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Chapter 10.

Noise

Contents

Glossary

Term	Definition
Daytime Hours	07:00 to 23:00 every day
Decibel	the ratio between the quietest audible sound and the loudest tolerable sound is a million to one in terms of the change in sound pressure. A logarithmic scale is used in noise level measurements because of this wide range. The scale used is the decibel (dB) scale which extends from 0 to 140 decibels (dB) corresponding to the intensity of the sound level.
Environmental Impact Assessment	Environmental Impact Assessment (EIA) is a means of carrying out, in a systematic way, an assessment of the likely significant environmental effects from a development.
Environmental Impact Assessment Regulations	The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (EIA Regulations)
Environmental Impact Assessment Report	A document reporting the findings of the EIA and produced in accordance with the EIA Regulations
L_{90}	An index that represents the noise level exceeded for 90 percent of the measurement period and is used to indicate quieter times during the measurement period. It is often used to measure the background noise level. The $L_{A90,10min}$ is the A-weighted background noise level over a ten minute measurement sample
Noise emission	the noise energy emitted by a source (e.g. a wind turbine).
Noise immission	the sound pressure level detected at a given location (e.g. the nearest dwelling).
Night Time Hours	ETSU-R-97 defines the night time hours as 23.00 to 07.00 every day
Proposed Development	The South Kyle II Wind Farm development
Proposed Development Area	The area within the “Site boundary” as illustrated on Figure 1.1 which the Proposed Development will be located
Quiet Daytime Hours	ETSU-R-97 defines the amenity hours as 18.00 to 23.00 Monday to Friday, 13.00 to 23.00 on Saturdays and 07.00 to 23.00 on Sundays.
Standardised Wind Speed	a wind speed measured at a height different than 10 m (generally measured at the turbine hub height) which is expressed to a reference height of 10 m using a roughness length of 0.05 for standardisation purpose (in accordance with the IEC 61400-11 standard).
Wind Shear	The increase of wind speed with height above the ground.

List of Abbreviations

Abbreviation	Description
AM	Amplitude Modulation
AOD	Above Ordnance Datum
BESS	Battery Energy Storage System
dB	Decibel
EHO	Environmental Health Officer
ECU	Energy Consents Unit
FI	Financial Involvement
FML	Fixed Minimum Limit
GPG	Good Practice Guidance
GW	Gigawatts
IOA	Institute of Acoustics
LFN	Low Frequency Noise
MW	Megawatts
NAL	Noise Assessment Location
NSR	Noise Sensitive Receptor
NWG	Noise Working Group
PAN	Planning Advice Note
SSNL	Site Specific Noise Limit
TNL	Total ETSU-R-97 Noise Limit

10.1. Introduction

10.1.1. This Chapter considers the likely significant effects with respect to the noise associated with the operation of the Proposed Development.

10.1.2. The specific objectives of the chapter are to:

- describe the noise baseline;
- describe the assessment methodology and significance criteria used in completing the impact assessment;
- describe the potential effects (including cumulative effects);
- describe the mitigation measures proposed to address likely significant effects (if required); and
- assess the residual effects remaining following the implementation of mitigation (if required).

10.1.3. This chapter is supported by the following figures and appendices:

- Figure 10.1: Noise Assessment and Wind Turbine Locations;
- Technical Appendix 10.1: Operational Noise Report.

10.1.4. The Figures and the supporting Appendix are referenced in the text where relevant.

10.2. Legislation, Policy and Guidance

10.2.1. The assessment used the following combination of guidance and assessment methodologies:

- National Planning Framework 4, (Scottish Government, 2023)[1]
- Onshore wind: policy statement 2022 (Scottish Government, 2022)[2];
- Web Based Renewables Advice: 'Onshore Wind Turbines' (Scottish Government, 2014)[3];
- ETSU-R-97 'The Assessment and Rating of Noise from Wind Farms' (NWG, 1996)[4];
- ISO 9613-2:1996 'Acoustics – Attenuation of sound during propagation outdoors Part 2: General method of calculation' (ISO, 1996)[5]; and
- Institute of Acoustics (IOA) 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (IOA GPG, 2013)[6].

10.2.2. The above documents are discussed in detail within Section 2 of Appendix 10.1: Operational Noise Report, where relevant.

[1] Scottish Government (2023). National Planning Framework 4 [Online] Available from National Planning Framework 4

[2] Scottish Government (2022). Onshore wind: policy statement 2022 [Online] Available from Onshore Wind Policy Statement 2022

[3] Scottish Government (2014) Web Based Renewables Advice: 'Onshore Wind Turbines' [Online] Available From https://www.gov.scot/publications/onshore-wind-turbines-planning-advice/ [Accessed 3rd September 2024]

[4] The Working Group on Noise from Wind Turbines (1996). ETSU-R-97 The Assessment and Rating of Noise From Wind Farms. UK: Energy Technology Support Unit

[5] ISO (1996). ISO 9613-2:1996 Acoustics – Attenuation of Sound during Propagation Outdoors: Part 2 – General Method of Calculation. Geneva: International Organization for Standardisation.

[6] IOA (2013). A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise'. UK: Institute of Acoustics.

