Adapt Biogas, Murrow PE13 4HN

Permit Number: EPR/FB3133AW

Carbon Capture Noise Impact Assessment

dBx Acoustics Ltd

Beehive Mill

Jersey Street

Manchester

22027 Adapt Biogas Carbon Capture NIA R02

Client: Adapt Biogas

Date: 08/09/2022

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REVISION HISTORY

Revision	Date	Revision Details	Author	Checked
R01	08/09/2022	Original Issue	Angela Lamacraft Angela Lamacraft BSc IEng MIOA	Ben Tomlin Ben Tomlin BSc MIOA

1 SYNOPSIS

1.1.1 This noise impact assessment has been undertaken to accompany a permit variation at Adapt Biogas, Murrow (PE13 4HN) to allow proposed carbon capture equipment at the site. The existing site permit number is EPR/FB3133AW.

1.1.2 dBx Acoustics has carried out background sound measurements at a nearby noise sensitive receptor to the site. These were compared to sound measurements undertaken by Noise and Vibration Consultants Ltd in 2011 to determine the typical background sound level at nearby noise sensitive receptors to the site.

1.1.3 A noise model of the site, including the proposed carbon capture equipment, and surrounding area, including nearby noise sensitive receptors, has been prepared. A significant adverse impact has been predicted due to noise from the proposed carbon capture equipment based on the single-figure noise level provided by the manufacturer for the proposed equipment.

1.1.4 Calculations indicate that a noise barrier is ineffective due to the large distances between the proposed carbon capture equipment and nearest noise sensitive receptors.

1.1.5 A noise rating level has been suggested for the proposed carbon capture equipment that is estimated to result in a low impact of noise from the proposed carbon capture equipment.

1.1.6 It is suggested that further assessment of noise from the proposed carbon capture equipment should be undertaken once more accurate noise data is available.

2 INTRODUCTION

2.1 Background

2.1.1 dBx Acoustics Ltd has been appointed by Adapt Biogas Ltd to undertake a noise impact assessment for an application to the Environment Agency (EA) to vary the current permit at the site to enable use of proposed carbon capture equipment.

2.1.2 A Glossary of Acoustic Terminology is provided in Appendix 1 in order to assist the reader.

2.2 Site Description

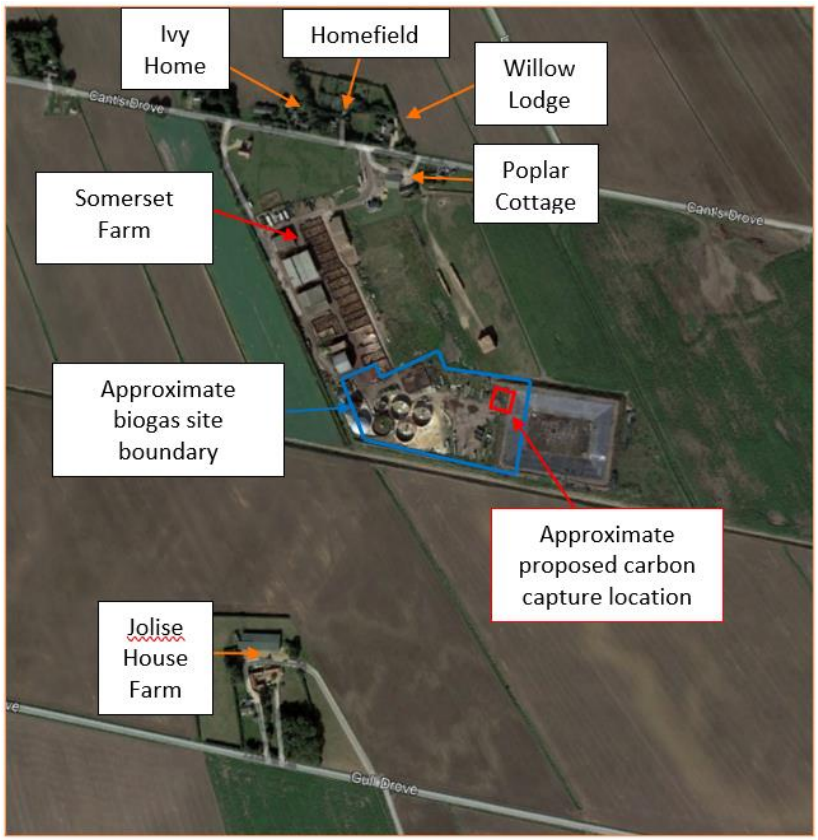
2.2.1 The site is located at Somerset Farm, Cant's Drove, Murrow, Wisbech PE13 4HN.

2.2.2 The site comprises an anaerobic digestion (AD) plant, established in 2013, including five primary digesters and one after digester. The AD is fed on a majority of cattle muck and residual farm feed, alongside a small amount of energy crops.

2.2.3 The majority of the equipment at the site operates intermittently over a 24-hour period, except for shredder activities which only occur during the daytime.

2.2.4 The nearest noise sensitive receptors (NSRs) to the site, determined from the GP Planning Consultants Ltd '*Site Receptor Plan*' (drawing reference GPP/AB/M/21/04, dated 23rd June 2021), are the dwellings illustrated on Figure 1.

Figure 1: Nearest Noise Sensitive Receptors



2.3 History of Complaints

2.3.1 Adapt Biogas is currently liaising with the EA to address complaints of noise from the resident at Homefield, approximately 320 m to the north of the Adapt Biogas site.

2.4 Previous Noise Assessments

Noise & Vibration Consultants Ltd ('NVC') '*Noise Impact Assessment*'

2.4.1 Noise & Vibration Consultants Ltd ('NVC') provided a '*Noise Impact Assessment*' report reference R11.0901/DRK dated 20th August 2011 for the 2011 planning application for AD plant (Cambridgeshire County Council planning reference F/02015/11).

