Noise Impact Assessment

Site Address: Land off A16, Surfleet Bank, Spalding, Lincolnshire, PE11 4DP

Client Name: Naylor Farms

Project Reference No: NP-010707

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1. Introduction

NOVA Acoustics Ltd has been commissioned to prepare a noise impact assessment for a plant-based protein extraction factory ('the proposed development') on vacant land off the A16, Surfleet Bank, Spalding, Lincolnshire, PE11 4DP ('the site').

The client has submitted a planning application to the Local Planning Authority ('LPA'), South Holland District Council. The application is titled as follows:

'*H17-1097-23 – Proposed plant-based protein extraction facility and anaerobic digestor plant*'.

This report is intended to form part of the overall application and provides supplementary technical information regarding the site's suitability for the proposed use.

A noise survey has been undertaken to establish the prevailing background sound levels at the closest Noise Sensitive Receptors ('NSRs'). The report details the existing background sound climate and the noise emissions associated with the site to establish what impact, if any, is expected at the surrounding NSRs. Measures required to mitigate noise impact have been recommended where necessary and assessed in accordance with the relevant performance standards, legislation, policy and guidance.

This noise assessment is necessarily technical in nature; therefore, a glossary of terms is included in Appendix A to assist the reader.

1.1 Standards, Legislation, Policy & Guidance

The following performance standards, legislation, policy and guidance have been considered to ensure good acoustic design in the assessment:

- National Planning Policy Framework (2023)
- Noise Policy Statement for England (2010)
- BS4142:2014+A1:2019 – 'Methods for rating and assessing commercial and industrial sound'
- British Standard BS5228:2009+A1:2014 – 'Code of practice for noise and vibration control on construction and open sites'

Further information on the legislation can be found in Appendix B.

1.2 Proposal Brief

The proposal is for a new plant-protein processing facility complete with a factory building, digestate processing ('DP') building, waste transfer ('WT') building and ancillary external plant ('AD plant'). Along the east of the site is a proposed attenuation pond and to the south is a recycling centre. At present, the site is used to grow cabbages.

Note that the details of the recycling centre are not known, therefore it hasn't been included within the assessment. Instead, a fixed plant rating level limit has been set which will be applicable to this area.

It is understood that the majority of plant will be operational 24/7, although no mobile plant or HGV deliveries shall take place outside of daytime hours (07:00 – 23:00).

Figure 1 on the overleaf shows the site layout plan for the proposed development.

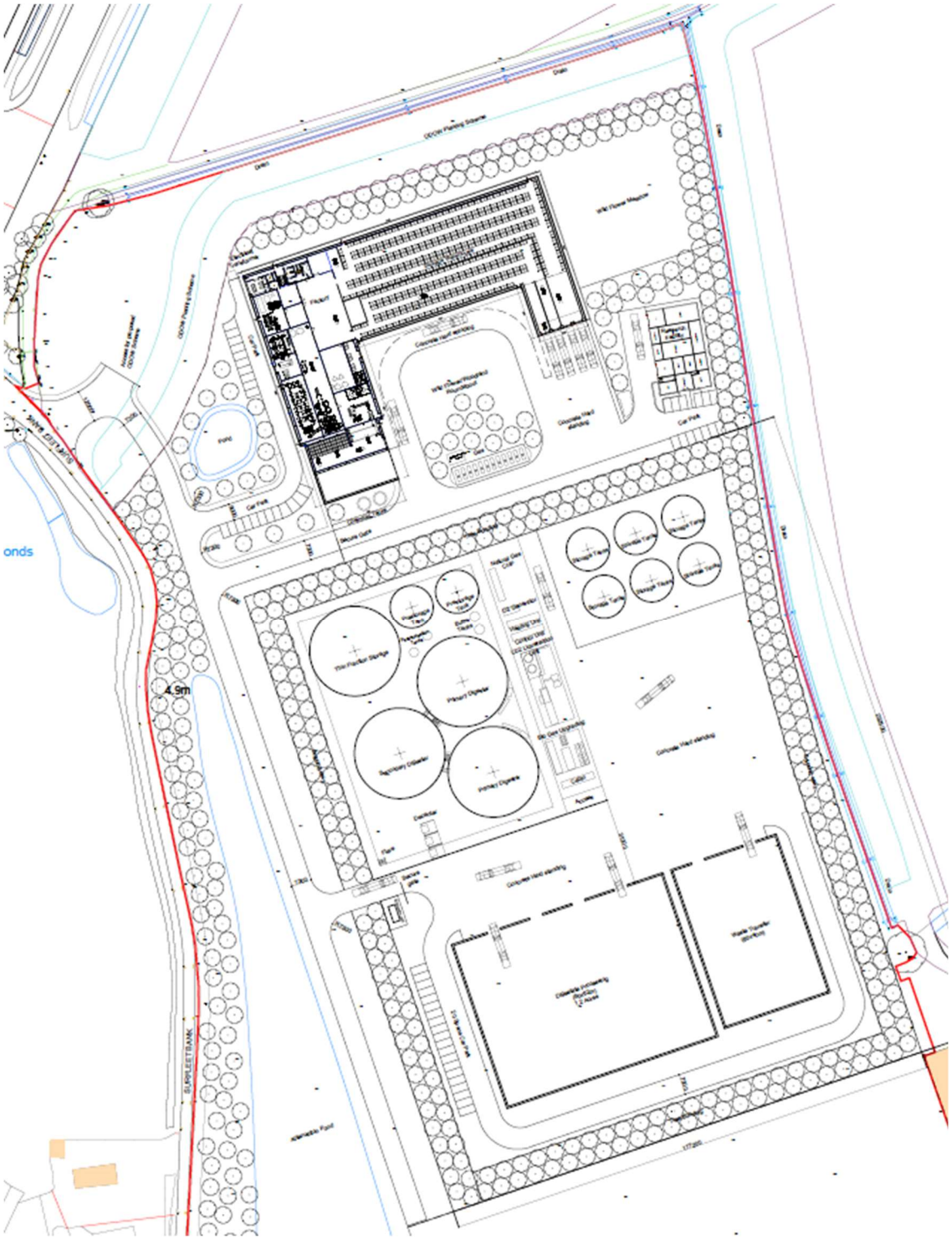


Figure 1 – Site Layout Plan of Proposed Development

1.3 Local Planning Authority

The LPA has combined with nearby councils Boston Borough Council and Lincolnshire County Council to form the South East Lincolnshire Joint Strategic Planning Committee, which is responsible for the Local Plan for the area. The South East Lincolnshire Local Plan 2011-2036, adopted in March 2019, has been consulted and any policies applicable to the site have been reproduced on the overleaf. For conciseness, any large portions of text within the policy not applicable to noise have been removed.

"Policy 2: Development Management

Proposals requiring planning permissions for development will be permitted to provided that sustainable development considerations are met, specifically in relation to:

[…]

6. impact upon neighbouring land uses by reason of noise, odour, disturbance or visual intrusion;

[…]"

And

"Policy 30: Pollution

Development proposals will not be permitted where, taking account of any proposed mitigation measures, they would lead to unacceptable adverse impacts upon:

1. health and safety to the public;

2. the amenities of the area; or

3. the natural, historic and built environment;

By way of:

4. air quality, including fumes and odour;

5. noise including vibration

[…]"

