MATRIX ACOUSTIC DESIGN CONSULTANTS

Thoresby Bridge Farm
North Cotes
DN36 5TY

Proposed Replacement Poultry Units

NOISE IMPACT ASSESSMENT

Acoustics Report M2405/R01
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1. Introduction

This acoustic report documents a noise impact assessment for the proposed replacement poultry units at Thoresby Bridge Farm, North Cotes; Figures 1 – 3.

The report is divided into the following sections:

- Section 2: Overview of the Development
- Section 3: Noise Assessment Criteria
- Section 4: Background Noise Survey
- Section 5: Noise Impact Assessment
- Section 6: Conclusion
- Appendix A: Noise monitor and weather station data
- Appendix B: Calculations
- Appendix C: Extract fan noise data

2. Overview of the Development

The proposed scheme is for the demolition of the existing poultry development at Thoresby Bridge Farm, North Cotes and the construction of two new poultry units.

The nearest private dwellings, labelled Receptors A and B in Figure 1, are approximately 105m and 195m respectively from the proposed replacement poultry sheds.

For the assessment, the main operational noise sources generated by proposed replacement poultry units have been reviewed, namely:

- **Ventilation extract fans:** The proposed replacement poultry units will be ventilated using roof mounted and gable end extract fans. These will consist of:
  - *Roof extract fans:* 19 x Skov BA820-10 units, arranged along the ridge of the shed
  - *Gable end fans:* 8 x Skov DA1700-5 units, located on the south-east gable end

  Manufacturers' data sheets for the fans are provided in Appendix C.

  The roof fans will typically provide the ventilation requirements on their own; the gable end fans are only needed if the ridge fans are not able to provide the required ventilation due to failure or during periods of high external temperatures.

  There will be an unobstructed noise path between the ridge mounted extract fan duct terminations and Receptors A and B. The gable end fans however will be fully acoustically shielded (i.e., the line of sight will be fully block) by the poultry units themselves.

- **Transport noise:** Transport noise includes commercial vehicles manoeuvring and loading/unloading stock on the concrete apron to the north of the proposed units.

  Table 1 provides the number and type of commercial vehicle movements for the existing poultry development and the proposed number for the replacement sheds.

  As can be seen in Table 1, there will be no change in the type of vehicles accessing the site or activities undertaken as a result of the replacement poultry units. There will however be an increase in the number of vehicle movements, though this will not result in a greater number of movements within any BS4142 1hr assessment period.

  Activities on the concrete apron of the proposed replacement poultry units will be fully acoustically shielded from Receptor A by the retained farmhouse/barn; there will be an unobstructed noise path for Receptor B without the noise barrier shown in Figure 7.

Note that for the concrete apron serving the existing poultry development this is partially shielding of the activities for Receptor A and an unobstructed noise path for Receptor B.

As with the existing poultry units, for the majority of the time the only noise emissions associated with the poultry development will be those from the extract fans.

The proposed replacement poultry units are within context of the existing poultry development, in both terms of operation and nature of noise emissions.

Table 1. Existing and proposed commercial vehicle movements

Activity	Vehicle Size	Frequency per flock	
		Existing (68,300 birds)	Proposed (114,000 birds)
Shavings Delivery	16.5m Articulated HGV	1	1
Chick Delivery	16.5m Articulated HGV	1	2
Feed Delivery	16.5m Articulated HGV	8	13
Bird Removal	16.5m Articulated HGV	9	14
Manure Removal	16.5m Articulated HGV	4	6
Dirty Water Removal	Tanker	1	1
Dead Bird Collection	7.5 tonne box van	6	6
Gas Deliver	Tanker	3	5
Total per flock		33	48
Total per annum (7.6 flocks)		**251 (502 movements)**	**365 (730 movements)**