2.4.2 The purpose of the report was to provide a noise assessment of the proposed AD site to nearby NSRs.

2.4.3 Background and ambient noise measurements were undertaken at the site boundary in the vicinity of nearby residential properties, approximately 5 m from Cant's Drove, during a typical weekday period. The noise measurements are therefore free-field.

2.4.4 The typical background sound level was determined to be 39 dB $L_{A90,\,T}$ during the daytime and 34 dB $L_{A90,\,T}$ during the night-time. The ambient noise level was determined to be 50 dB $L_{Aeq,\,16h}$ during the daytime and 45 dB $L_{Aeq,\,8h}$ during the night-time.

2.4.5 The main source of existing noise affecting nearest receptors was determined to be the movement of traffic along local roads and intermittent farming activities. There were no harvesting activities being carried out during the survey period.

Environment Agency '*Noise Survey 2/11/2021*'

2.4.6 The EA issued a '*Noise Survey 2/11/2021*' report on 11th November 2021 following complaints from the resident of Homefield, approximately 320 m to the north of the Adapt Biogas site.

2.4.7 Noise measurements were made by the EA on 2nd November 2021. The complainant reported that they could not hear noise from the site that day. The prevailing wind direction on that day was reported to be from the north west.

2.4.8 The ambient noise level at the residential property was reported as 67 dB $L_{Aeq,\,15min}$. The data was reported as showing no particular tonal characteristics, and noise from the AD plant was reported to be barely discernible.

2.4.9 The measurements made close to equipment on site identified a number of items with tonal characteristics, but are inconclusive in identifying the potential source of complaints.

2.4.10 The report suggested that "*The next steps would be to liaise more with the local residents to try and get a better idea of conditions when the noise is more apparent. Another run of longer duration monitoring will also be conducted at some point in the near future but will be highly weather dependant.*"

Environment Agency '*Noise Survey 8th March – 11th March 2022*'

2.4.11 The EA report '*Noise Survey 8th March – 11th March 2022*' summarises the results of additional noise measurements undertaken by the EA.

2.4.12 The report identifies "*sound from birds in nearby trees, occasional vehicles passing on the road, farm sounds from the farmyard opposite, occasional aeroplane sounds and sound from the AD*

plant located to the rear of the farm buildings". It is also reported that "*road traffic noise from the A47 was not noted at the monitoring location, it was audible at locations further along Cants Drove once the sound from the AD plant dropped off*". Furthermore, it is report that "*for much of the monitoring period wind noise was the dominant feature recorded*".

2.4.13 The report identifies that the average ambient noise level between 23:00 hrs and 05:30 hrs is 43 dB $L_{Aeq, T}$. After 05:30 hrs the ambient noise level is identified as 45 dB to 50 dB $L_{Aeq, T}$, which "is predominantly due to the AD plant". It is reported that the recorded plant noise does not contain any specific noise characteristics such as tonality, impulsivity and intermittency.

2.4.14 The background sound level is estimated to "*probably be 1 – 2 dB lower than the road traffic noise values*" from the A47, which were determined to be between 28 dB and 32 dB $L_{Aeq, T}$ from publicly available road traffic noise values[1]. The background sound level is therefore estimated by the EA to be between 26 dB and 30 dB $L_{A90, T}$ at the monitoring position.

2.4.15 The report concludes that

- "*Taking a best case value of 32 dB for the residual sound level and 43 dB for the specific sound level of the AD plant we can see there is a difference of 11 dB.*
- *Taking the worst case of 26 dB for the residual sound level and 43 dB for the AD plant we can see there is a difference of 17 dB.*"

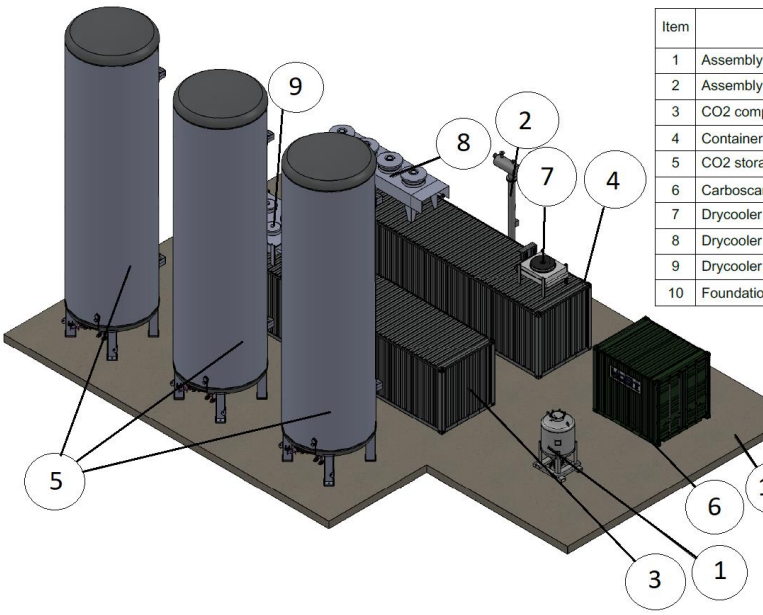
2.4.16 It should be noted that whilst the EA report suggests that this is a BS 4142 assessment, the methodology in that standard compares the background sound level rather than the residual sound level. However, the "residual sound level" reported by the EA is the same as the estimated background sound levels, therefore it is possible that the EA conclusion contains typographical errors and does provide an estimate of the BS 4142 assessment ('estimate' because the background sound level is estimated from the daytime and night-time $L_{Aeq, T}$ values based on modelled road traffic).

[1] www.extrium.co.uk/noiseviewer.html, no date of access provided in the EA report.

2.5 Proposed Plant

2.5.1 Figure 2 illustrates the proposed equipment, which comprises a containerised solution, including three 50 tonne storage tanks, one compressor container, one drycooler, one reboiler, one carboscan monitoring system and pipework back to the upgrader.

