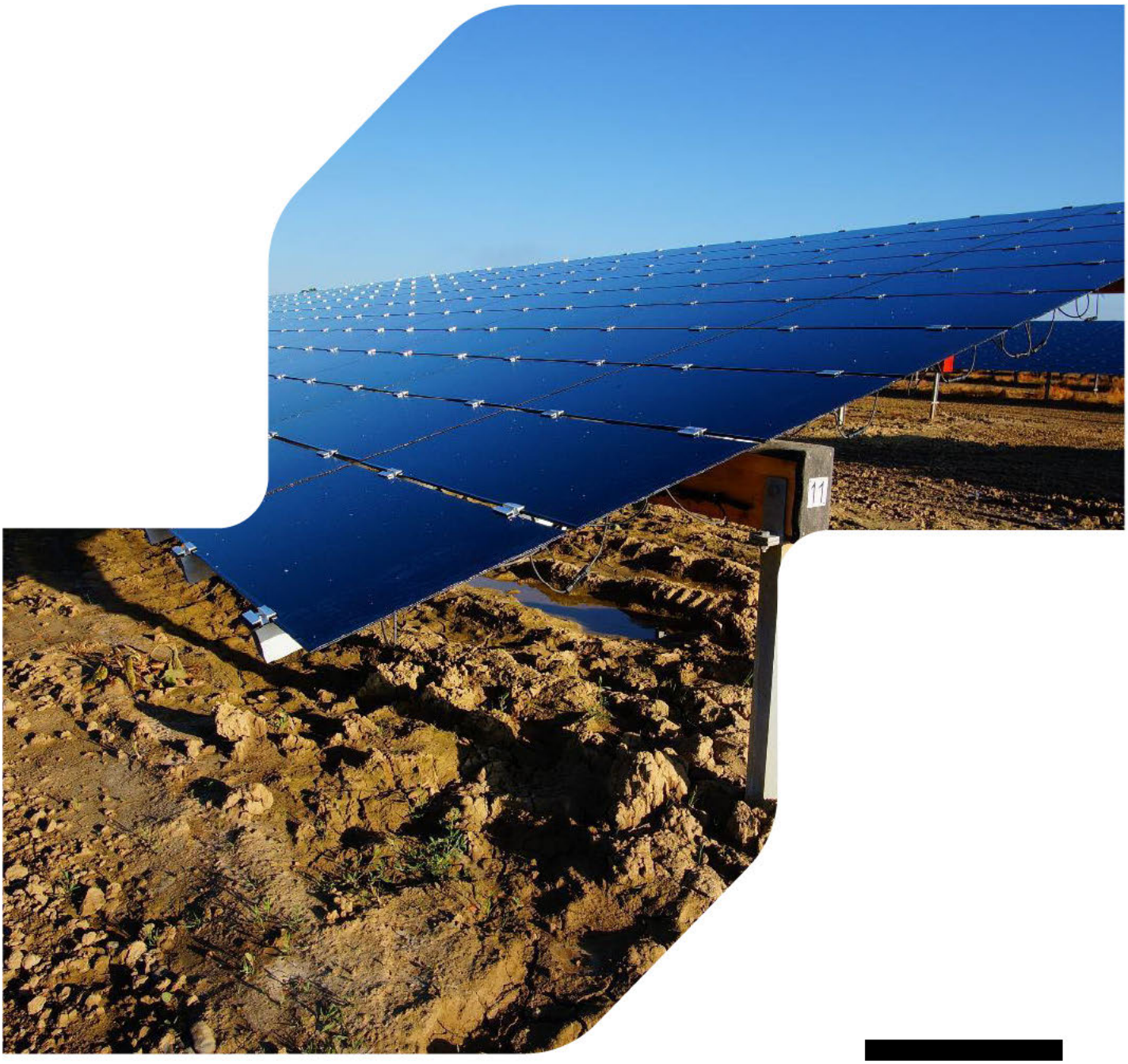
Noise Impact Assessment

Stocking Pelham Solar Farm

For Statera Energy Ltd



Quality Management

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1 Introduction

1.1 RPS has been commissioned by Statera Energy Ltd to undertake a noise impact assessment (NIA) in relation to a proposed solar farm development on land to the north of Stocking Pelham Substation, Buntingford, SG9 0JA. The site is located within the administrative boundary of the Uttlesford District Council (UDC). The west boundary of the proposed development is part of the border between the Uttlesford and East Herts District, with the latter being under the authority of Hertfordshire County Council (HCC) and East Hertfordshire District Council (EHDC).

1.2 The NIA has been undertaken based upon appropriate information of the proposed development provided by Statera Energy Ltd, and manufacturer's data. RPS is a member of the Association of Noise Consultants (ANC), the representative body for acoustics consultancies, having demonstrated the necessary professional and technical competence. The NIA has been undertaken with integrity, objectivity and honesty in accordance with the Code of Conduct of the Institute of Acoustics (IOA) and ethically, professionally and lawfully in accordance with the Code of Ethics of the ANC.

1.3 The technical content of this NIA has been provided by RPS personnel, all of whom are corporate (MIOA) or non-corporate, associate members (AMIOA) of the IOA (the UK's professional body for those working in acoustics, noise and vibration). Personnel and individual qualifications are provided within the Quality Management table at the start of this report and in Appendix A in accordance with the requirement of Section 12 of British Standard (BS) 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound' [1].This report has been peer reviewed within the RPS team to ensure that it is technically robust and meets the requirements of our Integrated Management System.

2 Policy, Guidance and Standards

Noise Policy Statement for England

2.1 The Noise Policy Statement for England (NPSE) [2] sets out the long-term overarching vision of Government noise policy, which is to promote good health and a good quality of life through the management of noise within the context of Government policy on sustainable development. Whilst the NPSE does not seek to change pre-existing policy, the document is intended to aid decision makers by making explicit the implicit underlying principles and aims regarding noise management and control that are to be found in existing policy documents, legislation and guidance.

2.2 The NPSE describes a Noise Policy Vision and three Noise Policy Aims and states that these visions and aims provide:

"the necessary clarity and direction to enable decisions to be made regarding what is an acceptable noise burden to place on society."

2.3 In other words, the purpose of the document is to provide guidance for the decision maker on whether or not the noise impact is an acceptable burden to bear in order to receive the economic and other benefits of the proposal.

2.4 Where existing policy and guidance does not provide adequate guidance then decision makers can go back to the aims of the policy statement to provide overriding guidance. The *"Noise Policy Vision"* is to *"promote good health and good quality of life through the effective management of noise within the context of Government policy on sustainable development".* This long-term vision is supported by the following aims, through effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

i. avoid significant adverse impacts of health and quality of life;

ii. mitigate and minimise adverse impacts on health and quality of life; and

iii. where possible, contribute to the improvement of health and quality of life.

2.5 The aims of the policy differentiate between noise impacts on health (e.g. sleep disturbance, hypertension, stress etc.) and noise impacts on quality of life (e.g. amenity, enjoyment of property etc.). The aims also differentiate between 'significant adverse impacts' and 'adverse impacts'. The explanatory note to the NPSE clarifies that a significant adverse impact is deemed to have occurred if the 'Significant Observed Adverse Effect Level' (SOAEL) is exceeded. An adverse effect, on the other hand, lies between the 'Lowest Observed Adverse Effect Level' (LOAEL) and the SOAEL.

2.6 In assessing whether a development should be permitted, there are therefore four questions that should be answered, with reference to the principles of sustainable development, viz. will the development result in:

a) a significant adverse impact to health;

b) a significant adverse impact to quality of life;

c) an adverse impact to health; or

d) an adverse impact to quality of life?

2.7 If the answer to question a) or b) is yes, then the NPSE provides a clear guidance that the development should be viewed as being unacceptable (item i. above). If the answer to question c) or d) is yes, then the NPSE provides a clear steer that the impact should be mitigated and minimised (item ii. above).

National Planning Policy Framework

2.8 The National Planning Policy Framework (NPPF) [3] sets out the Government's planning policies for England and how these are expected to be applied. The emphasis of the Framework is to allow development to proceed where it can be demonstrated to be sustainable. In relation to noise, Paragraph 185 of the Framework states:

> *"Planning policies and decisions should 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 the 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; and*
>
> *c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation."*

2.9 The point 'a)' refers to SOAEL in the NPSE, although the term 'effect' is used instead of the term 'impact'. However, these have been deemed to be interchangeable in this context. Therefore, given the comments above on the NPSE with regards to assessment methods and criteria, the current content of the NPPF does not require any change in previously adopted approaches.

Planning Practice Guidance - Noise

2.10 Planning Practice Guidance on Noise (PPG-N) [4] provides guidance to local planning authorities to ensure effective implementation of the planning policy set out in the NPPF. The PPG suggests that planning authorities should ensure that unavoidable noise emissions are controlled, mitigated or removed at source and establish appropriate noise limits for extraction in proximity to noise sensitive properties.

2.11 The PPG-N reiterates general guidance on noise policy and assessment methods provided in the NPPF, NPSE and British Standards and contains examples of acoustic environments commensurate with various effect levels. Paragraph 006 of the PPG-N explains that:

> *"The subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation."*

2.12 According to the PPG-N, factors that can influence whether noise could be of concern include:

- the source and absolute level of the noise together with the time of day it occurs;
- for non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise;
- the spectral content and the general character of the noise;
- the local topology and topography along with the existing and, where appropriate, the planned character of the area;
- where applicable, the cumulative impacts of more than one source should be taken into account along with the extent to which the source of noise is intermittent and of limited duration;
- whether adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on windows being kept closed most of the time;
- in cases where existing noise sensitive locations already experience high noise levels, a development that is expected to cause even a small increase in the overall noise level may result in a significant adverse effect occurring even though little to no change in behaviour would be likely to occur;
- where relevant, Noise Action Plans, and, in particular the Important Areas identified through the process associated with the Environmental Noise Directive and corresponding regulations;
- the effect of noise on wildlife;

- if external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces; and
- the potential effect of a new residential development being located close to an existing business that gives rise to noise should be carefully considered. This is because existing noise levels from the business even if intermittent (for example, a live music venue) may be regarded as unacceptable by the new residents and subject to enforcement action. To help avoid such instances, appropriate mitigation should be considered, including optimising the sound insulation provided by the new development's building envelope. In the case of an established business, the policy set out in paragraph 182 of the NPPF should be followed.

2.13 The PPG-N provides a relationship between various perceptions of noise, effect level and required action in accordance with the NPPF. This is reproduced in Table 2.1 below.

2.14 The PPG-N describes sound that is not noticeable to be at levels below the 'No Observed Effect Level' (NOEL). It describes exposures that are noticeable but not to the extent there is a perceived change in quality of life as below the LOAEL and need no mitigation. The audibility of sound from a development is not, in itself, a criterion to judge noise effects that is commensurate with national planning policy.

2.15 The PPG-N suggests that noise exposures above the LOAEL cause small changes in behaviour. Examples of noise exposures above the LOAEL provided in the PPG-N include:

- having to turn up the volume on the television;
- needing to speak more loudly to be heard;
- where there is no alternative ventilation, closing windows for some of the time because of the noise; or a potential for some reported sleep disturbance.

Table 2.1: Noise Exposure Hierarchy based on the Likely Average Response

Perception	Examples of Outcomes	Increasing Effect Level	Action
No Observed Effect Level (NOEL)			
Not present	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level (NOAEL)			
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 (LOAEL)			
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 (SOAEL)			
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

2.16 In line with the NPPF and NPSE, the PPG-N states that consideration needs to be given to mitigating and minimising effects above the LOAEL but taking account of the economic and social benefits being derived from the activity causing the noise.

