REPORT TITLE:

Blackhillock BESS – Baseline Noise Survey & Noise Impact Assessment

CLIENT DETAILS:

Blackhillock Flexpower Ltd

DATE:

11th November 2024

REPORT REFERENCE:

PC-23-0056-RP1-RevI

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Document Status and Revision Schedule

Issue/Revision	Description/Comments	Date	Prepared by	Approved by
First Issue	Checked & Authorised	23/05/23	PY	MJ
RevA	Local authority criteria updated & assessment	08/06/23	PY	MJ
RevB	Calculation & assessment updated with latest information. Policy & criteria section updated. Site plan updated. TAN assessments added.	11/12/23	PY	MJ

RevC	Updated battery noise data	22/12/23	PY	MJ
RevD	Battery numbers reduced to 208	19/06/24	PY	MJ
RevE	Significant revision following Blackhillock Flexpower modelling, assessment outcomes updated	19/09/24	PY	MJ
RevF	p.7 layout updated, p.23 ground absorption updated, section 5.4 corrected	09/10/24	PY	MJ
RevG	Inverter noise data updated and assessment updated. GRID NOISE MAP STILLTO BE UPDATED.	10/10/24	PY	MJ
RevH	Grid noise map corrected and SGT noise data amended	16/10/24	PY	MJ
RevI	Site layout (barriers and bunds) updated in model and report. Battery unit updated with new noise data. Relevant calculations and assessments updated.	08/11/24	PY	MJ

1. Introduction

1.1.1. Pace Consult Limited was appointed and instructed by Blackhillock Flexpower Ltd to complete a baseline noise survey & noise impact assessment for the proposed Blackhillock, Aberdeenshire BESS development.

1.1.2. The site is located at Gibston Farm, Blackhillock, Ketih, AB55 5NY.

1.1.3. The development covers approximately 21 acres, plus a laydown area and consists of the installation of a new battery energy storage system facility. The development will include battery units, inverters, back-up transformers and grid transformers.

1.1.4. There is unlikely to be any risk of noise impact *on* the site, so this report does not assess this aspect. However, due to the plant items being introduced there is a potential for noise impact to occur to nearby sensitive receptors.

1.1.5. In order to assess and mitigate these potential impacts a baseline noise survey and noise impact assessment has been completed by Pace Consult Ltd as part of the planning stage design. This technical report details the site, assessment criteria, baseline survey and an initial noise impact assessment.

1.1.6. This technical report details the baseline noise survey & noise impact assessment. The baseline survey has been completed following the guidance of BS4142:2014 + A1:2019 *Methods for rating and assessing industrial and commercial units* & BS 7445: *Description & Measurement of Environmental Noise (Parts 1-3)*.

1.1.7. Assessment of the potential noise impacts arising from the site have been completed following the guidance of BS BS4142:2014 + A1:2019 *Methods for rating and assessing industrial and commercial units*.

2. The Site

2.1. Existing Site

2.1.1. The site is located at Gibston Farm, Blackhillock, Ketih, AB55 5NY. The land is currently used for pasture but does contain overhead power lines running from the nearby Blackhillock sub-station.

2.1.2. The site is bounded to the north, east and south by agricultural and pastureland. The pre-existing Blackhillock sub-station site is located adjacent to the site, to the south-west. Blackhillock Quarry is also located approximately 300m to the south.

2.1.3. Potential noise sensitive receptors are located in each direction around the site.

2.1.4. Figure 1 overleaf shows the existing site layout.

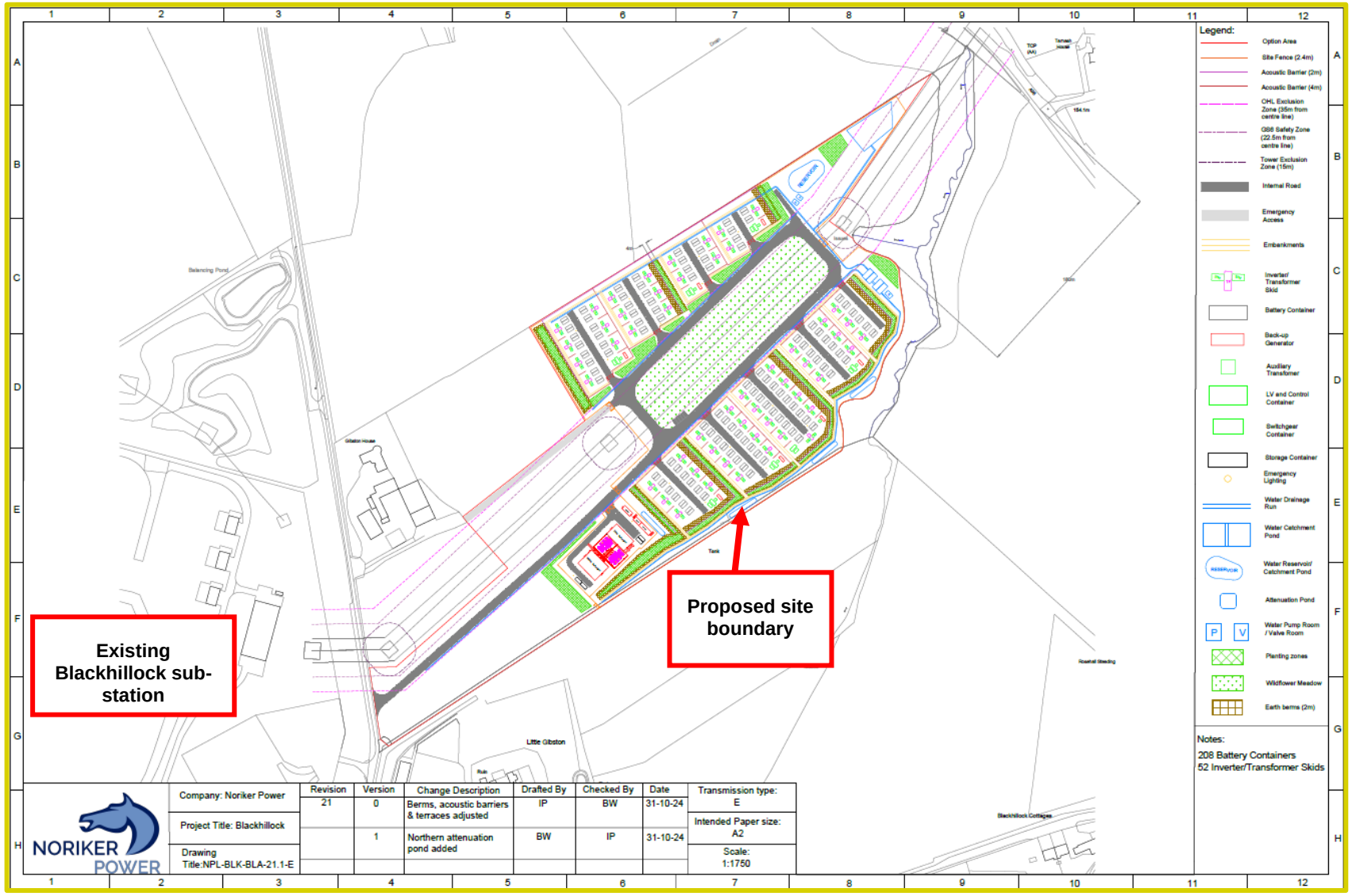
2.2. Proposed Development

2.2.1. The development covers approximately 21 acres, plus a laydown area and consists of the installation of a new battery energy storage system facility. The development will include battery units, inverters, back-up transformers and grid transformers.

2.2.2. Figure 2 overleaf shows the proposed layout of the new development.

Figure 1: Existing site layout

Figure 2: Proposed site layout



3. Assessment Methodology & Criteria

3.1. Moray Council Local Authority Policy

3.1.1. As part of the design process discussions with Moray Council's Environmental Health Department have been held on 16th May 2023. Further liaison is also ongoing. The Environmental Health Officer has noted that noise impact from the site should be assessed following the methodology of BS 4142. With regards to rating levels they have stated the below:

Where the cumulative impact is not significant from other developments around (ideally 10 dB down), it would seem reasonable to apply a similar rating level at your site, rather than a rating level at the background as we previously discussed . No rise above background would be considered optimal with background + 5 acceptable (where cumulative issues not creating creeping ambient noise issues)

3.2. PAN 1/2011

3.2.1. The Scottish Government's Planning Advice Note 1/2011 (PAN) gives advice and guidance. It's principal aim is the adoption of a good acoustic design approach. Developments can be defined as 'noise sensitive' or noise generating'. The document recommends early consultation between acoustic consultants and other members of the planning and design teams. It also stresses the need to support growth and allows for qualitative consideration of other non-acoustic factors.

3.3. Assessment of Noise Technical Advice Note

3.3.1. The Assessment of Noise Technical Advice Note (or TAN) is additional guidance relating to noise impact assessments, provided by the Scottish Government. This document recommends 5 stages of assessment when evaluating noise impact assessments. These stages are shown below.

2.10 Stage 1: Initial Process: The initial process requires the identification of all noise sensitive receptors (NSR) that may potentially be affected by the development and to prioritise each NSR according to their level of sensitivity. The following steps are then carried out for each NSR identified.

2.11 Stage 2: Quantitative Assessment: The procedure within a quantitative assessment depends on the type of development i.e.NGD or NSD. The final procedure in this stage is to determine the magnitude of the impact.

2.12 Stage 3: Qualitative Assessment: A qualitative assessment allows additional factors to be included in the assessment procedure to augment the quantitative evaluation. The outcome from this process allows the magnitude of impacts determined from the quantitative assessment to be adjusted accordingly.

2.13 Stage 4: Level of Significance: The level of significance of the noise impact at the NSR is obtained through the relationship of the receptor's sensitivity to noise and the magnitude of the noise impact. The result of this process is entered into the Summary Table of Significance of Noise Impacts.

2.14 Stages 2, 3 and 4 are repeated for each NSR.

2.15 Stage 5: The Decision Process: The number of noise sensitive receptors within each level of significance is totalled to complete the Summary Table of Significance. The Summary Table will normally form only part of the information required to inform the decision process when applying for planning permission.

