

Technical Appendix 10.2: Operational Noise Report



A specialist energy consultancy

Technical Appendix 10.2

Operational Noise Report

Watchman Energy Park

Watchman Energy Park Limited

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CLIENT'S DISCRETION



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Executive Summary

TNEI Services was commissioned by Watchman Energy Park Limited ('the Applicant') to undertake predictions of the wind turbine noise that would be emitted by the operation of the proposed Watchman Energy Park (hereinafter referred to as 'the Proposed Development'). The noise predictions were used to assess the potential impact of operational noise from the Proposed Development on the nearest noise sensitive receptors (NSRs).

The Scottish Government's web based renewables advice on 'Onshore Wind Turbines' states: *'The Report, "The Assessment and Rating of Noise from Wind Farms" (Final Report, Sept 1996, DTI), (ETSU-R-97), describes a framework for the measurement of wind farm noise, which should be followed by applicants and consultees, and used by planning authorities to assess and rate noise from wind energy developments, until such time as an update is available. This gives indicative noise levels thought to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable burdens on wind farm developers, and suggests appropriate noise conditions.'* The advice document then goes on to state: *'The Institute of Acoustics (IOA) has since published Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise [IOA GPG]. The document provides significant support on technical issues to all users of the ETSU-R-97 method for rating and assessing wind turbine noise, and should be used by all IOA members and those undertaking assessments to ETSU-R-97. The Scottish Government accepts that the guide represents current industry good practice.'*

In June 2024, the UK Government Department for Energy Security and Net Zero (DESNZ) awarded a contract to Noise Consultants Limited to update ETSU-R-97. A draft update of the new guidance 'Assessment and Rating of Wind Turbine Noise' (2025) was published for consultation on the 4th July 2025. The closing date for consultation responses was the 29 August 2025. Given the draft status of the guidance and the potential for any final update to differ, the consultation draft has not been considered further in this assessment. There is no confirmed date for the publication of final guidance. The guidance contained within ETSU-R-97 and current good practice has been used to assess the potential operational noise impact of the Proposed Development.

The operational noise assessment has been undertaken in three stages:

- 1) deriving the Total ETSU-R-97 Noise Limits (which are applicable to noise from all wind turbines in the area operating concurrently) at NSRs;
- 2) predicting the likely effects (undertaking a cumulative noise assessment where required) to determine whether noise immission at NSRs would meet the Total ETSU-R-97 Noise Limits; and,
- 3) deriving Site-Specific Noise Limits for the Proposed Development (taking account of the noise limit that has already been allocated to/could realistically be used by other schemes) and undertaking predictions against those limits.

Background noise monitoring was undertaken at six NSRs. The monitoring locations were considered to be representative of the NSRs located closest to the Proposed Development.

A total of 20 NSRs were chosen as Noise Assessment Locations (NALs). The NALs were chosen to represent the NSRs located closest to the Proposed Development, with more distant receptors included to consider cumulative noise impacts. For the assessment locations where no background noise measurements were undertaken, noise data collected at one of the noise monitoring locations deemed representative of the expected background noise environment was instead used to assess the wind turbine noise impact at those receptors.

Wind speed data was measured using a LIDAR unit. The wind data measured at 155 m height was standardised to a height of 10 m in accordance with current good practice. Analysis of the measured data has been undertaken in accordance with ETSU-R-97 and current good practice to determine the pre-existing background noise environment and to establish the Daytime and Nighttime noise limits at each of the NALs.

Based on the guidance in ETSU-R-97 and to reflect the presence of existing wind turbines in the area, the Daytime Total ETSU-R-97 Noise Limits were set at 40 dB(A) or background plus 5 dB whichever is the greater. The Nighttime Total ETSU-R-97 Noise Limit was set at 43 dB(A) or background plus 5 dB whichever is the greater. The Daytime Site-Specific Noise Limits for noise associated with the Proposed Development has been set such that it never exceeds 35 dB(A) or background plus 5 dB, whichever is the greater. This represents the lower end of the Daytime limits that can be applied under ETSU-R-97. The Nighttime Site-Specific Noise Limits have been set at 43 dB(A) or background plus 5 dB whichever is the greater.

The exception to the setting of both the Daytime and Nighttime fixed minimum noise limits occurs where a property occupier has a financial involvement in the wind farm development where the fixed minimum limit can be increased to 45 dB(A) or a higher permissible limit above background during the Daytime and Nighttime periods. For the purposes of this assessment it has been assumed that there are three properties financially involved with the Proposed Development, and an additional property financially involved in a 3rd party development.

Predictions of wind turbine noise for the Proposed Development were made, based upon the sound power level data for a candidate wind turbine, the Siemens-Gamesa SG7.0-170 7.0 MW with a hub height of 155 m. This wind turbine model has been chosen as it is considered to be representative of the type of turbine that could be installed at the site.

Modelling was undertaken using the ISO 9613: 2024 'Acoustics – Attenuation of sound during propagation outdoors Part 2: Engineering method for the prediction of sound pressure levels outdoors' noise prediction model which accords with current good practice and is considered to provide a realistic impact assessment. For the other schemes, predictions have been undertaken using sound power level data for the installed turbines or a suitable candidate. The model of turbine was either identified through an online search, or through the use of the Council's Planning Application Portal.

A cumulative assessment was undertaken at the NALs where predictions from the Proposed Development were found to be within 10 dB of the noise predictions from all other schemes. The likely cumulative assessment shows that the Proposed Development can operate concurrently with the operational, consented and proposed wind farms in the area, whilst still meeting the Total ETSU-R-97 Noise Limits at the receptors.

Site-Specific Noise Limits have also been derived that take account (where required) of the other wind farm developments. Where wind turbine immission from the other wind turbines at a given receptor were found to be at least 10 dB below the Total ETSU-R-97 Noise Limit, it is considered that they would be using a negligible proportion of the limit, as such it was considered appropriate to allocate the entire noise limit to the Proposed Development. For the receptors where turbine predictions were found to be within 10 dB of the Total ETSU-R-97 Noise Limit, apportionment of the Total ETSU-R-97 Noise Limits was undertaken in accordance with current good practice.

In the first instance, predicted noise levels indicate that wind turbine noise immission were below the Site-Specific Noise Limits at all NALs, except during the Daytime at NALs 12 to 15, where a maximum exceedance of 3.1 dB is predicted at NAL15 within the standardised windspeed range of 6 to 12 ms⁻¹. Predicted noise levels have therefore been reduced to ensure that the Site-Specific Noise Limits are met, this would be achieved by the adoption of low noise modes, but this would only be required for a limited range of wind speeds and wind directions. The use of Site-Specific Noise Limits would ensure

that the Proposed Development could operate concurrently with other wind farms/turbines in the area and would also ensure that the Proposed Development’s individual contribution could be measured and enforced if required.

Should consent be granted for the Proposed Development it would be appropriate to include a set of noise related planning conditions, which detail the noise limits applicable to the Proposed Development.

There are a number of wind turbine makes and models that may be suitable for the Proposed Development. Should the Proposed Development receive consent the final choice of turbine would be subject to a competitive tendering process. As such, predictions of wind turbine noise are for information only. The final choice of turbine would, however, have to meet the noise limits determined and contained within any condition imposed.

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1 Introduction

1.1 Brief

- 1.1.1 TNEI was commissioned by Watchman Energy Park Limited ('the Applicant') to undertake an operational noise assessment for the proposed Watchman Energy Park (hereinafter referred to as 'the Proposed Development'). The following steps summarise the noise assessment process:
- Measure existing background noise levels and present the noise data with reference to existing Government Guidance and the recommendations of the Department of Trade and Industry Noise Working Group on Noise from Wind Turbines which are contained within ETSU-R-97 'The Assessment and Rating of Noise from Wind Farms' (1) and 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (2) (IOA GPG), which represents current good practice;
 - Determine the Total ETSU-R-97 Noise Limits applicable to all wind farms in the area;
 - Undertake a cumulative noise assessment, where required, to take account of other operational, consented and proposed schemes near to the Proposed Development;
 - Derive Site-Specific Noise Limits for the Proposed Development, suitable for inclusion in a noise related planning condition;
 - Undertake predictions of the operational wind turbine noise emission from the Proposed Development that would be incident at neighbouring noise sensitive receptors (NSRs);
 - Compare the predictions of operational wind turbine noise from the Proposed Development against the Site-Specific Noise Limits; and
 - Assess the impact of noise from the Proposed Development with reference to existing Government Guidance and the recommendations of the Department of Trade and Industry Noise Working Group on Noise from Wind Turbines, which are contained within ETSU-R-97 and the IOA GPG (current good practice).

1.2 Background

- 1.2.1 The Proposed Development is located approximately 10 km south of Crawford, 7 km south of Elvanfoot and 12 km to the west of Moffat, wholly within the administrative boundary of South Lanarkshire Council (SLC). The proposed turbine layout is shown on **Figure A1.1a** in **Annex 1**.
- 1.2.2 In the absence of a confirmed turbine model, this noise assessment models a candidate turbine, the Siemens-Gamesa SG7.0-170 7.0 MW with a hub height of 155 m. This turbine is representative of the turbine type that could be installed at the site.
- 1.2.3 The noise assessment has considered schemes that are operational, consented and proposed (planning application submitted) but not those in the pre-planning stage (i.e. Scoping). The schemes considered in the assessment are summarised in **Table 1.1**.

Table 1.1 Cumulative Wind Farm/ Turbine Development

Wind Farm/ Wind Turbine	Number of Turbines	Status	Make and Model of Turbine considered in Modelling
Clyde Wind Farm	152	Operational	Siemens VS93m 2.3 MW
Clyde Extension Wind Farm	54	Operational	Siemens SWT-3.2-101 3.2 MW
Harestanes Wind Farm	68	Operational	Gamesa G87-2000CS
Minnygap Wind Farm	10	Operational	Nordex N100/2500
Crookedstane Wind Farm	4	Consented	Siemens SWT-2.3-82VS 2.3 MW
Lion Hill Wind Farm	4	Consented	Siemens SWT-2.3-82VS 2.3 MW
Daer Wind Farm	17	In Planning	Siemens-Gamesa SG6.6-155 6.6 MW, Mode AMO
Harestanes West Wind Farm	12	In Planning	Vestas V162 7.2 MW with Serrated Blades, Mode PO7200
Harestanes South Wind Farm	8	In Planning	Siemens-Gamesa SWT 5.0-145
Rivox Wind Energy Hub	29	In Planning	Vestas V162 6.8 MW with Serrated Blades, Mode PO6800

- 1.2.4 **Figure A1.1b** in **Annex 1** shows the location of the above developments relative to the Proposed Development.
- 1.2.5 The Site-Specific Noise Limits presented in this report for the Proposed Development have taken account of the noise limits that have already been allocated to, or could potentially be used by, the other schemes in the area.
- 1.2.6 For the purposes of assessing the above schemes in conjunction with the Proposed Development, the following terms have been referred to throughout the assessment:
- 'Total ETSU-R-97 Noise Limits'; defined as being the limit that should not be exceeded from the cumulative operation of all wind farm developments, including the Proposed Development; and
 - 'Site-Specific Noise Limits'; defined as being the limit that is specific to the Proposed Development only, and derived through the apportionment (where required), of the 'Total ETSU-R-97 Noise Limits,' in accordance with current good practice.
- 1.2.7 Note that in this report, the term 'noise emission' relates to the sound power level radiated from each wind turbine, whereas the term 'noise immission' relates to the sound pressure level (the received noise) at any receptor location, due to the operation of the wind turbines. All references to dB are dB(A) unless otherwise stated. A full glossary of terms is provided in **Section 8**.

2 Noise Planning Policy and Guidance

2.1 Overview of Noise Planning Policy and Guidance

2.1.1 In assessing the potential noise impacts of the Proposed Development, the following guidance and policy documents have been considered:

- National Planning Policy (3);
- Local Planning Policy;
- Web Based Renewables Advice: 'Onshore Wind Turbines' (5);
- Planning Advice Note PAN 1/2011: 'Planning and Noise' (6);
- ETSU-R-97 'The Assessment and Rating of Noise from Wind Farms' (1); and
- Institute of Acoustics 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (IOA GPG) May 2013 (2).

2.2 National Planning Policy

2.2.1 As the Proposed Development has capacity to generate over 50 MW, the Proposed Development requires a section 36 consent. In such cases the Planning Authority is a statutory consultee in the development management process and procedures.

2.2.2 In determining an application for section 36 consent, the Scottish Ministers must first have regard to the extent to which the Applicant has met its duties in terms of Schedule 9 of the Electricity Act 1989. The Applicant must assess and, if required, mitigate the effects of the Proposed Development on environmental matters.

2.2.3 Furthermore, decision makers must also consider national energy and planning policy, and, in the context of a section 36 application, the statutory Development Plan. As of February 2023, National Planning Framework 4 ('NPF4') (3) now forms part of the statutory Development Plan alongside the relevant Local Development Plan and any related supplementary guidance. Such plans will often contain policies tailored specifically to control certain kinds of development, and such policies should carry more weight and be more dominant in the minds of decision makers.

2.2.4 NPF4 was adopted on 13 February 2023 and supersedes National Planning Framework 3 and Scottish Planning Policy. Policy 11 – Energy, states that renewable energy projects must be able to demonstrate how any noise impacts on communities have been addressed through the project's design and any associated mitigation. Policy 23 – Health and Safety, outlines how 'development proposals that are likely to raise unacceptable noise issues will not be supported' and states that 'a Noise Impact Assessment may be required where the nature of the proposal or its location suggests that significant effects are likely.'

2.2.5 The Scottish Government's online Onshore Wind: Policy Statement 2022 (4) (in Section 3.7) that:

'The Assessment and Rating of Noise from Wind Farms' (Final Report, Sept 1996, DTI), (ETSU-R-97) provides the framework for the measurement of wind turbine noise, and all applicants are required to follow the framework and use it to assess and rate noise from wind energy developments.'

2.3 Web Based Planning Advice – Onshore Wind Turbines

2.3.1 The 'Onshore Wind Turbines' (5) web-based document describes the types of noise (mechanical and aerodynamic) that wind turbines generate. Mechanical noise is generated by the gearbox and generator and other parts of the drive train, which can be radiated as noise through the nacelle, gear box, tower and supporting structures; together with the aerodynamic noise, which is generated by the action of the blades rotating through the air. The document states, 'there has been significant reduction in the mechanical noise generated by wind turbines through improved turbine design' and goes on to note:

'The Report, "The Assessment and Rating of Noise from Wind Farms" (Final Report, Sept 1996, DTI), (ETSU-R-97), describes a framework for the measurement of wind farm noise, which should be followed by applicants and consultees, and used by planning authorities to assess and rate noise from wind energy developments, until such time as an update is available. This gives indicative noise levels thought to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable burdens on wind farm developers, and suggests appropriate noise conditions.'

2.3.2 The web-based document then refers to the IOA GPG as a source, which provides:

'significant support on technical issues to all users of the ETSU-R-97 method for rating and assessing wind turbine noise, and should be used by all IOA members and those undertaking assessments to ETSU-R-97. The Scottish Government accepts that the guide represents current industry good practice.'

2.3.3 The document also refers to the role of PAN1/2011 'Planning and Noise' (6) to:

'provide advice on the role of the planning system in helping to prevent and limit the adverse effects of noise. The associated Technical Advice Note provides guidance which may assist in the technical evaluation of noise assessment.'

2.3.4 Examination of the Technical Advice Note (7) confirms that it provides advice on wind farms by referring to ETSU-R-97 and relevant parameters for modelling identified in the Institute of Acoustics Bulletin March 2009 (8), on page 37. This was superseded by the introduction of the IOA GPG in May 2013.

2.4 Planning Advice Note PAN 1/2011: Planning and Noise

2.4.1 PAN 1/2011 (6) provides advice on the role of the planning system in helping to prevent and limit the adverse effects of noise. Paragraph 29 contains some specific information on noise from wind farms and states the following:

'There are two sources of noise from wind turbines - the mechanical noise from the turbines and the aerodynamic noise from the blades. Mechanical noise is related to engineering design. Aerodynamic noise varies with rotor design and wind speed, and is generally greatest at low speeds. Good acoustical design and siting of turbines is essential to minimise the potential to generate noise. Web based planning advice on renewable technologies for Onshore wind turbines provides advice on 'The Assessment and Rating of Noise from Wind Farms' (ETSU-R-97) published by the former Department of Trade and Industry [DTI] and the

findings of the Salford University report into Aerodynamic Modulation of Wind Turbine Noise.'

2.5 Local Policy

South Lanarkshire Local Development Plan

- 2.5.1 The adopted Development Plan for the area comprises the South Lanarkshire Local Development Plan 2 (LDP2) (22) which was adopted on 9 April 2021. The Local Plan sets out the vision, objectives and strategy which will be used to guide future development proposals in South Lanarkshire.
- 2.5.2 The Plan contains a number of overarching policies, the aim of which is to deliver high standards of development including Policy 5: Development Management and Placemaking and Policy RE1: Renewable Energy. Policy 5 states: *'development shall not have an unacceptable significant adverse impact on the amenity of any nearby residential properties in terms of overshadowing, overlooking or other loss of residential amenity as a result of light, noise, odours, dust or particulates or other emissions'*. Policy RE1 then specifically considers renewable energy developments and refers to an Assessment Checklist (included as Appendix 1 of LDP Volume 2) for Renewable Energy Proposals which in turn references the Supporting Planning Guidance (SPG) on Renewable Energy.
- 2.5.3 The SPG directs developers to consider the Scottish Government PAN 1/2011 Planning and Noise (6), the Scottish Governments online guidance for Onshore Wind Farms (5) as well as the Institute of Acoustics (IOA) Best Practice Guide (A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise, May 2013) (2). These documents are discussed further below and have been used to inform the scope of the assessment.

2.6 ETSU-R-97 The Assessment and Rating of Noise from Wind Farms

- 2.6.1 As wind farms started to be developed in the UK in the early 1990's, it became apparent that existing noise standards did not fully address the issues associated with the unique characteristics of wind farm developments, and there was a need for an agreed methodology for defining acceptable noise limits for wind farm developments. This methodology was developed for the former Department of Trade and Industry (DTI) by the Working Group on Noise from Wind Turbines (WGNWT).
- 2.6.2 The WGNWT comprised a number of interested parties including, amongst others, Environmental Health Officers (EHOs), wind farm operators, independent acoustic consultants and legal experts, who:
- '...between them have a breadth and depth of experience in assessing and controlling the environmental impact of noise from wind farms.'*
- 2.6.3 In this way it represented the views of all the stakeholders that are involved in the assessment of noise impacts of wind farm developments. The recommendations of the WGNWT are presented in the DTI Report – ETSU-R-97 *'The Assessment and Rating of Noise from Wind Farms (1996) (1),'* hereafter referred to as ETSU-R-97.

- 2.6.4 The basic aim of the WGNWT in arriving at the ETSU-R-97 recommendations was the intention to provide:
- 'Indicative noise levels thought to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable restrictions on wind farm development or adding to the costs and administrative burdens on wind farm developers or local authorities.'*
- 2.6.5 ETSU-R-97 makes it clear from the outset that any noise restrictions placed on a wind farm must balance the environmental impact of the wind farm against the national and global benefits that would arise through the development of renewable energy sources:
- 'The planning system must therefore seek to control the environmental impacts from a wind farm whilst at the same time recognising the national and global benefits that would arise through the development of renewable energy sources and not be so severe that wind farm development is unduly stifled.'*
- 2.6.6 Where noise immission levels at the nearest residential NSRs is limited to an $L_{A90,10min}$ of 35 dB(A) up to wind speeds of 10 ms^{-1} at a height of 10 m, then it does not need to be considered any further through a noise assessment, as protection of the amenity of these receptors can be controlled through a simplified noise limit. In this regard ETSU-R-97 states that:
- 'For single turbines or wind farms with very large separation distances between the turbines and the nearest properties, a simplified noise condition may be suitable. If the noise is limited to an $L_{A90,10min}$ of 35 dB(A) up to wind speeds of 10 m/s at 10 m height, then this condition alone would offer sufficient protection of amenity, and background noise surveys would be unnecessary.'*
- 2.6.7 The ETSU-R-97 assessment procedure specifies that where wind turbine noise is expected to be above the simplified limit of 35 dB L_{A90} , noise limits should be set relative to existing background noise levels at the nearest NSRs. These limits should reflect the variation in both turbine source noise and background noise with wind speed. Absolute lower limits, different for Daytime and Nighttime, are applied where low levels of background noise are measured. The wind speeds that should be considered range between the cut-in wind speed for the turbines (usually about 2 to 3 ms^{-1}) and up to 12 ms^{-1} , where all wind speeds are referenced to a 10-m measurement height.
- 2.6.8 Separate noise limits apply for Daytime and for Nighttime. Daytime limits are chosen to protect a property's external amenity, whereas Nighttime limits are chosen to prevent sleep disturbance indoors, with windows open.
- 2.6.9 The Daytime noise limit is derived from background noise data measured during so-called 'quiet periods of the day', which comprise weekday evenings (18:00 to 23:00), Saturday afternoons and evenings (13:00 to 23:00) and all day and evening on Sundays (07:00 to 23:00).
- 2.6.10 Multiple samples of 10-minute background noise levels using the $L_{A90,10min}$ measurement index are logged continuously over a range of wind speed conditions. These measured noise levels are then plotted against concurrent wind speed data and a 'best fit' curve is fitted to the data to establish the background noise level as a function of wind speed. The ETSU-R-97 Daytime noise limit, sometimes referred to as a 'criterion curve', is then set at a level 5 dB(A)

above the best fit curve over the desired wind speed range; subject to an appropriate Daytime fixed minimum limit:

'For wind speeds where the best fit curve to the background noise data lies below a level of 30 - 35 dB(A) the criterion curve is set at a fixed level in the range 35 - 40 dB(A). The precise choice of criterion curve level within the range 35 - 40 dB(A) depends on a number of factors: the number of noise affected properties, the likely duration, the level of exposure and the potential impact on the power output of the wind farm. The quiet daytime limits have been set in ETSU-R-97 on the basis of protecting the amenity of residents whilst outside their dwellings in garden areas.'

2.6.11 Although the limits are set based on the quiet Daytime baseline data, the Daytime limits apply to the entire Daytime period (07:00 to 23:00).

2.6.12 The Nighttime noise limit is derived from background noise data measured during the night-time periods (23:00 to 07:00), with no differentiation being made between weekdays and weekends. The 10-minute L_{A90} noise levels measured over the Nighttime periods are plotted against concurrent wind speed data and a 'best fit' correlation is established. The Nighttime noise limit is also based on a level 5 dB(A) above the best fit curve over the 0 to 12 ms^{-1} wind speed range, with a fixed minimum limit of 43 dB L_{A90} .

2.6.13 The exception to the setting of both the Daytime and Nighttime fixed minimum limits occurs where a property occupier has a financial involvement in the wind farm development. In this regard, paragraph 24 of ETSU-R-97 states:

'The Noise Working Group recommends that both day and night time lower fixed limits can be increased to 45 dB(A) and that consideration should be given to increasing the permissible margin above background where the occupier of the property has some financial involvement in the wind farm.'

2.6.14 ETSU-R-97 provides a robust basis for determining the noise limits for wind turbine(s) and since its introduction has become the accepted standard for such developments across the UK.

2.7 Current Good Practice

A Good Practice Guide on the Application of ETSU-R-97

2.7.1 In May 2013, the Institute of Acoustics issued 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (2) (hereafter referred to as IOA GPG). The document provides guidance on background data collection, data analysis and limit derivation, noise predictions, cumulative issues, reporting requirements and other matters such as noise related planning conditions.

2.7.2 The Authors of the IOA GPG sets out the scope of the document in Section 1.2:

'This guide presents current good practice in the application of the ETSU-R-97 assessment methodology for all wind turbine developments above 50 kW, reflecting the original principles within ETSU-R-97, and the results of research carried out and experience gained since ETSU-R-97 was published. The noise limits in ETSU-R-97 have not been examined as these are a matter for Government.'

2.7.3 The guidance document was endorsed, on behalf of Scottish Government by the Cabinet Secretary for Finance, Employment and Sustainable Growth, Mr John Swinney MSP (9). Accordingly, the recommendations included in the IOA GPG have been considered and applied throughout this noise assessment for the Proposed Development.

2.7.4 The IOA GPG refers to six Supplementary Guidance Notes and where applicable these have also been considered in this report.

2.7.5 The guidance contained within ETSU-R-97 and the IOA GPG has therefore been used to assess and rate the operational noise emissions from the Proposed Development.

2.8 WSP BEIS Report

2.8.1 In February 2023, WSP published 'A review of noise guidance for onshore wind turbines' (10) ('hereafter referred to as the 'WSP BEIS report'). The report, which was subsequently re-issued as version 5 in September 2023, was commissioned by (the former) UK Government Department for Business, Energy & Industrial Strategy (BEIS). The primary aim of the review was to make a recommendation on whether, in view of government policies on noise and Net Zero, and available evidence, the existing guidance requires updating.