10.3. Consultations

10.3.1. An EIA Scoping Opinion for the Proposed Development was issued in June 2022 by the Energy Consents Unit (ECU) on behalf of the Scottish Government. A summary of consultation responses received as part of the scoping exercise and response / actions taken, is given in Table 10.1 below. A summary of the post-scoping consultation and response is given in Table 10.2 below.

Table 10.1: Scoping Consultation Response - Noise

Consultee	Summary of Response	Response/Action taken
ECU – Scoping	It was acknowledged that ETSU-R-97 and the IOA GPG would be the relevant guidelines, and a noise consultation should take place directly with EAC.	The appropriate standards have been used with details of post-scoping consultation presented in Table 10.2 and in Appendix 10.1
	The noise report should be formatted as per Table 6.1 of the IOA GPG.	Appendix 10.1: Operational Noise Report provides all the relevant information as detailed within Table 6.1 of the IOA GPG.
East Ayrshire Council (EAC) - Scoping consultee response	EAC suggested consultation may need be undertaken with third party used by the Council. EAC also indicated a preference towards lower end of the ETSU limits. Low Frequency noise was scoped out.	Details of the post-scoping consultation are presented in Table 10.2, with full details of the consultation within Appendix 10.1. Justification for the choice of Fixed Minimum Limits used in deriving the Total ETSU Noise Limits is presented in Table 6.11 of Appendix 10.1.
	EAC understands regarding Other Amplitude Modulation (OAM) that until such time as the relevant guidance is updated, there is no formally adopted method for assessing Amplitude Modulation and agrees that this can be scoped out of the assessment.	There is still no available methodology to predict the occurrence of OAM at the planning stage, so whilst the latest information on OAM has been provided in Appendix 10.1, an assessment of OAM was scoped out.

Table 10.2: Post-scoping Consultation Response - Noise

Consultee	Summary of Consultation	Response
	TNEI prepared a detailed consultation letter in June 2024 for the attention of Environmental Health Department at EAC.	The EH response letter received 26th June 2024, stated that they agreed BESS operational noise can be scoped out (no assessment required).
East Ayrshire Council (EAC)	In the TNEI letter, information on proposed noise assessment locations, background levels to be used, details on the selected noise limit criteria, and the cumulative wind turbines to be considered were provided.	It was noted by the Environmental Health Department that the selection of receptors was not an exhaustive list of all properties within the area. After a review, it is TNEI's view that the most relevant and important receptors in any direction have been assessed in detail, and the background levels selected to represent each receptor were very low, as explained in the consultation letter and in the baseline section of this chapter.
		Additionally, the variation in topography of the surrounding area was mentioned within the response. Topography is considered in detail in the noise predictions, as recommended in the IOA GPA, with full details on this aspect provided in Appendix 10.1.

Impacts Scoped Out

Wind Farm and BESS Construction Noise

10.3.2. Construction and decommissioning works will be undertaken within typical working hours and, as such, a detailed construction and decommissioning noise assessment for the wind farm and BESS development has not been undertaken and has been scoped out of the EIAR. This was agreed with EAC during post-Scoping consultation. However, at the time of consultation only the southern access track was proposed. As the proposed northern access track is already built, no further construction activities along the track are proposed and therefore a detailed construction and decommissioning noise assessment remains scoped out.

BESS Operational Noise

10.3.3. As part of the Proposed Development, a BESS and substation will be located close to the existing New Cumnock Substation. Due to the separation distance between the proposed BESS and substation and the nearest noise sensitive receptor (NSRs) to the southwest (2.0 km) and northeast (1.3 km), and the relatively small scale of the BESS (up to 50 MW), operational noise levels from the BESS and substation at the nearest NSRs are expected to be low. On that basis, BESS operational noise has been scoped out of the EIAR. This was agreed with EAC during post-Scoping consultation. However, at the time of consultation the BESS was proposed approximately 750 m southwest of its current proposed location; this difference in location does not alter the above statement.

Impacts Scoped In

Wind Farm Operational Noise

- Potential impact of operational noise from the proposed development at noise sensitive receptors located in proximity to the proposed development; and
- Potential impact of cumulative operational noise from the proposed development operating concurrently with other operational, consented and proposed (planning application submitted) developments in the area.

10.4. Method of Assessment

10.4.1. The assessment has been undertaken in accordance with ETSU-R-97 and current good practice. ETSU-R-97 provides a robust basis for determining acceptable noise limits for wind farm developments. Consequently, the test applied to operational noise is whether or not the calculated wind farm noise levels at nearby noise sensitive properties would be below the noise limits derived in accordance with ETSU-R-97.

10.4.2. The need for a cumulative noise assessment was considered in accordance with the guidance contained within the IOA GPG. There are a number of operational and consented wind farm developments in proximity to the

Proposed Development (See Figure 10.1), therefore in order to consider the likely cumulative noise impacts, the noise assessment was undertaken in three separate stages:

- Stage 1 – establish the 'Total ETSU-R-97 Noise Limits' (TNL) for each Noise Assessment Location (NAL);
- Stage 2 – undertake noise predictions to determine whether the contribution from the Proposed Development on its own is within 10 dB of the noise predictions from other wind turbines within the area. Where turbine predictions are within 10 dB then a likely cumulative noise assessment should be undertaken, and the results compared to the TNL; and
- Stage 3 – establish the 'Site Specific Noise Limits' (SSNL) for the Proposed Development and compare the noise predictions from the Proposed Development on its own against the SSNL.

