LFAcoustics
consulting engineers

NOISE ASSESSMENT

COTMOOR SOLAR FARM

JBM SOLAR PROJECTS 6 LTD

JULY 2020

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Revision	Prepared By	Date
2.1	L Jephson BEng (Hons) MIOA	2/7/20

Contents

1. Introduction

LF Acoustics Ltd have been appointed by JBM Solar Projects 6 Ltd to undertake an operational noise assessment for a proposed solar farm to be located on land to the north of Halloughton.

It is proposed to construct the solar farm on land between Halloughton village to the south and the B6386, Southwell Road, to the north. There would be a number of central inverter and battery stations located around the site, which would feed into a DNO substation, located within the southern site area.

The following section of this report presents an overview of the relevant standards and guidelines applicable when assessing noise from this type of facility. Section 3 provides a description of the site, its surroundings and proposed operation, with an assessment of the existing noise environment provided in Section 4. The calculation and assessment of noise levels associated with the operation of the solar farm is provided in Section 5. Finally, Section 6 provides a summary of the assessment.

2. Standards and Guidelines

A description of the noise units referred to in this report is provided in Appendix A.

2.1. National Planning Policy Framework

The National Planning Policy Framework (NPPF), revised in February 2019 [1], sets out the Government's planning policies for England and how these should be applied. It provides a framework upon which locally-prepared plans for housing and other development can be produced.

The purpose of the planning system is to contribute to the achievement of sustainable development and at the heart of the Framework is a presumption in favour of sustainable development.

With regards noise, local planning policies and decisions should contribute to and enhance the natural and local environment by:

- preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels noise pollution.
- mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development (including cumulative effects) – and avoid noise giving rise to significant adverse impacts on health and the quality of life;
- identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

Reference is made within the NPPF to the Noise Policy Statement for England [2] (NPSE), which sets out the long term vision of the Government noise policy. Further information has been provided on the assessment of noise within recent Planning Practice Guidance, published in March 2014 and available on the Government planning web site. Whilst this guidance does not provide any objective criteria upon which to base noise assessments, the guidance provides a description of the relevant Effects Levels identified within the NPPF and NPSE and this is reproduced in Table 2.1.

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect (NOEL)	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
		Lowest Observed Adverse Effect Level (LOAEL)	
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, 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 perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
		Significant Observed Adverse Effect Level (SOAEL)	
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, 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
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

Table 2.1 Significance Criteria

The NPPF advises that development should seek to ensure that noise from proposed developments does not give rise to significant impacts, i.e. a level identified as a Significant Observed Adverse Effect (SOAEL), which is at a level where the noise would cause a material change in behaviour.

2.2. British Standard BS 4142

BS 4142 [2] is the British Standard for rating and assessing noise of a commercial or industrial nature and is relevant to the noise associated with the operation of the proposed plant.

BS 4142 is a comparative standard in which the estimated noise levels from the proposed development are compared to the representative / typical background noise level from existing uses.

BS 4142 relates the likelihood of complaint to the difference between the Rating Level of the noise being assessed and the background noise level.

The background noise level is the L_{A90} noise level, usually measured in the absence of noise from the source being assessed, but may include other existing industrial or commercial sounds. The background noise levels should generally be obtained from a series of measurements each of not less than 15 minute duration.

The Rating Level of the noise being assessed is defined as its L_{Aeq} noise level (the 'specific noise level'), with the addition of appropriate corrections should the noise exhibit a marked impulsive and/or tonal component or should the noise be irregular enough in character to attract attention. The extent of the correction is dependent upon the degree of tonality or character in the noise and is determined either by professional judgement, where the plant is not operational at present, or by measurement.

Where the noise is tonal in nature, the standard imposes the following penalties when assessing the rating level:

- 2 dB for a tone which is just perceptible;
- 4 dB where the tone is clearly perceptible; and
- 6 dB where the tone is highly perceptible.

Methods for identifying whether noise is tonal in nature are provided within BS 4142.

Where noise exhibits other sound characteristics, the Standard advises a penalty of 3 dB should be applied.

During the daytime, the specified noise levels are determined over a reference time interval of 1 hour, with a 15 minute reference period adopted when assessing night-time noise.

If the Rating Level of the noise being assessed exceeds the background level by 10 dB or more BS 4142 advises that there is likely to be an indication of a significant adverse impact, depending upon context. A difference between background level and Rating Level of around 5 dB is likely to be an indication of an adverse impact, depending upon context. The lower the Rating Level is, relative to the background noise level, the less likely the specific source will have an adverse or significant adverse impact. Where the Rating Level does not exceed the background noise level is an indication of a low impact, depending upon context.

The assessment method outlined above is intended for the assessment of external noise levels and is not intended to assess the extent of impact at internal locations.

Where the initial assessment of impact, based upon and assessment of the external noise levels, needs to be modified due to the context, all pertinent factors should be taken into account, including:

- The absolute level of sound;
- 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; and
- The sensitivity of the receptor and whether the premises will already incorporate measures to ensure good internal and/or external acoustic conditions.

2.3. British Standard BS 8233

British Standard BS 8233 [3] principally provides design guidance for new buildings. For residential premises, the guidance advises for steady external noise sources, levels of noise internally not exceeding 30 dB $L_{Aeq, 8\ hour}$ within bedrooms at night are desirable, with a level of 35 dB $L_{Aeq, 16\ hour}$ representing a desirable standard of noise within living rooms and bedrooms for resting purposes during daytime periods.

Externally within gardens and amenity spaces, the guidance recommends a general limit of 50 dB $L_{Aeq, T}$.