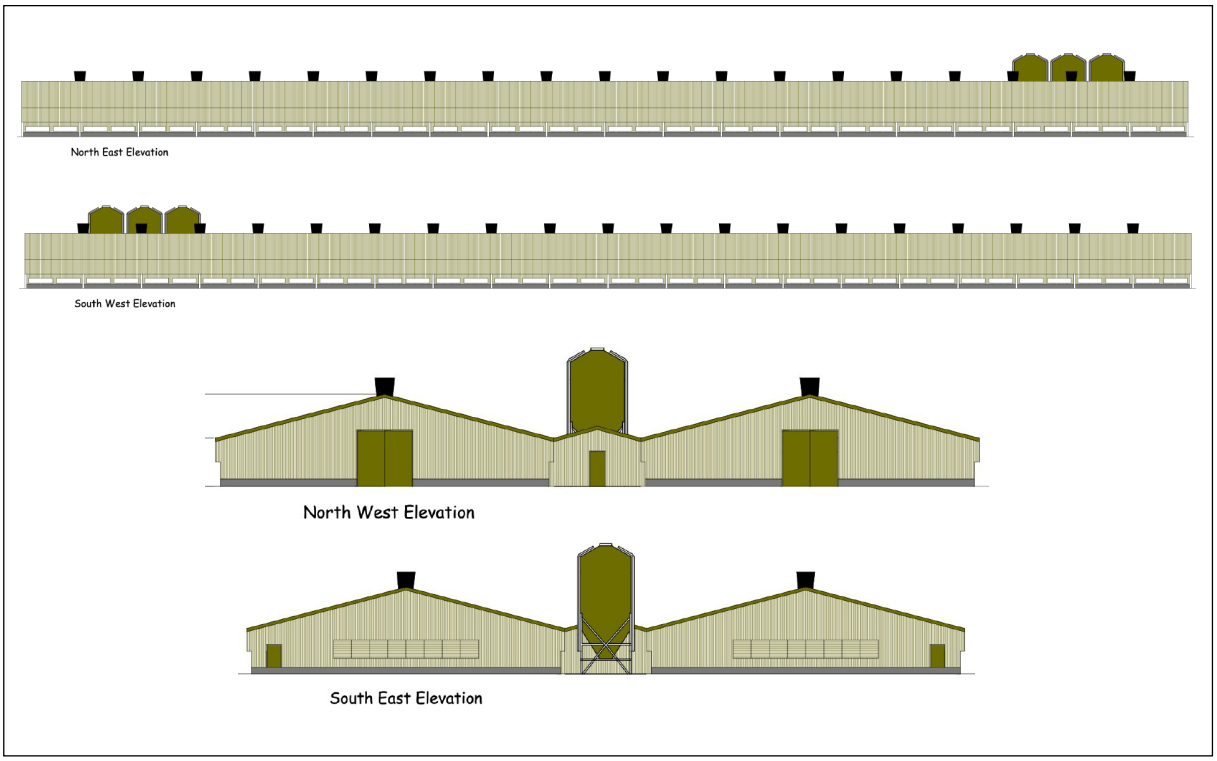


Figure 1. Elevations of proposed replacement poultry units

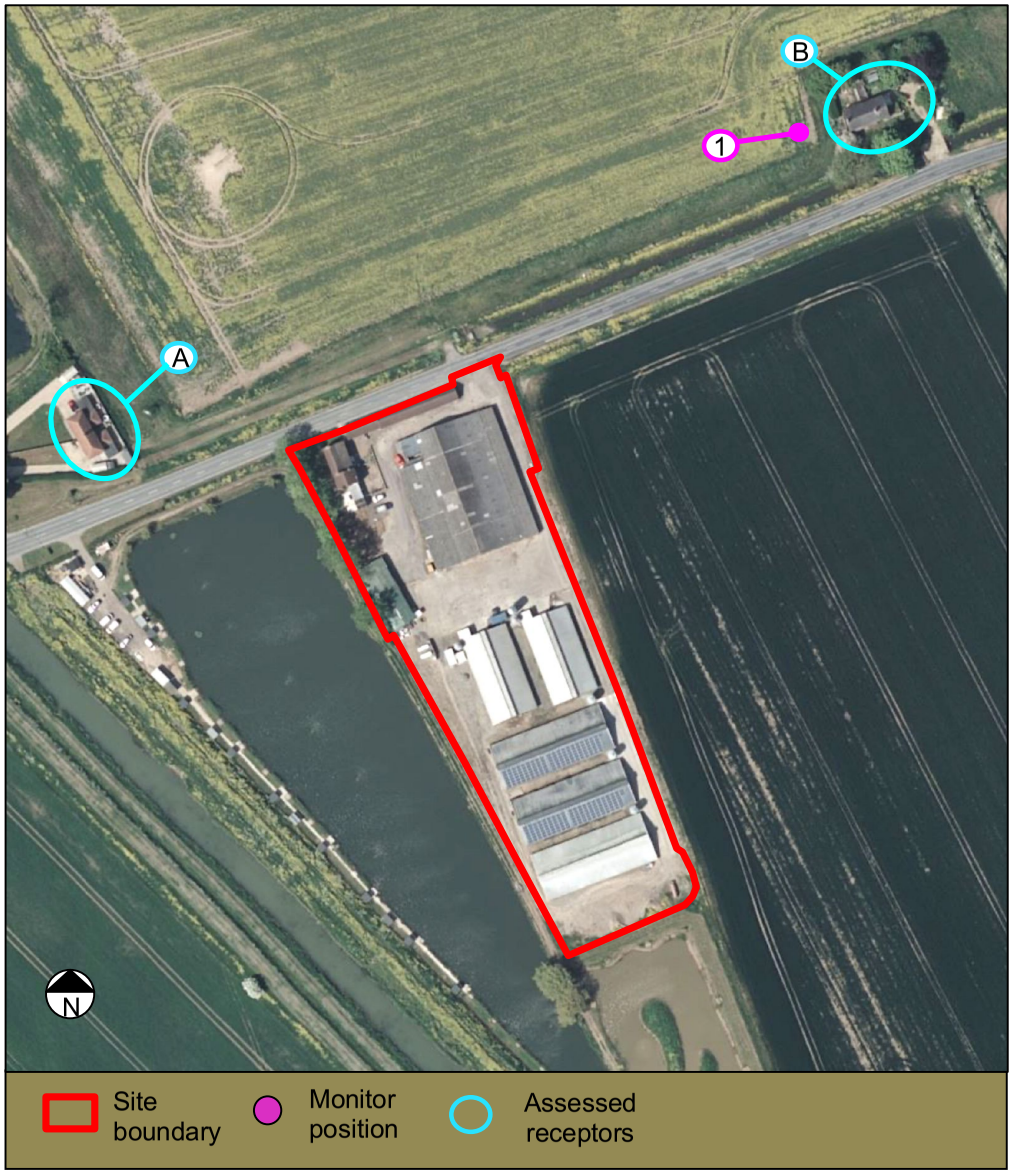


Figure 2. Aerial view (source: www.bing.com) showing existing development, monitor position and assessed receptors

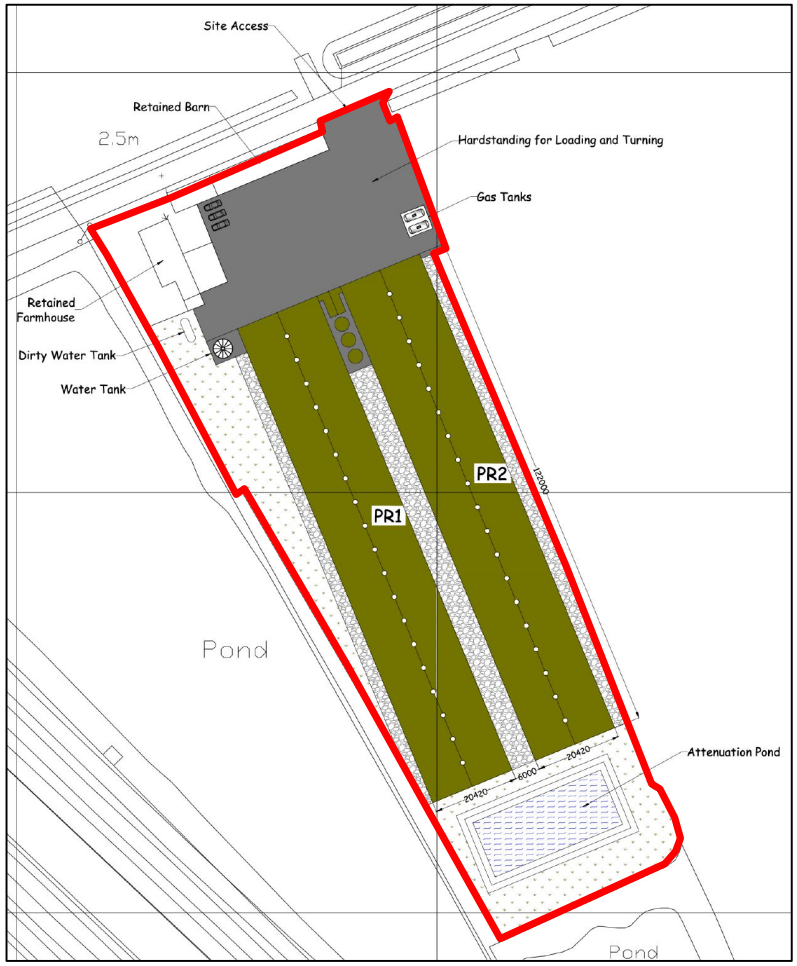


Figure 3. Plan showing the proposed replacement poultry units

3. Noise Criteria

To review the noise impact of the proposed replacement poultry unit's extract fans and transport related activity noise emissions, the following guidance documents have been considered;

3.1 BS4142:2014+A1:2019

BS4142 provides a methodology to assess the impact of industrial and commercial noise affecting dwellings, whereby the 'typical' background noise level is deducted from the industrial noise Rating Level (industrial noise corrected to account for the 'on-time' and noise character of the noise source. The following guidance is given based on the established difference:

- A difference of around +10dB or more is likely to be an indication of significant adverse impact, depending on context
- A difference of +5dB is likely to be an indication of an adverse impact, depending on 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 context

Context, as defined in BS4142:2014, includes the consideration of the following factors:

- The absolute level of the noise emissions
- Character and level of the residual sound compared to the character and level of the Specific Level
- Sensitivity of the receptor and any acoustic design measures (e.g., façade sound insulation, use of mechanical ventilation and acoustic screening) incorporated at premises used for residential purposes

Where background noise and Rating Levels are low, BS4142:2014+A1:2019 states that *'absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night'*. Low background noise and rating levels are not defined. However, in BS4142:1997 it states that '*background noise levels below 30dB and rating levels below about 35dB are considered to be very low'*.

To take account of industrial/commercial noise sources that do not operate continually an 'on-time' correction is applied using:

$$- 10 \log (r/r_{ref})$$

Where:

r_{ref}. = reference time (1hr between 07:00 – 23:00hrs and 15 minutes between 23:00 – 07:00hrs)

r = total 'on-time' during the reference period

Note that the shorter reference time interval between 23:00 – 07:00hrs is designed to penalise industrial/commercial noise events that occur during the night.