2.17 The PPG-N suggests that noise exposures above the SOAEL cause material changes in behaviour. Examples of noise exposures above the SOAEL provided in the PPG-N are:

- where there is no alternative ventilation, keeping windows closed for most of the time or avoiding certain activities during periods when the noise is present; and/or
- there is a potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep.

2.18 In line with the NPPF and NPSE, the PPG-N states that effects above the SOAEL should be avoided and that, whilst the economic and social benefits being derived from the activity causing the noise must be taken into account, such exposures are undesirable.

2.19 The PPG-N suggests that a noise impact may be partially offset if the residents of affected dwellings have access to a relatively quiet part of their dwelling, private external amenity area and/or external public or private amenity space nearby.

Local Planning Policy

2.20 It should be noted that the proposed development is on a site which is located at the border between East Herts District and Uttlesford District. Therefore, the local policies presented below reflect both East Herts and Uttlesford District.

East Herts District Plan 2018

2.21 Some of the NSRs in relation to the proposed development are located within the local planning authority of East Herts District Council (EHDC).

2.22 The East Herts District Plan [5], sets out the long-term vision and strategic context for managing and accommodating growth within East Herts until 2033.

2.23 Polices BE3 and NE5 of the VALP, referenced in Planning Condition 25, are reproduced below:

"Policy EQ2 Noise Pollution

I. Development should be designed and operated in a way that minimises the direct and cumulative impact of noise on the surrounding environment. Particular consideration should be given to the proximity of noise sensitive uses, and in particular, the potential impact of development on human health.

II. Applications should be supported by a Noise Assessment in line with the Council's Noise Assessment Planning Guidance Document.

III. Noise sensitive development should be located away from existing noise generating sources or programmed developments where possible to prevent prejudicing the continued existing operations. The use of design, layout, landscaping tools and construction methods should be employed to reduce the impact of surrounding noise sources."

East Herts District - The Development Plan

2.24 The Development Plan comprises the Saved Policies from the East Herts Local Plan Second Review (East Herts District Council, 2007).

2.25 EHDC is currently preparing the new East Herts District Plan. Saved Policies from the East Herts Local Plan Second Review will continue to form part of the statutory Development Plan until they are replaced by policies as part of the emerging East Herts District Plan.

2.26 Saved policy ENV24 Noise Generating Development from the East Herts Local Plan Second Review states:

> "*(I) The District Council will expect noise generating development to be designed and operated in such a way that minimises the impact of noise nuisance on the environment.*
>
> *(II) In considering proposals, the following will be taken into account:*
>
> *(a) the proximity of existing or proposed noise sensitive developments;*
>
> *(b) the proximity of nature conservation sites;*
>
> *(c) the cumulative impact of noisy development;*
>
> *(d) the time and nature of the noise;*
>
> *(e) the nature of the surrounding area.*"

Uttlesford Local Plan 2005

2.27 Some NSRs together with the proposed development are located within Uttlesford District Council (UDC).

2.28 UDC is committed to preparing a new Local Plan in an efficient and effective manner that provides for sustainable growth and benefits for the district. The new local plan will be delivered by summer 2024.

2.29 Uttlesford District councillors decided to withdraw the draft Uttlesford Local Plan 2019 and the existing policy includes the Local Plan 2005 [6].

2.30 Policy GEN4 - Good neighbourliness of the Local Plan states that "*development and uses whether they involve the installation of plant or machinery or not, will not be permitted where: a) noise or vibrations generated […] would cause material disturbance or nuisance to occupiers of surrounding properties.*"

2.31 Policy ENV11 - Noise Generators of the Local Plan states that "*noise generating development will not be permitted if it would be liable to affect adversely the reasonable occupation of existing or proposed noise sensitive development nearby, unless the need for the development outweighs the degree of noise generated.*"

Uttlesford Noise Assessment Technical Guidance

2.32 The Noise Assessment Technical Guidance (NATG) [7] document has been prepared in relation to UDCs local plan policy on noise. It is designed to take account of Planning Practice Guidance, British Standards, National Policy and other guidance to ensure that developments achieve the highest possible standards without compromising the health and well-being of people that live and work within UDC. The technical guidance aims to provide help and advice in relation to noise in a planning context to encourage good acoustic design.

2.33 The NATG states that for industrial developments:

"*BS 4142 should be used to assess the likely impact of noise from industrial and commercial sources at noise sensitive premises (section 3.5). One of the indications of the impact of a BS 4142 assessment is the lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.*

The Council consider that new developments should contribute and enhance the area in which they are located and where possible, contribute to the improvement of people's health and quality of life as per the NPSE. With this in mind, the design objective should be:

'The development should be designed so as to achieve a rating level of 5 dB (LAeq) below the typical background (L_{A90}) level at the nearest noise sensitive location'.

Where this criterion cannot be achieved, the various noise control measures considered as part of the assessment should be fully explained (i.e. relocation of noise sources, use of quieter equipment, enclosures, screening, and restriction of the hours of operation) and the achievable noise level should be identified. This information will allow us to make a judgement concerning the application and its likely impact on the surrounding area.

In addition to the above, maximum noise levels should also be adequately controlled. Where uses generate high noise levels of a short duration (e.g. loud bangs) on a regular basis, these should aim to be controlled so as not to exceed 55 dB (L_{Amax}) at the façade of noise sensitive premises nearby in accordance with the recommendations of the World Health Organisation.

[…]"

2.34 With regards to noise and vibration from fixed plant / equipment the NATG states that:

"*Noise from fixed plant, equipment or machinery can be very annoying and disruptive to people living nearby particularly where that item involved emits a noise with impulsive or tonal characteristics.*

Many of the noise complaints Environmental Health receive about noise from plant, equipment and machinery specifically concern the character of the noise emitted.

Any noise assessment needs to consider not only the overall level of noise emitted but also its particular characteristics. The noise assessment should be based on BS 4142: 2014 and any application for fixed plant, equipment or machinery must demonstrate that:

'Externally mounted ancillary plant, equipment and servicing shall be selected and/or acoustically treated in accordance with a scheme designed so as to achieve a rating level of 5 dB (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location'.

By designing the sound pressure level of any plant items to generate a noise impact of at least 5 dB below the existing background level, any plant noise impact should be of a negligible level which should not give rise to complaints from users or occupiers of existing noise-sensitive usages.

Past experience has shown that this criterion can be readily achieved. Where available, product specification data for new items should be submitted with the acoustic report.

Consultants should be using these to compare with data from the noise survey, and propose mitigation where the levels are above those specified in the criterion. Where this information is not available, a consultant may choose to measure the noise levels generated by the equipment in question where the equipment has already been installed elsewhere (and in accordance with the guidance in BS 4142).

Where fixed plant, equipment or machinery is attached to a building the vibration caused by it can pass through the building structure and cause structure borne noise elsewhere in the building. Where it is to be installed in or on a building containing a noise sensitive use, structure borne noise should be considered in the noise assessment and adequate control measures should be proposed. An example of where this would be required is where there is a proposal to install fixed plant or equipment on the roof of a residential apartment block."

British Standard 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'

2.35 BS 4142:2014+A1:2019 primarily provides a numerical method by which to determine the significance of sound of an industrial nature (i.e. the 'specific sound' from the proposed development) at residential NSRs. The specific sound level may then be corrected for the character of the sound (e.g. perceptibility of tones and/or impulses), if appropriate, and it is then termed the 'rating level', whether or not a rating penalty is applied. The 'residual sound' is defined as the ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound.

2.36 The specific sound levels should be determined separately in terms of the $L_{Aeq,T}$ index over a period of T = 1-hour during the daytime and T = 15-minutes during the night-time. For the purpose of the Standard, daytime is typically between 07:00 and 23:00 hours and night-time is typically between 23:00 and 07:00 hours.

2.37 BS 4142:2014+A1:2019 requires that the background sound levels adopted for the assessment be representative for the period being assessed. The Standard recommends that the background sound level should be derived from continuous measurements of normally not less than 15-minute intervals, which can be contiguous or disaggregated. However, the Standard states that there is no 'single' background sound level that can be derived from such measurements.

2.38 BS 4142:2014+A1:2019 states that measurement locations should be outdoors, where the microphone is at least 3.5 m from any reflecting surfaces other than the ground and, unless there is a specific reason to use an alternative height, at a height of between 1.2 m and 1.5 m above ground level. However, where it is necessary to make measurements above ground floor level, the measurement position, height and distance from reflecting surfaces should be reported, and ideally measurements should be made at a position 1 m from the façade of the relevant floor if it is not practical to make the measurements at least 3.5 m from the facade.

2.39 With regards to the rating correction, paragraph 9.2 of BS 4142:2014+A1:2019 states:

"Consider the subjective prominence of the character of the specific sound at the noise-sensitive locations and the extent to which such acoustically distinguishing characteristics will attract attention."

2.40 The commentary to paragraph 9.2 of BS 4142:2014+A1:2019 suggests the following subjective methods for the determination of the rating penalty for tonal, impulsive and/or intermittent specific sounds:

*"**Tonality***

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

Impulsivity

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

NOTE 2 If characteristics likely to affect perception and response are present in the specific sound, within the same reference period, then the applicable corrections ought normally to be added arithmetically. However, if any single feature is dominant to the exclusion of the others then it might be appropriate to apply a reduced or even zero correction for the minor characteristics.

Intermittency

When the specific sound has identifiable on/off conditions, the specific sound level should be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time. … If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.

Other sound characteristics

Where the specific sound features characteristics that are neither tonal nor impulsive, nor intermittent, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied."

2.41 An initial estimate of the impact of the specific sound is obtained by subtracting the measured background sound level from the rating level of the specific sound. In the context of the Standard, adverse impacts include, but are not limited to, annoyance and sleep disturbance. Typically, the greater this difference, the greater is the magnitude of the impact:

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

2.42 Whilst there is a relationship between the significance of impacts determined by the method contained within BS 4142:2014+A1:2014 and the significance of effects described in the PPG-N, there is not a direct link. It is not appropriate to ascribe numerical rating / background level differences to LOAEL and SOAEL because this fails to consider the context of the sound, which is a key requirement of the Standard.

2.43 The significance of the effect of the noise in question (i.e. whether above or below SOAEL and LOAEL) should be determined on the basis of the initial estimate of impact significance from the BS 4142:2014+A1:2014 assessment with reference to the examples of outcomes described within the PPG-N and after having considered the context of the sound. It is necessary to consider all pertinent factors, including:

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

Guidelines for Community Noise

2.44 The World Health Organisation (WHO) published guidance on the desirable levels of environmental noise in 2000. In this document, Guidelines for Community Noise (GCN) [8], the authors consider that sleep disturbance criteria should be taken as an internal noise level of 30 dB $L_{Aeq,8h}$ or an external level of 45 dB $L_{Aeq,8h}$, measured at 1 m from the façade. It is also suggested that internal L_{Amax} levels of 45 dB and external L_{Amax} levels of 60 dB, should not be exceeded.

2.45 For daytime levels, it is considered that:

> *"To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55 dB L_{Aeq} on balconies, terraces, and outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50 dB L_{Aeq}. Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development."*

3 Baseline Noise Description

Site location & Noise Sensitive Receptors

3.1 Stocking Pelham solar farm site is located on land to the north of Stocking Pelham Substation, Buntingford, SG9 0JA, approximately 9.5 km west of Buntingford, a predominantly rural location. The approximate site location can be seen in Figure 3.1.

