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NOISE IMPACT ASSESSMENT

Change of use of agricultural building to storage use (Class B8) and ancillary business use (Class B1), erection of a new build warehouse and retention of haulage yard in haulage use.

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1. Introduction

This acoustic report documents a noise impact assessment with regard to the change of use of an agricultural building to storage use (Class B8) and ancillary business use (Class B1), erection of a new build warehouse and the retention of haulage yard in haulage use.

The report is divided into the following sections:

- Section 2: Overview of the Development
- Section 3: Noise Assessment Criteria
- Section 4: Storge/Distribution Warehouse
- Section 5: Agricultural Barn
- Section 6: Noise Impact Assessment
- Section 6: Conclusion
- Appendix A: Survey Data
- Appendix B: Calculations

2. Overview of the Development

Figure 1 provides an aerial view with the new build warehouse, change of use agricultural building, existing haulage yard and nearest dwellings identified. See Figure 2 for elevations of the change of use agricultural building and Figure 3 for site photos of the new build warehouse.

Both the new build warehouse and change of use of the agricultural building and wider yard have been operational since July 2018.

2.1 New build warehouse & change of use agricultural building

The constructions of the buildings are:

- **New build warehouse:**
  - Roof & façade: profiled metal sheeting
  - Entrance: four 16m^2 roller shutter doors on the east façade and two 2m^2 steel doors on the west façade
- **Change of use agricultural building:**
  - Roof: corrugated fibre cement sheets
  - Facades (south & north): 1.5m high concrete panels at low level with 1.5m high timber panels above
  - Gable end entrance (west façade): 1.5m high concrete panels at low level with 1.5m – 4.5m high timber panels above. 23m^2 steel roller shutter door.
  - Ventilation: eight ridge vents (non-mechanical)

Both the new build warehouse and change of use agricultural use building are currently used for the storage of toys, with electric forklifts and an electric cherry picker used for the movement of stock.

The operating hours of both the new build warehouse and change of use agricultural building are 07:30 – 17:00hrs Monday – Friday.

The loading/unloading of delivery vehicles are undertaken within the service yard to the east of the new build warehouse and south of the change of use building. Typically, an electric forklift is used, though we understand that on occasion a diesel forklift is employed. The reversing alarms on the forklifts have been disabled.

Running along the southern boundary of the delivery yard is an approximately 1m high earth bund.

There are three categories of delivery vehicles, namely:

- Box van: stock loaded/unloaded by hand or forklift. Loading/unloading is less than 30minutes.
- 7.5 tonne truck: stock loaded/unloaded by forklift. Loading/unloading takes approximately 30minutes.
- Shipping container articulated HGV: HGV reversed to entrance of the new build warehouse/change of use agricultural building, with the stock loaded/unloaded by forklift. Loading/unloading takes up to 3hrs.

We have been informed that the maximum capacity of delivery vehicles during any 1hr period (i.e., the number of delivery vehicles that can be loaded/unloaded) is six box vans, two 7.5 tonne trucks and one articulated shipping container HGV. Typically, however the number of delivery vehicles is substantially less.

It must be highlighted that the number of delivery vehicles that are loaded/unloaded per hour will not tally with the number of vehicle movements. For example, a box delivery van may have two movements in a 1hr period (one in and one out), whereas the articulated HGV may have no movements if it is midway through the 3hr load/unload period.

For the assessment of delivery vehicles, the duration of the noise emissions generated by the loading/unloading process and the vehicles manoeuvring has therefore been considered.

In addition to the storage of toys, ancillary light manufacturing is also undertaken in the change of use agricultural building. This involves the use of an automated up-cut saw, dust extraction and compressed air machines.

There are no other items of plant associated with either of the buildings.

2.2 Noise Sensitive Receptors

The nearest dwellings not in the client's ownership, labelled A and B in Figure 1, are approximately:

- 90 – 100m from the nearest façade of the new build warehouse
- 145m – 160m from the nearest façade of the change of use agricultural building
- 110m – 130m from the centre of the delivery yard

Due to the elevated position of Penrhos Farm relative to both Dwellings A and B (just over a 10m difference), the line of sight of the change of use agricultural building, activities on the delivery yard and the majority of the new build warehouse are fully blocked by topography.

In the client's ownership at Penrhos Farm is a farm house (currently occupied an employee of Rebo UK Ltd) and a barn with extant permission for conversion to a single dwelling (implementation has commenced but is not complete).

We have been informed that the client is willing to enter into a legal agreement restricting residential use of the farmhouse and barn to employees of Rebo UK Ltd.

We have therefore not included either of these two properties in our assessment.