2.8.2 The WSP BEIS report concluded that:

'the guidance would benefit from further review and updating of the aspects identified. This could be supported by currently available evidence, which is summarised in this report. However, the study has also highlighted gaps in the state of knowledge, which should be addressed by further research, to support any updates to the guidance.'

2.8.3 A series of recommendations are made within the document regarding further research, whilst some additional suggestions are included regarding the development of new or updated guidance. The following recommendation is included on page 26 of the WSP BEIS report:

'the separation of the 'policy position' (addressing the balance between controlling noise impact and enabling renewable energy development), 'technical guidance' (application of the assessment approach), and 'technical justification' (the supporting evidence) into discrete, linked documents'

2.8.4 The WSP BEIS report notes at the outset that 'Any views expressed within it do not necessarily represent the views of the UK government or the governments of any of the devolved administrations'. The report does state on page 25 that:

'Consideration should be given to including a clear position statement in guidance confirming the intended policy balance between protection from noise impact, and enabling of renewable energy development (to achieve Net Zero), linked with the wider policies that underpin the government approach to noise management.'

2.8.5 In June 2024, the UK Government Department for Energy Security and Net Zero (DESNZ) awarded a contract to Noise Consultants Limited to update ETSU-R-97. A draft update of new guidance 'Assessment and Rating of Wind Turbine Noise' (2025) was published for consultation on 4 July 2025, with the closing date being the 29 August 2025. Given the draft status of the guidance and the potential for any final update to differ, the consultation draft

has not been considered further in this assessment. There is no confirmed date for the publication of final guidance.

- 2.8.6 In relation to the guidance that should be used to assess the Proposed Development, the Scottish Government Guidance is clear; the Onshore Wind Policy Statement 2022 (4) states:

'3.7.1. 'The Assessment and Rating of Noise from Wind Farms' (Final Report, Sept 1996, DTI), (ETSU-R-97) provides the framework for the measurement of wind turbine noise, and all applicants are required to follow the framework and use it to assess and rate noise from wind energy developments.'

'3.7.4. Until such time as new guidance is produced, ETSU-R-97 should continue to be followed by applicants and used to assess and rate noise from wind energy developments.'

- 2.8.7 The guidance contained within ETSU-R-97 and the IOA GPG has therefore been used to assess and rate the operational noise emissions from the Proposed Development.

3 Potential Impacts

3.1 Operational Noise Sources

- 3.1.1 Wind turbines may emit two types of noise. Firstly, aerodynamic noise is a more natural sounding 'broad band' noise, albeit with a characteristic modulation, or 'swish', which is produced by the movement of the rotating blades through the air. Secondly, mechanical noise may emanate from components within the nacelle of a wind turbine. Potential sources of mechanical noise include gearboxes or generators.

- 3.1.2 Aerodynamic noise is usually perceived when the wind speeds are fairly low, although at very low wind speeds the blades do not rotate, or rotate very slowly, and so negligible aerodynamic noise is generated. In higher winds, aerodynamic noise may be masked by the normal sound of wind blowing through the trees and around buildings. The level of this natural 'masking' noise relative to the level of wind turbine noise is one of the several factors that determine the subjective audibility of the wind turbines (11).

3.2 Infrasound, Low Frequency Noise and Vibration

- 3.2.1 The term infrasound can be defined as the frequency range below 20 Hz, while low frequency noise (LFN) is typically in the frequency range 20 to 200 Hz (12). An average young healthy adult has an audible range from 20 Hz to 20,000 Hz, although the sensitivity of the ear varies with frequency and is most sensitive to sounds with frequencies between 500 Hz and 4,000 Hz. Wind turbines do produce low frequency sounds (13), but our threshold of hearing at such low frequencies is relatively high and they therefore go unnoticed. Infrasound from wind turbines is often at levels below that of the noise generated by wind around buildings and other obstacles.

- 3.2.2 In 2004, the former DTI commissioned The Hayes McKenzie Partnership to report on claims that infrasound or LFN emitted by wind turbine generators (WTGs) were causing health effects. Of the 126 wind farms operating in the UK, five had reported LFN problems, therefore, such complaints are an exception, rather than a general problem that exists for all wind farms. Hayes McKenzie investigated the effects of infrasound and LFN at three wind farms for which complaints had been received and the results were reported in May 2006 (14). The report concluded that:

- *'infrasound associated with modern wind turbines is not a source which will result in noise levels which may be injurious to the health of a wind farm neighbour;*
- *low frequency noise was measurable on a few occasions but below the existing permitted Night Time Noise Criterion. Wind turbine noise may result in internal noise levels within a dwelling that is just above the threshold of audibility, however at all sites it was always lower than that of local road traffic noise;*
- *that the common cause of complaint was not associated with LFN, but the occasional audible modulation of aerodynamic noise especially at night. Data collected showed that the internal noise levels were insufficient to wake up residents at these three sites. However once awoken, this noise can result in difficulties in returning to sleep.'*

- 3.2.3 The Applied and Environmental Geophysics Research Group at Keele University was commissioned by the Ministry of Defence (MOD), the DTI and the British Wind Energy Association (BWEA) to undertake microseismic and infrasound monitoring of LFN and vibrations from wind farms for the purposes of siting wind farms in the vicinity of Eskdalemuir in Scotland. Whilst the testing showed that vibration can be detected several kilometres away from wind turbines, the levels of vibration from wind turbines were so small that only the most sophisticated instrumentation can reveal their presence and they are almost impossible to detect. Nevertheless, the Renewable Energy Foundation alleged potential adverse health effects and when that story was picked up in the popular press, notably the Scotsman, the report's authors expressed concern over the way in which their work had been misinterpreted and issued a rebuttal statement (15) in August 2005:

'Vibrations at this level and in this frequency range will be available from all kinds of sources such as traffic and background noise – they are not confined to wind turbines. To put the level of vibration into context, they are ground vibrations with amplitudes of about one millionth of a millimetre. There is no possibility of humans sensing the vibration and absolutely no risk to human health.'

- 3.2.4 In response to concerns that wind turbines emit infrasound and cause associated health problems, Dr Geoff Leventhall, Consultant in Noise Vibration and Acoustics and author of the Defra Report on Low Frequency Noise and its Effects, said in the article in the Scotsman ('Wind farm noise rules 'dated' - James Reynolds, 5 August 2005'):

'I can state quite categorically that there is no significant infrasound from current designs of wind turbines.'

- 3.2.5 An article (8) published in the IOA Bulletin (March/April 2009) concluded that there is no robust evidence that either low frequency noise (including 'infrasound') or ground-borne vibration from wind farms, has an adverse effect on wind farm neighbours.

- 3.2.6 Work (16) by Dr Leventhall looked at infrasound levels within the ear compared to external sources and concluded:

'The conclusion is that the continuous inner ear infrasound levels due to internal sources, which are in the same frequency range as wind turbine rotational frequencies, are higher than the levels produced in the inner ear by wind turbines, making it unlikely that the wind turbine noise will affect the vestibular systems, contrary to suggestions made following the measurements at Shirley. The masking effect is similar to that in the abdomen (Leventhall 2009). The body, and vestibular systems, appear to be built to avoid disturbance from the high levels of infrasound which are produced internally from the heartbeat and other processes. In fact, the hearing mechanisms and the balance mechanisms, although in close proximity, have developed to minimise interaction (Carey and Amin 2006).'

- 3.2.7 More recently, during a planning Appeal (PPA-310-2028, Clydeport Hunterston Terminal Facility, approximately 2.5 km southwest of Fairlie, 9 Jan 2018), the health impacts related to LFN associated with wind turbines were considered at length by the appointed Reporter (Mr M Croft). The Reporter considered evidence from Health Protection Scotland and the National Health Service. In addition, he also considered LFN surveys undertaken by the Appellant and the Local Authority, both of which demonstrated compliance with planning conditions and did not identify any problems attributable to the turbine operations; some

periods with highest levels of low frequency noise were in fact recorded when the turbines were not operating.

- 3.2.8 The Reporter concluded that:

- The literature reviews by bodies with very significant responsibilities for the health of local people found insufficient evidence to confirm a causal relationship between wind turbine noise and the type of health complaints cited by some local residents;
- The NHS's assessment is that concerns about health impact are not supported by good quality research; and
- Although given the opportunity, the Community Council failed to provide evidence that can properly be set against the general tenor of the scientific evidence.

- 3.2.9 The WSP BEIS Report (10) notes on page 115 that:

'Several studies have investigated the claimed links between adverse health symptoms and infrasound emissions from wind turbines. Although some experimental studies have linked infrasonic signals with activation of physiological sensory processing, these have tended to be based on signals that are not representative of wind turbine infrasound. There remains no compelling evidence of adverse health effects associated with wind turbine infrasound exposure at sound frequencies and' levels expected to be present at noise-sensitive receptor locations in the vicinity of wind farms'

- 3.2.10 The WSP BEIS Report goes on to note on page 116 that:

'Overall, the findings from the existing evidence base indicate that infrasound from wind turbines at typical exposure levels has no direct adverse effects on physical or mental health, and reported symptoms of ill-health are more likely to be psychogenic in origin.'

- 3.2.11 It is noted that research into infrasound is ongoing, but the WSP BEIS report concluded that:

'It is expected that further evidence from ongoing studies into wind turbine infrasound effects will emerge soon, in particular from the NHMRC studies in Australia. However, based on the existing scientific evidence, it does appear probable that the above findings will not be contradicted by newer evidence.'

- 3.2.12 Since the publication of the WSP BEIS report, NHMRC (the National Health and Medical Research Council of Australia) study was presented in the Environmental Health Perspectives (EHP) journal, which is published by the United States National Institute of Environmental Health. The study (17) aimed to test the effect of exposure to 72 hours of infrasound (designed to simulate a wind turbine infrasound signature) exposure on human physiology, particularly sleep. The study concluded that:

'Our findings did not support the idea that infrasound causes WTS¹. High level, but inaudible, infrasound did not appear to perturb any physiological or psychological measure tested in these study participants.'

¹ WTS stands for Wind Turbine Syndrome which is a term for adverse human health effected related to the proximity of wind turbines.

- 3.2.13 It is therefore not considered necessary to carry out specific assessments of LFN and it has not been considered further in the noise assessment.

3.3 Amplitude Modulation of Aerodynamic Noise (AM)

- 3.3.1 In the context of wind turbine noise, amplitude modulation describes a variation in noise level over time; for example, observers may describe a 'whoosh whoosh' sound, which can be heard close to a wind turbine as the blades sweep past. Amplitude Modulation of aerodynamic noise is an inherent characteristic of wind turbine noise and was noted in ETSU-R-97, on page 68:

'The modulation or rhythmic swish emitted by wind turbines has been considered by some to have a characteristic that is irregular enough to attract attention. The level and depth of modulation of the blade noise is, to a degree, turbine-dependent and is dependent upon the position of the observer. Some wind turbines emit a greater level of modulation of the blade noise than others. Therefore, although some wind turbines might be considered to have a character that may attract one's attention, others have noise characteristics which are considerably less intrusive and unlikely to attract one's attention and be subject to any penalty.'

This modulation of blade noise may result in a variation of the overall A-weighted noise level by as much as 3dBA (peak to trough) when measured close to a wind turbine. As distance from the wind turbine [or] wind farm increases, this depth of modulation would be expected to decrease as atmospheric absorption attenuates the high frequency energy radiated by the blade.'

- 3.3.2 In recent times the acoustics community has sought to make a distinction between the AM discussed within ETSU-R-97, which is expected at most wind farms and as such may be considered as 'Normal Amplitude Modulation' (NAM), compared to the unusual AM that has sometimes been heard at a small number of wind farms, hereinafter referred to as 'Other Amplitude Modulation' (OAM). The term OAM is used to describe an unusual feature of aerodynamic noise from wind turbines, where a greater than normal degree of regular fluctuation in sound level occurs at blade passing frequency, typically once per second. In some appeal decisions it has also been referred to as 'Excess Amplitude Modulation' (EAM). It should be noted that the noise assessment and rating procedure detailed in ETSU-R-97 fully takes into account the presence of the intrinsic level of NAM when setting acceptable noise limits for wind farms.
- 3.3.3 On 16 December 2013, RenewableUK (RUK) released six technical papers (18) on AM, which reflected the outcomes of research commissioned over the previous three years, together with a template planning condition. Whilst this research undoubtedly improved understanding of Other Amplitude Modulation (OAM) and its effects, it should be noted that at the time of writing it has not been endorsed by any relevant body such as the Institute of Acoustics (IOA).
- 3.3.4 On 22 January 2014, the IOA released a statement regarding the RUK research and the proposed planning condition to deal with the issue of amplitude modulation from a wind turbine and stated:

'This research is a significant step forward in understanding what causes amplitude modulation from a wind turbine, and how people react to it. The proposed planning

condition, though, needs a period of testing and validation before it can be considered to be good practice. The IOA understands that RenewableUK will shortly be making the analysis tool publicly available on their website so that all interested parties can test the proposed condition, and the IOA will review the results later in the year. Until that time, the IOA cautions the use of the proposed planning condition.'

- 3.3.5 Research regarding amplitude modulation continued. In April 2015, the IOA issued a discussion document entitled 'Methods for Rating Amplitude Modulation in Wind Turbine Noise'. The document presented three methods that can be used to quantify the level of AM at a given measurement location. After extensive consultation a preferred method of measuring OAM, which provides a framework for practitioners to measure and rate AM, was recommended by the IOA.
- 3.3.6 On 3 August 2015, the Department for Energy and Climate Change (DECC), now the Department for Business, Energy and Industrial Strategy (BEIS), commissioned independent consultants WSP Parsons Brinkerhoff to carry out a literature review on OAM (which they refer to simply as AM). The stated aims were as follows:
- To review the available evidence on Amplitude Modulation (AM) in relation to wind turbines, including but not limited to the research commissioned and published by RenewableUK in December 2013;
 - To work closely with the Institute of Acoustics' AM working group, who are expected to recommend a preferred metric and methodology for quantifying and assessing the level of AM in a sample of wind turbine noise data;
 - To review the robustness of relevant dose response relationships, including the one developed by the University of Salford as part of the RenewableUK study, on which the correction (or penalty) for amplitude modulation proposed as part of its template planning condition is based;
 - To consider how, in a policy context, the level(s) of AM in a sample of noise data should be interpreted, in particular determining at what point it causes a significant adverse impact;
 - To recommend how excessive AM might be controlled through the use of an appropriate planning condition; and
 - To consider the engineering/cost trade-offs of possible mitigation measures.
- 3.3.7 Their report (19), which was released in October 2016, concluded that there is sufficient robust evidence that excessive AM leads to increased annoyance from wind turbine noise and recommended that excessive AM is controlled through a suitably worded planning condition, which will control it during periods of complaint. Those periods should be identified by measurement using the metric proposed by the work undertaken by the IOA, and enforcement action would rely upon professional judgement by Local Authority Environmental Health Officers based on the duration and frequency of occurrence.
- 3.3.8 It is not clear within the body of the report which evidence the authors relied upon to arrive at their conclusions, although the Executive Summary states (page 4);

"It is noted that none of the Category 1 or 2 papers have been designed to answer the main aim of the current review in its entirety. The Category 1 studies have limited representativeness due to sample constraints and the artificiality of laboratory

environments, whereas the Category 2 studies generally do not directly address the issue of AM WTN exposure-response. A meta - analysis of the identified studies was not possible due to the incompatibility of the various methodologies employed. Notwithstanding the limitations in the evidence, it was agreed with DECC that the factors to be included in a planning condition should be recommended based on the available evidence, and supplemented with professional experience”.

- 3.3.9 The report (19) states that any planning condition must accord with existing planning guidance and should be subject to legal advice on a case by case basis. Existing guidance would include compliance with the six tests of a planning condition embodied in Circular 4/98. The report’s authors did not dictate a particular condition to be used but did suggest that any condition should include the following elements (p5):

- *“The AM condition should cover periods of complaints (due to unacceptable AM);*
- *The IoA-recommended metric should be used to quantify AM (being the most robust available objective metric);*
- *Analysis should be made using individual 10-minute periods, applying the appropriate decibel ‘penalty’ to each period, with subsequent analysis;*
- *The AM decibel penalty should be additional to any decibel penalty for tonality; and*
- *An additional decibel penalty is proposed during the night time period to account for the current difference between the night and day limits on many sites to ensure the control method works during the most sensitive period of the day.”*

- 3.3.10 AM was considered in the WSP BEIS report. The report notes that the IOA Method provides a suitable approach to measure and quantify AM (whilst noting that work is ongoing to refine the approach) but also highlights that further work is required to develop a robust mechanism for controlling AM that could be incorporated into a planning condition. In relation to the potential adoption of a penalty scheme to control AM the WSP BEIS report notes on page 208 that:

‘In practice, the details of applying such a penalty scheme are complicated by the complexities of wind turbine sound measurements. These often involve a considerable amount of data filtering and data aggregation to address the practical difficulties of measuring a highly variable source, which is often also at a level that is relatively low compared with other, fluctuating residual sounds present in the acoustic environment. Such details will need to be carefully considered in further study, and the example planning condition proposed by a group of IOA members in 2017 should be considered as a starting point.’

- 3.3.11 Until such a ‘further study’ is completed and additional guidance is published, the approach set out in the IOA GPG remains valid, which states (paragraph 7.2.10):

‘7.2.1 The evidence in relation to “Excess” or “Other” Amplitude Modulation (AM) is still developing. At the time of writing, current practice is not to assign a planning condition to deal with AM.’

4 Methodology

4.1 Assessing Operational Noise Impact

- 4.1.1 To undertake an assessment of the operational noise impact in accordance with the requirements of ETSU-R-97 and the IOA GPG, the following steps are required:

- Specify the location of the wind turbines for the Proposed Development;
- Measure the background noise levels as a function of on-site wind speed at a selection of representative Noise Monitoring Locations (NML);
- Identify the locations of all nearby NSRs and select a sample of relevant Noise Assessment Locations (NALs). For each NAL, identify the most representative measured background noise data;
- Establish NAL the Total ETSU-R-97 Noise Limits for each on analysis of the measured background noise levels;
- Specify the likely noise emission levels of the wind turbines for the Proposed Development and all nearby cumulative wind turbines;
- Calculate the likely noise immission levels due to the cumulative operation of all relevant wind turbines and compare it to the Total ETSU-R-97 Noise Limits;
- Determine the Site-Specific Noise Limits, which take account of the noise limit already allocated to, or could theoretically be used by, other schemes in the area; and
- Calculate the likely noise immission levels due to the operation of the Proposed Development on its own and compare it to the Proposed Development’s Site-Specific Noise Limits.

- 4.1.2 In order to consider the steps outlined above, the assessment has been split into three separate stages:

- Stage 1 – determine the Total ETSU-R-97 Noise Limits (which are applicable to noise from all wind turbines in the area operating concurrently) at the NALs;
- Stage 2 – undertake a cumulative assessment, where noise predictions from the Proposed Development are within 10 dB of the total noise predictions from the other wind farms/turbines within the area; and
- Stage 3 – establish the Proposed Development’s Site-Specific Noise Limits (at levels below the Total ETSU-R-97 Noise Limits, where limit apportionment is required) and compare the noise predictions from the Proposed Development on its own against these limits.

- 4.1.3 There are a range of turbine makes and models that may be appropriate for the Proposed Development, therefore, the assessment is based upon an appropriate candidate model only. The final selection of turbine would follow a competitive tendering process, so the final turbine model may differ from that upon which this assessment has been based. However, the final choice of turbine would still be required to comply with the noise limits that have been established for the Site.

4.2 Consultation

Consultation with South Lanarkshire Council EHO (February 2025)

- 4.2.1 Prior to the commencement of the noise impact assessment for the Proposed Development, direct consultation was undertaken with the Environmental Health Department at South Lanarkshire Council (SLC) to agree the approach to the noise assessment and the baseline noise monitoring locations.
- 4.2.2 An EHO from SLC responded via a phone call agreeing with the proposed monitoring locations and approach to the noise assessment.
- 4.2.3 A copy of the original consultation letter is included in **Annex 2**.

Scoping Opinion (dated March 2025)

- 4.2.4 In the Scoping Opinion, SLC stated that they agreed in the use of ETSU-R-97 and the IOA GPG to assess the impacts of operational wind turbine noise on nearby NSRs. They also agreed that vibration, low frequency noise, infrasound and amplitude modulation can be scoped out of the noise assessment. Furthermore, SLC stated that due to number of neighbouring wind turbine developments the simplified approach as specified in ETSU-R-97 would not be appropriate and that a detailed cumulative assessment would be required instead.
- 4.2.5 In the Scoping Opinion, the ECU stated the following:
The noise assessment should be carried out in line with relevant legalisation and standards as detailed in section 3.9 of the scoping report. The noise assessment report should be formatted as per Table 6.1 of the IOA "A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise".
- 4.2.1 The assessment of operational wind turbine noise from the Proposed Development has therefore been undertaken with cognisance to these considerations that were raised during the scoping process.

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

Background Noise Levels and Wind Shear

- 4.3.1 Wind shear can be defined as 'the change in the relationship between wind speed at different heights'. Due to wind shear, wind speeds recorded on one meteorological mast at different heights are usually different, generally the higher the anemometer the higher the wind speed recorded. For example, if a wind speed of 4 ms⁻¹ is recorded at 80 m height, 3.5 ms⁻¹ may be recorded at 40 m and 2.5 ms⁻¹ may be recorded at 10 m.
- 4.3.2 Hub height wind speed is the key wind speed for a wind farm noise assessment, as it is the wind speed at hub height which would inform the turbine control system, influence the turbine operation and ultimately, determine the noise emitted by the wind turbine. Ideally, both wind turbine noise predictions and background noise level measurements should refer to hub height wind speed (or a representation thereof), ensuring that there is no discrepancy between the wind speed at which the noise is emitted and the wind speed at which the corresponding background noise is measured.

- 4.3.3 The IOA GPG states that one of three methods to account for wind shear may be adopted (A, B or C). For this assessment, 'Method A' of section 2.6.3 of the IOA GPG was used to fully take account of wind shear. The details are described below in Section 5 'Baseline'.

Noise Impact Criteria in ETSU-R-97

- 4.3.4 Analysis of the measured data has been undertaken in accordance with ETSU-R-97 and the IOA GPG to determine the pre-existing background noise environment and to establish, for each NAL, the Daytime and Nighttime Total ETSU-R-97 Noise Limits, which would apply for the cumulative operation of all wind turbines in the area. The Total ETSU-R-97 Noise Limits for the Daytime have been set at 40 dB(A) or background plus 5 dB, whichever is the greater; and the Total ETSU-R-97 Noise Limits at Nighttime have been set at 43 dB(A) or background plus 5 dB, whichever is the greater. This 'Total' limit relates to noise from all wind farm developments in the area. The limit was chosen with due regard to the guidance in ETSU-R-97.
- 4.3.5 ETSU-R-97 suggests that the Daytime fixed minimum limit should be set in the range between 35 to 40 dB(A). The precise choice of criterion level depends on a number of factors, including the number of dwellings in the neighbourhood of the wind farm, the effect of noise limits on the number of kWh generated, and the duration and level of exposure to any noise. Site-Specific Noise Limits have been derived such that they are always at or below the limit established using the lower fixed minimum limit of 35 dB (A).
- 4.3.6 Depending on the levels of background noise, the satisfaction of the ETSU-R-97 derived limits can lead to a situation whereby, at some locations and under certain wind conditions, wind turbine noise could be audible for a proportion of the time. Acceptable limits for wind turbine operational noise, however, are clearly defined for all time periods by the application of the ETSU-R-97 methodology and consequently, the test applied to operational noise is whether or not the predicted wind turbine noise immission levels lie below the ETSU-R-97 noise limits, rather than whether or not they are audible.

4.4 Assessment of likely effects and the requirement for a cumulative assessment (Stage 2)

- 4.4.1 The IOA GPG includes a detailed section on cumulative noise and provides guidance on where a cumulative assessment is required. Section 5.1.4 and 5.1.5 of the IOA GPG state:

'During scoping of a new wind farm development consideration should be given to cumulative noise impacts from any other wind farms in the locality. If the proposed wind farm produces noise levels within 10 dB of any existing wind farm/s at the same receptor location, then a cumulative noise impact assessment is necessary.

Equally, in such cases where noise from the proposed wind farm is predicted to be 10 dB greater than that from the existing wind farm (but compliant with ETSU-R-97 in its own right), then a cumulative noise impact assessment would not be necessary.'
- 4.4.2 An assessment was undertaken at each of the NSRs proximate to the Proposed Development and other nearby operational, consented and proposed wind farm developments, to determine whether the wind turbine noise immission from the Proposed Development were within 10 dB of the immission levels from the other schemes. Where predictions were found

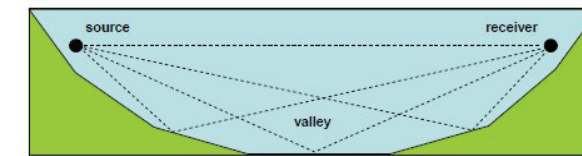
to be within 10 dB of each other, then a cumulative noise assessment was undertaken to determine the likely cumulative impact, however, if wind turbine immission were more than 10 dB apart, a cumulative noise assessment was not required.