3.2 The noise sensitive receptors (NSRs) identified at the vicinity of the site are summarised below:

- **NRS A1 Ginns Road:** Located approximately 55 m north of the site boundary and 475 m from proposed noise generating plant;
- **NSR A2 Benskin Close**: Located approximately 95 m north of the site boundary and 510 m from proposed noise generating plant;
- **NSR B1 High Fields:** Located approximately 200 m southeast of the site boundary and 520 m from proposed noise generating plant;
- **NSR B2 51°56'14.3"N 0°07'45.1"E:** Located approximately 60 m southeast of the site boundary and 385 m from proposed noise generating plant;
- **NSR B3 51°56'14.4"N 0°07'44.3"E:** Located approximately 45 m southeast of the site boundary and 370 m from proposed noise generating plant;
- **NSR C1 Barn Cottage:** Located approximately 285 m east of the site boundary and 410 m from proposed noise generating plant;
- **NSR C2 Berden Hall:** Located approximately 255 m east of the site boundary and 375 m from proposed noise generating plant;
- **NSR C3 Durwards:** Located approximately 350 m east of the site boundary and 470 m from proposed noise generating plant;
- **NSR C4 Vicarage:** Located approximately 330 m east of the site boundary and 460 m from proposed noise generating plant;
- **NSR D1 Crabbs Lane:** Located approximately 265 m west of the site boundary and 280 m from proposed noise generating plant;
- **NSR D2 Crabbs Lane:** Located approximately 240 m west of the site boundary and 255 m from proposed noise generating plant;

3.3 The nearest NSRs to the site boundary that will be considered in this assessment are the following:

- NRS A Ginns Road;
- NSR B 51°56'14.3"N 0°07'45.1"E;
- NSR C Barn Cottage, and
- NSR D Crabbs Lane.

3.4 These receptors can be seen in Figure 3.1 below. It should be noted that NSR A, NSR B and NSR C all fall within the jurisdiction of EHDC, whereas NSR D falls within the jurisdiction of UDC.

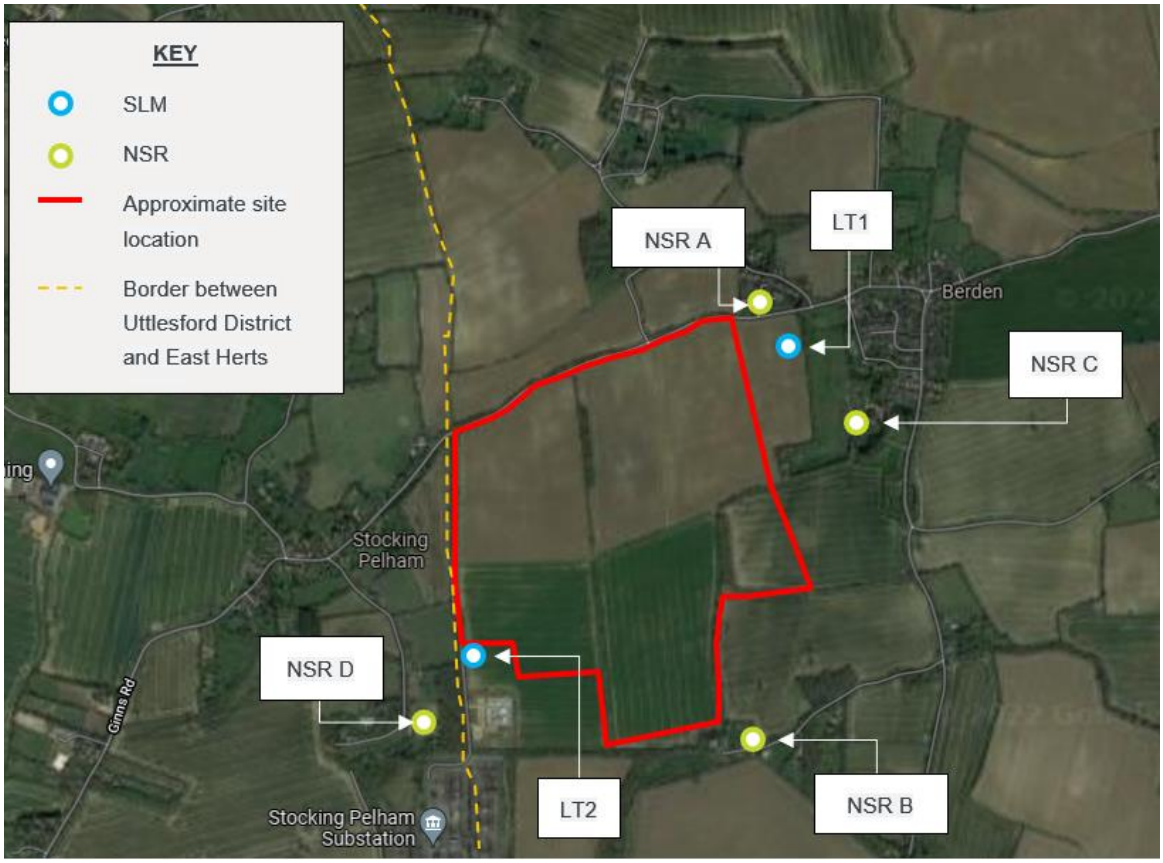

Figure 3.1: Site, Noise Sensitive Receptors and Baseline Survey Locations

Proposed Development

3.5 The proposed development will comprise a solar farm with associated plant. The noise generating plant of the proposed development includes the operation of 11 standalone photovoltaic (PV) inverter units and a new substation. The proposed development layout and plant (ref: 375_MP_03, date: 28/01/2022) can be seen in Figure 3.2.

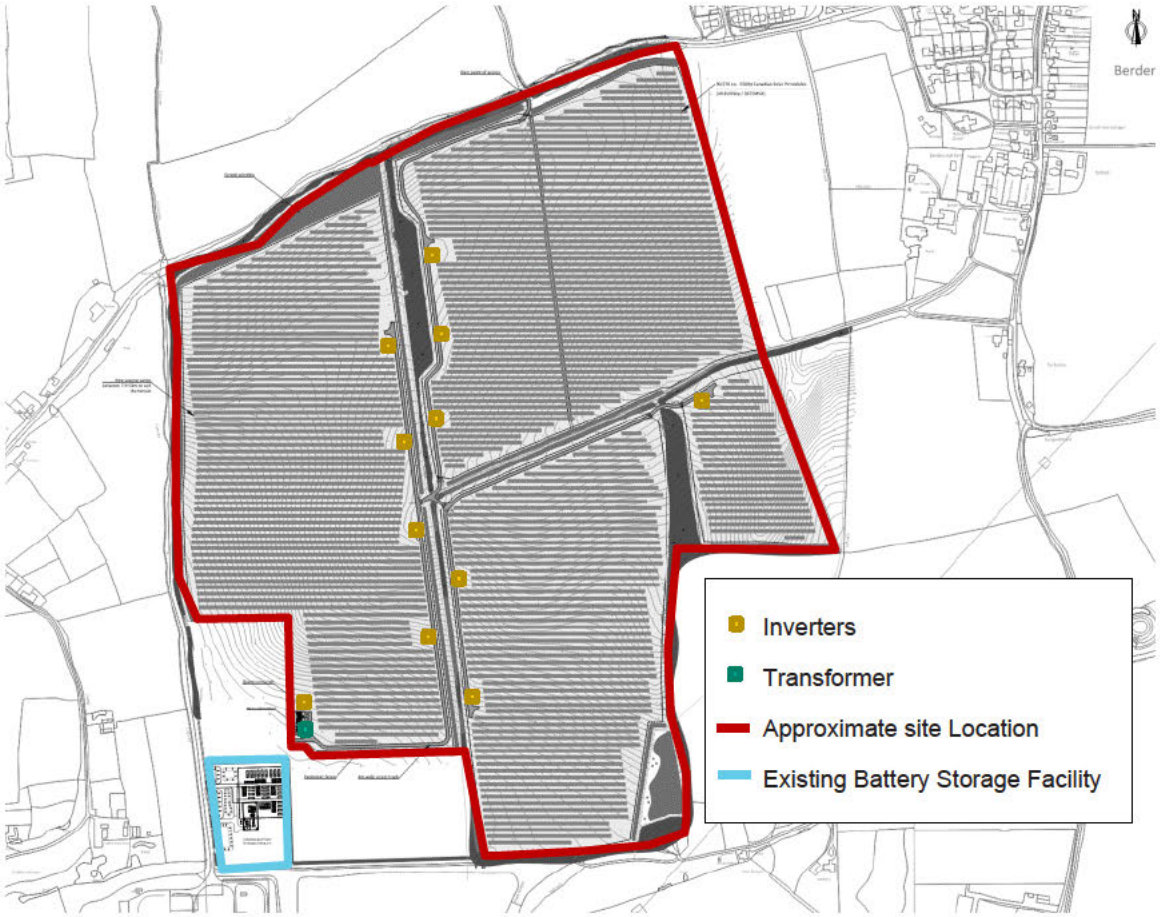

Figure 3.2: Proposed Development Layout/Plant and Existing Battery Storage Facility

Cumulative Schemes

3.6 It should be noted that RPS has previously undertaken a noise impact assessment for a Battery Storage Facility at Pelham Substation, Park Green Lane, Berden, Hertfordshire (ref: 9473e_Pelham_PC3Report_Rev0_20170518 dated: 18/05/2017). This battery storage facility is located directly at the southwest corner of the proposed development as shown in Figure 3.2.

3.7 To ensure that the noise impact of both the proposed development and the existing battery storage are taken into consideration, this assessment considers the proposed development and the cumulative impacts with the existing facility.

Baseline Noise Monitoring Dates and Locations

3.8 In order to establish baseline acoustic conditions at the nearest NSRs, two unattended concurrent sound level surveys were deployed on Monday 31st January 2022 and collected on Monday 7th February 2022.

3.9 The purpose of each long-term monitor was to capture sound levels considered representative at each NSR. Monitoring location LT1 is considered representative of NSR A and NSR C. Monitoring location LT2 is considered representative of NSR B and D. The monitoring locations are shown in Figure 3.1.

3.10 The microphones were mounted on poles 1.5 m above ground level in a free-field position (at least 3.5 m from any reflecting surface, excluding the ground). At the time of setting up and collecting the survey the following noise sources were noted as affecting the acoustic environment: road traffic movements and natural sounds (wind in trees, bird calls, insects etc.).

3.11 All sound level measurements were made using 'Class 1' Rion NL-52 sound level meters (SLM) in accordance with BS 7445-2:1991 [9]. The SLMs were set up to log the A-weighted broadband sound pressure level (SPL) in 100 ms periods. Levels were post-processed into 15-minute periods.

3.12 The equipment calibration level was checked prior to and after the monitoring periods; no significant deviation (i.e. above 0.5 dB) was noted.

Meteorological Conditions

3.13 Meteorological conditions have been assessed using Weather Underground station ID Manuden - IESSEXMA2 [redacted]

3.14 During the survey period there were periods of rain and wind speeds were relatively low below 5 m/s, as such, data has been removed from the subsequent analysis to match these events.

Baseline Results and Discussion

3.15 Table 3.1 and Table 3.2 below provide a summary of baseline sound levels measured at LT1 and LT2 and over the 7-day survey period respectively.

3.16 Figure 1 and 2 at the end of the report provide a graphical presentation of post processed 15-minute levels for LT1 and LT2, respectively.

[redacted]

Table 3.1: LT1 Baseline Sound Levels

Period	Residual Sound Levels (dB $L_{Aeq,15min}$)					Background Sound Levels (dB $L_{A90,15min}$)				
	Min	25th %[1]	50th %	75th %	Max	Min	25th %	50th %	75th %	Max
Early Morning (05:00 to 07:00)	26	37	43	49	56	23	28	35	43	50
Daytime (07:00 to 23:00)	31	44	47	53	63	21	34	38	46	56
Night-time (23:00 to 07:00)	23	34	39	45	60	21	28	33	38	54
Notes:										
1. Percentile value, for example 25th % is the value below which 25% of the data is found.										

