MORGAN AND MORECAMBE OFFSHORE WIND FARMS: TRANSMISSION ASSETS

Environmental Statement

Volume 3, Annex 8.3: Operational Noise

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Prepared by:

RPS

Prepared for:

Morgan Offshore Wind Limited
Morecambe Offshore Windfarm Ltd

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Glossary

Term	Meaning
400 kV grid connection cable corridor	The corridor within which the 400 kV grid connection cables will be located.
Attenuation	The reduction in magnitude of sound energy.
A-weighting	A frequency weighting devised to attempt to account for the fact that human response to sound is not equally sensitive to all frequencies. It consists of an electronic filter in a sound level meter which attempts to build this variability into the indicative sound level reading so that it will correlate, approximately, with the human response.
Background sound level, $L_{A90,T}$	The A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, *T*, measured using fast time-weighting, F, and quoted to the nearest whole number of decibels.
Broadband	A sound with energy distributed across a wide range of frequencies. Used to describe a single-figure sound level.
Decibel	The ratio between two physical quantities, typically expressed as a logarithmic power ratio.
Dimensionless	A pure number having no units attached and having a numerical value that is independent of whatever system of units may be used to derive it.
Environmental Impact Assessment	The process of identifying and assessing the significant effects likely to arise from a project. This requires consideration of the likely changes to the environment, where these arise as a consequence of a project, through comparison with the existing and projected future baseline conditions.
Ground factor, G	A dimensionless parameter which allows for the consideration of the acoustic properties of the ground surface between a sound source and the receptor.
Hemispherical radiation	The emission of sound throughout a hemisphere in the presence of a single reflective surface (e.g. the ground). Corresponds to a radiation loss of 8 dB.
Impulsivity	A method for describing how sudden or sharp a sound of short duration is. Examples of impulsive sounds include bangs or gun shots.
Intermittency	A measure of the ‘on/off’ nature of a sound source which may result in higher perceptibility at a receptor.
Landfall	The area in which the offshore export cables make landfall (come on shore) and the transitional area between the offshore cabling and the onshore cabling. This term applies to the entire landfall area at Lytham St. Annes between Mean Low Water Springs and the transition joint bays inclusive of all construction works, including the offshore and onshore cable routes, intertidal working area and landfall compound(s).
Mean High Water Springs	The height of mean high water during spring tides in a year.
Mean Low Water Springs	The height of mean low water during spring tides in a year.
Morecambe Offshore Windfarm Transmission Assets	The offshore export cables, landfall and onshore infrastructure required to connect the Morecambe Offshore Windfarm to the National Grid.

Term	Meaning
Morgan and Morecambe Offshore Wind Farms: Transmission Assets	The offshore and onshore infrastructure connecting the Morgan Offshore Wind Project and the Morecambe Offshore Windfarm to the national grid. This includes the offshore export cables, landfall site, onshore export cables, onshore substations, 400 kV grid connection cables and associated grid connection infrastructure such as circuit breaker compounds. Also referred to in this report as the Transmission Assets, for ease of reading.
Morgan Offshore Wind Project Transmission Assets	The offshore generation assets and associated activities for the Morecambe Offshore Windfarm.
Noise	An unwanted or unexpected sound.
Onshore export cables	The cables which would bring electricity from the landfall to the onshore substations.
Onshore substations	The onshore substations will include a substation for the Morgan Offshore Wind Project: Transmission Assets and a substation for the Morecambe Offshore Windfarm: Transmission Assets. These will each comprise a compound containing the electrical components for transforming the power supplied from the generation assets to 400 kV and to adjust the power quality and power factor, as required to meet the UK Grid Code for supply to the National Grid.
Porosity	The ratio of space or holes and the total volume of a material. A means of defining the ability of a material to allow sound to transmit through it.
Propagation	The transmission of acoustic energy through a medium via a sound wave.
Residual sound level, $L_r = L_{\mathrm{Aeq},T}$	The ambient sound level at a receptor in the absence of influence from the sound source under assessment.
Sound	Fluctuations of pressure within a medium (gas, solid or fluid) within the audible range of loudness and frequencies which excite the sensation of hearing.
Specific sound level, $L_{\mathrm{s},} = L_{\mathrm{Aeq},Tr}$	The equivalent continuous A-weighted sound pressure level produced by the specific noise source at the assessment location over a given reference time internal, T_{r}.
Spectrum	The presentation of sound in terms of the amount of energy at different frequencies.
Study area	This is an area which is defined for each environmental topic which includes the Transmission Assets Order Limits as well as potential spatial and temporal considerations of the impacts on relevant receptors. The study area for each topic is intended to cover the area within which an impact can be reasonably expected.
Substation	Part of an electrical transmission and distribution system. Substations transform voltage from high to low, or the reverse by means of electrical transformers.
Tonality	A method to account for the dominance of a single frequency in a sound’s spectrum which may be more perceptible at a receptor.
Transmission Assets	See Morgan and Morecambe Offshore Wind Farms: Transmission Assets (above)

Term	Meaning
Transmission Assets Order Limits	The area within which all components of the Transmission Assets will be located, including areas required on a temporary basis during construction and/or decommissioning

Acronyms

Acronym	Meaning
AIS	Air Insulated Switchgear
BS	British Standard
EIA	Environmental Impact Assessment
ES	Environmental Statement
DCO	Development Consent Order
GIS	Gas Insulated Switchgear
ISO	International Standard Organisation
MDS	Maximum Design Scenario
MLWS	Mean Low Water Springs
MSR	Mechanically Switched Reactors
NTM	Natural Tranquillity Method
OS	Ordnance Survey
SGT	Super Grid Transformer
SVC	Static VAR compensator (also known as Dynamic Reactive Power Compensator)

Units

Unit	Description
dB	Decibels
dB(A)	Decibel (A-weighted)
km	Kilometres
kV	Kilovolt
m	Metre

1 Operational noise

1.1 Introduction

1.1.1.1 This document forms Annex 8.3 of Volume 3 of the Environmental Statement prepared for the Morgan and Morecambe Offshore Wind Farms: Transmission Assets. The Environmental Statement (ES) presents the findings of the Environmental Impact Assessment (EIA) process for the Morgan and Morecambe Offshore Wind Farms: Transmission Assets (hereafter referred to as the Transmission Assets).

1.1.1.2 This document provides details of the assessment of noise impacts on nearby noise-sensitive receptors within the study area due to the operational noise sources associated with the Transmission Assets. These sources include the electrical components forming the plant strategy for the Morgan and Morecambe Onshore Substations. The operation of the substations has been assessed both individually and cumulatively.

1.2 Methodology

1.2.1 Study area

1.2.1.1 The study area for noise and vibration assessment of the Transmission Assets focuses on receptors landward of the Mean Low Water Springs (MLWS) where potential noise impacts are most likely to occur.

1.2.1.2 The study area relevant to Volume 3, Chapter 8: Noise and Vibration of the Environmental Statement and this annex is defined as:

- the area of land to be temporarily or permanently occupied during the construction, operation and maintenance, and decommissioning of the Transmission Assets (landward of MLWS);
- noise sensitive receptors located within 1 kilometre (km) of the landfall and Onshore Substations.

1.2.2 Assessment methodology

1.2.2.1 Operational noise levels due to the Transmission Assets have been calculated at representative noise-sensitive receptors within the study area via 3D acoustic modelling. Subsequently, the predicted levels have been assessed with reference to the guidance in BS 4142:2014+A1:2019 – ‘Methods for rating and assessing industrial and commercial sound’.

1.2.2.2 The nearest noise sensitive receptors are presented graphically in **Figure 1.1**.

British Standard 4142:2014+A1:2019

1.2.2.3 BS 4142:2014+A1:2019 – ‘Methods for rating and assessing industrial and commercial sound’ provides a method for rating industrial and commercial sound and a method for assessing resulting impacts upon people. The method is applicable to fixed plant installations, sound from industrial and manufacturing process and other associated activities.

1.2.2.4 In summary, this Standard provides guidance on determining ‘rating sound levels’ by correcting the ‘specific sound level’ from the site or operations under consideration to account for any distinctive acoustic characteristics such as tonality, impulsivity, and intermittency. The Standard provides the following corrections to be applied where each is appropriate:

‘Tonality -For sound ranging from not tonal to prominently tonal the Joint Nordic Method gives a correction of between 0 dB and +6 dB for tonality. Subjectively, this can be converted to a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible.