BS4142 provides four noise character correction categories with associated penalties that must be applied when determining the Rating Level, namely:

- **Tonality:**
  - Not perceptible = 0dB
  - Just perceptible = +2dB
  - Clearly perceptible = +4dB
  - Highly perceptible = +6dB

- **Impulsivity:**
  - Not perceptible = 0dB
  - Just perceptible = +3dB
  - Clearly perceptible = +6dB
  - Highly perceptible = +9dB
- **Intermittency:** +3dB if the intermittency of operation is readily distinctive against the residual noise environment
- **Other:** +3dB applied if the specific sound is neither tonal or impulsive but features noise characteristics that are readily distinctive against the residual noise environment

With regard to noise ingress (noise from outside to inside), BS4142 states that *'The standard is not intended to be applied to the assessment of indoor sound levels'* and the assessment methodology *'... is not intended to be used to assess the extent of the impact at indoor locations'*; in the worked Examples 6 and 8 given in BS4142, comparison with BS8233 noise ingress limits is used to review potential acceptability.

3.2 Noise Ingress (BS8233:2014)

BS8233 provides guidance noise ingress limits for habitable rooms within residential premises, namely;

- Living rooms: $L_{Aeq,16hr}$ 35dB (day)
- Dining room/area: $L_{Aeq,16hr}$ 40dB (day)
- Bedrooms: $L_{Aeq,16hr}$ 35dB (day), $L_{Aeq,8hr}$ 30dB (night)

In order to avoid sleep disturbance, in accordance with guidance given in PRoPG, individual noise events should not exceed 45 dB $L_{Amax,F}$ more than 10 times within bedrooms during the night period.

The above noise limits must be met with windows closed and trickle vents (if applicable) open.

Where the external noise source has a specific character, such as a strong low-frequency content or is irregular enough to attract attention, BS8233 advises lower noise limits might be appropriate.

Taking into account the characteristics of the potential noise emissions from the proposed replacement poultry units (intermittent and some noise sources may include impulsive elements) we consider noise ingress levels 5dB below BS8233 noise ingress limits will be considered acceptable.

Purge ventilation, which could be required on occasion to mitigate against overheating, may require open windows. It is generally accepted that there is a compromise between providing rapid ventilation via an open window and the unavoidable higher noise ingress levels (a façade with an open window provides around a 13dB reduction between outside to inside).

For this situation 'Acoustics Ventilation and Overheating - Residential Design Guide: 2020' (AVO) advises that 'reasonable' internal conditions for habitable rooms may be considered to be noise ingress levels up to 5dB above BS8233's noise ingress limits.

In line with AVO's guidance, we therefore consider that 'reasonable' poultry development noise ingress levels via an open window will be 5dB above are suggested noise ingress level with windows closed; this equates to parity with the noise ingress limits given in BS8233.

3.3 Change in transport noise emissions

To review the impact in relation to the change in transport related noise emissions, the following boundaries have been used (these are based on guidance given in the Institute of Environmental Management & Assessment's 'Guidelines for Environmental Noise Impact Assessment: 2014'):

- **0 to <3dB: Negligible;** under normal conditions a change of less than 3dB is not perceptible (this takes into account there will be no change in nature or spectral characteristics in the noise sources)
- **3 to <5dB: Marginal;** the change in noise emissions will be just perceptible
- **5dB to <10dB: Adverse;** change in noise emission will be perceptible
- **≥10dB: Significant Adverse;** change in noise emissions will be clearly perceptible (a 10dB increase is perceived as a doubling in noise level)

4. Noise Survey

A noise survey has been conducted in order to establish representative background noise levels at the nearest dwellings to the proposed development. During the survey the existing poultry units were not operational.

- **Survey dates**: Tuesday 5th – Wednesday 6th March 2024
- **Weather;** Table A2, Appendix A:
  - Precipitation: Dry
  - Wind Speed: Highest recorded wind speeds of 1.7m/sec; median 0.0m/s
  - Wind direction:
    - 13:30 – 01:00hrs: N – NE
    - 01:00 – 10:00hrs: NW
    - 10:00 – 14:00hrs: S - SW
- **Noise monitor locations:** With the microphone attached to a tripod, the noise monitor was located at Position 1 as shown in Figure 2.
- **Weather station location:** Weather station, mounted on a tripod, located at Position 1; Figure 2
- **Equipment:**
  - Weather Station: Kestrel type 4500
  - Noise monitors: Brüel & Kjær Type 2238
- **Monitor configuration:**
  - Weather station: Configured to measure the average wind speed and temperature over consecutive 10-minute periods
  - Noise Monitors: configured to measure consecutive 15-minute samples of noise.
- **Calibration:** Noise monitors calibrated before and after the survey using a Brüel & Kjær Type 4231 calibrator with no deviations found

All noise measurements are free-field. Full tabulated results are given in Tables A1 and A2, Appendix A.

Figure 4 shows the variation in the measured maximum (L_{Amax}), ambient (L_{Aeq}) and background (L_{A90}) noise levels obtained at Position 1.

The weather conditions will not have adversely affected the noise measurements.

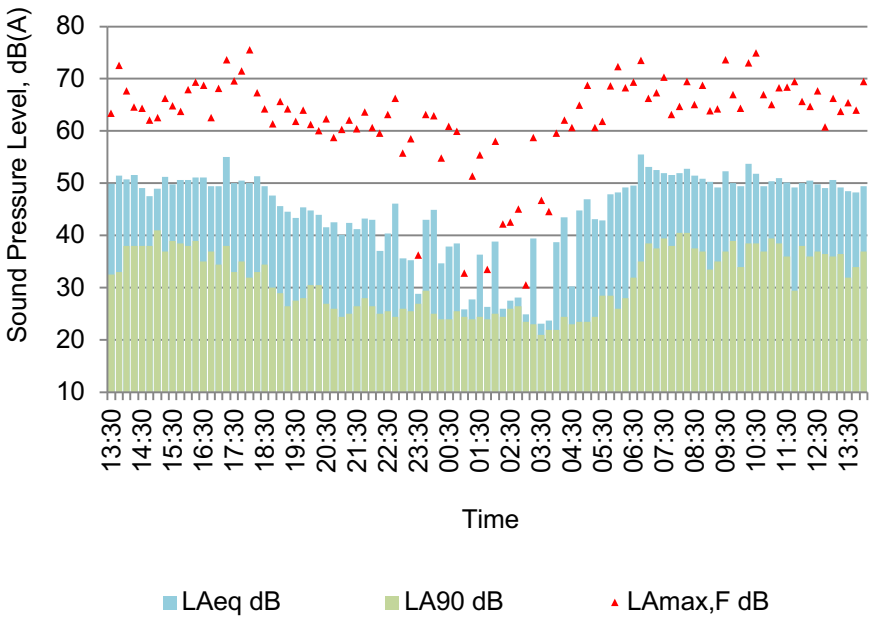
4.1 Survey observations

The dominant noise source affecting the local area was noted to be from vehicle passes on A1031. As the existing poultry development was not operational, the measurement positions were not exposed to any commercial noise.

4.2 Representative background noise level, L_{A90}, at Receptors A and B

Figure 4 shows the variation in the background (L_{A90}) noise levels obtained at Position 1.

Figure 4. Position 1 noise monitor data (free-field)



Analysing the survey data, typical background noise levels have been established for the day, evening and night periods:

- Day (07:00 – 20:00hrs): L_{A90} 37dB
- Evening (20:00 – 23:00hrs): L_{A90} 25dB
- Night (23:00 – 07:00hrs): L_{A90} 24dB

The above values are considered to be representative of the typical background noise levels that will occur at Receptors A and B. It should be highlighted that the evening and night period background noise levels are very low.

5. Noise Impact Assessment

5.1 Calculation of Extract Fan & Transport Noise Emissions at Receptors A and B

The full calculations of the noise emissions from the proposed replacement poultry unit's extract fans and transport activities on the concrete apron are provided in Tables B1 – B3, Appendix B.