Table 3.2: LT2 Baseline Sound Levels

Period	Residual Sound Levels (dB $L_{Aeq,15min}$)					Background Sound Levels (dB $L_{A90,15min}$)				
	Min	25th %[1]	50th %	75th %	Max	Min	25th %	50th %	75th %	Max
Early Morning (05:00 to 07:00)	34	36	39	42	45	30	34	36	38	38
Daytime (07:00 to 23:00)	28	41	44	48	59	27	33	37	42	54
Night-time (23:00 to 05:00)	31	34	36	40	49	28	33	34	36	46
Notes:										
1. Percentile value, for example 25th % is the value below which 25% of the data is found.										

Representative Baseline Sound Levels

3.17 BS 4142:2014+A1:2019 requires that the background sound levels adopted for the assessment are representative of the period being assessed. The Standard recommends that the background sound level should be derived from continuous measurements of normally not less than 15-minute intervals, which can be contiguous or disaggregated (paragraph 8.13 of BS 4142:2014+A1:2019).

3.18 However, the Standard states that there is no 'single' background sound level that can be derived from such measurements. It is particularly difficult to determine what is 'representative' of the night-time period because it can be subject to a wide variation in background sound level between the beginning and end of the night period, and the quieter middle part of the night period. The accompanying note states that *"a representative level should account for the range of background sounds levels and should not automatically be assumed to be either the minimum or modal value"*.

3.19 In this instance the 50th percentile from the surveyed period has been used to characterise the baseline sound environment, i.e., the values below which the 50% of the background data is found. The 50th percentile is slightly lower than the linear average of the background noise levels.

3.20 Similarly, representative baseline residual levels have been based on the linear average of the residual levels of each day.

3.21 Table 3.3 and Table 3.4 below provides a summary of representative sound levels used in the subsequent assessment for LT1 and LT2 respectively.

Table 3.3: LT1 Representative Baseline Sound Levels

NSRs	Period	Background Sound Level $L_{A90, T}$ (dB)	Residual Sound Level $L_{Aeq, T}$ (dB)
NSR A, NSR C	Early Morning (05:00 to 07:00)	35	44
	Daytime (07:00 to 23:00)	38	50
	Night-time (23:00 to 07:00)	33	39

Table 3.4: LT2 Representative Baseline Sound Levels

NSRs	Period	Background Sound Level $L_{A90, T}$ (dB)	Residual Sound Level $L_{Aeq, T}$ (dB)
NSR B, NSR D	Early Morning (05:00 to 07:00)	36	40
	Daytime (07:00 to 23:00)	37	46
	Night-time (23:00 to 07:00)	34	36

4 Calculations and 3D Modelling

4.1 In order to calculate specific sound levels associated with operation of the solar farm at the NSRs, a 3D sound model has been built using SoundPLAN v8.2 noise modelling software.

4.2 The model predicts sound levels under light down-wind conditions based on hemispherical sound propagation with corrections for atmospheric absorption, ground effects, screening and directivity based on the procedure detailed in ISO 9613-2:1996 'Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation' [10].

4.3 Acoustic input properties of the proposed PV inverter units have been based on source data of a typical solar inverter unit[1]. Based on this data, the PV inverter units would have a maximum operational sound power level (SWL) of 91 dBA L_W, with the SWL appropriately lower in the early morning and evening periods when solar radiation is reduced. This data is summarised in Table 4.1 below.

Table 4.1: Modelled Plant Items

Plant	#	Maximum Sound Power Level (dBA L_W)	On-Time	Type of Noise Source in the Noise Model
Standalone Solar PV Inverter	11	91	-100% on-time between 07:00 and 23:00 hours - not operational between 23:00 and 05:00 hours - 100% on-time but with a maximum sound power level of 76 dBA L_W.	Industrial buildings
New Substation	1	87	- 100% on-time on a 24/7 basis	Point source
Notes: SWL based on data for a large substation transformer as previously assessed by RPS.				

4.4 The PV inverters have been modelled as industrial buildings with radiating facades. The PV inverters will only operate during periods of sunlight, with a lower sound power level in the early morning and evening periods when solar radiation is reduced.

4.5 Based on previous RPS experience of measuring noise from solar PV units, on a clear June day, noise emissions commenced at ~05:00 (approximately 15-minutes after sunrise), and gradually increased by 15 dB over the subsequent 3-hour period, such that by 08:00 hours the inverter was operating at maximum capacity and generating maximum levels of noise.

4.6 This 'ramping up' is shown graphically on the Figure 4.1 chart below, which shows the measured 1-minute ambient noise level at 1 m from a single PV inverter.

[1] Sunny Central SC 4600 UP, sound pressure level at 10 m 63 dBA.

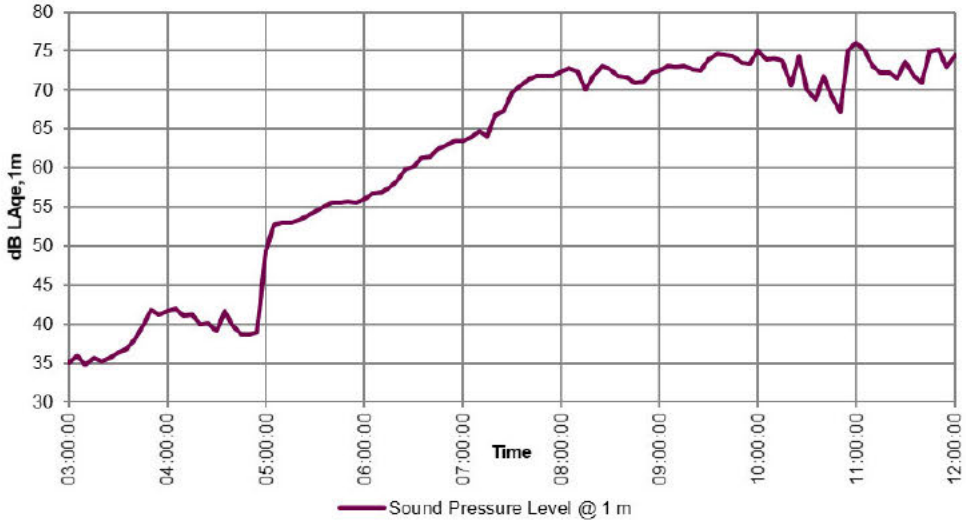

Figure 4.1: PV Inverter Noise Emissions Over Time

4.7 On the basis of the above, the PV inverters have been modelled with a SWL of 76 dBA L_W during the early morning period between 05:00 and 07:00 hours (which technically falls inside the overall night-time period of 23:00 to 07:00 hours), 15 dB lower than the maximum operational SWL that occurs when solar radiation is sufficiently high, i.e. 91 dB dBA L_W between 08:00 and 18:00 (around 3-hours after and before sunrise and sunset respectively). The on-times for the inverters are summarised in Table 4.1, and is considered a worst-case approach.

4.8 The transformer of the new substation has been modelled as a point source which operates on a 24/7 basis with a steady noise emission over time.

4.9 Spectral data for all plant items has been based on data previously measured by RPS at an operational solar farm. Relative one-third-octave band SWLs for the 50 Hz to 5 kHz bands, are summarised below.

Table 4.2: Spectral Data

Third-octave Band Relative Sound Power Level (dB L_W)																			
50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k
-11	-15	-19	-8	-21	-20	-20	-23	-18	-21	-27	-29	-29	-26	-29	-31	-32	-12	-3	-24	-24

4.10 The layout of the site has been based on the drawing submitted as part of the planning application 'General Arrangement' (ref: 375_MP_03_Pelham Masterplan 31.02.22).

4.11 The following assumptions have been incorporated into the noise model:

- the topography of the site and the surrounding area has been obtained from site surveyed topographical data and Ordnance Survey OS) open data (Terrain 50);
- the effect of screening from solid structures (buildings) has been incorporated into the modelling process by importing OS Open Data 'Settlement Area' shape file data into the model; and
- the ground type in the model has been set to soft (G=1) as the site and surrounding area are fields.

Existing Battery Storage Noise Sources

4.12 The existing battery storage facility considered as part of the cumulative schemes, has been modelled based on the available information from the commissioning tests of the facility available in Appendix B.

3D Model Results

4.13 Table 4.3 and Table 4.4 below provide a summary of modelled specific sound levels at the nearest NSRs for the early morning, daytime and night-time periods from the proposed development and the proposed development including noise from the cumulative scheme.

Table 4.3 Predicted Specific Sound Levels – Proposed Development

NSR	Specific Sound Level $L_{Aeq,Tr}$ (dB)		
	Early Morning (05:00 to 07:00 hours)	Daytime (07:00 to 23:00 hours)	Night-time (23:00 to 05:00 hours)
NSR A Ginns Rd	10	19	8
NSR B	17	23	16
NSR C Barn Cottage	9	18	7
NSR D Crabbs Lane	23	26	23

Table 4.4 Predicted Specific Sound Levels – Proposed Development and Cumulative Schemes

NSR	Specific Sound Level $L_{Aeq,Tr}$ (dB)		
	Early Morning (05:00 to 07:00 hours)	Daytime (07:00 to 23:00 hours)	Night-time (23:00 to 05:00 hours)
NSR A Ginns Rd	17	21	17
NSR B	25	27	25
NSR C Barn Cottage	16	20	16
NSR D Crabbs Lane	34	34	34

5 Assessment

BS 4142:2014+A1:2019 Assessment – Proposed Development

5.1 A BS 4142:2014+A1:2019 initial estimate of the noise impact for the early morning (05:00-07:00 hours), daytime (09:00-23:00 hours) and night-time (23:00-05:00 hours) is provided in Table 5.1, Table 5.2 and Table 5.3, respectively, for the operational noise from the proposed development.

5.2 A penalty of + 3 dB was applied to the predicted specific sound levels at all receptors to account for potential tonal characteristics at lower frequencies related to the proposed transformer. The predicted specific sound levels at all receptors do not exceed the residual sound levels during all the assessed time periods. Therefore, although the proposed plant operation is expected to be intermittent, the intermittency is not expected to be readily distinctive against the residual acoustic environment. As a result, no rating penalty has been applied to account for intermittency or the distinct character of the specific sound. It is also not considered necessary to apply any additional rating penalty related to impulsivity (e.g. high noise levels of a short duration) as the specific noise is not expected to present such characteristics.

Table 5.1: BS 4142:2014+A1:2019 Assessment (Early Morning) – Proposed Development

NSRs Location	Representative Baseline Sound Levels		Specific Sound Level, dB L_S	Rating Penalty, dB	Rating Level, dB $L_{Ar,Tr}$	Rating -Background Level Difference, dB
	Background, dB $L_{A90,T}$	Residual, dB $L_{Aeq,T}$				
NSR A Ginns Rd	35	44	10	3	13	**-22**
NSR B	36	40	17	3	20	**-16**
NSR C Barn Cottage	35	44	9	3	12	**-23**
NSR D Crabbs Lane	36	40	23	3	26	**-10**

Table 5.2: BS 4142:2014+A1:2019 Assessment (Daytime) – Proposed Development

NSRs Location	Representative Baseline Sound Levels		Specific Sound Level, dB L_S	Rating Penalty, dB	Rating Level, dB $L_{Ar,Tr}$	Rating -Background Level Difference, dB
	Background, dB $L_{A90,T}$	Residual, dB $L_{Aeq,T}$				
NSR A Ginns Rd	38	50	19	3	22	**-16**
NSR B	37	46	23	3	26	**-11**
NSR C Barn Cottage	38	50	18	3	21	**-17**
NSR D Crabbs Lane	37	46	26	3	29	**-8**

Table 5.3: BS 4142:2014+A1:2019 Assessment (Night-time) – Proposed Development

NSRs Location	Representative Baseline Sound Levels		Specific Sound Level, dB L_S	Rating Penalty, dB	Rating Level, dB $L_{Ar,Tr}$	Rating -Background Level Difference, dB
	Background, dB $L_{A90,T}$	Residual, dB $L_{Aeq,T}$				
NSR A Ginns Rd	33	39	8	3	11	**-22**
NSR B	34	36	16	3	19	**-15**
NSR C Barn Cottage	33	39	7	3	10	**-23**
NSR D Crabbs Lane	34	36	23	3	26	**-8**

5.3 With regards to the rating/background level difference, BS 4142:2014+A1:2019 states:

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context; and
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

5.4 On the basis of the above, and with reference to Table 5.1 to Table 5.3, it is considered that as rating levels do not exceed background sound levels for any time period, there is a low risk that operation of the solar farm would result in adverse impact, significant or otherwise, depending on the context.