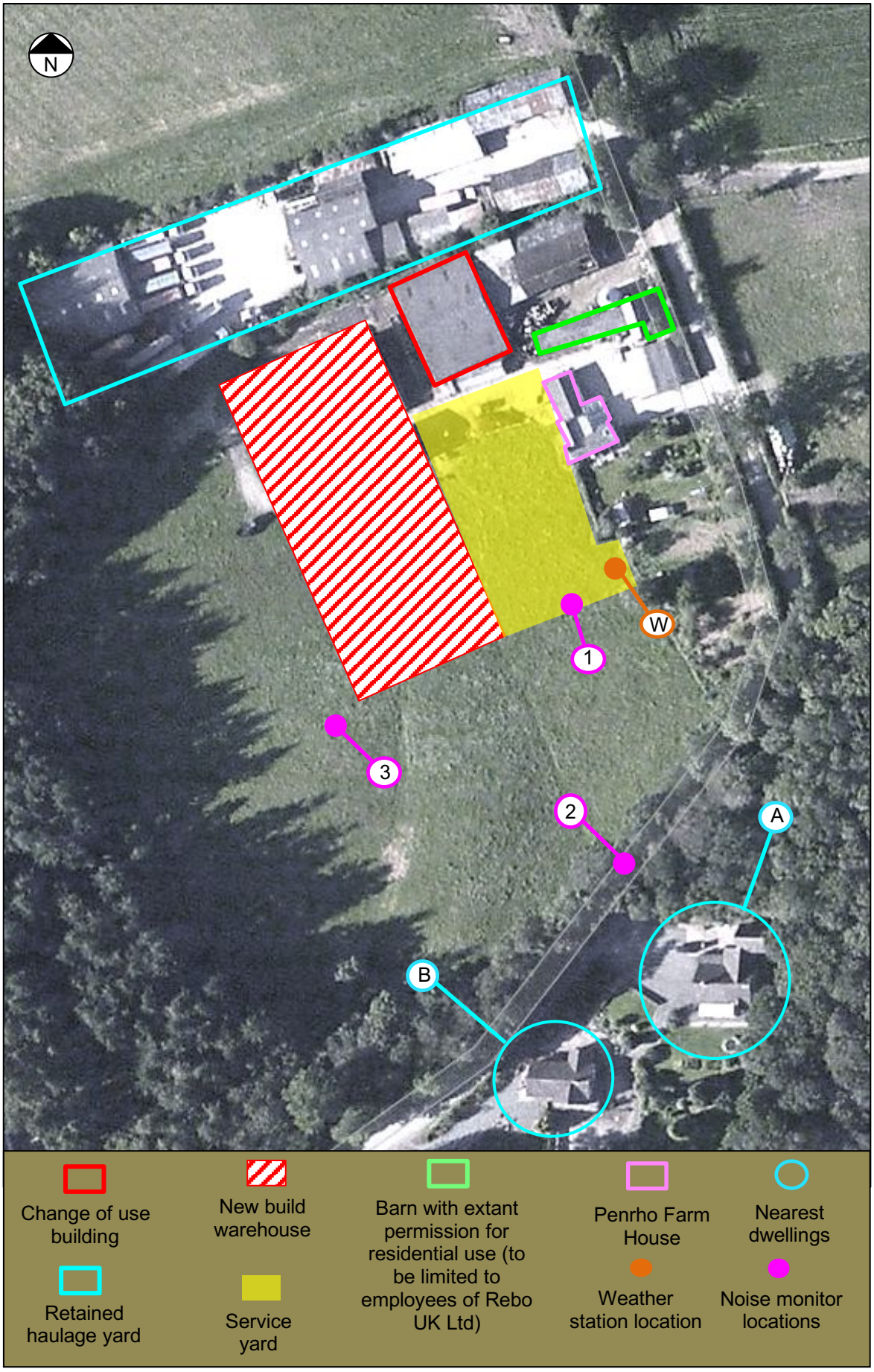


Figure 1. Aerial view (source: www.bing.com) with storage/distribution warehouse, agricultural barn and noise and weather station locations and nearest dwellings identified

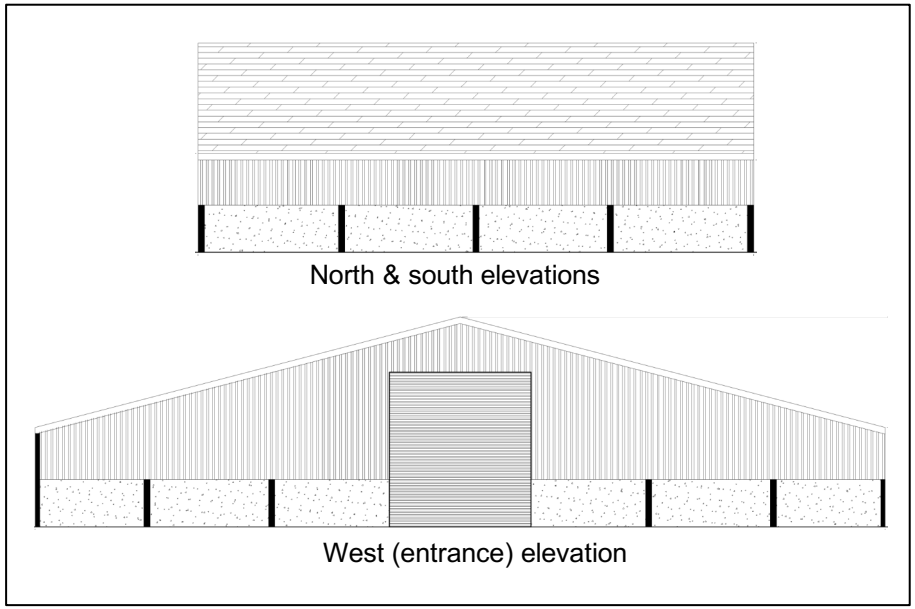


Figure 2. Change of use agricultural building elevations

Photo 3. View of the east façade of the new build warehouse and delivery yard, with two 7.5 tonne trucks being unloaded and Position 1 noise monitors in the foreground

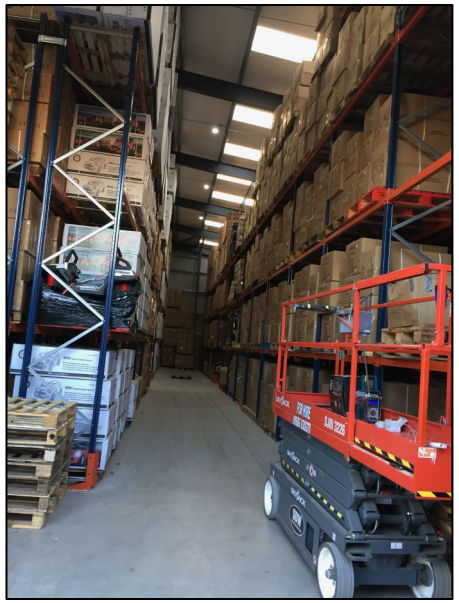


Photo 4. View of inside of new build warehouse, with electric cherry picker in the foreground

Figure 3. Photos showing the east façade/delivery yard and internal storage of the new build warehouse

3. Noise Assessment Criteria

The following guidance has been used to assess the activity/plant noise emissions associated with the new build warehouse and change of use of the exiting agricultural building.

3.1 BS4142

For noise generating developments Planning Guidance (Wales) Technical Advice Note 11 (TAN 11) states that the development must not cause an unacceptable degree of disturbance, with both the noise emission levels and characteristics taken into account

TAN 11 states that '*The likelihood of adverse impacts arising from noise of an industrial and/or commercial nature can be assessed, where the application of BS 4142:2014 is appropriate, using the guidance set out in that standard.'*

BS4142:2014 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. 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 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*'.

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

4. Noise Impact Assessment

4.1 Noise Survey

A noise survey has been undertaken to establish the activity noise emissions from the new build warehouse and change of use agricultural building at the nearest dwellings.

During the survey the new build warehouse, change of use agricultural building and existing haulage yard were operational. For the new build warehouse/change of use agricultural building this consisted of deliveries in the service yard and forklift movements within the buildings.