Noise Predictions / Propagation Model

- 4.4.3 Modelling was undertaken using the methodology presented in ISO 9613:2024 'Acoustics – Attenuation of sound during propagation outdoors Part 2: Engineering method for the prediction of sound pressure levels outdoors' (20).
- 4.4.4 The ISO 9613-2 model can take account of the following factors that influence sound propagation outdoors:
- Geometric divergence;
 - Atmospheric absorption;
 - Reflecting obstacles;
 - Screening;
 - Vegetation; and
 - Ground attenuation.
- 4.4.5 The model uses as its acoustic input data the octave band sound power output of the turbine and calculates, on an octave band basis, attenuation due to the factors above, as appropriate.
- 4.4.6 There is currently no standard approach to specifying error bands for wind turbine noise predictions, however, Table 4 of ISO 9613-2 suggests an estimated of accuracy for downwind conditions of ± 3 dB(A) for calculations of up to 1000 m for broadband noise levels.
- 4.4.7 The ISO 9613-2 noise model is intended for the modelling of many noise source types and was not written specifically for the modelling of wind turbine noise, however, a number of studies have been undertaken to determine the standard's accuracy for wind turbine noise predictions and some amendments to the propagation model have been widely adopted for the modelling of wind turbine noise in the UK, primarily through the incorporation of recommendations in the IOA GPG.
- 4.4.8 In 1998, a European Commission (EC) research project into wind farm noise propagation over large distances, published 'Development of a Wind Farm Noise Prediction Model,' JOULE project JOR3-CT95-0051, which identified a simplified version of ISO 9613-2 as the most suitable prediction method at that time.
- 4.4.9 Additional wind farm specific studies have also been undertaken to validate the use of the Standard and these are referenced in Section 4 of the IOA GPG, which goes on to conclude that: *"The outcome of this research has demonstrated that the ISO 9613-2 standard in particular, which is widely used in the UK, can be applied to obtain realistic predictions of noise from on-shore wind turbines during worst case propagation conditions (i.e. sound speed gradients due to downwind conditions or temperature inversions), but only provided that the appropriate choice of input parameters and correction factors are made."*

- 4.4.10 It should be noted that the IOA GPG references the 1996 version of the 9613 standard, which was updated in 2024, however, use of either version when adopting the IOA GPG amendments to the noise model, results in negligible differences in predicted noise levels.
- 4.4.11 TNEI's experience of undertaking compliance monitoring for operational wind farms also indicates that noise predictions undertaken using ISO 9613-2, whilst following the guidance in the IOA GPG, show a good correlation with measured noise levels, with predicted levels usually slightly higher than measured levels.
- 4.4.12 The IOA GPG quotes a comparative study undertaken in Australia that indicated ISO 9613-2 can, in some conditions, under-predict ground attenuation effects and the potential for additional reflection paths 'across a valley', whilst slightly over-predicting wind turbine noise on flat terrain. With due regard to this study, the IOA GPG states that a *'further correction of +3 dB should be added to the calculated overall A-weighted level for propagation 'across a valley', i.e. a concave ground profile or where the ground falls away significantly between a turbine and the receiver location.'* The potential reflection paths are illustrated in Schematic 4.1 below.

Schematic 4.1: Multiple reflection paths for sound propagation across concave ground



Source: IOA GPG, page 21, Figure 5

- 4.4.13 A formula from the aforementioned JOULE Project is suggested for determining whether the +3 dB correction is required.
- $$hm \geq 1.5 \times (\text{abs}(hs - hr) / 2)$$
- 4.4.14 Where hm is the mean height above the ground of the direct line of sight from the receiver to the source (as defined in ISO 9613-2, Figure 3), and hs and hr are the heights above local ground level of the source and receiver respectively).
- 4.4.15 The calculation of h_m requires consideration of the digital terrain model and needs to be performed for each path between every turbine and every receiver. Interpretation of the results of the calculation above, and the subsequent inclusion of a concave ground profile correction, requires careful consideration with any topographical variation considered in the context of a site.
- 4.4.16 The IOA GPG also discusses the potential for topographical screening effects of the terrain between a wind farm and nearby NSRs (barrier attenuation), and although screening from barriers in ISO 9613-2 can provide attenuation of up to 15 dB, the IOA GPG states that where there is no line of sight between the highest point on the rotor and the receiver location, a reduction of no more than 2 dB should be applied.
- 4.4.17 All of the modelling parameters used in this assessment are detailed in this report.

4.5 Setting the Site-Specific Noise Limits (Stage 3)

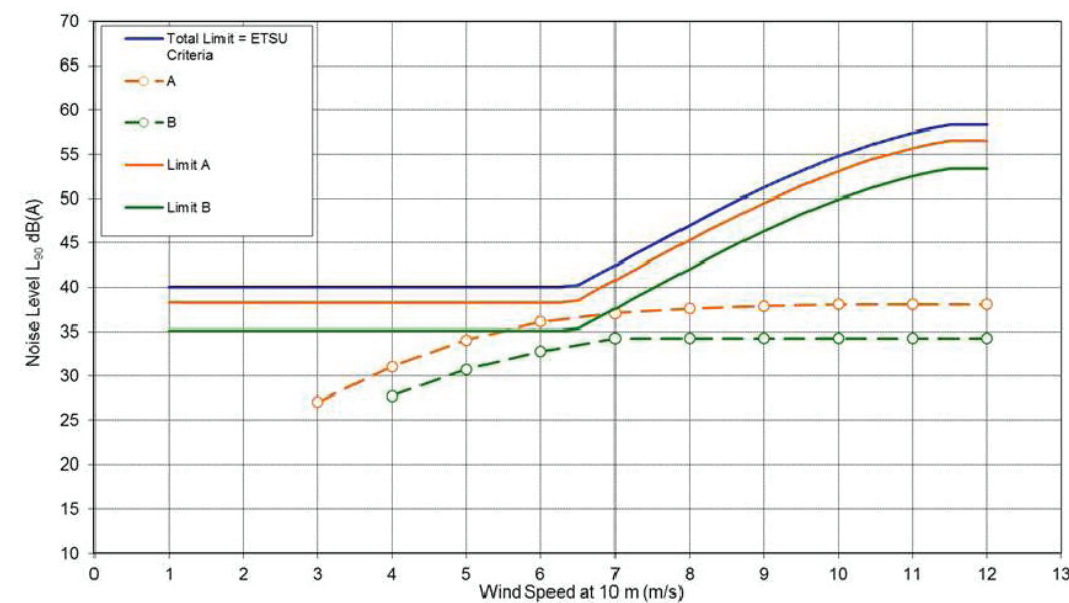
4.5.1 Summary Box 21 of the IOA GPG states:

'Whenever a cumulative situation is encountered, the noise limits for an individual wind farm should be determined in such a way that no cumulative excess of the total ETSU-R-97 noise limit would occur.'

4.5.2 In order to determine Site-Specific Noise Limits at receptors in proximity to the Proposed Development (where required), apportionment of the Total ETSU-R-97 Limit has been undertaken. The limit apportionment has considered the noise limit already allocated to other wind farms in the area.

4.5.3 This approach is demonstrated in Graph 4.1 below. In this example the Total ETSU-R-97 Noise Limit (shown in blue) is shared between wind farm A and wind farm B. The two site specific wind farm noise limits for a given receptor (the solid orange and green lines), when added together, equal the Total ETSU-R-97 Noise Limit, and the predicted levels for each wind farm (the dashed lines), meet the Site-Specific Limits for the individual wind farms.

Graph 4.1: Limit Apportionment Example



4.5.4 The limit derivation can also be undertaken with consideration to the amount of headroom between another schemes(s) predictions and the Total Noise Limit. With regard to this, Section 5.4.11 of the IOA GPG states:

'In cases where there is significant headroom (e.g. 5 to 10 dB) between the predicted noise levels from the existing wind farm and the Total Noise Limits, where there would be no realistic prospect of the existing wind farm producing noise levels up to the Total Noise Limits, agreement could be sought with the LPA as to a suitable predicted noise level (including an appropriate margin to cover factors such as potential increases in noise) from the existing wind farm to be used to inform the available headroom for the cumulative assessment without the need for negotiation or cumulative conditioning. This may be the case particularly at low wind speeds.'

4.5.5 With this in mind, and where appropriate, an additional 2 dB buffer has been added to the other schemes' turbine noise predictions. This is considered to be a suitable buffer in accordance with Section 5.4.11 of the IOA GPG and would represent a 60 % increase in emitted noise levels from the other schemes.

4.5.6 Where predicted wind turbine noise levels from the individual wind farm/turbine schemes are found to be >10 dB below the Total ETSU-R-97 Noise Limits then it has been deemed appropriate to allocate the entire noise limit to the Proposed Development.

4.5.7 Detailed information on the approach to apportionment per NAL is provided in Section 6.6.

5 Baseline

5.1 Identification of Potential Noise Receptors

- 5.1.1 The properties identified for noise monitoring were selected following a detailed review of the area using aerial photography to identify receptors that would be suitably representative of other nearby properties. Where possible, locations were selected that were subject to minimal influence from other local noise sources, such as watercourses, operational wind turbines and vegetation.
- 5.1.2 The IOA GPG notes that *'noise-sensitive receptors, [are] principally houses (existing or for which planning consent is being sought / has been given) and any building used for long-term residential purposes (such as a nursing home)'*. Following a review of NSRs surrounding the Proposed Development, all of the closest receptors were found to be residential properties.

5.2 Background Noise Survey

- 5.2.1 Background noise monitoring was undertaken within the period 18 February 2025 to 15 April 2025 at six Noise Monitoring Locations (NMLs).
- 5.2.2 Details of the exact monitoring periods, the rationale behind the exact kit location, and the dominant noise sources observed at each of the NMLs, are detailed in the Noise Monitoring, included in **Annex 3**.
- 5.2.3 The NMLs are detailed in **Table 5.1** is the position that the sound level meter was sited at each property, as shown on **Figure A1.1a to b (Annex 1)** and summarised in **Table 5.1** below.

Table 5.1 Noise Monitoring Locations

NML - Receptor Name	Easting	Northing
NML1 – Troloss House	291621	608447
NML2 – Over Fingland	292791	609549
NML3 – Peden Gill	294825	612844
NML4 – Hitteril	296158	609613
NML5 – Kirkhope Cleuch Cottage	296574	607230
NML6 – Kirkhope	296303	605423

5.3 Noise Monitoring Equipment

- 5.3.1 Section 2.4 of the IOA GPG includes information on the type and specification of noise monitoring equipment that should be used for background noise surveys and states:

'Noise measurement equipment and calibrators used on site should comply with Class 1/Type 1 of the relevant standard(s). Enhanced microphone windscreens should be used. Standard windshields of a diameter of less than 100 mm cannot be relied upon to provide sufficient reduction of wind noise in most circumstances.'

- 5.3.2 The noise monitoring equipment used for the background noise survey meets with the requirements of the IOA GPG. Details of the noise monitoring equipment used, the calibration drift recorded and photographs at each NML are detailed in the Noise Monitoring Record included in **Annex 3**. The IOA GPG states that for calibration drift greater than 1 dB the measurements should be discarded. The maximum calibration drift recorded during the noise survey was +/- 0.2 dB as detailed in the Noise Monitoring Record (included in **Annex 3**) therefore no correction has been applied to the noise data.
- 5.3.3 Copies of the calibration/conformance certificates for the sound level meters and sound level calibrator used for the noise survey are included in **Annex 4** All sound level meters conform to Class 1/ Type 1.
- 5.3.4 The microphones were all mounted between 1.2 m and 1.5 m above local ground level, situated at least 3.5 m from the dwelling and were located *'in an area frequently used for rest and relaxation'* (Section 2.5.1 of IOA GPG), where appropriate, away from obvious local sources of noise such as boiler flues, fans and running water. The sound level meters were situated as far away from hard reflective surfaces such as fences and walls as practicable. At NML5 – Kirkhope Cleuch Cottage, it was not possible to gain permission to monitor at the property, therefore the kit was sited approximately 100 m to the west, within the Landowner Boundary for the Proposed Development. The soundscape at this alternative location was deemed representative of that at the property.
- 5.3.5 All measurement systems were set to log the L_{A90} and L_{Aeq} noise levels over the required ten minute intervals continuously over the deployment period.

5.4 Meteorological Data

- 5.4.1 ETSU-R-97 states on Page 84 that:
- 'background noise measurements should be correlated with wind speed measurements performed at the proposed site, such that the actual operating noise levels from the turbines may be compared with the noise levels that would otherwise be experienced at a dwelling.'*
- 5.4.2 The preferred methodologies for measuring or calculating wind shear are detailed in Section 4.3.1.3.3.
- 5.4.3 For the Proposed Development, concurrent wind speed/direction was recorded using a LIDAR unit located within the Site. The meteorological data was collected and provided by the Applicant. The installation report and calibration information for the LIDAR can be provided upon request.
- 5.4.4 Two tipping bucket rain gauges were installed for the duration of the noise survey to record periods of rainfall, time synchronised to the sound measurements. As per the recommendations in Section 3.1.9 of the IOA GPG, the rain data was analysed by TNEI and the 10-minute periods that contained registered rainfall events (at either rain gauge), plus the preceding 10-minute period were excluded. All excluded rainfall periods are shown on **Figures A1.2a to f (Annex 1)** as blue squares.
- 5.4.5 Wind speed and direction data were collected over the same time-scale, and averaged over the same ten minute periods as the noise data, to provide the analysis of the measured background noise as a function of wind speed and direction.

- 5.4.6 In accordance with the IOA GPG, methodology A was adopted for this assessment, which involved using data collected directly at 155 m by the LiDAR (height used to derive the noise limits), which were then standardised to a height of 10 m above the ground.

5.5 Influence of Existing Turbines on Background Measurements

- 5.5.1 ETSU-R-97 states that background noise levels should be determined such that they are not influenced by existing turbine noise. The IOA GPG notes that in situations where measurement locations are potentially influenced by existing turbine noise, the following approaches can be adopted:

1. The existing wind turbines can be switched off (assuming the applicant has control of those turbines and noting that there would be associated cost implications);
2. The contribution of the wind turbines can be accounted for by filtering the measured data by direction (only including background data when a receptor is upwind of the wind turbines) or by subtracting predicted turbine noise from the measured levels;
3. Limits can be set using 'proxy' datasets measured at location(s) outside of the influence of the wind turbines; or
4. Limits can be set using data collected as part of previous background noise assessments undertaken before the wind turbines were operational, providing the equipment and both noise and meteorological data obtained are appropriate.

- 5.5.2 The operational Clyde Wind Farm and Clyde Extension Wind Farm are located to the northeast of the Proposed Development. To ensure that the influence of any operational wind turbine noise was appropriately considered, the noise measurements at NML4 - Hitteril were directionally filtered such that downwind and crosswind conditions from Clyde Wind Farm and Clyde Extension Wind Farm were excluded. The filter angle was selected as a 270° arc such that any measurements obtained when the wind direction was outwith 175° to 265° were excluded from the regression analysis.

- 5.5.3 At NML3 – Peden Gill, it was found that directional filtering resulted in an increase in the background noise levels, therefore no directional filtering has been undertaken for this NML. Incidentally, the measured background noise levels at NML3 were also heavily watercourse affected. Whilst this is deemed representative of the soundscape at this location (and the neighbouring receptors), due to this and the inability to minimise the potential influence of operational turbine noise, the background noise levels at NML3 have been provided for context only, rather than for the setting of noise limits.

- 5.5.4 The downwind predicted noise levels from the operational Clyde Wind Farm and Clyde Extension Wind Farm at NMLs 1, 2, 5 and 6, were such that there was likely a negligible contribution from operational turbine noise at these measurement locations and therefore further analysis was deemed not necessary. This was also the case for other operational wind farms proximate to the Proposed Development, such as Harestanes and Minnygap.

5.6 Analysis of Measured Data

- 5.6.1 Analysis of the measured data has been undertaken in accordance with the recommendations in ETSU-R-97 and the IOA GPG.

- 5.6.2 At NMLs 3 and 6, watercourses were audible during the installation and collection of the noise equipment, however, the measured sound level at these locations was considered to be representative of the acoustic environment at the monitoring locations and at their neighbouring properties.

- 5.6.3 Time series graphs are provided in **Annex 5**, which show the variation in measured wind speed, wind direction and noise level over the monitoring period.

5.7 Prevailing Background Noise Level

- 5.7.1 **Table 5.2** and **Table 5.3** summarise the prevailing background noise levels measured during the noise monitoring period, after filtering of the individual datasets as discussed above.

Table 5.2 Summary of Prevailing Background Noise Levels during Quiet Daytime Periods (dB(A))

NML	Prevailing Background Noise Level $L_{A90,10 \text{ min}}$											
	1	2	3	4	5	6	7	8	9	10	11	12
NML1 – Troloss House	22.9	24.1	25.2	26.3	27.7	29.2	31.1	33.4	36.4	40.0	44.5	49.9
NML2 – Over Fingland	24.8	25.4	26.2	27.0	27.9	29.0	30.3	31.8	33.5	35.5	37.8	40.4
NML3 – Peden Gill	36.1	36.3	36.6	37.0	37.5	38.0	38.6	39.1	39.6	40.0	40.4	40.6
NML4 – Hitteril	23.3	24.0	24.8	25.9	27.0	28.2	29.4	30.6	31.7	32.8	33.7	34.4
NML5 – Kirkhope Cleuch Cottage	32.5	32.6	32.9	33.4	34.2	35.2	36.4	37.8	39.3	41.1	43.0	45.1
NML6 - Kirkhope	26.6	27.1	27.6	27.9	28.3	28.7	29.2	29.8	30.7	31.8	33.3	35.2

Table 5.3 Summary of Prevailing Background Noise Levels during Nighttime Periods (dB(A))

NML	Prevailing Background Noise Level $L_{A90,10 \text{ min}}$											
	1	2	3	4	5	6	7	8	9	10	11	12
NML1 – Troloss House	22.1	23.5	24.4	24.9	25.3	25.8	26.6	27.9	29.8	32.6	36.4	41.5
NML2 – Over Fingland	25.9	26.1	26.5	27.0	27.6	28.5	29.5	30.6	31.9	33.4	35.1	36.9
NML3 – Peden Gill	37.4	38.4	38.9	39.1	39.0	38.7	38.3	37.8	37.5	37.3	37.4	37.8
NML4 – Hitteril	24.9	25.2	25.6	26.0	26.5	27.1	27.7	28.4	29.2	30.1	31.0	32.0

NML	Prevailing Background Noise Level $L_{A90,10\text{ min}}$											
	1	2	3	4	5	6	7	8	9	10	11	12
NML5 – Kirkhope Cleuch Cottage	34.0	34.7	35.1	35.3	35.3	35.2	35.2	35.3	35.7	36.3	37.4	38.9
NML6 - Kirkhope	28.8	28.9	29.0	29.2	29.3	29.4	29.6	29.8	30.0	30.2	30.4	30.6

- 5.7.2 A series of graphs are presented for each of the NMLs as **Figures A1.2a to f (Annex 1)**. For each of the NMLs, a graph shows the range of wind speeds and directions recorded during the survey, and a second graph shows the 10-minute average wind speeds plotted against the recorded $L_{A90,10\text{ min}}$ noise levels, along with a calculated ‘best fit’ polynomial regression line for the quiet Daytime and Nighttime periods. Each Figure also includes a table with the number of recorded data points per integer wind speed bin, and the prevailing background noise levels.
- 5.7.3 The prevailing background noise levels have been calculated using a best fit polynomial regression line of no more than a fourth order through the measured $L_{A90,10\text{ min}}$ noise data, as required by ETSU-R-97 and the IOA GPG.
- 5.7.4 Section 2.9.5 of the IOA GPG recommends that no fewer than 200 valid data points should be recorded in each of the quiet Daytime and Nighttime periods, with no fewer than 5 valid data points in any 1 ms^{-1} wind speed bin. Where the background noise data has been filtered by wind direction the IOA GPG (Section 2.9.6) recommends that 100 data points and 3 per wind speed bin may be appropriate. These criteria were met for all NMLs.
- 5.7.5 In line with the recommendations included in Section 3.1.21 of the IOA GPG, where relevant, the polynomial background curve for the low-speed conditions has been flatlined at the lower wind speeds where the derived minimum occurs. This is presented on the figures; the final regression analysis curve is shown as a continuous black line and the original polynomial line of best fit through the data is shown as a dashed black line. This was undertaken at NML6 during the Nighttime for windspeeds of 7 ms^{-1} and below. Here the derived minimum within the windspeed range 2 ms^{-1} to 7 ms^{-1} occurs; it was therefore determined to be appropriate to flatline from this value, noting that the actual derived minimum occurs at 1 ms^{-1} , which is outwith the windspeed range for which wind turbines would be operating the therefore generating noise.

6 Noise Assessment Results

6.1 Noise Assessment Locations

- 6.1.1 Noise Assessment Locations (NALs) refer to the position on the curtilage denoted by the blue house symbol on **Figure A1.1a to b (Annex 1)**. A total of 20 NSRs were chosen as representative NALs. The NALs chosen were the closest receptors to the Proposed Development and, where required, other wind farm developments. Predictions of wind turbine noise have been made at each of the NALs as detailed in **Table 6.1**.
- 6.1.2 This approach ensures that the assessment considers the worst case (highest) noise immission level expected at each group of NSRs, as, generally speaking, sound levels decrease with distance and thus the closer to a noise source, the higher the noise level.

6.1.3 **Table 6.1** details which NML has been used to set noise limits for each NAL.

Table 6.1 Noise Assessment Locations (NALs)

Noise Assessment Location (NAL)	Easting (m)	Northing (m)	Elevation (m AOD)	Distance to Nearest Watchman Energy Park Wind Turbine* (m)	NML Used
NAL1 - High Gateslack	289617	602543	190	5140 (T8)	1
NAL2 - Greenbrae	289499	603791	187	4691 (T8)	1
NAL3 - Murcleuch	288500	605094	185	5428 (T8)	1
NAL4 - Merrick School	288439	607013	234	5471 (T7)	1
NAL5 - Troloss	291568	608181	338	2449 (T2)	1
NAL6 - Troloss House	291661	608445	335	2343 (T2)	1
NAL7 - Troloss Cottage	292936	609476	331	1490 (T2)	1
NAL8 - Nether Fingland	293834	610753	301	2323 (T2)	2
NAL9 - Peden Cottage	294550	612262	290	3865 (T2)	2 (3)
NAL10 - Potrail Cottage	295127	612751	283	4459 (T2)	2 (3)
NAL11 - Allershaw Lodge	296056	612355	286	4424 (T2)	2 (3)
NAL12 - Bracadale	296490	610118	295	2496 (T1)	4
NAL13 - Wintercleugh House	296534	609999	292	2422 (T1)	4

Noise Assessment Location (NAL)	Easting (m)	Northing (m)	Elevation (m AOD)	Distance to Nearest Watchman Energy Park Wind Turbine* (m)	NML Used
NAL14 - Daerbank	296580	609796	292	2288 (T1)	4
NAL15 - Hitteril	296194	609629	311	1925 (T1)	4
NAL16 - Sweetshaw Foot	298356	609066	360	3384 (T1)	4
NAL17 - Kirkhope Cleuch Cottage	296669	607218	344	1310 (T11)	5
NAL18 - Crookburn	296607	605627	352	903 (T11)	6
NAL19 - Kirkhope	296337	605455	359	845 (T11)	6
NAL20 - Daerhead	296379	603041	400	2611 (T12)	6

* Please note the approximate 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), not the dwelling.

6.1.4 No noise level data has been used from NML3 as the potential influence of operational turbine noise from Clyde Wind Farms could not be adequately accounted for within the dataset. Instead, the background noise levels determined for NML2 have been used to set the noise limits for any properties for which NML3 had previously been deemed representative (indicated by (3) in the table above). This is a cautious approach due to the background noise levels of NML2 being notably lower than those of NML3.

6.2 Noise Emission Characteristics of the Wind Turbines

- 6.2.1 There are a range of wind turbine models that may be suitable for installation at the Proposed Development. This assessment considers the Siemens-Gamesa SG7.0-170 7.0 MW.
- 6.2.2 A detailed list of all the wind farms/wind turbine developments considered in the noise predictions are included in **Annex 6**. Details of the sound power level, octave data and measurement uncertainty used for the turbines considered in this assessment are included in **Annex 7**.
- 6.2.3 The data for the candidate turbine and for modelling some of the other nearby schemes has not been included due to data confidentiality, however, the detailed noise data could be made available upon request, subject to the signing of the appropriate Non-Disclosure Agreement.
- 6.2.4 Due to the differences in the way in which levels are provided by the different manufacturers, TNEI has accounted for uncertainty using the guidance contained within Section 4.2 of the IOA GPG.
- 6.2.5 Manufacturer data is usually supplied based on a specific hub height, whilst values are presented as standardised to 10 m height. The noise model used in this assessment alters

turbine noise data to account for different hub heights, where applicable. The hub heights considered for the other wind farm/turbine developments are summarised in **Annex 6**.