5.5 In this instance, it is considered that the context of the noise further reduces the risk for adverse impact during all time periods, such that adverse impact/effects would be very unlikely, significant, or otherwise, as reasoned below.

Noise Change Assessment - Proposed Development

5.6 The ambient sound levels with and without the proposed development in operation are shown in Table 5.4 to Table 5.6. The results show that sound from the plant is predicted to result in no change in the ambient sound levels at all receptors during all assessment time-periods.

Table 5.4: Ambient Noise Level Change Assessment – Early Morning – Proposed Development

NSRs Location	Residual Sound Level (dB $L_{Aeq, T}$)	Specific Sound Level (dB $L_{Aeq, Tr}$)	Ambient Sound Level (dB $L_{Aeq, T}$)	Change (dB)
NSR A Ginns Rd	44	10	44	+0
NSR B	40	17	40	+0
NSR C Barn Cottage	44	9	44	+0
NSR D Crabbs Lane	40	23	40	+0

Table 5.5: Ambient Noise Level Change Assessment – Daytime – Proposed Development

NSRs Location	Residual Sound Level (dB $L_{Aeq, T}$)	Specific Sound Level (dB $L_{Aeq, Tr}$)	Ambient Sound Level (dB $L_{Aeq, T}$)	Change (dB)
NSR A Ginns Rd	50	19	50	+0
NSR B	46	23	46	+0
NSR C Barn Cottage	50	18	50	+0
NSR D Crabbs Lane	46	26	46	+0

Table 5.6: Ambient Noise Level Change Assessment – Night-time - Proposed Development

NSRs Location	Residual Sound Level (dB $L_{Aeq, T}$)	Specific Sound Level (dB $L_{Aeq, Tr}$)	Ambient Sound Level (dB $L_{Aeq, T}$)	Change (dB)
NSR A Ginns Rd	39	8	39	+0
NSR B	36	16	36	+0
NSR C Barn Cottage	39	7	39	+0
NSR D Crabbs Lane	36	23	36	+0

Discussion of Context - Proposed Development

5.7 According to Table 5.1, Table 5.2 and Table 5.3, no adverse impacts are predicted at any of the receptors and at any assessment period. The predicted combined noise rating levels of the plant at NSR A, NSR B and NSR C, which fall within the jurisdiction of UDC, given in Table 5.1 to Table 5.3 are at least 11 dB below the measured background noise levels, which is in agreement with the NATG requirement for fixed plant (see paragraph 2.34).

5.8 According to Table 5.4 to Table 5.6, no sound increase above background levels has been predicted at all receptors and at any assessment period.

5.9 Thus, taking into account the context presented above, sound from the proposed development is not expected to result in an adverse impact on quality of life and the predicted sound levels from the operational site are considered to be equivalent to NOEL and below NOAEL.

5.10 The BS 4142:2014+A1:2019 initial estimate of impact indicates that there is a low risk that sound from the facility may result in adverse impacts depending on the context. Taking into account the context of the scenario discussed above, the outcome of the BS 4142:2014+A1:2019 initial estimate of impact is still considered valid and therefore adverse impact/effects would be very unlikely, significant, or otherwise at all NSRs.

BS 4142:2014+A1:2019 Assessment – Proposed Development and Existing Development

5.11 A BS 4142:2014+A1:2019 initial estimate of the noise impact for the early morning (05:00-07:00 hours), daytime (09:00-23:00 hours) and night-time (23:00-05:00 hours) is provided in Table 5.7, Table 5.8 and Table 5.9, respectively, for the operational noise from the proposed development including noise from the existing scheme.

5.12 A penalty of + 3 dB was applied to the predicted specific sound levels at all receptors to account for potential tonal characteristics at lower frequencies related to the proposed transformer. The predicted specific sound levels at all receptors do not exceed the residual sound levels during all the assessed time periods. Therefore, although the proposed plant operation is expected to be intermittent, the intermittency is not expected to be readily distinctive against the residual acoustic environment. As a result, no rating penalty has been applied to account for intermittency or the distinct character of the specific sound. It is also not considered necessary to apply any additional rating penalty related to impulsivity (e.g. high noise levels of a short duration) as the specific noise is not expected to present such characteristics.

Table 5.7: BS 4142:2014+A1:2019 Assessment (Early Morning) –Cumulative Schemes

NSRs Location	Representative Baseline Sound Levels		Specific Sound Level, dB L_S	Rating Penalty, dB	Rating Level, dB $L_{Ar,Tr}$	Rating -Background Level Difference, dB
	Background, dB $L_{A90,T}$	Residual, dB $L_{Aeq,T}$				
NSR A Ginns Rd	35	44	17	3	20	**-15**
NSR B	36	40	25	3	28	**-8**
NSR C Barn Cottage	35	44	16	3	19	**-16**
NSR D Crabbs Lane	36	40	34	3	37	**+1**

Table 5.8: BS 4142:2014+A1:2019 Assessment (Daytime) –Cumulative Schemes

NSRs Location	Representative Baseline Sound Levels		Specific Sound Level, dB L_S	Rating Penalty, dB	Rating Level, dB $L_{Ar,Tr}$	Rating -Background Level Difference, dB
	Background, dB $L_{A90,T}$	Residual, dB $L_{Aeq,T}$				
NSR A Ginns Rd	38	50	21	3	24	**-14**
NSR B	37	46	27	3	30	**-7**
NSR C Barn Cottage	38	50	20	3	23	**-15**
NSR D Crabbs Lane	37	46	34	3	37	**+0**

Table 5.9: BS 4142:2014+A1:2019 Assessment (Night-time) – Cumulative Schemes

NSRs Location	Representative Baseline Sound Levels		Specific Sound Level, dB L_S	Rating Penalty, dB	Rating Level, dB $L_{Ar,Tr}$	Rating -Background Level Difference, dB
	Background, dB $L_{A90,T}$	Residual, dB $L_{Aeq,T}$				
NSR A Ginns Rd	33	39	17	3	20	**-13**
NSR B	34	36	25	3	28	**-6**
NSR C Barn Cottage	33	39	16	3	19	**-14**
NSR D Crabbs Lane	34	36	34	3	37	**+3**

5.13 With regards to the rating/background level difference, BS 4142:2014+A1:2019 states:

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context; and
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

5.14 On the basis of the above, and with reference to Table 5.7 to Table 5.9, for NSR A, NSR B and NSR C the rating levels do not exceed background sound levels for any time period. Thus, when the cumulative schemes are being considered, there is a low risk that operation of the developments would result in adverse impact, significant or otherwise, depending on the context.

5.15 With reference to Table 5.7 to Table 5.9, for NSR D the rating levels do not exceed background sound levels during daytime; the background noise levels at NSR D are exceeded only by 1 dB during the early morning and by 3 dB during night-time. Thus, when the cumulative schemes are

being considered, there is a low risk that operation of the solar farm would result in adverse impact, significant or otherwise, depending on the context.

5.16 In this instance, it is considered that the context of the noise further reduces the risk for adverse impact during all time periods, such that adverse impact/effects would be very unlikely, significant, or otherwise, as reasoned below.

Noise Change Assessment - Proposed Development and Cumulative Scheme

5.17 The ambient sound levels with and without the proposed development in operation are shown in Table 5.10 to Table 5.12. The results show that sound from the plant is predicted to result in no change in the ambient sound levels at all receptors during all assessment time-periods.

Table 5.10: Ambient Noise Level Change Assessment (Early Morning) –Cumulative Schemes

NSRs Location	Residual Sound Level (dB $L_{Aeq, T}$)	Specific Sound Level (dB $L_{Aeq, Tr}$)	Ambient Sound Level (dB $L_{Aeq, T}$)	Change (dB)
NSR A Ginns Rd	44	17	44	+0
NSR B	40	25	40	+0
NSR C Barn Cottage	44	16	44	+0
NSR D Crabbs Lane	40	34	41	+1

Table 5.11: Ambient Noise Level Change Assessment (Daytime) –Cumulative Scheme

NSRs Location	Residual Sound Level (dB $L_{Aeq, T}$)	Specific Sound Level (dB $L_{Aeq, Tr}$)	Ambient Sound Level (dB $L_{Aeq, T}$)	Change (dB)
NSR A Ginns Rd	50	21	50	+0
NSR B	46	27	46	+0
NSR C Barn Cottage	50	20	50	+0
NSR D Crabbs Lane	46	34	46	+0

Table 5.12: Ambient Noise Level Change Assessment – Night-time - Proposed Development and Cumulative Scheme

NSRs Location	Residual Sound Level (dB $L_{Aeq, T}$)	Specific Sound Level (dB $L_{Aeq, Tr}$)	Ambient Sound Level (dB $L_{Aeq, T}$)	Change (dB)
NSR A Ginns Rd	39	17	39	**+0**
NSR B	36	25	36	**+0**
NSR C Barn Cottage	39	16	39	**+0**
NSR D Crabbs Lane	36	34	38	**+2**

Discussion of Context – Proposed Development and Cumulative Scheme

5.18 Based on the predicted specific noise levels in Table 5.7 to Table 5.9, no adverse impacts are predicted at any of the receptors and at any assessment period. The predicted combined noise rating levels of the plant at NSR A, NSR B and NSR C, which fall within the jurisdiction of UDC, given in Table 5.7 to Table 5.9 are at least 6 dB below the measured background noise levels, which is in agreement with the NATG requirement for fixed plant (see paragraph 2.34).

5.19 Based on the predicted noise level changes in Table 5.10 to Table 5.12, no sound increase above background levels has been predicted at receptors NSR A, NSR B and NSR C and at any assessment period. For NSR D, a 1 dB increase was predicted during the early morning period, a 2 dB increase was predicted during night-time and no increase was predicted during daytime. For steady sound noise sources, an increase of 3 dB in noise levels is considered to be just perceptible for most people. Therefore, the predicted noise level changes at NRS D are considered to be below the threshold of perception during both the early morning period and night-time.

5.20 Thus, taking into account the context presented above, sound from the proposed development when the cumulative schemes are being considered is not expected to result in an adverse impact on quality of life and the predicted sound levels from the operational site are considered to be equivalent to NOAEL, and below the LOAEL.

5.21 The BS 4142:2014+A1:2019 initial estimate of impact indicates that there is a low risk that sound from the proposed development may result in adverse impacts depending on the context. Taking into account the context of the scenario discussed above, the outcome of the BS 4142:2014+A1:2019 initial estimate of impact is still considered valid and therefore adverse impact/effects would be very unlikely, significant, or otherwise at all NSRs.