- **Survey date:** 29th October 2018
- **Weather station location:** Weather station, mounted on a tripod, positioned at position W; Figure 1
- **Weather:** Dry with still conditions (maximum recorded wind speed of 0.7m/s); Table A3, Appendix A.
- **Noise monitor locations; Figure 1:**
  - Positions 1 and 2: two monitors used at each measurement position, both attached to tripods,
  - Positions 3: a single monitor used, attached to a tripod
  - Spot measurements: monitor hand held
- **Configuration:**
  - Noise monitors:
    - Position 1 and 2: one monitor configured to measure consecutive 15-minute samples of noise and the other adjacent monitor to consecutive 1-minute samples of noise. The short measurement duration was chosen in order to identify short duration activity noise sources associated with the warehouse activities
    - Position 3: configured to measure consecutive 15-minute samples of noise
  - Weather station: configured to measure average wind speed and temperature over consecutive 10-minute periods
- **Equipment:**
  - Weather Station: Kestrel type 4000
  - Noise monitors: Brüel & Kjær Type 2238 (Positions 1, 2 and 3; 15-minute duration measurements) and Brüel & Kjær Type 2260 (Positions 1 and 2; 1-minute duration measurements and spot measurements)
- **Calibration:** Noise monitors successfully calibrated before and after the survey using a Brüel & Kjær Type 4231 calibrator.

All measurements are free-field values. Tabulated survey data is provided in Tables A1 and A2, Appendix A. The weather conditions will not have affected the measurements.

The noise data obtained at Position 2 is considered representative to the noise levels that will occur at Dwellings A and B.

4.2 Survey Observations

During the survey there were three commercial vehicles, consisting of two 7.5 tonne trucks and one box van.

Both the 7.5 tonne trucks arrived at approximately 15:00hrs; one was unloaded using an electric forklift and left at 15:15hrs. The other was first unloaded and then loaded, again using an electric forklift; the truck left at approximately 15:41hrs.

The box van arrived at 15:54hrs and parcels hand delivered. The van left approximately 5mintues later.

In all cases the 2nd roller shutter door from the south end of the new build warehouse were used for the deliveries/collections; this was the only open shuttered door, which was open throughout the survey until 17:00hrs.

The loading/unloading was undertaken at approximately 25 – 30m from Position 1.

At 16:17hrs the diesel forklift was used to move a steel platform from one side of the yard to the other (approximately 50m from Position 1). At 16:48hrs the diesel forklift was started again, being driven to the roller shutter door nearest the south gable end of the new build warehouse (15m from Position 1); the roller shutter door was then opened and the forklift driven in for night-time storage.

A radio, which was located on the cherry picker platform, was operating at a low volume throughout the survey. Between 16:00 – 17:00hrs the cherry picker was parked outside the roller shutter door of the new build warehouse.

Within the new build warehouse both the electric forklift and cherry picker were observed in operation. The noise emissions were noted to be very low, aided by the smooth concrete floor of the warehouse. The overall activity noise levels within the warehouse were considered to be low.

The noise emissions from the loading/unloading of the vehicles were noted to be low; stock was carefully moved with no noticeable impact noise or rattles and forklifts driven slowly on the level yard.

The overall activity noise levels of the warehouse activities were considered to be generally low; this was partly as a result of the use of electric forklifts, considerate operation and relatively short duration of activities.

At Position 2, which was on the other side of the road from Dwellings A and B, the dominant noise source was observed to be passing road traffic. This included several commercial vehicles including HGVs and tractors. The only warehouse activity heard at Position 2 was at a low level and considered to not be intrusive.

Noise emissions 10m from the rear of the new build warehouse (Position 3) could just be heard on occasion above the residual noise.

At Position 2 (represents the nearest dwellings) no activity noise emissions related to the haulage yard use could be heard.

4.3 Survey Findings

Figure 4 shows the variation in the consecutive 1-minute maximum (L_{Amax}), ambient (L_{Aeq}) and background (L_{A90}) noise measurements obtained at Positions 1 and 2.

The observed individual warehouse activity noise events are highlighted in Figure 4. As can be seen during these periods there are increased noise levels recorded at Position 1. There is however not correlation in the increased noise levels at Position 1 with the corresponding

measurements made at Position 2. This indicates that activity noise emissions had a low to very low impact at Position 2, which is in line with the survey observations.

From the survey data noise emissions from example warehouse activities within the yard have been established; Table 1.

At Position 2 clear peaks in the ambient noise levels can be identified ranging from $L_{Aeq,1min}$ 45 – 64dB. These will be due to vehicles passes on the adjacent road and confirms the survey observation that road traffic noise was the dominant noise source affecting Position 2.

Figure 5 shows the variation in the recorded 15-minute period background noise levels at Positions 1 – 3. As can be seen the background noise levels at Position 1 are consistently higher than those obtained at Positions 2 and 3. This will be due to the influence of general warehouse activities both within the yard and internally; the dominant noise path for the internal noise emissions was via the open roller shutter door.

The background noise levels at Positions 2 and 3 follow the same fluctuation and return near identical values. This indicates that:

- Internal warehouse activity noise emissions via the façade are negligible
- The recorded background noise levels at Positions 2 and 3 are representative to the underlying noise environment without the contribution of warehouse activity noise
- Traffic flow on the road adjacent to Position 2 is not constant with vehicle passes being of a relatively short duration

From the 15-minute survey data the typical background noise level at Positions 2 and 3 has been established as L_{A90} 28dB. This very low background noise level is considered representative to the typical background noise levels at Dwellings A and B during the day period operating hours (07:30 – 17:00hrs).

