 - Stoneleigh	23.6	24		-8
AL04 – Western Farm	22.1	22		-10
AL05 – Canal Cottages	20.5	21		-11
AL06 – Brightwater Lodge	19.5	20		-12
AL07 – Wolvesacre Mill	21.0	21		-11
AL08 – Llethr Mill	21.3	21		-11
AL09 – Gate House	25.3	25		-7
AL10 – Iscoyd Park	24.7	25		-7
AL11 – Moor Cottage	24.1	24		-8

Table 7 above indicates that noise generated by the solar farm would meet the proposed noise limit with a reasonable to good margin at all of the receptor locations.

It is reiterated that the predicted noise levels are based on the facility operating at 100% capacity, which is representative of the solar farm operating during a sunny, daytime period. The proposed noise limits are based on night-time noise limits derived from the WHO on the premise that the solar farm may begin generating power from around 5am during the summer months when sunrise is earlier. While the solar farm may start generating during the earlier morning periods, it is highly unlikely to be operating at 100% therefore noise from the various items of plant is not likely to be as high as those detailed above. In practice, the solar farm is unlikely to be audible at the residential locations.

In terms of the noise exposure hierarchy table (Table 2 above). The noise climate with the solar farm would have noise levels lower than no observed effect level. Therefore, there is no mitigation required in terms of noise

5.3 Uncertainty

BS 4142 requires an assessment of uncertainty. The prediction methodology in ISO 9613[7] is thought to be accurate to ±3dB but further uncertainty can occur in the source noise levels. That said, the predicted noise levels are low in absolute terms and would remain relatively low even if uncertainty is considered. The noise source data used is assumed to be conservative and the noise targets have been derived by taking a 10dB reduction from a WHO night-time limit. To that end, uncertainty in the calculations is not considered to have a significant impact on the assessment outcomes.

6 Summary

A noise assessment has been carried out for a proposed solar farm on land at Bubney Farm, near Whitchurch, Shropshire. An absolute noise limit L_{Ar} 32dB has been proposed, in line with BS 4142 guidance on assessing in low noise conditions and to ensure that there is no exceedance of WHO sleep disturbance limits for early morning periods when the solar farm could be generating.

Overall, the calculations indicate that operational noise from the solar farm during the likely operating hours would be relatively low in absolute terms and would largely comply with the operational noise target at all the noise sensitive receptors. To that end, noise from the solar farm is unlikely to be audible and the resultant impact across all receptor locations is low.

Given the above, it is considered that there are no noise-related issues associated with the proposed solar farm which would prevent the granting of full planning permission.

[7] ISO 9613:1996 Acoustics – Attenuation of sound propagation outdoors

Appendix A – Noise Data for the Conversion Unit (Inverter Noise Data)

Inverter Unit Proxy – Basic Unit

Plant	Sound Pressure Level [dB(A)]	Sound Power Level SWL [dB(A)]	Octave Band Sound Power Level SWL [dB]							
			63	125	250	500	1k	2k	4k	8k
Central Inverter	64.3 @10m	97	80	86	93	86	83	86	93	90
Central Inverter (Battery Station)	63.0 @10m	96	79	85	92	85	82	85	92	89
DC-DC Converter	<65 @10m	96	79	86	93	85	83	86	93	89
HVAC Unit for Battery Container / DC-DC Converter Container	-	76	60	71	64	69	71	71	68	61

Table 5.1 Source Term Noise Levels

Pegasus Group

PEGASUS GROUP BRISTOL

First Floor, South Wing, Equinox North,
Great Park Road, Almondsbury, Bristol, BS32 4QL

E Bristol@pegasusgroup.co.uk
T 01454 625 945

PEGASUSGROUP.CO.UK

LinkedIn Pegasus Group
@pegasusgroup