6 Uncertainty

6.1 In all assessments, it is good practice to consider uncertainty which can arise from a number of different aspects. There are degrees of uncertainty associated with: instrumentation used for surveying; measurement technique and the variables influencing the measurement results such as transmission path and weather conditions; source terms used for modelling; calculation uncertainty; assessment uncertainty; and the subjective response of residents to noise sources.

6.2 Uncertainty due to instrumentation has been significantly reduced with the introduction of more modern instrumentation and is reduced further by undertaking field calibration checks on sound level meters before and after each measurement period and that all instrumentation is within accepted laboratory calibration intervals.

6.3 Every effort has been made to reduce the uncertainty of the baseline sound level measurements. The duration of the baseline survey is considered to significantly reduce the uncertainty associated with the baseline sound levels. Based on professional judgement including substantial experience of acquiring and analysing baseline data for numerous sites in various locations, and a desk-based review of the site and surrounding area, it is considered that the baseline data acquired during the survey is typical of the area.

6.4 Calculation uncertainty and assessment uncertainty have been reduced by peer review of all baseline data, model input data, model results and assessment calculations, and by using the appropriate level of precision at each stage of the assessment calculations.

6.5 A quantitative assessment has been undertaken based on source levels measured by RPS personnel, provided by the project team for the proposed equipment or based on recognised and accepted empirical calculation methodologies. Where assumptions have been made, they have favoured a worst-case scenario.

6.6 With regards to subjective response, the noise standards adopted for the assessment will have been based upon the subjective response of the majority of the population or will be based upon the most likely response of the majority of the population. This is considered to be the best that can be achieved in a population of varying subjective response which will vary dependent upon a wide range of factors.

6.7 All areas and potential consequences of uncertainty have been minimised at every stage of the assessment process. On the basis of the above, and in the context of subjective response, the effects of uncertainty on the assessment are considered minimal.

7 Conclusions

7.1 RPS was commissioned by Statera Energy Ltd to undertake a noise impact assessment (NIA) in relation to a proposed solar farm development on land to the north of Stocking Pleham Substation, Buntingford, SG9 0JA. The site is located within the administrative boundary of the Uttlesford District Council (UDC). The west boundary of the proposed development is part of the border between the Uttlesford and East Herts District.

7.2 The proposed development will include 11 standalone photovoltaic (PV) inverter units and a new substation.

7.3 Baseline noise conditions at the nearest noise sensitive receptors (NSRs) were established by the baseline monitoring undertaken on site over a 7-day period from Monday 31st January until Monday 7th February 2022.

7.4 A 3D noise model of the proposed development was built, considering plant information provided by the design team and based on the RPS source term library.

7.5 The BS 4142:2014+A1:2019 initial estimate of impact indicates that there is a low risk that sound from the development may result in adverse impacts depending on the context. Taking into account the context, the outcome of the BS 4142:2014+A1:2019 initial estimate of impact is still considered valid and therefore adverse impact/effects would be very unlikely, significant, or otherwise at all NSRs.

7.6 The BS 4142:2014+A1:2019 initial estimate of impact indicates that there is a low risk that sound from the development, when the cumulative scheme is also considered, may result in adverse impacts depending on the context. Taking into account the context, the outcome of the BS 4142:2014+A1:2019 initial estimate of impact is still considered valid and therefore adverse impact/effects would be very unlikely, significant, or otherwise at all NSRs.

7.7 The predicted combined noise rating levels of the plant, i.e., considering any penalties for sound characteristics such as tonality, at NSR A, NSR B and NSR C that fall within the jurisdiction of UDC, at least 5 dB below the measured background noise levels, as per the NATG requirement.

7.8 On the basis of the above, it is concluded that levels of sound arising from the operation of the facility will not result in any significant adverse impacts at any of the nearby NSRs. Sound arising from the operation of the facility is therefore acceptable in accordance with the relevant British Standards, national and local planning policy.

Figures

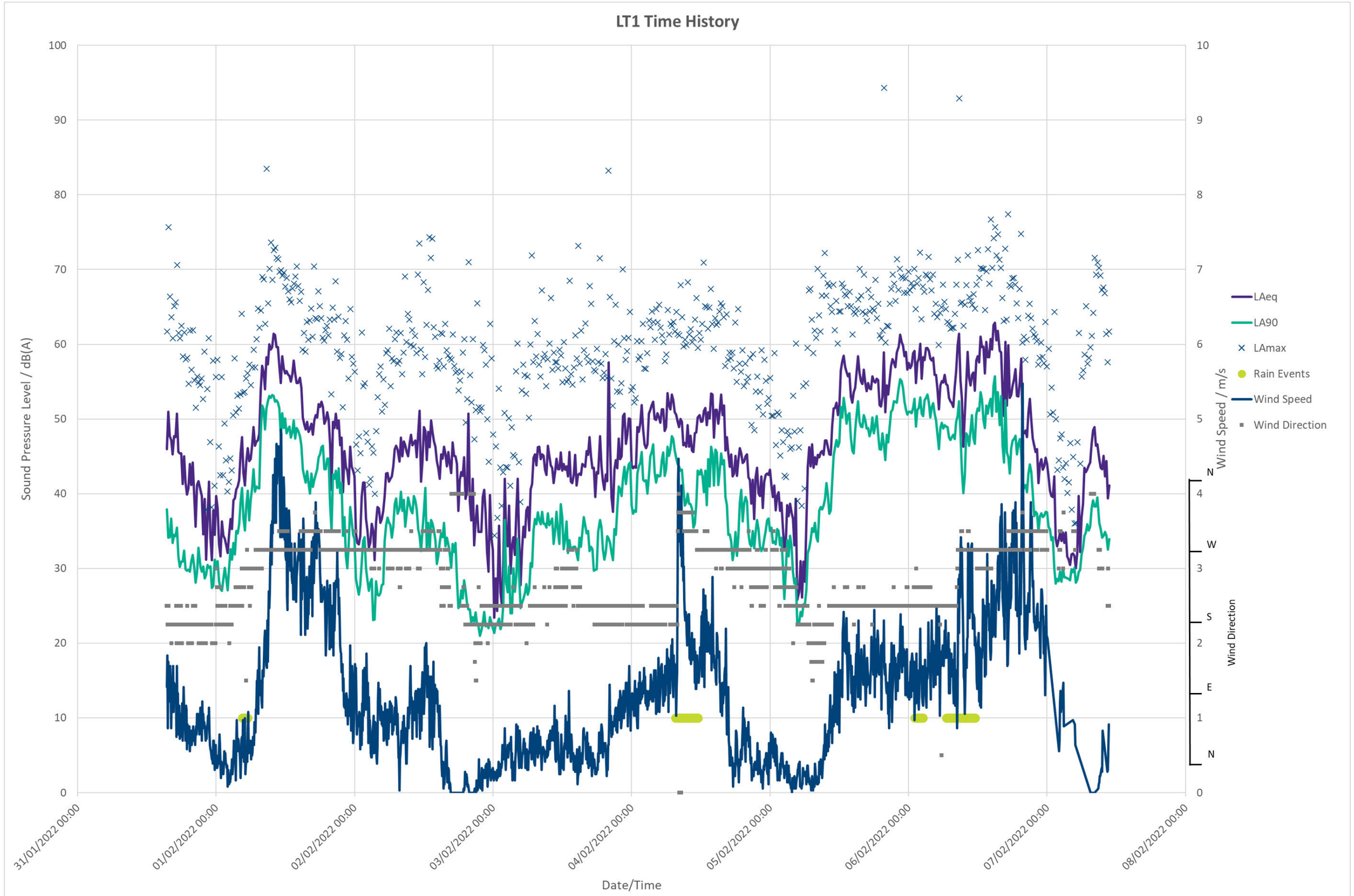

Figure 1: LT1 Baseline Data

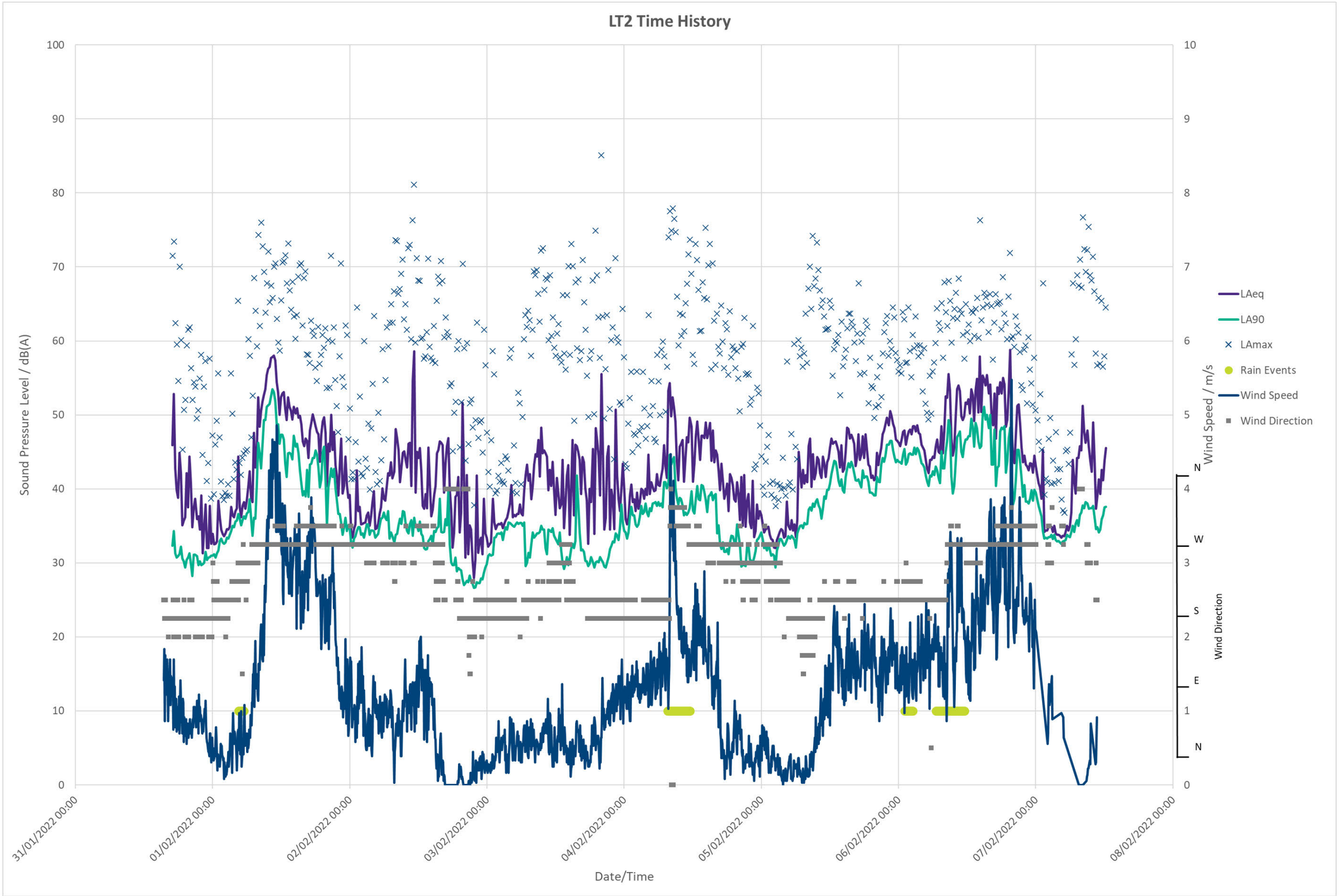

Figure 2: LT2 Baseline Data

Appendices

Appendix A: BS 4142 Statements

Lise W. Tjellesen – Technical Director – Acoustics

MEngSc Acoustics; Member of the Institute of Acoustics; Member Acoustical Society of America; Member of Danish Acoustic Society; Member of Audio Engineering Society

A.1 Lise is Technical Director of the RPS Acoustics Team with 20 years of experience in acoustics. She is a specialist acoustic consultant with a wide range of experience gained in the UK, Denmark and worldwide. She has worked with electroacoustics, psychoacoustics, architectural acoustics, vibrations and environmental acoustics. She has gained particular experience in the fields of architectural acoustics (building and room) working with the construction industry on a variety of projects, including residential, commercial, education, health and entertainment.