2.4. World Health Organisation Guidelines

The World Health Organisation guidance [4] provides additional guidance upon potential effects in relation to noise.

The guidance advises:

- few people are moderately annoyed by noise levels of below 50 dB L_{Aeq} during the daytime;
- for a good night's sleep, noise levels within bedrooms should not exceed 30 dB L_{Aeq}, with individual noise events not exceeding 45 dB L_{Amax}; and
- special attention should be given to noise sources in an environment with low background noise levels and to noise sources with low frequency components.

Assuming an open window provides a reduction in noise levels of between 10 – 15 dB(A), during the night-time the WHO guidance indicates that external noise levels should remain below 40 – 45 dB L_{Aeq} to maintain the restorative processes of sleep.

The WHO produced additional noise guidance in relation specifically to night-time noise in 2009 [5], which is generally considered to be the most noise sensitive period. This report provides a description of the no observed adverse effect level (which is equivalent to a No Observed Effects Level, NOEL) and advises for night-time noise (which is considered to be the most sensitive period of the day) that this concept is less useful, as the adversity of effects are less clear. Instead, it advises the use of the observed effects thresholds, above which an effect starts to occur or shows itself to be dependent upon the exposure level.

The guidance is presented in terms of external and internal recommendations to minimise any potential adverse effects. Externally, the guidance advises that an average night-time noise level L_{night} (the $L_{Aeq, 8\ hour}$) of 40 dB is equivalent to the Lowest Observed Adverse Effect Level (LOAEL) and advises this guideline value is recommended for the protection of public health from night-noise. However, below this level there was no change in the small number of awakenings identified and hence a reason for considering that the NOEL was not an appropriate descriptor in noise terms for identifying adverse effects and hence recommend the use of the observed effects threshold as an appropriate descriptor to identify the potential for the onset of adverse effects.

The guidance, however, advises that an external night-time noise level of 30 $L_{Aeq, 8\ hour}$ would be equivalent to the NOEL, as their research indicated that there were no detectable effects on sleep observed below this level.

The potential for Significant Observed Adverse Effects (SOAEL) were identified to occur at levels considerably above 40 dB $L_{Aeq, 8\ hour}$.

3. Site Description and Identification of Potentially Affected Dwellings

The layout of the proposed solar farm is as indicated on Figure 1.

Nine separate central inverter cabins and eleven battery stations (incorporating an inverter) are proposed to be sited around the farm, as indicated on the Figure. The operation of the equipment within the cabins would be the main source of noise within the solar farm, with the noise generated principally attributable to the cooling equipment located in the facades of the cabins.

The inverters would be operational during daylight periods when the farm was generating. The operation of the fans is temperature controlled and would only operate at full speed (i.e. generating the highest levels of noise) when the temperatures within the cabins were high, which would occur during the middle of the day when solar generation was at a peak. During the early morning and late evening periods, when solar energy was lower, the fans would generally either not be operational or running at a lower speed, thus generating lower levels of noise.

A DNO substation is proposed to be located within the southern part of the site, north-east of the village. The main noise generating element within this area of the site would be attributable to the operation of the main transformer.

It is proposed to locate a battery stations around the site. The battery stations would charge whilst the panels were generating during the daytime period and typically discharge during the peak morning and evening periods. They would also recharge at other times of the day, particularly overnight, when the cost of electricity is low. The principal source of noise within the battery stations would be associated with the inverters, which would be located adjacent to the battery containers. Given that the battery stations would potentially operate on a 24 hour basis, these inverters would be provided with additional noise attenuation to ensure noise levels overnight were minimised. There would additionally be HVAC units within the battery containers, used to cool the batteries, which would also generate low levels of noise potentially on a 24 hour basis.

As indicated on Figure 1, there are no residential properties within close proximity to the noise generating areas of the solar farm, with the inverters and battery stations to be sited well away from neighbouring residential properties. There are a number of properties to the north of the farm and to the south within Halloughton, which could be potentially affected by noise and the properties identified and considered within this assessment are indicated on Figure 2.

4. Baseline Noise Assessment

Due to the effect of the of the global Coronavirus pandemic, it has not been possible to undertake reliable noise monitoring at the present time upon which to establish typical baseline noise data, as the present restrictions have resulted in many businesses either being closed or operating at reduced capacity, with considerable reductions also in road and rail traffic.

Alternative methods to derive the typical background noise levels have therefore been utilised, in accordance with the current Institute of Acoustics guidance [6]. The guidance advises that the professional will need to consider whether alternative sources of information in respect of sound levels can reasonably be used.

Given the location, it is unlikely that there has been any recent noise monitoring carried out in the area, which could be reviewed and used, if considered appropriate, to estimate the background noise levels at this location.

During daytime periods, noise levels are likely to be typically attributable to distant road traffic from vehicles travelling along the A612 to the east and B6386 to the north, with noise from agricultural activities in the surrounding fields also likely to be audible at times. Given the distances to the roads and volumes of traffic, daytime noise levels are likely to be low, with background noise levels likely to be of the order of 35 dB L_{A90} during the daytime periods.

Overnight, road traffic will reduce, and typical background noise levels are likely to be very low and at or below a level of 30 dB L_{A90}.

Given the location, it is therefore considered that the background noise levels within the surrounding area are low. In this regard, BS 4142 advises that an assessment of the absolute levels of noise might be as, or more, relevant than the margin by which the rating level exceeds the background, which is especially true at night. Taking this guidance into account, the fact that the facility is located on an operational farm and given the rural location, it has been considered appropriate to assess the noise level attributable to the operation of the plant against other appropriate standards, as described in Section 2.