5.2 Mitigation measures

The following mitigation measures have been included in the assessment:

- *Roof extract fans:* Attenuators fitted to the atmosphere side of each roof extract fan that achieve the minimum insertion losses given in Table 2.

Table 2. Minimum insertion losses for roof extract fan attenuators			
Octave Band Centre Frequency, Hz			
63	125	250	500
3	5	9	13

- *Transport:* 2m high noise barrier erected along the north-east boundary of the concrete apron; Figure 7. The noise barrier must have a minimum surface density of 10kg/m^2 and be of a closed surface without large crack or gaps. Suitable constructions are a good quality close-boarded timber fence or masonry wall.

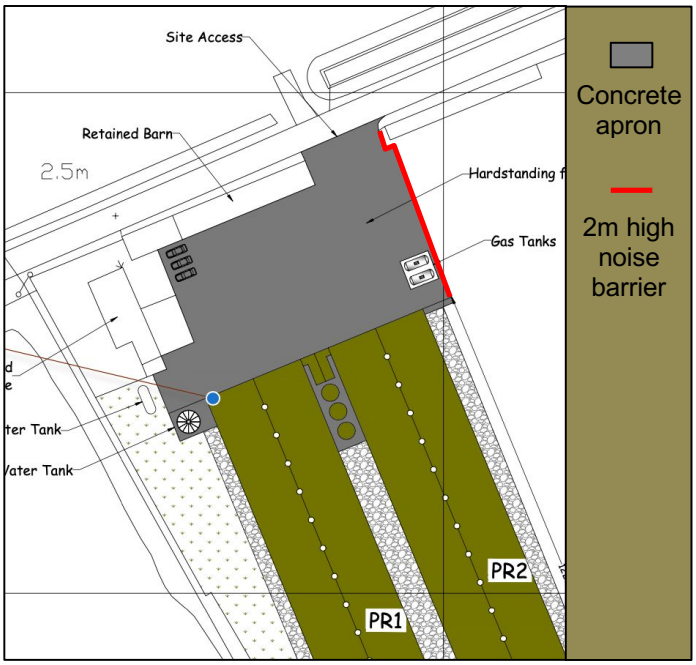


Figure 7. Plan showing advised 2m high noise barrier along the north-east boundary of the concrete apron

5.3 Source Noise Data

- **Extract fans:**
  - Roof extract fans
    - Type: Skov DA820-10
    - Sound Pressure Level: 69dB(A) at 2m, 45° lateral; see Appendix C for manufacturers data sheet
    - Total number of units: 19 per shed
    - Location: ridge mounted, arranged along the length of the shed
  - Gable end extract fans
    - Type: Skov DA1700-5
    - Sound Pressure Level: 70dB(A) at 2m, 45° lateral; see Appendix C for manufacturers data sheet
    - Total number of units: 8 per shed
    - Location: south-east gable end
- **Transport noise:** Inhouse measured source noise levels
  - Stock delivery/collection (HGV arriving/departing, manoeuvring and loading/unloading using a diesel forklift): $L_{Aeq,1hr}$ 60dB, $L_{Aeq,15\ mins}$ 62dB, $L_{Amax,F}$ 79dB at 20m

5.4 Extract Fan Operation

The temperature within the sheds is determined by a combination of the heat generated by the birds themselves, the external temperature and the ventilation provided by the extract fans.

To provide sufficient ventilation of the bird generated heat, as required to maintain the ideal internal operating temperature of around 20°C, up to 25% of the roof extract fans will be required to operate (either intermittently or on variable speed).

With the influence of the external temperature additional extract fans may be required in order to maintain the ideal operating internal temperature. Here the fans are operated in Stages, triggered with each 1°C rise above the ideal internal temperature. The highest Stage will typically only be triggered when the internal temperature rises above 23°.

Normally the roof extract fans will provide sufficient extraction on their own; the gable end fans are only required during periods of extreme external temperatures or due to failure of the roof extract fans.

The operation of 100% of the roof extract fans, and additionally the gable end fans if required, are only expected to occur during the day period when the external temperatures have the potential to be higher.

During the evening and night, when the external temperature will fall, there will be a corresponding decrease in the number of roof extract fans needed above those for bird generated heat alone; the expected percentage of ridge extract fans required to maintain the set temperature are 50% and 25% for the evening and night periods respectively.

For the assessment the calculations have therefore reviewed the following scenarios:

- Day (07:00 – 20:00hrs): 100% roof and gable end extract fans operating
- Evening (20:00 – 23:00hrs): 50% roof extract fans operating
- Night (23:00 – 07:00hrs): 25% roof extract fans operating

5.5 Transport Vehicle Operation

Loading/unloading of the HGVs for the proposed replacement poultry units will be undertaken using a forklift on the concrete apron to the north of the new sheds.

As with the existing poultry development, the majority of transport movements will only occur during the working day (07:00 – 20:00hrs). However, in order to avoid stressing the birds catching is typically undertaken during the night.

5.6 Derivation of Extract/Transport Noise Emissions

The individual noise level of each assessed noise source has been calculated at Receptors A and B; Figure 2. The following corrections have been applied to the source noise data:

- ***Directivity correction (extract fans only):***
  - Roof fans: correction to convert the fan noise data from the manufacturers stated level at 45° lateral to 90° lateral (the propagation angle for the assessed dwellings), determined using the corrections given in Duct Directivity Index Applications (Day H. Hansen C & Bennett B, Acoustics Australia 96 Vol. 37 December (2009) No. 3). For the calculation a typical axial frequency spectra has been used
  - Gable end fans: correction to convert the fan noise data from the manufacturers stated level to the propagation angle for the assessed dwellings, determined using the corrections given in Figure 11.2, p322, Noise Control in Building Services, SRL Ltd. For the calculation a typical axial frequency spectra has been used
- ***Reflections (extract fans only):*** 3dB added to account for reflections off the poultry shed roof/facade
- ***Distance correction:*** 20 x log (d_1/d_0), where d_1 = distance between receptor and the noise source and d_0 = reference distance.

- ***Shielding attenuation:*** Where the line of sight between the noise source and dwelling is fully blocked by a solid barrier (e.g., by the sheds themselves) 10dB shielding correction has been applied in accordance with BS5228-1 2009
- ***Ground absorption correction:*** ISO 9613-2: Attenuation of sound during propagation outdoors, Formula 10:

  $$A_{gr} = 4.8 – (2h_m/d)[17 + (300/d)]$$

  Where,

  h_m = mean height of the propagation path above ground

  d = distance from source to receptor

  In accordance with ISO 9613-2 the ground absorption correction is assumed to be zero when the line of sight of the noise source is partially or fully blocked by a solid body (i.e., when a shielding correction is applicable).
- ***Atmospheric attenuation:*** ISO 9613-2: Attenuation of sound during propagation outdoors, Formula 8:

  $$A_{atm} = \alpha d/100$$

  Where,

  α = is the atmosphere attenuation coefficient for a temperature of 10°C and 70% relative humidity

  d = distance from source to receptor

  The attenuation at 500Hz has been used.
- **On-time correction:** The following on-times have been used:
  - Extract fans: it has been assumed that the fans are operating continuously and consequently no 'on-time' correction has been applied
  - Transport movements:
    - Day (over any 1-hour period): 45-minutes for loading/unloading and 2 minutes for manoeuvring
    - Night (over any 15-minute period): 15-minutes for loading/unloading and 2 minutes for manoeuvring

Tables B1 – B3, Appendix B provide the full calculations.