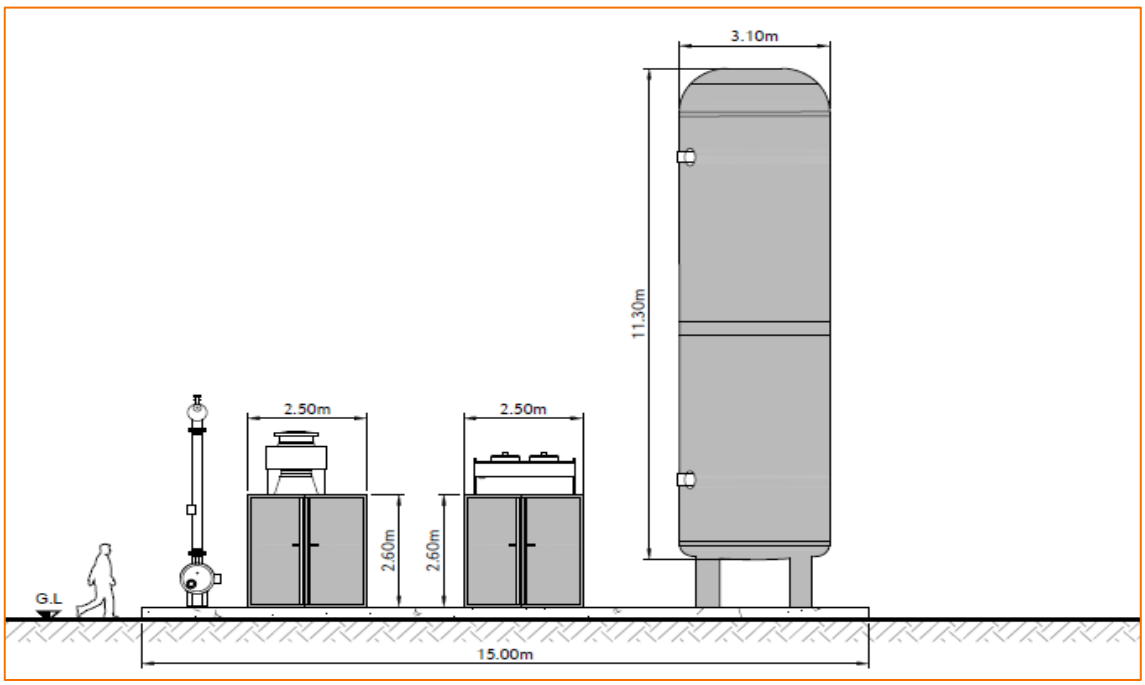
Figure 2: Proposed Carbon Capture Plant



Item	Description	Qty.
1	Assembly carbon filter	1
2	Assembly reboiler	1
3	CO2 compressor container	1
4	Container 40"	1
5	CO2 storage	3
6	Carboscan 300	1
7	Drycooler	1
8	Drycooler	1
9	Drycooler flat compact	1
10	Foundation 15 x 21.5m	1

2.5.2 Figure 3 illustrates the western elevation of the proposed plant.

Figure 3: Proposed Carbon Capture Plant: West Elevation



3 NOISE ASSESSMENT METHODOLOGY

3.1 BS 4142:2014 'Methods for Rating and Assessing Industrial and Commercial Sound'

3.1.1 BS 4142:2014 sets out a procedure for assessing noise impact whereby a noise rating is determined and compared with the existing local Background Sound Level.

3.1.2 The rating level (dB $L_{Ar,\,Tr}$) is evaluated from the specific noise level by including several, cumulative corrections to account for factors such as distinguishable tone, impulse, intermittency or other readily distinguishable sound characteristics.

3.1.3 The assessment of the impact depends upon the margin by which the rating level of the specific sound source exceeds the background sound level. An initial estimate of the impact of the specific sound is made by subtracting the background sound level from the rating level, while considering the following points:

- Typically, the greater this difference, the greater 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.

3.1.4 BS 4142 requires consideration of the context of the sound and the uncertainty of the data and calculations.

3.2 Environment Agency Guidance: Noise and Vibration Management: Environmental Permits

3.2.1 The EA guidance[2] provides advice on how to manage noise, including how to carry out a noise impact assessment. It was last updated on 31st January 2022.

3.2.2 The guidance indicates that a noise impact assessment is required when applying to vary a permit. It advises that the noise impact assessment should be carried out by competent personnel, "*for example, holders of either an Institute of Acoustics: Diploma in Acoustics and Noise Control or Certificate of Competence in Environmental Noise Measurement, with relevant experience.*" CVs are provided in Appendix 2.

3.2.3 The guidance advises that BS 4142 must be used and provides four steps for a noise assessment:

- Step 1: desktop risk assessment;
- Step 2: off-site monitoring survey;

[2] https://www.gov.uk/government/publications/noise-and-vibration-management-environmental-permits/noise-and-vibration-management-environmental-permits, accessed 25/08/2022.

- Step 3: source assessment; and
- Step 4: BAT [Best Available Techniques] or appropriate measures justification.

4 NOISE SURVEY

4.1 Equipment

4.1.1 dBx Acoustics attended site on Friday 1st April 2022 to carry out attended measurements within the site (adjacent to existing AD plant), and to deploy a logging sound level meter at Homefield, one of the nearest NSRs to the site.

4.1.2 The equipment used is summarised in Table 1.

Table 1: Equipment Used During Environmental Noise Survey

Equipment	Unattended Measurements (Manufacturer & Part Number)	Serial Number	Calibration Date
Calibrator	Cirrus CR:515	87160	31/01/2022
Sound Level Meter	Cirrus Optimus CR:171B	G300741	31/01/2022
Microphone	Cirrus MK:224	211753D	31/01/2022
Pre-amplifier	Cirrus MV:200F	9082F	31/01/2022

4.1.3 The sound level meter was field calibrated before and after measurements, with no significant drift recorded. An accredited laboratory calibrated the equipment not more than two years prior to the measurements being made, with the exception of the calibrator, which had been calibrated not more than one year prior to the survey.

