

Table 8 - Night time L_{A90} (dB) noise limits derived from historical baseline data and the baseline noise survey according to ETSU-R-97 and lower fixed limit of 43 dB(A) for the Proposed Development. Noise assessment locations considered financially involved with the Proposed Development are indicated with '(FI)'.

Property	Standardised 10 m Wind Speed (m/s)											
	1	2	3	4	5	6	7	8	9	10	11	12
Lettershaws Farm	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Kirkton	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Glencaple Farm House	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Glencaple	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Boghead	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Carlisle Road North	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Hurlieburn Lodge	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Carlisle Road South	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Stoneyburn	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Elvanfoot Farm	43.0	43.0	43.0	43.0	43.0	43.4	43.8	44.2	44.6	44.9	45.3	45.7
Lodge Cottages	43.0	43.0	43.0	43.0	43.0	43.4	43.8	44.2	44.6	44.9	45.3	45.7
Leadhills Road	43.0	43.0	43.0	43.0	43.0	43.4	43.8	44.2	44.6	44.9	45.3	45.7
North Shortcleugh (FI)	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
South Shortcleugh	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Hass	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Waterhead Toll Cottage	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
New Glendorch	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Glengeith	43.0	43.0	43.0	43.0	43.0	43.4	43.8	44.2	44.6	44.9	45.3	45.7
Leadhills	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Leadhills (south)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Dentercleuch	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
Snar Farm	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.1	46.3	46.3	46.3
Glendouran Farm	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.1	46.3	46.3	46.3
Stranclough Farm	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.1	46.3	46.3	46.3

5. Noise Impact Assessment

5.1 Predicted Construction Noise and Vibration Levels

- 5.1.1 The level of construction noise that occurs at the surrounding properties will be highly dependent on a number of factors such as the final site programme, equipment types used for each process, and the operating conditions that prevail during construction. It is not practically feasible to specify each and every element of the factors that may affect noise levels, therefore it is necessary to make

reasonable allowance for the level of noise emissions that may be associated with key phases of the construction.

- 5.1.2 In order to determine representative emission levels for this study, reference has been made to the scheduled sound power data provided by BS 5228. Based on experience of the types and number of equipment usually associated with the key phases of constructing a wind farm, the scheduled sound power data has been used to deduce the upper sound emission level over the course of a working day. In determining the rating applicable to the working day, it has generally been assumed that the plant will operate for between 75% and 100% of the working day. In many instances, the plant would actually be expected to operate for a reduced percentage, thus resulting in noise levels lower than predicted in this assessment.
- 5.1.3 To relate the sound power emissions to predicted noise levels at surrounding properties, the prediction methodology outlined in BS 5228 has been adopted. The prediction method accounts for factors including screening and soft ground attenuation. The size of the Site and resulting separation distances to surrounding properties allows the calculations to be reliably based on positioning all the equipment at a single point within a particular working area (for example, in the case of turbine erection, it is reasonable to assume all associated construction plant is positioned at the base of the turbine under consideration). In applying the BS 5228 methodology, it has been conservatively assumed that there are no screening effects, and that the ground cover is characterised as 50% hard / 50% soft.
- 5.1.4 Table 9 lists the key construction activities, the associated types of plant normally involved, the expected worst-case sound power level over a working day for each activity, the property which would be closest to the activity for a portion of construction, and the predicted noise level. It must be emphasised that these predictions only relate the noise level occurring during the time when the activity is closest to the referenced property. In many cases such as access track construction and turbine erection, the separating distances will be considerably greater for the majority of the construction period, and the predictions are therefore the worst-case periods of the construction phase.

Table 9 - Predicted construction noise levels

Task Name	Plant/Equipment	Upper Collective Sound Emission Over Working Day $L_{WA,T}$ dB(A)	Nearest Receiver	Minimum Distance to Nearest Receiver (metres)	Predicted Upper Day-Time L_{Aeq} dB(A)
Construct temporary site compounds	excavators / dump trucks / tipplers / rollers/ delivery trucks	120	Lettershaws Farm	420	54
Construct site tracks	excavators / dump trucks / tipplers / dozers / vibrating rollers	120	Lettershaws Farm Cottage	30	82 (short-term)
Construct Sub-Station	excavators / concrete trucks / delivery trucks	110	Lettershaws Farm	930	36
Construct crane hard stand ngs	excavators / dump trucks	115	Waterhead Toll Cottage	600	45
Construct turbine foundations	piling rigs / excavators / tipplers / concrete trucks / mobile cranes / water pumps / pneumatic hammers	120	Waterhead Toll Cottage	600	50