5. Calculation and Assessment of Noise from the Operation of the Solar Farm

5.1. Proposed Plant and Equipment

The solar panels would be connected to 9 centralised inverter cabins and 11 battery stations (including an inverter), located around the site, at positions where appropriate connections could be made to the solar arrays.

A DNO substation is proposed to be sited on land to the north of the village. Within this area, the main transformer would be the only noise generating plant.

Whilst the solar inverters would only operate during hours of daylight, the inverters associated with the operation of the battery stations would operate on a 24 hour basis, along with the DNO substation.

The locations of the inverter cabins, substation and battery stations are indicated on Figure 1.

Source term noise levels for the proposed plant have been obtained from manufacturers specifications and are provided in Table 5.1 below.

Plant	Sound Power Level SWL [dB(A)]	Octave Band Sound Power Level SWL [dB]							
		63	125	250	500	1k	2k	4k	8k
Solar / battery station Inverter	97	70	86	93	86	83	86	93	90
Battery Container HVAC Unit	77	60	71	64	69	71	71	68	61
Transformer	73	62	77	77	74	60	52	46	46

Table 5.1 Source Term Noise Levels

The inverters located closest to neighbouring residential properties would be provided with additional noise insulation, to provide a reduction in noise levels and ensure any potential noise impacts are minimised. The additional attenuation to be provided for these inverters would provide a further reduction of 15 dB(A) in the noise levels compared to the levels presented in the table above. The inverters to be insulated are indicated on Figure 1.

5.2. Calculation of Noise Levels

As indicated above, the main noise generating element of the proposed development would be attributable to the operation of the inverters associated with the solar panels and battery stations.

Calculations have been made using SoundPlan, which implements the calculation methodology from ISO 9613-2. The calculations have taken account of the land formation around the site based upon Lidar mapping.

The inverters and battery containers have been modelled as volume sources within the model, with the sound power distributed across each side and top and assuming standard hemispherical radiation.

Calculations have been prepared on the basis of all plant fully operational, which represents the likely worst case conditions during the peak daytime periods. This approach will provide an overestimate of the noise levels during the early morning and evening periods whilst the solar inverters are operating at a lower power.

Calculations have also been made for the overnight period, during which time the battery stations and DNO substation would continue to operate.

The operation of the cooling fans within the solar inverter cabins is temperature controlled. During the early morning periods, when temperatures are lower and solar energy low, it is less likely that the fans would need to operate and if so, they would only operate at low speed, thus generating lower levels of noise. The fans would be most likely to operate at full speed during the mid part of the day when the sun is at its highest level and thus generating the maximum energy. During the evening periods, the output from the solar panels would reduce as the sun sets and thus the requirement for the cooling fans to operate would gradually reduce later into the evening. As indicated previously, there would be no requirement for the fans to operate overnight during hours of darkness.

With regards to the battery station inverters, their operation would be similar, generating the highest noise levels during periods of charging or discharging at full capacity.

Noise levels have been calculated on the basis of the site layout indicated on Figure 1.

Figures 3 and 4 present the day and night-time calculated operational noise levels in graphical format and additionally provide the calculated façade noise levels in numerical form at the properties potentially most likely to be affected by the operation of the site. The calculated noise levels at the potentially most affected properties are additionally summarised in Table 5.2 below.

Location	**Distance to Site Boundary / Closest Inverter Station [m]**	**Calculated Façade Noise Level at First Floor Level [dB $L_{Aeq,T}$]**	
		Full Daytime Operation	**Battery Stations / DNO Substation**
Thorney Abbey Farm / Wild Briars	140 / 510	24	21
New Radley Farm	25 / 290	32	28
Dwelling on Stubbins Lane	190 / 300	27	25
The Willows	240 / 350	26	24
Newlands	200 / 290	24	22

Table 5.2 Noise Levels Generated by Operation of Proposed Solar Farm

5.3. Assessment Criteria

As indicated previously, background noise levels in the vicinity of the site are likely to be low, throughout the day.

Whilst the battery stations would be operational on a 24 hour basis, the solar panels and associated inverters would only be operational during daylight hours, potentially between 05:00 – 21:00 hours during summer months.

To provide a worst case assessment therefore, the noise levels attributable to the full daytime operation have been assessed for daytime and the early morning (night-time) periods, in addition to the night-time assessment of the noise attributable to the operation of the battery stations.

Due to the current situation with Covid-19, it has not be possible to obtain reliable baseline data at this time and the assessment has therefore been based upon professional judgement of the noise environment in the surrounding area , together with reference to absolute noise standards and guidance, which seek to ensure the operation would not result in adverse noise impacts.

Given the rural location, background (L_{A90}) noise levels at the surrounding properties are likely to be low throughout the day and night-time periods.

On this basis, it has been considered reasonable to assume background noise levels during the early morning period would be below 30 dB L_{A90}, with daytime levels above this, however, still likely to remain low and typically likely to be of the order of 35 dB L_{A90}.

BS 4142 advises in situations where background and rating levels are low, as at this site, it is often more appropriate to assess noise levels against absolute noise standards, rather than by the amount the rating level exceeds the background noise levels to determine the likely significance of any potential impacts and effects.

Consideration has therefore been given to information contained within BS 8233 and by the WHO, which provides guidance on absolute noise levels to ensure potential adverse impacts are minimised.

BS 8233 advises for steady state external noise sources, it is desirable that the internal ambient noise level does not exceed a level of 35 dB $L_{Aeq,16\ hour}$ during the daytime period within living rooms and bedrooms and 30 dB $L_{Aeq,\ 8\ hour}$ within bedrooms at night. On the basis of an open window typically providing a sound reduction of between 10 – 15 dB(A), equivalent external levels below 45 dB $L_{Aeq,\ 16\ hour}$ daytime and 40 dB $L_{Aeq,\ 8\ hour}$ night-time, would seek to ensure an acceptable noise environment was maintained within the properties.