2. Environmental Noise Survey

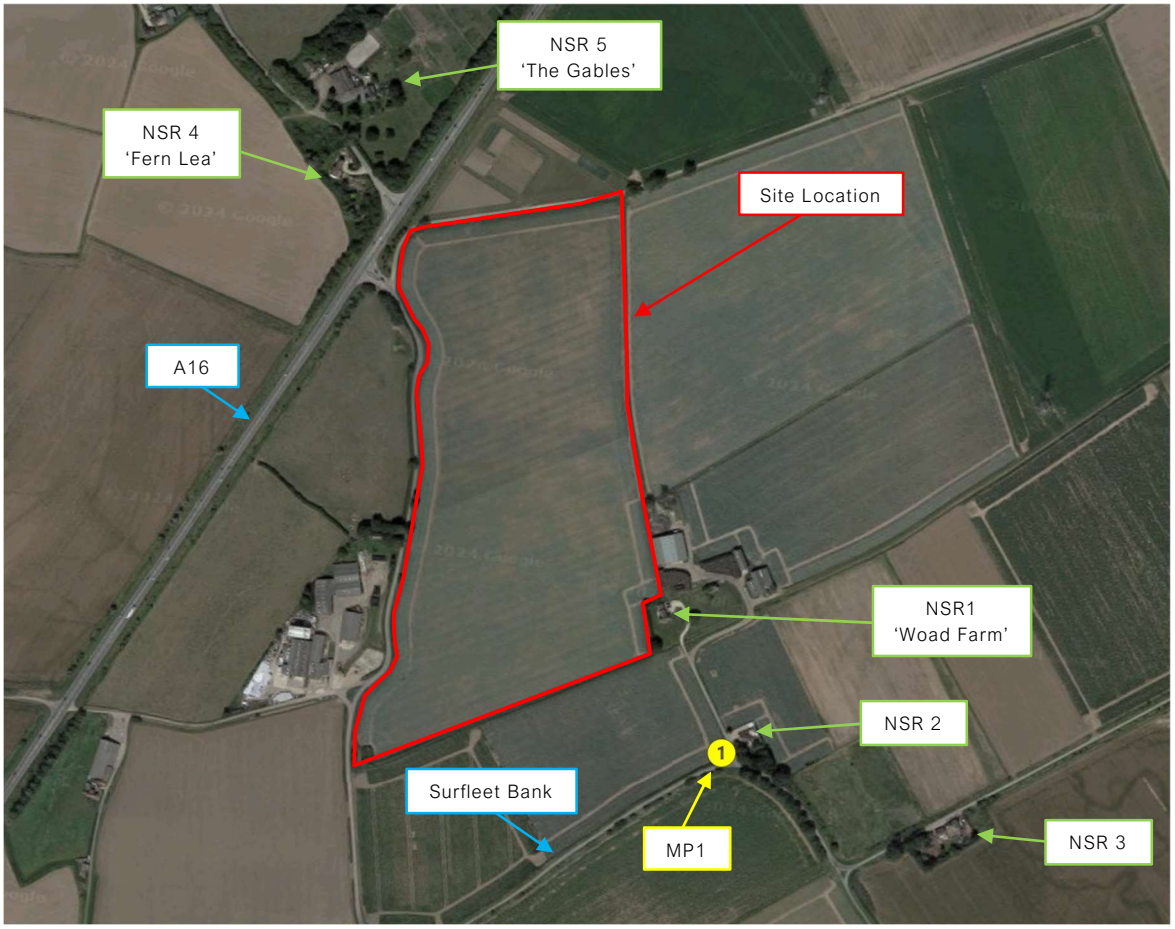
2.1 Measurement Methodology

The following table outlines the measurement dates and particulars.

Location	Survey Dates	Measurement Particulars
MP1	13/02/2024 – 14/02/2024	Equipment affixed to a telegraph post on Surfleet Bank with a measurement height approximately 3m above local ground to avoid interference by the general public. Measurement position representative of the first-floor window of the nearest NSRs.

Table 1 – Measurement Methodology

The figure below outlines the site surroundings and measurement locations:



Imagery ©2023 Infoterra Ltd & Bluesky, Maxar Technologies, The GeoInformation Group, Map data ©2023

Figure 2 – Measurement Locations and Site Surroundings

2.2 Context & Subjective Impression

The site is currently used for agricultural purposes and is situated within a rural area on the outskirts of Spalding known as 'Surfleet Bank' and 'Surfleet Marsh'. The surrounding area predominantly consists of arable farmland, with residential dwellings positioned sporadically around the site. With the exception of the A16 to the west, the majority of the surrounding roads are quiet country roads supporting low levels of traffic, including large agricultural vehicles.

Located to the southeast of the site is 'Woad Farm', which comprises of a residential dwelling and multiple agricultural buildings. This is referred to as 'NSR1' in the previous figure. Approximately 145m and 365m further southeast are two more independent residential dwellings, referred to as NSR2 and NSR3 respectively. Located to the west is a commercial / industrial premises consisting of agricultural buildings; this is understood to be a recycling centre. North of the A16 are residential properties 'Fern Lea' (NSR4) and 'The Gables' (NSR5), which approximately 100m and 160m respectively from the proposed site boundary. Although NSRs 4 and 5 are closer than NSRs 2 and 3, given their proximity to the A16 they are considered to be less sensitive due to the higher noise climate present.

Overall, the acoustic environment is described as being low to moderate in level, with noise from the A16 providing a constant humming noise from passing traffic. Other sources, secondary in nature, include birdsong and local wildlife, the rustling of trees and very infrequent vehicle movements along Surfleet Bank.

Considering the above, it should be acknowledged that the proposed development is likely to present as a new and unfamiliar noise source in the environment.

2.3 Environmental Noise Survey Results

Background Sound Level Analysis

The following section outlines the measured background sound levels that have been used as the baselines for the subsequent BS4142 noise assessments. The figures below show histogram graphs of the background sound levels measured during the daytime and night-time periods throughout the entire measurement period. The complete time history results can be found in Appendix D.

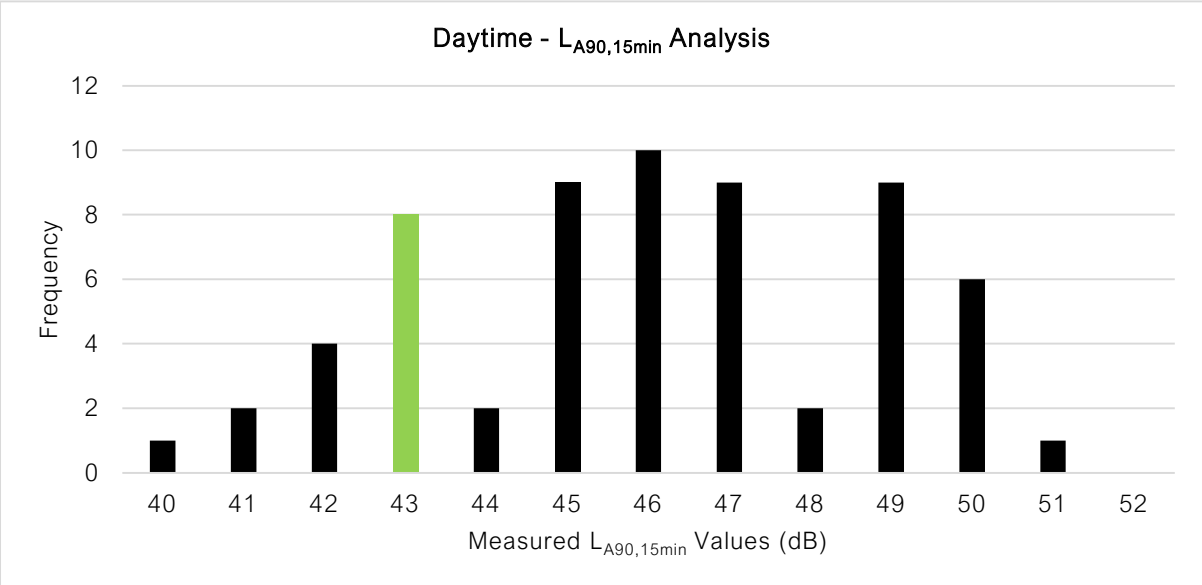


Figure 3 – MP1 Operational Hours Background Sound Level Analysis – Daytime

As can be seen in the figure above, the daytime results are bimodal, therefore as a conservative approach the 'lowest typical' background sound level of **43 dB** $L_{A90,15min}$ has been selected. This has been used as the daytime baseline in the following BS4142 assessment.