10.4.3. The TNL is applicable to all operational and consented wind farms in the area so a set of SSNL are derived to control the specific noise from the Proposed Development.

10.4.4. The aim of the operational noise assessment therefore is to establish the TNL, determine the likely impacts of the Proposed Development at the nearest noise sensitive receptors, derive SSNL and to demonstrate that the Proposed Development can meet the limits (i.e. noise levels will be at or below).

10.4.5. The exact model of wind turbine to be used for the Proposed Development will be the result of a future tendering process should consent be granted. Achievement of the noise limits determined by this assessment would be a key determining factor in the final choice of wind turbine. Predictions of wind turbine noise for the Proposed Development were based upon the sound power level data for a candidate wind turbine, the Siemens-Gamesa SG 6.6-170 6.6 MW with a hub height of 115 m, as it is considered representative of the type of wind turbine likely to be installed at the Proposed Development.

10.4.6. All the operational and consented wind turbines modelled, inclusive of those used in the cumulative noise assessment, are shown on Figure 10.1 and summarised in Table 1.1 of Appendix 10.1. Uncertainty in sound power data has been accounted for using the guidance contained within Section 4.2 of the IOA GPG.

10.4.7. Noise predictions have been undertaken using the propagation model contained within Part 2 of International Standard ISO 9613-2, 'Acoustics – Attenuation of sound during propagation outdoors'. The model calculates on an octave band basis, accounting for attenuation due to geometric spreading, atmospheric absorption and ground effects. The noise model was set up to provide realistic noise predictions, including mixed ground attenuation (G=0.5) and atmospheric attenuation relating to 70% Relative Humidity and 10°C.

10.4.8. Typically, wind farm noise assessments assume all properties are downwind of all wind turbines at all times (as this would result in the highest wind turbine noise levels). However, where properties are located in between groups of wind turbines, or when turbines are spread over a wide angle of view, they cannot be downwind of all wind turbines simultaneously, so it is appropriate to consider the effect of wind direction on predicted noise levels. Directivity has been considered using the guidance in the IOA GPG (further information can be found in Section 6.3 of Appendix 10.1).

10.4.9. In line with the IOA GPG, an assessment has been undertaken to determine whether a concave ground profile correction (+3 dB) or barrier correction (-2 dB), is required due to the topography between the wind turbines and the noise sensitive receptors. Propagation across a valley (concave ground) increases the number of reflection paths, and in turn, has the potential to increase sound levels at a given receptor. Topographical screening effects from terrain surrounding a wind farm can result in reductions in the observed sound level between the source and receiver where no line of sight is present. A concave ground and barrier correction was found to be required for a number of wind turbines at a number of receptors (as detailed in Annex 4, Appendix 10.1). Topographical corrections have been applied where necessary to the predictions presented in all tables and graphs.

Assessment of Effects

10.4.10. The Scottish Government's 'Onshore wind: policy statement 2022' states that ETSU-R-97 in conjunction with the IOA GPG should be used in the assessment and rating of noise from wind energy developments. It is acknowledged that the UK Government has been considering the extent to which ETSU-R-97 may require updating to align with the potential effects from more modern turbines. However, it is stated that until such time that new guidance is produced, ETSU-R-97 should still be used in the assessment and rating of noise from wind energy developments. ETSU-R-97 does not define significance criteria but instead describes a framework for the measurement of wind farm noise, giving indicative noise levels considered to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable restrictions on wind farm development. Achievement of ETSU-R-97 derived noise limits ensures that wind turbine noise will comply with current Government guidance.

10.4.11. In terms of the EIA Regulations, the use of the term "significance" in this Chapter refers to compliance/ non-compliance with the ETSU-R-97 derived noise limits. For situations where predicted wind turbine noise meets or is less than the noise limits defined in ETSU-R-97, then the noise effects are deemed not significant. Any breach of the ETSU-R-97 derived noise limits due to the Proposed Development is deemed to result in a significant effect.

10.4.12. For the purposes of this assessment, residential dwellings are considered to be noise sensitive receptors.

Limitations and Assumptions

10.4.13. A candidate wind turbine has been used for predictions of operational noise from the Proposed Development. The final model of wind turbine to be used may differ from that presented here, however the operational noise levels from the Proposed Development would have to comply with the noise limits imposed within the noise condition attached to any consent. No other assumptions or data gaps have been identified.

10.5. Baseline

Current Baseline

10.5.1. The Proposed Development is located within a rural location where existing background noise levels at the noise sensitive receptors are generally considered to be low. The predominant noise sources in the area include wind induced noise (wind passing through vegetation and around buildings), local watercourses, agricultural noise and birdsong. At some receptors the soundscape may include intermittent road traffic noise and noise from existing operational turbines. Background noise monitoring was undertaken at four locations proximate to the Proposed Development in 2015 as part of noise assessment for Enoch Hill Wind Farm, the locations of which can be seen on Figure 10.1. No additional background noise monitoring was undertaken, as the background levels established in 2015 for the quietest of four monitoring locations were judged appropriate and representative. This ensures that the background levels do not include the influence of existing operational wind turbines in the area.