5.7 Rating Level

To establish the Rating Levels the following BS4142 character corrections have been applied to the established Specific Levels.

- **Extract fans:**
  - *Tonality:* 0dB; in common with the majority of modern fans, and in line with our own measurements of comparable fans at other poultry sites, the fans are not expected to be tonal
  - *Impulsivity*: 0dB; the proposed extract fans will not contain an impulsive noise element such as bangs or a very sudden jump in sound output due to quick start-up/change in fan speed.
  - *Intermittency:* 0dB; the starting/stopping of individual fans will not be readily distinctive against the residual noise environment and consequently an intermittency penalty is not applicable
  - *Other:* 0dB; no 'other' noise characteristics of the fans are expected

- **Stock collection/delivery**
  - *Tonality:* 0dB; measurements confirm that the stock collections/deliveries are not tonal.
  - *Impulsivity:* 6dB; the use of a forklift has the potential to generate 'highly perceptible' impulsive noise. Note that we have observed that with careful operation of the forklift (i.e., slowing loading crates) impulsive noise can be minimised.
  - *Intermittency:* 3dB; stock collections and HGV movements will be intermittent.
  - *Other:* 0dB; no 'other' noise characteristics are expected/have been identified

As is standard practice, the total character corrections have been capped at 6dB

Table 3 provides the resultant Rating Levels at Receptors A and B.

Table 3. Typical background and calculated Rating and Assessment Levels at Receptors A and B

Noise Source	Receptor	Day: 07:00 - 20:00hrs			Evening : 20:00 - 23:00hrs			Night : 23:00 - 07:00hrs		
		Typical L_{A90} dB	Rating Level, dB	Assessment Level, dB	Typical L_{A90} dB	Rating Level, dB	Assessment Level, dB	Typical L_{A90} dB	Rating Level, dB	Assessment Level, dB
			100% roof & gable end extract fans operating			50% roof extract fans operating			25% roof extract fans operating	
Extract fans	A	37	29	-8	25	25	0	24	22	-2
	B	37	25	-12	25	21	-4	24	18	-6
Transport: diesel forklift loading/ unloading HGV	A	37	41	4	25	N/A		24	43	19
	B	37	37	0	25	N/A		24	39	15

5.8 Noise Impact

We define Assessment Level = RL – min L_{A90} dB, where:

RL = Rating Level, dB(A)

L_{A90} dB = the typical background noise level, L_{A90}, derived from the noise survey data

Table 3 provides the resultant Assessment Levels at Receptors A and B.

Where the Rating Level is at parity with the typical background noise level (Assessment Level = 0 dB) BS4142 states that the Specific Level will have a low impact; an adverse impact is indicated where the Rating Level is ≥ 5dB and <10dB above the typical background noise level.

As can be seen in Table 3, the Assessment Levels of the extract fans during the day, evening and night do not exceed 0dB. We therefore conclude that the noise impact of the extract fans (with attenuators fitted to the roof fans that comply with the insertion losses given in Table 2) will be low.

The transport activities on the concrete apron result in Assessment Levels of up to 4dB during the day, which indicates to a 'marginal' noise impact (between BS4142 'low' and 'adverse' noise

impact). This is considered acceptable when taking into account that the proposed scheme will result in a beneficial 3dB to 5dB reduction in transport related 1hr noise emissions when compared with the existing poultry development (i.e., a negligible noise impact when the change in noise emissions is considered).

During the night period, when occupiers are expected to be indoors, the transport noise ingress levels via an open window will comply with our suggested ambient noise ingress levels and maximum noise events will be below PRoPG's threshold with regard to sleep disturbance. We therefore conclude that during the night the poultry transport noise ingress levels will be acceptable, resulting in a low noise impact.

5.9 Calculation uncertainty

With all calculations there is a level of uncertainty, which in this case we do not expect to be greater than +/-3dB (3dB is a just perceptible change in noise level). This small level of uncertainty is not considered to have any significance to the outcome of the assessment.

The noise survey was undertaken without the existing poultry development operating. The established representative background noise level may therefore be lower than would have historically occurred.

The difference between halving or doubling the number of fans operating (e.g., 50% to 100%) is 3dB. With smaller changes in the number of fans operating, for example, 50% to 70%, the change in aggregate noise emissions will be less than 2dB; this represents an imperceptible change in noise.

We therefore consider the used percentage of fans as suitably robust for the purpose of the assessment; it reflects the percentage of fans used in poultry units as advised by both operators and experts and would not result in a perceptible change in noise emissions with a 20 – 25% increase/decrease in the number of fans operating.

6. Conclusion

A noise impact assessment has been undertaken for the proposed replacement poultry units at Thoresby Bridge Farm, North Cotes; Figures 1 – 3.

The proposed replacement poultry units are within context of the sheds that they will replace, in both terms of operation and nature of noise emissions; the two main noise sources will be ventilation extract fans and transport activities (e.g., stock deliveries/collections).

For the noise impact assessment, two mitigation measures have been included, namely:

- *Roof extract fans:* Attenuators fitted to the roof extract fans that achieve the minimum insertion losses provide in Table 2. These values can be provided to an attenuator manufacture in order to select a suitable product.
- *Transport activities on the concrete apron:* 2m high noise barrier along the north-east boundary of the concrete apron; Figure 7

The assessment included:

- A noise survey to establish representative background noise levels at the nearest private dwellings (Receptors A and B, Figure 1); Appendix A and Figure 4
- Calculation of the noise emissions and corresponding BS4142 Rating Levels generated by the extract fans and transport activities; Table 3 and Tables B1 – B3, Appendix B

The findings of the assessment established:

- *Extract fans:* The Rating Level of the extract fans, with attenuators fitted to the roof units (Table 2), will not exceed the representative background noise levels, indicating a BS4142 low noise impact

- *Transport activities:* The Rating Levels during the day period may exceed the representative background noise levels by up to 4dB, which indicates a 'marginal' noise impact during the day period. This is considered acceptable when the context that poultry transport noise emissions already occur, with the proposed scheme resulting in a beneficial reduction in the 1hr transport related activity noise emissions over the current situation; according to IEMA this indicates a negligible impact with regard to the change in the noise environment.

  During the night period, when occupiers are expected to be indoors, the transport noise ingress complies with our suggested ambient noise ingress limits and the maximum noise events will be below the PRoPG guidance threshold with regard to sleep disturbance; this indicates a low noise impact during the night.

On the basis that the proposed replacement poultry units will result in a low noise impact for the extract fans, a reduction in the transport related noise emissions and acceptable noise ingress levels during the night, we conclude that on noise grounds the proposed scheme is acceptable.