Task Name	Plant/Equipment	Upper Collective Sound Emission Over Working Day L _{WA,T} dB(A)	Nearest Receiver	Minimum Distance to Nearest Receiver (metres)	Predicted Upper Day-Time L _{Aeq} dB(A)
	/ compressors / vibratory pokers				
Excavate and lay site cables to substation	excavators / dump trucks / tractors & cable drum trailers / wacker plates	120	Lettershaws Farm	930	46
Erect turbines	cranes / turbine delivery vehicles / artics for crane movement / generators / torque guns	115	Waterhead Toll Cottage	600	45
Reinstate crane bases	excavator / dump truck	115	Waterhead Toll Cottage	600	45
Reinstate road verges	excavator / dump truck	115	Lettershaws Farm Cottage	30	77(short-term)
Concrete Batching	Batching Plant	110	Lettershaws Farm	420	44
Demolition	Batching Plant	120	Lettershaws Farm	420	54
Forrest Felling	Harvesters and forwarders, characterised by saw noise diesel engine noise emissions commonly associated with tractors and excavation noise	115	Waterhead Toll Cottage	1170	38
Winning Stone	Boulder Breakers / excavators / Dump trucks / lorry	125	Lettershaws Farm Cottage	600	55
Borrow Pit Quarrying	Lorries / breakers / crushers stockpilers / conveyors / hoppers	125	Lettershaws Farm Cottage	600	55

- 5.1.5 Comparing the above predicted noise levels to the range of background noise levels measured around the Proposed Development suggests that the noisier construction activities would be audible at various times throughout the construction phase. However, comparing the levels to the significance criteria presented previously in Table 1 indicates that the majority of construction activities will have impacts of ‘negligible to minor’ magnitude.
- 5.1.6 For the activity associated with Reinstating Road verges, which is closest to Lettershaws Farm Cottage, predicted noise levels are likely to represent impact of ‘moderate’ magnitude for a very short-term period when activity is closest to the receptor. Noise levels will quickly diminish as site track and associated road construction progresses, moving the activity further from the property, therefore, the short-term impact of this activity will be lower in practice.
- 5.1.7 In terms of vibration, the new access track or road works may involve vibratory ground compaction. Using guidance in BS 5228-2, based on worst-case assumptions (0.8 mm drum vibration amplitude and a 1.5 m drum width), vibration levels at 30 m distance (closest point to Lettershaws Farm