Impulsivity - A correction of up to +9 dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a penalty of 3 dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible, and 9 dB where it is highly perceptible.

Intermittency - When the specific sound has identifiable on/off conditions, the specific sound level should be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time. … If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.

Other sound characteristics - Where the specific sound features characteristics that are neither tonal nor impulsive, nor intermittent, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.’

1.2.2.5 An initial estimate of the impact of the source is obtained by subtracting the measured background sound level from the rating sound level of the proposed plant. Background sound levels at the receptors were identified from baseline sound surveys undertaken in June 2023 and March 2024 (see Volume 3, Annex 8.1: Baseline Sound Survey of the ES).

1.2.2.6 The representative background sound levels at each receptor are presented in Volume 3, Chapter 8: Noise and Vibration of the ES. The representative background sound levels have been derived via statistical analysis of the measured $L_{A90,T}$ levels during the day and night-time periods, respectively. Note 1 of paragraph 8.1.4 of BS 4142:2014+A1:2019 states the following regarding the derivation of a representative background sound level:

‘A representative level should account for the range of background sound levels and should not automatically be assumed to be either the minimum or modal value.’

1.2.2.7 As such, histograms of the cumulative frequency of occurrence have been plotted to show the most frequently occurring background sound levels during each period and compared with the time-history graphs.

1.2.2.8 Acoustic character corrections are applied to the specific sound level at the receptor, as presented in Appendix B.

1.2.2.9 Typically, the greater the difference between the measured background sound level and the rating sound level, the greater the magnitude of the impact. The operational noise criteria adopted for the Transmission Assets are presented in **Table 1.1**.

Table 1.1: Operational noise impact magnitude criteria

Magnitude of impact	BS 4142:2014+A1:2019 semantic description	Difference Δ between rating sound level $L_{Ar,Tr}$ and background sound level $L_{A90,T}$ (dB)
High	A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.	Δ ≥ 10
Medium	A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.	5 ≤ Δ < 10
Low	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 the context.	0 ≤ Δ < 5
Negligible		-10 ≤ Δ < 0
No change	-	Δ < -10

1.2.2.10 All nearby noise sensitive receptors are residential and are thus considered to be of medium sensitivity during the daytime and high sensitivity during the night-time, as described in **Table 8-15** in Volume 3, Chapter 8: Noise and Vibration of the ES.

1.2.2.11 This Annex presents the quantitative impacts resulting from the assessment. A contextual assessment of the likely impacts has been undertaken in Volume 3, Chapter 8: Noise and vibration of the ES as part of the assessment of significant effects.

Tranquil Spaces: Measuring the Tranquillity of Public Spaces

1.2.2.12 Tranquillity mapping studies, such as those undertaken by Campaign for Rural England (CPRE, 2006), focus on tranquillity in rural environments..

1.2.2.13 Tranquil Spaces: Measuring the Tranquillity of Public Spaces (Bentley, 2019) outlines the Natural Tranquillity Method (NTM) which has been developed to provide an empirical, evidence-based formula which accounts for sound level and the character of the acoustic environment.

1.2.2.14 This method allows for a wider assessment of acoustics and tranquillity since more consideration is given to the presence and behaviour of people as well as noise sources other than road traffic noise.

1.2.2.15 The NTM depends on four key variables set out below:

- NAMM: A number between one and five representing the proportion of natural and man-made sounds;
- PONS: The percentage of time during the survey period where only natural sounds are heard.

- L_{RR}: The contribution of road and rail noise to the tranquillity score. Rail noise must be reduced by 6 dB for this parameter and, when both are present, they should be added together (logarithmically);
- L_{AT}: The overall corrected ambient sound level. Generally, this will be the same as the measured $L_{Aeq,T}$ level over the measurement period.

1.2.2.16 A descriptor of the NAMM parameter values is provided in **Table 1.2** below.

Table 1.2: NAMM values

NAMM Parameter Value	Description
1	All or virtually all sound is from man-made sources.
2	Sounds are mainly from man-made sources but natural sounds are also present.
3	NAMM noise sources contribute equally to the overall sound level.
4	Sounds are mainly from natural sources but man-made sounds are also present.
5	All or virtually all sound is from natural sources.

1.2.2.17 Following completion of a site review and on-site measurements, the collected data and information can be used to predict a tranquillity score for each location. The output will be a numerical score and associated description as detailed in **Table 1.3** below.

Table 1.3: Tranquillity score

Tranquility Score	Description
1	Frantic/chaotic/harsh
2	Busy/noisy
3	Unsettled/slightly busy
4	Not quite tranquil
5	Just tranquil
6	Fairly tranquil
7	Good tranquillity
8	Excellent tranquillity
9	Perfect tranquillity

1.2.2.18 Upper noise impact magnitude levels have been defined for each natural tranquillity score detailed in **Table 1.3** above. The impact magnitude criteria adopted for the assessment are presented in **Table 1.4** below. These impact magnitudes have been derived with reference to the following:

- NTM does not explicitly outline the applicability of this limit to operational noise sources, the operational noise associated with the onshore substations will be continuous and thus the above limit of 60 dB(A) provides a useful upper guideline level to be considered within the assessment.

- The upper impact magnitude level for tranquillity scores of 4 to 6 has been obtained from “Minerals: Guidance on planning for mineral extraction in plan making and the application process” (Department for Levelling Up, Housing and Communities, 2023). This level of 55 dB(A) is equivalent to the upper guideline level outlined in Guidelines for Community Noise (WHO, 1999) at which ‘“serious annoyance’” can be expected during the daytime and evening periods in outdoor living areas.
- The upper impact magnitude level for tranquillity scores of 7 to 9 haves been defined as the lower guideline level in the WHO guidance of 50 dB(A) corresponding to the level at which moderate annoyance may occur during the daytime and evening periods in outdoor living areas.

Table 1.4: Natural tranquillity impact magnitude criteria

Magnitude of Impact	Noise Level (dB) for Natural Tranquillity Score		
	1 – 3	4 – 6	7 – 9
High	$L_{Aeq,T} \geq 60$	$L_{Aeq,T} \geq 55$	$L_{Aeq,T} \geq 50$
Medium	$55 \leq L_{Aeq,T} < 60$	$50 \leq L_{Aeq,T} < 55$	$45 \leq L_{Aeq,T} < 50$
Low	$50 \leq L_{Aeq,T} < 55$	$45 \leq L_{Aeq,T} < 50$	$40 \leq L_{Aeq,T} < 45$
Negligible	$L_{Aeq,T} \leq 50$	$L_{Aeq,T} \leq 45$	$L_{Aeq,T} \leq 40$

The noise impact magnitude criteria defined in **Table 1.4** allow for more onerous criteria in more tranquil areas than in those considered less tranquil.

1.2.3 Acoustic modelling methodology

1.2.3.1 A 3D acoustic model has been constructed using the SoundPLAN v8.2 software package. This software implements the outdoor sound propagation method detailed within ISO 9613-2:1996: ‘Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation’. Sound levels have been predicted under light down-wind conditions based on hemispherical radiation with corrections added for atmospheric absorption, ground effects, screening, and source directivity, where each is appropriate. This standard is widely accepted as the industry-standard model.

1.2.3.2 The maximum design scenario (MDS) is the concurrent operation of both the Morgan and Morecambe Onshore Substations. The list of proposed plant items and maximum quantities for the Morgan and Morecambe Onshore Substations are presented in **Table 1.5** and **Table 1.6** below, respectively.

1.2.3.3 The input parameters relevant to the Transmission Assets include the information outlined in the paragraphs 1.2.3.4 to 1.2.3.22.

Local topographical features

1.2.3.4 Variable local topography can affect the 'line of sight' of a receptor to the source and result in greater or fewer obstacles between the source of noise and the receptor such as ground cover, hills, and buildings.

1.2.3.5 The receptors and other buildings which may provide screening effects have been obtained by importing OS Mastermap Topography Layer for the Morgan and Morecambe Onshore Substations.

1.2.3.6 A digital ground model has been calculated using detailed OS Terrain 5 data for the Morgan and Morecambe Onshore Substations.

Ground effects

1.2.3.7 Sound propagating outdoors comprises direct waves travelling straight from source to receiver and reflected waves which interact with the ground. Harder surfaces reflect more sound thereby resulting in enhanced noise levels at the receptor. Softer surfaces such as grass, trees, or vegetation have a higher porosity and thus can absorb reflected waves resulting in lower noise levels at the receptor.