3.3.2. The assessment tables relating to the above are also included below.

Table 1: TAN Table 2.1: Level of Sensitivity Associated with Various Examples of NSRs

Sensitivity	Description	Examples of NSR
High	Receptors where people or operations are particularly susceptible to noise	•Residential, including private gardens where appropriate. •Quiet outdoor areas used for recreation •Conference facilities •Theatres/Auditoria/Studios •Schools during the daytime •Hospitals/residential care homes •Places of worship
Medium	Receptors moderately sensitive to noise, where it may cause some distraction or disturbance	•Offices •Bars/Cafes/Restaurants where external noise may be intrusive. •Sports grounds when spectator noise is not a normal part of the event and where quiet conditions are necessary (e.g. tennis, golf, bowls)
Low	Receptors where distraction or disturbance from noise is minimal	•Buildings not occupied during working hours •Factories and working environments with existing high noise levels •Sports grounds when spectator noise is a normal part of the event •Night Clubs

Table 2: TAN Table 2.2 Classification of Magnitude on Noise Impacts

Descriptors for Magnitude of Impact	Generic Criteria of Descriptor
Major	Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements (Adverse).
Moderate	Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements (Adverse).
Minor	Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements (Adverse).
Negligible	Very minor loss or detrimental alteration to one or more characteristics, features or elements (Adverse)
No Change	No loss or alteration of characteristics, features or elements; no observable impact in either direction

It is noted that the document also contains descriptors for beneficial magnitudes of impact where noise levels are reduced. These are not included above.

Table 3: Associated change in noise level with magnitude of impact

Exceedance of BS 4142 Rating Level above L_{A90}	Magnitude of Impact
+10	Major
≤10 but ≥5	Moderate
≤5 but ≥3	Minor
<3 but ≥0	Negligible
<0	No Change

Table 4: Descriptors for Qualitative Impacts from Noise on Residential Properties

Perception	Criteria of Descriptor	Descriptor for qualitative impact
Noticeable (Very disruptive)	Significant 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	Major

Noticeable (Disruptive)	Causes an important change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion. 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 character of the area.	Moderate
Noticeable (Mildly intrusive)	Noise can be heard and may cause small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; closing windows more often. Potential for non-awakening sleep disturbance. Can slightly affect the character of the area but not such that there is a perceived change in the quality of life.	Minor
Just Noticeable (Non-intrusive)	Noise can be heard, but does not cause any change in behaviour or attitude, e.g. increasing volume of television; speaking more loudly; closing windows. Can slightly affect the character of the area but not such that there is a perceived change in the quality of life.	Negligible
Not noticeable	None	No Impact

Table 5: Summary Table of Significance

Magnitude of Impact	**Level of Significance Relative to Sensitivity of Receptor**		
	Low	**Medium**	**High**
Major	Sligh/Moderate	Moderate/Large	Large/Very Large
Moderate	Slight	Moderate	Moderate/Large
Minor	Neutral/Slight	Slight	Slight/Moderate
Negligible	Neutral/Slight	Neutral/Slight	Slight
No Change	Neutral	Neutral	Neutral

3.4. BS4142:2014 + A1:2019

3.4.1. In order to complete the quantitative assessment aspect of TAN, BS 4142: 2014 + a1 2019 was agreed as the appropriate methodology for the quantitative assessment. Following the guidance of TAN, magnitudes in noise changes will be assessed using the BS 4142 Noise Rating Level relative to the Background L_{A90} noise level. This methodology is outlined below.

3.4.2. BS4142:2014 + A1:2019 Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas provides a numerical means of assessing the significance of building plant noise. A key aspect of the BS 4142 assessment procedure is a comparison between the background noise level in the vicinity of noise sensitive receptors and the rating level of the noise source under consideration. The relevant parameters in this instance are as follows:

3.4.3. Background Sound Level, $L_{A90,T}$, defined in the Standard as the 'A-weighted sound pressure level that is exceeded by the residual sound for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels';

3.4.4. Specific Sound Level, $L_{Aeq,T}$, the 'equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T (being 1 hour for assessments between 07:00-23:00hrs and 15 minutes for night time assessments 23:00-07:00hrs) ; and

3.4.5. Rating Level, $L_{Ar,Tr}$, the specific sound level plus any adjustment made for the characteristic features of the sound'.

3.4.6. BS 4142 allows for, as an absolute worst case, a cumulative +15 dB correction to be applied to the specific sound level based upon the presence or expected presence of the following 'Acoustic Feature Corrections':

- Tonality – up to +6 dB penalty;
- Impulsivity – up to +9 dB penalty (this can be summed with tonality penalty)
- Intermittency – up to +3 dB penalty
- Other sound characteristics (neither tonal nor impulsive but still distinctive) – +3 dB penalty.

3.4.7. The amendment made to BS4142 in 2019 does however allow for the focus on one characteristic if it is dominant above others, reducing or even eliminating the corrections which would have otherwise been added together arithmetically, in a more reasonable approach to assessment.

3.4.8. BS 4142 provides guidance as to the likely response from sensitive residential receptors to new fixed noise sources (e.g. building plant or services) through comparison of the rating level of the new noise source with the existing background level. The higher the rating noise level in comparison to the background noise level, the greater the likelihood of complaints arising. BS 4142 requires separate analysis for day and night-time periods.

3.4.9. The criteria for determining the significance of changes in noise levels from building services plant, based on guidance within BS 4142, and the potential effect on noise sensitive receptors are presented in below, as they relate to TAN

Table 6: Associated change in noise level with magnitude of impact

Exceedance of BS 4142 Rating Level above L_{A90}	**Magnitude of Impact**
+10	Major
≤10 but ≥5	Moderate
≤5 but ≥3	Minor
<3 but ≥0	Negligible
<0	No Change

4. Baseline Noise Survey

4.1. Method

4.1.1. The baseline noise survey was completed between Friday 14th & Monday 17th April 2023 to measure representative noise levels at the site of the proposed development, and closest noise sensitive receptors, during typical weekday and weekend periods.

4.1.2. The closest noise sensitive receptors are indicated in figure 1, on page 5 of this report. Each of the four receptors is a rural residential dwelling and as such would be classed as High sensitivity under TAN (see table 1).

4.1.3. Noise levels at the site and closest NSRs are primarily affected by:

- Road traffic nose on the A96
- Site activity at Blackhillock Quarry (mineral extraction)
- Underlying noise from Blackhillock sub-station

4.1.4. A combination of long-term unattended and short-term attended measurements was utilized in order to accurately quantify noise levels at the closest noise sensitive receptors.

4.1.5. The survey was carried out in accordance with the principles of BS 7445:1997 Parts 1-3, '*Description and Measurement of Environmental Noise'*, and British Standard BS4142: 2014 + A1:2019: *Methods for rating and assessing industrial and commercial sound*.

4.1.6. The figure overleaf shows the survey measurement positions and each is described below.

- LT1 – Long term unattended continuous measurement position. The microphone was tripod mounted at a height of 1.5m.
- ST1 to ST5 – Short term attended measurement position. The sound level meter was operated handheld. Measurements were made for 15 minutes at each location.

Figure 3: Baseline noise survey measurement positions

4.2. Measurement Parameters

4.2.1. The following measurement parameters were recorded, as a minimum:

- $L_{A90,T}$ dB

4.2.2. A 15-minute measurement period was used, with a 1s sampling time. The measurements at all survey positions comprised of consecutive measurement periods in terms of the most relevant standards and guidelines.

4.3. Equipment

4.3.1. All noise measurements were made with calibrated precision grade 1 sound level meters, which achieve the requirements of BS EN 61672:2003.

4.3.2. The equipment used for each survey position is shown in the table below.

Table 7: Baseline noise survey equipment list

Measurement Position	Item Name	Serial Number	Calibration Certificate
MP1	Svantek Svan 958	36584	1500385-1a/-1b
ST1-5	Norsonic Nor 118	31301	U37815
Calibrator	Norsonic Nor 1251	30998	U39543

4.3.3. The sound level meters were calibrated before and after the survey. No significant drift was noted between the two reference checks.

4.4. Weather

4.4.1. In order to evaluate the weather conditions two weather checks measurements were undertaken on site. A handheld RS ProIM-740 weather monitor was used.

Table 8: Baseline noise survey weather conditions

Date	Temperature ^{0}C	Wind Speed (m/s) & Direction
14/04/23	12^{0c}	4.2 m/s
17/04/23	14^{0c}	3.9 m/s

4.5. Results

4.5.1. The measured baseline noise survey results are summarised in the tables below. The full set of survey data is provided graphically in Appendix A.

Table 9: Measurement position MP1 environmental noise survey data

Date & Time	$L_{A90,T}$ dB (*Typical)
14/04/23 16:00 to 23:00	42 (1 hour)
14/04/23 23:00 to 15/04/23 07:00	31 (15 minutes)
15/04/23 07:00 to 23:00	43 (1 hour)
15/04/23 23:00 to 16/04/23 07:00	32 (15 minutes)
16/04/23 07:00 to 23:00	40 (1 hour)
16/04/23 23:00 to 17/04/23 07:00	30 (15 minutes)
17/04/23 07:00 to 10:00	46 (1 hour)

**Note: Following the guidance of BS4142:2014 + A1:2019 Methods for rating and assessing industrial and commercial units & The Association of Noise Consultants BS4142:2014 + A1:2019 Technical Note 2020 Ver 1.0, typical background noise levels for each period have been selected based on statistical analysis of the data. The statistical analyses are included in appendix B at the rear of this report.*

Table 10: Short term daytime measurement position results

Measurement Position	$L_{A90,T}$ dB (*Typical)
ST1	43 (15 minutes)
ST2	44 (15 minutes)
ST3	48 (15 minutes)
ST4	46 (15 minutes)
ST5	44 (15 minutes)

4.6. Adopted Noise Rating Limits

4.6.1. Based on the criteria and methodology discussed in section 3 and the measured background noise levels, the following noise rating limits for new plant have been established for the closest noise sensitive receptors.

4.6.2. The recommended noise rating limits are for a level not more than 5 dB above the prevailing background. This would equate to a 'minor' magnitude of change and a 'Slight/Moderate' level of significance under TAN.

Table 11 –Noise rating limits

Position	Noise rating limit at closest sensitive receiver $L_{Aeq, T}$
Daytime (07:00 to 23:00)	47 dB
Night-time (23:00 to 07:00)	36 dB

Table It is proposed that the rating limits above should apply at 1m from the closest residential facades to the site.

4.6.3. The selection of new plant at the time of writing has not been finalized. A detailed noise analysis should be completed and a specification for noise control of plant items developed to meet the cumulative plant noise limits above.