Figure 5. Positions 1 - 3; 15 minute background noise levels (free-field)

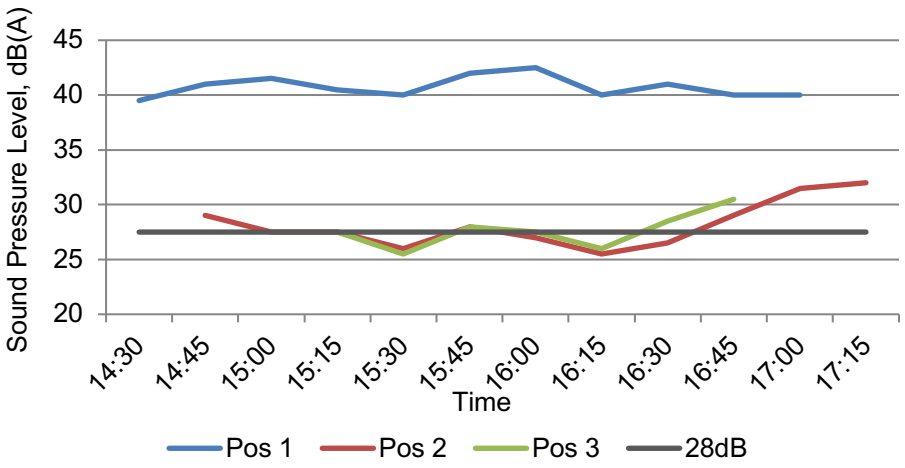
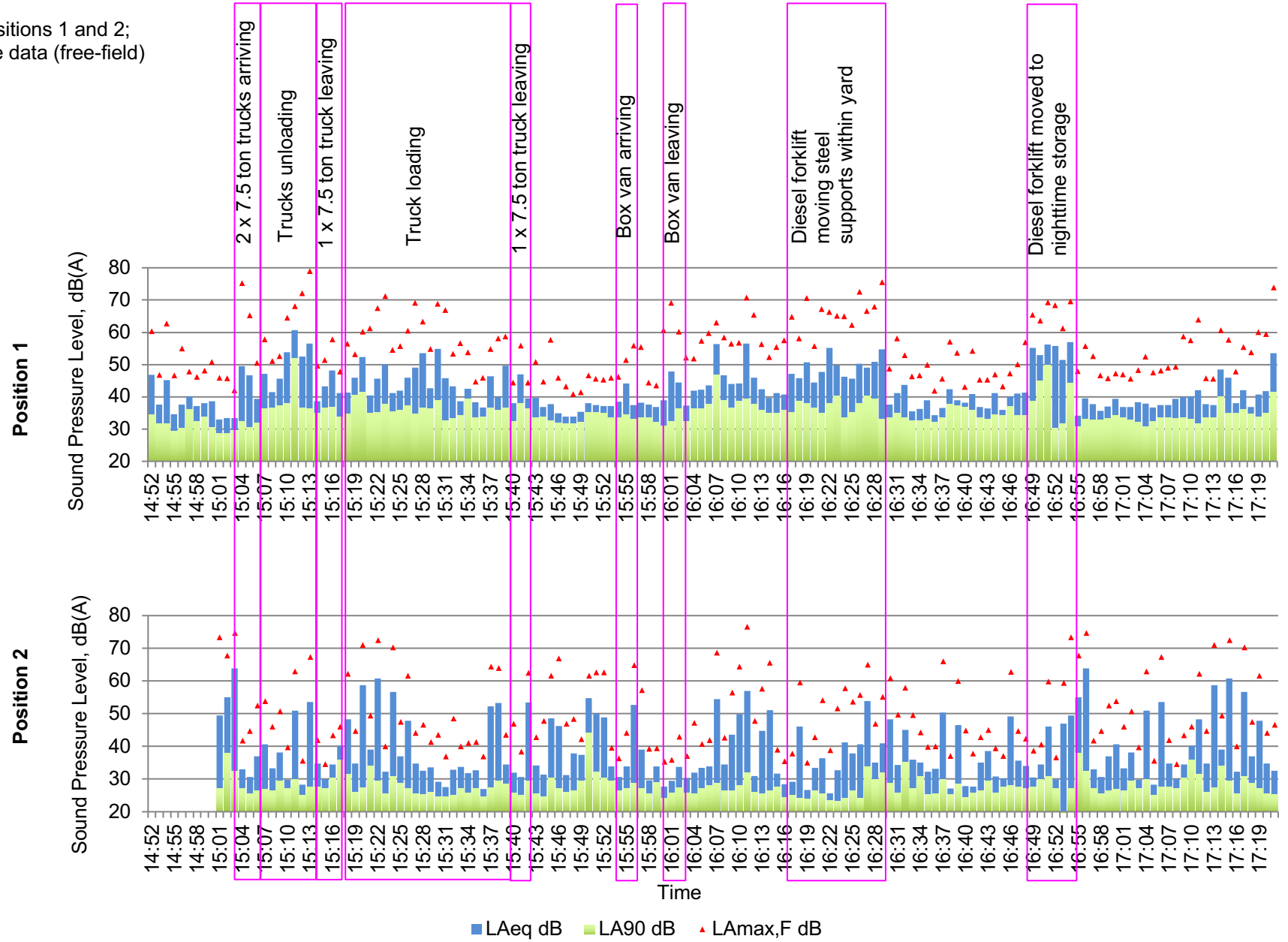


Figure 4. Positions 1 and 2;
1-minute noise data (free-field)



4.4 Noise Impact Assessment

As identified by the survey, the dominant typical noise emissions from the new build warehouse and change of use building are related to deliveries/collections within the yard (vehicle movements and loading/unloading using a forklift). These noise sources have therefore been assessed to review their noise impact at the nearest dwellings.

In addition, the noise emissions generated by the ancillary light manufacturing undertaken in the change of use agricultural building (automated up-cut saw, dust extraction and compressed air machines) has been considered.

Delivery Yard Activity Noise: The delivery/collection activity noise levels were too low in relation to the residual environmental noise to measure at the nearest dwellings. The noise emissions and BS4142 Rating Levels of example delivery/collection activities, including the occasional use of the diesel forklift, have therefore been calculated at Dwellings A and B; Table B1, Appendix B. The calculations are based on:

- Source noise levels derived from the survey data and HGV manoeuvring noise emission levels measured elsewhere.
- Distance correction: 20 x log (d_2/d_1), where d_1 = distance between noise source and measurement location and d_2 is the distance between the noise source and dwelling
- On-time correction: 10 x log (T/n), where T is the assumed duration in minutes of the activity over a 1hr period during the day
- Atmospheric attenuation: ISO 9613-2: Attenuation of sound during propagation outdoors, Formula 8: A_{atm} = αd/100, where, α = is the atmosphere attenuation coefficient for a temperature of 10°C and 70% relative humidity and d = distance from source to receptor
- Shielding correction: Shielding attenuation provided by the local topography has been calculated in accordance with Maekawa's "Noise Reduction by Screen" (1968) using:

  $$-1\ [10\log(3+\{(40 \times \mathbf{pd} \times \mathbf{f})/344\})]$$

  Where,

  pd = path difference
  f = octave frequency band in question

  The resultant single figure dB(A) value is presented in Table 1.
- BS4142 character corrections:
  - Tonality:
    - Correction: 0dB
    - Reason: the 1/3 octave band measurements confirm that the assessed noise sources are not tonal
  - Impulsivity:
    - Correction: 3dB diesel forklift, 0dB for electric forklift/vehicle movements
    - Reason: The use of the diesel forklift may on occasion result in impulsive noise. From observation the use of the electric forklift and vehicle movements did not contain impulsive noises of any consequence.
  - Intermittency:
    - Correction: 0dB
    - Reason: the intermittency of operation will not be readily distinctive against the residual noise environment at the nearest dwelling for all the assessed noise sources
  - Other
    - Correction: 0dB