Future Baseline

10.5.2. It is possible that noise propagation and resulting noise immission levels could change over the life of the project due to climate change (as noise attenuation is influenced by air temperature, relative humidity and ground conditions). However, noise limits would be set for the lifetime of the project and the operator would be required to meet them for the lifetime of the wind farm. If climate change resulted in the exceedance of limits, turbine noise

could be reduced through mode management measures. There are no other known current or predicted future processes that are likely to change the baseline conditions.

Identified Sensitive Receptors

10.5.3. A total of nine noise sensitive receptors were chosen as representative Noise Assessment Locations (NALs). The NALs chosen were the closest receptors to the Proposed Development and other wind farm developments such that cumulative impacts could be assessed.

10.5.4. The NALs refer to the position in the curtilage of a property which is closest to the Proposed Development, as detailed in Table 10.3 and shown on Figure 10.1. This approach ensures that the assessment considers the worst case (loudest) noise immission level expected at the noise sensitive receptor.

Table 10.3: Operational Noise Assessment Locations

NAL	Easting	Northing	Elevation (m AOD)	Approximate Distance to Nearest South Kyle II Wind Turbine (m)*
NAL1 - Maneight	254289	609687	314	2868 (T9)
NAL2 - Knockenlee	253710	609315	270	2488 (T5)
NAL3 - Nith Lodge	253633	609133	275	2296 (T5)
NAL4 - Meiklehill	253491	608827	294	1965 (T5)
NAL5 - Clawfin	250608	607295	256	1274 (T2)
NAL6 - Pennyvenie	249453	606652	212	2169 (T1)
NAL7 - Mossdale Farm	249404	604217	229	3063 (T1)
NAL8 - Glenmuck	251495	602140	304	3590 (T4)
NAL9 – Brownhill	255895	602599	300	3620 (T10)

** Please note the distances to nearest turbines quoted above may differ from those reported elsewhere. Distances for the noise assessment are taken from the nearest turbine to the closest edge of the amenity area (usually the garden).*

10.6. Assessment of Potential Effects

Setting the Total ETSU-R-97 Noise Limits (Stage 1)

10.6.1. In order to establish Total ETSU-R-97 Noise Limits in accordance with ETSU-R-97 it is necessary to determine the relationship between wind speed measured at the Proposed Development site and background noise levels measured at the closest noise sensitive receptors. Measured background noise levels should not be influenced by noise from operational wind turbines, this is an important consideration for this assessment given the number of operational wind turbines in the area.

10.6.2. With due regard to the location of key receptors relative to operational turbines and the existing background noise data collected previously, it was acknowledged at consultation that the background noise data gathered as part of the July 2015 Environmental Statement (ES) for Enoch Hill Windfarm be reused. The Total ETSU-R-97 Noise Limits for all Noise Assessment Locations have been set using the background noise levels from Meiklehill.

10.6.3. It is worth noting that an analysis to consider wind shear variation was undertaken by TNEI as the original Enoch Hill dataset was for a hub height up to 82 m. Following this analysis, the dataset is now considered applicable for a hub height of up to 115 m. However, it should be noted that due to very low background levels not exceeding 35 dB(A) at any wind speeds, the resulting Total ETSU-R-97 limits used for this assessment are worst-case with a flat 40 dB limit at all wind speeds during the daytime and a flat 43 dB limit during the night-time.

10.6.4. The TNL have been established for each of the NALs. A TNL based on the daytime Fixed Minimum Limit (FML) of 40 dB has been adopted for daytime periods and 43 dB during night time periods. A TNL of 45 dB, has been used where the occupiers of a property are Financially Involved (FI) with a wind farm.

10.6.5. The TNL are summarised in Tables 14.4 and 14.5 below.

Table 10.4: Total ETSU-R-97 Noise Limit – applicable to the daytime period

NAL	Wind Speed (ms^{-1}) as standardised to 10 m height											
	1	2	3	4	5	6	7	8	9	10	11	12
NAL1 - Maneight	40	40	40	40	40	40	40	40	40	40	40	40
NAL2 - Knockenlee	40	40	40	40	40	40	40	40	40	40	40	40
NAL3 - Nith Lodge	40	40	40	40	40	40	40	40	40	40	40	40
NAL4 - Meiklehill	40	40	40	40	40	40	40	40	40	40	40	40
NAL5 – Clawfin*	45	45	45	45	45	45	45	45	45	45	45	45
NAL6 - Pennyvenie	40	40	40	40	40	40	40	40	40	40	40	40
NAL7 - Mossdale Farm	40	40	40	40	40	40	40	40	40	40	40	40
NAL8 - Glenmuck	40	40	40	40	40	40	40	40	40	40	40	40
NAL9 – Brownhill**	45	45	45	45	45	45	45	45	45	45	45	45