- Cottage) would be no more than 0.9 mm/s. Based on BS 5228-2 guidance (Table 1), these levels represent a ‘minor’ magnitude of impact.
- 5.1.8 The construction of the new northern site access track associated with the proposed access from the B797, as outlined in Chapter 9: Traffic and Transport, will however involve more earthwork and therefore a longer works duration, occurring in relatively close proximity to the properties near the main Site access; Lettershaws Farm in particular. Although the closest point of activity is nearer to Lettershaws Farm Cottage, the activity is expected to move further from the property after a short period, however the access track construction activity is expected to remain in proximity to Lettershaws Farm for a longer period.
- 5.1.9 For building the portion of the proposed new access track within 30 m to 65 m of Lettershaws Farm and the adjacent Lettershaws Campsite (250 m of the site track from access point), worst-case noise levels from 75 dB(A) to 82 dB(A) may be experienced based on the conservative assumptions made. It is expected that this activity, comprising the first 250 m extent of the access track construction, can be completed within 4 weeks. This would therefore represent a ‘moderate’ impact according to the criteria in Table 1. The above predictions are based on worst-case assumptions, with actual activity levels (and therefore associated noise) likely to be lower in practice. Exact details of the construction activity are unknown at this stage and depends on a number of factors such as ground conditions, presence of hard rock etc.
- 5.1.10 Direct engagement and discussion will be undertaken with the nearest residents including those of Lettershaws Farm to inform them of the access track works, the associated noise generation and to discuss potential mitigation and management measures that can be employed, and the timing the works.
- 5.1.11 It may be feasible to substantially reduce noise levels (by 10 dB or more) from the construction of access track using temporary solid screening, close to the property boundary, of a height sufficient to screen the track construction activities. The final design and specification and practical feasibility of such screening will be determined as part of the detailed design of the access track, following ground investigations. Noise monitoring would also be undertaken to assist in managing these impacts. If the noise monitoring reveals measured levels at Lettershaws Farm above 75 dB L_{Aeq}, for a period of 10 or more days of working in any 15 consecutive days (with brief exceptions), then further mitigation measures (in addition to the above) can be explored, such as quieter construction techniques, reduced levels of activity or reduced construction hours, although this may extend the duration of the works.
- 5.1.12 Implementing these measures is expected to reduce the impact from these activities at Lettershaws Farm to a ‘minor’ magnitude. The measures will be detailed in the Noise Management Plan and implemented as part of the CEMP.
- 5.1.13 No construction activities are expected to occur during Saturday afternoons and Sundays day-time periods, which is outside the hours assumed when determining the criteria of Table 1(see 3.5.3). Should activities be required outside these hours e.g., turbine blade delivery etc. then written permissions will be obtained from the SLC for the works and the associated impacts would be limited.
- 5.1.14 In addition to on-site activities, construction traffic passing to and from the site will also represent a potential source of noise to surrounding properties. The traffic statement for the proposal is presented in Chapter 9: Traffic and Transport. Specifically, the highest volume of traffic generated by construction is expected to occur in the 11th month of construction, in which an average of 230 total vehicle daily trips (two way, 194 large heavy good vehicles (HGV) and 86 cars/light good vehicles (LGV)) are predicted, resulting in a worst case 16 two-way HGV trips per hour, across a typical 12 hour day. This is assuming 100% of aggregate materials are imported to the Site as a worst case. Table 9.7 and Table 9.10 of Chapter 9: Traffic and Transport have been used to ascertain the projected traffic flows for scenarios without and with the Proposed Development in 2035.

Table 10 - Projected traffic flows

Road	Without Development Future Baseline 2035		With Development Future Baseline plus Construction Traffic in 2035	
	Annual Average Daily Traffic Flow	% Heavy Goods Vehicles	Annual Average Daily Traffic Flow	% Heavy Goods Vehicles
B797, at Site Accesses	453	16.8%	733	36.8%
B797, north of Leadhills	533	3.4%	547	3.3%
A702, north of Abington Village	1,964	5.9%	2,037	5.6%
A702 North of 2702/Carlisle Rd/A74(M)	994	12.8%	1,183	27.0%
M74, south of Junction 12	36,033	34.2%	36,258	34.5%
A74(M), north of Junction 14	39,312	33.9%	39,537	34.2%

Table 11 - CRTN predicted increase in day time average traffic noise levels (LA10,18hour)

Road	Maximum Change in Traffic Noise Level, dB(A)	Magnitude of Impact
B797, at Site Accesses	-	See paragraph 5.1.16
B797, north of Leadhills	-	See paragraph 5.1.16
A702, north of Abington Village	0.2	Negligible
A702 North of 2702/Carlisle Rd/A74(M)	-	See paragraph 5.1.16
M74, south of Junction 12	0.1	Negligible
A74(M), north of Junction 14	0.1	No Change

- 5.1.15 In conclusion for all routes assessed in line with the DMRB criteria outlined in paragraph 3.5.4, the maximum change in traffic noise level for the Proposed Development is 0.2 dB(A) and therefore correspond to a negligible impact at most. The predicted baseline traffic flow values on three of the identified road sections (B797, at Site Access, B797, north of Leadhills, and A702 north of Carlisle Road) surrounding the Proposed Development are of less than 1000 vehicles per day, which is considered too low for the CRTN prediction methodology. Assessment of construction traffic noise along these two routes therefore considers absolute noise levels, based on the prediction methodology in BS 5288-1.
- 5.1.16 The nearest residential property locations in respect of vehicle movements along the B797, at Site Access, the B797 north of Leadhills, lie within 5 to 10 metres to the midsection of the B797 routes and 45 m from the A702 north of Carlisle Road. Large heavy goods vehicles can generate noise levels in the order of 108 dB L_{WA} (sound power level) when in motion. However, these types of plant usually pass a receiver location quite quickly. When stationary the same vehicles will be operating in idle which considerably lowers the noise output to the environment. Based on the prediction methodology in BS 5288-1 and accounting for a worst case 16 two-way HGV trips per hour on all routes and moving at an estimated 70 km/h along the B797 and A702 road and 50 km/h at the access point, the predicted noise levels at properties along the B797 road range between 62 dB(A) and 61 dB(A), and 52 dB L_{Aeq,12hour} at A702 road. Based on the assessment criteria of BS 5288-1 (see Table 1), these noise levels correspond to a minor impact for both B797 routes and negligible impact for the A702 road, during the peak construction month 11, and therefore representing a minor impact for construction traffic noise as worst-case.