Table A1. Noise monitor data (free-field)							
Start Time	$L_{Amax,F}$ dB	L_{Aeq} dB	L_{A90} dB	Start Time	$L_{Amax,F}$ dB	L_{Aeq} dB	L_{A90} dB
13:30	63.4	49.9	32.5	02:00	58.0	38.8	25.0
13:45	72.6	51.5	33.0	02:15	42.2	26.0	24.5
14:00	67.7	50.8	38.0	02:30	42.6	27.5	26.0
14:15	64.6	51.6	38.0	02:45	45.0	28.1	26.5
14:30	64.4	49.1	38.0	03:00	30.5	24.9	23.5
14:45	62.1	47.5	38.0	03:15	58.7	39.5	23.0
15:00	62.5	49.0	41.0	03:30	46.7	23.1	21.0
15:15	66.3	51.3	37.0	03:45	44.6	23.7	22.0
15:30	64.8	49.8	39.0	04:00	59.6	38.7	22.0
15:45	63.8	50.6	38.5	04:15	62.1	43.5	24.5
16:00	67.9	50.6	38.0	04:30	60.7	30.3	23.0
16:15	69.4	51.1	39.0	04:45	64.9	44.8	23.5
16:30	68.8	51.1	35.0	05:00	68.8	47.0	23.5
16:45	62.6	49.4	37.0	05:15	60.7	43.1	24.5
17:00	68.2	49.4	34.5	05:30	61.9	42.9	28.5
17:15	73.6	55.1	38.0	05:45	68.6	47.9	28.5
17:30	69.6	50.0	33.0	06:00	72.3	48.3	26.0
17:45	71.5	50.5	35.0	06:15	68.3	49.2	28.0
18:00	75.5	50.1	32.0	06:30	69.3	49.6	32.0
18:15	67.3	51.4	33.0	06:45	73.5	55.5	35.0
18:30	64.2	49.4	34.5	07:00	66.3	53.2	38.5
18:45	61.4	47.7	30.0	07:15	67.3	52.5	37.5
19:00	65.6	45.7	29.0	07:30	70.3	52.0	39.5
19:15	64.2	44.6	26.5	07:45	63.2	51.6	38.0
19:30	61.9	43.4	27.5	08:00	64.7	52.0	40.5
19:45	64.0	45.4	28.0	08:15	69.5	52.8	40.5
20:00	61.3	44.8	30.5	08:30	65.1	51.5	37.5
20:15	60.0	44.0	30.5	08:45	68.8	50.9	37.0
20:30	62.3	41.6	27.0	09:00	63.9	50.3	33.5
20:45	58.7	42.6	26.0	09:15	64.2	49.2	35.0
21:00	60.3	40.2	24.5	09:30	73.6	52.3	37.0
21:15	62.1	42.4	25.0	09:45	67.0	50.1	39.0
21:30	60.4	41.2	26.5	10:00	64.4	49.4	34.0
21:45	63.6	43.3	28.0	10:15	73.0	53.8	38.5
22:00	60.6	43.0	26.5	10:30	75.0	51.8	38.5
22:15	59.6	37.1	25.0	10:45	67.0	49.4	37.0
22:30	63.1	40.4	25.5	11:00	65.0	50.4	39.5
22:45	66.3	46.1	24.5	11:15	68.3	51.0	38.5
23:00	55.8	35.6	26.0	11:30	68.4	50.2	36.0
23:15	58.5	35.3	25.5	11:45	69.5	49.2	29.5
23:30	36.2	28.8	27.0	12:00	65.7	50.0	38.0
23:45	63.1	43.0	29.5	12:15	64.7	50.5	36.0
00:00	62.9	44.9	25.0	12:30	67.7	49.8	37.0
00:15	54.8	34.7	24.0	12:45	60.8	49.1	36.5
00:30	60.9	37.9	24.0	13:00	66.3	50.6	36.0
00:45	59.9	38.5	25.5	13:15	63.8	49.2	36.5
01:00	32.8	25.9	24.5	13:30	65.4	48.5	32.0
01:15	51.4	27.8	24.0	13:45	64.0	48.3	34.0
01:30	55.4	36.3	24.5	14:00	69.5	49.5	37.0
01:45	33.5	26.3	24.0				

Table A2. Weather station data											
Start Time	Wind Speed, m/s	Temp, °C	Start Time	Wind Speed, m/s	Temp, °C	Start Time	Wind Speed, m/s	Temp, °C	Start Time	Wind Speed, m/s	Temp, °C
13:30	0.7	8.9	19:40	0.0	6.3	01:50	0.0	4.9	08:00	0.0	6.6
13:40	1.7	8.8	19:50	0.0	6.5	02:00	0.0	5.2	08:10	0.0	6.7
13:50	0.0	10.3	20:00	0.0	6.7	02:10	0.0	5.4	08:20	0.0	6.7
14:00	0.0	9.4	20:10	0.6	6.6	02:20	0.0	5.6	08:30	0.0	6.8
14:10	1.1	8.7	20:20	0.6	6.4	02:30	0.0	5.8	08:40	0.0	6.9
14:20	0.0	9.6	20:30	0.6	6.1	02:40	0.0	5.8	08:50	0.0	7.0
14:30	0.0	10.1	20:40	0.7	6.1	02:50	0.0	5.5	09:00	0.0	7.0
14:40	0.0	10.0	20:50	0.0	5.9	03:00	0.0	5.5	09:10	0.0	7.2
14:50	0.0	9.0	21:00	0.8	5.8	03:10	0.0	5.6	09:20	0.0	7.2
15:00	0.4	8.9	21:10	0.9	6.0	03:20	0.0	5.6	09:30	0.0	7.3
15:10	0.8	8.2	21:20	1.0	6.1	03:30	0.0	5.7	09:40	0.0	7.3
15:20	0.8	8.5	21:30	0.8	6.1	03:40	0.4	5.9	09:50	0.0	7.4
15:30	0.4	8.4	21:40	0.4	6.0	03:50	0.7	6.1	10:00	0.0	7.4
15:40	0.9	8.1	21:50	0.8	6.2	04:00	0.0	6.1	10:10	0.0	7.5
15:50	0.8	8.0	22:00	1.6	6.4	04:10	1.1	6.3	10:20	0.0	7.3
16:00	0.4	8.1	22:10	1.0	6.4	04:20	0.0	6.2	10:30	0.0	7.5
16:10	0.0	7.9	22:20	0.7	6.3	04:30	0.0	6.2	10:40	0.0	7.4
16:20	0.0	8.1	22:30	1.0	6.3	04:40	0.0	5.8	10:50	0.0	7.3
16:30	0.0	8.1	22:40	0.0	6.2	04:50	0.0	5.9	11:00	0.0	7.4
16:40	0.0	8.0	22:50	0.0	6.2	05:00	0.0	5.9	11:10	0.0	7.3
16:50	0.0	8.0	23:00	0.0	6.2	05:10	0.0	6.0	11:20	0.0	7.4
17:00	0.7	7.8	23:10	0.0	6.3	05:20	0.0	6.0	11:30	0.0	7.5
17:10	0.5	8.0	23:20	0.0	6.1	05:30	0.0	6.1	11:40	0.0	7.8
17:20	0.5	7.9	23:30	0.0	6.1	05:40	0.0	6.2	11:50	0.0	7.6
17:30	0.6	7.8	23:40	0.0	5.9	05:50	0.0	6.3	12:00	0.0	7.8
17:40	0.0	7.5	23:50	0.0	5.7	06:00	0.0	6.4	12:10	0.0	8.0
17:50	0.0	7.1	00:00	0.0	5.9	06:10	0.0	6.3	12:20	0.0	8.1
18:00	0.0	6.9	00:10	0.0	5.6	06:20	0.0	6.4	12:30	0.0	8.7
18:10	0.0	6.5	00:20	0.0	5.3	06:30	0.0	6.3	12:40	0.0	9.3
18:20	0.0	6.7	00:30	0.0	5.3	06:40	0.0	6.4	12:50	0.0	10.1
18:30	0.0	6.8	00:40	1.1	5.7	06:50	0.0	6.4	13:00	0.0	10.3
18:40	0.0	6.6	00:50	0.0	5.5	07:00	0.0	6.5	13:10	0.0	9.6
18:50	0.0	6.4	01:00	0.0	5.5	07:10	0.0	6.6	13:20	0.0	9.3
19:00	0.0	6.3	01:10	0.0	5.0	07:20	0.0	6.5	13:30	0.0	9.6
19:10	0.8	6.2	01:20	0.0	4.9	07:30	0.0	6.5	13:40	0.0	9.2
19:20	0.0	6.2	01:30	0.0	4.8	07:40	0.0	6.5	13:50	0.0	8.8
19:30	0.0	6.2	01:40	0.0	4.8	07:50	0.0	6.6			