- Reason: no 'other' noise characteristics are expected

Table 1 provides the resultant Rating Levels for each reviewed noise source, the aggregate Rating Level assuming all noise sources occur at the same time (worst case scenario) and corresponding Assessment Level (Rating Level – typical background noise level). Note that as a conservative measure the noise levels generated by box vans can be assumed to be comparable to those generated by a 7.5 truck

Table 1. Calculated Delivery Yard Activity Rating Levels

	Noise Source	A	B
Rating Level, dB	Diesel forklift movements	24	22
	HGV manoeuvring + loading/unloading using electric forklift	23	22
	7.5 tonne truck manoeuvring + loading/unloading using electric forklift	24	22
	Aggregate Rating Level, dB	28	27
	Typical background noise level, LA90 dB	28	28
	Assessment Level, dB	0	-1

Where the Rating Level is at parity with the typical background noise level (Assessment Level = 0dB) BS4142 states that the Specific Level will have a low impact.

As can be seen in Table 1 the individual Assessment Levels for the delivery noise sources and the aggregate Assessment Levels do not exceed 0dB. On this basis we therefore conclude that the delivery yard activity noise emissions will result in a low noise impact and are therefore acceptable.

This finding is in line with the survey observation of when the warehouse activity noise levels where audible at Position 2 they were at a sufficiently low level to not be considered intrusive.

Ancillary Light Industrial Use: For the ancillary light industrial use in the change of use agricultural building, the noise break-out has been considered.

In the absence of measurements of the equipment operating, an internal reverberant noise level of $L_{Aeq,1hr}$ 85dB has been assumed, which equates to the upper action exposure level given in The Control of Noise at Work Regulations 2005.

For the calculation of the noise break-out the noise emissions from the ridge vents and the facades/roof facing the dwellings have been established using the following corrections applied to the assumed internal noise level:

- **Roof vents:**
  - Vent area correction: 10 x Log (A), where A is the open area of the vent (assumed to be 0.4m^2 for each vent). The resultant value is added to the assumed internal sound pressure level to establish the sound power level at the vent opening
  - Distance correction: 20 x Log (d) + 11, where d is the distance between the vent and dwelling
  - Shielding correction: Shielding attenuation provided by the local topography has been calculated in accordance with Maekawa's "Noise Reduction by Screen"
  - 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 and d = distance from source to receptor
- **Façade/roof:**
  - Distance correction: 10 x log (2 x π x d^2), where d = distance between the dwelling and the radiating façade/roof

- Façade/roof sound reduction: composite sound insulation of façade/roof determined by the sound reduction and areas of the proposed façade/roof elements.
- Façade/roof area correction: 10 x log (A), where A is the total area of the façade/roof
- Shielding correction: Shielding attenuation provided by the local topography has been calculated in accordance with Maekawa's "Noise Reduction by Screen"
- Atmospheric attenuation: ISO 9613-2: Attenuation of sound during propagation outdoors, Formula 8: A_{atm} = αd/100, where, α = is the atmosphere attenuation coefficient for a temperature of 10°C and 70% relative humidity and d = distance from source to receptor
- Note that the calculation determines the noise emissions from the façade/roof facing the dwelling only; these will be the dominant noise emissions from the barn

The full calculations of the Specific and Rating Levels, which include a precautionary +6dB BS4142 character correction, are provided in Tables B2 and B3, Appendix B. Table 2 provides the resultant Rating and Assessment Levels.

Table 2. Calculated Change of Use Building's Light Industrial Use Rating Levels at Dwellings A and B

Dwelling	Aggregate Rating Level, dB	Typical background noise level, L_{A90} dB	Assessment Level, dB
A	27	28	-1
B	26	28	-2

As can be seen in Table 2 the established Assessment levels for the ancillary light industrial use noise emissions from the change of use agricultural building are in both cases below zero, indicating a BS4142 low noise impact.

Aggregate Noise Impact: The ancillary light industrial use of the change of use agricultural building and the highest capacity of the service yard are not expected to occur at the same time. However, on the assumption that this scenario does occur, the highest aggregate Rating Level will be 31dB, which exceeds the very low typical background by 3dB.

This is considered to be acceptable as:

- The excess over the typical background is below the BS4142 'adverse' noise impact threshold
- A 3dB change in noise level is just perceptible, i.e., the elevated Rating Level would only be just perceived as higher than the very low typical background noise level
- The absolute noise emissions will be very low
- If the ancillary light industrial use did occur at the same time as the maximum capacity of the delivery yard, it would be very infrequent

4.5 Assessment uncertainty

The potential areas of uncertainty in the assessment are:

- Calculations: 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.

- Shipping container HGV source noise levels: Measurements of a shipping container HGV manoeuvring or unloading at site were not able to be obtained during the survey (the timetabled delivery was cancelled). The used in-house data of an HGV manoeuvring in the assessment however is expected to be comparable and loading/unloading noise is not expected to differ from that measured in relation to the 7.5 tonne trucks. The uncertainty in the source noise levels is therefore considered to be small, which would have no significance to the outcome of the assessment.
- Typical background noise levels: The typical background noise levels at the nearest dwellings were established from 2hr 20mintues worth of survey data. As the resultant representative noise level was very low we consider it is very unlikely that a lower typical background noise level would be established with a survey duration over the whole operation period of the warehouse.
- Ancillary light industrial use: noise measurements of the ancillary light industrial use equipment in the change of use agricultural building could not be undertaken. An 85dB(A) internal noise level combined with a +6dB BS4142 character correction has therefore been assumed for the assessment. This is a relatively high noise level (upper action exposure level given in The Control of Noise at Work Regulations 2005), with the character corrections allowing for either 'highly perceptible' tonality or 'clearly perceptible' impulsivity. The assumed internal noise level and applied character corrections are therefore considered suitably robust for the purpose of the assessment.