** The occupiers are Financially Involved (FI) with the Proposed Development.*

*** The occupiers are FI with South Kyle Wind Farm.*

Table 10.5: Total ETSU-R-97 Noise Limit – applicable to the night time period

NAL	Wind Speed (ms^{-1}) as standardised to 10m height											
	1	2	3	4	5	6	7	8	9	10	11	12
NAL1 - Maneight	43	43	43	43	43	43	43	43	43	43	43	43
NAL2 - Knockenlee	43	43	43	43	43	43	43	43	43	43	43	43
NAL3 - Nith Lodge	43	43	43	43	43	43	43	43	43	43	43	43
NAL4 - Meiklehill	43	43	43	43	43	43	43	43	43	43	43	43
NAL5 – Clawfin*	45	45	45	45	45	45	45	45	45	45	45	45
NAL6 - Pennyvenie	43	43	43	43	43	43	43	43	43	43	43	43
NAL7 - Mossdale Farm	43	43	43	43	43	43	43	43	43	43	43	43
NAL8 - Glenmuck	43	43	43	43	43	43	43	43	43	43	43	43
NAL9 – Brownhill**	45	45	45	45	45	45	45	45	45	45	45	45

** The occupiers are Financially Involved (FI) with the Proposed Development.*

*** The occupiers are FI with South Kyle Wind Farm.*

Predicting the Likely Effects and the Requirement for a Cumulative Noise Assessment (Stage 2)

10.6.6. Where the predictions from the Proposed Development are within 10 dB of the total cumulative predictions from all other schemes then a cumulative assessment is required. In this case, the predictions from the Proposed Development are greater than 10 dB below the cumulative predictions from all other schemes at NAL8 and NAL9, a comparison of which is presented within Annex 4 of Technical Appendix 10.1. At NALs 1-7, cumulative noise predictions are within 10 dB and therefore a cumulative assessment was undertaken. A list of cumulative schemes considered in the assessment is provided in Table 1.1 of Technical Appendix 10.1.

10.6.7. Predicted noise levels from all schemes (including the Proposed Development) were compared to the TNL and as shown in Tables 10.6 and 10.7, the predicted wind turbine noise immission levels from all schemes are below the TNLs under all conditions and at all NALs during both daytime and night time periods. These predictions assumed that all turbines are operating unconstrained. There would be **no significant effects.**

Table 10.6: TNL Compliance Table – Day time

NAL		Wind Speed (ms^{-1}) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL1 - Maneight	TNL L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Predictions L_{A90}	-	-	-	27.7	32.7	36.4	37.0	37.0	37.0	37.0	37.0	37.0
	Exceedence Level	-	-	-	-12.3	-7.3	-3.6	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
NAL2 – Knockenlee	TNL L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Predictions L_{A90}	-	-	-	25.9	30.9	34.6	35.3	35.3	35.3	35.3	35.3	35.3
	Exceedence Level	-	-	-	-14.1	-9.1	-5.4	-4.7	-4.7	-4.7	-4.7	-4.7	-4.7
NAL3 - Nith Lodge	TNL L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Predictions L_{A90}	-	-	-	26.0	31.0	34.7	35.4	35.4	35.5	35.5	35.5	35.5
	Exceedence Level	-	-	-	-14.0	-9.0	-5.3	-4.6	-4.6	-4.5	-4.5	-4.5	-4.5
NAL4 - Meiklehill	TNL L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Predictions L_{A90}	-	-	-	27.1	32.0	35.6	36.2	36.3	36.3	36.3	36.3	36.3
	Exceedence Level	-	-	-	-12.9	-8.0	-4.4	-3.8	-3.7	-3.7	-3.7	-3.7	-3.7
NAL5 – Clawfin*	TNL L_{A90}	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	Predictions L_{A90}	-	-	-	28.5	33.3	36.5	37.0	37.0	37.1	37.1	37.1	37.1
	Exceedence Level	-	-	-	-16.5	-11.7	-8.5	-8.0	-8.0	-7.9	-7.9	-7.9	-7.9
NAL6 - Pennyvenie	TNL L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Predictions L_{A90}	-	-	-	24.0	28.8	32.2	32.9	32.9	32.9	32.9	32.9	32.9
	Exceedence Level	-	-	-	-16.0	-11.2	-7.8	-7.1	-7.1	-7.1	-7.1	-7.1	-7.1
NAL7 - Mossdale Farm	TNL L_{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Predictions L_{A90}	-	-	-	21.7	26.5	30.1	30.8	30.9	31.0	31.0	31.0	31.0
	Exceedence Level	-	-	-	-18.3	-13.5	-9.9	-9.2	-9.1	-9.0	-9.0	-9.0	-9.0