6.2.6 The location of the wind turbines are shown on **Figure A1.1a to b** and grid references are included in **Annex 6**.

6.3 Noise Propagation Parameters

- 6.3.1 The noise level predictions have been undertaken using a receiver height of 4.0 m above local ground level and an air absorption co-efficient based on a temperature of 10 °C and 70 % relative humidity. Most of the turbines have been modelled with mixed ground (G=0.5), however at NAL16 and NAL17, due to the presence of Daer Reservoir, some turbines required modelling with hard ground (G=0) to account for the reflective surface of the water being more than 50% of the propagation path from some turbines. For NAL16, T7 from the proposed Daer Wind Farm was modelled assuming hard ground conditions due to the reservoir accounting for 62% of the propagation path. For NAL17, T7 and T8 from the proposed Daer Wind Farm were modelled assuming hard ground conditions due to the reservoir accounting for 60% and 55% of the propagation path, respectively. It was found that none of the turbines for the Proposed Development fulfilled this criterion, with T11 having the largest percentage of hard ground at 45% for NAL16. Therefore, all the Proposed Development turbines were modelled assuming mixed ground conditions. The modelling parameters reflect current good practice as detailed within the IOA GPG.
- 6.3.2 The wind turbine noise immission levels are based on the $L_{A90,10 \text{ minute}}$ noise indicator in accordance with the recommendations in ETSU-R-97, which were obtained by subtracting 2 dB(A) from the turbine sound power level data (L_{Aeq} indicator).
- 6.3.3 A topographical assessment has been undertaken between each NAL and wind turbine location to determine whether any concave ground profiles exist between the source and receiver. Analysis undertaken using a combination of CadnaA (21) and an Excel model found that if the formula in the IOA GPG is applied directly, a +3 dB correction is required for some turbines at a number of receptors. These corrections are detailed in **Annex 6**.
- 6.3.4 In addition, an assessment has been undertaken to determine whether any topographical screening effects of the terrain occur where there is no direct line of sight between the highest point on the turbine rotor and the receiver location. Upon analysis of each NAL it was found that a barrier correction of -2 dB could be applied for some turbine/receptor combinations. This is also detailed in **Annex 6**.
- 6.3.5 In reality, there is significant screening at some of the locations, so more attenuation may occur in practice, and the use of a 2 dB value is considered to be conservative.
- 6.3.6 The need to include the above concave ground or screening corrections may change, depending on the final location of the turbines (following micro-siting) and the final turbine hub height. Nevertheless, turbine noise levels would have to meet the noise limits detailed in planning conditions regardless of any difference in noise propagation caused by topography and the need to apply a concave slope correction would need to be considered again by the Applicant, prior to the final selection of a turbine model for the Proposed Development.

- 6.3.7 The cumulative assessment has taken into account directivity effects in line with good practice. The directivity of wind turbines has been recognised for some time. Building on earlier work by NASA, in 1988 Wyle Laboratories studied sound propagation using an omnidirectional loudspeaker source elevated 80 ft above ground, in upwind, downwind and cross wind situations, and in both flat and hilly terrain, then compared those measurements to measured data from actual wind turbines. Their study quantified directivity factors for a limited frequency range but was unable to conclusively demonstrate the anticipated directivity effects of real wind turbines. It also highlighted, but was unable to explain, measured differences observed between flat and hilly terrain.
- 6.3.8 Hubbard (1990) (IOA GPG Section 4.4.3) described a number of factors believed to influence propagation and directivity, notably refraction caused by vertical wind and temperature gradients. In the downwind direction the wind gradient causes the sound rays to bend toward the ground, whereas in the upwind direction the rays curve upward away from the ground. Upwind of the turbine, this results in a region of increased attenuation termed the 'shadow zone'. This increased level of attenuation is frequency dependent, with lowest the frequencies attenuated the least. Relating this to the earlier NASA studies, Hubbard noted that the distance from the source to the edge of the shadow zone is related to the wind speed gradient and the elevation of the source, which for a typical turbine source was calculated to be approximately 5 times the source height.
- 6.3.9 This observation was adopted in the IOA GPG, which states in Section 4.4.2 '*Such reductions (due to "shadow zone" refraction effects) will in practice only progressively come into play at distances of between 5 and 10 turbine tip heights*'. Section 4.4.3 of the IOA GPG provides graphical examples of increasing broadband directivity with increasing tip height scaling, for both flat and hilly terrain, without qualifying either of those designations.
- 6.3.10 The IOA GPG recommends, in Section 4.4.1, that directivity attenuation factors adopted in any assessment should be clearly stated. The TNEI noise model can consider the effect of directivity, and in line with current good practice the attenuation values used are in detailed in **Table 6.2**. These are based upon the examples given in Section 4.4.2 of the IOA GPG, using interpolation where required, to adopt a single attenuation value for receptors located more than 5 tip heights from a receiver.

Table 6.2 Wind Directivity Attenuation Factors used in Modelling

Direction (°)	0	15	30	45	60	75	90	105	120	135	150	165
Attenuation dB(A)	-10	-9.9	-9.3	-8.3	-6.7	-4.6	-2	0	0	0	0	0
Direction (°)	180	195	210	225	240	255	270	285	300	315	330	345
Attenuation (dB(A))	0	0	0	0	0	0	-2	-4.6	-6.7	-8.3	-9.3	-9.9

6.4 Total ETSU-R-97 Noise Limits (Stage 1)

- 6.4.1 The Total ETSU-R-97 Noise Limits have been established for each of the NALs as detailed in **Table 6.3** and **Table 6.4** below, based on a fixed minimum of 40 dB(A) (Daytime) or 43 dB(A)

(Nighttime) or background plus 5 dB(A). For Financially Involved NALs, the Total ETSU-R-97 Noise Limits have been established based on the greater of a fixed minimum of 45 dB(A) (Daytime and Nighttime) or background plus 5 dB(A).

Table 6.3 Total ETSU-R-97 Noise Limits Daytime

Location	Wind Speed (ms ⁻¹) as standardised to 10m height											
	1	2	3	4	5	6	7	8	9	10	11	12
NAL1 - High Gateslack	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.5	45.2	49.6	55.0
NAL2 - Greenbrae	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.5	45.2	49.6	55.0
NAL3 - Murcleuch	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.5	45.2	49.6	55.0
NAL4 - Merrick School	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.5	45.2	49.6	55.0
NAL5 - Troloss	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.5	45.2	49.6	55.0
NAL6 - Troloss House	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.5	45.2	49.6	55.0
NAL7 - Troloss Cottage	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.5	42.8	45.4
NAL8 - Nether Fingland	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.5	42.8	45.4
NAL9 - Peden Cottage	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.5	42.8	45.4
NAL10 - Potrail Cottage	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.5	42.8	45.4
NAL11 - Allershaw Lodge	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.5	42.8	45.4
NAL12 - Bracadale	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
NAL13 - Wintercleugh House	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
NAL14 - Daerbank	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
NAL15 - Hitteril	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
NAL16 - Sweetshaw Foot**	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
NAL17 - Kirkhope Cleuch Cottage*	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	46.1	48.0	50.1
NAL18 – Crookburn*	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0

Location	Wind Speed (ms ⁻¹) as standardised to 10m height											
	1	2	3	4	5	6	7	8	9	10	11	12
NAL19 – Kirkhope*	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
NAL20 - Daerhead	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.2

*Financially Involved with the Proposed Development

**Financially Involved with Daer Wind Farm

Table 6.4 Total ETSU-R-97 Noise Limits Nighttime

Location	Wind Speed (ms ⁻¹) as standardised to 10m height											
	1	2	3	4	5	6	7	8	9	10	11	12
NAL1 - High Gateslack	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.5
NAL2 - Greenbrae	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.5
NAL3 - Murcleuch	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.5
NAL4 - Merrick School	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.5
NAL5 - Troloss	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.5
NAL6 - Troloss House	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.5
NAL7 - Troloss Cottage	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NAL8 - Nether Fingland	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NAL9 - Peden Cottage	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NAL10 - Potrail Cottage	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NAL11 - Allershaw Lodge	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NAL12 - Bracadale	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NAL13 - Wintercleugh House	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NAL14 - Daerbank	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NAL15 - Hitteril	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0

Location	Wind Speed (ms ⁻¹) as standardised to 10m height											
	1	2	3	4	5	6	7	8	9	10	11	12
NAL16 - Sweetshaw Foot**	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
NAL17 - Kirkhope Cleuch Cottage*	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
NAL18 – Crookburn*	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
NAL19 – Kirkhope*	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
NAL20 - Daerhead	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0

*Financially Involved with the Proposed Development

**Financially Involved with Daer Wind Farm

6.5 Predicting the requirement for a cumulative assessment and the likely effects (Stage 2)

- 6.5.1 A comparison has been undertaken of the predicted noise immission levels from the Proposed Development alongside all other schemes to determine whether predictions are within 10 dB of each other. All turbines have been assumed to be operating in unconstrained operating modes. **Table 6.5** summarises the results and details whether a cumulative noise assessment is required. If the predictions are greater than 10 dB apart then a cumulative noise assessment is not required. Where predictions are found to be within 10 dB of each other a cumulative assessment is required.

Table 6.5 Cumulative Assessment Requirement

Noise Assessment Location (NAL)	Are predicted wind turbine noise levels within 10 dB?	Is a cumulative assessment required?
NAL1 - High Gateslack	YES	YES
NAL2 - Greenbrae	YES	YES
NAL3 - Murcleuch	YES	YES
NAL4 - Merrick School	YES	YES
NAL5 - Troloss	YES	YES
NAL6 - Troloss House	YES	YES
NAL7 - Troloss Cottage	YES	YES
NAL8 - Nether Fingland	YES	YES
NAL9 - Peden Cottage	YES	YES
NAL10 - Potrail Cottage	NO	NO
NAL11 - Allershaw Lodge	NO	NO
NAL12 - Bracadale	YES	YES
NAL13 - Wintercleugh House	YES	YES

Noise Assessment Location (NAL)	Are predicted wind turbine noise levels within 10 dB?	Is a cumulative assessment required?
NAL14 - Daerbank	YES	YES
NAL15 - Hitteril	YES	YES
NAL16 - Sweetshaw Foot	YES	YES
NAL17 - Kirkhope Cleuch Cottage	YES	YES
NAL18 – Crookburn	YES	YES
NAL19 – Kirkhope	YES	YES
NAL20 - Daerhead	YES	YES

- 6.5.2 A cumulative noise assessment is required at all NALs except NAL10 and NAL11, where predicted noise levels from the Proposed Development are greater than 10 dB below the predicted cumulative noise levels from all other 3rd party schemes. However, they have been included within the assessment for completeness. A summary of the noise prediction comparisons are included in **Annex 6**.
- 6.5.3 The results of the cumulative noise assessment are summarised in **Table 6.6** and **Table 6.7**, which show that the predicted cumulative wind turbine noise immission levels meet the ‘Total ETSU-R-97 Noise limits’ under all conditions at all NALs.
- 6.5.4 The predicted ‘likely’ cumulative levels are the actual levels expected at an NAL and include the addition of an appropriate level of uncertainty to the turbine data as per Section 4.2 of the IOA GPG. The uncertainty level added is generally + 2 dB but this can vary depending on the turbine manufacturer data available for each turbine.
- 6.5.5 **Figures A1.3a to t (Annex 1)** show predictions from the Proposed Development and ‘cumulative (including Proposed Development)’ against the ‘Total ETSU-R-97 Noise Limits’. The individual contribution of the cumulative schemes are also shown.

Table 6.6 ETSU-R-97 Compliance Table – Likely Cumulative Noise - Daytime

Location		Wind Speed (ms ⁻¹) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL1 - High Gateslack	Total Noise Limit: ETSU-R-97 L _{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.4	45.0	49.5	54.9
	Predicted Wind Turbine Noise L _{A90}	-	-	-	17.2	21.7	24.7	25.1	25.2	25.3	25.3	25.3	25.3
	Exceedance Level	-	-	-	-22.8	-18.3	-15.3	-14.9	-14.8	-16.1	-19.7	-24.2	-29.6
NAL2 - Greenbrae	Total Noise Limit: ETSU-R-97 L _{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.4	45.0	49.5	54.9
	Predicted Wind Turbine Noise L _{A90}	-	-	-	17.6	22.1	25.0	25.4	25.5	25.5	25.6	25.6	25.6
	Exceedance Level	-	-	-	-22.4	-17.9	-15.0	-14.6	-14.5	-15.9	-19.4	-23.9	-29.3
NAL3 - Murcleuch	Total Noise Limit: ETSU-R-97 L _{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.4	45.0	49.5	54.9
	Predicted Wind Turbine Noise L _{A90}	-	-	-	16.8	21.2	24.0	24.5	24.6	24.6	24.7	24.7	24.7
	Exceedance Level	-	-	-	-23.2	-18.8	-16.0	-15.5	-15.4	-16.8	-20.3	-24.8	-30.2
NAL4 – Merrick School	Total Noise Limit: ETSU-R-97 L _{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.4	45.0	49.5	54.9
	Predicted Wind Turbine Noise L _{A90}	-	-	-	17.4	21.8	24.6	25.0	25.1	25.1	25.2	25.2	25.2
	Exceedance Level	-	-	-	-22.6	-18.2	-15.4	-15.0	-14.9	-16.3	-19.8	-24.3	-29.7
NAL5 - Troloss	Total Noise Limit: ETSU-R-97 L _{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.4	45.0	49.5	54.9
	Predicted Wind Turbine Noise L _{A90}	-	-	-	25.6	30.2	32.8	32.9	33.0	33.0	33.0	33.0	33.0
	Exceedance Level	-	-	-	-14.4	-9.8	-7.2	-7.1	-7.0	-8.4	-12.0	-16.5	-21.9
NAL6 – Troloss House	Total Noise Limit: ETSU-R-97 L _{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.4	45.0	49.5	54.9
	Predicted Wind Turbine Noise L _{A90}	-	-	-	25.8	30.5	33.0	33.2	33.2	33.3	33.3	33.3	33.3
	Exceedance Level	-	-	-	-14.2	-9.5	-7.0	-6.8	-6.8	-8.1	-11.7	-16.2	-21.6

Location		Wind Speed (ms ⁻¹) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL7 – Troloss Cottage	Total Noise Limit: ETSU-R-97 L _{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.5	42.8	45.4
	Predicted Wind Turbine Noise L _{A90}	-	-	-	28.2	32.4	34.9	35.5	35.5	35.5	35.6	35.6	35.6
	Exceedance Level	-	-	-	-11.8	-7.6	-5.1	-4.5	-4.5	-4.5	-4.9	-7.2	-9.8
NAL8 – Nether Fingland	Total Noise Limit: ETSU-R-97 L _{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.5	42.8	45.4
	Predicted Wind Turbine Noise L _{A90}	-	-	-	28.9	32.8	35.2	36.1	36.1	36.1	36.1	36.1	36.1
	Exceedance Level	-	-	-	-11.1	-7.2	-4.8	-3.9	-3.9	-3.9	-4.4	-6.7	-9.3
NAL9 – Peden Cottage	Total Noise Limit: ETSU-R-97 L _{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.5	42.8	45.4
	Predicted Wind Turbine Noise L _{A90}	-	-	-	29.4	32.9	35.3	36.6	36.6	36.6	36.6	36.6	36.6
	Exceedance Level	-	-	-	-10.6	-7.1	-4.7	-3.4	-3.4	-3.4	-3.9	-6.2	-8.8
NAL10 – Potrail Cottage	Total Noise Limit: ETSU-R-97 L _{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.5	42.8	45.4
	Predicted Wind Turbine Noise L _{A90}	-	-	-	31.4	34.7	37.1	38.7	38.7	38.7	38.7	38.7	38.7
	Exceedance Level	-	-	-	-8.6	-5.3	-2.9	-1.3	-1.3	-1.3	-1.8	-4.1	-6.7
NAL11 – Allershaw Lodge	Total Noise Limit: ETSU-R-97 L _{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.5	42.8	45.4
	Predicted Wind Turbine Noise L _{A90}	-	-	-	32.6	36.0	38.4	39.9	39.9	40.0	40.0	40.0	40.0
	Exceedance Level	-	-	-	-7.4	-4.0	-1.6	-0.1	-0.1	0.0	-0.5	-2.8	-5.4
NAL12 - Bracadale	Total Noise Limit: ETSU-R-97 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
	Predicted Wind Turbine Noise L _{A90}	-	-	-	31.3	35.1	37.9	39.2	39.2	39.3	39.3	39.3	39.3
	Exceedance Level	-	-	-	-8.7	-4.9	-2.1	-0.8	-0.8	-0.7	-0.7	-0.7	-0.7

Location		Wind Speed (ms ⁻¹) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL13 – Wintercleugh House	Total Noise Limit: ETSU-R-97 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
	Predicted Wind Turbine Noise L _{A90}	-	-	-	31.3	35.1	37.9	39.2	39.2	39.2	39.3	39.3	39.3
	Exceedance Level	-	-	-	-8.7	-4.9	-2.1	-0.8	-0.8	-0.8	-0.7	-0.7	-0.7
NAL14 - Daerbank	Total Noise Limit: ETSU-R-97 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
	Predicted Wind Turbine Noise L _{A90}	-	-	-	31.2	35.0	37.7	39.0	39.0	39.1	39.1	39.1	39.1
	Exceedance Level	-	-	-	-8.8	-5.0	-2.3	-1.0	-1.0	-0.9	-0.9	-0.9	-0.9
NAL15 - Hitteril	Total Noise Limit: ETSU-R-97 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
	Predicted Wind Turbine Noise L _{A90}	-	-	-	30.7	34.5	37.2	38.5	38.5	38.6	38.6	38.6	38.6
	Exceedance Level	-	-	-	-9.3	-5.5	-2.8	-1.5	-1.5	-1.4	-1.4	-1.4	-1.4
NAL16 – Sweetshaw Foot	Total Noise Limit: ETSU-R-97 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
	Predicted Wind Turbine Noise L _{A90}	-	-	-	31.6	35.8	38.4	38.9	39.0	39.1	39.2	39.2	39.2
	Exceedance Level	-	-	-	-13.4	-9.2	-6.6	-6.1	-6.0	-5.9	-5.8	-5.8	-5.8
NAL17 – Kirkhope Cleuch Cottage	Total Noise Limit: ETSU-R-97 L _{A90}	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	46.1	48.0	50.1
	Predicted Wind Turbine Noise L _{A90}	-	-	-	30.8	35.6	38.1	38.2	38.3	38.3	38.4	38.4	38.4
	Exceedance Level	-	-	-	-14.2	-9.4	-6.9	-6.8	-6.7	-6.7	-7.7	-9.6	-11.7
NAL18 - Crookburn	Total Noise Limit: ETSU-R-97 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
	Predicted Wind Turbine Noise L _{A90}	-	-	-	31.3	36.0	38.5	38.7	38.7	38.8	38.8	38.8	38.8
	Exceedance Level	-	-	-	-13.7	-9.0	-6.5	-6.3	-6.3	-6.2	-6.2	-6.2	-6.2

Location		Wind Speed (ms ⁻¹) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL19 - Kirkhope	Total Noise Limit: ETSU-R-97 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
	Predicted Wind Turbine Noise L _{A90}	-	-	-	32.0	36.8	39.3	39.4	39.4	39.4	39.4	39.4	39.4
	Exceedance Level	-	-	-	-13.0	-8.2	-5.7	-5.6	-5.6	-5.6	-5.6	-5.6	-5.6
NAL20 - Daerhead	Total Noise Limit: ETSU-R-97 L _{A90}	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.2
	Predicted Wind Turbine Noise L _{A90}	-	-	-	27.5	32.2	34.7	34.9	35.0	35.0	35.1	35.1	35.1
	Exceedance Level	-	-	-	-12.5	-7.8	-5.3	-5.1	-5.0	-5.0	-4.9	-4.9	-5.1

Note: For the cumulative noise predictions, the noise model considers the range of noise data available for each turbine type modelled. For some turbines noise data was not available for wind speeds less than 5 ms⁻¹ therefore no cumulative predictions are included for wind speeds less than 4 ms⁻¹.

Table 6.7 ETSU-R-97 Compliance Table – Likely Cumulative Noise – Nighttime

Location		Wind Speed (ms ⁻¹) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL1 - High Gateslack	Total Noise Limit: ETSU-R-97 L _{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.5
	Predicted Wind Turbine Noise L _{A90}	-	-	-	17.2	21.7	24.7	25.1	25.2	25.3	25.3	25.3	25.3
	Exceedance Level	-	-	-	-25.8	-21.3	-18.3	-17.9	-17.8	-17.7	-17.7	-17.7	-21.2
NAL2 - Greenbrae	Total Noise Limit: ETSU-R-97 L _{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.5
	Predicted Wind Turbine Noise L _{A90}	-	-	-	17.6	22.1	25.0	25.4	25.5	25.5	25.6	25.6	25.6
	Exceedance Level	-	-	-	-25.4	-20.9	-18.0	-17.6	-17.5	-17.5	-17.4	-17.4	-20.9
NAL3 - Murcleuch	Total Noise Limit: ETSU-R-97 L _{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.5
	Predicted Wind Turbine Noise L _{A90}	-	-	-	16.8	21.2	24.0	24.5	24.6	24.6	24.7	24.7	24.7
	Exceedance Level	-	-	-	-26.2	-21.8	-19.0	-18.5	-18.4	-18.4	-18.3	-18.3	-21.8
NAL4 – Merrick School	Total Noise Limit: ETSU-R-97 L _{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.5
	Predicted Wind Turbine Noise L _{A90}	-	-	-	17.4	21.8	24.6	25.0	25.1	25.1	25.2	25.2	25.2
	Exceedance Level	-	-	-	-25.6	-21.2	-18.4	-18.0	-17.9	-17.9	-17.8	-17.8	-21.3
NAL5 - Troloss	Total Noise Limit: ETSU-R-97 L _{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.5
	Predicted Wind Turbine Noise L _{A90}	-	-	-	25.6	30.2	32.8	32.9	33.0	33.0	33.0	33.0	33.0
	Exceedance Level	-	-	-	-17.4	-12.8	-10.2	-10.1	-10.0	-10.0	-10.0	-10.0	-13.5
NAL6 – Troloss House	Total Noise Limit: ETSU-R-97 L _{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.5
	Predicted Wind Turbine Noise L _{A90}	-	-	-	25.8	30.5	33.0	33.2	33.2	33.3	33.3	33.3	33.3
	Exceedance Level	-	-	-	-17.2	-12.5	-10.0	-9.8	-9.8	-9.7	-9.7	-9.7	-13.2

Location		Wind Speed (ms ⁻¹) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL7 – Troloss Cottage	Total Noise Limit: ETSU-R-97 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
	Predicted Wind Turbine Noise L _{A90}	-	-	-	28.2	32.4	34.9	35.5	35.5	35.5	35.6	35.6	35.6
	Exceedance Level	-	-	-	-14.8	-10.6	-8.1	-7.5	-7.5	-7.5	-7.4	-7.4	-7.4
NAL8 – Nether Fingland	Total Noise Limit: ETSU-R-97 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
	Predicted Wind Turbine Noise L _{A90}	-	-	-	28.9	32.8	35.2	36.1	36.1	36.1	36.1	36.1	36.1
	Exceedance Level	-	-	-	-14.1	-10.2	-7.8	-6.9	-6.9	-6.9	-6.9	-6.9	-6.9
NAL9 – Peden Cottage	Total Noise Limit: ETSU-R-97 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
	Predicted Wind Turbine Noise L _{A90}	-	-	-	29.4	32.9	35.3	36.6	36.6	36.6	36.6	36.6	36.6
	Exceedance Level	-	-	-	-13.6	-10.1	-7.7	-6.4	-6.4	-6.4	-6.4	-6.4	-6.4
NAL10 – Potrail Cottage	Total Noise Limit: ETSU-R-97 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
	Predicted Wind Turbine Noise L _{A90}	-	-	-	31.4	34.7	37.1	38.7	38.7	38.7	38.7	38.7	38.7
	Exceedance Level	-	-	-	-11.6	-8.3	-5.9	-4.3	-4.3	-4.3	-4.3	-4.3	-4.3
NAL11 – Allershaw Lodge	Total Noise Limit: ETSU-R-97 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
	Predicted Wind Turbine Noise L _{A90}	-	-	-	32.6	36.0	38.4	39.9	39.9	40.0	40.0	40.0	40.0
	Exceedance Level	-	-	-	-10.4	-7.0	-4.6	-3.1	-3.1	-3.0	-3.0	-3.0	-3.0
NAL12 - Bracadale	Total Noise Limit: ETSU-R-97 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
	Predicted Wind Turbine Noise L _{A90}	-	-	-	31.3	35.1	37.9	39.2	39.2	39.3	39.3	39.3	39.3
	Exceedance Level	-	-	-	-11.7	-7.9	-5.1	-3.8	-3.8	-3.7	-3.7	-3.7	-3.7

Location		Wind Speed (ms ⁻¹) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL13 – Wintercleugh House	Total Noise Limit: ETSU-R-97 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
	Predicted Wind Turbine Noise L _{A90}	-	-	-	31.3	35.1	37.9	39.2	39.2	39.2	39.3	39.3	39.3
	Exceedance Level	-	-	-	-11.7	-7.9	-5.1	-3.8	-3.8	-3.8	-3.7	-3.7	-3.7
NAL14 - Daerbank	Total Noise Limit: ETSU-R-97 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
	Predicted Wind Turbine Noise L _{A90}	-	-	-	31.2	35.0	37.7	39.0	39.0	39.1	39.1	39.1	39.1
	Exceedance Level	-	-	-	-11.8	-8.0	-5.3	-4.0	-4.0	-3.9	-3.9	-3.9	-3.9
NAL15 - Hitteril	Total Noise Limit: ETSU-R-97 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
	Predicted Wind Turbine Noise L _{A90}	-	-	-	30.7	34.5	37.2	38.5	38.5	38.6	38.6	38.6	38.6
	Exceedance Level	-	-	-	-12.3	-8.5	-5.8	-4.5	-4.5	-4.4	-4.4	-4.4	-4.4
NAL16 – Sweetshaw Foot	Total Noise Limit: ETSU-R-97 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
	Predicted Wind Turbine Noise L _{A90}	-	-	-	31.6	35.8	38.4	38.9	39.0	39.1	39.2	39.2	39.2
	Exceedance Level	-	-	-	-13.4	-9.2	-6.6	-6.1	-6.0	-5.9	-5.8	-5.8	-5.8
NAL17 – Kirkhope Cleuch Cottage	Total Noise Limit: ETSU-R-97 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
	Predicted Wind Turbine Noise L _{A90}	-	-	-	30.8	35.6	38.1	38.2	38.3	38.3	38.4	38.4	38.4
	Exceedance Level	-	-	-	-14.2	-9.4	-6.9	-6.8	-6.7	-6.7	-6.6	-6.6	-6.6
NAL18 - Crookburn	Total Noise Limit: ETSU-R-97 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
	Predicted Wind Turbine Noise L _{A90}	-	-	-	31.3	36.0	38.5	38.7	38.7	38.8	38.8	38.8	38.8
	Exceedance Level	-	-	-	-13.7	-9.0	-6.5	-6.3	-6.3	-6.2	-6.2	-6.2	-6.2

Location		Wind Speed (ms ⁻¹) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL19 - Kirkhope	Total Noise Limit: ETSU-R-97 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
	Predicted Wind Turbine Noise L _{A90}	-	-	-	32.0	36.8	39.3	39.4	39.4	39.4	39.4	39.4	39.4
	Exceedance Level	-	-	-	-13.0	-8.2	-5.7	-5.6	-5.6	-5.6	-5.6	-5.6	-5.6
NAL20 - Daerhead	Total Noise Limit: ETSU-R-97 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
	Predicted Wind Turbine Noise L _{A90}	-	-	-	27.5	32.2	34.7	34.9	35.0	35.0	35.1	35.1	35.1
	Exceedance Level	-	-	-	-15.5	-10.8	-8.3	-8.1	-8.0	-8.0	-7.9	-7.9	-7.9

Note: For the cumulative noise predictions, the noise model considers the range of noise data available for each turbine type modelled. For some turbines noise data was not available for wind speeds less than 5 ms⁻¹ therefore no cumulative predictions are included for wind speeds less than 4 ms⁻¹.