1.2.3.8 The acoustic properties of the ground are accounted for using the ground factor G which is a dimensionless parameter between 0 and 1. ISO 9613-2:1996 specifies a ground factor of 0 for hard surfaces and 1 for porous surfaces.

1.2.3.9 The area surrounding the Morgan and Morecambe Onshore Substations is predominantly grassland and thus has been assigned a ground factor of G = 0.8.

1.2.3.10 The onshore substation platform areas are assumed to comprise hard ground with a ground factor of G = 0.

Plant strategy and layout

1.2.3.11 The MDS is represented by all plant operating continuously at maximum operational duty 24/7. The primary model input is the source noise levels of the proposed plant strategy and the operating conditions for the Transmission Assets onshore substation sites.

1.2.3.12 The MDS for the Morgan Onshore Substation is represented by a Gas Insulated Switchgear substation, with the MDS for the Morecambe Onshore Station represented by a Air Insulated Switchgear substation. The location of each plant item has been obtained from indicative engineering layouts for each Onshore Substation.

1.2.3.13 The frequency content of the noise emission spectra have been obtained from operational noise assessments for similar schemes (such as East Anglia ONE (North) and The Sheringham Shoal and Dudgeon Extensions Offshore Wind Farm). The full spectra are presented in Appendix A.

Table 1.5: Indicative plant strategy for the Morgan onshore substation site

Plant item	Quantity	Height (m)	Sound power level, L_W dB(A)
400/220/33 kV Super Grid Transformer	4	7	90
220 kV Shunt Reactor	4	4	90
400 kV Shunt Reactor	2	4	90
Radiator Cooling (Transformers and Shunt Reactors)	10	3	81
Dynamic Reactive Power Compensator (SVC) Phase Reactors	12	5	85
Dynamic Reactive Power Compensator (SVC) Coolers	8	3	90
2x 33 kV Mechanically Switched Reactors (MSR)	24	5	85
275 kV Filter	4	10	85
400 kV Filter	4	10	85
33/0.4 kV Auxiliary Transformer	4	2	80

Table 1.6: Indicative plant strategy for the Morecambe onshore substation site

Plant item	Quantity	Height (m)	Sound power level, L_W dB(A)
400/275/33 kV Super Grid Transformer	2	7	90
275 kV Shunt Reactor	2	4	90
Radiator Cooling (Transformers and Shunt Reactors)	4	3	81
Dynamic Reactive Power Compensator (SVC) Phase Reactors	4	5	85
Dynamic Reactive Power Compensator (SVC) Coolers	4	3	85
2x 33 kV Mechanically Switched Reactors (MSR)	24	5	85
275 kV Filter	6	10	85
Low Voltage Transformer	2	3	80

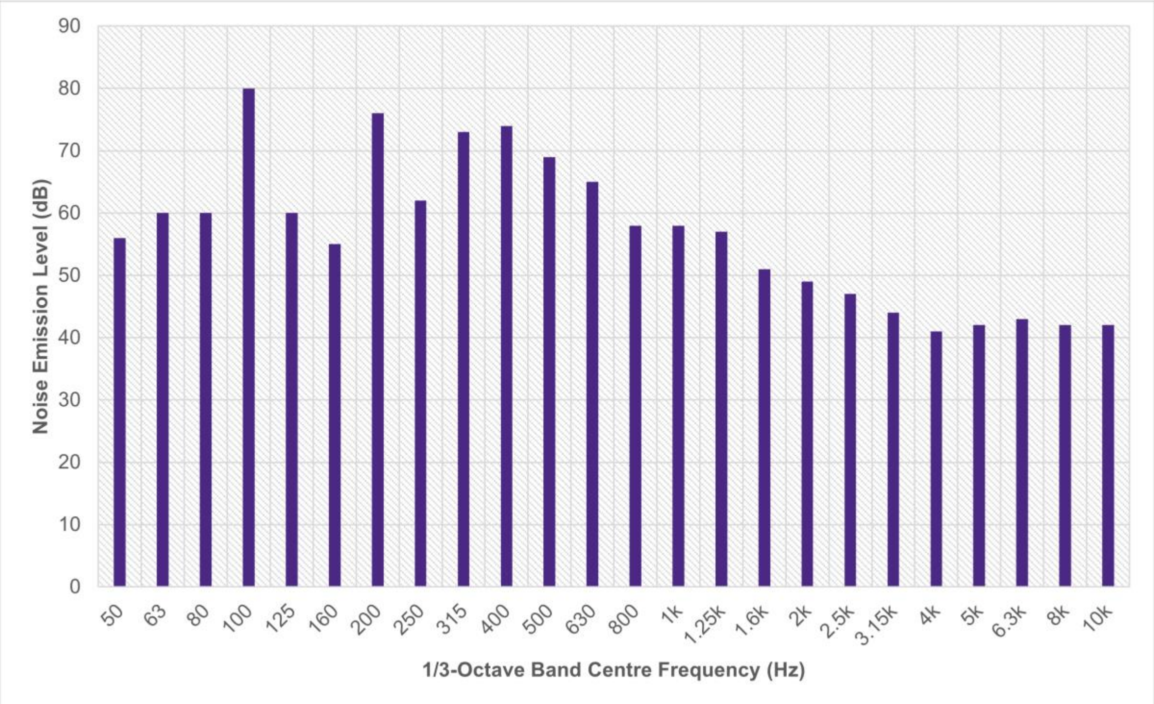
1.2.3.14 Additional notes on the assumptions adopted for the onshore substation plant noise emission levels are as follows:

- There are eight spaces shown on the Morgan Onshore Substation layout for harmonic filters. Each of these spaces is assumed to contain three filter phases which each comprise two capacitor banks per phase. The upper range sound power level per phase has been assessed

L_W 85 dB(A). It has been assumed that this is the sound power level per phase and thus each capacitor bank has a sound power level of L_W 82 dB(A).

1.2.3.15 The frequency content for the Super Grid Transformer has been sourced from research into the tonal components at low frequency (Gange, 2011). This frequency spectrum has been applied to the broadband sound power levels in **Table 1.5** and provides a robust representation of the noise emission spectrum for the Super Grid Transformers and Shunt Reactors. The fundamental frequency where the tonal components are generally present is the 100 Hz 1/3-octave frequency band, as shown in **Graph 1.1** below which shows the shape of a typical transformer spectrum (Gange, 2011). Subsequent harmonics to the fundamental frequency can be seen at higher frequencies. However, low frequency sound energy travels further due to the long wavelengths associated with the 100 Hz frequency band in comparison to the air through which the energy is transferred. As such, it is the low frequency sound rather than the higher frequency harmonics which requires most consideration.

Graph 1.1: Typical high voltage transformer noise emission spectrum.



1.2.3.16 As such, where these plant items are most influential to the overall receptor noise level, a correction of +2 dB, +4 dB, or +6 dB has been applied corresponding to ‘just perceptible’, ‘clearly perceptible’, and ‘highly perceptible’, respectively, in terms of BS 4142:2014+A1:2019.

1.2.3.17 At this stage, the design of the Morgan and Morecambe Onshore Substations are not finalised. During the detailed design phase, mitigation measures will be adopted to aid in the reduction of noise from the Morgan and Morecambe Onshore Substation plant at nearby receptors.

1.2.3.18 The plant layout will be designed to reduce noise impacts as much as is reasonably practicable and additional mitigation measures such as acoustic enclosures, attenuators, and acoustic barriers may be implemented as part of the Transmission Assets. The exact measures will be determined as the design progresses; and consideration has been given to the limiting plant noise emission levels and the type of mitigation measures which may allow for these levels to be achieved.

1.2.3.19 Acoustic enclosures are available which attenuate sound at 100 Hz by around 20 dB (National Grid, 2021). An enclosure which can achieve this amount of low frequency attenuation will reduce noise levels at higher frequencies by a greater amount. However, an overall noise reduction of 20 dB has been applied as a conservative assumption in the absence of a full enclosure specification.

1.2.3.20 Other mitigation options are available for the remaining plant items including, but not limited to:

- acoustic enclosures;
- acoustic barriers; and
- quieter plant selections;

1.2.3.21 In the absence of a detailed design, indicative mitigation measures which may be incorporated as a primary mitigation measure (as part of the design) have been included within the assessment. The losses for each measure and where they have been applied are presented in **Table 1.7** below.