5. Noise Impact from the Proposed Development

5.1. Equipment Noise Level Information

5.1.1. Noise level information used in the Soundplan model are shown on the following pages.

5.1.2. A summary is provided below, with the total number of items also noted.

Table 12: Summary of sources and noise levels

Item	Doc. Ref.	SPL @ 1m (dBA)	Calculated Sound Power L_{WA}
Battery Container (208 no.)	SBB 1.5 Noise Report UL Version	69.7	77.5 (70.1 attenuated)
Inverter (104 no.)	TN0056KI - Noise Reduction for PCSK GEN3 Inverters	-	85.7
Transformer (52 no.)	Noise Report 4390	51	59
Auxiliary Transformer (7 no.)	Provided by Blackhillock Flexpower Ltd via Email	55	63
Grid Transformer (2 no.)	Provided by Blackhillock Flexpower Ltd via Email	-	86

Figure 4: Battery unit sound pressure level data from report

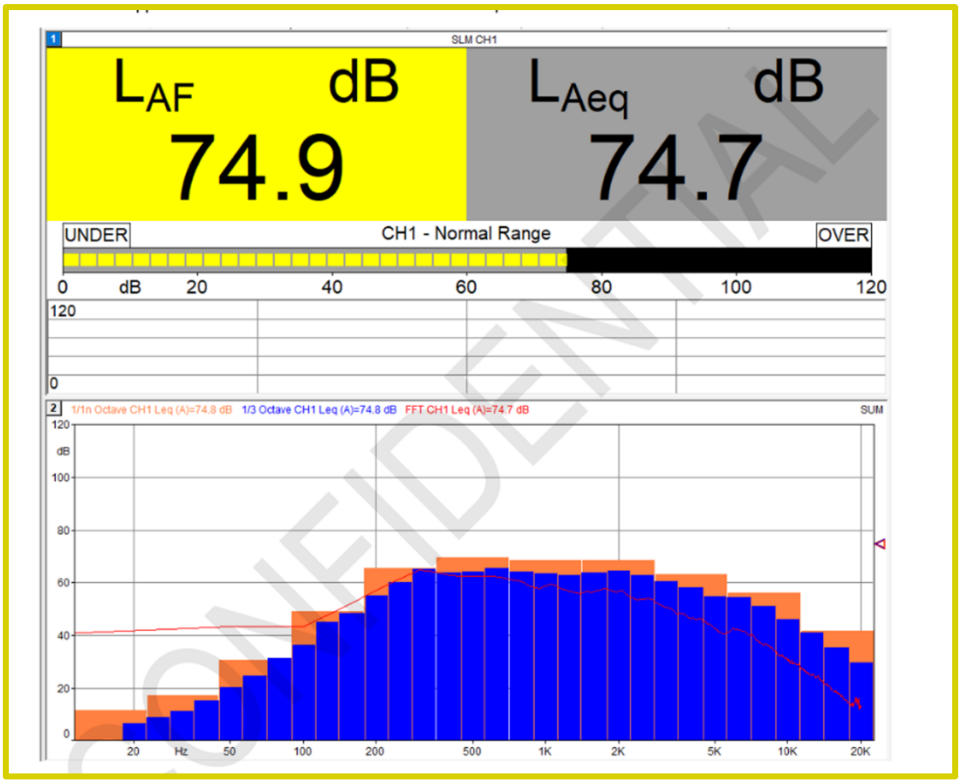
[Table 10] Mximum Noise Level and Noisy Points by Enclosure Surfaces

Measuring Point		Front	Rear	Left Side	Right Side	Top
Normal Operation Chiller 60% / HVAC 60%	Measuring Point	A11	B1	C6	C11	D10
	LAeq [dBA]	69.7	47.4	57.6	55.7	58.9
Silent Operation Chiller 40% / HVAC 60%	Measuring Point	A17	B1	C6	C8	D9
	LAeq [dBA]	62.2	44.1	52.2	49.6	52.5
Extreme Operation Chiller 80% / HVAC 80%	Measuring Point	A13	B4	C3	C8	D10
	LAeq [dBA]	76.0	54.1	63.9	62.0	64.7

5.1.3. The spectrum shape of the battery unit has been taken from the data in the figure below. It is noted that this is for a previous iteration of the unit (hence the higher dBA

level that quoted above). The spectrum shape of the latest unit has been derived pro rata from the below.

Figure 5: Battery unit frequency spectrum shape



5.1.4. The battery unit noise data is based on in-situ measurements taken at a variety of spatial locations around an example unit. Pace Consult has taken this noise data, converted to a sound power level and used it to calibrate a box in Soundplan representative of a single battery unit. The sides of this unit have been modelled as area sources, calibrated to give the levels shown at the various positions shown above.

5.1.5. In addition, the current assessment includes a bespoke attenuator package for the battery fan outlet. The insertion loss required for this attenuator is shown below.

Freq.	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Required Insertion Losses	3	5	7	8	11	8	6	5

5.1.6. Inverters have been modelled using the data below; 60% fan speed with factory attenuation.

With attenuation kit, 60%

MEAN TIME-AVERAGED SOUND PRESSURE LEVEL FROM THE ARRAY OF MICROPHONE POSITIONS OVER THE MEASUREMENT SURFACE
(ISO 3744, sections 8.2.2.1, 8.2.3 & 8.2.4)

Mid-band frequencies of octave bands (Hz)	$\overline{L'_p(ST)}$	$\overline{L_p(B)}$	ΔL_p	K_1	K_2
12.5	54,9	52,6	2,3	1,3000	
16	55,1	53,2	1,8	1,3000	
20	55,6	51,7	3,9	1,3000	
25	58,0	59,8	-1,8	1,3000	
31.5	63,5	60,2	3,3	1,3000	
40	57,0	54,1	2,8	1,3000	
50	58,6	53,0	5,6	1,3000	3,1635
63	55,8	51,6	4,2	1,3000	2,0243
80	54,8	47,1	7,7	0,8088	1,4982
100	55,4	44,2	11,2	0,3433	0,1095
125	64,6	42,5	22,1		1,0525
160	57,6	43,7	13,8	0,1837	0,4731
200	55,5	42,9	12,7	0,2425	0,1490
250	51,3	40,8	10,5	0,4093	0,2933
315	50,5	41,7	8,8	0,6080	0,5997
400	49,0	40,1	8,9	0,6012	0,6836
500	45,0	39,9	5,1	1,3000	0,7335
630	44,5	39,7	4,8	1,3000	0,8044
800	44,0	39,4	4,6	1,3000	0,6687
1k	43,6	39,1	4,6	1,3000	0,2141
1.25k	43,1	37,9	5,2	1,3000	0,1106
1.6k	42,7	35,7	6,9	0,9862	0,3938
2k	42,2	33,5	8,7	0,6311	0,7997
2.5k	43,5	32,3	11,2	0,3439	0,6858
3.15k	41,9	30,3	11,5	0,3159	0,6429
4k	41,4	26,1	15,3		0,1194
5k	43,1	22,8	20,3		-0,6347
6.3k	42,5	20,5	22,0		-0,9664
8k	38,5	19,4	19,1		-1,9054
10k	38,1	25,1	13,0	0,2208	-2,8112
12.5k	35,2	23,0	12,2	0,2690	-4,2102
16k	34,6	31,8	2,8	1,3000	-6,0448

	$\overline{L'_p(ST)}$	$\overline{L_p(B)}$	ΔL_p	K_1	K_2
A-weighted	56,8	48,2	8,5	0,6544	0,3100

SOUND POWER LEVEL FROM THE SOUND PRESSURE LEVEL, IN dB(A)
(ISO 3744, section 8.2.5)

$$\overline{L_p} = \overline{L'_p(ST)} - K_1 - K_2 \qquad L_W = \overline{L_p} + 10lg\frac{S}{S_0}$$

Area of measurement surface [S] = 628,32 m^2 $S_0 = 1\ m^2$ $S_0 = 1\ m^2$

L_W = 83,8 dB(A)

A-WEIGHTED SOUND POWER LEVEL FROM MID-BAND FREQUENCIES OF ONE-THIRD OCTAVE BANDS
(ISO 3744, Annex F)

Coef. C_k	$\overline{L_{pk}}$	L_{Wk}	Aux: $10^{0,1(Lwk+Ck)}$
-30,2	54,1548	82,1366	156.193
-26,2	52,4698	80,4516	266.173
-22,5	52,4974	80,4792	627.938
-19,1	54,9096	82,8914	2.394.086
-16,1	63,5116	91,4934	34.620.955
-13,4	56,9125	84,8943	14.106.759
-10,9	55,1398	83,1216	16.678.689
-8,6	50,5681	78,5499	9.885.247
-6,6	49,3372	77,3190	11.800.545
-4,8	47,7384	75,7202	12.360.064
-3,2	43,0129	70,9947	6.018.190
-1,9	42,3871	70,3689	7.028.993
0,8	41,9829	69,9647	11.925.416
	42,1041	70,0859	10.199.724
0,6	41,6934	69,6752	10.654.263
1	41,2891	69,2709	10.643.611
1,2	40,7248	68,7066	9.787.160
1,3	42,4650	70,4468	14.951.287
1,2	40,9118	68,8936	10.217.845
1	41,2712	69,2530	10.599.898
0,5	43,7562	71,7380	16.741.836
-0,1	43,4397	71,4215	13.556.549
-1,1	40,4009	68,3827	5.348.945
-2,5	40,7000	68,6818	4.151.243

$$\overline{L_{pk}} = \overline{L'_{pk}(ST)} - K_1 - K_2$$

$$L_{Wk} = \overline{L_{pk}} + 10lg\frac{S}{S_0}$$

$$L_{WA} = 10lg \sum_{k=k_{min}}^{k_{max}} 10^{0,1(L_{Wk}+C_k)}$$

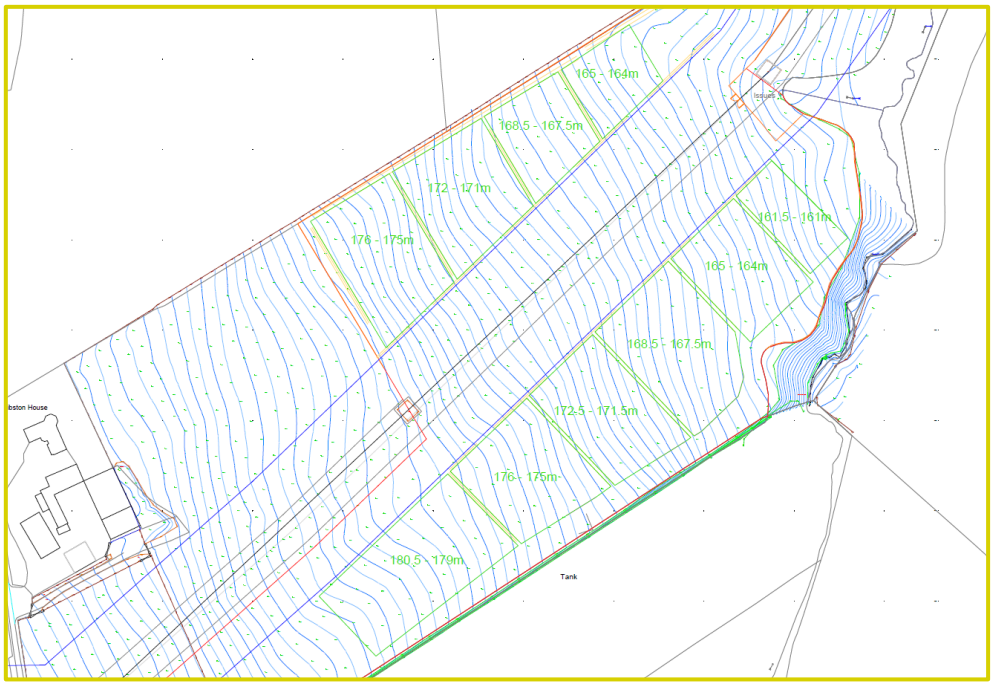
L_{WA} = 83,9 dB(A)

5.1.7. The specific noise level of the proposed new equipment has been calculated at the closest receptors using SoundPlan ver.9.0 3D noise modelling software. An image of the 3D noise model is provided below.