Additionally, for steady state noise, the WHO night-noise guidance advises that a level of 40 dB $L_{Aeq,\ 8\ hour}$ represents the Lowest Observed Adverse Effect Level (LOAEL) overnight, which is equivalent to the BS 8233 guidance for night noise, assuming an open window.

Taking account of the low background noise levels within the area, particularly during the early morning period, to ensure any potential adverse impacts are minimised, an external limit of 35 dB $L_{Aeq,\ T}$ has been proposed for the operation of the proposed plant at the surrounding properties.

Adopting this limit for both day and night-time operations would ensure that the noise levels within the properties, particularly during the most sensitive early morning and evening periods remained at least 5 dB(A) below a level which would represent the lowest adverse observed effects level and thus ensure that any potentially adverse effects were minimised.

5.4. Assessment

As indicated previously, noise would only be generated from the operation of the inverters associated with the solar panels during daylight hours, when the panels are producing electricity. The battery stations would be operational on a 24 hour basis. As discussed, the highest noise levels, which have been calculated, would only occur during the mid daytime periods whilst the solar panels were operating at full capacity, with the highest noise levels attributable to the operation of the battery stations during periods of peak charging or discharging.

With the exception of areas very close to the inverter cabins (typically, within 25 metres), where high frequency noise from the operation of the inverters is likely to be clearly audible, the noise generated by the inverters / transformers would be principally associated with the operation of the cooling fans located on each inverter cabin. At the large distances between the inverters and neighbouring properties, any high frequency components of the noise would be effectively mitigated, as the higher frequencies attenuate at a higher rate over distance compared to lower frequencies. Given that the fans operate at relatively slow speed, the character of the noise would be similar to air conditioning units, which typically generate broadband noise, which is not tonal in nature. On this basis and the fact that the inverters / associated equipment would be some distance from surrounding properties, it has been considered appropriate to apply a penalty of 3dB(A) for other characteristic sound in accordance with BS 4142 to determine the rating level of noise.

Uncertainties in the calculations have been considered. Given that the assessment has been based upon all plant and equipment fully operational, which is considered unlikely, particularly during the most sensitive early morning periods, the calculations are likely to have overestimated the noise levels at the dwellings and thus cover any uncertainty in the noise levels attributable to the operation of the plant or within the calculation methodology. It is additionally noted that the source data used represents the maximum design level for the plant.

The calculated noise levels have been assessed against the proposed limits specified within Section 5.3, taking account of advice within BS 4142, BS 8233 and the WHO guidance to evaluate the likelihood of potential adverse effects.

The assessment of the noise levels during the daytime period, assuming full operational and night-time periods assuming full operation and solely the operation of the battery stations / DNO substation are provided below. The assessments have been made for New Radley Farm, Stubbins Lane and The Willows within Halloughton Village, as the noise levels calculated at these properties were the highest.

New Radley Farm

	Assessment Period		
	Night-time (Battery Stations)	**Night-time (Full Operation)**	**Daytime (Full Operation)**
Specific Noise Level	28	32	32
Acoustic Feature Correction	3	3	3
Rating Level	31	35	35
Background Noise Level [dB L_{A90}]	30	30	35
Excess of Rating Over Background Level	1	5	0
Likelihood of Impact	Indication of Low Impact	Indication of Adverse Impact Depending upon Context	Indication of Low Impact

Table 5.3 BS 4142 Assessment – New Radley Farm

The assessment above indicates that the operation of the battery stations would not result in any adverse noise impacts at this property.

During the daytime period, the initial BS 4142 assessment indicates a potential for a low impact. Taking account of absolute noise criteria, as the noise levels calculated remain low, the levels at the property attributable to the operation of the plant and equipment would remain below a level which would result in a potential adverse impact, taking account of the guidance within BS 8233 and WHO guidelines. Furthermore, the noise levels would remain below a level which would represent the Lowest Observed Effects Level, when considered against the WHO night-noise guidance, which Is a stringent criterion for daytime noise.

During the early morning periods, when the battery stations and solar inverters would potentially be both operational, the assessment indicates that there would be a potential for an adverse noise impact, depending upon context. As discussed previously, the solar inverters would not be operating at full capacity during the early morning period, as there is not sufficient solar power at this time. As a result, it is unlikely that the fans within the solar inverters would be operational at this period, thus the assessment is very much worst case. In addition, the rating level of noise would remain below a level of 40 dB $L_{Aeq,T}$, which is considered within the WHO guidance as representing the Lowest Observed Effects Level. On this basis, any potential noise impacts during this period at the property would remain very low.

Stubbins Lane

	Assessment Period		
	Night-time (Battery Stations)	**Night-time (Full Operation)**	**Daytime (Full Operation)**
Specific Noise Level	25	27	27
Acoustic Feature Correction	3	3	3
Rating Level	28	30	30
Background Noise Level [dB L_{A90}]	30	30	35
Excess of Rating Over Background Level	-2	0	-5
Likelihood of Impact	Indication of Low Impact	Indication of Low Impact	Indication of Low Impact

Table 5.4 BS 4142 Assessment – Stubbins Lane

Noise levels attributable to the night-time operation of the battery stations / DNO substation would remain very low, and substantially below a level which would result in adverse noise impacts at this property.