Table 1.7: Indicative noise mitigation measures (Morgan and Morecambe Onshore Substations.

Plant item	Acoustic Mitigation Measure	Insertion Loss (dB)
400/220/33 kV Super Grid Transformer incl. Coolers	Enclosure	20
220 kV Shunt Reactor	Enclosure	20
400 kV Shunt Reactor	Enclosure	20
Dynamic Reactive Power Compensator (SVC) Phase Reactors	Quieter plant/barrier/enclosure	5
2x 33 kV Mechanically Switched Reactors (MSR)	Quieter plant/barrier/enclosure	5
275 kV Filter	Quieter plant/barrier/enclosure	10
400 kV Filter	Quieter plant/barrier/enclosure	10

Noise sensitive receptors

1.2.3.22 The nearest residential noise sensitive receptors are presented graphically in **Figure 1.1** and **Figure 1.2** for Morgan and Morecambe onshore substations, respectively. The relative distances of each receptor to the permanent onshore substation site compounds are presented in **Table 1.8** below. These distances have been calculated using geographical information software and correspond to the distance of the OS AddressBase data point to the onshore substation platform boundary.

Table 1.8: Distance of receptors to onshore substation site boundaries

Receptor	Distance to onshore substation site boundary (m)	
	Morgan	Morecambe
Freshfield Farm	233	-
Dowbridge Farm	596	-
21 Manor Drive	529	-
Sunfield	687	-
Mayfield	639	-
Church Farm	576	-
Pathways	583	-
8 Greenfield Lane	842	-
2 The Crescent	-	884
Bibby's Barn	864	876
Marybank Farm	894	241
Marsh View Farm	901	244
4 Carter Croft	-	776
Wyfold	460	626
Swinza Butts	469	588
2-8 Eland Way	605	909
Chestnut Tree Barn	624	-
Greenbank View	650	-

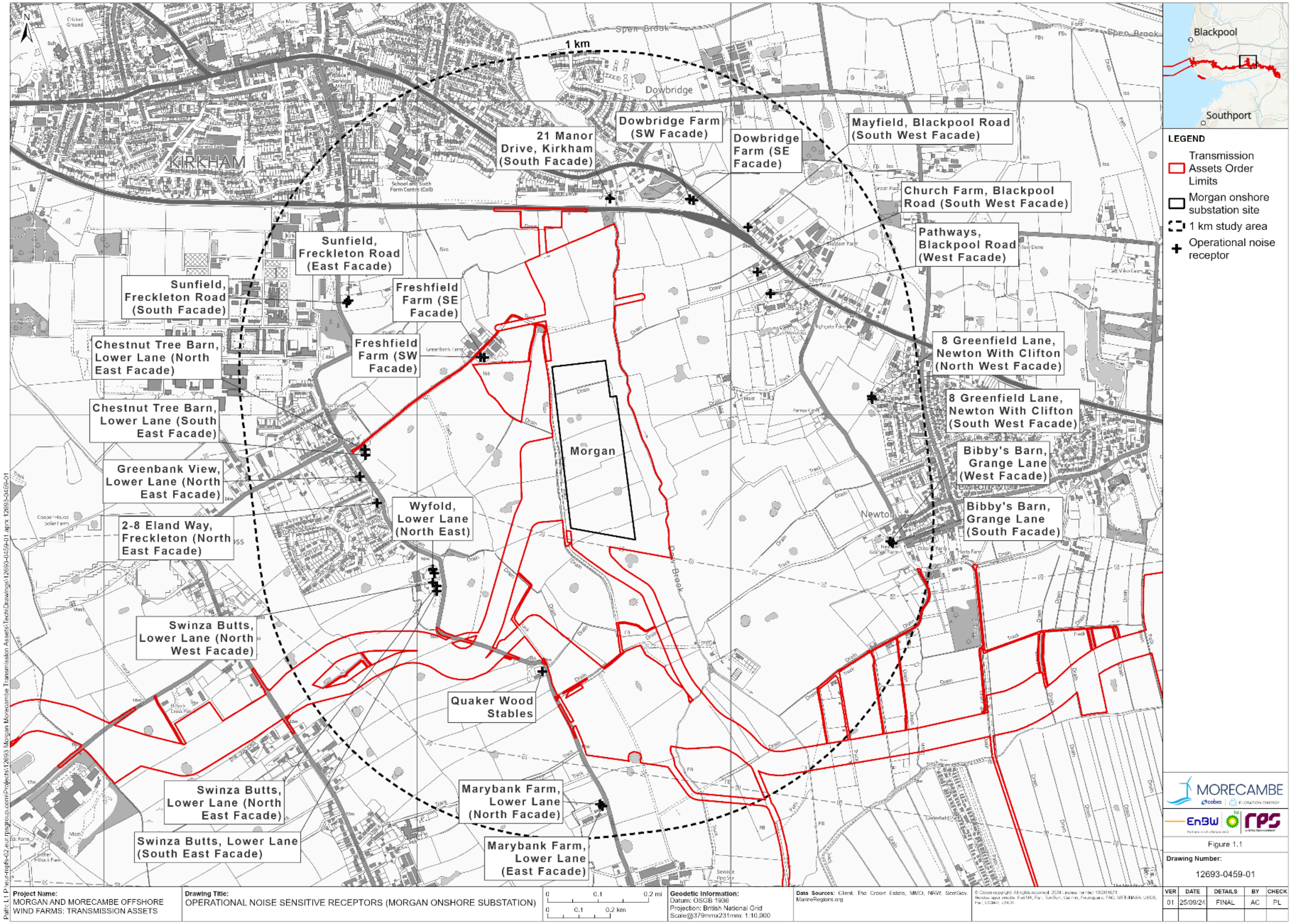


Figure 1.1: Operational noise sensitive receptors (Morgan Onshore Substation)