Taking the above into consideration we conclude that the level of uncertainty in the assessment is acceptable and will not change the findings.

5. Conclusion

A noise survey has been conducted to establish:

- activity noise emissions due to the existing use of the new build warehouse and change of use agriculture building at Penrhos Farm, Llanynynech, Powys
- typical background noise levels at the nearest dwellings.

Note that during the survey the existing haulage yard at Penrhos Farm was operational; no adverse noise emissions from this existing use were observed.

The survey established:

- the typical background noise levels at the nearest dwelling (A & B, Figure 1); the main noise source was road traffic on the adjacent road
- the dominant typical noise producing activities of the new build warehouse/change of use agricultural building was due to deliveries/collections within the service yard (vehicle movements and loading/unloading using a forklift)

Via calculation (Appendix B) it has been demonstrated that the Rating Levels will not exceed the typical background noise level at the nearest dwellings for the:

- service yard activities (assessed with the yard at full capacity)
- ancillary light industrial use equipment noise emissions from the change of use agricultural building (assessed using an internal noise level of 85dB combined with +6 BS4142 character corrections applied)

Where the Rating Level is at parity with the typical background noise level 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. On this basis we conclude that the noise impact of the service yard activities and ancillary light industrial use equipment will be low.

Overall, the assessment identifies that the noise emissions from the existing use of the new build warehouse and change of use agricultural building will not result in an '*unacceptable degree of disturbance'*, thereby satisfying the aims of TAN (Wales) 11. We therefore consider that on noise grounds the existing use of the new build warehouse and change of use agricultural building are acceptable.

Table A1. Positions 1 - 3; 1-minute duration data (free-field)