Noise levels attributable to the full operation of the solar farm during the daytime period would also remain very low and substantially below a level which would result in adverse noise effects upon the occupants of the property. Whilst the potential for adverse noise impacts would be higher during the early morning period, prior to 07:00 hours, the initial BS 4142 assessment above indicates the potential for a low impact, with the rating noise levels remaining substantially below the WHO night noise guidelines.

Noise levels at this property, with the incorporated mitigation measures proposed for the closest inverters would therefore remain acceptable.

Dwellings in Halloughton (The Willows)

	Assessment Period		
	Night-time (Battery Stations)	**Night-time (Full Operation)**	**Daytime (Full Operation)**
Specific Noise Level	24	26	26
Acoustic Feature Correction	3	3	3
Rating Level	27	29	29
Background Noise Level [dB L_{A90}]	30	30	35
Excess of Rating Over Background Level	-3	-1	-6
Likelihood of Impact	Indication of Low Impact	Indication of Low Impact	Indication of Low Impact

Table 5.5 BS 4142 Assessment – Halloughton (The Willows)

Noise levels attributable to the night-time operation of the battery stations at this and neighbouring properties would remain very low, and substantially below a level which would result in adverse noise impacts, when assessed against the WHO night-noise guidelines.

Noise levels attributable to the full operation of the solar farm during the daytime period would also remain very low and substantially below a level which would result in adverse noise effects.

Whilst the potential for adverse noise impacts would be higher during the early morning period, prior to 07:00 hours, with both the solar and battery stations operating the initial BS 4142 assessment above indicates the potential for a low impact. As indicated previously, the calculated noise levels during this period are a worst case and assume the solar inverters operating at full capacity, which is very unlikely during this period. During this period and assuming worst case conditions, the rating noise levels would remain substantially below the WHO night noise guidelines and thus ensure any potential adverse noise impacts were minimised.

Noise levels at the properties within Halloughton, with the incorporated mitigation measures proposed for the closest inverters would therefore remain acceptable and ensure any potential adverse noise impacts were minimised.

6. Summary

LF Acoustics Ltd were appointed by JBM Solar Projects 6 Ltd to undertake an operational noise assessment for a proposed solar farm to be located on land to the north of Halloughton.

It is proposed to construct the solar farm on land between Halloughton village to the south and the B6386, Southwell Road, to the north. There would be a number of central inverter / battery stations located around the site, which would feed into a DNO substation, located within the southern site area.

This report has presented calculations and an assessment of the likely worst case noise levels to be generated by the operation of the inverters / transformers to be located around the site.

The calculated noise levels have been assessed against relevant standards and guidance, to ensure that the operation of the plant does not result in occupants of nearby properties being unacceptably affected by levels of noise.

The assessment concluded that the operation of the solar farm would generate low noise levels at surrounding properties both during the day and night-time periods. Assessing the noise levels against relevant standards and guidance concluded that the operation of the plant would result in noise levels below a level which would represent the lowest observed adverse effects level, thus ensuring that the operation did not result in unacceptable levels of noise and thus complaint with the requirements of the NPPF.

References

1. Ministry of Housing, Communities and Local Government. National Planning Policy Framework. February 2019.

2. British Standards Institute. Methods for Rating and Assessing Industrial and Commercial Sound. BS 4142:2014 +A1:2019.

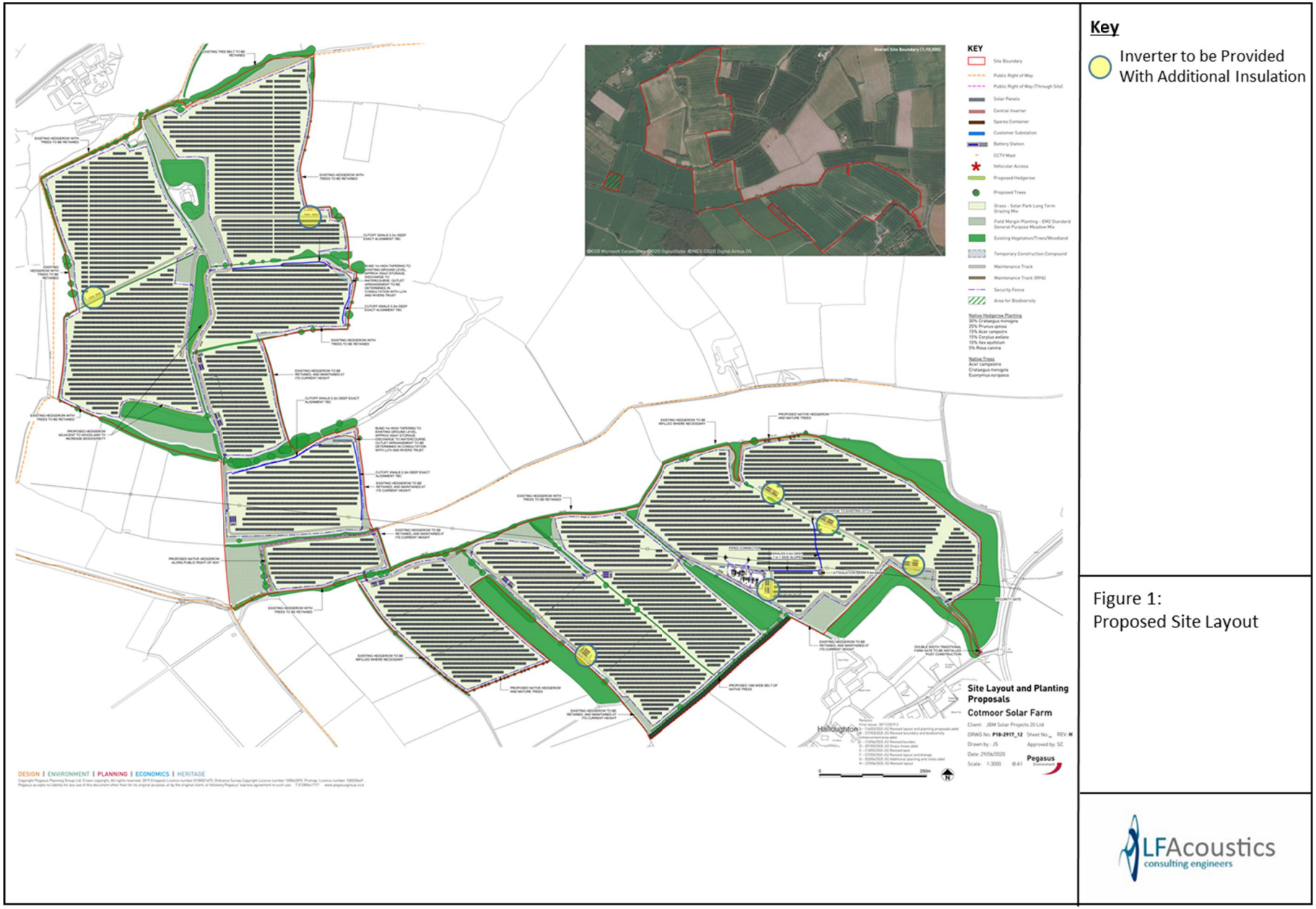
3. British Standards Institute. Guidance on Sound Insulation and Noise Reduction in Buildings. BS 8233: 2014.