A.2 Lise is an expert on the subject of room acoustics and room acoustic computer simulations, as well as a leading expert on the emerging field of archaeoacoustics. She has published several papers on the above subjects and on acoustics of offices.

A.3 Lise has been involved in many BS 4142 noise assessments for both the previous and current 2014 version of BS 4142. She has given evidence at public inquiries where BS 4142 has been the primary assessment methodology. On the basis of Lise's overall experience in acoustics (particularly in relation to environmental noise) combined with particular focus on BS 4142, he is deemed competent for BS 4142 assessments.

A.4 For this project Lise has taken on the role of Project Director, responsible for overseeing and delivering the project. Lise was also responsible for reviewing and authorising the report.

Christina Ioannidou – Senior Consultant – Acoustics
MSc Engineering Acoustics; Member of the Institute of Acoustics

A.1 Christina is an Acoustic Consultant and environmental acoustics specialist with seven years' experience. She has an Electrical and Computer Engineering Degree Bachelor and Master's Degree and has also a Master's Degree in Engineering Acoustics. She has been a member of the Institute of Acoustics since 2015.

A.2 Christina has project managed and undertaken noise assessments for a variety of developments, including: large scale mixed-use developments, incorporating commercial, retail, leisure and residential elements; energy from waste facilities; manufacturing facilities; distribution centres; retail units and minerals extraction and exploration. She has provided input into Environmental Impact Assessments (EIAs) since the start of her career in 2015 for residential, industrial, educational and mixed-use developments (including residential, hotel, commercial uses). She has also undertaken noise assessments to support planning applications and discharge planning conditions. She has a Continuous Professional Development (CPD) Record to support this competency and experience.

A.3 Within the past years Christina has been involved BS 4142 noise assessments for both the previous and current 2014 version of BS 4142. She is familiar with the Standard and has attended relevant talks organised by the Institute of Acoustics. On the basis of Christina's overall experience in acoustics, combined with particular focus on BS 4142 and with the assistance of more experienced colleagues, she is deemed competent for BS 4142 assessments.

A.4 For this project Christina has supported the Project Manager in the assessment and noise modelling. She was also responsible for reviewing the modelling and the report, figures and appendices.

Appendix B: Existing Battery Storage Facility – Source Measurements Report

RPS
6-7 Lovers Walk
Brighton
BN1 6AH

[redacted]

Quality Management

Prepared by:	Patrick Hoyle BSc(Hons), MIOA	Senior Consultant - Acoustics	[redacted]	16/01/2017
Reviewed, checked & authorised by:	Simon Stephenson CEng, BSc(Hons), MIOA, ASA	Technical Director - Acoustics	[redacted]	16/01/2017
Date of issue:	16 January 2018		**Revision number:**	0
Project number	JAT9473			
Document file path:	\\BRIG-LW-03\Projects\Jobs_9001-9900\9473t\Pelham\Pelham PC3 Rev2 Updated Based on Source Measurements\9473e_Pelham_As_Measured_Rev0_20180116.docx			
Appendices location:	O:\Jobs_9001-9900\9473t\Pelham\Pelham PC3 Rev2 Updated Based on Source Measurements\9473e_Pelham_As_Measured_Rev0_20171220.xlsx			

Battery Storage Facility at Pelham Substation, Park Green Lane, Berden, Hertfordshire

Results of Source Measurements

Introduction

1.1 The Acoustics Team at RPS Planning and Environment has been commissioned by Statera Energy Limited to undertake source measurements of the operational Energy Reserve Facility at Pelham. The source measurements were undertaken in order to better understand the sound generated by the particular plant installed at Pelham, and to test compliance with the requirements of planning condition 3, which states:

'Prior to the commencement of the development, details including the acoustic specification of all fixed plant and equipment together with a scheme of noise mitigation measures designed to achieve a noise rating level of $L_{Ar,Tr}$ (as defined in BS 4142:2014) not exceeding 35 dB(A) at the boundary of the garden of Crabbes Green Farm, shall be submitted and approved in writing by

the local planning authority. The scheme approved shall be fully implemented before the use hereby permitted is commenced and shall thereafter be maintained in strict accordance with the approved details.

REASON: In order to protect and safeguard amenity of the area in accordance with Policies GEN2 and ENV11 of the adopted Local Plan (2005).'

Results of Measurements and Comparison with Sound Power Levels used in Planning Assessment

1.2 Source measurements were undertaken using the sound intensity scanning method on 27th November 2017 whilst the facility was operated under a number of different conditions. Due to the ambient air temperature at the time of the measurements the condenser fans which form part of the battery storage air cooling units were likely operating on a very low duty. It is possible that the inverter cooling systems were also operating on a low duty. All sound power levels determined based on the measurements are provided in full in Appendix A.

Inverters & Transformer

1.3 At the planning stage the main sources of sound identified were the inverters and the main site transformer. Comparisons between the measured source data and the model input data used in the planning assessment for the inverters and transformer are presented in Table 1 and Table 2 below.

Table 1 Comparison of Model Input Data for Latest Planning Assessment and Measured Sound Power Levels - Inverters

Model Input Data for Planning	Measured Sound Power Level	
	Site Load/ Operating Mode	Overall Lw, dBA
As planning:	10% - 30% variable (FFR Mode)	65
	25% (FFR Mode)	67
Overall Lw at 50% Load: 81 dBA	40% (Charging)	69
Full load, for reference:	97% (Discharging)	79
	100% (Discharging)	81
Overall Lw at 100% Load: 86 dBA	100% (Charging)	79

1.4 The results in Table 1 indicate that the sound power levels of the inverters used in the planning assessment, which were the sound levels for 50% load, were the same, to the nearest whole decibel value, as that measured at 100% load. At 40% load the measured sound power level is around 13 dB lower than the model input data used in the final planning assessment. It is considered that the reason that the sound power levels determined in the measurements are lower than those used in the planning assessment are due to the cooling systems in the inverters being on a low duty cycle at the time of the measurements.

Table 2 Comparison of Model Input Data for Latest Planning Assessment and Measured Sound Power Levels – Main Transformer

Model Input Data for Planning	Measured Sound Power Level	
	Site Load/ Operating Mode	Overall Lw, dBA
Overall Lw: 83 dBA	10% - 30% variable (FFR Mode)	86
	25% (FFR Mode)	88
	40% (Charging)	86
	97% (Discharging)	86
	100% (Discharging)	84
	100% (Charging)	82

1.5 The results in Table 2 indicate that the sound power level used in the assessment is approximately equal (≤1 dB variation) to the measured sound power levels under 100% load. There is greater variance exhibited under other load conditions with the greatest difference observed under 25% FFR mode when the measured sound power level was 5 dB greater than that used in the planning assessment. The cause of the differences is unclear.

Other Items: MV Blocks and E-House Battery Storage Containers

1.6 At the time of the planning assessment, the Medium Voltage (MV) blocks were noted to be non-source items. On the basis of the measurement results, this appears to be appropriate advice as the sound power levels of the MV blocks were found to be negligible compared to the inverters. The greatest measured sound power levels of the MV blocks was 67 dB L_w during 100% load charge.

1.7 The E-House battery containers, also considered to be non-source items at the planning stage, were only measured during one operating condition: charging at 100% load. The measurement results indicate that the total sound power radiated by the E-House container surfaces in this operating mode is 79 dBA.

Model Results & Discussion

As Measured

1.8 Two operating modes have been modelled based on the measured source levels:

- 25% load FFR Mode, and
- 100% load discharging.

1.9 The two operating modes have been modelled in the existing scenario, with no acoustic fences, and for the scenario where the proposed acoustic fences are in situ. Predicted sound levels for the two operating modes, with and without acoustic fences, are provided in Table 3 below. All model input data is provided in Appendix B.

Table 3 Predicted Sound Levels: As Measured, With and Without Acoustic Fences

Prediction Scenario	Operating Condition	Predicted Specific Sound Level (dBA)
Based on Measured Source Levels	25% FFR	29
	100% Discharge	35
Based on Measured Source Levels, with Proposed Acoustic Fences	25% FFR	28
	100% Discharge	34

1.10 The results in Table 3 indicate that, on the basis of the measured sound levels, the specific sound level is unlikely to exceed the condition 3 criterion. However the condition 3 criterion is defined in terms of rating level (i.e. specific sound plus any rating penalties due to the character of the sound). As such if any rating penalties were applied then it is possible that the rating level could exceed the condition 3 criterion. It is unlikely that the specific sound would attract a rating penalty though it is possible that, under certain conditions, a rating penalty could be appropriate. In such instances the condition 3 criterion may be exceeded. On the basis of the above it is considered that, during periods when ambient air temperatures are low, the condition 3 criterion is unlikely to be regularly or significantly exceeded.

With Worst Case E-House Condenser Fan Sound Power Level

1.11 To investigate possible worst case sound levels from the facility, when the E-House condenser fans are operating on high duty, sound levels have been predicted with identical input data as above, except with the worst case sound level for the E-House condenser fans as used in recent planning assessments for other schemes. The results are provided below in Table 4.

Table 4 Predicted Sound Levels: With Worst Case E-House Condenser Fan Sound Levels, With and Without Acoustic Fences

Prediction Scenario	Operating Condition	Predicted Specific Sound Level (dBA)
Based on Measured Source Levels, with Worst Case Battery Storage Condenser Fan Source Level	25% FFR	37
	100% Discharge	39
Based on Measured Source Levels, with Proposed Acoustic Fences, with Worst Case Battery Storage Condenser Fan Source Level	25% FFR	36
	100% Discharge	38

1.12 The results in Table 4 indicate that, if the E-House condenser fans were to operate under maximum duty then it is likely that the condition 3 criterion would be exceeded whether the proposed acoustic fences were installed or not.

Discussion

1.13 A worst case level from the invertors has not been predicted as it is considered that the E-House condenser fans represent a more significant risk as they are located at high level, whilst sound from the inverters may be more easily attenuated by acoustic fencing, as the inverters are closer to ground level.

1.14 Without detailed information on the duty cycles, and resultant sound levels, of the cooling plant associated with the inverters and the E-House condenser fans it is difficult to determine the likelihood of the worst case maximum sound levels ever occurring.

1.15 The results of the modelling indicate that it is likely that, during periods of high demand that coincide with periods of elevated ambient air temperatures, the condition 3 criterion could be exceeded. Notwithstanding the point above regarding uncertainties associated with likely sound levels from the cooling plant under different loads, the exceedances above the condition 3 criterion could be in the order of around 5 dB. Depending on the magnitude of the rating penalty which would be appropriate in such situations, worst case exceedances of the condition 3 criterion could be up to around 10 dB, if a high rating penalty can be appropriately justified. However the likelihood of this occurring depends on many factors, and worst case exceedances could perhaps only occur for 1 hour a year or less, or may never occur at all.

1.16 Though the stated reason for condition 3 is to safeguard amenity it is considered that small exceedances of the criterion would be unlikely to result in significant impacts to residential amenity. Even worst case exceedances of the criterion may not result in significant impacts to residential amenity and on this basis it is considered unlikely that the operation of the facility would attract noise complaints and subsequent action by the local authority.