5.2. Mitigation

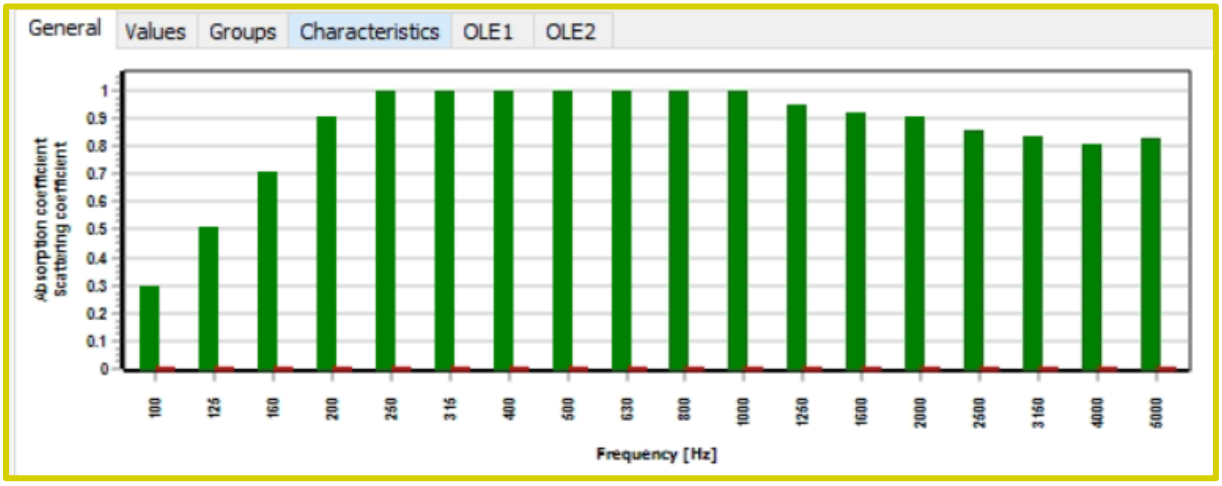
5.2.1. In addition to the factory attenuation to the battery and inverter units noted above, extensive noise barriers have also been modelled for the site. The model also takes into account the planned terracing of the site. The figure below shows the proposed terracing of the site.

Figure 6: Proposed site terracing



5.2.2. Blackhillock Flexpower Ltd has proposed a combination of earth bunds and acoustic barriers of varying heights around each terrace or area containing equipment. These are detailed in drawing NPL-BLK-BLA-21.1-E which can be seen in figure 2, page 7, of this report.

5.2.3. An absorption spectrum based on a Hales Sound Barrierl product has been used and is shown below. Suppliers should be able to demonstrate, through laboratory test data, that this absorption spectrum can be achieved.



5.2.4. The figures below show the extent of the modelled bunds and acoustic barriers.

Figure 7: 3D image of site noise model showing extent of noise barriers 1 of 2

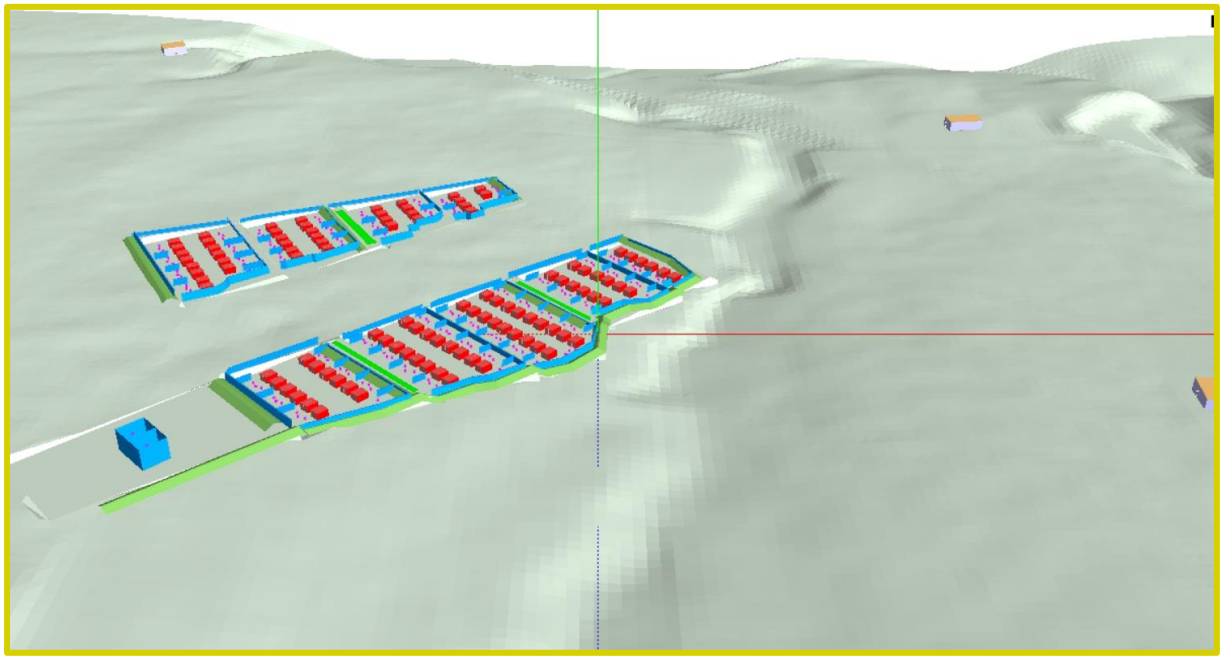
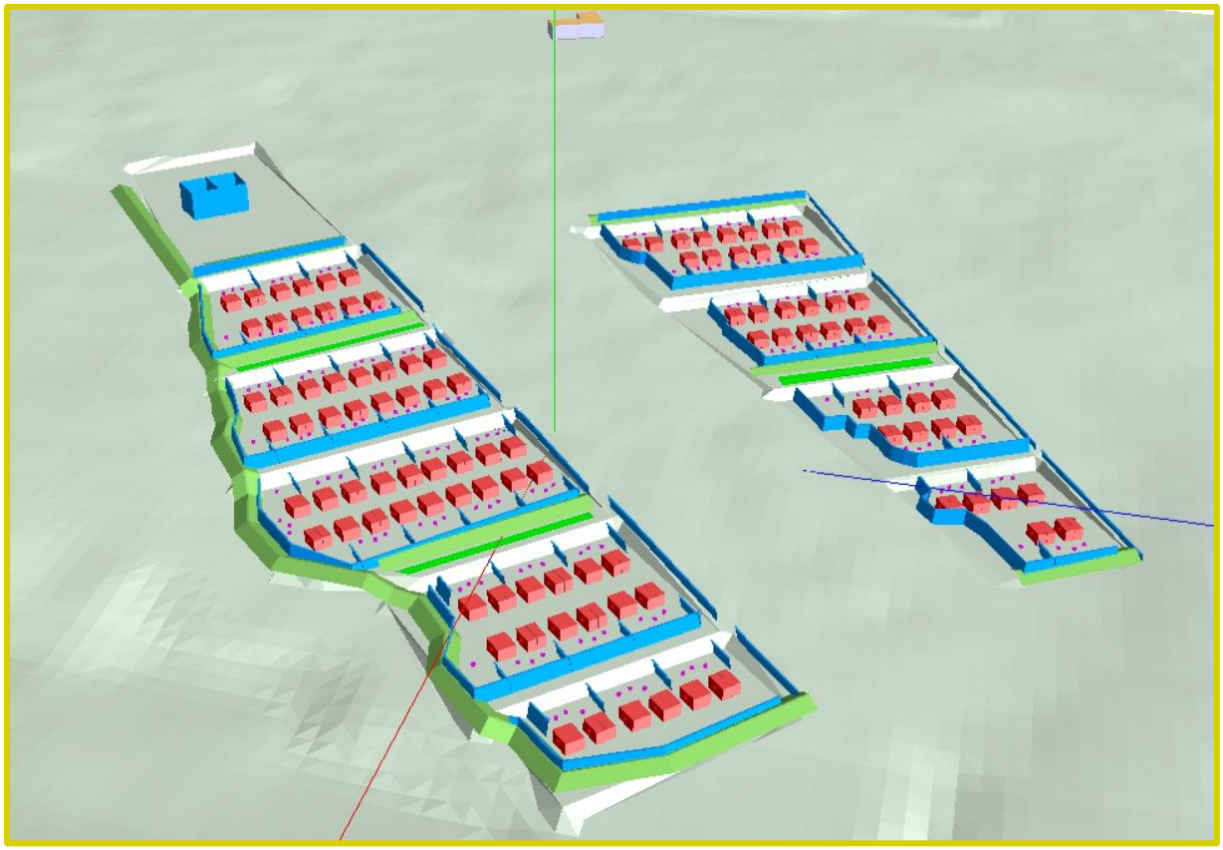


Figure 8: 3D image of site noise model showing extent of noise barriers 2 of 2



5.2.5. The grid transformers are also enclosed with a 10m blast wall, also internally lined with an absorptive acoustic lining equivalent to that detailed for the terrace noise barriers.

5.2.6. Furthermore, a ground absorption factor of G = 0.9 has been used for the surrounding land, while a factor of 0.4 has been used for the battery compound ground.

Ground factor, G ISO 9613-2:

a) **Hard ground,** which includes paving, water, ice, concrete and all other ground surfaces having a low porosity. Tamped ground, for example, as often occurs around industrial sites, can be considered hard. For hard ground $G = 0$.

NOTE 10 It should be recalled that inversion conditions over water are not covered by this part of ISO 9613.

b) **Porous ground,** which includes ground covered by grass, trees or other vegetation, and all other ground surfaces suitable for the growth of vegetation, such as farming land. For porous ground $G = 1$.

5.3. BS 4142 Assessment of Noise Impact (Quantitative Assessment)

5.3.1. As all equipment is expected to operate continuously throughout the day and night, the assessment has been based on the night-time criteria only. As set out in section 4.6, the night-time noise rating limit is 36 dB $L_{Aeq,T}$.