Start Time	Position 1			Position 2			Start Time	Position 1			Position 2			Start Time	Position 1			Position 2		
	$L_{Amax,F}$ dB	L_{Aeq} dB	L_{A90} dB	$L_{Amax,F}$ dB	L_{Aeq} dB	L_{A90} dB		$L_{Amax,F}$ dB	L_{Aeq} dB	L_{A90} dB	$L_{Amax,F}$ dB	L_{Aeq} dB	L_{A90} dB		$L_{Amax,F}$ dB	L_{Aeq} dB	L_{A90} dB	$L_{Amax,F}$ dB	L_{Aeq} dB	L_{A90} dB
14:52	60.4	46.8	34.6				15:42	44.4	39.5	36.4	62.5	53.4	29.4	16:32	53.0	43.7	33.6	58.0	45.1	35.4
14:53	46.8	37.6	31.8				15:43	50.8	39.7	33.8	42.9	34.1	25.8	16:33	46.3	35.5	32.8	49.6	35.9	27.2
14:54	62.7	45.2	31.8				15:44	44.8	36.8	34.0	47.8	31.4	24.8	16:34	46.7	36.3	32.8	44.3	35.1	30.8
14:55	46.7	34.6	29.6				15:45	57.7	37.7	32.8	61.6	48.6	30.6	16:35	49.9	38.9	33.2	39.9	32.3	25.4
14:56	55.0	37.6	30.4				15:46	46.0	34.9	32.0	67.0	46.2	27.0	16:36	41.9	34.3	32.4	40.1	33.1	25.6
14:57	47.9	40.1	36.2				15:47	43.3	33.8	31.6	46.9	31.2	26.2	16:37	45.6	36.6	33.6	66.0	50.4	29.8
14:58	46.2	37.2	32.6				15:48	40.9	33.8	31.8	48.4	37.8	26.6	16:38	57.1	42.3	37.6	37.1	27.1	25.4
14:59	48.2	38.1	34.0				15:49	41.5	35.3	32.4	42.2	37.4	29.6	16:39	53.6	38.9	37.4	60.1	46.5	28.6
15:00	50.9	38.6	30.8				15:50	46.7	38.1	35.4	61.6	54.7	44.2	16:40	43.1	38.2	37.0	44.9	27.8	24.6
15:01	46.0	33.0	28.8	73.4	49.5	27.2	15:51	45.7	37.5	35.4	62.7	50.1	32.4	16:41	54.2	40.9	36.0	37.8	27.7	26.0
15:02	45.8	33.4	28.8	67.8	55.0	38.0	15:52	45.3	37.2	35.0	62.7	48.9	30.4	16:42	45.4	36.8	33.6	42.8	35.1	26.4
15:03	42.0	33.4	29.8	74.8	63.9	32.6	15:53	45.9	37.1	33.6	39.6	33.8	29.4	16:43	45.4	36.4	33.2	45.1	38.5	29.4
15:04	75.2	49.5	32.6	41.8	33.0	27.0	15:54	46.2	38.5	33.8	36.4	30.6	26.6	16:44	47.0	41.1	34.6	39.5	30.8	26.0
15:05	65.3	46.6	30.8	44.7	30.7	25.8	15:55	51.4	44.1	34.6	44.2	33.9	27.0	16:45	43.3	36.0	34.4	37.1	30.2	27.8
15:06	50.6	39.4	32.0	52.6	36.9	26.4	15:56	55.9	37.5	33.2	64.9	52.7	29.0	16:46	47.3	39.9	37.2	62.8	49.1	28.2
15:07	57.9	47.1	36.4	53.8	40.6	26.8	15:57	55.4	38.2	33.6	57.2	39.0	27.2	16:47	50.1	41.0	34.4	44.8	35.7	27.8
15:08	51.2	41.5	36.6	46.1	33.3	26.4	15:58	44.4	37.6	33.8	39.3	29.6	25.8	16:48	56.9	41.3	34.4	42.4	34.0	27.2
15:09	52.6	45.7	37.4	50.8	38.1	29.4	15:59	43.5	36.8	32.4	39.4	33.8	29.2	16:49	65.5	55.2	38.8	38.7	30.5	27.8
15:10	64.6	53.8	38.0	39.7	29.8	27.0	16:00	60.7	38.9	31.2	35.3	27.7	24.4	16:50	63.6	52.9	45.0	40.7	34.5	29.8
15:11	68.1	60.6	52.0	63.0	50.9	29.8	16:01	69.1	47.8	32.6	35.9	29.4	26.0	16:51	69.3	56.2	50.0	59.9	46.0	31.0
15:12	72.1	52.5	36.8	35.7	28.3	25.2	16:02	60.2	44.4	36.4	43.0	33.7	27.6	16:52	68.4	55.7	30.4	36.6	29.9	27.2
15:13	79.0	56.5	36.4	67.4	53.6	27.8	16:03	52.2	37.3	32.6	37.1	30.4	26.0	16:53	61.3	51.4	31.6	59.5	47.0	0.0
15:14	49.7	38.7	35.0	42.0	34.7	27.8	16:04	51.9	41.9	36.4	47.2	31.9	25.8	16:54	69.6	56.9	44.4	73.4	49.5	27.2
15:15	51.5	43.3	36.6	34.6	30.0	27.4	16:05	57.4	42.2	36.4	40.8	33.4	27.4	16:55	48.0	34.2	31.0	67.8	55.0	38.0
15:16	57.8	48.1	37.0	43.4	34.5	30.4	16:06	59.8	43.5	37.8	42.0	33.8	28.2	16:56	55.8	39.5	33.2	74.8	63.9	32.6
15:17	47.9	41.1	34.0	46.0	40.2	36.0	16:07	63.0	56.3	46.8	68.7	54.4	29.0	16:57	52.6	37.8	33.0	41.8	33.0	27.0
15:18	56.5	41.3	34.8	62.3	48.3	31.6	16:08	58.5	46.6	39.0	42.7	34.5	26.6	16:58	46.7	35.6	33.0	44.7	30.7	25.8
15:19	53.2	46.0	40.6	44.8	34.7	26.2	16:09	56.5	44.0	36.8	56.5	43.6	26.6	16:59	45.8	37.0	33.4	52.6	36.9	26.4
15:20	60.3	52.4	41.6	71.1	58.7	27.6	16:10	56.8	44.2	38.8	64.4	49.9	28.2	17:00	47.2	39.3	34.4	53.8	40.6	26.8
15:21	61.3	40.4	35.2	49.4	39.0	34.2	16:11	70.8	56.5	39.6	76.6	56.9	32.2	17:01	46.9	36.8	33.6	46.1	33.3	26.4
15:22	67.5	45.6	35.4	72.5	60.8	29.6	16:12	65.4	45.9	37.6	47.8	31.0	26.2	17:02	45.7	36.9	33.0	50.8	38.1	29.4
15:23	71.3	50.1	37.8	40.1	32.2	25.8	16:13	56.3	42.3	35.8	57.7	44.7	25.6	17:03	48.3	38.4	32.4	39.7	29.8	27.0
15:24	54.5	41.2	35.6	70.3	56.7	31.0	16:14	52.3	39.6	35.0	65.6	51.0	26.4	17:04	52.5	37.9	31.0	63.0	50.9	29.8
15:25	55.7	41.9	36.0	47.6	36.9	29.0	16:15	55.5	41.2	35.2	39.0	31.7	27.8	17:05	47.6	36.7	32.6	35.7	28.3	25.2
15:26	60.5	46.0	37.4	61.6	47.9	27.4	16:16	57.6	40.7	35.8	35.5	28.5	24.6	17:06	48.1	37.5	33.8	67.4	53.6	27.8
15:27	69.2	49.0	34.8	44.2	34.8	25.8	16:17	64.9	47.1	35.4	37.8	29.1	25.0	17:07	49.0	37.5	33.6	42.0	34.7	27.8
15:28	63.4	53.5	36.6	46.6	32.5	25.4	16:18	58.1	45.8	38.8	59.6	46.1	24.4	17:08	49.4	39.4	33.4	34.6	30.0	27.4
15:29	54.8	42.7	36.4	41.4	33.6	26.2	16:19	70.6	50.7	38.2	35.0	26.6	24.0	17:09	58.8	39.9	33.6	43.4	34.5	30.4
15:30	68.8	54.8	39.0	43.5	29.1	24.8	16:20	55.7	44.5	36.8	42.9	33.5	26.6	17:10	57.5	40.1	33.2	46.0	40.2	36.0
15:31	66.9	45.8	32.8	36.9	27.6	24.8	16:21	67.2	47.7	35.2	54.2	36.4	25.8	17:11	63.9	42.1	31.8	62.3	48.3	31.6
15:32	53.3	43.3	33.4	48.5	32.9	25.2	16:22	66.3	55.1	38.0	38.8	25.7	23.6	17:12	45.8	37.7	33.8	44.8	34.7	26.2
15:33	56.6	38.7	34.4	40.0	33.7	27.2	16:23	65.1	49.8	40.4	51.6	32.7	23.4	17:13	45.7	37.5	33.8	71.1	58.7	27.6
15:34	53.8	42.5	39.4	41.1	31.8	26.0	16:24	65.0	46.2	33.6	57.9	41.2	24.4	17:14	60.6	48.5	40.2	49.4	39.0	34.2
15:35	44.7	38.4	33.6	41.4	32.7	27.4	16:25	62.3	45.7	35.4	53.7	37.9	26.4	17:15	57.7	46.0	35.2	72.5	60.8	29.6
15:36	45.9	36.7	34.0	36.9	27.0	24.8	16:26	72.6	50.2	38.2	55.8	40.6	24.4	17:16	47.9	38.1	35.0	40.1	32.2	25.8
15:37	54.9	46.4	36.6	64.5	52.2	27.6	16:27	66.7	49.1	40.4	65.0	53.8	34.0	17:17	55.5	42.0	36.2	70.3	56.7	31.0
15:38	58.1	39.9	35.8	64.0	53.3	29.4	16:28	68.0	50.8	39.4	47.0	35.1	29.8	17:18	53.8	36.9	34.8	47.6	36.9	29.0
15:39	58.8	49.7	36.6	43.5	34.5	28.6	16:29	75.6	54.7	33.2	55.2	40.9	32.2	17:19	60.1	40.7	34.0	61.6	47.9	27.4
15:40	44.4	38.1	32.6	47.0	32.0	26.0	16:30	48.7	37.6	33.6	60.9	48.3	28.8	17:20	59.5	41.7	35.0	44.2	34.8	25.8
15:41	55.9	46.9	38.0	38.4	30.7	25.0	16:31	58.1	41.1	35.0	49.7	34.3	26.0	17:21	74.0	53.5	41.6	46.6	32.5	25.4

Table A2. Positions 1 - 3; 15-minute duration data (free-field)