4.1.4 The noise measurement data was extracted from the sound level meter using Cirrus Noise Tools version 1.8.8.11707.

4.2 Weather Conditions

4.2.1 Field measurements of wind speed and temperature were undertaken during attended noise measurements with a Benetech GM8901 Digital Anemometer. The temperature during attended noise measurements ranged between approximately 4°C at 09:25 hrs and approximately 8°C at 13:12 hrs. The wind speed varied between approximately 2 $m \cdot s^{-1}$ and approximately 5.5 $m \cdot s^{-1}$ throughout the noise measurements. The wind direction moved from a north-westerly direction to a north-easterly direction through the noise measurement period.

4.2.2 Table 2 provides a summary of the publicly available historic weather data for Holbeach[3], approximately 18 km to the north of the site. This is the nearest location to the site for which historic data is available.

[3] https://www.wunderground.com/dashboard/pws/ILINCSHO2/graph/2022-04-1/2022-04-1/daily, accessed 19/04/2022

Table 2: Weather Data

Date	Publicly Available for Holbeach	
	Average Wind Speed ($m \cdot s^{-1}$)	Wind Direction
02/04/2022	2	N to NE
03/04/2022	2	NW to SW
04/04/2022	5	SW to W
05/04/2022	5	SW to W
06/04/2022	6	SW to W

4.2.3 It can be seen that the on-site weather observations summarised in Paragraph 4.2.1 and the publicly available weather data correlate well.

4.2.4 Periods of rainfall or wind speeds above 5 $m \cdot s^{1}$ have been excluded from the ambient and baseline noise levels used within the noise assessment. Measurements from the 5th April onwards have been disregarded due to constant high wind speeds.

5 OFF-SITE NOISE MEASUREMENT RESULTS

5.1.1 A logging sound level meter was installed with the microphone located at 1 m from the façade of an outbuilding at Homefield, which measured noise levels continuously between 13:18 hrs on Friday 1st April and 10:22 hrs on Thursday 7th April.

5.1.2 The monitoring location is illustrated in Figure 4 and a photograph of the noise monitoring equipment is provided in Figure 5.

Figure 4: Off-Site Noise Measurement Locations

Figure 5: Photograph of Off-Site Noise Monitoring Equipment

5.1.3 During attended measurements, it was noted that the dominant noise source at this location was birdsong and movement of vegetation due to the wind. Plant noise from Adapt Biogas was faintly audible during the short periods without birdsong or noise from vegetation.

5.2 Off-Site Measurement Results

5.2.1 Table 3 summarises the measured ambient and background noise levels measured at Homefield by the continuous noise monitor. A graph of the full noise measurements is provided in Appendix 3.

5.2.2 A correction has been applied to estimate the free-field noise level from the façade noise measurement. The data has been corrected to remove periods where wind speeds were greater than 5 $m \cdot s^{1}$. Due to prevalence of adverse weather during 6th April and 7th April, the measurements for these dates have been excluded from the noise survey results.

Table 3: Measurement Results at Homefield

Date	Period (hours)	Free-Field Ambient Noise Level (dB $L_{Aeq, T}$)	Free-Field Average Background Sound Level (dB $L_{A90, T}$)
1 April	Daytime (07:00-23:00)	43	28
	Night Time (23:00-07:00)	42	24
2 April	Daytime (07:00-23:00)	44	32
	Night Time (23:00-07:00)	38	25
3 April	Daytime (07:00-23:00)	43	33
	Night Time (23:00-07:00)	35	32
4 April	Daytime (07:00-23:00)	45	35
	Night Time (23:00-07:00)	43	30
5 April	Daytime (07:00-23:00)	44	35
	Night Time (23:00-07:00)	44	37

5.2.3 The measured noise levels have been compared to the reported ambient noise levels at the Cant's Drove properties from the Noise & Vibration Consultants Ltd ('NVC') '*Noise Impact Assessment*' report reference R11.0901/DRK provided for the 2011 planning application for the AD plant (Cambridgeshire County Council planning reference F/02015/11) in Table 4.

Table 4: Comparison of Ambient and Background Noise Levels at Cant's Drove

Date	Daytime (07:00 hrs to 23:00 hrs)		Night Time (23:00 hrs to 07:00)	
	Average Free-Field Ambient Noise Level (dB $L_{Aeq,T}$) [1]	Average Free-Field Background Sound Level (dB $L_{A90,T}$) [2]	Average Free-Field Ambient Noise Level (dB $L_{Aeq,T}$) [1]	Average Free-Field Background Sound Level (dB $L_{A90,T}$) [2]
2011	50	39	45	34
2022	43-45	28-35	35-44	23-37

Note 1: The ambient noise level is the logarithmic average of the $L_{Aeq, 15min}$ measured during the relevant time period.
Note 2: The background sound level is the arithmetic average of the $L_{A90, 15min}$ measured during the relevant time period.

5.2.4 It can be seen that the ambient and background noise levels at the residential receptor are lower in 2022 than in 2011. This is a positive indication that the normal operation of the AD plant has not significantly influenced the noise climate at the receptor.

6 NOISE ASSESSMENT

6.1 Background Sound Level

6.1.1 A comparison of the background sound levels from the NVC '*Noise Impact Assessment*' report reference R11.0901/DRK and those measured by dBx Acoustics between 1st April and 4th April 2022 is provided in Table 4.

6.1.2 The typical background sound level has been determined to be 33 dB $L_{A90,\ 15min}$ during the daytime and 28 dB $L_{A90,\ 15min}$ during the night-time.

6.2 Specific Noise Level

6.2.1 Bright Renewables Ltd has advised that detailed noise levels for individual items of equipment are not yet available, but that the overall noise level will be 80 dB $L_{Aeq,\ T}$ at 1 m. Octave band frequency data is also not yet available.