- 5.1.17 Based on the assumptions in Chapter 9: Traffic and Transport, no other significant traffic generating developments in the Study Area were identified during the construction of the Proposed Development. Therefore, no cumulative construction traffic noise assessment is required.
- 5.1.18 This conclusion is based on construction activities generally being limited to the following working hours: from 07:00 to 19:00 on weekdays, and 07:00 to 13:00 on Saturdays. No construction activities other than vehicle movements would be undertaken on Saturday afternoons and Sundays. However, activities that are unlikely to give rise to noise audible at the Site boundary will continue outside of the stated hours. Furthermore, turbine deliveries may take place outside these times with the prior consent of the relevant authorities. In addition, good practice measures recommended in BS 5228-1 should be used to minimise construction noise levels.
- 5.2 Decommissioning Noise
- 5.2.1 Decommissioning is likely to result in less noise than during construction of the Proposed Development. The construction phase has been considered to have ‘minor’ noise impacts, therefore decommissioning will, in the worst case, also have ‘minor’ noise impacts.
- 5.3 Operational Wind Turbine Emissions Data
- 5.3.1 The exact model of turbine to be used at the Site will be the result of a future tendering process and therefore a representative turbine model has been assumed for this noise assessment. The candidate turbine selected for the application is the Siemens Gamesa SG 7.0-170 with a maximum tip height of 220 m and hub height of 135 m. However, in order to represent a worst-case noise assessment, this operational noise assessment is based upon the noise specification of the Vestas V172-7.2 MW wind turbine which results in higher noise levels than for the SG7.0-170 turbine. 21 turbines have been modelled using the layout as indicated on Figure B1 at Annex B. The Vestas V172 is a variable speed, pitch-regulated machine with a rotor diameter of 172 m and a hub height of 134 metres. Due to its variable speed operation, the sound power output of the V172 turbine varies considerably with wind speed, being quieter at the lower wind speeds when the blades are rotating more slowly. The turbine also incorporates the use of Serrated Trailing Edges (or STE), which reduce noise emissions, as standard.
- 5.3.2 In addition to this general low noise characteristic at lower wind speeds the candidate turbine also incorporates noise control technology. This allows the sound power output of the turbine to be reduced across a range of operational wind speeds, albeit with some loss of electrical power generation, to enable the best compromise to be achieved in any given situation between emitted noise and electrical power generation. Noise control of the candidate turbine is provided in a number of noise control modes with various noise/power output combinations. Similar noise reduction management systems are also offered by other wind turbine manufacturers. These systems are generally similar in that they rely on the turbine’s computer-based controller adjusting either the pitch of the blades or holding back the rotational speed of the blades to reduce emitted noise under selected wind conditions (direction, speed or some combination of the two). In this manner noise management only comes into play (and therefore potential power generation capacity is only lost) for those conditions under which it is required.
- 5.3.3 For the purposes of the initial assessment, the wind turbines on the Proposed Development have been modelled assuming selective operation of some turbines in ‘Low Noise’ control modes for certain turbines to achieve compliance with the derived noise limits. Specifically, the model assumes turbines T2 in ‘SO3’ Mode, turbine T20 in ‘SO2’ Mode and turbine T21 in ‘SO1’ Mode (see turbine numbering on Figure B1 of Annex B).
- 5.3.4 EnVentus have supplied specified noise emission data for the V172-7.2 MW turbine which has been derived from various sound power tests, in the absence of specific information about uncertainty