Table 13: BS 4142 rating level calculations

Receptor ID	Calculated Specific Level dBA @1m from facade	BS 4142 Character Correction	Calculated Rating Level	Noise Rating Limit (+5 dB above L_{A90})	Difference between calculated rating level and required rating level
1 Gibston Farm (Land Owner)	36	0 (see below)	36	36	0
2 Rosehall Cottage	36	0 (see below)	36		0
3 Tarnash Farm	33	0 (see below)	33		-3
4 Denhead	35	0 (see below)	35		-1

Note: No tonality is observed in the emissions spectra at the receptors. See extracted diagrams below.

Figure 9: R1 Emissions spectrum

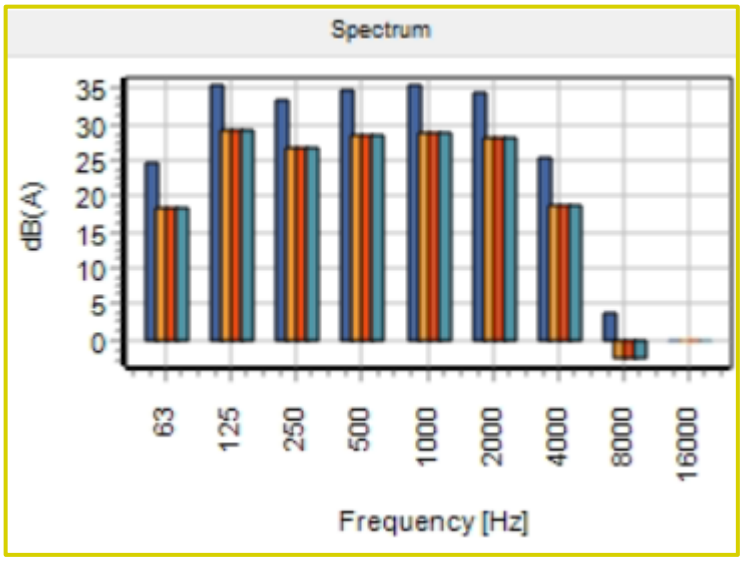


Figure 10: R2 Emissions spectrum

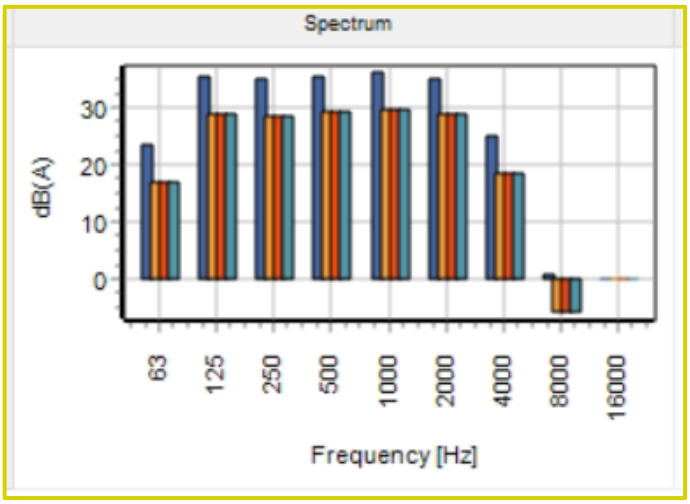


Figure 11: R3 Emissions spectrum

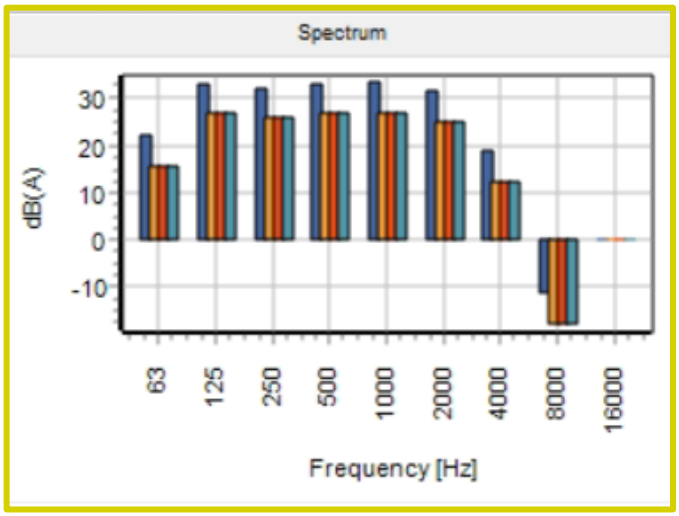
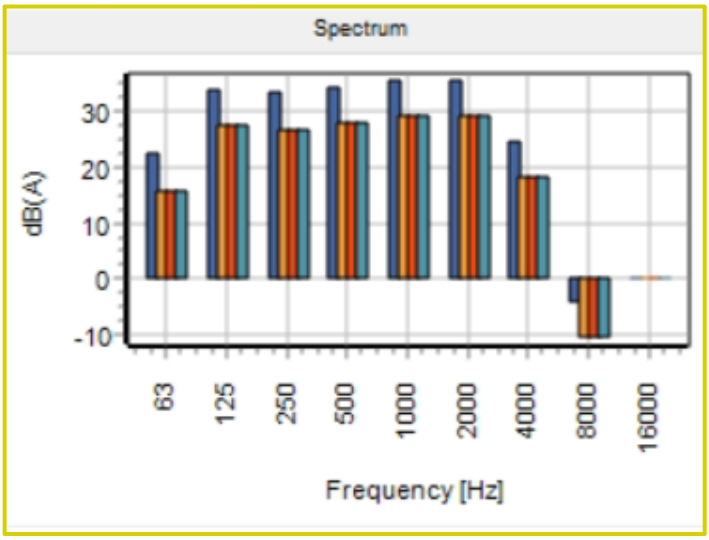


Figure 12: R4 Emissions spectrum



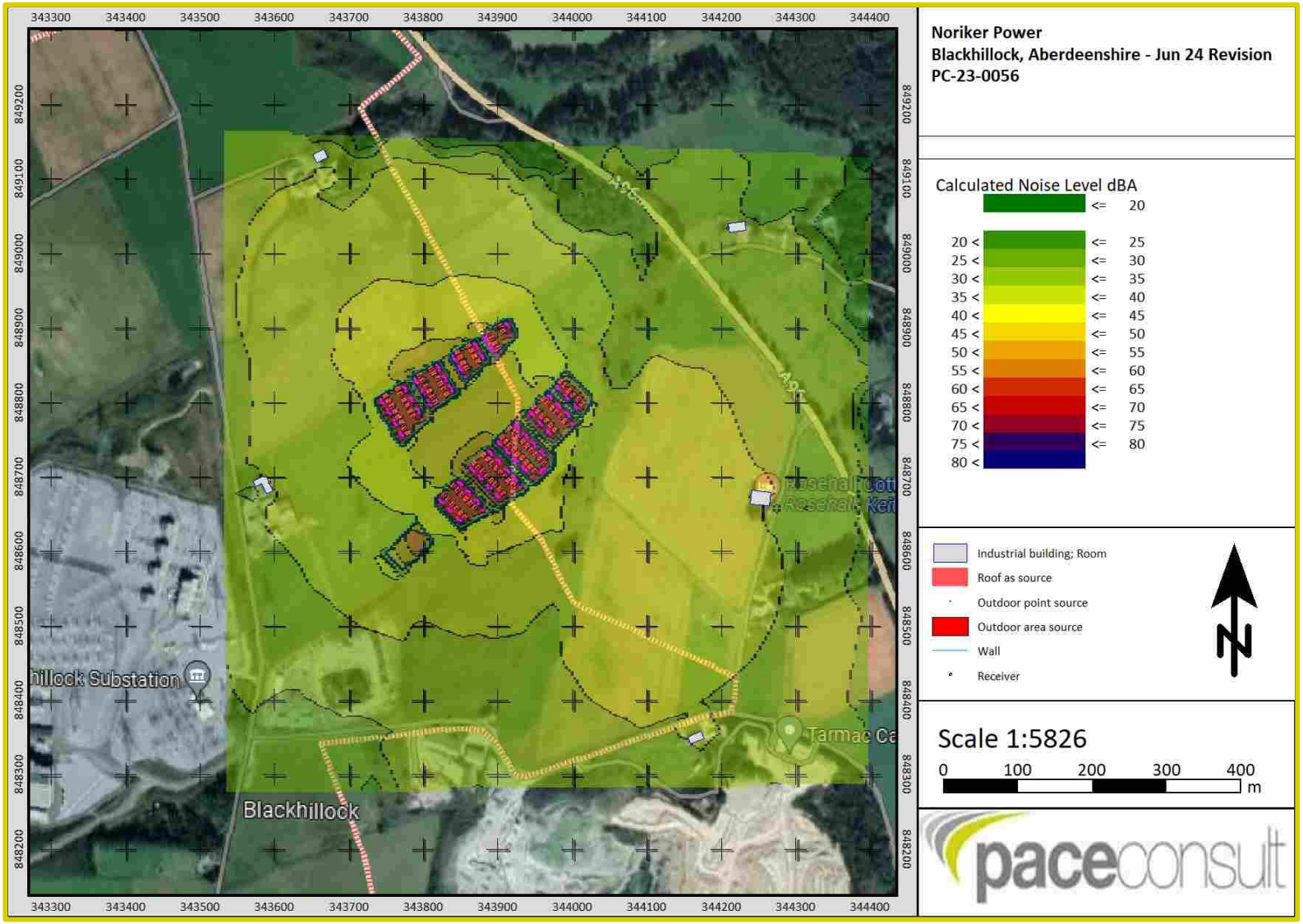
5.3.2. The table below contains the quantitative TAN assessment for the above noise levels.

Table 14: TAN quantitative assessment

Receptor ID	Magnitude of Impact
1 Gibston Farm (Land Owner)	Minor
2 Rosehall Cottage	Minor
3 Tarnash Farm	Negligible
4 Denhead	Minor

5.3.3. A grid noise map (modelled at 2m height) is also provided overleaf.

Figure 13: Grid noise map of initial calculation (at 2m height)



5.4. Qualitative Assessment

5.4.1. Following the guidance of TAN

Table 15: Descriptors for Qualitative Impacts from Noise on Residential Properties

Perception	Criteria of Descriptor	Descriptor for qualitative impact
Noticeable (Very disruptive)	Significant 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	Major
Noticeable (Disruptive)	Causes an important change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion. 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 character of the area.	Moderate
Noticeable (Mildly intrusive)	Noise can be heard and may cause small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; closing windows more often. Potential for non-awakening sleep disturbance. Can slightly affect the character of the area but not such that there is a perceived change in the quality of life.	Minor
Just Noticeable (Non-intrusive)	Noise can be heard, but does not cause any change in behaviour or attitude, e.g. increasing volume of television; speaking more loudly; closing windows. Can slightly affect the character of the area but not such that there is a perceived change in the quality of life.	Negligible
Not noticeable	None	No Impact

Table 16: Summary Table of Significance

Magnitude of Impact	Level of Significance Relative to Sensitivity of Receptor		
	Low	Medium	High
Major	Sligh/Moderate	Moderate/Large	Large/Very Large

Moderate	Slight	Moderate	Moderate/Large
Minor	Neutral/Slight	Slight	Slight/Moderate
Negligible	Neutral/Slight	Neutral/Slight	Slight
No Change	Neutral	Neutral	Neutral

5.4.2. Based on the tables above and the quantitative TAN assessment, the table below contains the TAN quantitative assessment for the project.