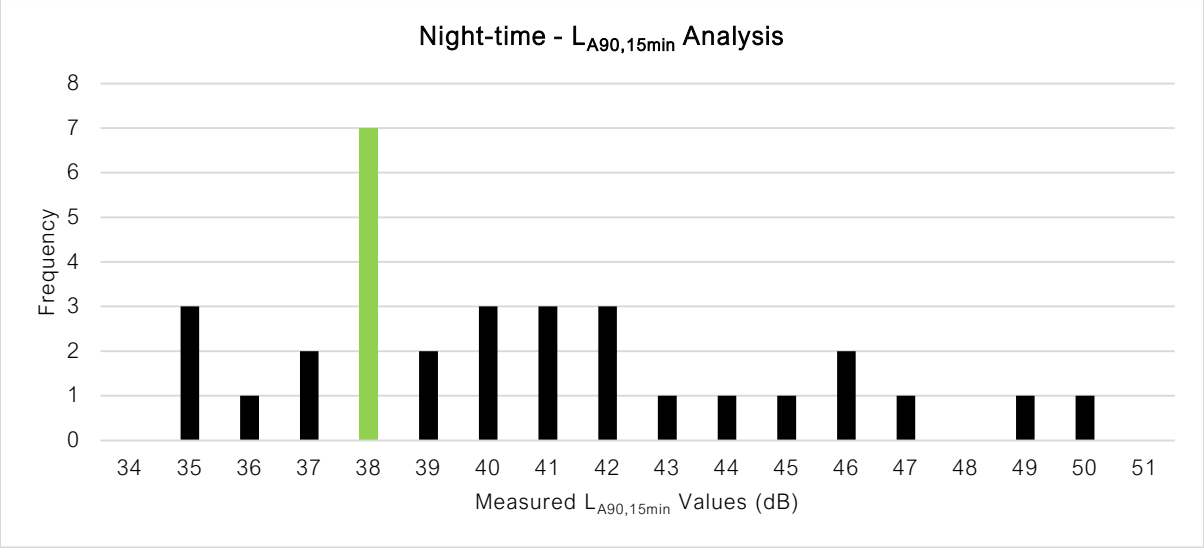


Figure 4 – MP1 Operational Hours Background Sound Level Analysis – Night-time

The night-time $L_{A90,15min}$ sound levels recorded are clearly modal and as such **38 dBA** has been used as the representative background sound level during the night.

3. Noise Impact Assessment

3.1 Specific Sound Levels & Plant Assumptions

Due to the bespoke nature of the equipment being installed, acoustic test data for separate plant elements are not readily available. However, noise data for the plant has been provided by the applicant's M&E designer. It must be noted that the data has the following limitations:

- No octave band spectral values have been provided. All values are single figure 'global' A-weighted levels only.
- No plant dimensions are provided, and all values are given as sound pressure levels measured at varying distances of 1-2m.
- The raw test data has not been provided, as such, the measurement procedures and equipment specifications are unknown.

Given the limitations shown above, the following assessment is **exclusively indicative in nature**. It is intended to be utilised to assess whether the site is likely to be suitable for the proposed use, but is in no way definitive. It is recommended that further assessment is undertaken during the detailed design phase. Further advice is provided in Section 5.

3.2 Processes and Machinery Under Assessment

The main noise generating elements are thought to be as follows:

External Fixed Plant

- This includes various pumps, mixers, gas processing and mixing, power generation, etc.

Internal Noise Breakout

- This includes noise breakout from within the factory, digestate processing and waste processing buildings.

External Mobile Plant

- This is likely to include noise from HGVs and effluent tankers.

The applicant has stated that all noise from input hoppers being loaded, etc. will take place within the digestate processing building, and the material will then be transported around the using pipework. As such, wheeled loaders and forklift trucks will not be operated in the external areas.

3.3 External Fixed Plant

The table contains details of the external plant understood to be included within the development, as provided by the M&E designer.

Plant Name	Quantity	Sound Level Provided (L_{Aeq}, dB)	Measurement Distance	Total Sound Pressure Level at 1m (dB)
CHP	1	113	1m	113
Oxygen Purification	1	66 [1]	--	58
Methane Upgrader	1	85	1m	85
Feed Pump	2	80	1m	83
Heating & Recirculating Pump	3	80	1m	85
Effluent Pump	1	80	1m	80
Thin Fraction Pump	1	80	1m	80
Spiral Mixer	2 per digester / 8 in total	70	2m	85
Spiral Mixer	1 per storage tank / 8 in total	70	2m	85
Roof Blower	12	73	1.5m	87
Flare	1	79	15m	103

Notes:

[1] No distance provided therefore the level is assumed to be a sound power level.

[2] As two different levels were provided for the spiral mixers, the levels with sound protection present have been used.

Table 2 – Sound Pressure Levels of Noise Generating Equipment

Sound power levels for each item of plant are calculated considering the following parameters:

Spiral Mixers

- 15kW spiral mixers are used to constantly mix the material contained in the digestors and storage silos. These are expected to act as point source noise emitters at a distance of 1m. A example product is the *'Landia POP-I Submersible Mixer 15kW'*, the motor for which has a housing with a maximum length of 1.2m, which suggests point source propagation at 1m. Mixers are also located within the digesters and silos; however, they will be fully submersed in material, and as such, are expected to be inaudible.
- It should be noted that sound levels were provided with and without sound protection present. The sound protection configuration must be installed to reduce noise emissions, allowing for the lower of the two values provided to be used within the assessment.

Pumps

- Noise emissions from pumps used for feeding the biogas plant, such as lobe pumps and progressive cavity pumps, are also thought to be exhibiting point source propagation at 1m due to their relatively small dimensions. An example of this is the *'LOBEPRO M100'* rotary pump, which has a maximum length of 0.7m.

CHP Unit and Oxygen Purification Generator

- The combined heat and power gas engine is used to generate electricity using the biogas produced on site. The oxygen purification generator is expected to comprise of various processes that remove hydrogen sulphide from the anaerobic digesters. The sound power levels of the CHP unit and oxygen purification generator are calculated considering the total surface area of each section, using the formula: $L_{WA} = L_{PA}$ *at 1m + 10 log (S).*
- The CHP unit must be housed in an enclosure capable of reducing noise emissions by a minimum of **45 dB**. It is thought that this can be achieved with a 100mm enclosure such as the 'WA-ACP-A100S' from Wakefield Acoustics or a bespoke product from the manufacturer of the CHP. Further assessment will be required when octave band data is available.

Methane Upgrader

- The job of the methane upgrader is to reduce levels of CO_2 in the system whilst increasing the quality of the methane. The majority of the sound emitted from the methane upgrader is thought to come from the gas compression motor. An example unit is the *'Meidinger AG / AHA/ 125/1020/1 G'*, which also emits a sound pressure level of 85 dBA at 1m. As such, this is considered to be exhibit point source behaviour at 1m.

CO_2 Liquefaction System

- The purpose of this system is to improve the carbon intensity (CI) score by recovering and liquefying the CO_2 from the biogas upgrading process. It is assumed that this process is not noise generating as noise emission data has not been provided.

Flare

- A standby gas flare will be situated to the southwestern section of the external plant area. This is typically expected to operate when the CHP is in shutdown for servicing or in case of emergency. As such, it is expected to be used very rarely. To provide a robust assessment a 10% on-time correction will be applied. However, it has been stated by the applicant that noise emissions could reach 79 dBA at 15m, which equates to a sound power level of 111 dBA. In order to avoid adverse impact, it is recommended that this is attenuated to a sound pressure level not exceeding **80 dBA** at 1m.

Roof Blowers

- The roofs of the digesters and silos are constructed from inflatable double membrane systems. In order to maintain a stable pressure, roof blowers are installed which operate during drops in pressure. The noise generating element of a roof blower is thought to be an externally mounted motor. The applicant has provided a range of noise emission values of 73 – 91 dBA at 1.5m. In order to avoid adverse impact, it is recommended that the lower value of **73 dBA** is achieved. This equates to a sound power level of **85 dBA** per blower. Again, it is expected that the blowers will be used rarely, however, to provide a robust assessment a 10% on-time correction will be applied.

Sound Power Level Calculations

Considering the parameters above, the sound power levels are predicted in the following table. All values are calculated assuming that sound pressure levels were measured against one reflective surface (giving a Q factor of 2).