** The occupiers are Financially Involved (FI) with the Proposed Development.*

Table 10.7: TNL Compliance Table – Night time

NAL		Wind Speed (ms^{-1}) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL1 - Maneight	TNL L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Predictions L_{A90}	-	-	-	27.7	32.7	36.4	37.0	37.0	37.0	37.0	37.0	37.0
	Exceedence Level	-	-	-	-15.3	-10.3	-6.6	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
NAL2 – Knockenlee	TNL L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Predictions L_{A90}	-	-	-	25.9	30.9	34.6	35.3	35.3	35.3	35.3	35.3	35.3
	Exceedence Level	-	-	-	-17.1	-12.1	-8.4	-7.7	-7.7	-7.7	-7.7	-7.7	-7.7
NAL3 - Nith Lodge	TNL L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Predictions L_{A90}	-	-	-	26.0	31.0	34.7	35.4	35.4	35.5	35.5	35.5	35.5
	Exceedence Level	-	-	-	-17.0	-12.0	-8.3	-7.6	-7.6	-7.5	-7.5	-7.5	-7.5

NAL4 - Meiklehill	TNL L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Predictions L_{A90}	-	-	-	27.1	32.0	35.6	36.2	36.3	36.3	36.3	36.3	36.3
	Exceedence Level	-	-	-	-15.9	-11.0	-7.4	-6.8	-6.7	-6.7	-6.7	-6.7	-6.7
NAL5 – Clawfin*	TNL L_{A90}	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	Predictions L_{A90}	-	-	-	28.5	33.3	36.5	37.0	37.0	37.1	37.1	37.1	37.1
	Exceedence Level	-	-	-	-16.5	-11.7	-8.5	-8.0	-8.0	-7.9	-7.9	-7.9	-7.9
NAL6 - Pennyvenie	TNL L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Predictions L_{A90}	-	-	-	24.0	28.8	32.2	32.9	32.9	32.9	32.9	32.9	32.9
	Exceedence Level	-	-	-	-19.0	-14.2	-10.8	-10.1	-10.1	-10.1	-10.1	-10.1	-10.1
NAL7 - Mossdale Farm	TNL L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Predictions L_{A90}	-	-	-	21.7	26.5	30.1	30.8	30.9	31.0	31.0	31.0	31.0
	Exceedence Level	-	-	-	-21.3	-16.5	-12.9	-12.2	-12.1	-12.0	-12.0	-12.0	-12.0

** The occupiers are Financially Involved (FI) with the Proposed Development.*

Operational Phase - Derivation of Site Specific Noise Limits for the Proposed Development (Stage 3)

10.6.8. Stage 2 has demonstrated that there would be no cumulative excess of the total ETSU-R-97 noise limit. This stage is to consider the fact that nearby wind farm may have the right to operate at higher levels than 'likely' predictions and to also consider the potential noise conditions applicable to the Proposed Development on its own.

10.6.9. Site Specific Noise Limits have been calculated as an apportionment of the Total ETSU-R-97 noise limits. The modelling done for any apportionment assumes that all nearby wind turbines considered are operating, which is a worst-case assumption. The SSNL have been derived in accordance with the IOA GPG.

10.6.10. Predicted noise levels from the Proposed Development were compared to the SSNL and as shown in Tables 10.8 and 10.9, the predicted wind turbine noise immission levels from the Proposed Development are below the SSNLs under all conditions and at all NALs during both daytime and night time periods. In order to meet the daytime SSNL at NAL4 it has been assumed that mode management will be implemented. The predictions presented herein assume that T5, T6 and T9 operate in Noise Reduced Mode N3, with the remaining turbines operating in Mode AM0. This would only be required during specific wind speeds and wind directions. Detailed results with both full mode and low noise mode (mitigated) operation are included on Figure A1.4d (NAL4) within Technical Appendix 10.1.

10.6.11. The candidate turbine was chosen as it is considered to be representative of the type of turbine that could be installed at the site. There are a number of wind turbine makes and models that may be suitable for the Proposed Development and that may not require the use of Low Noise Modes. Should the proposal receive planning permission, the final choice of turbine would be subject to a competitive tendering process. The final choice of turbine would have to meet the noise limits.

Table 10.8: SSNL Compliance Table – Day time

NAL		Wind Speed (ms^{-1}) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL1 - Maneight	SSNL L_{A90}	35.0	35.0	35.0	35.0	35.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
	Predictions L_{A90}	-	-	-	18.6	23.3	26.3	26.7	26.7	26.7	26.7	26.7	26.7
	Exceedence Level	-	-	-	-16.4	-11.7	-3.7	-3.3	-3.3	-3.3	-3.3	-3.3	-3.3
NAL2 – Knockenlee	SSNL L_{A90}	35.0	35.0	35.0	35.0	35.0	35.0	30.0	30.0	30.0	30.0	30.0	30.0
	Predictions L_{A90}	-	-	-	20.8	25.6	28.5	28.9	28.9	28.9	28.9	28.9	28.9
	Exceedence Level	-	-	-	-14.2	-9.4	-6.5	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1
NAL3 - Nith Lodge	SSNL L_{A90}	35.0	35.0	35.0	35.0	35.0	35.0	30.0	30.0	30.0	30.0	30.0	30.0
	Predictions L_{A90}	-	-	-	21.6	26.4	29.3	29.7	29.7	29.7	29.7	29.7	29.7
	Exceedence Level	-	-	-	-13.4	-8.6	-5.7	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
NAL4 - Meiklehill	SSNL L_{A90}	35.0	35.0	35.0	35.0	35.0	35.0	30.0	30.0	30.0	30.0	30.0	30.0
	Predictions L_{A90}	-	-	-	23.1	27.5*	29.5*	29.8*	29.8*	29.8*	29.8*	29.8*	29.8*
	Exceedence Level	-	-	-	-11.9	-7.5	-5.5	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
NAL5 - Clawfin	SSNL L_{A90}	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	Predictions L_{A90}	-	-	-	27.1	31.8	34.8	35.2	35.2	35.2	35.2	35.2	35.2
	Exceedence Level	-	-	-	-17.9	-13.2	-10.2	-9.8	-9.8	-9.8	-9.8	-9.8	-9.8
NAL6 - Pennyvenie	SSNL L_{A90}	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	37.1	39.1	39.1	39.1
	Predictions * L_{A90}	-	-	-	20.7	25.5	28.5	28.9	28.9	28.9	28.9	28.9	28.9
	Exceedence Level	-	-	-	-14.3	-9.5	-6.5	-6.1	-6.1	-8.2	-10.2	-10.2	-10.2