4. World Health Organisation. Guidelines for Community Noise. 1999. WHO Geneva.

5. World Health Organisation. Night Noise Guidelines for Europe. 2009.

6. Association of Noise Consultants / Institute of Acoustics. Joint Guidance on the Impact of COVID-19 on the Practicality and reliability of Baseline Sound Level Surveying and the Provision of Sound & Noise Impact Assessments. Version 4. 21st April 2020.

Figures



Key

Inverter to be Provided With Additional Insulation

Figure 1:
Proposed Site Layout

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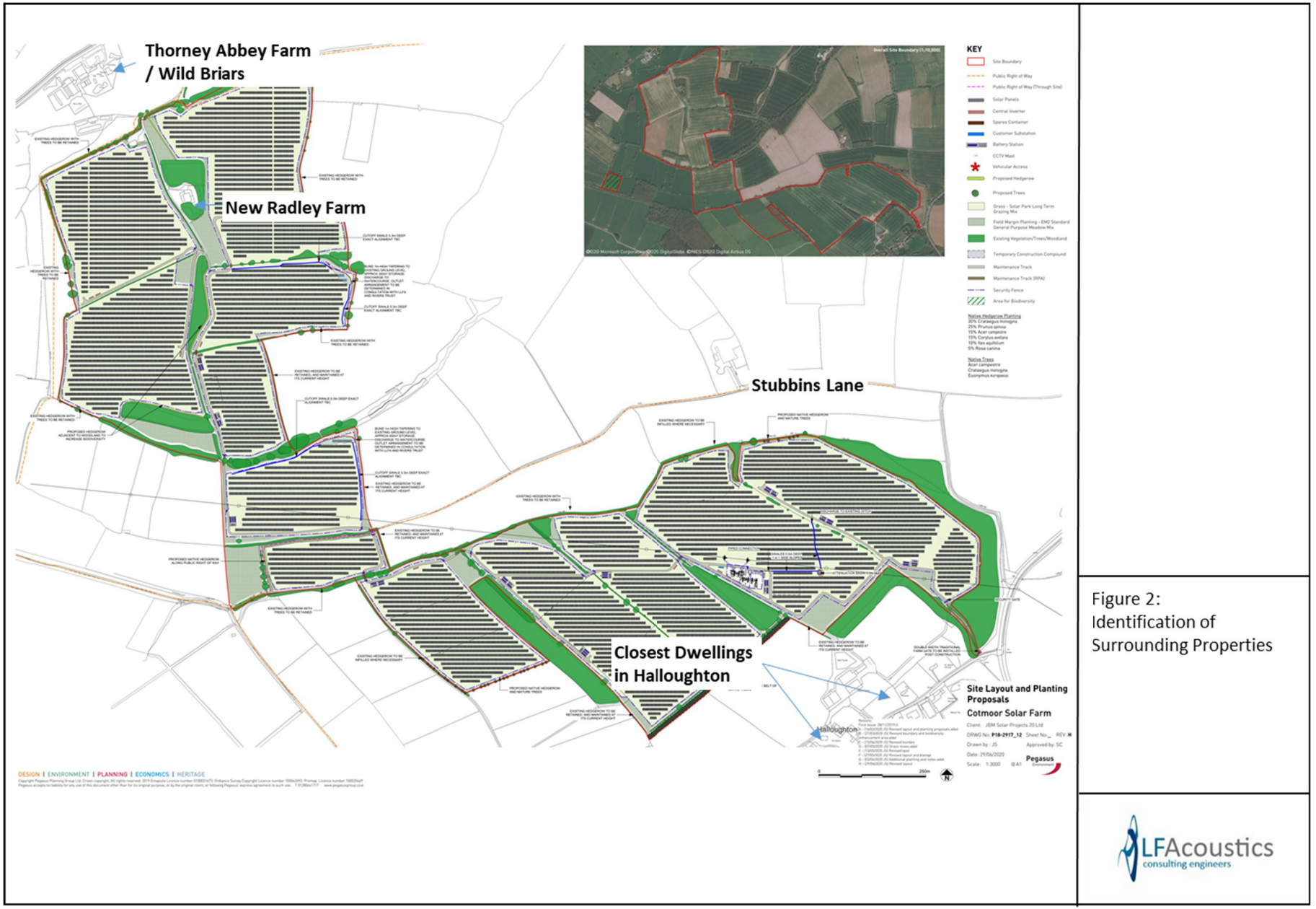