Start Time	Position 1			Position 2			Position 3		
	$L_{Amax,F}$ dB	L_{Aeq} dB	L_{A90} dB	$L_{Amax,F}$ dB	L_{Aeq} dB	L_{A90} dB	$L_{Amax,F}$ dB	L_{Aeq} dB	L_{A90} dB
14:30	75.1	48.7	39.5						
14:45	77.5	52.2	41.0	76.1	53.2	29.0			
15:00	70.8	50.0	41.5	75.2	53.4	27.5			
15:15	59.9	47.6	40.5	72.5	52.5	27.5	55.7	35.8	27.5
15:30	67.6	47.1	40.0	64.4	46.2	26.0	60.0	34.8	25.5
15:45	68.0	50.2	42.0	68.5	47.4	28.0	65.1	45.4	28.0
16:00	74.4	50.6	42.5	75.6	48.2	27.0	53.8	33.0	27.5
16:15	58.3	47.0	40.0	64.8	43.6	25.5	56.6	33.2	26.0
16:30	69.2	52.1	41.0	66.1	42.7	26.5	55.5	36.5	28.5
16:45	61.9	47.2	40.0	63.5	41.8	29.0	63.9	36.1	30.5
17:00	56.1	47.1	40.0	71.9	52.5	31.5			
17:15				65.4	47.9	32.0			

Table A3. 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
14:40	0.0	12.7	15:20	0.7	6.2	16:00	0.0	5.4	16:40	0.0	5.0
14:50	0.0	13.0	15:30	0.0	6.0	16:10	0.0	5.6	16:50	0.0	4.4
15:00	0.0	9.7	15:40	0.0	5.6	16:20	0.0	5.4	17:00	0.5	4.5
15:10	0.0	7.7	15:50	0.0	5.3	16:30	0.0	5.5	17:10	0.0	3.6

Table B1. Calculation of Delivery Yard Noise Source's Specific and Rating Levels at Dwellings A & B											
		Dwelling A					Dwelling B				
Noise source		HGV manoeuvring	7.5 tonne truck manoeuvring	Loading/ unloading using electric forklift	Diesel forklift moving steel posts	Diesel forklift manoeuvring	HGV manoeuvring	7.5 tonne truck manoeuvring	Loading/ unloading using electric forklift	Diesel forklift moving steel posts	Diesel forklift manoeuvring
LAeq at Xm		72	50	48	49	55	72	50	48	49	55
Measurement distance (X), m		5	30	30	40	15	5	30	30	40	15
Distance to nearest dwelling, m		105	105	105	105	105	120	120	120	120	120
Distance correction, dB		26.4	10.9	10.9	8.4	16.9	27.6	12	12	9.5	18.1
Atmospheric attenuation, dB		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Shielding correction, dB		14	14	14	14	14	14	14	14	14	14
On-time, mins		2	15	50	10	10	2	15	50	10	10
On-time correction, dB		-14.8	-6	-0.8	-7.8	-7.8	-14.8	-6	-0.8	-7.8	-7.8
Specific Level, dB		16.6	18.9	22.1	18.6	16.1	15.4	17.8	21	17.5	14.9
BS4142 corrections	Tonality	0	0	0	0	0	0	0	0	0	0
	Impulsivity	0	0	0	3	3	0	0	0	3	3
	Intermittency	0	0	0	0	0	0	0	0	0	0
	Other	0	0	0	0	0	0	0	0	0	0
Rating Level		17	19	22	22	19	15	18	21	21	18
		HGV manoeuvring + loading/unloading using electric forklift		7.5 tonne truck manoeuvring + loading/unloading using electric forklift		Diesel forklift movements	HGV manoeuvring + loading/unloading using electric forklift		7.5 tonne truck manoeuvring + loading/unloading using electric forklift		Diesel forklift movements
Aggregate Rating Level		23		24		24	22		23		22

Table B2. Calculation of light industrial use noise break-out from the change of use agricultural building's ridge ventilation openings at Dwellings A and B

Internal Lp	85	dB
Area of ventilation opening	0.4	m2
Lw	81	dB

Vent		Dwelling			Dwelling			Dwelling			Dwelling			Dwelling	
		A	B		A	B		A	B		A	B		A	B
1	Direct distance, m	159.7	173.4	Distance correction, dB	55.1	55.8	Shielding attenuation, dB	17	17	Atmospheric attenuation, dB	0.3	0.3	Sound pressure level at dwelling, dB	8.7	7.9
2		159.7	173.6		55.1	55.8		17	17		0.3	0.3		8.7	7.9
3		159.8	174.3		55.1	55.8		17	17		0.3	0.3		8.6	7.9
4		159.8	174.5		55.1	55.8		17	17		0.3	0.3		8.6	7.9
5		159.9	175.2		55.1	55.9		17	17		0.3	0.3		8.6	7.8
6		160.0	175.4		55.1	55.9		17	17		0.3	0.3		8.6	7.8
7		160.1	176.1		55.1	55.9		17	17		0.3	0.3		8.6	7.8
8		160.2	176.4		55.1	55.9		17	17		0.3	0.3		8.6	7.8
					Aggregate Lp at dwelling						Specific Level, dB			18	17

Table B3. Calculation of light industrial use noise emissions radiating from the change of use agricultural building's façades/roof facing Dwellings A and B

		Dwelling A	Dwelling B
	Internal Lp	85	85
Distance from radiating façade to dwelling, m	Distance to south side façade	146	145
	Distance to mid south roof	159	152
	Distance to mid west gable end	153	N/A
Distance corrections, dB	South side façade	51.3	51.2
	South roof	52.0	51.6
	West gable end	51.7	N/A
Sound reduction, Rw dB	South side façade	23	23
	South roof	25	25
	West gable end	23	N/A
Radiating façade/roof areas, m2	South side façade	55	55
	South roof	252	252
	West gable end	130	N/A
Area corrections, dB	South side façade	17.4	17.4
	South roof	24.0	24.0
	West gable end	21.1	N/A
Atmospheric attenuation, dB	South side façade	0.3	0.3
	South roof	0.3	0.3
	West gable end	0.3	N/A
Shielding attenuation, dB	South side façade	18	18
	South roof	17	17
	West gable end	18	N/A
Lp at dwelling, dB	South side façade	9.9	9.9
	South roof	14.7	15.1
	West gable end	13.2	N/A
	oof ventilation openings (see Table B2)	18.0	17.0
	Aggregate Lp (Specific Level)	21	20
	BS4142 character corrections	6	6
	Rating Level	27	26