6.2.2 The height of the different noise sources has been provided by the manufacturer and is summarised in Table 5.

Table 5: Height of Carbon Capture Equipment

Item	Description	Quantity	Height of Noise Emission (m)	Duration of operation (Minutes per Hour or %)
1	Assembly carbon filter	1	1	95%
2a	Assembly reboiler	1	1	95%
2b	Assembly reboiler	1	5	95%
3a	CO2 compressor container	1	0.8	95%
3b	CO2 compressor container	1	2.3	95%
4a	Container 40"	1	0.8	95%
4b	Container 40"	1	2.3	95%
5	CO2 storage	3	1	95%
6a	Carboscan 300	1	0.8	95%
6b	Carboscan 300	1	2.3	95%
7	Drycooler	1	4	95%
8	Drycooler	1	4	95%
9	Drycooler flat compact	1	4	95%

Noise Model

6.2.3 A SoundPLAN v8.2 noise model has been prepared of the site, the proposed carbon capture equipment and surrounding area. The noise model uses data from OpenStreetMap to ensure that the site terrain, and location and height of surrounding buildings are accurately represented within the model. The noise model uses the methodology in ISO 9613 to predict noise from point, line and area sources.

6.2.4 The proposed carbon capture equipment has been included within the noise model as point sources due to the distance between the source and NSRs[4]. The Bright Biomethane drawing B0850-tek02-200 '*Layout CO2 liquefaction*' revision 01 dated 28/01/2022 has been used to determine the location of the equipment.

6.2.5 The nearest NSR to the location of the proposed carbon capture plant is Coronation House, approximately 275 m to the north of the carbon capture location.

6.2.6 The calculated specific sound level at the nearest NSR is 40 dB $L_{Aeq, T}$.

6.3 BS 4142 Assessment

6.3.1 BS 4142 requires a character correction to be applied where sound is tonal, impulsive, intermittent or otherwise easily identifiable against the ambient noise climate.

6.3.2 In the case of Adapt Biogas, a 3 dB penalty has been applied due to the EA guidance that "*Where neither tonal nor impulsive corrections apply, the environment agencies will generally expect a +3 dB 'other' correction to be applied for readily distinguishable industrial noise, unless you can demonstrate this is not justified*" and the fact that it is unknown whether a tonal penalty will apply.

6.3.3 The rating level of the proposed carbon capture equipment is therefore 43 dB $L_{Ar, Tr}$.

[4] Smith, B. J., Peters, R. J., Owen, S. (1996) *Acoustics and Noise Control*.2nd edn. Harlow: Pearson Education Limited, pp.154.

6.3.4 Table 6 provides the BS 4142 noise assessment for the proposed carbon capture equipment.

Table 6: Initial BS 4142 Plant Noise Assessment

Item	Daytime Assessment (07:00 hrs to 23:00 hrs)	Night-Time Assessment (23:00 hrs to 07:00 hrs)	Relevant Clause	Comments
Typical background sound level	33 dB $L_{A90, 15min}$	28 dB $L_{A90, 15min}$	8.3	The typical background sound level determined from measurements during the relevant time period.
Specific sound level	40 dB $L_{Aeq, T}$	40 dB $L_{Aeq, T}$	7.3.3	A prediction made using the methodology outlined above, corrected for distance.
Acoustic feature correction	+3 dB	+3 dB	9.2	A 3 dB 'other' correction to be applied for readily distinguishable industrial noise as per EA guidance.
Rating Level	43 dB $L_{Ar, Tr}$	43 dB $L_{Ar, Tr}$	9.2	The predicted rating level during the relevant period.
Excess of Rating Level over background sound level	+10 dB	+15 dB	11	
	Assessment indicates significant adverse noise impact, depending on context.	Assessment indicates significant adverse noise impact, depending on context.	11	
Uncertainty of the assessment	Medium	Medium	10	Background sound level based on repeatable measurements. The predicted rating level is based on established prediction methodologies.

6.3.5 Table 6 indicates that the proposed carbon capture equipment will likely result in a significant adverse noise impact at the nearest NSR using the assumptions outlined in Section 6.2.

6.3.6 It should be noted that the rating level is similar to the existing ambient noise level (43-45 dB $L_{Aeq,T}$ during the daytime and 35-44 dB $L_{Aeq,T}$ during the night-time).

6.4 Discussion of Context

6.4.1 The proposed plant is similar to existing plant located at Adapt Biogas, therefore the proposed plant is in keeping with the existing use of the site.

6.4.2 The site is located in a rural area with agricultural noise sources not associated with Adapt Biogas observed during the off-site noise measurements.

6.5 Discussion of Uncertainty

Noise Survey

6.5.1 The background sound level has been determined by comparing background sound level measured by NVC in 2011 and dBx Acoustics in 2022.

6.5.2 NVC completed a baseline noise survey from 12:30 hrs to 07:00 hrs on the following day. The date of the noise survey is not provided in the report, which introduces uncertainty regarding the suitability of the baseline noise measurement.

6.5.3 The dBx Acoustics noise measurements undertaken for this noise survey are considered to be robust and of limited uncertainty. Noise measurements were undertaken over typical weekday and weekend periods and any periods of adverse weather have been removed from the results.

6.5.4 All equipment used has been calibrated to laboratory standards and used by a suitably qualified acoustic consultant.

6.5.5 Onsite calibration indicated that there was no significant drift in measured noise levels throughout the noise survey, indicating accurate measurements have been obtained.

6.5.6 The uncertainty of the noise measurements is therefore considered to be low.

Noise Assessment

6.5.7 The noise assessment has been based on a single figure noise level for the proposed items, therefore the frequency content of the noise is unknown. However, the noise level used in the assessment is based on manufacturers' data, which reduces the uncertainty.

6.5.8 There is low uncertainty associated with the noise pathway, as outlined in the EA guidance, as the ground cover between the unattended noise measurement location and Adapt Biogas site is similar to the ground cover between the site and other receptors.