Figure 2:
Identification of
Surrounding Properties

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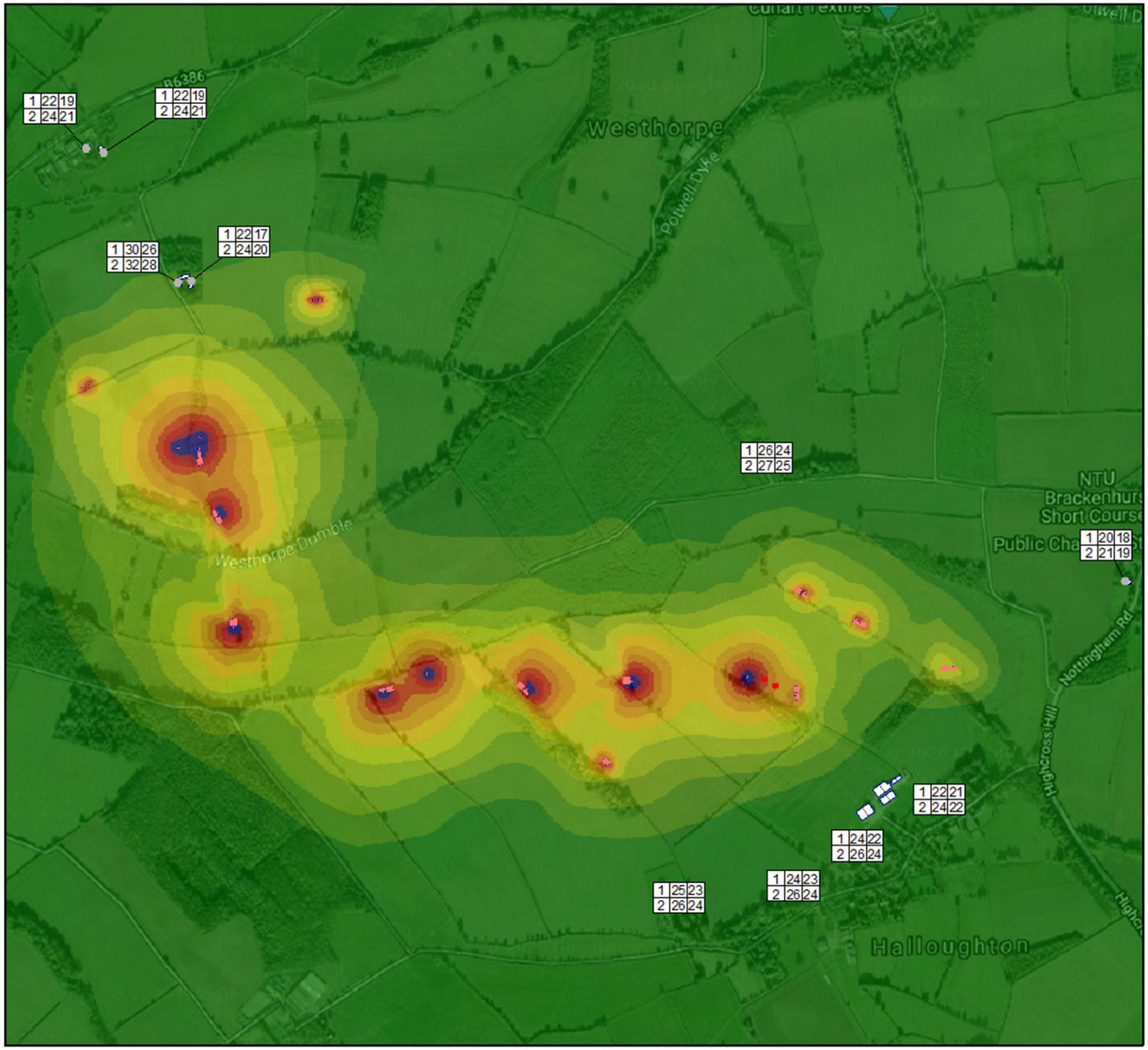

Noise Level LAeq,T
in dB(A)

< 30
30 - 33
33 - 36
36 - 39
39 - 42
42 - 45
45 - 48
48 - 51
51 - 54
54 - 57
57 - 60
>= 60

1	32	26
2	33	27

Floor | Facade $L_{Aeq,T}$ Daytime | Facade $L_{Aeq,T}$ Night-time

Note:
Contours Calculated for Ground Floor (1.5 metres)