Plant Name	Quantity	Sound Pressure Level at 1m Per Unit (dBA)	Predicted Sound Power Level Per Unit (dBA)	Total Sound Power Level (dBA)
CHP	1	68 [1]	88 [1]	88 [1]
Oxygen Purification	1	58	76	76
Methane Upgrader	1	85	93	93
Feed Pump	2	80	88	91
Heating & Recirculating Pump	3	80	88	93
Effluent Pump	1	80	88	88
Thin Fraction Pump	1	80	88	88
Spiral Mixer	2 per digester / 8 in total.	76	84	93
Spiral Mixer	1 per storage tank / 8 in total.	76	84	93
Roof Blower	12	77	75 [2]	85 [2]
Flare	1	80 [3]	78 [2, 3]	78 [2, 3]
Cumulative Sound Power Level for All External Fixed Plant				101

Notes:

[1] CHP noise emissions with enclosure.
[2] 10% on-time correction applied (-10 dB).
[3] Attenuated level.

Table 3 – Sound Power Levels of Noise Generating Fixed Plant

3.4 Internal Noise Breakout

Internal plant is to be located within the factory, digestate processing building and waste transfer building. Further to this, loading and unloading activities are expected to take place within the waste transfer and digestate processing buildings. The predicted noise levels within the buildings are as follows:

Factory Building

The extent of the internal plant required within the factory and the proposed internal configuration is unknown; however, a similar factory understood to undertake like-for-like processes for the same client is currently under construction following conditional approval being granted by the LPA in January 2022 (planning ref H16-0959-21).

NOVA Acoustics provided a planning stage report for the aforementioned factory which included noise levels for various items of plant present within the proposed factory. An internal level of 85 dB $L_{Aeq,T}$ was not expected to be exceeded within the majority of rooms, in line with the 'Upper Exposure Action Value' specified in the Control of Noise at Work Regulations ('CNWR'). The exception to this is the room containing the compressors and blowers, which are understood to reach sound pressure levels of 100 dB(A) when measured at 1m from the source. Should the same compressors and blowers be required for the factory within the proposed development, it is recommended that localised mitigation is installed to reduce the internal noise level to 85 dB(A), in line with the 'Upper Exposure Action Value' from the CNWR. Further details regarding the plant for the similar factory can be found within NOVA Acoustics report 6470PI dated 02/09/2021.

Should any internal equipment be ducted to the external environment, further attenuation in the form of attenuators or acoustic louvres may be required dependent on the severity of the noise emissions. Any ductwork or external louvres should be placed sympathetically to the surrounding NSRs, with a direct line of sight avoided unless absolutely necessary.

Digestate and Waste Transfer

The location and extent of the plant and activities could not be accurately determined by the M&E designer at this stage, however, considering the usage of the buildings, the following parameters have been used in the calculations:

- From previous experience, ambient noise levels in warehouse areas, where the primary source of noise is forklift loading / unloading, are unlikely to exceed 80 dBA.

Building Constructions and Calculation Parameters

- The building envelopes will be constructed from composite panels, similar to Kingspan KS1000 panels, providing a sound reduction of approximately 25 dB R_W. Rooms will be created within the buildings, giving a total sound reduction 40 dB R_W.
- A diffusivity (C_d) correction of -3 dB is applied as per ISO 9613-2.
- It is assumed that roller shutter doors located on the northern façades of the digestate / waste transfer buildings, and the roller shutter doors on the southern façade of the factory building will be frequently opened to allow for HGV access. As such, to present a worst-case scenario, these are modelled as constantly open.

Fixed Plant for Buildings

NOVA Acoustics have been informed that air purification systems will be installed within the digestate processing and waste transfer buildings which will vent externally. The systems will comprise of scrubbers and carbon filters which will vent to the external atmosphere. It is stated in the manufacturer's literature that noise at the external vents for these systems will not exceed 69 dBA at 1m. No duct lengths, duct dimensions, spectral data or specific locations are available at this stage. Further to this, *'Centrair Solution'* fans will also be included, which operate at 72 dBA at 1m. These have been modelled on the worst-case façades of both buildings. The odour abatement system is assumed to be located internally however, should this not be the case, the assessment must be updated accordingly.

Internally, noise from the fixed plant within the buildings is not expected to exceed 69 dBA, which is negligible when considering the sound reduction provided by the building envelopes.

The assumed fixed plant locations and heights are shown in the figure below. The yellow stars represent the locations of the roof blower motors (positioned at ground level).

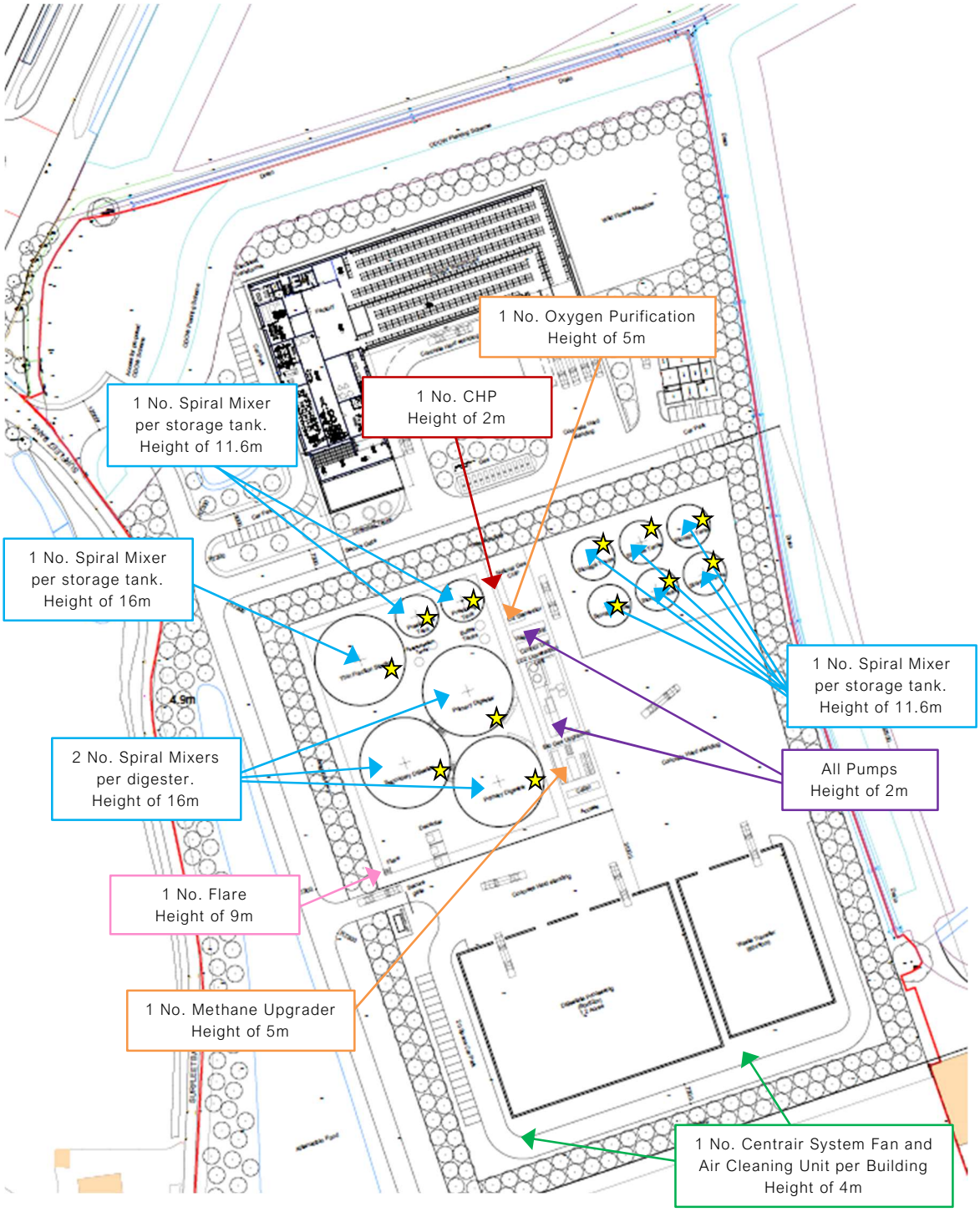


Figure 5 – Assumed Plant Locations

3.5 Mobile Plant

HGVs will access the site six days a week for deliveries and will be limited to daytime hours only, although the number of HGVs is unknown. For the purpose of this assessment, it is assumed that HGVs and effluent tankers will be traversing the site for a maximum of 20% of the time, equating to 12 minutes per hour. According to the plans provided, all loading and unloading will take place internally and as such is not expected to contribute to the assessment outcome.