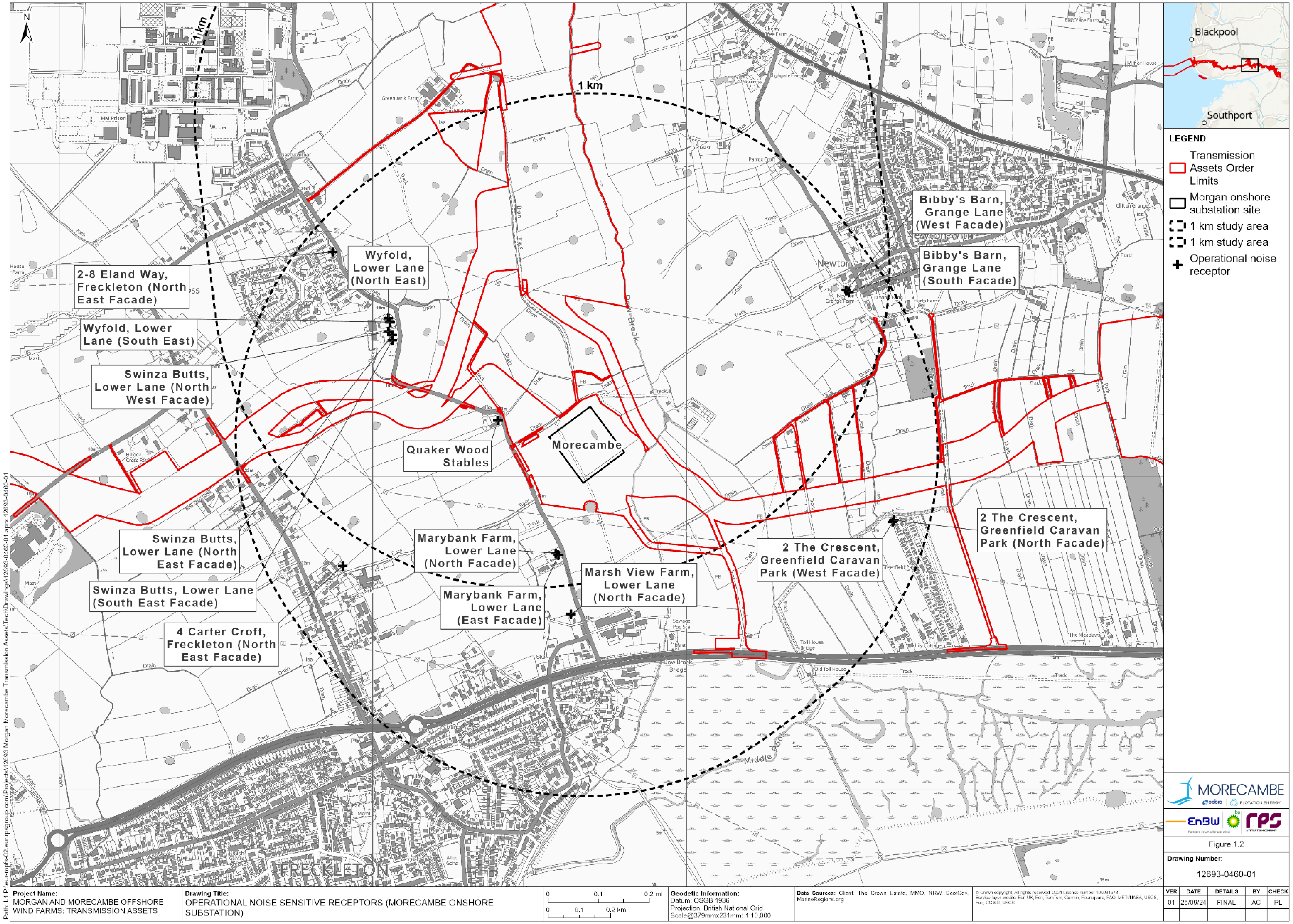


Figure 1.2: Operational noise sensitive receptors (Morecambe Onshore Substation)

1.3 Operational noise limits

1.3.1.1 Operational noise impacts are proposed to be controlled via noise limits at the nearest receptors to be secured as a requirement of the Development Consent Order (DCO).

1.3.1.2 The operational noise limits have been derived based on representative background sound levels measured during the night-time at the most exposed receptors to the Morgan and Morecambe Onshore Substations.

1.3.1.3 The impact magnitude criteria in **Table 1.1** have been derived based on the guidance in BS 4142:2014+A1:2019 which, as outlined in **section 1.2.2** above, states that the difference between the rating level of all plant operating concurrently and the representative background sound level of +5 dB is indicative of an adverse impact. As such, a rating level with a magnitude less than +5 dB above the background sound level indicates that adverse impacts have been avoided, depending on the context.

1.3.1.4 Based on the above, the operational noise limit in **Table 1.9** is proposed to control operational noise impacts at the nearest noise-sensitive receptors.

Table 1.9: Operational noise limits for the Onshore Substations

Receptor	Operational Noise Emission Limit, $L_{Ar,T}$ (dB)
Nearest noise-sensitive receptors.	$L_{Ar,T} < L_{A90,T} + 5$

1.4 Operational noise model output and assessment

1.4.1 Baseline scenario

1.4.1.1 The results of the baseline (unmitigated) scenario for the operation of Morgan and Morecambe Onshore Substations are presented in **Table 1.10** to **Table 1.11**.

1.4.1.2 The results shown in **Table 1.10** to **Table 1.11** identifies a number of medium and high impacts during the night-time period where background sound levels are lower and have the potential to result in significant adverse effects. It should be noted that the sound power levels used as noise model inputs are in the upper range for the type of plant assessed and, as outlined in **Table 1.7**, mitigation measures have been proposed to assess the levels required to avoid significant adverse effects.

1.4.2 Mitigated scenario

1.4.2.1 The mitigated rating levels at receptors are presented in **Table 1.12** to **Table 1.13** which include the required noise reductions outlined in **Table 1.7**. These tables show that, with mitigation measures in place.

1.4.2.2 Employing these measures reduces the rating levels at receptors sufficiently such that significant adverse effects are avoided. The results also demonstrate that compliance with the operational noise limits defined in **Table 1.9** above results in a negligible to low impact overall at receptors.

Table 1.10 : Baseline (unmitigated) operational noise assessment for Morgan Onshore Substation.

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
2-8 Eland Way, Freckleton (NE Facade)	37	31	35	35	4	39	39	2	8	**Low**	**Medium**
8 Greenfield Lane, Newton With Clifton (NW Facade)	42	31	32	32	4	36	36	-6	5	**Negligible**	**Medium**
8 Greenfield Lane, Newton With Clifton (SW Facade)	42	31	31	31	4	35	35	-7	4	**Negligible**	**Low**
21 Manor Drive, Kirkham (South Facade)	50	37	34	34	4	38	38	-12	1	**Negligible**	**Low**
Bibby's Barn, Grange Lane (South Facade)	42	31	24	24	4	28	28	-14	-3	**Negligible**	**Negligible**
Bibby's Barn, Grange Lane (West Facade)	42	31	31	31	4	35	35	-7	4	**Negligible**	**Low**
Chestnut Tree Barn, Lower Lane (NE Facade)	37	31	34	34	4	38	38	1	7	**Low**	**Medium**

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
Chestnut Tree Barn, Lower Lane (SE Facade)	37	31	34	34	4	38	38	1	7	**Low**	**Medium**
Church Farm, Blackpool Road (SW Facade)	50	37	33	33	4	37	37	-13	0	**Negligible**	**Negligible**
Dowbridge Farm (SE Facade)	50	37	32	32	4	36	36	-14	-1	**Negligible**	**Negligible**
Dowbridge Farm (SW Facade)	50	37	33	33	4	37	37	-13	0	**Negligible**	**Negligible**
Freshfield Farm (SE Facade)	34	30	39	39	4	43	43	9	13	**Medium**	**High**
Freshfield Farm (SW Facade)	34	30	38	38	4	42	42	8	12	**Medium**	**High**
Greenbank View, Lower Lane (NE Facade)	37	31	34	34	4	38	38	1	7	**Low**	**Medium**
Marybank Farm, Lower Lane (East Facade)	39	32	29	29	4	33	33	-6	1	**Negligible**	**Low**
Marybank Farm, Lower Lane (North Facade)	39	32	29	29	4	33	33	-6	1	**Negligible**	**Low**

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
Mayfield, Blackpool Road (SW Facade)	50	37	33	33	4	37	37	-13	0	**Negligible**	**Negligible**
Pathways, Blackpool Road (West Facade)	39	32	37	37	4	41	41	2	9	**Low**	**Medium**
Quaker Wood Stables	39	32	31	31	4	35	35	-4	3	**Negligible**	**Low**
Sunfield, Freckleton Road (East Facade)	34	30	31	31	4	35	35	1	5	**Low**	**Medium**
Sunfield, Freckleton Road (South Facade)	34	30	34	34	4	38	38	4	8	**Low**	**Medium**
Swinza Butts, Lower Lane (NE Facade)	37	31	34	34	4	38	38	1	7	**Low**	**Medium**
Swinza Butts, Lower Lane (NW Facade)	37	31	31	31	4	35	35	-2	4	**Negligible**	**Low**
Swinza Butts, Lower Lane (SE Facade)	37	31	34	34	4	38	38	1	7	**Low**	**Medium**

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
Wyfold, Lower Lane (NE Facade)	37	31	34	34	4	38	38	1	7	**Low**	**Medium**
Wyfold, Lower Lane (SE Facade)	37	31	36	36	4	40	40	3	9	**Low**	**Medium**

Table 1.11: Baseline (unmitigated) operational noise assessment for Morecambe Onshore Substation.

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
2-8 Eland Way, Freckleton (NE Facade)	37	31	26	26	2	28	28	-9	-3	**Negligible**	**Negligible**
Greenfield Caravan Park (North Facade)	39	32	27	27	2	29	29	-10	-3	**Negligible**	**Negligible**
Greenfield Caravan Park (West Facade)	39	32	27	27	2	29	29	-10	-3	**Negligible**	**Negligible**
4 Carter Croft, Freckleton (NE Facade)	39	32	28	28	4	32	32	-7		**Negligible**	**Low**
Bibby's Barn, Grange Lane (South Facade)	42	31	28	28	4	32	32	-10	1	**Negligible**	**Low**
Bibby's Barn, Grange Lane (West Facade)	42	31	28	28	4	32	32	-10	1	**Negligible**	**Low**
Marsh View Farm, Lower Lane (North Facade)	39	32	32	32	4	36	36	-3	4	**Negligible**	**Low**