Table 17: TAN quantitative assessment for all receptors

Receptor ID	Magnitude of Impact	Perception	Level of Significance Relative to Sensitivity of Receptor
1 Gibston Farm (Land Owner)	Minor	Noticeable (Mildly intrusive)	Slight/Moderate
2 Rosehall Cottage	Minor	Noticeable (Mildly intrusive)	Slight/Moderate
3 Tarnash Farm	Negligible	Just Noticeable (Non-intrusive)	Slight
4 Denhead	Minor	Noticeable (Mildly intrusive)	Slight/Moderate

5.4.3. The predicted noise rating levels meet the local authorities own proposed noise rating limits for the site, as set out in the criteria section of this report. Although the context of the site is partly a rural location, the number of receptors affected even by the predicted minor impacts is very low (4). In addition, the surrounding area is also already home to a large sub-station site and several more distant industrial sites.

5.4.4. Under the TAN assessment, the quantitative BS 4142 assessment also shows a negligible to minor magnitude of impact while the qualitative assessment shows a slight to moderate level of significance, relative the sensitivity of the residential receptors.

5.4.5. It is also noted that the site represents a significant and desirable piece of green energy infrastructure

5.4.6. As such adverse noise impact from the site should be suitably controlled by the proposed construction/mitigation of the site.

5.5. Cumulative Impact

5.5.1. In addition to the application assessed here it has also been noted by the local authority and local stakeholders that other similar sites are currently present or proposed. A need to account for the potential cumulative noise impact of all sites has been stressed.

5.5.2. It is understood that planning consent has been given to a synchronous compensator facility, also on land adjacent to Blackhillock Electricity Substation, to the north-west of this site.

5.5.3. Noise impact from this site has been assessed by Envirocentre (Project Number 376034, Document Number 13023). It is noted that due to it's location, not all noise sensitive receptors overlap between the Envirocentre site and the Blackhillock Flexpower site dealt with in this report.

5.5.4. Table 6-2 from the Envirocentre report is reproduced below, showing the predicted noise levels at each receptor.

Figure 14: Envirocentre noise level data

Table 6-2: Summary BS 4142 Assessment for all NSRs

NSR ID	Period	Background Sound Level (dB $L_{A90,T}$)	Specific Sound Level (dB L_s)	Acoustic Feature Correction (dB)	Rating Level (dB L_r)	Excess (dB)
01 Ashdrew Pad	Daytime	28	14	3	17	-11
	Night Time	21	15	3	18	-3
02 Auchorties	Daytime	34	20	3	23	-11
	Night Time	34	20	3	23	-11
03 Gibstone	Daytime	29	15	3	18	-11
	Night Time	26	15	3	18	-8
04 Coldhome	Daytime	32	16	3	19	-13
	Night Time	32	17	3	20	-12

5.5.5. Ther highlighted receptor above represents the landowners dwelling for the Blackhillock Flexpower application. This is also the worst affected receptor assessed in this report.

5.5.6. As can be seen, the predicted noise levels from the Envirocentre site are (as per criteria section 3.1.1 provided by Moray Council) more than 10 dB below the predicted level from this site.

5.5.7. As such it is not considered necessary to make adjustments to this assessment due to cumulative impact.

5.5.8. Additionally, a further BESS storage facility is also proposed to the south of this proposed site.

5.5.9. This has been assessed by Apex Acoustics in report 9169.1C.

5.5.10. It is noted that the receptors assessed in the Apex Acoustics report do not overlap with those in this report.

5.5.11. The predicted noise rating levels at the closest noise sensitive receptors to the BESS facility range from 32-26 dB $L_{,Tr}$.

5.5.12. The receptors assessed in this report are a minimum of 700m from the proposed BESS facility, while the worst affected receptor near to the BESS facility is 160m away.

5.5.13. Therefore, we would expect noise contribution from the BESS facility to be not more than 21 dB $L_{,Tr}$.

5.5.14. As such it is not considered necessary to make adjustments to this assessment due to cumulative impact from the BESS facility.

6. Conclusions

6.1.1. Pace Consult has completed a baseline noise survey & noise impact assessment at the site of the proposed Blackhillock, Aberdeenshire BESS development.

6.1.2. Representative noise levels have been measured over typical weekday and weekend periods.

6.1.3. Noise rating limits have been established for daytime & night-time periods, following the guidance of BS4142:2014 + A1:2019 Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas.

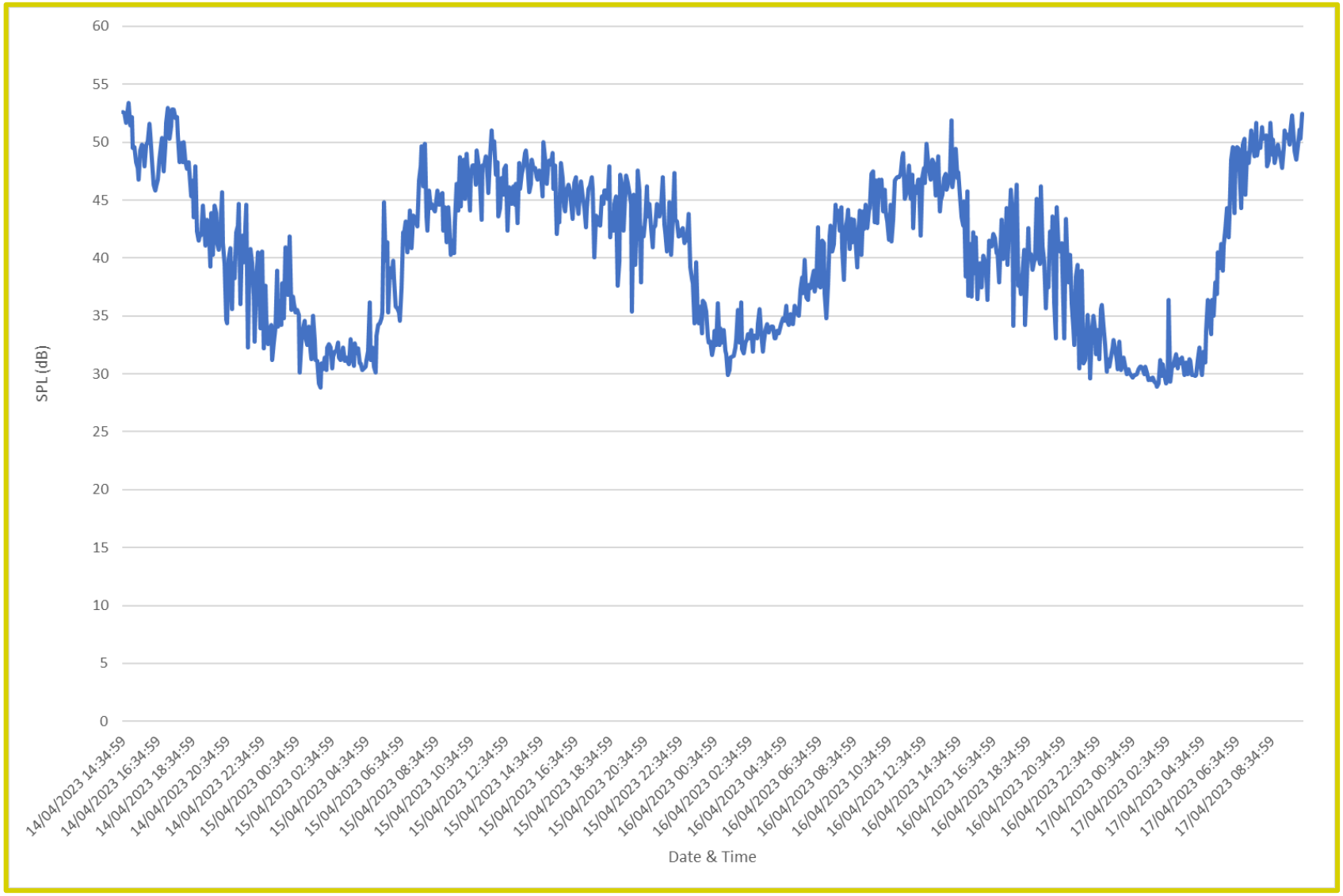
6.1.4. The site has been assessed following the guidance of PAN 1/2011 & TAN.

6.1.5. The assessment shows that the local authorities noise rating limits can be met. The TAN quantitative assessment shows a negligible to minor magnitude of impact and the qualitative assessment shows a slight to moderate level of significance, relative the sensitivity of the residential receptors.