6.6 Derivation of Site-Specific Noise Limits (Stage 3)

- 6.6.1 To protect residential amenity, the IOA GPG recommendations are that cumulatively, all schemes operate within the Total ETSU-R-97 Noise Limits. This can be found in summary box SB21 of the IOA GPG (2013) which states:
- ‘Whenever a cumulative situation is encountered, the noise limits for an individual wind farm should be determined in such a way that no cumulative excess of the total ETSU-R-97 noise limit would occur.’*
- 6.6.2 The Daytime Site-Specific Noise Limits (SSNLs) have been derived based on the lower Fixed Minimum Noise Limits as detailed within ETSU-R-97. This assumes that all consented/in planning turbines are built and that the operational turbines continue to operate for the lifetime of their consent.
- 6.6.3 The apportionment options provided in the IOA GPG were considered to determine the most appropriate option for each NAL. **Table 6.8** summarises the approach adopted at each NAL to derive the Site-Specific Noise Limits.

Table 6.8 Limit Derivation Strategy

NAL	Limit Derivation Strategy
NALs 1 to 6	The likely predicted levels from other schemes were found to be greater than 10 dB below the Total ETSU-R-97 Noise Limits. As such, the whole limit has been allocated to the Proposed Development.
NALs 7 to 8, 16*, 17-19**, 20	The likely predicted levels from other schemes were found to be within 10 dB of the Total ETSU-R-97 Noise Limits. As such, the limit has been apportioned based on a cautious prediction of cumulative turbine noise. The noise predictions for the other cumulative schemes show that there is, in theory, significant headroom between the likely predicted levels and the Total ETSU-R-97 Noise Limit (>5 dB). In accordance with Section 4.5 above, a 2 dB buffer was therefore added to the turbine noise predictions for each of the other developments; this is considered to be a suitable buffer in accordance with Section 5.4.11 of the IOA GPG and would represent a 60 % increase in emitted noise levels from the other schemes. The resulting ‘cautious’ predictions of cumulative wind turbine noise have then been logarithmically subtracted from the Total ETSU-R-97 Noise Limit to determine the ‘residual noise limit’. The Site-Specific Noise Limits were then determined as follows: • The Nighttime limit is set to the residual noise limit. • The Daytime noise limit is determined by taking the lowest of either: ○ The residual noise limit; or ○ Background noise plus 5 dB or the Daytime fixed minimum limit of 35 dB (whichever is greater).

NAL	Limit Derivation Strategy
	*NAL16 is Financially Involved with the proposed 3rd Party scheme Daer Wind Farm. It has therefore been afforded a higher fixed minimum limit of 45 dB when deriving the Total ETSU-R-97 Day and Night Noise Limits. However, the Site-Specific Noise Limits for the Proposed Development have been derived based on a Daytime fixed minimum of 35 dB, and a Nighttime fixed minimum of 43 dB, such that the Proposed Development does not gain benefit from this 3rd party financial involvement. **NALs 17 to 19 are Financially Involved with the Proposed Development, affording a higher fixed minimum limit of 45 dB during the Daytime and Nighttime when deriving both the ETSU-R-97 Noise Limits and Site-Specific Noise Limits. The Site-Specific Noise Limits were therefore set to the residual noise limit for both the Day and Nighttime periods.
NALs 9 to 15	The likely predicted levels from other schemes were found to be within 5 dB of the Total ETSU-R-97 Noise Limits at certain wind speeds during both Day and Nighttime periods. As such, the Site-Specific Noise Limit at these wind speeds was derived to be 10 dB below the Total ETSU-R-97 Noise Limit. At wind speeds where the predicted cumulative noise (excluding the Proposed Development) was >5 dB below the Total ETSU-R-97 Noise Limit, significant headroom was available. In accordance with Section 4.5 above, a 2 dB buffer was therefore added to the turbine noise predictions for each of the other developments; this is considered to be a suitable buffer in accordance with Section 5.4.11 of the IOA GPG and would represent a 60 % increase in emitted noise levels from the other schemes. The resulting ‘cautious’ predictions of cumulative wind turbine noise have then been logarithmically subtracted from the Total ETSU-R-97 Noise Limit to determine the ‘residual noise limit’. The Site-Specific Noise Limits were derived as follows: • When significant headroom is not available, the Site-Specific Noise Limits were derived to be 10 dB below the Total ETSU-R-97 Noise Limit. • When significant headroom is available, the Site-Specific Noise Limits were then determined by taking the lowest of either: ○ The residual noise limit; or ○ Background noise plus 5 dB or the Daytime FML of 35 dB (whichever is greater).

- 6.6.4 Please note the buffers detailed above are in addition to the appropriate level of uncertainty already added to the turbine data as per Section 4.2 of the IOA GPG.
- 6.6.5 **Table 6.9** and **Table 6.10** show the Daytime and Nighttime Site-Specific Noise Limits, noise predictions for the Proposed Development and the exceedance level. A negative exceedance demonstrates compliance with the Site-Specific Noise Limits.
- 6.6.6 The Tables show that the predicted wind turbine noise immission levels assuming all turbines operate in full unconstrained mode meet the limits at all receptors except at NALs 12 to 15, where an exceedance ranging from 1.1 dB to 3.1 dB was predicted between 6 ms⁻¹ and

12 ms⁻¹ during the Daytime. Additionally, an exceedance of 0.1 dB was predicted at NAL15 during the Nighttime between 6 ms⁻¹ and 12 ms⁻¹. Predicted noise levels have therefore been reduced to ensure that the limits are met, this would be achieved by the adoption of low noise modes, but this would only be required for a limited range of wind speeds and wind directions.

- 6.6.7 The Tables show that, subject to the adoption of mitigation to ensure compliance, the predicted wind turbine noise immission levels meet the Site-Specific Noise Limits under all conditions and at all locations for both Daytime and Nighttime periods.
- 6.6.8 A series of graphs to show the predicted wind turbine noise from the Proposed Development compared to the Site-Specific Noise Limits are included as **Figures A1.4a-t (Annex 1)**. Two graphs are provided for each NAL (Daytime and Nighttime), which show the Total ETSU-R-97 Noise Limit (solid red line), the Site-Specific Noise Limit (dashed red line with triangles) and the predicted wind turbine noise from the Proposed Development (solid blue line).

Table 6.9 Site-Specific Noise Limits Compliance Table – Daytime

Location		Wind Speed (ms ⁻¹) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL1 - High Gateslack	Site Specific Noise Limit L _{A90}	35.0	35.0	35.0	35.0	35.0	35.0	36.1	38.6	41.4	45.0	49.5	54.9
	Predicted Wind Turbine Noise L _{A90}	-	11.2	11.2	12.8	17.7	20.2	20.2	20.2	20.2	20.2	20.2	20.2
	Exceedance Level	-	-23.8	-23.8	-22.2	-17.3	-14.8	-15.9	-18.4	-21.2	-24.8	-29.3	-34.7
NAL2 - Greenbrae	Site Specific Noise Limit L _{A90}	35.0	35.0	35.0	35.0	35.0	35.0	36.1	38.6	41.4	45.0	49.5	54.9
	Predicted Wind Turbine Noise L _{A90}	-	12.2	12.2	13.8	18.7	21.2	21.2	21.2	21.2	21.2	21.2	21.2
	Exceedance Level	-	-22.8	-22.8	-21.2	-16.3	-13.8	-14.9	-17.4	-20.2	-23.8	-28.3	-33.7
NAL3 - Murcleuch	Site Specific Noise Limit L _{A90}	35.0	35.0	35.0	35.0	35.0	35.0	36.1	38.6	41.4	45.0	49.5	54.9
	Predicted Wind Turbine Noise L _{A90}	-	11.3	11.3	12.9	17.8	20.3	20.3	20.3	20.3	20.3	20.3	20.3
	Exceedance Level	-	-23.7	-23.7	-22.1	-17.2	-14.7	-15.8	-18.3	-21.1	-24.7	-29.2	-34.6
NAL4 – Merrick School	Site Specific Noise Limit L _{A90}	35.0	35.0	35.0	35.0	35.0	35.0	36.1	38.6	41.4	45.0	49.5	54.9
	Predicted Wind Turbine Noise L _{A90}	-	12.5	12.5	14.1	19.0	21.5	21.5	21.5	21.5	21.5	21.5	21.5
	Exceedance Level	-	-22.5	-22.5	-20.9	-16.0	-13.5	-14.6	-17.1	-19.9	-23.5	-28.0	-33.4
NAL5 - Troloss	Site Specific Noise Limit L _{A90}	35.0	35.0	35.0	35.0	35.0	35.0	36.1	38.6	41.4	45.0	49.5	54.9
	Predicted Wind Turbine Noise L _{A90}	-	22.9	22.9	24.6	29.4	31.9	31.9	31.9	31.9	31.9	31.9	31.9
	Exceedance Level	-	-12.1	-12.1	-10.4	-5.6	-3.1	-4.2	-6.7	-9.5	-13.1	-17.6	-23.0
NAL6 – Troloss House	Site Specific Noise Limit L _{A90}	35.0	35.0	35.0	35.0	35.0	35.0	36.1	38.6	41.4	45.0	49.5	54.9
	Predicted Wind Turbine Noise L _{A90}	-	23.3	23.3	24.9	29.8	32.3	32.3	32.3	32.3	32.3	32.3	32.3
	Exceedance Level	-	-11.7	-11.7	-10.1	-5.2	-2.7	-3.8	-6.3	-9.1	-12.7	-17.2	-22.6

Location		Wind Speed (ms ⁻¹) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL7 – Troloss Cottage	Site Specific Noise Limit L _{A90}	35.0	35.0	35.0	35.0	35.0	35.0	35.3	36.8	38.5	39.3	42.8	45.4
	Predicted Wind Turbine Noise L _{A90}	-	23.8	23.8	25.4	30.3	32.8	32.8	32.8	32.8	32.8	32.8	32.8
	Exceedance Level	-	-11.2	-11.2	-9.6	-4.7	-2.2	-2.5	-4.0	-5.7	-6.5	-10.0	-12.6
NAL8 – Nether Fingland	Site Specific Noise Limit L _{A90}	35.0	35.0	35.0	35.0	35.0	35.0	35.3	36.8	37.5	38.4	41.7	45.4
	Predicted Wind Turbine Noise L _{A90}	-	22.4	22.4	24.1	28.9	31.4	31.4	31.4	31.4	31.4	31.4	31.4
	Exceedance Level	-	-12.6	-12.6	-10.9	-6.1	-3.6	-3.9	-5.4	-6.1	-7.0	-10.3	-14.0
NAL9 – Peden Cottage	Site Specific Noise Limit L _{A90}	35.0	35.0	35.0	35.0	35.0	35.0	30.0	30.0	30.0	30.5	41.0	44.5
	Predicted Wind Turbine Noise L _{A90}	-	18.4	18.4	20.0	24.9	27.4	27.4	27.4	27.4	27.4	27.4	27.4
	Exceedance Level	-	-16.6	-16.6	-15.0	-10.1	-7.6	-2.6	-2.6	-2.6	-3.1	-13.6	-17.1
NAL10 – Potrail Cottage	Site Specific Noise Limit L _{A90}	35.0	35.0	35.0	35.0	35.0	30.0	30.0	30.0	30.0	30.5	32.8	43.6
	Predicted Wind Turbine Noise L _{A90}	-	13.8	13.8	15.5	20.3	22.8	22.8	22.8	22.8	22.8	22.8	22.8
	Exceedance Level	-	-21.2	-21.2	-19.5	-14.7	-7.2	-7.2	-7.2	-7.2	-7.7	-10.0	-20.8
NAL11 – Allershaw Lodge	Site Specific Noise Limit L _{A90}	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.5	32.8	42.8
	Predicted Wind Turbine Noise L _{A90}	-	17.7	17.7	19.3	24.2	26.7	26.7	26.7	26.7	26.7	26.7	26.7
	Exceedance Level	-	-12.3	-12.3	-10.7	-5.8	-3.3	-3.3	-3.3	-3.3	-3.8	-6.1	-16.1
NAL12 - Bracadale	Site Specific Noise Limit 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
	Predicted Wind Turbine Noise L _{A90}	-	22.5	22.5	24.1	29.0	30*	30*	30*	30*	30*	30*	30*
	Exceedance Level	-	-12.5	-12.5	-10.9	-6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Location		Wind Speed (ms ⁻¹) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL13 – Wintercleugh House	Site Specific Noise Limit 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
	Predicted Wind Turbine Noise L _{A90}	-	22.1	22.1	23.8	28.6	30*	30*	30*	30*	30*	30*	30*
	Exceedance Level	-	-12.9	-12.9	-11.2	-6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NAL14 - Daerbank	Site Specific Noise Limit 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
	Predicted Wind Turbine Noise L _{A90}	-	22.3	22.3	23.9	28.8	30*	30*	30*	30*	30*	30*	30*
	Exceedance Level	-	-12.7	-12.7	-11.1	-6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NAL15 - Hitteril	Site Specific Noise Limit 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
	Predicted Wind Turbine Noise L _{A90}	-	24.1	24.1	25.8	30.6	30*	30*	30*	30*	30*	30*	30*
	Exceedance Level	-	-10.9	-10.9	-9.2	-4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NAL16 – Sweetshaw Foot	Site Specific Noise Limit L _{A90}	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.6	36.7	37.8	38.7	39.4
	Predicted Wind Turbine Noise L _{A90}	-	20.2	20.2	21.8	26.7	29.2	29.2	29.2	29.2	29.2	29.2	29.2
	Exceedance Level	-	-14.8	-14.8	-13.2	-8.3	-5.8	-5.8	-6.4	-7.5	-8.6	-9.5	-10.2
NAL17 – Kirkhope Cleuch Cottage	Site Specific Noise Limit L _{A90}	45.0	45.0	45.0	45.0	45.0	43.8	43.7	43.6	43.6	45.0	48.0	50.1
	Predicted Wind Turbine Noise L _{A90}	-	27.7	27.7	29.3	34.2	36.7	36.7	36.7	36.7	36.7	36.7	36.7
	Exceedance Level	-	-17.3	-17.3	-15.7	-10.8	-7.1	-7.0	-6.9	-6.9	-8.3	-11.3	-13.4
NAL18 - Crookburn	Site Specific Noise Limit L _{A90}	45.0	45.0	45.0	45.0	45.0	44.0	44.0	43.9	43.9	43.9	43.9	43.9
	Predicted Wind Turbine Noise L _{A90}	-	28.2	28.2	29.8	34.7	37.2	37.2	37.2	37.2	37.2	37.2	37.2
	Exceedance Level	-	-16.8	-16.8	-15.2	-10.3	-6.8	-6.8	-6.7	-6.7	-6.7	-6.7	-6.7

Location		Wind Speed (ms ⁻¹) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL19 - Kirkhope	Site Specific Noise Limit L _{A90}	45.0	45.0	45.0	45.0	45.0	44.2	44.2	44.1	44.1	44.1	44.1	44.1
	Predicted Wind Turbine Noise L _{A90}	-	29.5	29.5	31.1	36.0	38.5	38.5	38.5	38.5	38.5	38.5	38.5
	Exceedance Level	-	-15.5	-15.5	-13.9	-9.0	-5.7	-5.7	-5.6	-5.6	-5.6	-5.6	-5.6
NAL20 - Daerhead	Site Specific Noise Limit L _{A90}	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.7	36.8	37.7	38.0
	Predicted Wind Turbine Noise L _{A90}	-	20.6	20.6	22.2	27.1	29.6	29.6	29.6	29.6	29.6	29.6	29.6
	Exceedance Level	-	-14.4	-14.4	-12.8	-7.9	-5.4	-5.4	-5.4	-6.1	-7.2	-8.1	-8.4

**Predicted noise levels inclusive of indicative mitigation.*

Table 6.10 Site-Specific Noise Limits Compliance Table – Nighttime

Location		Wind Speed (ms ⁻¹) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL1 - High Gateslack	Site Specific Noise Limit L _{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.5
	Predicted Wind Turbine Noise L _{A90}	-	11.2	11.2	12.8	17.7	20.2	20.2	20.2	20.2	20.2	20.2	20.2
	Exceedance Level	-	-31.8	-31.8	-30.2	-25.3	-22.8	-22.8	-22.8	-22.8	-22.8	-22.8	-26.3
NAL2 - Greenbrae	Site Specific Noise Limit L _{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.5
	Predicted Wind Turbine Noise L _{A90}	-	12.2	12.2	13.8	18.7	21.2	21.2	21.2	21.2	21.2	21.2	21.2
	Exceedance Level	-	-30.8	-30.8	-29.2	-24.3	-21.8	-21.8	-21.8	-21.8	-21.8	-21.8	-25.3
NAL3 - Murcleuch	Site Specific Noise Limit L _{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.5
	Predicted Wind Turbine Noise L _{A90}	-	11.3	11.3	12.9	17.8	20.3	20.3	20.3	20.3	20.3	20.3	20.3
	Exceedance Level	-	-31.7	-31.7	-30.1	-25.2	-22.7	-22.7	-22.7	-22.7	-22.7	-22.7	-26.2
NAL4 – Merrick School	Site Specific Noise Limit L _{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.5
	Predicted Wind Turbine Noise L _{A90}	-	12.5	12.5	14.1	19.0	21.5	21.5	21.5	21.5	21.5	21.5	21.5
	Exceedance Level	-	-30.5	-30.5	-28.9	-24.0	-21.5	-21.5	-21.5	-21.5	-21.5	-21.5	-25.0
NAL5 - Troloss	Site Specific Noise Limit L _{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.5
	Predicted Wind Turbine Noise L _{A90}	-	22.9	22.9	24.6	29.4	31.9	31.9	31.9	31.9	31.9	31.9	31.9
	Exceedance Level	-	-20.1	-20.1	-18.4	-13.6	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-14.6
NAL6 – Troloss House	Site Specific Noise Limit L _{A90}	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	46.5
	Predicted Wind Turbine Noise L _{A90}	-	23.3	23.3	24.9	29.8	32.3	32.3	32.3	32.3	32.3	32.3	32.3
	Exceedance Level	-	-19.7	-19.7	-18.1	-13.2	-10.7	-10.7	-10.7	-10.7	-10.7	-10.7	-14.2

Location		Wind Speed (ms ⁻¹) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL7 – Troloss Cottage	Site Specific Noise Limit 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
	Predicted Wind Turbine Noise L _{A90}	-	23.8	23.8	25.4	30.3	32.8	32.8	32.8	32.8	32.8	32.8	32.8
	Exceedance Level	-	-19.2	-19.2	-17.6	-12.7	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2
NAL8 – Nether Fingland	Site Specific Noise Limit L _{A90}	43.0	43.0	43.0	43.0	43.0	43.0	42.0	41.9	41.9	41.9	41.9	41.9
	Predicted Wind Turbine Noise L _{A90}	-	22.4	22.4	24.1	28.9	31.4	31.4	31.4	31.4	31.4	31.4	31.4
	Exceedance Level	-	-20.6	-20.6	-18.9	-14.1	-11.6	-10.6	-10.5	-10.5	-10.5	-10.5	-10.5
NAL9 – Peden Cottage	Site Specific Noise Limit L _{A90}	43.0	43.0	43.0	43.0	43.0	41.9	41.3	41.3	41.3	41.3	41.3	41.3
	Predicted Wind Turbine Noise L _{A90}	-	18.4	18.4	20.0	24.9	27.4	27.4	27.4	27.4	27.4	27.4	27.4
	Exceedance Level	-	-24.6	-24.6	-23.0	-18.1	-14.5	-13.9	-13.9	-13.9	-13.9	-13.9	-13.9
NAL10 – Potrail Cottage	Site Specific Noise Limit L _{A90}	41.8	41.8	41.8	41.8	41.8	40.7	33.0	33.0	33.0	33.0	33.0	33.0
	Predicted Wind Turbine Noise L _{A90}	-	13.8	13.8	15.5	20.3	22.8	22.8	22.8	22.8	22.8	22.8	22.8
	Exceedance Level	-	-28.0	-28.0	-26.3	-21.5	-17.9	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2
NAL11 – Allershaw Lodge	Site Specific Noise Limit L _{A90}	41.4	41.4	41.4	41.4	41.4	33.0	33.0	33.0	33.0	33.0	33.0	33.0
	Predicted Wind Turbine Noise L _{A90}	-	17.7	17.7	19.3	24.2	26.7	26.7	26.7	26.7	26.7	26.7	26.7
	Exceedance Level	-	-23.7	-23.7	-22.1	-17.2	-6.3	-6.3	-6.3	-6.3	-6.3	-6.3	-6.3
NAL12 - Bracadale	Site Specific Noise Limit L _{A90}	41.8	41.8	41.8	41.8	41.8	40.3	33.0	33.0	33.0	33.0	33.0	33.0
	Predicted Wind Turbine Noise L _{A90}	-	22.5	22.5	24.1	29.0	31.5	31.5	31.5	31.5	31.5	31.5	31.5
	Exceedance Level	-	-19.3	-19.3	-17.7	-12.8	-8.8	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5