6.5.9 The unattended noise measurement location at Homefield was 1 m from the façade of an out-building, therefore noise measurements undertaken in this location have had a 3 dB subtraction to estimate the free-field noise levels.

Summary of Uncertainty

6.5.10 Overall it is considered that there is a medium level of uncertainty associated with the noise assessment and calculation procedures.

6.5.11 It is therefore recommended that the Noise Impact Assessment is updated when more detailed equipment noise data is available to reduce the uncertainty of the noise assessment. Bright Renewables have advised that this should be possible towards the end of 2022.

7 NOISE MITIGATION MEASURES

7.1 Noise Barrier

7.1.1 Due to the distance between the proposed carbon capture equipment and the nearest NSRs, calculations indicate that even a tall noise barrier (3 m height) does not provide a significant reduction in equipment noise levels.

7.2 Reduction of Equipment Noise Levels

7.2.1 The noise mitigation method that will provide the greatest benefit to surrounding NSRs is to reduce the noise emission of the carbon capture equipment.

7.2.2 Table 7 indicates that a carbon capture equipment emission level of 68 dB $L_{Aeq, T}$ at 1 m is likely to result in an acceptable rating level at the NSRs.

7.2.3 This result is only an estimate at this stage as it is not possible to carry out accurate calculations until octave frequency band sound power levels (or sound pressure levels with reference distance) of each equipment item listed in Table 5 are known.

Table 7: BS 4142 Plant Noise Assessment with Reduced Noise Emission

Item	Daytime Assessment (07:00 hrs to 23:00 hrs)	Night-Time Assessment (23:00 hrs to 07:00 hrs)	Relevant Clause	Comments
Typical background sound level	33 dB $L_{A90, 15min}$	28 dB $L_{A90, 15min}$	8.3	The typical background sound level determined from measurements during the relevant time period.
Specific sound level	28 dB $L_{Aeq, T}$	28 dB $L_{Aeq, T}$	7.3.3	A prediction made using the methodology outlined above, corrected for distance.
Acoustic feature correction	3 dB	3 dB	9.2	A 3 dB 'other' correction to be applied for readily distinguishable industrial noise as per EA guidance.
Rating Level	31 dB $L_{Ar, Tr}$	31 dB $L_{Ar, Tr}$	9.2	The predicted rating level during the relevant period.
Excess of Rating Level over background sound level	-2 dB	3 dB	11	

Item	Daytime Assessment (07:00 hrs to 23:00 hrs)	Night-Time Assessment (23:00 hrs to 07:00 hrs)	Relevant Clause	Comments
	Assessment indicates a low noise impact, depending on context.	Assessment falls between a low noise impact and adverse noise impact, depending on context.	11	
Uncertainty of the assessment	Medium	Medium	10	Background sound level based on repeatable measurements. The predicted rating level is based on established prediction methodologies.

7.2.4 Due to the context of the site as an operational biogas centre in an area with agricultural land use, a rating level 3 dB above background sound level during the night-time is considered to result in a low impact.

7.2.5 The predicted rating level is also at least 4-13 dB lower than typical existing ambient noise levels in the area, and hence would not be expected to be noticeable.

8 CONCLUSION

8.1.1 This report details the results of the noise assessment undertaken for the proposed carbon capture equipment at Adapt Biogas, Murrow, Wisbech PE13 4HN.

8.1.2 dBx Acoustics carried out background sound measurements at a nearby noise sensitive receptor to the site which were compared to sound measurements undertaken by Noise and Vibration Consultants Ltd in 2011. The typical background sound level has been determined to be 33 dB $L_{A90,\ 15min}$ during the daytime and 28 dB $L_{A90,\ 15min}$ during the night-time.

8.1.3 The manufacturer of the data provided a single-figure noise level for the equipment (80 dB $L_{Aeq,\ T}$ at 1 m) . This has been included within a noise model of the site, proposed carbon capture equipment and surrounding area to predict the specific noise level at the nearest noise sensitive receptor (Coronation House, approximately 275 m to the north of the proposed carbon capture equipment location). A 3 dB acoustic character correction has been applied for "*readily distinguishable industrial noise*" as required in the EA guidance for noise impact assessments.

8.1.4 The rating noise level of the proposed plant is predicted to exceed the background sound level by 10 dB during the daytime and 15 dB during the night-time, which is an indication that the carbon capture equipment would have a significant adverse impact.

8.1.5 Calculations indicate that a noise barrier is ineffective due to the large distances between the proposed carbon capture equipment and nearest noise sensitive receptors.

8.1.6 The noise rating level of the proposed plant is predicted to result in a low impact if the noise emission of the proposed carbon capture plant is limited to 68 dB $L_{Aeq,\ T}$ at 1 m.

8.1.7 The accuracy of this result can be improved once octave frequency band noise data is provided by the manufacturer of the proposed carbon capture equipment.

8.1.8 On the basis of the above, it is considered that further assessment of noise from the proposed carbon capture equipment should be undertaken once more accurate noise data is available.

8.1.9 However, noise should not be a limiting factor in any permit variation if the noise emission of the proposed carbon capture equipment can be limited to 68 dB $L_{Aeq,\ T}$ at 1 m.

APPENDIX 1

Glossary of Acoustic Terminology

Decibel, dB	A unit of level derived from the logarithm of the ratio between the value of a quantity and a reference value. For sound pressure level (Lp) the reference quantity is 2x10-5 N/m2. The sound pressure level existing when microphone measured pressure is 2x10-5 N/m2 is 0 dB, the threshold of hearing.
Frequency	Number of cycles per second, measured in hertz (Hz), related to sound pitch.
A-weighting	Arithmetic corrections applied to values of L_p according to frequency. When logarithmically summed for all frequencies, the resulting single "A weighted value" becomes comparable with other such values from which a comparative loudness judgement can be made, then, without knowledge of frequency content of the source.
$L_{Aeq, T}$	Equivalent continuous level of A weighted sound pressure which, if it actually existed for the integration time period, T, of the measurement would possess the same energy as the constantly varying values of L_p actually measured.
$L_{An, T}$	Level in dBA which was exceeded for n% of time, T.
L_{AFmax}	The instantaneous maximum A weighted sound pressure level which occurred during the measurement. F indicates that the fast time-weighting is used.
$L_{Ar, Tr}$	The rating level: the equivalent continuous A-weighted sound pressure level of the noise, plus any adjustment for the characteristic features of the noise.