NAL7 - Mossdale Farm	SSNL L_{A90}	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	37.1	39.7	39.7	39.7
	Predictions L_{A90}	-	-	-	17.0	21.7	24.7	25.1	25.1	25.1	25.1	25.1	25.1
	Exceedence Level	-	-	-	-18.0	-13.3	-10.3	-9.9	-9.9	-12.0	-14.6	-14.6	-14.6

* *Mode Management applied.*

Table 10.9: SSNL Compliance Table – Night time

NAL		Wind Speed (ms^{-1}) as standardised to 10m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL1 - Maneight	SSNL L_{A90}	43.0	43.0	43.0	43.0	43.0	41.3	40.9	40.9	40.9	40.9	40.9	40.9
	Predictions L_{A90}	-	-	-	18.6	23.3	26.3	26.7	26.7	26.7	26.7	26.7	26.7
	Exceedence Level	-	-	-	-24.4	-19.7	-15.0	-14.2	-14.2	-14.2	-14.2	-14.2	-14.2
NAL2 – Knockenlee	SSNL L_{A90}	43.0	43.0	43.0	43.0	43.0	41.9	41.7	41.7	41.7	41.7	41.7	41.7
	Predictions L_{A90}	-	-	-	20.8	25.6	28.5	28.9	28.9	28.9	28.9	28.9	28.9
	Exceedence Level	-	-	-	-22.2	-17.4	-13.4	-12.8	-12.8	-12.8	-12.8	-12.8	-12.8
NAL3 - Nith Lodge	SSNL L_{A90}	43.0	43.0	43.0	43.0	43.0	41.9	41.7	41.7	41.7	41.7	41.7	41.7
	Predictions L_{A90}	-	-	-	21.6	26.4	29.3	29.7	29.7	29.7	29.7	29.7	29.7
	Exceedence Level	-	-	-	-21.4	-16.6	-12.6	-12.0	-12.0	-12.0	-12.0	-12.0	-12.0
NAL4 - Meiklehill	SSNL L_{A90}	43.0	43.0	43.0	43.0	43.0	41.7	41.5	41.5	41.5	41.5	41.5	41.5
	Predictions L_{A90}	-	-	-	23.0	27.8	30.8	31.2	31.2	31.2	31.2	31.2	31.2
	Exceedence Level	-	-	-	-20.0	-15.2	-10.9	-10.3	-10.3	-10.3	-10.3	-10.3	-10.3
NAL5 - Clawfin	SSNL L_{A90}	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	Predictions L_{A90}	-	-	-	27.1	31.8	34.8	35.2	35.2	35.2	35.2	35.2	35.2
	Exceedence Level	-	-	-	-17.9	-13.2	-10.2	-9.8	-9.8	-9.8	-9.8	-9.8	-9.8
NAL6 - Pennyvenie	SSNL L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Predictions L_{A90}	-	-	-	20.7	25.5	28.5	28.9	28.9	28.9	28.9	28.9	28.9
	Exceedence Level	-	-	-	-22.3	-17.5	-14.5	-14.1	-14.1	-14.1	-14.1	-14.1	-14.1
NAL7 - Mossdale Farm	SSNL L_{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Predictions L_{A90}	-	-	-	17.0	21.7	24.7	25.1	25.1	25.1	25.1	25.1	25.1
	Exceedence Level	-	-	-	-26.0	-21.3	-18.3	-17.9	-17.9	-17.9	-17.9	-17.9	-17.9

10.7. Additional Mitigation

Mitigation during Construction and Decommissioning

10.7.1. Construction activities will be undertaken during typical working hours; 7 am to 7 pm Monday to Friday and 7 am to 4 pm on Saturdays. No construction work will be undertaken on Sundays and Public Holidays. Nevertheless, a range of good practice measures would be detailed in the Construction Environmental Management Plan (CEMP) and employed to minimise noise impacts. The CEMP would be agreed under the planning conditions post consent, although an outline CEMP has been included in Appendix 5.1.

Mitigation during Operation

10.7.2. The exact model of wind turbine to be used for the Proposed Development would be the result of a future tendering process. Achievement of the noise limits determined by this assessment would be a key determining factor in the final choice of wind turbines for the site. Modern turbines have the ability to operate in a range of lower noise modes if required.