Location		Wind Speed (ms ⁻¹) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL13 – Wintercleugh House	Site Specific Noise Limit L _{A90}	41.8	41.8	41.8	41.8	41.8	40.3	33.0	33.0	33.0	33.0	33.0	33.0
	Predicted Wind Turbine Noise L _{A90}	-	22.1	22.1	23.8	28.6	31.1	31.1	31.1	31.1	31.1	31.1	31.1
	Exceedance Level	-	-19.7	-19.7	-18.0	-13.2	-9.2	-1.9	-1.9	-1.9	-1.9	-1.9	-1.9
NAL14 - Daerbank	Site Specific Noise Limit L _{A90}	41.8	41.8	41.8	41.8	41.8	40.4	33.0	33.0	33.0	33.0	33.0	33.0
	Predicted Wind Turbine Noise L _{A90}	-	22.3	22.3	23.9	28.8	31.3	31.3	31.3	31.3	31.3	31.3	31.3
	Exceedance Level	-	-19.5	-19.5	-17.9	-13.0	-9.1	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7
NAL15 - Hitteril	Site Specific Noise Limit L _{A90}	42.0	42.0	42.0	42.0	42.0	40.9	33.0	33.0	33.0	33.0	33.0	33.0
	Predicted Wind Turbine Noise L _{A90}	-	24.1	24.1	25.8	30.6	33.1	33*	33*	33*	33*	33*	33*
	Exceedance Level	-	-17.9	-17.9	-16.2	-11.4	-7.8	0.0	0.0	0.0	0.0	0.0	0.0
NAL16 – Sweetshaw Foot	Site Specific Noise Limit L _{A90}	43.0	43.0	43.0	43.0	43.0	43.0	42.9	42.9	42.8	42.7	42.7	42.7
	Predicted Wind Turbine Noise L _{A90}	-	20.2	20.2	21.8	26.7	29.2	29.2	29.2	29.2	29.2	29.2	29.2
	Exceedance Level	-	-22.8	-22.8	-21.2	-16.3	-13.8	-13.7	-13.7	-13.6	-13.5	-13.5	-13.5
NAL17 – Kirkhope Cleuch Cottage	Site Specific Noise Limit L _{A90}	45.0	45.0	45.0	45.0	45.0	43.8	43.7	43.6	43.6	43.6	43.6	43.6
	Predicted Wind Turbine Noise L _{A90}	-	27.7	27.7	29.3	34.2	36.7	36.7	36.7	36.7	36.7	36.7	36.7
	Exceedance Level	-	-17.3	-17.3	-15.7	-10.8	-7.1	-7.0	-6.9	-6.9	-6.9	-6.9	-6.9
NAL18 - Crookburn	Site Specific Noise Limit L _{A90}	45.0	45.0	45.0	45.0	45.0	44.0	44.0	43.9	43.9	43.9	43.9	43.9
	Predicted Wind Turbine Noise L _{A90}	-	28.2	28.2	29.8	34.7	37.2	37.2	37.2	37.2	37.2	37.2	37.2
	Exceedance Level	-	-16.8	-16.8	-15.2	-10.3	-6.8	-6.8	-6.7	-6.7	-6.7	-6.7	-6.7

Location		Wind Speed (ms ⁻¹) as standardised to 10 m height											
		1	2	3	4	5	6	7	8	9	10	11	12
NAL19 - Kirkhope	Site Specific Noise Limit L _{A90}	45.0	45.0	45.0	45.0	45.0	44.2	44.2	44.1	44.1	44.1	44.1	44.1
	Predicted Wind Turbine Noise L _{A90}	-	29.5	29.5	31.1	36.0	38.5	38.5	38.5	38.5	38.5	38.5	38.5
	Exceedance Level	-	-15.5	-15.5	-13.9	-9.0	-5.7	-5.7	-5.6	-5.6	-5.6	-5.6	-5.6
NAL20 - Daerhead	Site Specific Noise Limit L _{A90}	43.0	43.0	43.0	43.0	43.0	42.1	42.0	42.0	42.0	42.0	42.0	42.0
	Predicted Wind Turbine Noise L _{A90}	-	20.6	20.6	22.2	27.1	29.6	29.6	29.6	29.6	29.6	29.6	29.6
	Exceedance Level	-	-22.4	-22.4	-20.8	-15.9	-12.5	-12.4	-12.4	-12.4	-12.4	-12.4	-12.4

**Predicted noise levels inclusive of indicative mitigation.*

- 6.6.9 In the event that consent is granted for the Proposed Development it would be appropriate to set noise limits within the planning conditions that are equal to the Site-Specific Noise Limits contained **Table 6.9** and **Table 6.10**.

6.7 Choice of Daytime Fixed Minimum Noise Limit (35 to 40 dB)

- 6.7.1 Having due regard to the guidance in ETSU-R-97 and considering the cumulative impacts of the Proposed Development operating in conjunction with other operational, consented or proposed schemes a fixed minimum limit of 40 dB has been adopted. This aligns with the approach adopted for the noise assessments for the operational Clyde Wind Farm, among others. For Site-Specific Noise Limits, the lowest Fixed Minimum Limit of 35 dB is proposed for the Daytime period.
- 6.7.2 If consent is granted for the Proposed Development it would be appropriate to set noise limits equal to the Site-Specific Noise Limits contained within **Table 6.9** and **Table 6.10** which have been determined based on the use of a 40 dB Daytime fixed minimum limit to set Total ETSU-R-97 Noise Limits and a 35 dB Daytime fixed minimum limit to set Site-Specific Noise Limits. In the event that an alternative Daytime fixed minimum limit is deemed appropriate new Site-Specific Noise Limits would need to be calculated in accordance with the methodology presented in this report.

6.8 Micrositing

- 6.8.1 A 100 m micrositing distance is proposed. It should be noted that the need to include a concave ground profile correction and/or barrier correction may change depending on the final location of the turbines (following micrositing) and the final turbine hub height. Nevertheless, turbine noise levels would have to meet the noise limits established in this report regardless of any increases and decreases in noise propagation caused by topography. Should consent be granted, the need to apply a concave ground profile/ barrier correction would need to be considered by the Applicant prior to the final selection of a turbine model for the Site.

7 Summary and Conclusions

- 7.1.1 This report has assessed the potential impact of operational noise from the Proposed Development on the residents of nearby residential receptors (noise sensitive receptors (NSRs)). The guidance contained within ETSU-R-97 and current good practice (IOA GPG) has been used to assess the potential noise impact of the Proposed Development.
- 7.1.2 Background noise monitoring was undertaken by TNEI at six NSRs neighbouring the Proposed Development. A total of 20 NSRs were chosen as Noise Assessment Locations (NALs). The assessment locations were chosen to represent the NSRs located closest to the Proposed Development and other nearby wind farms.
- 7.1.3 Wind speed data was collected using a LIDAR unit located within the wind farm site. The data collected at 155 m height was standardised to 10 m height, in accordance with current good practice.
- 7.1.4 Analysis of the measured data was undertaken in accordance with ETSU-R-97 and current good practice to determine the pre-existing background noise environment and to establish the Daytime and Nighttime noise limits for each of the assessment locations. A 'Total ETSU-R-97 Noise Limit' of 40 dB(A) Daytime or background plus 5 dB (whichever is the greater) and 43 dB(A) Nighttime or background plus 5dB (whichever is the greater) was used for this assessment.
- 7.1.5 There are a number of operational, consented and proposed wind farms in proximity to the Proposed Development. A cumulative assessment was undertaken where predicted levels from the Proposed Development were found to be within 10 dB of the predicted cumulative levels from other schemes in the area. The results show that the predicted cumulative wind farm noise immission levels would meet the Total ETSU-R-97 Noise Limits at all NALs during both the Daytime and Nighttime periods.
- 7.1.6 Site-Specific Noise Limits have been derived based on a Daytime fixed minimum limit of 35 dB or background plus 5 dB, and a Nighttime limit of 43 dB or background plus 5 dB. For all receptors, apportionment of the Total ETSU-R-97 Noise Limits was undertaken.
- 7.1.7 The wind turbine noise immission levels from the Proposed Development were predicted to be below the Site-Specific Noise Limits at all NALs, subject to the application of mitigation in the form of mode management at NALs 12 to 15 during the Daytime, and at NAL15 during the Nighttime, when considering the Siemens-Gamesa SG7.0-170 7 MW, as a candidate turbine.
- 7.1.8 The Siemens-Gamesa SG7.0-170 7 MW turbine model 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. Should the proposal receive consent, the final choice of turbine would be subject to a competitive tendering process. The final choice of turbine would, however, have to meet the noise limits determined and contained within any condition imposed.

8 Glossary of Terms

AOD: Above Ordnance Datum is the height above sea level.

Amplitude Modulation: a variation in noise level over time; for example observers may describe a 'whoosh whoosh' sound, which can be heard close to a wind turbine as the blades sweep past.

Attenuation: the reduction in level of a sound between the source and a receiver due to any combination of effects including: distance, atmospheric absorption, acoustic screening, the presence of a building façade, etc.

Background Noise: the noise level rarely fallen below in any given location over any given time period, often classed according to Daytime, Evening or Nighttime periods. The L_{A90} indices (see below) is often used to represent the background noise level.

Bin: subset or group into which data can be sorted; in the case of wind speeds, bins are often centred on integer wind speeds with a width of 1 ms^{-1} . For example the 4 ms^{-1} bin would include all data with wind speeds of 3.5 to 4.5 ms^{-1} .

Dawn Chorus: noise due to birds which can occur at sunrise.

Broadband Noise: noise with components over a wide range of frequencies.

Decibel (dB): 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.

dB(A): the ear has the ability to recognise a particular sound depending on its pitch or frequency. Microphones cannot differentiate noise in the same way as the ear, and to counter this weakness the noise measuring instrument applies a correction to correspond more closely to the frequency response of the human ear. The correction factor is called 'A Weighting' and the resulting measurements are written as dB(A). The dB(A) is internationally accepted and has been found to correspond well with people's subjective reaction to noise. Some typical subjective changes in noise levels are:

- a change of 3 dB(A) is just perceptible;
- a change of 5 dB(A) is clearly perceptible;
- a change of 10 dB(A) is twice (or half) as loud.

Directivity: the property of a sound source that causes more sound to be radiated in one direction than another.

Frequency: the pitch of a sound in Hz or kHz. See Hertz.

Ground Effects: the modification of sound at a receiver location due to the interaction of the sound wave with the ground along its propagation path from source to receiver. Described using the term 'G', and ranges between 0 (hard), 0.5 (mixed) and 1 (soft).

Hertz (Hz): sound frequency refers to how quickly the air vibrates, or how close the sound waves are to each other (in cycles per second, or Hertz (Hz)).

L_w : is the sound power level. It is a measure of the total noise energy radiated by a source of noise, and is used to calculate noise levels at a distant location. The L_{WA} is the A-weighted sound power level.

L_{eq} : is the equivalent continuous sound level, and is the sound level of a steady sound with the same energy as a fluctuating sound over the same period. It is possible to consider this level as the ambient noise encompassing all noise at a given time. The $L_{Aeq,T}$ is the A-weighted equivalent continuous sound level over a given time period (T).

L_{90} : index 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).

Nighttime Hours: ETSU-R-97 defines the night time hours as 23.00 to 07.00 every day.

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.

Sound Level Meter: an instrument for measuring sound pressure level.

Sound Power Level: the total sound power radiated by a source, in decibels.

Sound Pressure Level: a measure of the sound pressure at a point, in decibels.

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).

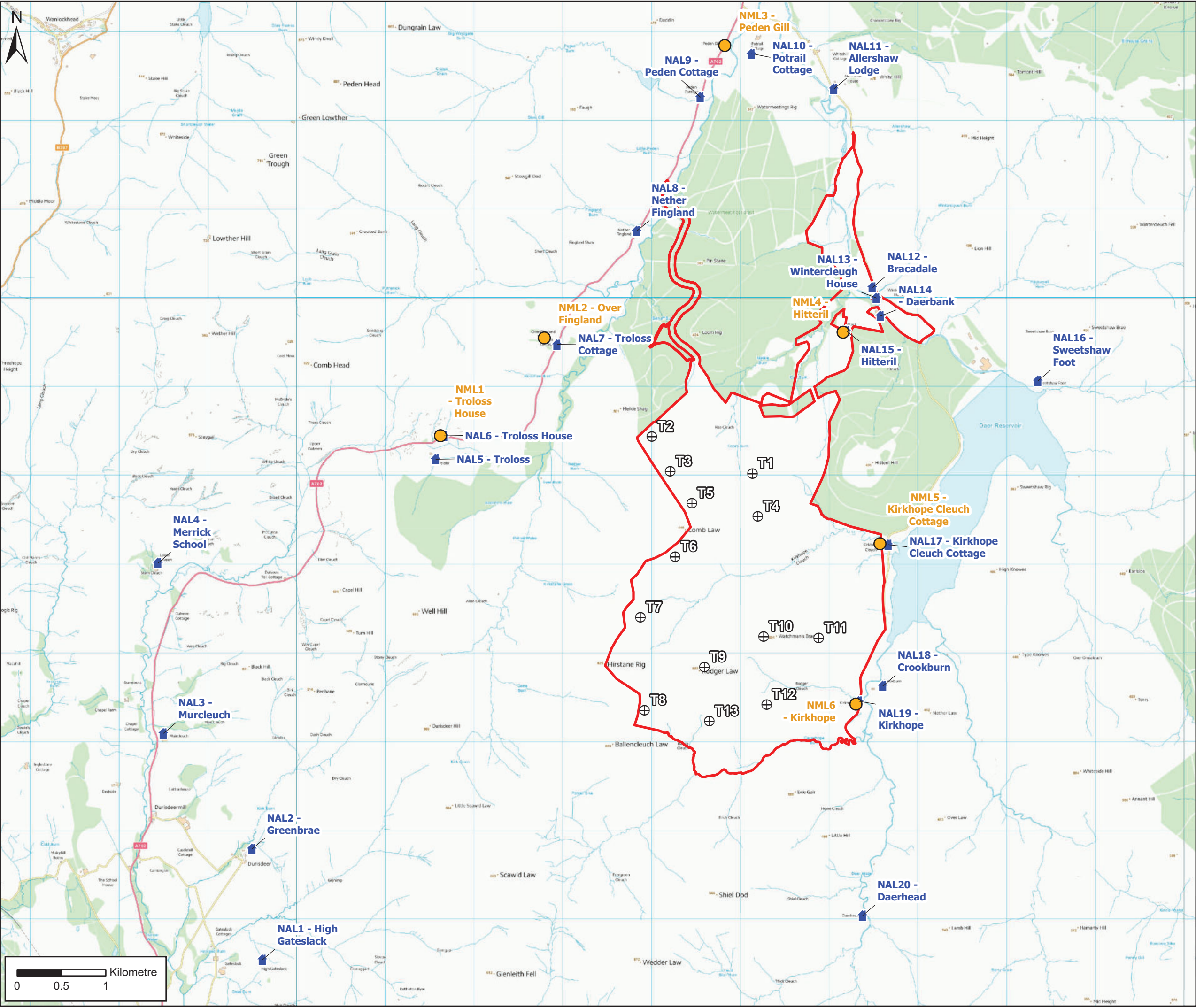
Tonal Noise: noise which covers a very restricted range of frequencies (e.g. a range of $\leq 20 \text{ Hz}$). This noise can be more annoying than broadband noise.

Wind Shear: the increase of wind speed with height above the ground.

9 References

1. **ETSU for the DTI (Department of Trade and Industry).** *The Working Group on Noise from Wind Turbines ETSU-R-97 The Assessment and Rating of Noise from Wind Farms*. 1996.
2. **Institute of Acoustics.** *Good Practice Guidance on the application of ETSU-R-97 for wind turbine noise assessment*. 2013.
3. **The Scottish Government.** *National Planning Policy Framework 4*. 2023.
4. —. *Onshore wind: policy statement 2022*.
5. —. Web Based Renewables Advice: ‘Onshore Wind Turbines’ – <http://www.scotland.gov.uk/Resource/0045/00451413.pdf>. [Online] 28 May 2014.
6. —. Planning Advice Note PAN 1/2011: Planning and Noise – <http://www.scotland.gov.uk/Resource/Doc/343210/0114180.pdf>. [Online] 2011.
7. —. *Technical Advice Note Assessment of Noise*.
8. **Institute of Acoustics Bulletin.** *Prediction and assessment of wind turbine noise*. 2009.
9. **Letter John Swinney, MSP Cabinet Secretary for Finance, Employment and Sustainable Growth to Prof B Shield, IOA, 29 May 2013.** <http://www.ioa.org.uk/pdf/scottish-government-endorsement-of-ioa-gpg.pdf>. [Online]
10. **WSP.** A review of noise guidance for onshore wind turbines. [Online] 10 02 2023. <https://www.wsp.com/en-gb/insights/wind-turbine-noise-report>.
11. *Visual and acoustic impact of wind turbine farms in residents Final report*. Frits van den Berg et al. s.l. : FP6-2005-Science-and-Society-20 Specific Support Action, 3 June 2008.
12. *Low frequency noise and annoyance* . HG, Leventhall. s.l. : Noise & Health Journal, 2004, Vol. 6.
13. *Do wind turbines produce significant low frequency sound levels? Conference paper 11th International Meeting on Low Frequency Noise and Vibration and its Control* . Berg, G.P. van den. Maastricht The Netherlands : s.n., 2004.
14. **Department of Trade and Industry.** *The Measurement of LFN at three UK Wind Farms* . 2006 : s.n.
15. **Keele University Rejects Renewable Energy Foundation.** <http://archive.is/d3WB>. *Low Frequency Noise Research Claims* . [Online]
16. *Infrasound and the ear, 5th International conference on Wind Turbine Noise*. Leventhall, G. Denver : s.n., 2013.
17. *The Health Effects of 72 Hours of Simulated Wind Turbine Infrasound: A Double-Blind Randomized Crossover Study in Noise-Sensitive, Healthy Adults* - PMC (nih.gov).
18. **renewable UK.** <http://www.renewableuk.com/search/all.asp?bst=amplitude+modulation>. [Online]
19. **Department of Energy & Climate Change.** *Wind Turbine AM Review Phase 2 Report*. 2016.
20. **(ISO), International Organisation for Standardisation.** *Acoustics – Attenuation of sound during propagation outdoors Part 2: Engineering method for the prediction of sound pressure levels outdoors*. Geneva : ISO, 2024. ISO 9613-2:2024.
21. **DataKustik GmbH.** *CadnaA Version 4.4*.
22. **The Scottish Government.** *The Electricity Act 1989*.

Annex 1 – Figures



LEGEND

Site Boundary

Noise Monitoring Locations (NMLs)

Noise Assessment Locations (NALs)

Turbine Location

1	18/12/2025	CLIENT COMMENTS	JCM	AD
0	09/09/2025	FIRST ISSUE	ST	AD
Rev.	Date	Amendment Details	Drawn	Approved

Lowther Hills

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tnei

Client

WATCHMAN ENERGY PARK LTD

Drawing Status:

FOR PLANNING

Project Title:

WATCHMAN ENERGY PARK

Drawing Title:

FIGURE A1.1a OPERATIONAL NOISE MONITORING AND ASSESSMENT LOCATIONS

Scale: 1:40,000

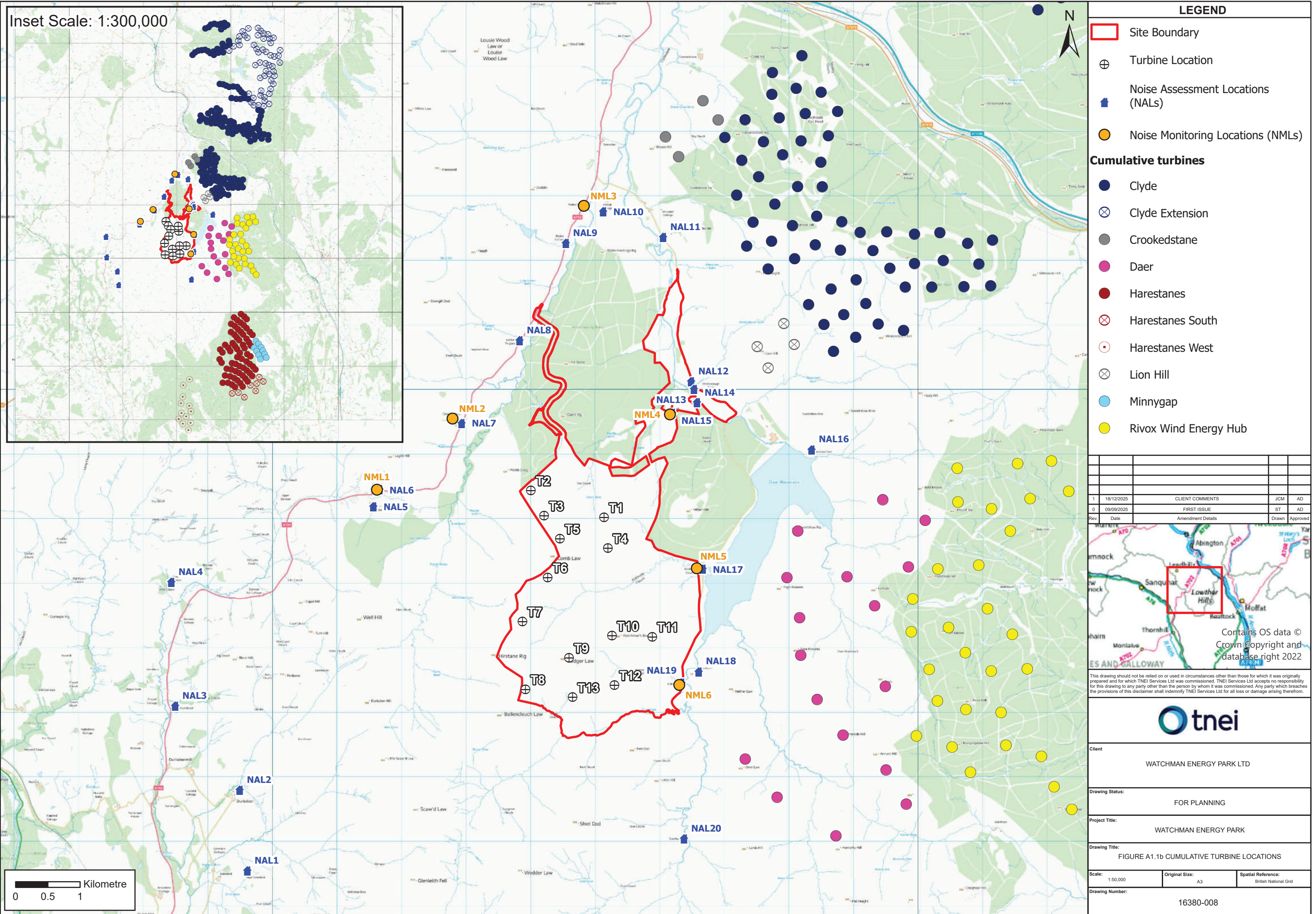
Original Size: A3

Spatial Reference: British National Grid

Drawing Number:

16380-007

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LEGEND

Site Boundary

⊕

Turbine Location

Noise Assessment Locations (NALs)

●

Noise Monitoring Locations (NMLs)

Cumulative turbines

●

Clyde

⊗

Clyde Extension

●

Crookedstane

●

Daer

●

Harestanes

⊗

Harestanes South

⊗

Harestanes West

⊗

Lion Hill

●

Minnygap

●

Rivox Wind Energy Hub

1	18/12/2025	CLIENT COMMENTS	JCM	AD	
0	09/09/2025	FIRST ISSUE	ST	AD	
Rev	Date	Amendment Details	Drawn	Approved	

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Client

WATCHMAN ENERGY PARK LTD

Drawing Status:

FOR PLANNING

Project Title:

WATCHMAN ENERGY PARK

Drawing Title:

FIGURE A1.1b CUMULATIVE TURBINE LOCATIONS

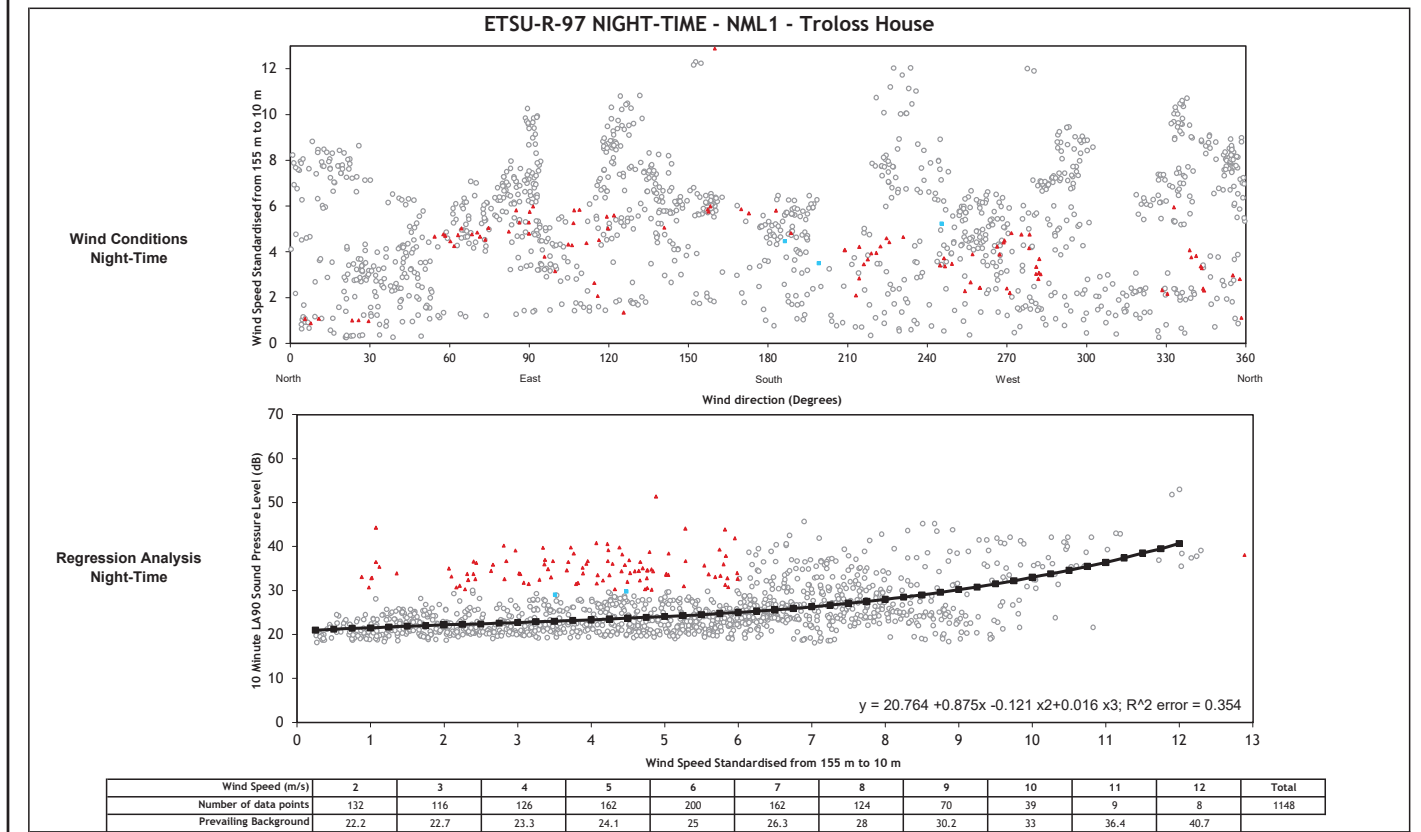
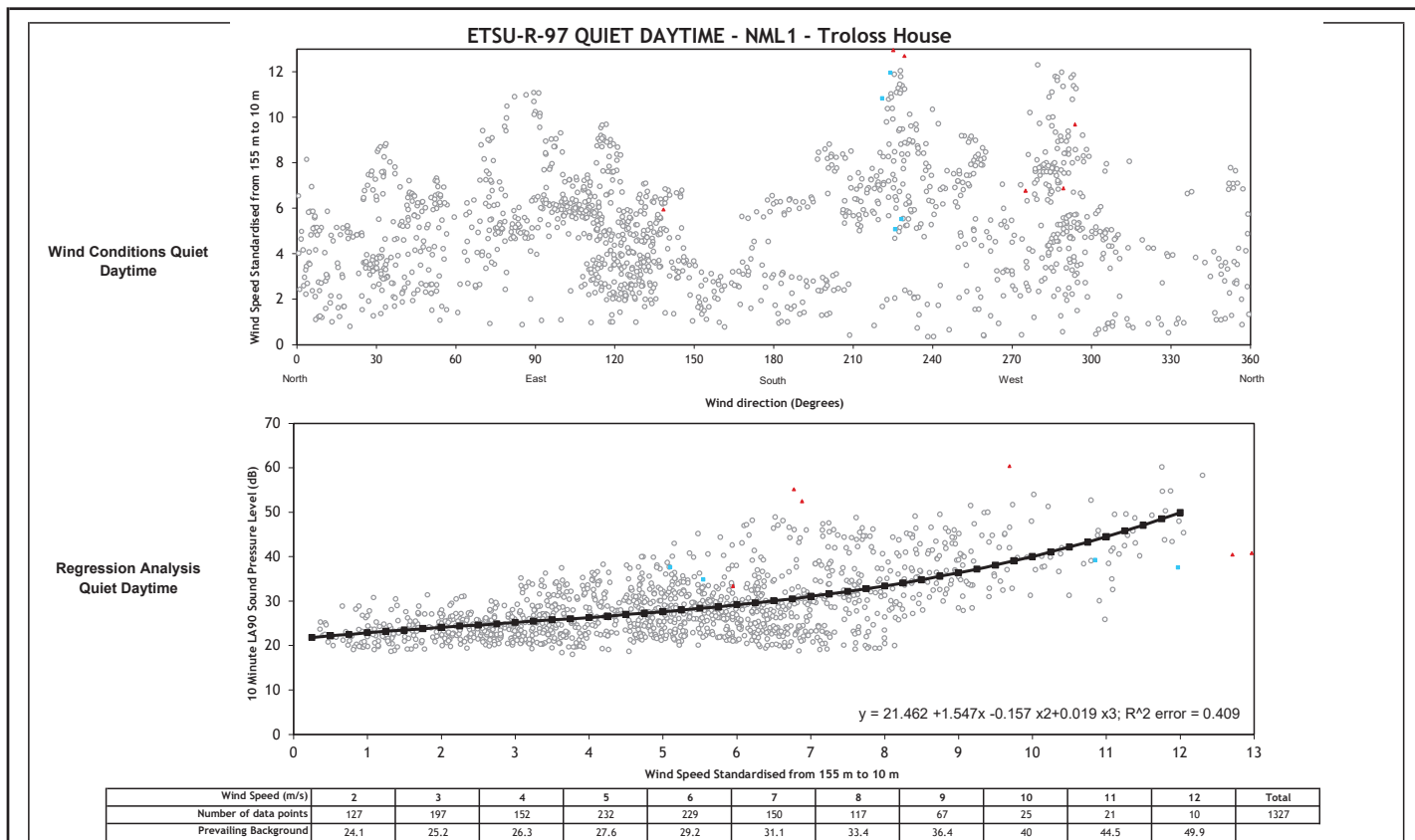
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Drawing Number:

16380-008



Legend:

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- Line of best fit
- Line of best fit flat lined where appropriate(Prevailing Background)
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- Excluded Data-Rain
- Excluded Data-Filtered Wind Direction

Project Watchman Energy Park

Client Watchman Energy Park Limited

Title Wind Conditions&Regression Analysis

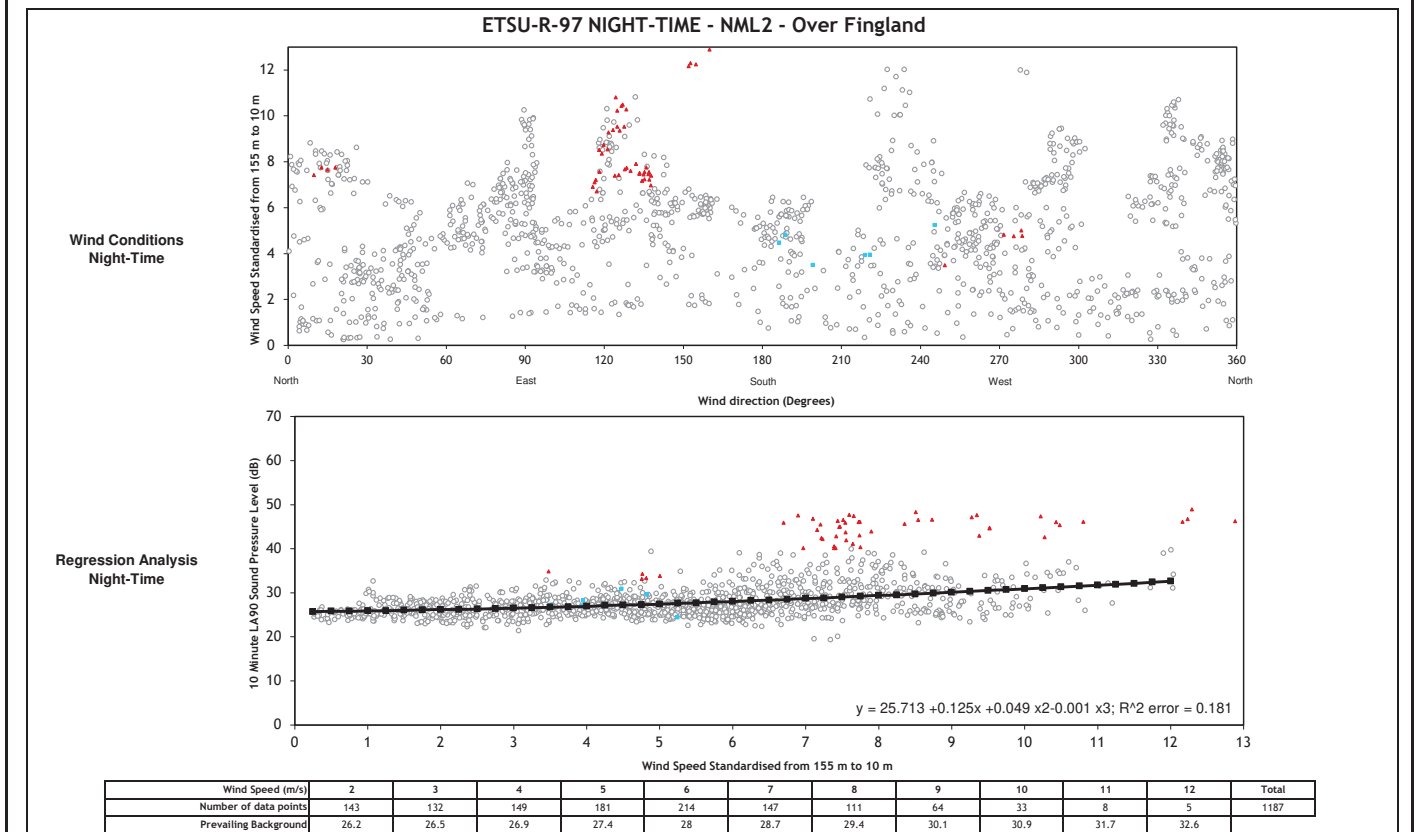
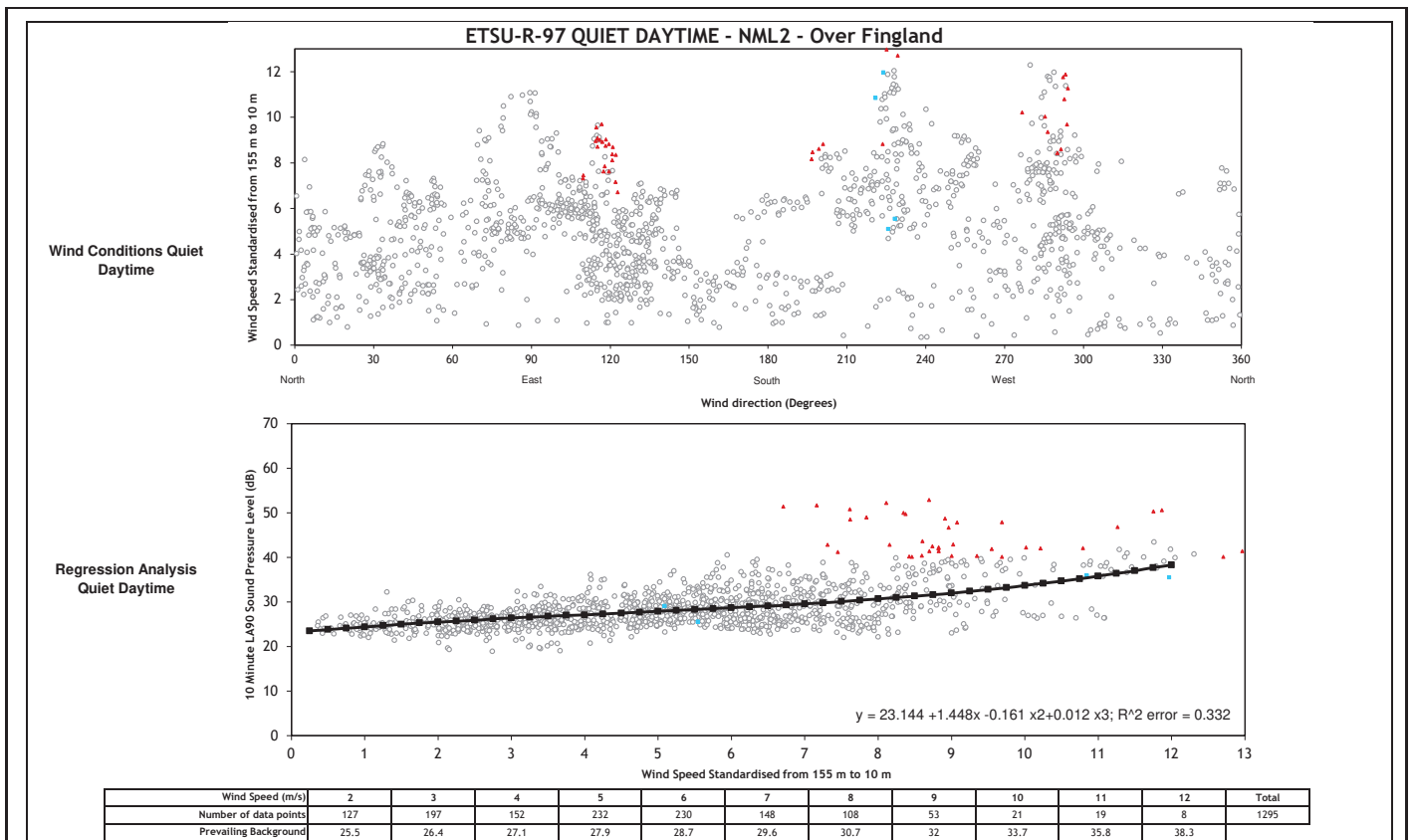
Figure Number 1.2a

Drawn AD

Checked GC

Date 20/05/2025

Document Reference 16380-Models



Legend:

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Project Watchman Energy Park

Client Watchman Energy Park Limited

Title Wind Conditions&Regression Analysis

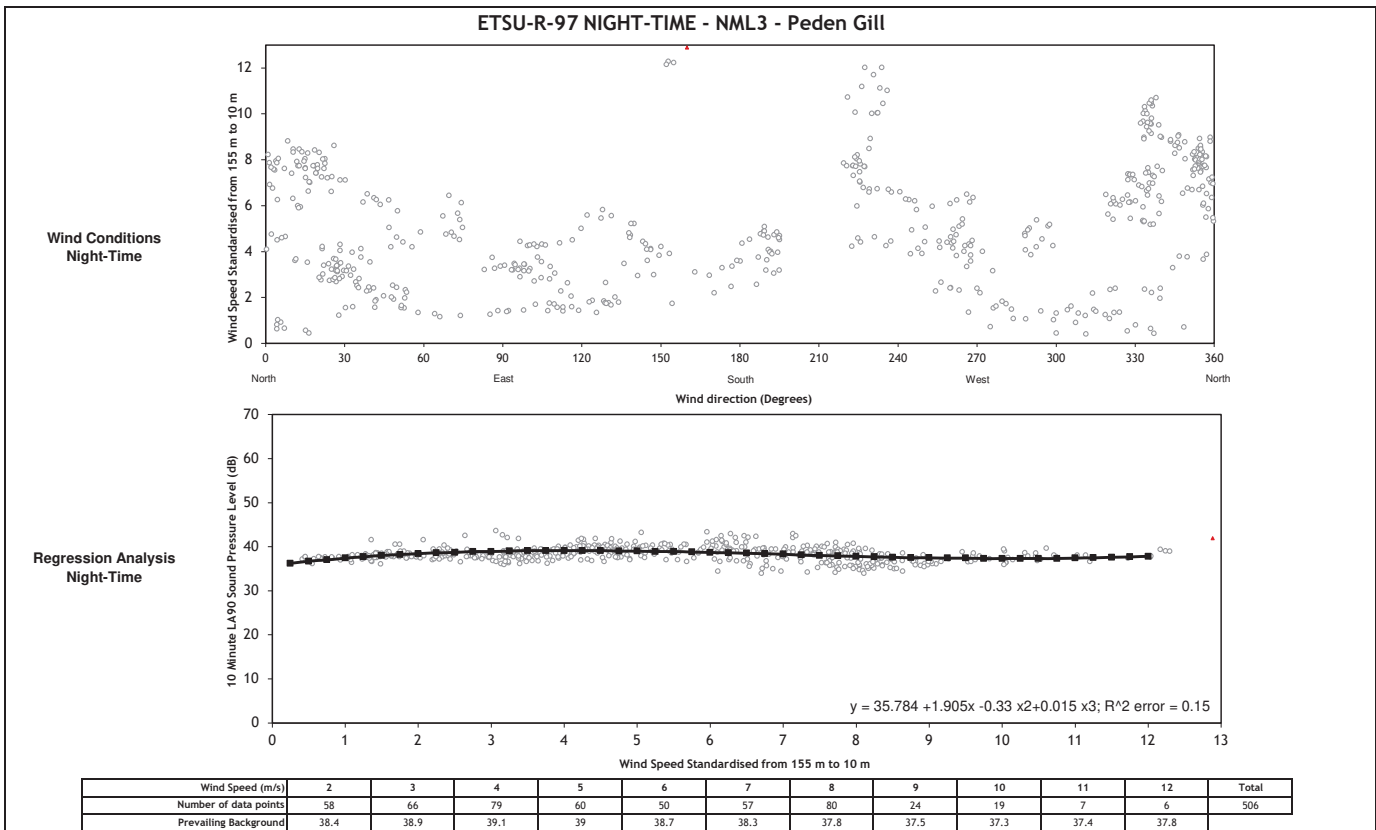
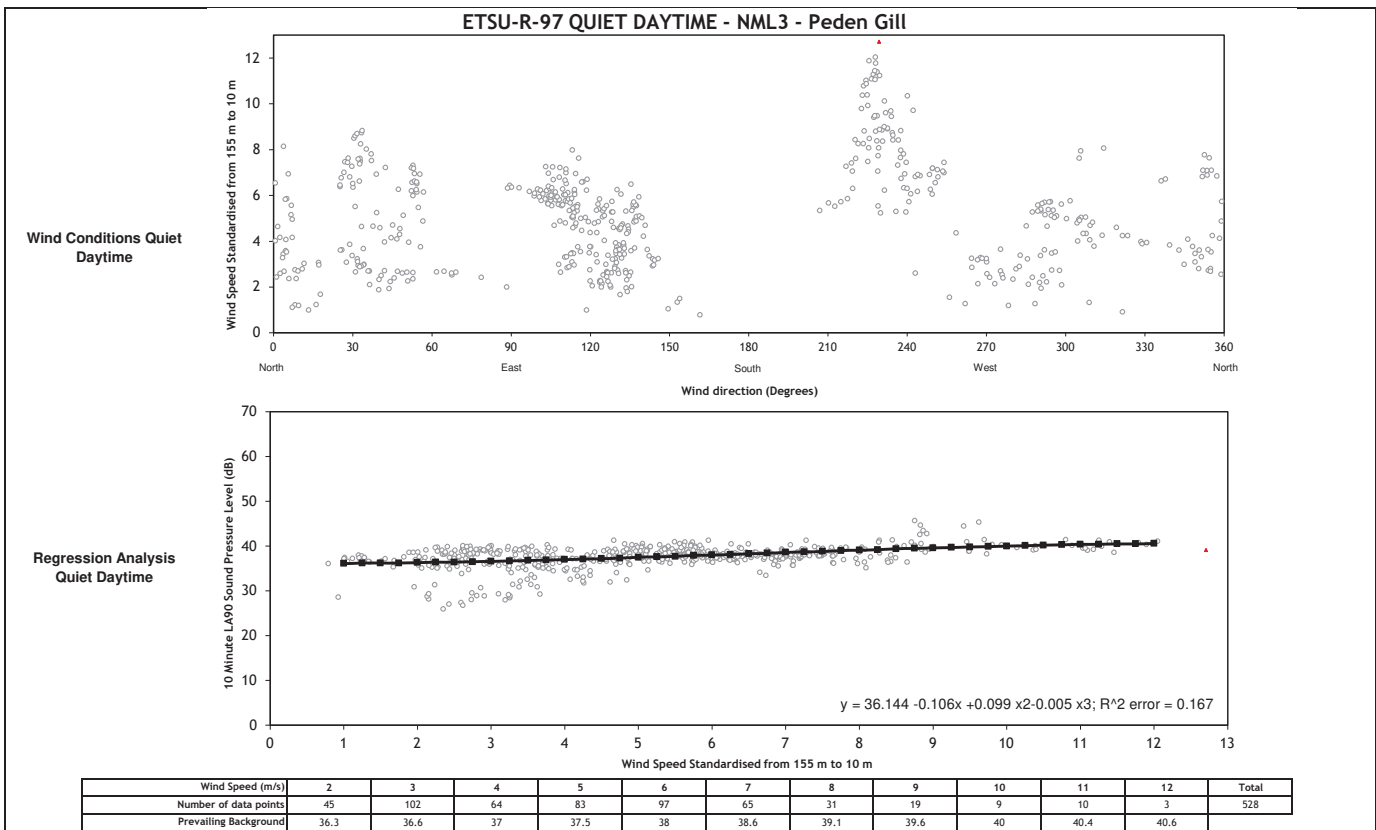
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Drawn AD

Checked GC

Date 20/05/2025

Document Reference 16380-Models



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Project Watchman Energy Park