APPENDIX 2

Curriculum Vitae: Angela Lamacraft (Author)

Qualifications

BSc (Hons) Audio and Music Technology with First Class Honours, Anglia Polytechnic University (2004)

Diploma of Noise and Vibration, Institute of Acoustics (2008)

MSc Sound and Vibration Studies with Distinction, ISVR at the University of Southampton (2014)

Prizes

Elsevier prize for best performance in the taught modules for the MSc Sound and Vibration Studies (2014)

Professional Membership

Member of the Institute of Acoustics (MIOA, 2010)

Incorporated Engineer (IEng, 2011)

Publications

'*Ideas for Improving Diversity and Inclusion in Acoustics*', Inter-noise 2022, August 2022.

'*Establishing a Relationship Between the External LAeq,16hr and the External Lden Noise Descriptors*' (joint author), Institute of Acoustics Conference 'WHO Environmental Noise Guidelines for the European Region', January 2019.

'*Underwater Sound Measurement*'. A Lamacraft. Institute of Acoustics 'Acoustics Bulletin', Vol 38, No. 1, Feb 2013.

'*Comparison of Instrumentation Specified for the Measurement of Environmental Noise*'. A Lamacraft. Institute of Acoustics 'Acoustics Bulletin', Vol 35, No. 6, Dec 2010.

Profile

Angela specialises in environmental noise, transportation noise and vibration and industrial noise control. Her experience includes undertaking noise and vibration surveys, analysing data, writing reports and advising on outline and detailed mitigation measures across a range of sectors (including retail, commercial, scientific, technical, residential and industrial). She is an experienced noise modeller and has prepared models for numerous projects such as construction work, new roads, a firing range, a large Sustainable Urban Extension and electricity substations.

Angela has a good knowledge of national and local policies and national and international standards relating to noise and planning, industrial noise, road traffic noise, railway noise and vibration and construction and demolition noise and vibration.

Angela has considerable experience in the management of projects, both of stand-alone acoustic teams and multi-disciplinary projects with internal colleagues and those employed by other companies.

Angela has extensive experience of working as part of multidisciplinary teams and discussing acoustics with a variety of stakeholders who may not be familiar with the discipline. She has also advised local planning authorities on the suitability of Noise and Vibration ES Chapters for planning applications for residential and mixed-use developments and wind farm noise assessments.

Selected Project Experience

Vandyke Tileworks: Noise impact assessment for proposed change of packaging plant at an operational tileworks with existing dwellings approximately 120 m to the east of the location of the proposed packaging plant). Angela was Project Manager for the project, undertook the background sound measurements and noise measurements of existing equipment, predicted noise to the nearby noise sensitive receptors, and carried out a BS 4142 assessment of the proposed equipment.

Barrington: Restoration of an adjacent area of the quarry needed to be considered for the early years of inhabitancy of the consented residential development. The noise and vibration assessment required substantial research of the potential noise and vibration levels from the quarry restoration (by review of planning documentation on the minerals authority website) and the potential noise and vibration levels from a light railway that bisects the development (by use of a report by a previous consultant for the application of the proposed residential development and a consultant report instructed by the local planning authority). Angela consulted with the operator of the adjacent quarry to establish current levels of activity in order to undertake additional noise and vibration measurements.

Angela attended Design Team Meetings and began the assessment of the potential noise and vibration impacts of the quarry restoration and light railway movements on the proposed residential development. Upon handing over the technical work to a colleague, Angela maintained her role as Project Manager and main point of contact for the client and design team.

Dock Street, London: Assessment of noise from existing and proposed roof-top plant associated with a demonstration kitchen. As Project Manager, Angela had to overcome difficulties with arranging access to site including helping the client to understand the requirements of the noise survey. Angela prepared the CadnaA noise model which required thorough consultation with the client regarding source noise data for proposed items of plant not yet in use at the site. She also prepared the technical report for a planning application.

Land at Urlay Nook: Assessment of sound from a Police Tactical Training Centre to proposed dwellings. The project required extensive consultation with the local planning authority, client, planning consultant and site staff regarding the noise assessment criteria, sound survey methodology and access to the site which Angela undertook proficiently and successfully. As Project Manager, Angela organised and undertook the sound survey, including measurement of sound from a range of firearms and explosives as well as offsite measurements requiring attention to the health and safety requirements of the site. She prepared a noise model using LimA that included the directivity of the firearms and devised two typical training scenarios for assessment and prepared the report.

Hydropower Scheme: Assessment of sound from an Archimedes Screw style hydropower scheme in tidal water on the River Thames. The proposed equipment did not yet exist, and no sound power level data was available, so Angela arranged measurement of a similar scheme and devised a correction to allow for the difference in size. Angela prepared a SoundPLAN noise

model of the site including different water heights to allow for the tidal nature of the river. In addition to consultation with the local planning authority, client and planning consultant, Angela liaised with the previous acoustic consultants involved in the project. A nearby stakeholder objected to the scheme and instructed acoustic consultants to review the assessment so Angela consulted with those consultants and a third acoustic consultant (an academic) brought in to peer review the noise assessments.

Environmental Statement Chapters: Angela has prepared the Noise and Vibration ES Chapters for numerous projects.