Figure 3:
Calculated Noise Levels
Daytime – Full Operation

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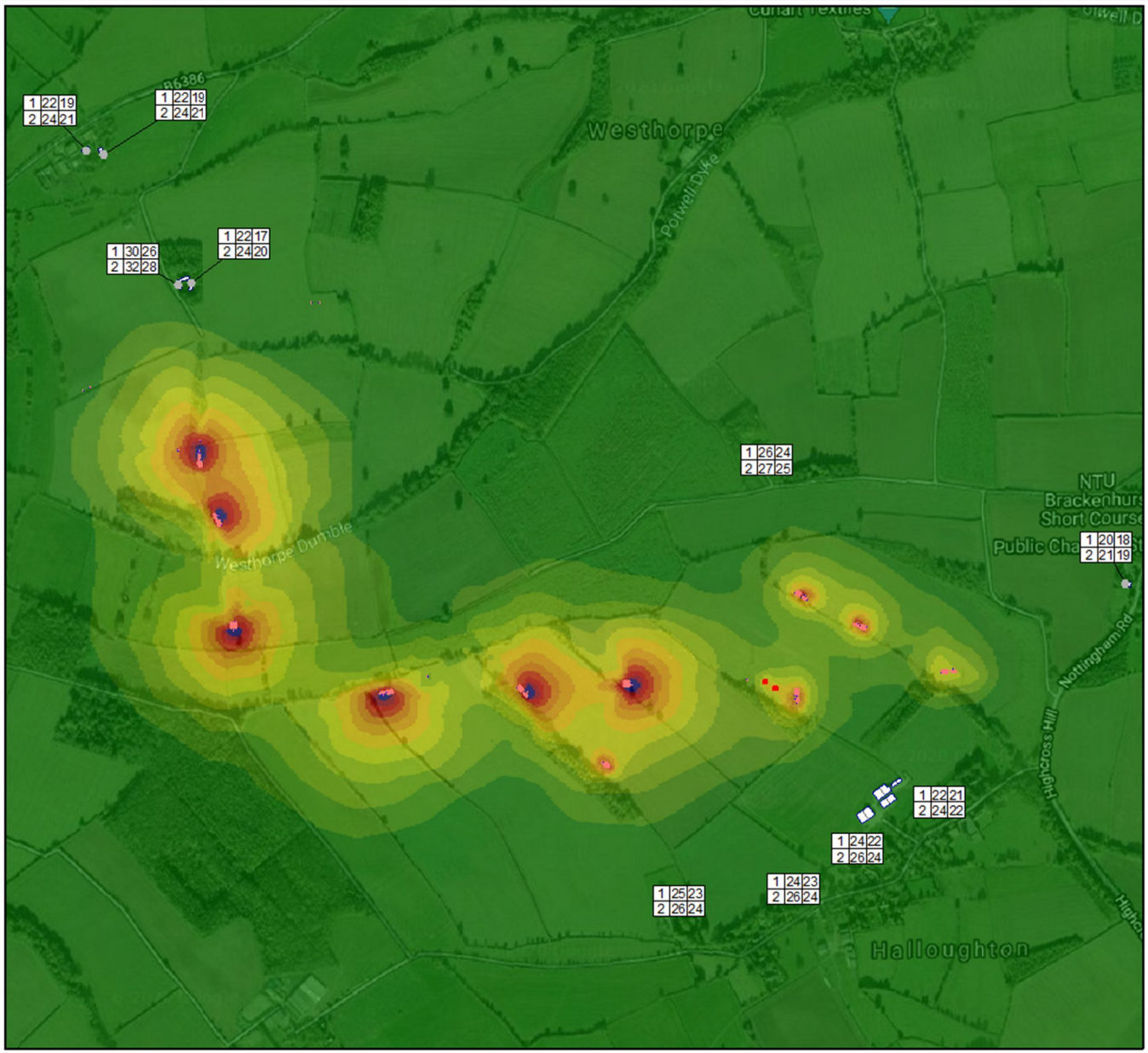

Noise Level LAeq,T
in dB(A)

< 30
30 - 33
33 - 36
36 - 39
39 - 42
42 - 45
45 - 48
48 - 51
51 - 54
54 - 57
57 - 60
>= 60

1	32	26
2	33	27

Floor | Facade $L_{Aeq,T}$ Daytime | Facade $L_{Aeq,T}$ Night-time

Note:
Contours Calculated for Ground Floor (1.5 metres)

Figure:
Calculated Noise Levels
Night-time
– Battery Storage

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Appendix A
Noise Units

Decibels (dB)

Noise can be defined as unwanted sound. Sound in air can be considered as the propagation of energy through the air in the form of oscillatory changes in pressure. The size of the pressure changes in acoustic waves is quantified on a logarithmic decibel (dB) scale firstly because the range of audible sound pressures is very great, and secondly because the loudness function of the human auditory system is approximately logarithmic.

The dynamic range of the auditory system is generally taken to be 0 dB to 140 dB. Generally, the addition of noise from two sources producing the same sound pressure level, will lead to an increase in sound pressure level of 3 dB. A 3 dB noise change is generally considered to be just noticeable and a 10 dB change is generally accepted as leading to the subjective impression of a doubling or halving of loudness. A 5 dB change is generally considered to be clearly discernible.

A-weighting

The bandwidth of the frequency response of the ear is usually taken to be from about 18 Hz to 18,000 Hz. The auditory system is not equally sensitive throughout this frequency range. This is taken into account when making acoustic measurements by the use of A-weighting, a filter circuit which has a frequency response similar to the human auditory system.

Units Used to Describe Noises Which Change Their Level with Time

The Equivalent Continuous A-Weighted Sound Pressure Level ($L_{Aeq,T}$) is the principal measurement index for environmental noise. The $L_{Aeq,T}$ is defined as the A-weighted sound pressure level of the steady sound which contains the same acoustic energy as the noise being assessed over a specific time period, T.

The L_{A90} is the noise level exceeded for 90% of the measurement period. It is generally used to quantify the background noise level, the underlying level of noise which is present even during the quieter parts of the measurement period.

The L_{Amax} is the single maximum value that the A-weighted sound pressure level reaches during a measurement period. $L_{Amax\ F}$, or Fast, is averaged over 0.125 of a second and $L_{Amax\ S}$, or Slow, is averaged over 1 second. The measured L_{Amax} noise levels in this assessment are Fast.