Table B1. Calculation of proposed replacement poultry unit's extract fan Rating Levels at Receptor A

Source Noise Levels		Octave Band Centre Frequency, Hz 63	125	250	500	1k	2k	4k	dB(A)	Octave Band Centre Frequency, Hz 63	125	250	500	1k	2k	4k	dB(A)
		Roof Fans: Skov BS820-10								Gable End Fans: Skov DA1700-5							
	[A] Lp at 2m, 45° lateral:	71	67	65	62	64	62	62	69	79	73	69	69	63	61	57	70
	[B] directivity correction (90° lateral):	0	1.5	3	4.5	9	11	18		2.5	4.5	9	23	23	23	23	
	[C] Reflection off poultry shed roof/facade:	3	3	3	3	3	3	3		3	3	3	3	3	3	3	
	[D] generic attenuator, 600mm, 40% free area:	3	5	9	13	15	16	11									
	[A] - [B] + [C] - [D] L_p at 2m:	71	64	56	48	43	38	36	53	80	71.5	63	49	43	41	37	60

Fan	Direct distance, m	Shed 1 Roof Fans	Shed 1 Gable Fans	Shed 2 Roof Fans	Shed 2 Gable Fans	Distance correction, dB	Shed 1 Roof Fans	Shed 1 Gable Fans	Shed 2 Roof Fans	Shed 2 Gable Fans	Shielding attenuation, dB	Shed 1 Roof Fans	Shed 1 Gable Fans	Shed 2 Roof Fans	Shed 2 Gable Fans	Ground absorption, dB	Shed 1 Roof Fans	Shed 1 Gable Fans	Shed 2 Roof Fans	Shed 2 Gable Fans	Atmospheric attenuation, dB	Shed 1 Roof Fans	Shed 1 Gable Fans	Shed 2 Roof Fans	Shed 2 Gable Fans	Sound pressure level at dwelling, dB	Shed 1 Roof Fans	Shed 1 Gable Fans	Shed 2 Roof Fans	Shed 2 Gable Fans
1		107.6	194.4	130.2	206.8		34.6	39.8	36.3	40.3		0	10	0	10		2.7	0.0	3.1	0.0		0.2	0.4	0.2	0.4		15.5	9.5	13.4	8.9
2		111.0	195.0	133.0	207.4		34.9	39.8	36.5	40.3		0	10	0	10		2.8	0.0	3.2	0.0		0.2	0.4	0.3	0.4		15.1	9.5	13.1	8.9
3		114.6	195.5	136.0	208.1		35.2	39.8	36.7	40.3		0	10	0	10		2.9	0.0	3.2	0.0		0.2	0.4	0.3	0.4		14.8	9.4	12.9	8.9
4		118.5	196.0	139.3	208.8		35.5	39.8	36.9	40.4		0	10	0	10		2.9	0.0	3.2	0.0		0.2	0.4	0.3	0.4		14.4	9.4	12.6	8.8
5		122.5	196.6	142.7	209.4		35.7	39.9	37.1	40.4		0	10	0	10		3.0	0.0	3.3	0.0		0.2	0.4	0.3	0.4		14.0	9.4	12.4	8.8
6		126.7	197.2	146.2	210.1		36.0	39.9	37.3	40.4		0	10	0	10		3.1	0.0	3.3	0.0		0.2	0.4	0.3	0.4		13.7	9.3	12.1	8.8
7		131.0	197.7	150.0	210.8		36.3	39.9	37.5	40.5		0	10	0	10		3.1	0.0	3.4	0.0		0.2	0.4	0.3	0.4		13.3	9.3	11.8	8.7
8		135.5	198.3	153.9	211.5		36.6	39.9	37.7	40.5		0		0			3.2		3.4			0.3		0.3			12.9		11.6	
9		140.1		157.9			36.9		37.9			0		0			3.3		3.4			0.3		0.3			12.6		11.3	
10		144.8		162.1			37.2		38.2			0		0			3.3		3.5			0.3		0.3			12.2		11.0	
11		149.7		166.4			37.5		38.4			0		0			3.4		3.5			0.3		0.3			11.9		10.8	
12		154.6		170.8			37.8		38.6			0		0			3.4		3.6			0.3		0.3			11.5		10.5	
13		159.5		175.3			38.0		38.9			0		0			3.5		3.6			0.3		0.3			11.2		10.2	
14		164.6		179.8			38.3		39.1			0		0			3.5		3.6			0.3		0.3			10.9		10.0	
15		169.7		184.5			38.6		39.3			0		0			3.6		3.7			0.3		0.4			10.6		9.7	
16		174.9		189.3			38.8		39.5			0		0			3.6		3.7			0.3		0.4			10.2		9.4	
17		180.2		194.1			39.1		39.7			0		0			3.6		3.7			0.3		0.4			9.9		9.2	
18		185.5		199.0			39.3		40.0			0		0			3.7		3.7			0.4		0.4			9.6		8.9	
19		190.8		204.0			39.6		40.2			0		0			3.7		3.8			0.4		0.4			9.3		8.7	

	BS4142 character correction	0
Day (07:00 - 20:00hrs):	100% roof & gable end extract fans operating	Specific Level, dB: 29
		Rating Level, dB: 29
Evening (20:00 - 23:00hrs):	50% roof extract fans operating (assumed odd no. fans running)	Specific Level, dB: 25
		Rating Level, dB: 25
Night: (23:00 - 07:00hrs):	25% roof extract fans operating (assumed no. 2, 6, 10 & 18 fans running)	Specific Level, dB: 22
		Rating Level, dB: 22

Table B2. Calculation of proposed replacement poultry unit's extract fan Rating Levels at Receptor B

Source Noise Levels		Octave Band Centre Frequency, Hz 63	125	250	500	1k	2k	4k	dB(A)	Octave Band Centre Frequency, Hz 63	125	250	500	1k	2k	4k	dB(A)
		Roof Fans: Skov BS820-10								Gable End Fans: Skov DA1700-5							
	[A] Lp at 2m, 45° lateral:	71	67	65	62	64	62	62	69	79	73	69	69	63	61	57	70
	[B] directivity correction (90° lateral):	0	1.5	3	4.5	9	11	18		2.5	4.5	9	23	23	23	23	
	[C] Reflection off poultry shed roof/facade:	3	3	3	3	3	3	3		3	3	3	3	3	3	3	
	[D] generic attenuator, 600mm, 40% free area:	3	5	9	13	15	16	11									
	[A] - [B] + [C] - [D] L_p at 2m:	71	64	56	48	43	38	36	53	80	71.5	63	49	43	41	37	60