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
Marybank Farm, Lower Lane (East Facade)	39	32	36	36	4	40	40	1	8	**Low**	**Medium**
Marybank Farm, Lower Lane (North Facade)	39	32	36	36	4	40	40	1	8	**Low**	**Medium**
Quaker Wood Stables	39	32	37	37	4	41	41	2	9	**Low**	**Medium**
Swinza Butts, Lower Lane (NE Facade)	37	31	30	30	4	34	34	-3	3	**Negligible**	**Low**
Swinza Butts, Lower Lane (NW Facade)	37	31	21	21	4	25	25	-12	-6	**Negligible**	**Negligible**
Swinza Butts, Lower Lane (SE Facade)	37	31	30	30	4	34	34	-3	3	**Negligible**	**Low**
Wyfold, Lower Lane (NE Facade)	37	31	29	29	4	33	33	-4	2	**Negligible**	**Low**
Wyfold, Lower Lane (SE Facade)	37	31	29	29	4	33	33	-4	2	**Negligible**	**Low**

Table 1.12: Mitigated operational noise assessment for Morgan Onshore Substation

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
2-8 Eland Way, Freckleton (NE Facade)	37	31	27	28	0	27	28	-6	-3	**Negligible**	**Negligible**
8 Greenfield Lane, Newton With Clifton (NW Facade)	42	31	24	25	0	24	25	-13	-6	**Negligible**	**Negligible**
8 Greenfield Lane, Newton With Clifton (SW Facade)	42	31	24	25	0	24	25	-13	-6	**Negligible**	**Negligible**
21 Manor Drive, Kirkham (South Facade)	50	37	27	28	0	27	28	-19	--9	**Negligible**	**Negligible**
Bibby's Barn, Grange Lane (South Facade)	42	31	12	17	0	12	17	-25	-14	**Negligible**	**Negligible**
Bibby's Barn, Grange Lane (West Facade)	42	31	23	24	0	23	24	-15	-7	**Negligible**	**Negligible**
Chestnut Tree Barn, Lower Lane (NE Facade)	37	31	27	28	0	27	28	-6	-3	**Negligible**	**Negligible**

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
Chestnut Tree Barn, Lower Lane (SE Facade)	37	31	27	28	0	27	28	-10	-3	**Negligible**	**Negligible**
Church Farm, Blackpool Road (SW Facade)	50	37	26	27	0	26	27	-19	--10	**Negligible**	**Negligible**
Dowbridge Farm (SE Facade)	50	37	25	26	0	25	26	-20	-11	**Negligible**	**Negligible**
Dowbridge Farm (SW Facade)	50	37	25	26	0	25	26	-19	--11	**Negligible**	**Negligible**
Freshfield Farm (SE Facade)	34	30	33	34	0	33	34	3	4	**Negligible**	**Low**
Freshfield Farm (SW Facade)	34	30	28	31	0	28	31	-1	1	**Negligible**	**Low**
Greenbank View, Lower Lane (NE Facade)	37	31	27	28	0	27	28	-6	-3	**Negligible**	**Negligible**
Marybank Farm, Lower Lane (East Facade)	39	32	21	22	0	21	22	-13	-10	**Negligible**	**Negligible**
Marybank Farm, Lower Lane (North Facade)	39	32	22	23	0	22	23	-13	-9	**Negligible**	**Negligible**

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
Mayfield, Blackpool Road (SW Facade)	50	37	26	27	0	26	27	-19	-10	**Negligible**	**Negligible**
Pathways, Blackpool Road (West Facade)	50	37	25	26	0	25	26	-19	-11	**Negligible**	**Negligible**
Quaker Wood Stables	39	32	25	25	0	25	25	-10	-14	**Negligible**	**Negligible**
Sunfield, Freckleton Road (East Facade)	34	30	25	26	0	25	26	-5	-4	**Negligible**	**Negligible**
Sunfield, Freckleton Road (South Facade)	34	30	25	26	0	25	26	-5	-4	**Negligible**	**Negligible**
Swinza Butts, Lower Lane (NE Facade)	37	31	28	29	0	28	29	-6	-2	**Negligible**	**Negligible**
Swinza Butts, Lower Lane (NW Facade)	37	31	28	29	0	28	29	-5	-2	**Negligible**	**Negligible**
Swinza Butts, Lower Lane (SE Facade)	37	31	21	24	0	21	24	-11	-7	**Negligible**	**Negligible**

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
Wyfold, Lower Lane (NE Facade)	37	31	28	30	0	28	30	-5	-1	**Negligible**	**Negligible**
Wyfold, Lower Lane (SE Facade)	37	31	28	29	0	28	29	-5	-2	**Negligible**	**Negligible**

Table 1.13: Mitigated operational noise assessment for Morecambe Onshore Substation.

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
2-8 Eland Way, Freckleton (NE Facade)	37	31	25	25	0	25	25	-12	-6	**Negligible**	**Negligible**
Greenfield Caravan Park (North Facade)	39	32	26	26	0	26	26	-13	-6	**Negligible**	**Negligible**
Greenfield Caravan Park (West Facade)	39	32	26	26	0	26	26	-13	-6	**Negligible**	**Negligible**
4 Carter Croft, Freckleton (NE Facade)	39	32	27	27	0	27	27	-12	-5	**Negligible**	**Negligible**
Bibby's Barn, Grange Lane (South Facade)	42	31	27	27	0	27	27	-15	-4	**Negligible**	**Negligible**
Bibby's Barn, Grange Lane (West Facade)	42	31	27	27	0	27	27	-15	-4	**Negligible**	**Negligible**
Marsh View Farm, Lower Lane (North Facade)	39	32	30	30	0	30	30	-9	-2	**Negligible**	**Negligible**

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
Marybank Farm, Lower Lane (East Facade)	39	32	35	35	0	35	35	-4	3	**Negligible**	**Low**
Marybank Farm, Lower Lane (North Facade)	39	32	35	35	0	35	35	-4	3	**Negligible**	**Low**
Quaker Wood Stables	39	32	37	37	0	37	37	-2	5	**Negligible**	**Medium**
Swinza Butts, Lower Lane (NE Facade)	37	31	29	29	0	29	29	-8	-2	**Negligible**	**Negligible**
Swinza Butts, Lower Lane (NW Facade)	37	31	21	21	0	21	21	-16	-10	**Negligible**	**Negligible**
Swinza Butts, Lower Lane (SE Facade)	37	31	29	29	0	29	29	-8	-2	**Negligible**	**Negligible**
Wyfold, Lower Lane (NE Facade)	37	31	28	28	0	28	28	-9	-3	**Negligible**	**Negligible**
Wyfold, Lower Lane (SE Facade)	37	31	28	28	0	28	28	-9	-3	**Negligible**	**Negligible**

1.4.3 Concurrent operation

1.4.3.1 An iteration of the 3D acoustic modelling has been undertaken for both the baseline and mitigated scenarios to predict the noise impacts due to the concurrent operation of the Morgan and Morecambe Onshore Substations.

1.4.3.2 The results are presented graphically in **Figure 1.3** to **Figure 1.6** below and are tabulated in **Table 1.14 to Table 1.15**.

1.4.3.3 In summary, there is the potential for significant adverse effects during the night-time to occur at eight noise sensitive receptors without mitigation in place. This is due to the concurrent operation of Morgan and Morecambe onshore substations resulting medium and high impacts as shown in **Table 1.14.** With the indicative mitigation measures described in **Table 1.7** in place, no significant effects are likley to occur at any NSRs.

Figure 1.3: Baseline daytime operational noise levels (Morgan and Morecambe Onshore Substations)

Figure 1.4: Baseline night-time operational noise levels (Morecambe and Morecambe Onshore Substations)

Table 1.14 : Baseline (unmitigated) operational noise assessment for Morgan and Morecambe Onshore Substations.