6.1.6. Potential cumulative noise impacts have also been reviewed.

7. Appendix A - Baseline Noise Survey Data

Figure 15: Baseline noise survey LA90 time history



8. Appendix B – L_{A90} Statistical Analyses

Figure 16: 14/04/23 16:00 to 23:00

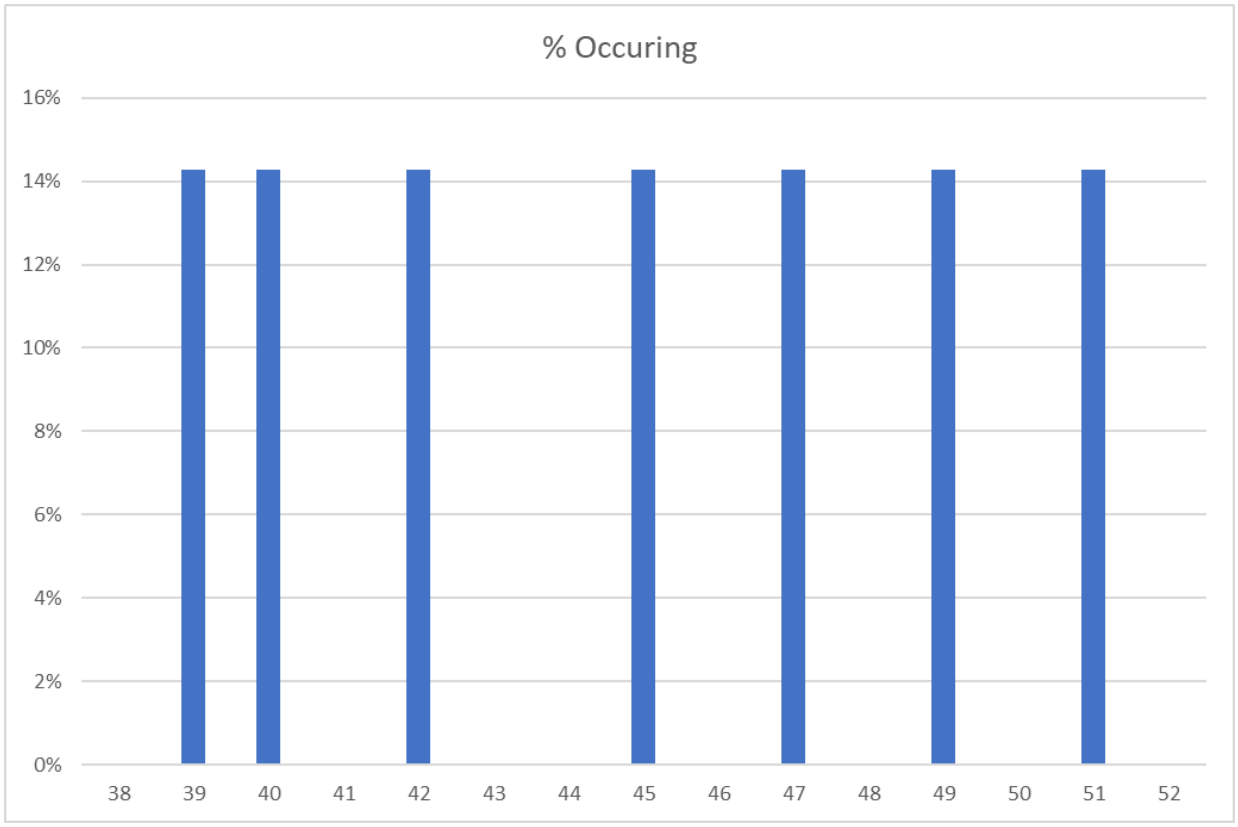


Figure 17: 14/04/23 23:00 to 15/04/23 07:00

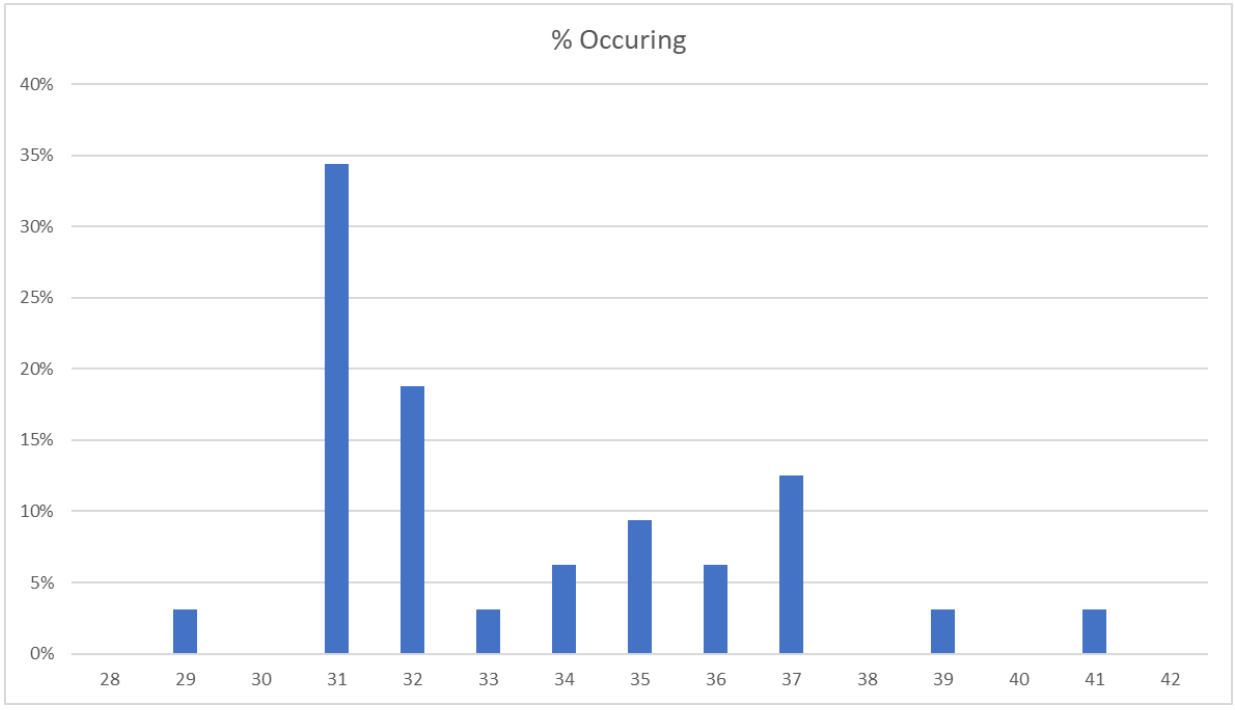


Figure 18: 15/04/23 07:00 to 23:00