Fan	Direct distance, m	Distance correction, dB		Shielding attenuation, dB				Ground absorption, dB				Atmospheric attenuation, dB				Sound pressure level at dwelling, dB			
		Shed 1		Shed 2		Shed 1		Shed 2		Shed 1		Shed 2		Shed 1		Shed 2		Shed 1		Shed 2	
		Roof Fans	Gable Fans	Roof Fans	Gable Fans	Roof Fans	Gable Fans	Roof Fans	Gable Fans	Roof Fans	Gable Fans	Roof Fans	Gable Fans	Roof Fans	Gable Fans	Roof Fans	Gable Fans	Roof Fans	Gable Fans	Roof Fans	Gable Fans
1		196.5	269.5	172.4	251.6	39.8	42.6	38.7	42.0	0	10	0	10	3.7	0.0	3.6	0.0	0.4	0.5	0.3	0.5	9.0	6.5	10.4	7.1
2		199.1	268.7	175.3	250.9	40.0	42.6	38.9	42.0	0	10	0	10	3.7	0.0	3.6	0.0	0.4	0.5	0.3	0.5	8.9	6.5	10.2	7.2
3		201.9	267.9	178.4	250.1	40.1	42.5	39.0	41.9	0	10	0	10	3.8	0.0	3.6	0.0	0.4	0.5	0.3	0.5	8.8	6.6	10.0	7.2
4		204.8	267.1	181.7	249.4	40.2	42.5	39.2	41.9	0	10	0	10	3.8	0.0	3.6	0.0	0.4	0.5	0.3	0.5	8.6	6.6	9.8	7.2
5		207.9	266.3	185.1	248.7	40.3	42.5	39.3	41.9	0	10	0	10	3.8	0.0	3.7	0.0	0.4	0.5	0.4	0.5	8.5	6.6	9.7	7.2
6		211.1	265.5	188.7	247.9	40.5	42.5	39.5	41.9	0	10	0	10	3.8	0.0	3.7	0.0	0.4	0.5	0.4	0.5	8.3	6.6	9.5	7.3
7		214.4	264.7	192.4	247.2	40.6	42.4	39.7	41.8	0	10	0	10	3.8	0.0	3.7	0.0	0.4	0.5	0.4	0.5	8.2	6.7	9.3	7.3
8		217.8	263.9	196.1	246.5	40.7	42.4	39.8	41.8	0		0		3.8		3.7		0.4		0.4		8.0		9.1	
9		221.4		200.1		40.9		40.0		0		0		3.9		3.8		0.4		0.4		7.8		8.9	
10		225.1		204.1		41.0		40.2		0		0		3.9		3.8		0.4		0.4		7.7		8.7	
11		228.8		208.2		41.2		40.3		0		0		3.9		3.8		0.4		0.4		7.5		8.5	
12		232.7		212.4		41.3		40.5		0		0		3.9		3.8		0.4		0.4		7.3		8.3	
13		236.6		216.7		41.5		40.7		0		0		3.9		3.8		0.4		0.4		7.2		8.0	
14		240.7		221.1		41.6		40.9		0		0		3.9		3.9		0.5		0.4		7.0		7.8	
15		244.8		225.6		41.8		41.0		0		0		4.0		3.9		0.5		0.4		6.8		7.6	
16		249.0		230.1		41.9		41.2		0		0		4.0		3.9		0.5		0.4		6.6		7.4	
17		253.3		234.7		42.1		41.4		0		0		4.0		3.9		0.5		0.4		6.5		7.2	
18		257.7		239.4		42.2		41.6		0		0		4.0		3.9		0.5		0.5		6.3		7.0	
19		262.1		244.2		42.3		41.7		0		0		4.0		4.0		0.5		0.5		6.1		6.8	
																				BS4142 character correction		0	

Day (07:00 - 20:00hrs):	100% roof & gable end extract fans operating	Specific Level, dB	25
		Rating Level, dB	25
Evening (20:00 - 23:00hrs):	50% roof extract fans operating (assumed odd no. fans running)	Specific Level, dB	21
		Rating Level, dB	21
Night: (23:00 - 07:00hrs):	25% roof extract fans operating (assumed no. 2, 6, 10 & 18 fans running)	Specific Level, dB	18
		Rating Level, dB	18

Table B3. Calculation of HGVs loading/unloading BS4142 Assessment Level at Receptors A and B							
Source noise levels	Stock delivery at 20m	*Day*	$L_{Aeq,1hr}$ dB 60	*Night*	$L_{Aeq,15min}$ dB 62	$L_{Amax,F}$ dB 79	
		Receptor A	Receptor B		Receptor A	Receptor B	
		Existing sheds	Proposed replacement sheds		Existing sheds	Proposed replacement sheds	
Corrections	Distance, m	135	111		192	175	
	Distance correction, dB	17	15		20	19	
	Shielding correction, dB	5	10		0	10	
	Ground absorption, dB	0	0		4	0	
	Atmospheric attenuation, dB	0	0		0	0	
BS4142 Specific Level	Day	38	35		36	31	
	Night	40	37		38	33	
BS4142 character corrections		6	6		6	6	
Rating Level	Day	44	41		42	37	
	Night	46	43		44	39	
Night noise ingress via open window	$L_{Aeq,15minutes}$ dB	27	24		25	20	
	$L_{Amax,F}$ dB	44	41		42	37	

DA 820 Fans

		445036 DA 820-10 LPC 1x230 V w/thermal cutout	445026 DA 820-10 LPC 1x230 V	445028 DA 820-12 LPC 1x230 V
Air output at -10 Pa	m^3/h	24000		28300
Air output at -20 Pa	m^3/h	23200		27700
Air output at -30 Pa	m^3/h	22500		27100
Air output at -40 Pa	m^3/h	21700		26400
Air output at -50 Pa	m^3/h	20900		25700
Air output at -60 Pa	m^3/h	20000		25100
Power consumption at -10 Pa	W	808		1311
Specific output at -10 Pa	m^3/kWh	29700		21600
Specific energy at -10 Pa	Watt/1000 m^3/h	34		46
Testing body		SKOV A/S		
Environment				
Temperature, operation	°C (°F)	÷ 40 to + 40 (÷ 40 to 104)		
Start temperature	°C (°F)	÷ 40 to + 50 (÷ 40 to 122)		
Storage temperature	°C (°F)	÷ 40 to + 70 (÷ 40 to 158)		
Ambient humidity, operation	% RH	10 - 95		
Protection class	IP	Motor controller: IP 65. Fan motor: IP 55		
Fan noise, outside (2 m, 45 degrees)	dB (A)	69		73
Shipment				
Motor control - dimensions (H x W x D)	mm	266 x 185 x 90		
Fan - dimensions (H x W x D)	mm	278 x 800 x 800		
Weight	g	21432		
Shipping weight	g	26117		

Air output m^3/h (at -110 Pa)	-	15000
Air output m^3/h (at -120 Pa)	-	13000
Power consumption [W] (at -10 Pa)	676	1093
Specific output m^3/kWh (at -10 Pa)	65500	48600
Specific energy [Watt/1000 m^3/h] (at -10 Pa)	15	21
Environment	**DA 1700-4**	**DA 1700-5**
Operating temperature [°C]	- 40 to +45	
Start temperature [°C]	- 40 to +50	
Storage temperature [°C]	- 40 to +70	
Ambient humidity, operation [%] RH	10-95	
Corrosion-resistant	EN/ISO12944-2:1998 category C4	
Protection class	Controller: IP 65 Fan motor: IP 65	
Encapsulation material Bottom Top	Aluminium (EN AB-44300) Aluminium 5052 Polypropylene (PP)	
*Fan noise, outside (2 m, 45 degrees) [dB(A)]	66	70
Shipping		
DA 1700 fan housing packed HxWxD [mm]	800x735x1.600	
Inside safety net packed HxWxD [mm]	3x1410x1.354	
Fan motor packed HxWxD [mm]	320x320x400	
Fan blade packed HxWxD [mm]	800x270x130	
Motor controller packed HxWxD [mm]	310x165x230	
DA 1700 fan housing weight [g]	72600	
Cover [g]	6784	
Inside safety net weight [g]	2600	
Fan motor weight [g]	25400	
Fan blade weight [g]	7500	
Motor controller weight [g]	2890	

*The noise levels are calculated sound pressure, L_p [dB (A)] at a distance of 2 m from the outflow of the exhaust unit, provided that the sound spreads in an ideal half ball.
Based on measured sound effect, L_w [dB (A)] according to ISO 9614-2.