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
2-8 Eland Way, Freckleton (NE Facade)	37	31	34	34	4	38	38	1	7	**Low**	**Medium**
2 The Crescent, Greenfield Caravan Park (North Facade)	39	32	28	28	4	32	32	-7	0	**Negligible**	**Low**
2 The Crescent, Greenfield Caravan Park (West Facade)	39	32	28	28	4	32	32	-7	0	**Negligible**	**Low**
4 Carter Croft, Freckleton (NE Facade)	39	32	30	30	4	34	34	-5	2	**Negligible**	**Low**
8 Greenfield Lane, Newton With Clifton (NW Facade)	42	31	31	31	4	35	35	-7	4	**Negligible**	**Low**
8 Greenfield Lane, Newton With Clifton (SW Facade)	42	31	31	31	4	35	35	-7	4	**Negligible**	**Low**

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
21 Manor Drive, Kirkham (South Facade)	50	37	32	32	4	36	36	-14	-1	**Negligible**	**Negligible**
Bibby's Barn, Grange Lane (South Facade)	42	31	27	27	4	31	31	-11	0	**Negligible**	**Low**
Bibby's Barn, Grange Lane (West Facade)	42	31	31	31	4	35	35	-7	4	**Negligible**	**Low**
Chestnut Tree Barn, Lower Lane (NE Facade)	37	31	33	33	4	37	37	0	6	**Low**	**Medium**
Chestnut Tree Barn, Lower Lane (SE Facade)	37	31	34	34	4	38	38	1	7	**Low**	**Medium**
Church Farm, Blackpool Road (SW Facade)	50	37	33	33	4	37	37	-13	0	**Negligible**	**Low**
Dowbridge Farm (SE Facade)	50	37	31	31	4	35	35	-15	-2	**Negligible**	**Negligible**
Dowbridge Farm (SW Facade)	50	37	32	32	4	36	36	-14	-1	**Negligible**	**Negligible**
Freshfield Farm (SE Facade)	34	30	38	38	4	42	42	8	12	**Medium**	**High**

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
Freshfield Farm (SW Facade)	34	30	35	35	4	39	39	5	9	**Medium**	**Medium**
Greenbank View, Lower Lane (NE Facade)	37	31	33	33	4	37	37	0	6	**Low**	**Medium**
Marsh View Farm, Lower Lane (North Facade)	39	32	32	32	4	36	36	-3	4	**Negligible**	**Low**
Marybank Farm, Lower Lane (East Facade)	39	32	35	35	4	39	39	0	7	**Low**	**Medium**
Marybank Farm, Lower Lane (North Facade)	39	32	35	35	4	39	39	0	7	**Low**	**Medium**
Mayfield, Blackpool Road (SW Facade)	50	37	32	32	4	36	36	-14	-1	**Negligible**	**Negligible**
Pathways, Blackpool Road (West Facade)	50	37	32	32	4	36	36	-14	-1	**Negligible**	**Negligible**
Quaker Wood Stables	39	32	39	39	4	43	43	4	11	**Low**	**High**

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
Sunfield, Freckleton Road (East Facade)	34	30	31	31	4	35	35	1	5	**Low**	**Medium**
Sunfield, Freckleton Road (South Facade)	34	30	31	31	4	35	35	1	5	**Low**	**Medium**
Swinza Butts, Lower Lane (NE Facade)	37	31	35	35	4	39	39	2	8	**Low**	**Medium**
Swinza Butts, Lower Lane (NW Facade)	37	31	34	34	4	38	38	1	7	**Low**	**Medium**
Swinza Butts, Lower Lane (SE Facade)	37	31	33	33	4	37	37	0	6	**Low**	**Medium**
Wyfold, Lower Lane (NE)	37	31	35	35	4	39	39	2	8	**Low**	**Medium**
Wyfold, Lower Lane (SE)	37	31	35	35	4	39	39	2	8	**Low**	**Medium**

Figure 1.5: Mitigated daytime operational noise levels (Morgan and Morecambe Onshore Substations)

Figure 1.6: Mitigated night-time operational noise levels (Morecambe and Morecambe Onshore Substations)

Table 1.15 : Mitigated operational noise assessment for Morgan and Morecambe Onshore Substations.

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
2-8 Eland Way, Freckleton (NE Facade)	37	31	30	30	0	30	30	-7	-1	**Negligible**	**Negligible**
2 The Crescent, Greenfield Caravan Park (North Facade)	39	32	27	27	0	27	27	-12	-5	**Negligible**	**Negligible**
2 The Crescent, Greenfield Caravan Park (West Facade)	39	32	27	27	0	27	27	-12	-5	**Negligible**	**Negligible**
4 Carter Croft, Freckleton (NE Facade)	39	32	28	28	0	28	28	-11	-4	**Negligible**	**Negligible**
8 Greenfield Lane, Newton With Clifton (NW Facade)	42	31	28	28	0	28	28	-14	-3	**Negligible**	**Negligible**
8 Greenfield Lane, Newton With Clifton (SW Facade)	42	31	28	28	0	28	28	-14	-3	**Negligible**	**Negligible**

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
21 Manor Drive, Kirkham (South Facade)	50	37	28	28	0	28	28	-22	-9	**Negligible**	**Negligible**
Bibby's Barn, Grange Lane (South Facade)	42	31	27	27	0	27	27	-15	-4	**Negligible**	**Negligible**
Bibby's Barn, Grange Lane (West Facade)	42	31	29	29	0	29	29	-13	-2	**Negligible**	**Negligible**
Chestnut Tree Barn, Lower Lane (NE Facade)	37	31	29	29	0	29	29	-8	-2	**Negligible**	**Negligible**
Chestnut Tree Barn, Lower Lane (SE Facade)	37	31	30	30	0	30	30	-7	-1	**Negligible**	**Negligible**
Church Farm, Blackpool Road (SW Facade)	50	37	29	29	0	29	29	-21	-8	**Negligible**	**Negligible**
Dowbridge Farm (SE Facade)	50	37	27	27	0	27	27	-23	-10	**Negligible**	**Negligible**
Dowbridge Farm (SW Facade)	50	37	28	28	0	28	28	-22	-9	**Negligible**	**Negligible**

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
Freshfield Farm (SE Facade)	34	30	34	34	0	34	34	0	4	**Low**	**Low**
Freshfield Farm (SW Facade)	34	30	32	32	0	32	32	-2	2	**Negligible**	**Low**
Greenbank View, Lower Lane (NE Facade)	37	31	29	29	0	29	29	-8	-2	**Negligible**	**Negligible**
Marsh View Farm, Lower Lane (North Facade)	39	32	31	31	0	31	31	-8	-1	**Negligible**	**Negligible**
Marybank Farm, Lower Lane (East Facade)	39	32	35	35	0	35	35	-4	3	**Negligible**	**Low**
Marybank Farm, Lower Lane (North Facade)	39	32	35	35	0	35	35	-4	3	**Negligible**	**Low**
Mayfield, Blackpool Road (SW Facade)	50	37	28	28	0	28	28	-22	-9	**Negligible**	**Negligible**
Pathways, Blackpool Road (West Facade)	50	37	28	28	0	28	28	-22	-9	**Negligible**	**Negligible**

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, L_S (dB)		Acoustic Character Correction (dB)	Rating Sound Level, $L_{Ar,Tr}$ (dB)		Difference Δ Between Rating Sound Level and Background Sound Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night		Day	Night	Day	Night	Day	Night
Quaker Wood Stables	39	32	37	37	0	37	37	-2	5	**Negligible**	**Medium**
Sunfield, Freckleton Road (East Facade)	34	30	28	28	0	28	28	-6	-2	**Negligible**	**Negligible**
Sunfield, Freckleton Road (South Facade)	34	30	28	28	0	28	28	-6	-2	**Negligible**	**Negligible**
Swinza Butts, Lower Lane (NE Facade)	37	31	32	32	0	32	32	-5	1	**Negligible**	**Low**
Swinza Butts, Lower Lane (NW Facade)	37	31	30	30	0	30	30	-7	-1	**Negligible**	**Negligible**
Swinza Butts, Lower Lane (SE Facade)	37	31	31	31	0	31	31	-6	0	**Negligible**	**Low**
Wyfold, Lower Lane (NE)	37	31	32	32	0	32	32	-5	1	**Negligible**	**Low**
Wyfold, Lower Lane (SE)	37	31	32	32	0	32	32	-5	1	**Negligible**	**Low**

1.5 Recreational receptors

1.5.1.1 Noise impacts at recreational receptors on the public footpath (5-5-BW 16) situated to the west of the Morgan Onshore Substation and to the north of Morecambe Onshore Substation have been assessed with reference to the TR, as detailed in **section 1.2.2**.

1.5.1.2 Baseline sound survey measurements were undertaken at four locations along the public footpath, as detailed in Volume 3, Annex 8.1: Baseline sound survey of the ES.

1.5.1.3 Receptor points have been included within the 3D acoustic model in the locations at which survey measurements were undertaken. The receptors are presented graphically in **Figure 1.7 Figure 1.7**below. The specific sound levels have been predicted at these receptors and assessed in line with the criteria in **Table 1.4** depending upon the tranquillity score derived from the baseline survey measurements.