Curriculum Vitae: Ben Tomlin (Reviewer)

Qualifications

BSc (Hons) Audio Technology, Salford University (1999)

Professional Membership

Member of the Institute of Acoustics (MIOA, 2002)

Profile

Ben has been a consultant or acoustic engineer in the field of noise and vibration engineering since 2000, with a wide of experience encompassing industrial, planning, environmental, building services and building and architectural acoustics.

Ben has significant experience in a wide range of acoustical, environmental noise, and noise control design services, including Leisure Buildings, Hospitals, Schools, Colleges and Universities, Industrial, Housing, Offices, Pubs, Clubs and Restaurants, Sports Facilities, Prisons, Transport / Distribution, Call Centres, Drilling / 'Fracking' rigs, and Noise at Work assessments.

Selected Project Experience

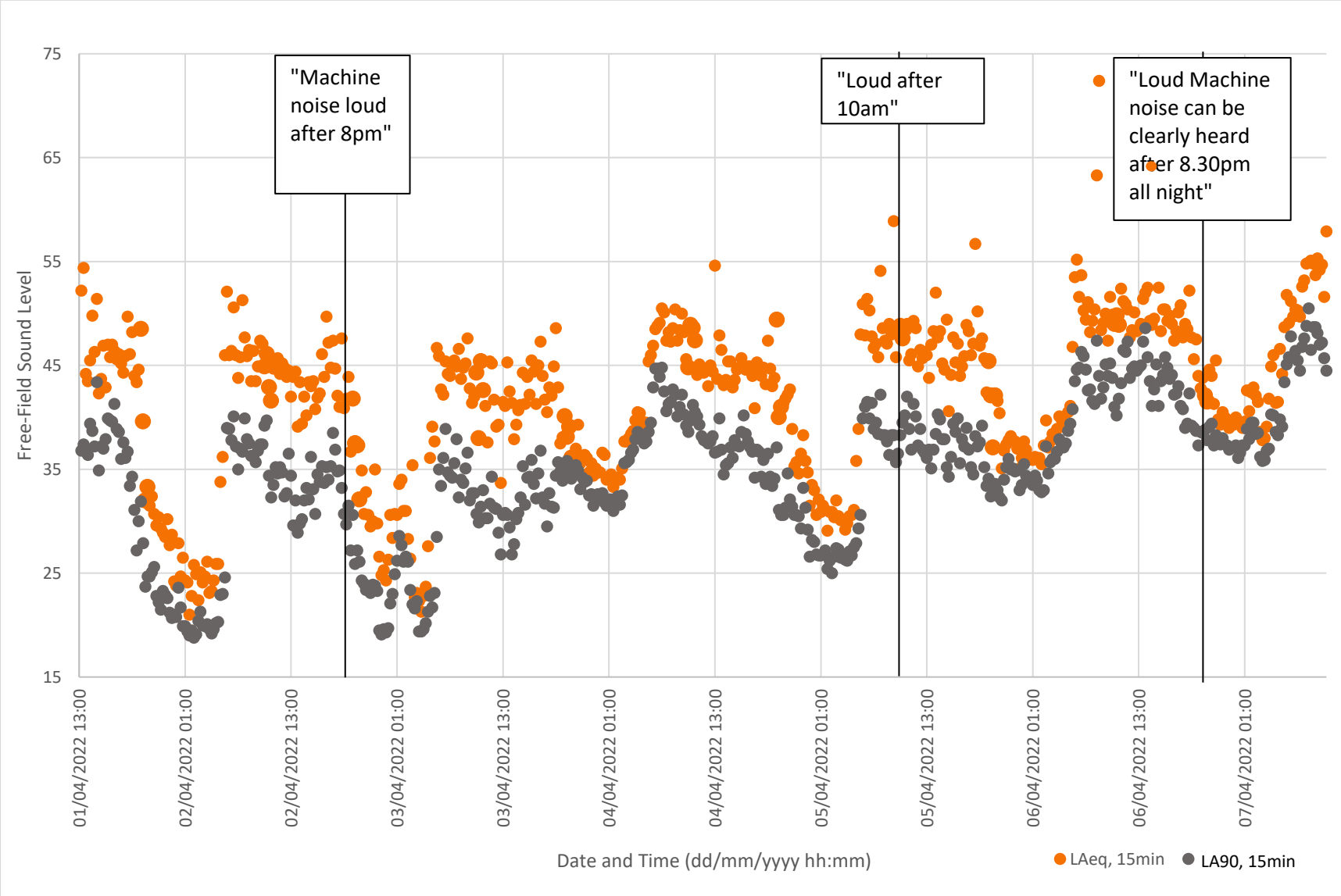
Highways England Noise Insulation Scheme: Ban was lead acoustic consultant for the project, whereby over 3000 properties across England were assessed for eligibility for replacement glazing and ventilation when located close to major roads. Ben's work Included calculations, noise surveys and preparation of reports, along with project management and attendance at project meetings. Ben managed a team of four consultants working for the main contractor.

Belle Vue Sports Village: Ben completed noise surveys, design and noise modelling for the complex scheme, incorporating the new National Speedway Stadium, new National Basketball Performance Centre, and 3G pitches. Work was undertaken from the planning stage to the post-completion verification stage, where the measured noise levels were within 1 dB of the predicted levels.

Environmental Statement Chapters: Ben has prepared several Noise and Vibration ES Chapters.

APPENDIX 3

Noise Measurement Results


"Machine noise loud after 8pm"
"Loud after 10am"
"Loud Machine noise can be clearly heard after 8.30pm all night"
Free-Field Sound Level
75
65
55
45
35
25
15
01/04/2022 13:00
02/04/2022 01:00
02/04/2022 13:00
03/04/2022 01:00
03/04/2022 13:00
04/04/2022 01:00
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05/04/2022 13:00
06/04/2022 01:00
06/04/2022 13:00
07/04/2022 01:00
Date and Time (dd/mm/yyyy hh:mm)
LAeq, 15min
LA90, 15min

Signature: 

Email: angela@dbxacoustics.com