10.8. Residual Effects

Residual Operational Effects

The results of the noise assessment show that, subject to the adoption of mitigation measures in the form of low noise mode operation when required for the candidate wind turbine, the predicted wind turbine noise levels would meet the Site Specific Noise Limits under all conditions and at all locations for both daytime and night time periods. There are a number of wind turbine makes and models that would be suitable for the Proposed Development and that may not require the use of low noise modes. **There would be no significant residual effects.**

10.8.1. At some locations, under some wind conditions and for a certain proportion of the time operational wind farm noise would be audible; however, it would be at an acceptable level in relation to the ETSU-R-97 guidelines and there would be no significant residual effects.

Residual Cumulative Effects

10.8.2. Predicted cumulative wind farm operational noise levels lie below the TNL at all NALs, there would be **no significant residual effects** due to the Proposed Development.

10.9. Statement of Significance

10.9.1. The guidance contained within ETSU-R-97 and the IOA GPG was used to assess the likely operational noise impact of the Proposed Development. Predicted levels indicate that for dwellings neighbouring the Proposed Development the operational noise impact is not significant after the SSNLs are adopted, subject to the adoption of mitigation measures in the form of low noise mode operation when required for the candidate turbine.

10.9.2. There are a range of wind turbine models that may be appropriate for the Proposed Development. If the Proposed Development receives consent, further data would be obtained from the supplier for the final choice of wind turbine model to demonstrate compliance with the operational noise limits derived in this report.

10.10. Statement of Competence

10.10.1. This Chapter was prepared by TNEI Services Ltd. TNEI is a specialist energy consultancy with an Acoustics team which has undertaken noise assessments for over five gigawatts (GW) of onshore wind farm developments. The assessment was carried out by Alex Dell and Moise Coulon. Alex holds a PhD in Mechanical Engineering with 3 years of experience in undertaking operational noise assessments for wind farms, he is an Associate Member of the Institute of Acoustics. Moise holds the IOA Diploma in Acoustics and Noise control with over 16 years of experience in wind farm noise assessments, he is a full Member of the Institute of Acoustics. The assessment has been reviewed and approved by Gemma Clark. Gemma has been undertaking operational noise assessments for wind farms for over 17 years and is a Full Member of the Institute of Acoustics.

10.11. Non-Technical Summary

A noise assessment was undertaken to determine the likely significant noise effects from the operational phase of the Proposed Development, on nearby noise sensitive receptors which were identified as residential properties.

Construction noise activities will be undertaken during typical working hours, a detailed construction noise assessment was not required. However, typical mitigation is recommended via the use of best practice during construction and the preparation of a CEMP which considers noise.

Background noise data previously collected for Enoch Hill Wind Farm at four locations proximate to the Proposed Development was used to establish background noise levels (in the absence of any wind turbine noise) and to set the Total ETSU-R-97 Noise Limits at the nearest receptors to the Proposed Development.

As the hub heights of the Proposed Development is circa 115 m and the background noise levels referred to wind speeds up to 82 m, a wind shear analysis was undertaken and the background and limits in this report are valid for 115 m.

The operational noise assessment was undertaken in three stages, which involved setting the Total ETSU-R-97 Noise Limits (which are limits for noise from all wind farms in the area) at the nearest noise sensitive receptors, predicting the likely effects (undertaking a cumulative noise assessment where required) and setting Site Specific Noise Limits for the Proposed Development.

Predicted cumulative operational noise levels indicate that for noise sensitive receptors neighbouring the Proposed Development, cumulative wind turbine noise (which considers noise predictions from all nearby operational, consented and proposed wind farms and the Proposed Development) would meet the Total ETSU-R-97 Noise Limits at all Noise Assessment Locations.

The Total ETSU-R-97 Noise Limit is applicable to all operational and consented wind farms in the area so Site Specific Noise Limits have also been derived to control the specific noise from the Proposed Development. In accordance with the guidance in Institute of Acoustics (IOA) Good Practice Guidance (GPG).

Predictions of wind turbine noise from the Proposed Development have been made in accordance with good practice using a candidate wind turbine, the Siemens-Gamesa SG 6.6-170 6.6 MW with a hub height of 115 m. Predicted operational noise levels from the Proposed Development indicate that for noise sensitive receptors neighbouring the Proposed Development, wind turbine noise from the Proposed Development would meet the Site Specific Noise Limits at all Noise Assessment Locations (NAL), subject to the adoption of mitigation measures in the form of low noise mode operation when required for the candidate turbine, and are therefore deemed to be not significant.

The use of Site Specific Noise Limits would ensure that the Proposed Development could operate concurrently with other operational wind farm developments in the area and would also ensure that the Proposed Development's individual contribution could be measured and enforced if required.

The wind turbine model was chosen in order to allow a representative assessment of the noise impacts. Should the Proposed Development receive planning permission, the final choice of wind turbine would be subject to a competitive tendering process. The final choice of wind turbine would, however, have to meet the Site Specific Noise Limits presented in the noise assessment.