The table below shows the sound power level used to represent HGVs in the noise model.

Plant Name	Source Reference	Uncorrected L_{WA} (dB)	On-time Correction (dB)	L_W Including Correction (dBA)
HGV or Effluent Tanker in Motion	Table C.11, Ref no. 13	106	-7 [1]	99

Notes

[1] An on-time correction is to allow for 20% movement time.

Table 4 – HGV Sound Power Levels

3.6 Noise Modelling Data

The noise generating equipment and processes defined in the previous section have been modelled within SoundPlan 9.0 prediction software.

The following assumptions have been made within the software:

- To accurately model the land surrounding the Proposed Development, the topographical data has been obtained from the EA's 'National LIDAR Programme' on the DEFRA Data Services Platform.
- For the purpose of the assessment, the ground between the source and receivers is considered to be primarily acoustically 'soft' surfaces.
- ISO 9613-2 assumes a 'downwind' model to the NSRs.
- The sound map grid height has been set to 1.5m, however, the noise levels used in the assessment has been taken from the most exposed point of each façade.
- The Proposed Development has been modelled in accordance with Figure 5 and using the source levels in Table 3.
- Point source emitters have been used to represent all noise sources under assessment. Each source has been modelled at the heights specified in Figure 5.
- To provide a 'robust' assessment, all noise sources are assumed to operate continuously.
- All roller shutters will remain closed during the night-time operational periods.

The elevation drawings provided indicate that a 6m earth bund with planted landscaping on top shall enclose the majority of the site. This bund has been included within the noise mode, as shown in Figures 7 and 9; however, should the bund contain no solid earth element then the calculations and report will need to be updated.

The sound maps showing the specific sound levels emission from the Site can be seen in the following figures.