1.5.1.4 The results are presented in **Table 1.16** to **Table 1.19** below.

Table 1.16: Baseline (unmitigated) operational noise assessment at recreational receptors for Morgan Onshore Substation

Receptor	Tranquillity Score	Specific Sound Level, $L_{Aeq,T}$ (dB)	Magnitude of Impact
TR1	6	34	**Negligible**
TR2	6	42	**Negligible**
TR3	5	50	**Low**
TR4	5	44	**Negligible**

Table 1.17: Mitigated operational noise assessment at recreational receptors for Morgan Onshore Substation

Receptor	Tranquillity Score	Specific Sound Level, $L_{Aeq,T}$ (dB)	Magnitude of Impact
TR1	6	26	**Negligible**
TR2	6	32	**Negligible**
TR3	5	43	**Negligible**
TR4	5	40	**Negligible**

Table 1.18: Baseline (unmitigated) operational noise assessment at recreational receptors for Morecambe Onshore Substation

Receptor	Tranquillity Score	Specific Sound Level, $L_{Aeq,T}$ (dB)	Magnitude of Impact
TR1	6	37	**Negligible**

Receptor	Tranquillity Score	Specific Sound Level, $L_{Aeq,T}$ (dB)	Magnitude of Impact
TR2	6	31	**Negligible**
TR3	5	27	**Negligible**
TR4	5	25	**Negligible**

Table 1.19: Mitigated operational noise assessment at recreational receptors for Morecambe Onshore Substation

Receptor	Tranquillity Score	Specific Sound Level, $L_{Aeq,T}$ (dB)	Magnitude of Impact
TR1	6	33	**Negligible**
TR2	6	27	**Negligible**
TR3	5	23	**Negligible**
TR4	5	21	**Negligible**

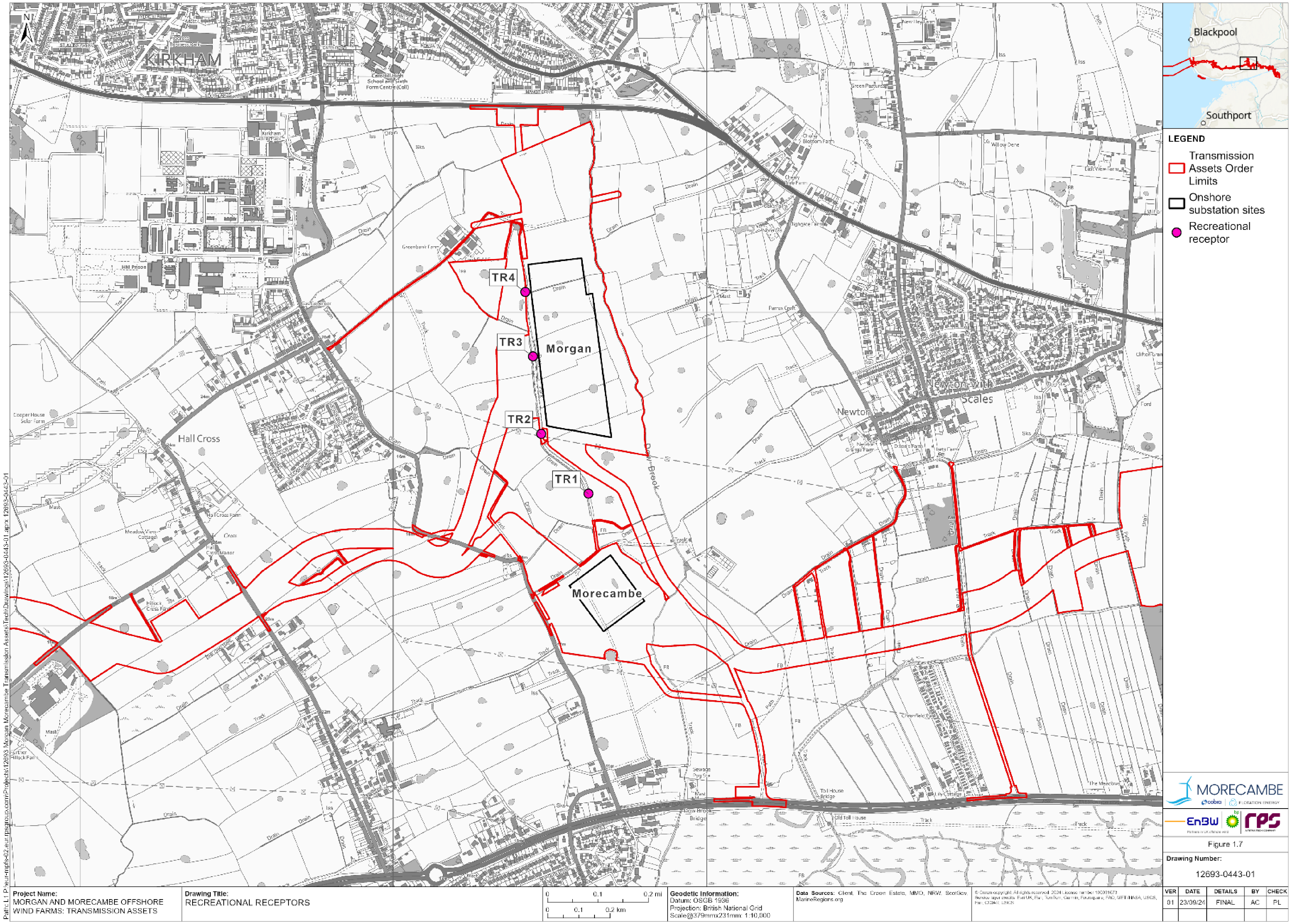


Figure 1.7: Recreational receptors

1.6 References

Bentley. C (2019), *Tranquil Spaces: Measuring the tranquillity of public spaces,* Suffolk, Sharps Redmore Press

Morgan and Morecambe Offshore Wind Farms: Transmission Assets Environmental Impact Assessment Scoping Report (2022). Available: https://infrastructure.planninginspectorate.gov.uk/projects/north-west/morgan-and-morecambe-offshore-wind-farms-transmission-assets/?ipcsection=docs&stage=1&filter1=Environmental+Impact+Assessment+Scoping Accessed April 2023

British Standards Institution (2019) 'British Standard 4142:2014+A1:2019 – 'Methods for rating and assessing industrial and commercial sound'.

British Standards Institution (2014) 'British Standard 8233:2014– 'Guidance on sound insulation and noise reduction for buildings'.

Ganga. M (2011), 'Low-frequency and Tonal Characteristics of Transformer Noise', Proceedings of ACOUSTICS 2011, Gold Coast, Australia

International Organisation for Standards (1996) 'ISO 9613-2:1996 – Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation'

National Grid (2021), Operational Noise Assessment for the Proposed Little Hosted 400 kV Substation, Available: https://planning.wealden.gov.uk/plandisp.aspx?recno=153380. Accessed November 2023

Appendix A: Operational noise model source spectra

Table 1.20: Operational noise model input spectra (1/1-octave bands)

Plant Item	Sound Power Level (dB) at Octave Band Centre Frequency (Hz)								dB(A)
	63	125	250	500	1k	2k	4k	8k	
275/400 kV Shunt Reactor incl. Coolers	89	94	92	87	86	79	69	59	**90**
Dynamic Reactive power Compensator (SVC) Phase Reactors	55	100	66	76	78	50	50	52	**85**
Dynamic Reactive power Compensator (SVC) Coolers	88	88	92	87	86	80	69	59	**90**
33kV Mechanically Switched Reactors (MSR)	47	99	75	84	27	26	26	28	**85**
275/400 kV Filter	83	88	93	78	60	40	40	38	**85**
33/0.4 kV auxiliary Transformer	83	88	93	78	60	40	40	38	**85**

Plant Item	Sound Power Level (dB) at Octave Band Centre Frequency (Hz)								dB(A)
	63	125	250	500	1k	2k	4k	8k	
DRC Heating, Ventilation and Air Conditioning Units	101	92	78	68	62	54	52	72	**80**
Control Building Heating, Ventilation and Air Conditioning Units	84	89	76	76	75	72	65	64	**80**

Table 1.21: Super grid transformer input spectrum (1/3-octave bands)

Super Grid Transformer Sound Power Level (dB) at 1/3-Octave Centre Frequency (Hz)																								dB(A)
50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	6.3k	8k	10k	
72	76	76	96	76	71	92	78	89	90	85	81	74	74	73	67	65	63	60	57	58	59	58	58	**90**