1.17 However, if sound from the facility exceeded the condition 3 criterion, and the exceedances were identified, then mitigation measures could be specified to reduce sound levels at the boundary of Crabb's Green Farm. The mitigation measures would likely consist of:

- E-House Condenser Fans: selection of quieter plant, or provision of engineering noise control options such as attenuators and acoustic cladding; and
- The specification and installation of acoustic fencing, with the planning design as an initial design on which the detailed design would be based.

Summary and Conclusions

1.18 The Acoustics Team at RPS Planning and Environment has been commissioned by Statera Energy Limited to undertake source measurements of the operational Energy Reserve Facility at Pelham. The source measurements were undertaken in order to better understand the sound generated by the particular plant installed at Pelham, and to test compliance with the requirements of planning condition 3, which is reproduced in the Introduction, for reference.

1.19 The source sound levels measured on site were processed and the sound power levels were determined. On the basis of the determined sound power levels a number of scenarios were modelled.

1.20 The results of the modelling indicate that, during periods of low ambient air temperatures, the condition 3 criterion is unlikely to be regularly or significantly exceeded.

1.21 Consideration of possible worst case sound levels indicates that, if worst case sound levels provided in manufacturer's data for the E-House condenser fans actually occur, and a high rating

penalty can be justified, then the condition 3 criterion could be exceeded by around 5 dB and possibly, in the worst case, up to 10 dB. The likelihood of such a scenario ever occurring is hard to define, although it is considered that this may only occur for less than an hour per year.

1.22 In the event that exceedances of the condition 3 criterion are identified it will be possible to reduce sound levels at the boundary of Crabb's Green Farm through the provision of mitigation measures such as: engineered noise control measures to the E-House condenser fans and the provision of acoustic fences.

Appendices

Appendix A: Summary of Source Sound Power Levels

Plant Item & Operating Conditions			Overall Sound Power, L_w, dBA	Linear Sound Power Level, dB, per Third Octave Band, Hz																							
Equipment	Item	Op Condition		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	6.3k	8k	10k
Invertor	Air inlet	FFR mode (25% fixed power)	**46**		62	65	58	55	49	39	39		35		21	29	27	13									
Invertor	Air outlet	FFR mode (25% fixed power)	**60**						45	43	18									27	51	54	36	44	56	40	41
Invertor	Air outlet duct	FFR mode (25% fixed power)	**55**	41			41	25	41	40	33	37	29		23	23	25	22	26	26	43	45	31	41	54	33	33
Invertor	Enclosure	FFR mode (25% fixed power)	**65**	62	62	59	56	50	51	41	46	48	50	39	36	41	35	49	40	43	51	53	47	52	63	53	53
Invertor switchgear	Enclosure	FFR mode (25% fixed power)	**57**							63	45	54	47	53	45		43	39	33	31	35	47	36		45	38	41
Invertor transformer	Enclosure	FFR mode (25% fixed power)	**60**			50	51			52	45	60		44	44	46	47	41			46	52	34	45	53	50	51
Main site transformer	Transformer	FFR mode (25% fixed power)	**88**	79	76	79	85	77	75	92	74	87	81	82	86	74	67	62	48		45	51			43		33
Invertor	Air inlet	FFR mode (10'-30% variable)	**47**	57	63	65	60	58	48		42	36															
Invertor	Air outlet	FFR mode (10'-30% variable)	**61**						46	43		31	28							26	49	55	34	45	57	38	39
Invertor	Air outlet duct	FFR mode (10'-30% variable)	**50**	45			46	44	42	42	29	40	38	36	34	34	31	31	32	29	38	37	36	37	47	32	28
Invertor	Enclosure	FFR mode (10'-30% variable)	**63**	65	64	55	57	56	57	54	34	47	47	51	24	44	42	40	42	40	45	49	41	50	61	51	52
Invertor switchgear	Enclosure	FFR mode (10'-30% variable)	**56**						49	55	52	54	50	53	50	43	42	35			44	31		24	44		34
Invertor transformer	Enclosure	FFR mode (10'-30% variable)	**61**			57	56	53	45	54	46	60	54	58	52	47	49	41	37	36	47	49	33	39	49		
Main site transformer	Transformer	FFR mode (10'-30% variable)	**86**	83	72	77	85	70	71	89	75	87	69	81	84	73	63	51									
Invertor	Air inlet	Discharging 50 MW (100% power)	**76**	73	80	81	83	79	75	78	77	73	65	65	61	64	63	61	63	62	59	57	54	52		50	50
Invertor	Air outlet	Discharging 50 MW (100% power)	**72**	67	67	67	68	66	62	57	65	65	67	65	63	61	60	59	58	58	59	61	52	54	64	50	50
Invertor	Air outlet duct	Discharging 50 MW (100% power)	**69**	71	78	79	85	71	72	69	63	61	60	57	54	53	52	50	49	48	50	53	39	46	56	40	41
Invertor	Enclosure	Discharging 50 MW (100% power)	**78**	80	80	80	80	74	73	77	75	78	69	67	65	66	67	64	61	58	62	64	53	60	69	60	60
Invertor switchgear	Enclosure	Discharging 50 MW (100% power)	**60**		71		69	63		58		59	54	53	53	47	47	43	47	38	44	45	34				
Invertor transformer	Enclosure	Discharging 50 MW (100% power)	**62**				73		65	58	51	60	57	55	42	52	48	47	43			45		33	51		38
Main site transformer	Transformer	Discharging 50 MW (100% power)	**84**	90	74		90	62	75	89	71	85	79	78	78	70	67	60	54	50	55	60	46	46	51	41	41
Invertor	Air inlet	Discharging 48.5 MW (97% power)	**72**	74	80	80	73	76	73	73	74	69	63	60	60	60	60	59	61	60	55	48	50			42	
Invertor	Air outlet	Discharging 48.5 MW (97% power)	**72**	60	59	60	61	58	54	53	66	66	66	64	61	60	60	59	58	57	59	63	53	54	64	50	50
Invertor	Air outlet duct	Discharging 48.5 MW (97% power)	**66**	73	75	75	73	68	70	67	60	60	59	56	53	51	50	48	47	46	50	49	47	48	53	43	44
Invertor	Enclosure	Discharging 48.5 MW (97% power)	**76**	77	75	79	78	73	70	74	71	73	69	67	64	66	65	64	60	58	59	60	50	58	68	56	57
Invertor switchgear	Enclosure	Discharging 48.5 MW (97% power)	**62**				70	64		66	50	57	54	51		47	48	48	47	44	47	49	38	45	53	35	37
Invertor transformer	Enclosure	Discharging 48.5 MW (97% power)	**63**				72		68	62	54		57	54		54	52	48	48	44	48	50	40	44	55	40	44
Main site transformer	Transformer	Discharging 48.5 MW (97% power)	**86**	84			87		56	89	74	88	77	78	83	71	64	58	52	47	52	58		41	53		
Battery storage	Condenser fan	Charging 50 MW (100% power) - fan on very low power	**46**			31			48	44	46	42	43	39	38	33	27	33	28	23	28	27	27	21	24	20	17
Battery storage	Enclosure	Charging 50 MW (100% power)	**79**	58						63		53	57	57	60	60	58	58	61	65	68	70	71	72	71	69	67
Invertor	Air inlet	Charging 50 MW (100% power)	**72**	73	80	79	75	76	72	71	74	69	62	60	58	61	59	59	60	60	55	49	50			39	
Invertor	Air outlet	Charging 50 MW (100% power)	**73**	76	78	78	75	75	75	73	64	66	65	64	60	59	59	58	57	56	59	63	52	55	67	50	51
Invertor	Air outlet duct	Charging 50 MW (100% power)	**66**	74	75	74	73	68	70	67	61	60	59	55	53	51	49	46	47	46	52	52	41	45	58	43	46
Invertor	Enclosure	Charging 50 MW (100% power)	**75**	78	77	77	77	72	71	72	67	68	68	66	64	65	64	62	58	56	58	60	50	59	71	57	58
Invertor switchgear	Enclosure	Charging 50 MW (100% power)	**62**		63			64		67	46	60	53	51	40	46	47	48	47	46	49	49	38	40	50	39	42
Invertor transformer	Enclosure	Charging 50 MW (100% power)	**65**				71		62	59	55	58	58	54	51	56	53	52	49	45	48	50	40	48	60	45	48
Main site transformer	Transformer	Charging 50 MW (100% power)	**82**	87	72		85		66	88	67	74	78	71	78	71		65				56					
Invertor	Air inlet	Charging 20 MW (40% power)	**45**	52	58	62	58	55	49	43	38																
Invertor	Air outlet	Charging 20 MW (40% power)	**63**						45	43		28	20	15					17	31	54	58	39	46	59	42	43
Invertor	Air outlet duct	Charging 20 MW (40% power)	**55**	46		37	52	40	49	37			31			42		34	30	39	47	46	31	37	53	33	35
Invertor	Enclosure	Charging 20 MW (40% power)	**67**	53	59	58	59	54	50	50	44	46	41	43	44	44	43	39	35	34	49	54	38	53	65	53	54
Invertor switchgear	Enclosure	Charging 20 MW (40% power)	**54**						32	56	37	50	43	45	41	39	39	39	38	34	28	43	38	37	49	35	35
Invertor transformer	Enclosure	Charging 20 MW (40% power)	**60**				59	64	51	55	30	59		47		43	41	41	34	37	43	47	31	46	57	46	46
Main site transformer	Transformer	Charging 20 MW (40% power)	**86**	79	69	67	84	68	72	91	73	83	76	73	84	74	67	57	45			50					

[redacted]

100% Discharge (Except for E-House Battery Storage Measured at 100% Charge)

Item	Overall Sound Power		Linear Sound Power, dB, per Octave Band, Hz							
	Index	Sound Power, dB	63	125	250	500	1k	2k	4k	8k
Invertor Enclosure	L_{WA}	78	98	86	76	62	57	50	50	56
Inverter Outlet & Outlet Ducting	L_{WA}	74	108	104	82	74	65	62	61	65
Invertor Inlets	L_{WA}	76	109	103	91	73	68	65	59	55
MV Block	L_{WA}	64	81	78	58	50	40	33	31	35
E-House Battery Storage (Container)	L_{WA}	79	66	-	51	43	41	46	52	52
E-House Battery Storage (Condenser Fan)	L_{WA}	46	54	62	59	50	37	31	30	27
Main Site Transformer	L_{WA}	84	120	109	100	86	72	57	59	52

FFR 25% Fixed Power (Except for E-House Battery Storage Measured at 100% Charge)

Item	Overall Sound Power		Linear Sound Power, dB, per Octave Band, Hz							
	Index	Sound Power, dB	63	125	250	500	1k	2k	4k	8k
Invertor Enclosure	L_{WA}	65	80	62	44	41	35	36	41	50
Inverter Outlet & Outlet Ducting	L_{WA}	61	71	63	56	34	29	51	54	59
Invertor Inlets	L_{WA}	47	90	78	51	39	31	-96	-96	-93
MV Block	L_{WA}	62	56	54	59	42	35	29	37	42
E-House Battery Storage (Container)	L_{WA}	79	66	-	51	43	41	46	52	52
E-House Battery Storage (Condenser Fan)	L_{WA}	46	54	62	59	50	37	31	30	27
Main Site Transformer	L_{WA}	88	110	104	103	91	75	49	50	44

Worst Case E-House Condenser Fan Sound Power Level

Item	Overall Sound Power		Linear Sound Power, dB, per Octave Band, Hz							
	Index	Sound Power, dB	63	125	250	500	1k	2k	4k	8k
E-House Battery Storage (Condenser Fan)	L_{WA}	81	75	83	75	76	76	75	72	65

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