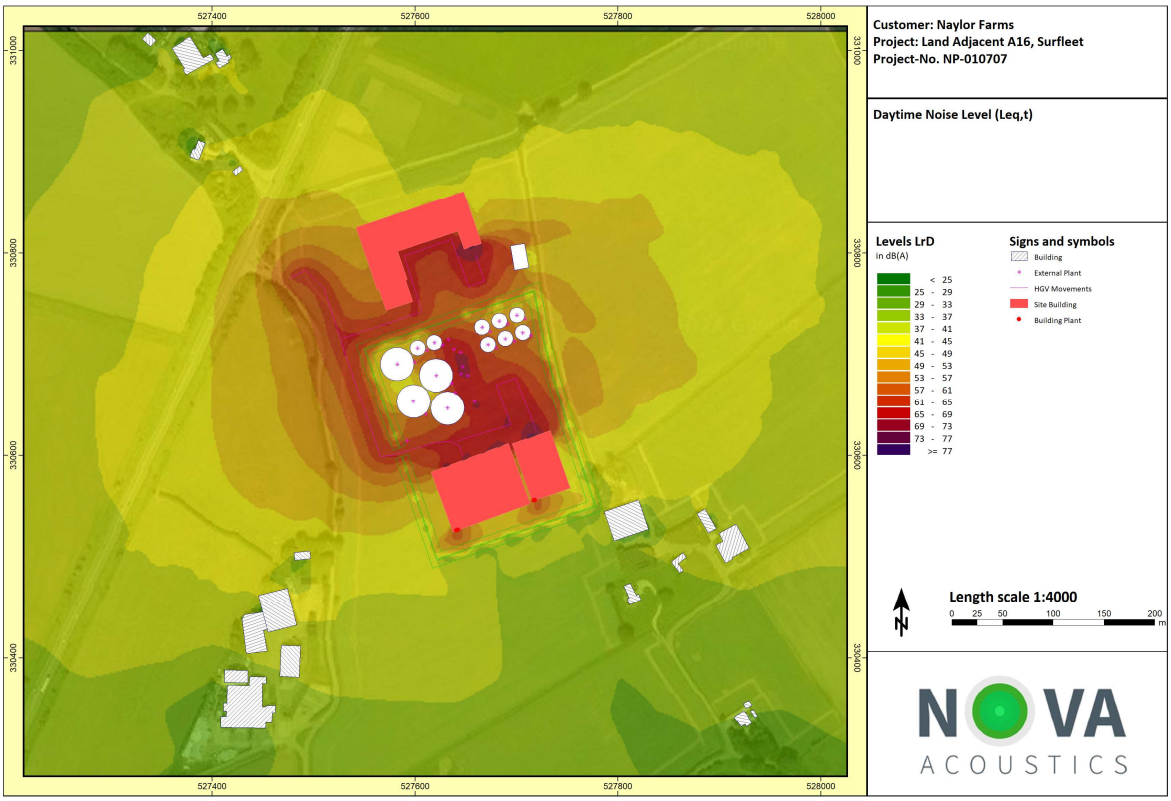


Figure 6 – Daytime Specific Sound Level Map – 1.5 Grid Map Height – 2D

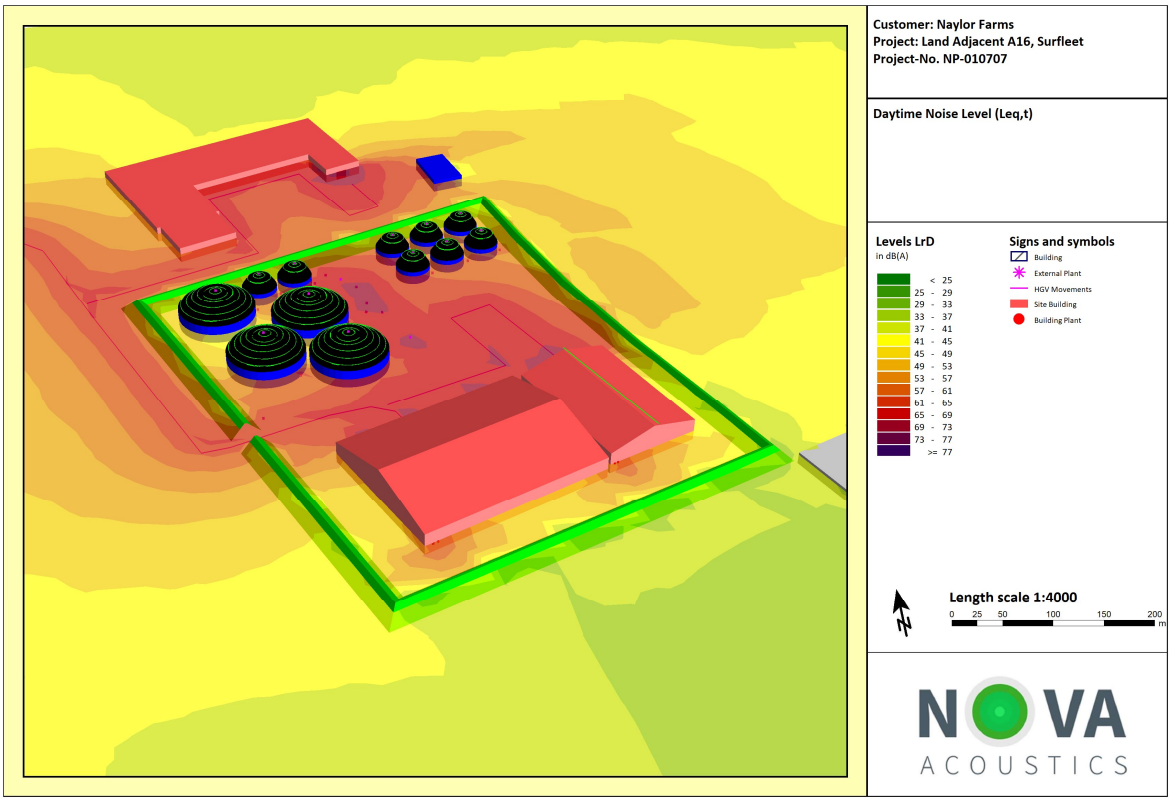


Figure 7 – Daytime Specific Sound Level Map – 1.5 Grid Map Height – 3D

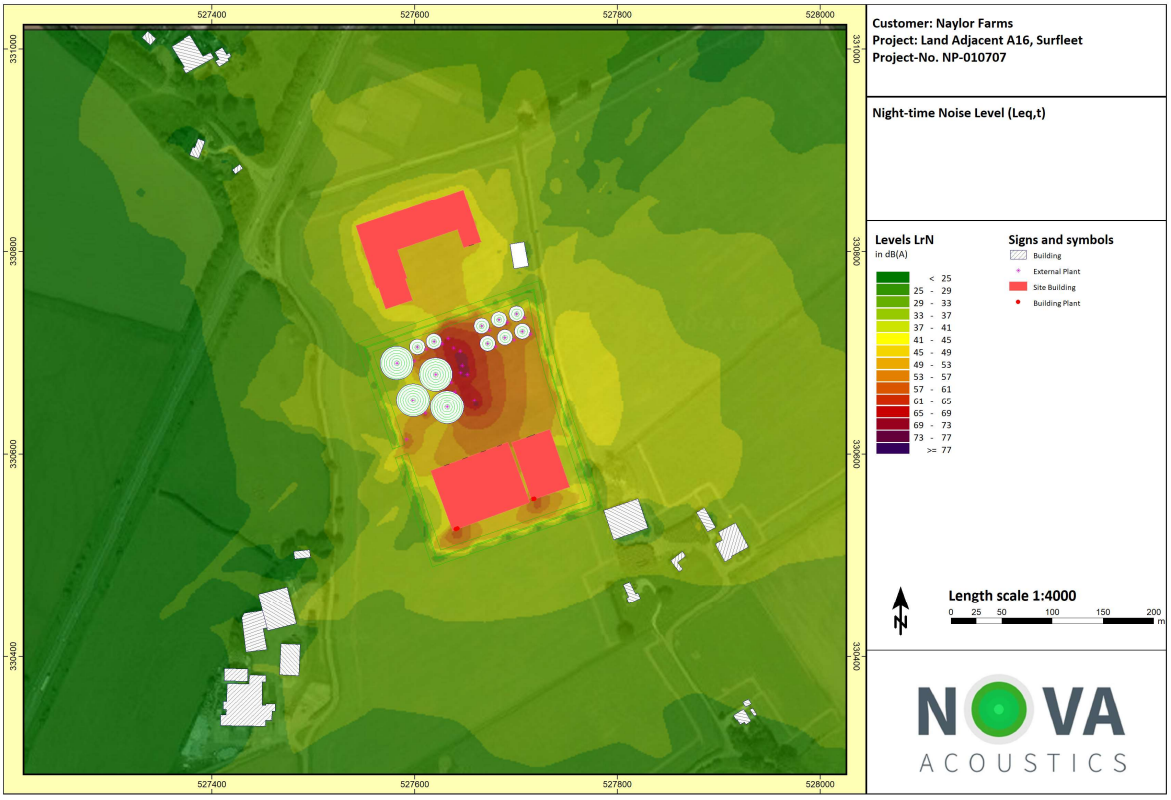


Figure 8 – Night-time Specific Sound Level Map – 1.5 Grid Map Height – 2D

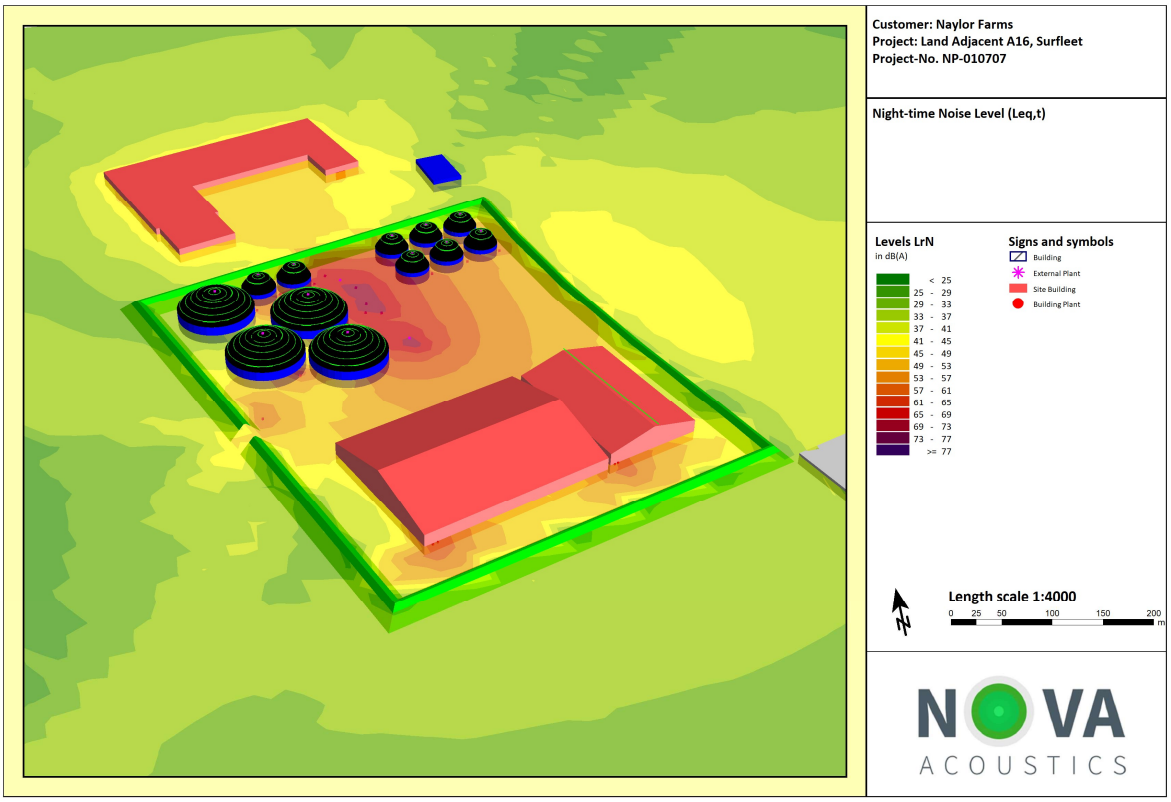


Figure 9 – Night-time Specific Sound Level Map – 1.5 Grid Map Height – 3D

3.7 BS4142 Noise Impact Assessment

The BS4142 noise impact assessments are conducted at the most affected NSRs in the table below. During the daytime, the highest specific noise levels are expected to be experienced at 'Fern Lea' (NSR4) and during the night, the highest levels are expected at 'Woad Farm' (NSR1).

Noise Impact Assessment at NSR4 – Daytime		
Description	**Comments and Explanation**	**Overall (dBA)**
Specific Sound Level at NSR4 (L_{eq})	Cumulative noise levels from the site.	40
Acoustic Feature Correction	A +2 dB penalty is applied for a 'just perceptible' tonality as spectral content of the plant is unknown. A +3 dB penalty is applied for intermittency as multiple items of plant will operate intermittently.	+5
Rating Sound Level ($L_{Ar,T}$)	Specific sound level plus rating penalties.	45
Background Sound Level (MP1 – L_{A90})	Lowest typical background ($L_{A90,15min}$) at MP1 during the daytime.	43
Exceedance of L_{A90}	Exceedance of rating level above background.	+2
BS4142 Assessment Outcome	'Low Likelihood of Adverse Impact, dependent on context'.	
NPPF & NPSE Outcome	'Lowest Observed Adverse Effect Level ('LOAEL').	
Further mitigation measures may be required (see discussion below table)		
Noise Impact Assessment at NSR1 – Night-time		
Description	**Comments and Explanation**	**Overall (dBA)**
Specific Sound Level at NSR1 (L_{eq})	Cumulative noise levels from the site.	33
Acoustic Feature Correction	A +2 dB penalty is applied for a 'just perceptible' tonality as spectral content of the plant is unknown. A +3 dB penalty is applied for intermittency as multiple items of plant will operate intermittently.	+5
Rating Sound Level ($L_{Ar,T}$)	Specific sound level plus rating penalties.	38
Background Sound Level (MP1 – L_{A90})	Typical background measured ($L_{A90,15min}$) at MP1 during the night.	38
Exceedance of L_{A90}	Exceedance of rating level above background.	0
BS4142 Assessment Outcome	'Low Impact, dependent on context'.	
NPPF & NPSE Outcome	'No Observed Adverse Effect Level ('NOAEL').	
No further mitigation measures are deemed necessary.		