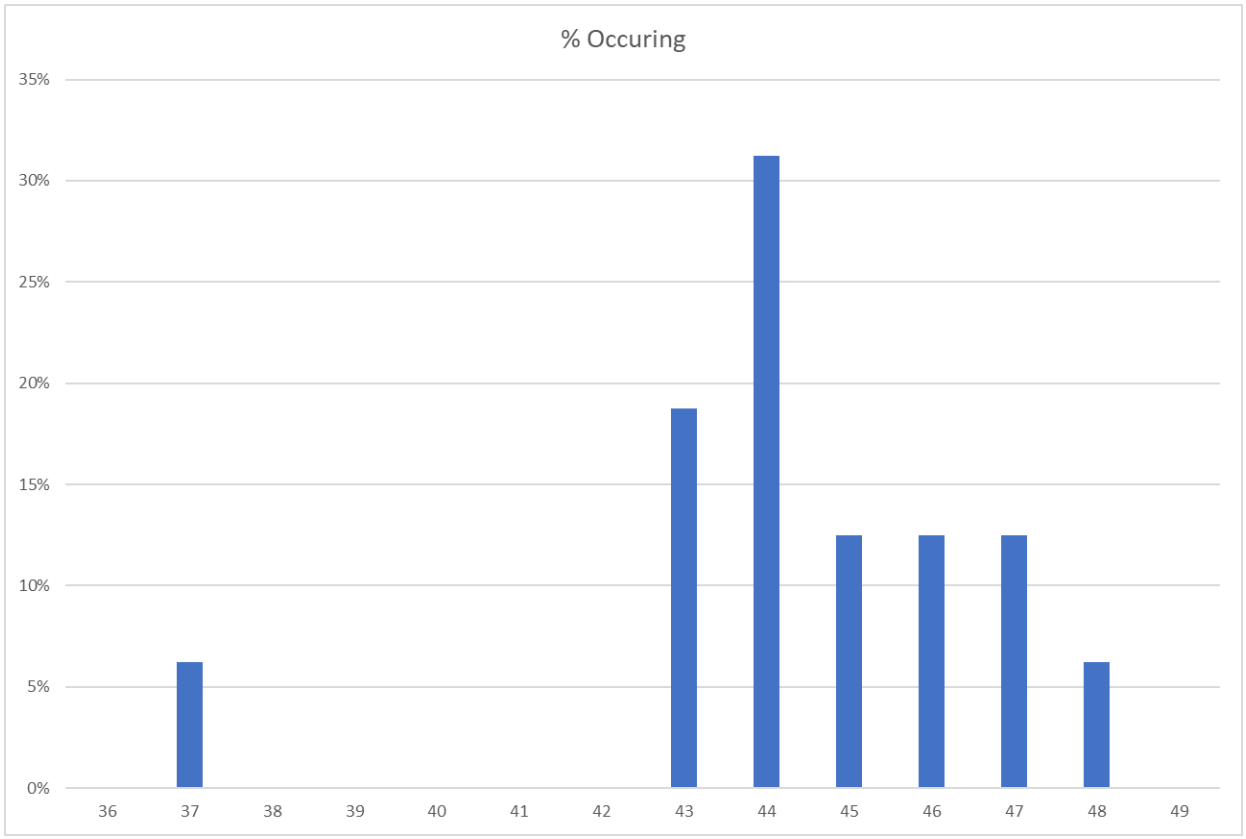


Figure 19: 15/04/23 23:00 to 16/04/23 07:00

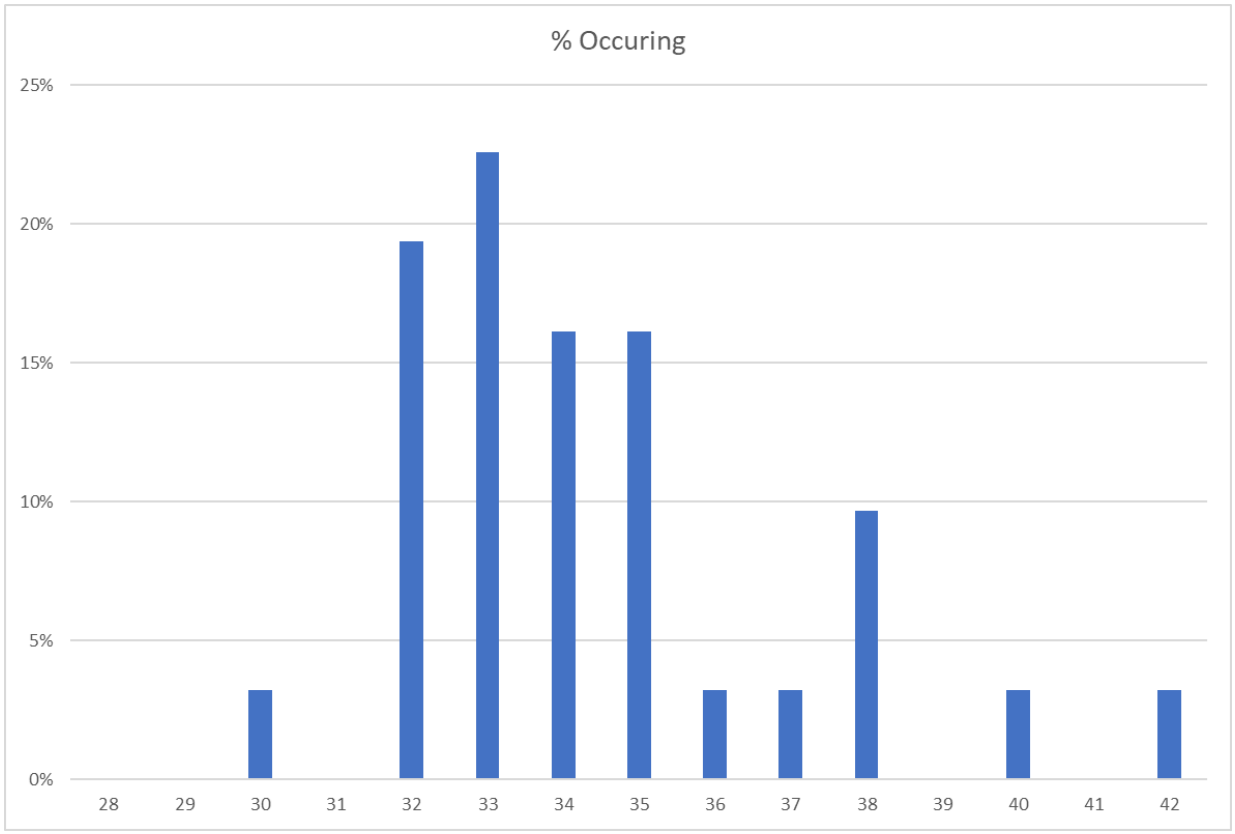


Figure 20: 16/04/23 07:00 to 23:00

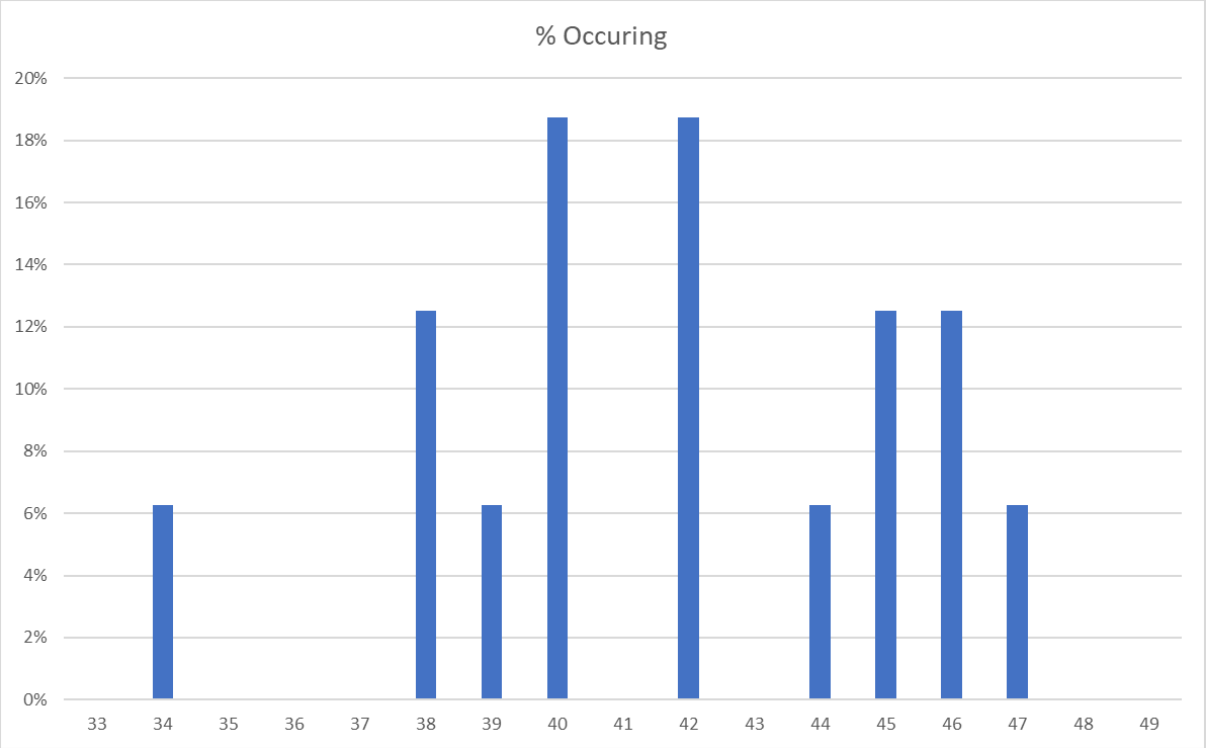


Figure 21: 16/04/23 23:00 to 17/04/23 07:00

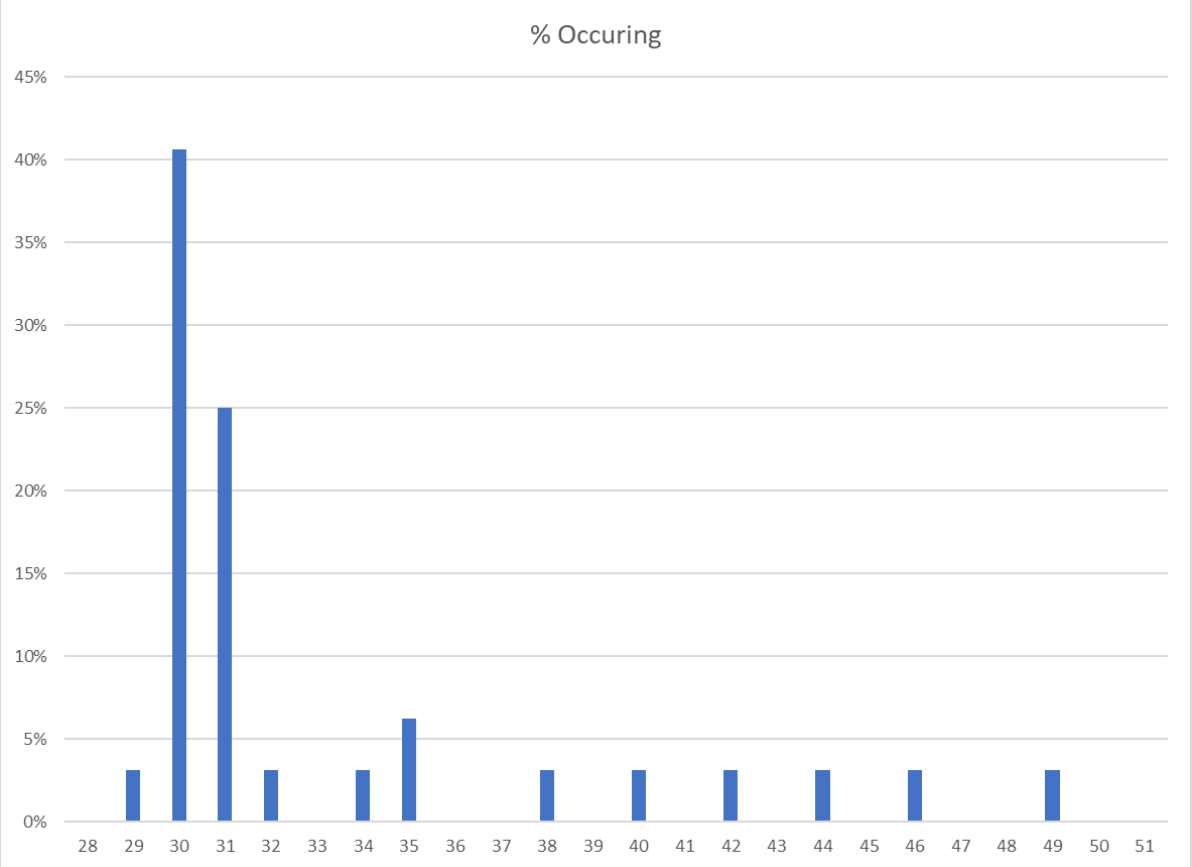
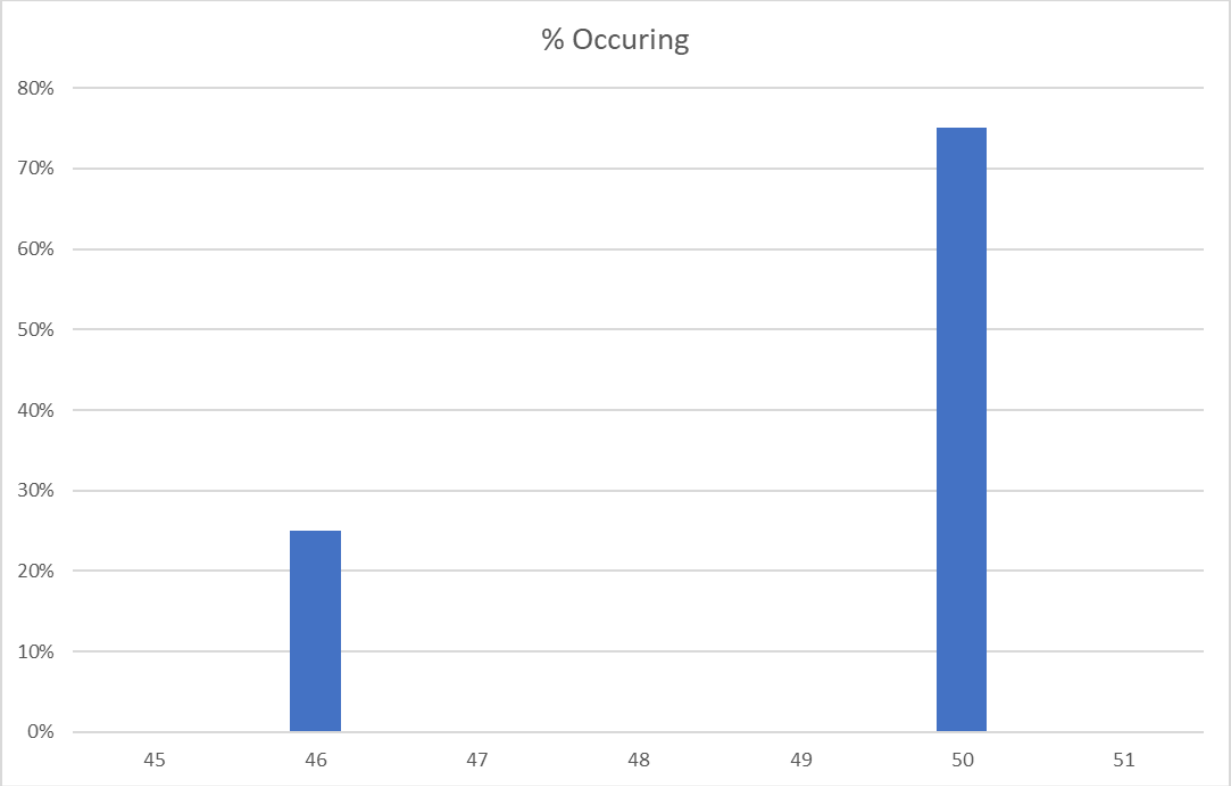


Figure 22: 17/04/23 07:00 to 10:0



End of Report