Table 5 – BS4142 Noise Impact Assessment

As can be seen in the previous table, the rating noise levels are expected to exceed the background noise level by 2 dB during the daytime period. Analysis of the source contributions has shown that this exceedance is caused primarily by noise from HGVs entering the site. Whilst this is classed as 'Lowest Observed Adverse Effect Level', and may be viewed as acceptable, considering the nature of the acoustic environment, it is likely that further noise control will be required. This could involve the installation of acoustic fencing at the site entrance.

3.8 Recommendations and Best Practicable Means

It is imperative that the site should operate with best practicable means in mind. In line with good acoustic practices, it is recommended that the following procedures are enforced:

- All HGVs should be courteous to the surrounding neighbours and abide to on-site speed restrictions. Use of horns should be prohibited unless required for safety purposes.
- All mobile plant and fixed plant should be turned off when not in use. HGVs should be discouraged from waiting outside nearby residential properties and not left in idle during loading or unloading.
- The use of mobile plant should be strictly prohibited during the night-time period (between 23:00 and 07:00 hours).
- All plant should be routinely serviced and maintained to ensure it is operating at optimal efficiency.
- Plant should be placed sympathetically to the surrounding NSRs with a direct line of sight to fixed plant and ductwork terminations avoided wherever possible.
- Shouting and external radios should be discouraged given the proximity to the nearby farms.
- All façade openings to internally noisy areas should remain closed when in use whenever possible, including any windows, roller shutter doors or other façade openings.
- Should any heavy or mobile plant be required for the proposed recycling centre should be assessed separately to ensure that no adverse impact is anticipated at the surrounding NSRs.

4. Rating Level Limits

Given the level of uncertainty inherent within this assessment and its speculative nature, fixed plant rating level limits have been defined to ensure that any future plant or plant not included as part of this assessment does not result in unacceptable noise levels at the surrounding NSRs.

The rating levels should be determined 1m from most exposed façade of the nearest NSRs and should not exceed the limits outlined in the table below. Note that these limit levels are inclusive of any rating penalties that should be applied to account for increased levels of subjective annoyance, due to factors such as impulsivity, tonality, etc.

Period	Background Sound Levels ($L_{A90,T}$ dB)	Rating Level Limit ($L_{Ar,Tr}$ dB)
Daytime (07:00 – 23:00)	43	33
Night-time (23:00 – 07:00)	38	28

Table 6 – Rating Level Limits

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5. Conclusion and Action Plan

The proposed development has been assessed against the requirements of BS4142 and the LPA's policies and guidance.

In order to achieve a low likelihood of adverse impact, the following mitigation should be implemented:

- All buildings must provide a minimum sound reduction of **40 dB R_w**.
- The CHP unit must be housed in an enclosure capable of reducing noise emissions by a minimum of **45 dB**. It is thought that this can be achieved with a 100mm enclosure such as the 'WA-ACP-A100S' from Wakefield Acoustics or a bespoke product from the manufacturer of the CHP.
- Noise from the flare must be reduced to a maximum of **80 dBA** at 1m.
- The 'Best Practicable Means' defined in Section 3.8 must be adhered to.
- An acoustic fence and gate should be installed by the entrance to the site to reduce noise emissions from HGVs traversing the site.

Considering the number of inherent limitations detailed in Section 3.1, this assessment is **exclusively indicative in nature**. It is intended to be utilised to assess whether the site is likely to be suitable for the proposed use but is in no way definitive. For this reason, it is recommended that further assessment is undertaken during the detailed design phase, which should include a full octave band analysis. If this is not possible, and planning permission is granted, it is instead recommended that a validation testing condition is imposed by the Local Authority. It should be noted that if any further mitigation is required due to the results of the validation testing this is likely to be onerous and costly for the applicant.

Appendix A – Acoustic Terminology

A-weighted sound pressure level, L_{pA}	Quantity of A-weighted sound pressure given by the following formula in decibels (dBA). $L_{pA} = 10 \log_{10} (pA/p_0)^2$. Where: pA is the A-weighted sound pressure in pascals (Pa) and $p0$ is the reference sound pressure (20 μPa)
Background Sound	Underlying level of sound over a period, T, which might in part be an indication of relative quietness at a given location
Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$	Value of the A-weighted sound pressure level in decibels (dB) of a continuous, steady sound that, within a specified time interval, T, has the same mean-squared sound pressure as the sound under consideration that varies with time
Facade level	Sound pressure level 1 m in front of the facade
Free-field level	Sound pressure level away from reflecting surfaces
Indoor ambient noise	Noise in a given situation at a given time, usually composed of noise from many sources, inside and outside the building, but excluding noise from activities of the occupants
Noise Criteria	Numerical indices used to define design goals in a given space
Noise Rating (NR)	Graphical method for rating a noise by comparing the noise spectrum with a family of noise rating curves
Octave Band	Band of frequencies in which the upper limit of the band is twice the frequency of the lower limit
Percentile Level, $L_{AN,T}$	A-weighted sound pressure level obtained using time-weighting "F", which is exceeded for N% of a specified time interval
Rating Level, $L_{Ar,Tr}$	Equivalent continuous A-weighted sound pressure level of the noise, plus any adjustment for the characteristic features of the noise
Reverberation time, T	Time that would be required for the sound pressure level to decrease by 60 dB after the sound source has stopped
Sound Pressure, p	root-mean-square value of the variation in air pressure, measured in pascals (Pa) above and below atmospheric pressure, caused by the sound
Sound Pressure Level, L_p	Quantity of sound pressure, in decibels (dB), given by the formula: $L_p = 10\log_{10}(p/p_0)^{2.}$ Where: p is the root-mean-square sound pressure in pascals (Pa) and $p0$ is the reference sound pressure (20 μPa)
Weighted sound reduction index, R_w	Single-number quantity which characterizes the airborne sound insulating properties of a material or building element over a range of frequencies

Appendix B – Standards, Legislation, Policy, and Guidance

This report is to be primarily based on the following standards, legislation, policy and guidance.

B.1 – National Planning Policy Framework (2023)

Government policy on noise is set out in the National Planning Policy Framework (NPPF), published in 2023. This replaced all earlier guidance on noise and places an emphasis on sustainability. In section 15, Conserving and enhancing the natural and local environment, paragraph 180e, it states:

Preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans;

Paragraph 185 states:

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

a) *Mitigate and reduce to a minimum potential adverse impact resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;*
b) *Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and*
c) *Limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.*

B.2 – Noise Policy Statement for England (2010)

Paragraph 185 of the NPPF also refers to advice on adverse effects of noise given in the Noise Policy Statement for England (NPSE). This document sets out a policy vision to:

Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.

To achieve this vision the Statement identifies the following three aims:

Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- Avoid significant adverse impacts on health and quality of life;
- Mitigate and minimise adverse impacts on health and quality of life;
- Where possible, contribute to the improvement of health and quality of life.

In achieving these aims the document introduces significance criteria as follows:

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur. It is stated that "significant adverse effects on health and quality of life should be avoided while also considering the guiding principles of sustainable development".

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected. It is stated that the second aim above lies somewhere between LOAEL and SOAEL and requires that: "all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also considering the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur."

NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise. This can be related to the third aim above, which seeks: "where possible, positively to improve health and quality of life through the pro-active management of noise while also considering the guiding principles of sustainable development, recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim."

The NPSE recognises that it is not possible to have a single objective noise-based measure that is mandatory and applicable to all sources of noise in all situations and provides no guidance as to how these criteria should be interpreted. It is clear, however, that there is no requirement to achieve noise levels where there are no observable adverse impacts but that reasonable and practicable steps to reduce adverse noise impacts should be taken in the context of sustainable development and ensure a balance between noise sensitive and the need for noise generating developments.

Any scheme of noise mitigation outlined in this report will, therefore, aim to abide by the above principles of the NPPF and NPSE whilst recognizing the constraints of the site.

B.3 – BS4142:2014+A1:2019 – 'Methods for rating and assessing industrial and commercial sound'

Overview

BS4142:2014 sets out a method to assess the likely effect of sound from factories, industrial premises or fixed installations and sources of an industrial nature in commercial premises, on people who might be inside or outside a dwelling or premises used for residential purposes in the vicinity.

The procedure contained in BS4142:2014 for assessing the effect of sound on residential receptors is to compare the measured or predicted sound level from the source in question, the $L_{Aeq,T}$ 'specific sound level', immediately outside the dwelling with the $L_{A90,T}$ background sound level.

Where the sound contains a tonality, impulsivity, intermittency and other sound characteristics, then a correction depending on the grade of the aforementioned characteristics of the sound is added to the

specific sound level to obtain the $L_{Ar,Tr}$ 'rating sound level'. A correction to include the consideration of a level of uncertainty in sound measurements, data and calculations can also be applied when necessary.

Rating Penalty

Section 9 of BS4142:2014 describes how the rating sound level should be derived from the specific sound level, by deriving a rating penalty.

BS4142:2014 states:

"Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, add a character correction to the specific sound level to obtain the rating level. This can be approached in three ways:

a) subjective method;
b) objective method for tonality;
c) reference method."

Due to the nature of the development the subjective method has been adopted to derive the rating sound level from the specific sound level. This is discussed in Section 9.2 of BS4142:2014, which states:

"Where appropriate, establish a rating penalty for sound based on a subjective assessment of its characteristics. This would also be appropriate where a new source cannot be measured because it is only proposed at that time, but the characteristics of similar sources can subjectively be assessed. Correct the specific sound level if a tone, impulse or other characteristics occurs, or is expected to be present, for new or modified sound sources."

BS4142:2014 defines four characteristics that should be considered when deriving a rating penalty, namely; tonality; impulsivity; intermittency; and other sound characteristics, which are defined as:

a) Tonality

A rating penalty of +2 dB is applicable for a tone which is "just perceptible", +4 dB where a tone is "clearly perceptible", and +6 dB where a tone is "highly perceptible".

b) Impulsivity

A rating penalty of +3 dB is applicable for impulsivity which is "just perceptible", +6 dB where it is "clearly perceptible", and +9 dB where it is "highly perceptible".

c) Other Sound Characteristics

BS4142:2014 states that where "the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distance against the residual acoustic environment, a penalty of +3 dB can be applied."

d) Intermittency

BS4142:2014 states that when the "specific sound has identifiable on/off conditions, the specific sound level ought to 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."

Background Sound Level

The background sound level is the underlying level of sound over a period, T, and is indicative of the relative quietness at a given location. It does not reflect the occurrence of transient and/or higher sound level events and is generally governed by continuous or semi-continuous sounds.

To ensure the background sound level values used within the assessment are reliable and suitably represent both the particular circumstance and periods of interest, efforts have been made to quantify a 'typical' background sound level for a given period. The purpose has not been to simply select the lowest measured value. Diurnal patterns have also been considered as they can have a major influence on background sound levels, for example, the middle of the night can be distinctly different (and potentially of lesser importance) compared to the start or end of the night time period for sleep purposes.

Since the intention is to determine a background sound level in the absence of the specific sound that is under consideration, it is necessary to understand that the background sound level can in some circumstances legitimately include industrial and/or commercial sounds that are present as separate to the specific sound.

Assessment of Impact

BS4142:2014 states: "The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs". An estimation of the impact of the specific sound can be obtained by the difference of the rating sound level and the background sound level and considering the following:

- "Typically, the greater this difference, the greater the magnitude of the impact."
- "A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context."
- "A difference of around +5dB 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 negligible impact, depending on the context."

Interpreting the guidance given in BS4142:2014, with consideration of the guidance given in the NPSE and NPPG Noise, an estimation of the impact of the rating sound is summarised in the following text:

- A rating sound level that is +10 dB above the background sound level is likely to be an indication of a Significant Observed Adverse Effect Level;
- A rating sound level that is +5 dB above the background sound level is likely to be an indication of a Lowest Observed Adverse Effect Level;
- The lower the rating sound 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 sound level does not exceed the background sound level, this is an

indication of the specific sound source having a negligible impact and would therefore classified as No Observed Adverse Effect Level.

During the daytime, the assessment is carried out over a reference time period of 1-hour. The periods associated with day or night, for the purposes of the Standard, are 07.00 to 23.00 and 23.00 to 07.00, respectively.

Appendix C – Environmental Survey

C.1 – Time History Noise Data

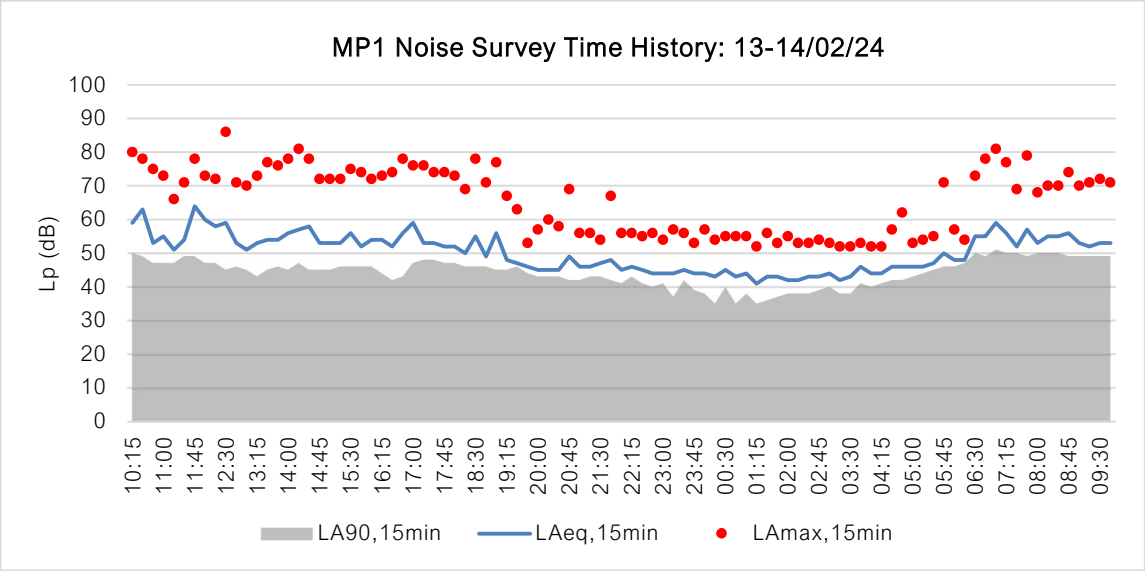

Figure 10 – MP1 Noise Survey Time History

C.2 – Surveying Equipment

Piece of Equipment	Serial No.	Calibration Deviation
Svantek 971 Class 1 Sound Level Meter	141345	0.0
CESVA CB011 Class 1 Calibrator	T253551	

Table 7 – Surveying Equipment

All equipment used during the survey was field calibrated at the start and end of the measurement period with no deviation present. All sound level meters are calibrated every 24 months, and all calibrators are calibrated every 12 months by a third-party calibration laboratory. All microphones were fitted with a protective windshield for the entire measurements period. Calibration certificates can be provided upon request.

C.3 – Meteorological Conditions

As the environmental noise survey was carried out over a long un-manned period no localised records of weather conditions were taken. However, all measurements have been compared with met office weather data of the area, specifically the closest weather station, and the data from the weather station is outlined in the table below. When reviewing the time history of the noise measurements, any scenarios that were considered potentially to be affected by the local weather conditions have been omitted. The analysis of the noise data includes statistical and percentile analysis and review of minimum and maximum values, which aids in the preclusion of any periods of undesirable weather conditions. The weather conditions were deemed suitable for the measurement of environmental noise in accordance with BS7445 Description and Measurement of Environmental Noise. The table below presents the average temperature, wind speed and rainfall range for each 24-hour period during the entire measurement.

Weather Conditions – Rippingale (Approx. 18.3km West of Site)				
Time Period	Air Temp (^{0}C)	Rainfall (mm/h)	Prevailing Wind Direction	Wind Speed (m/s)
13/02/24 – 00:00 – 23:59	4.1 – 7.4	0.0 – 2.0	SSW	0.0 – 4.9
14/02/24 – 00:00 – 23:59	11.4 – 14.2	0.0	SSW	0.0 – 3.5

Table 8 – Weather Conditions

Rainfall occurred between 15:30 and 16:00 as a short shower and has not affected the measured noise levels.

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