Client Watchman Energy Park Limited

Title Wind Conditions&Regression Analysis

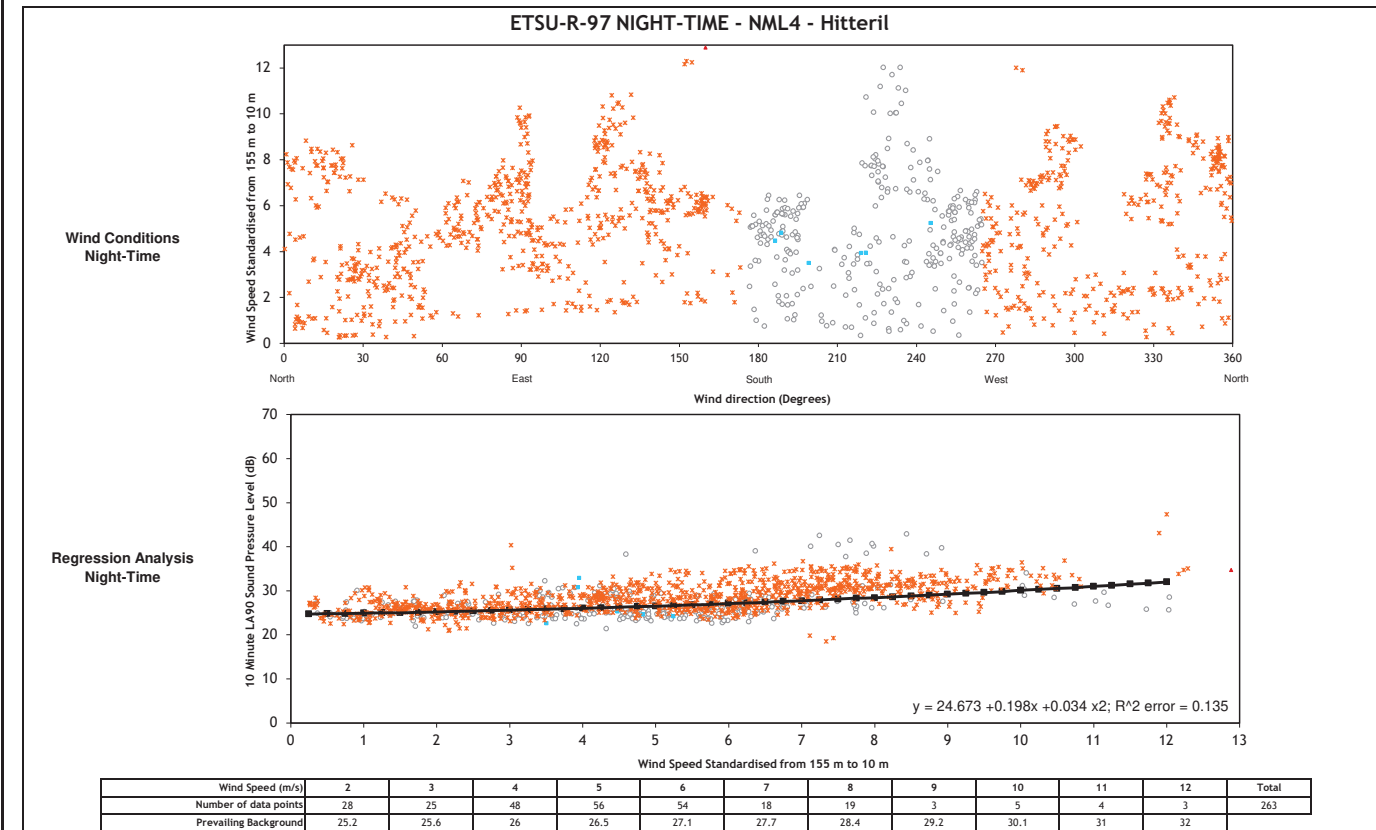
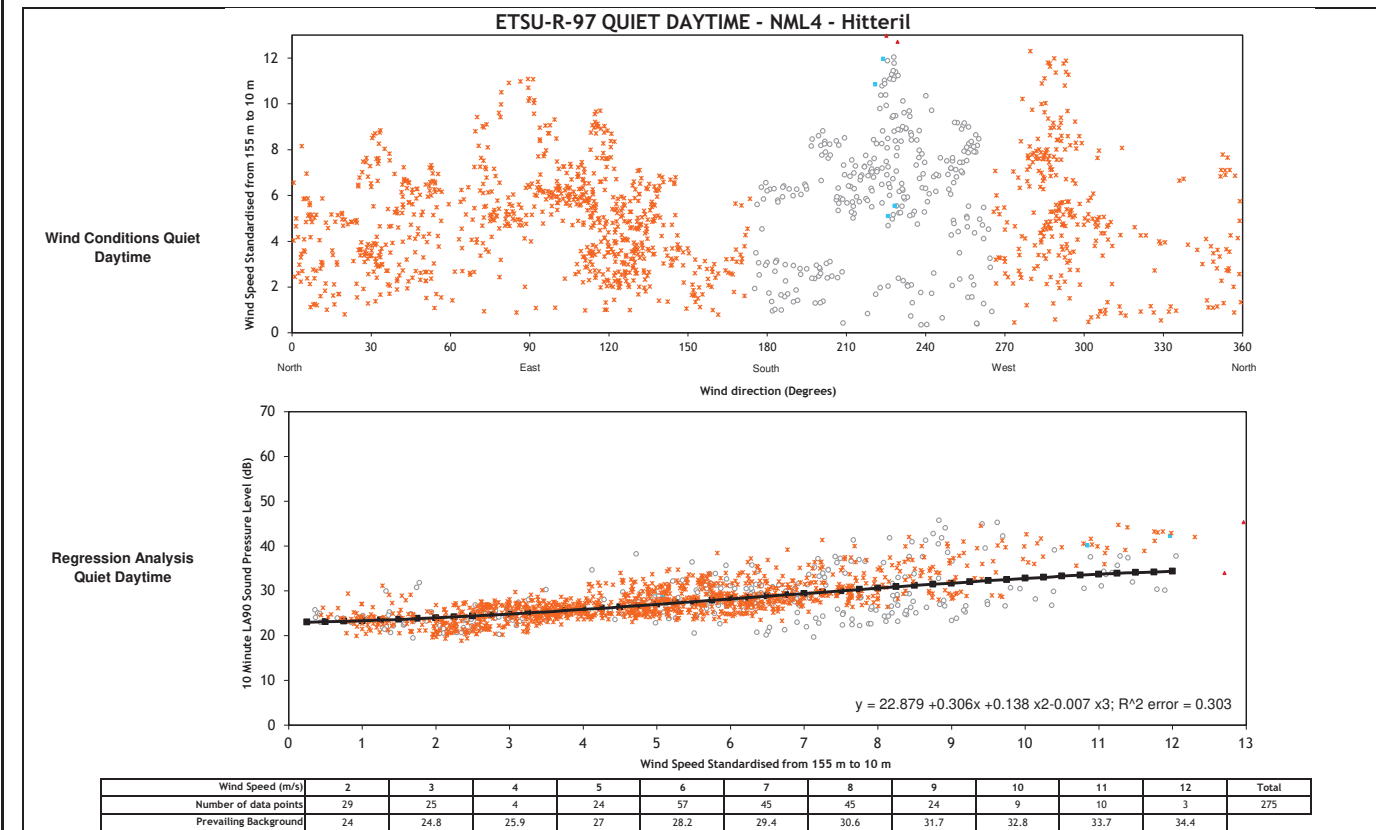
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Date 20/05/2025

Document Reference 16380-Models



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Project Watchman Energy Park

Client Watchman Energy Park Limited

Title Wind Conditions&Regression Analysis

Figure Number A1.2d

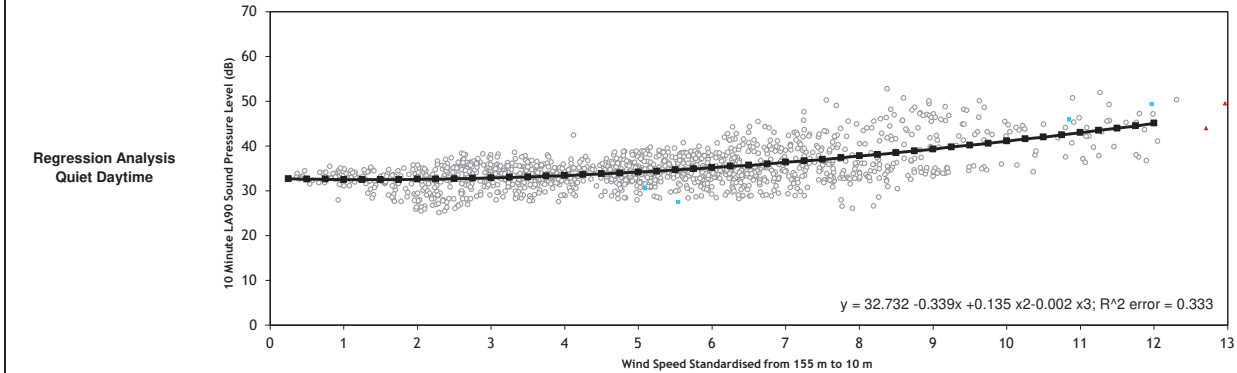
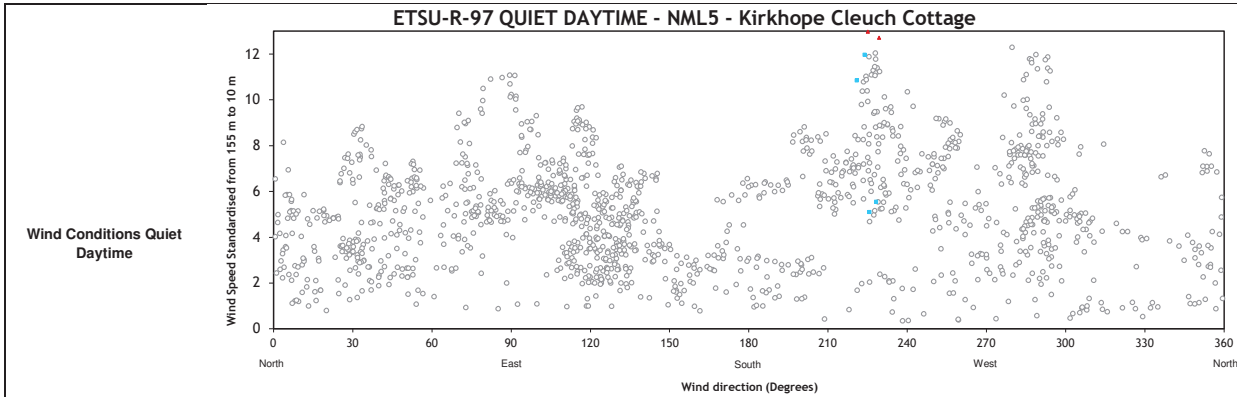
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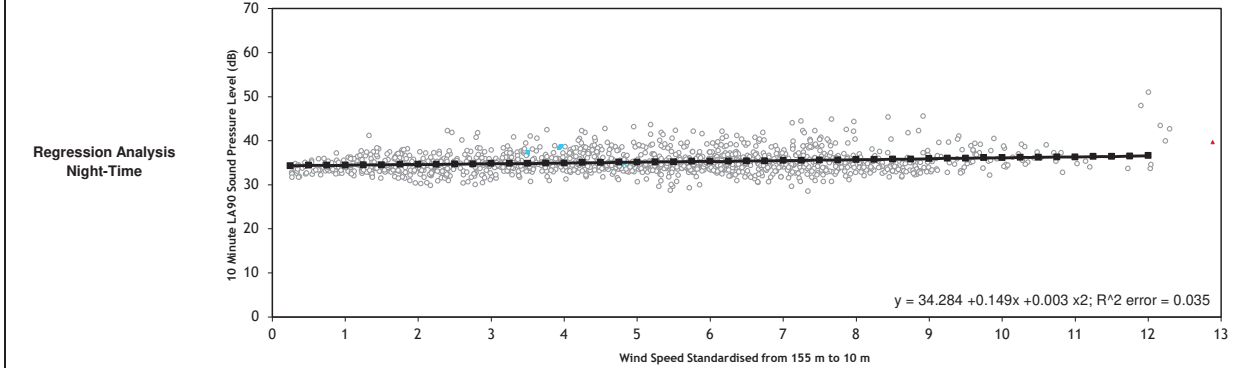
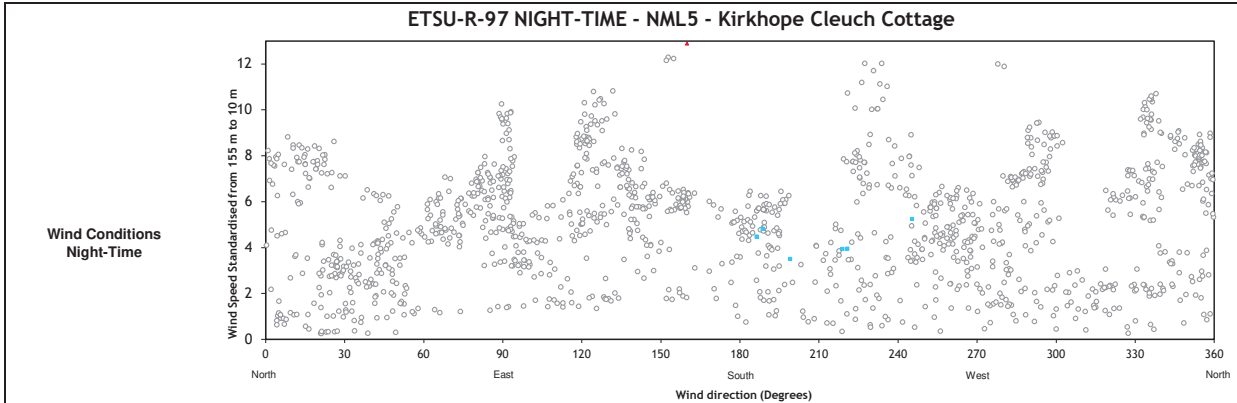
Date 20/05/2025

Document Reference 16380-Models





Wind Speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Total
Number of data points	127	197	152	232	230	152	117	67	26	21	10	1331
Prevailing Background	32.6	32.9	33.4	34.2	35.2	36.4	37.8	39.3	41.1	43	45.1	



Wind Speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Total
Number of data points	143	133	149	185	214	162	124	70	39	9	8	1236
Prevailing Background	34.6	34.8	34.9	35.1	35.3	35.5	35.7	35.9	36.1	36.3	36.6	

Legend:

- L₉₀ 10 Minute Measurement Point
- Line of best fit
- Line of best fit flat lined where appropriate(Prevailing Background)
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- Excluded Data-Rain
- Excluded Data-Filtered Wind Direction

Project Watchman Energy Park

Client Watchman Energy Park Limited

Title Wind Conditions&Regression Analysis

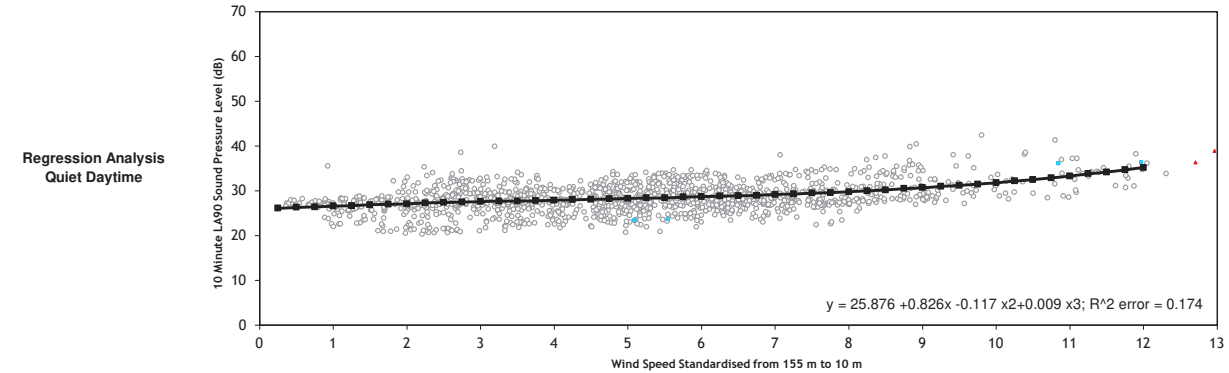
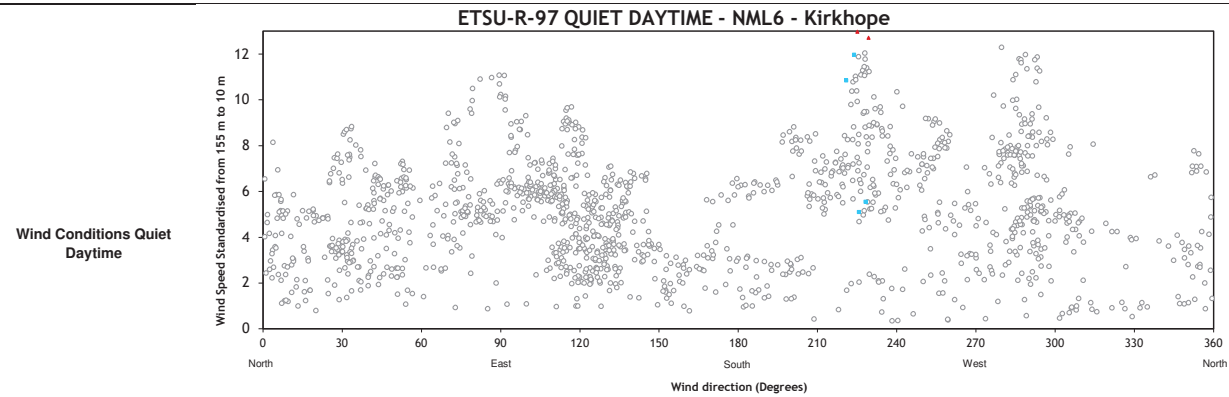
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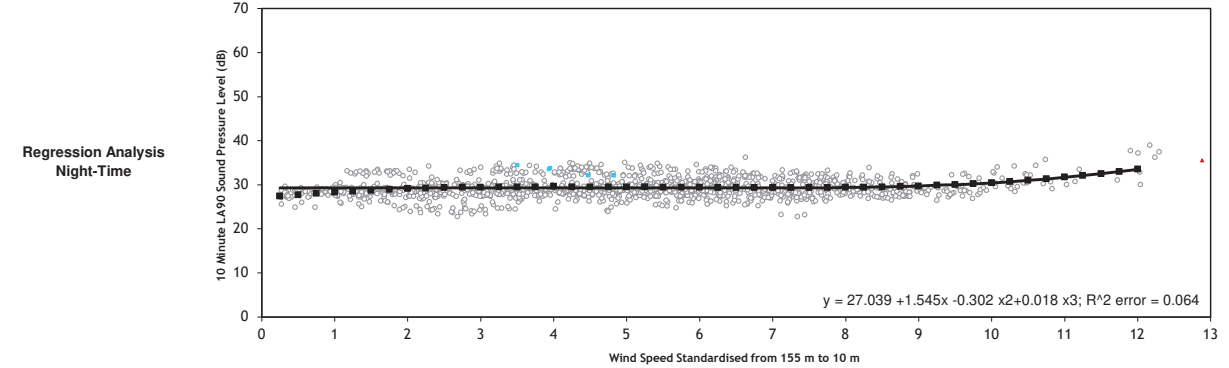
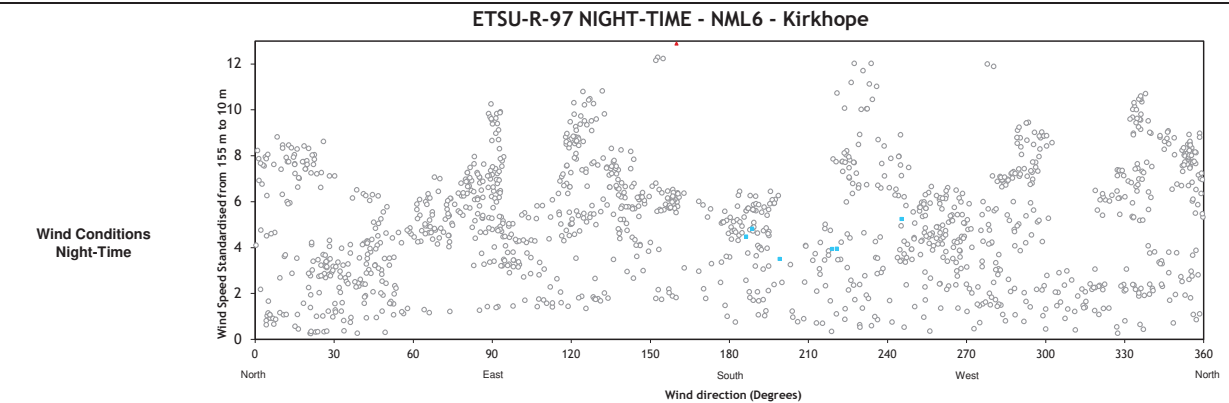
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Date 20/05/2025

Document Reference 16380-Models



Wind Speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Total
Number of data points	127	197	152	232	230	152	117	67	26	21	10	1331
Prevailing Background	27.1	27.6	27.9	28.3	28.7	29.2	29.8	30.7	31.8	33.3	35.2	



Wind Speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Total
Number of data points	143	133	149	185	214	162	124	70	39	9	8	1236
Prevailing Background	29.3	29.3	29.3	29.3	29.3	29.3	29.4	29.7	30.4	31.7	33.5	

Legend:

- L₉₀ 10 Minute Measurement Point
- Line of best fit
- Line of best fit flat lined where appropriate(Prevailing Background)
- Excluded Data-Manual exclusion
- Excluded Data-Rain
- Excluded Data-Filtered Wind Direction

Project Watchman Energy Park

Client Watchman Energy Park Limited

Title Wind Conditions&Regression Analysis

Figure Number A1.2f

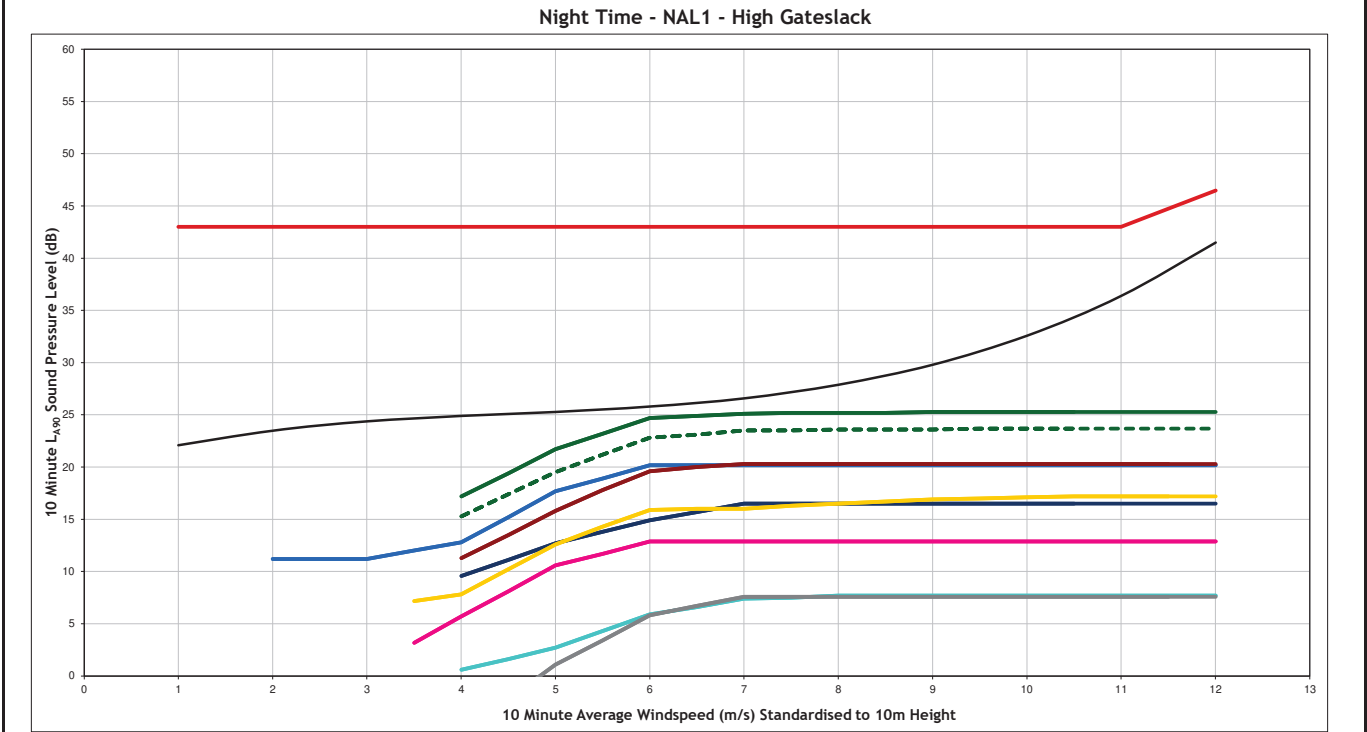
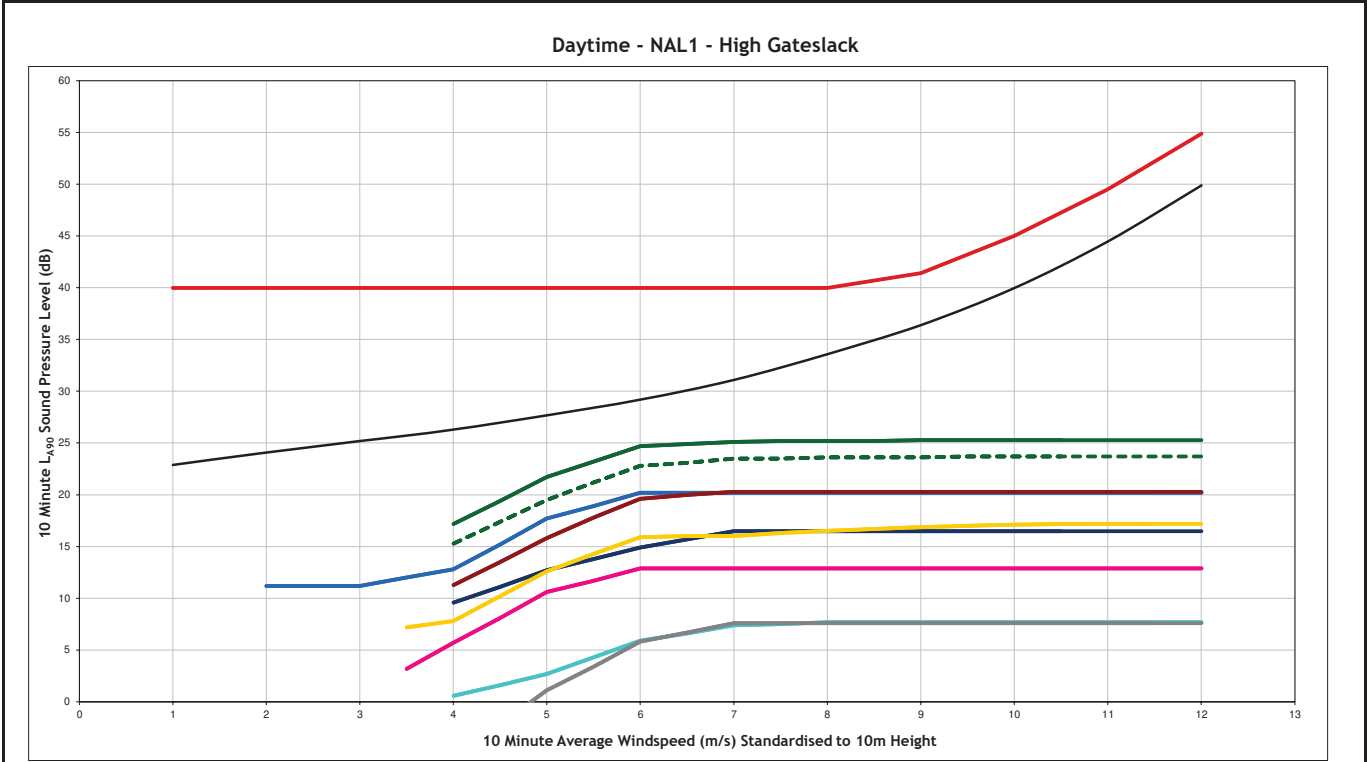
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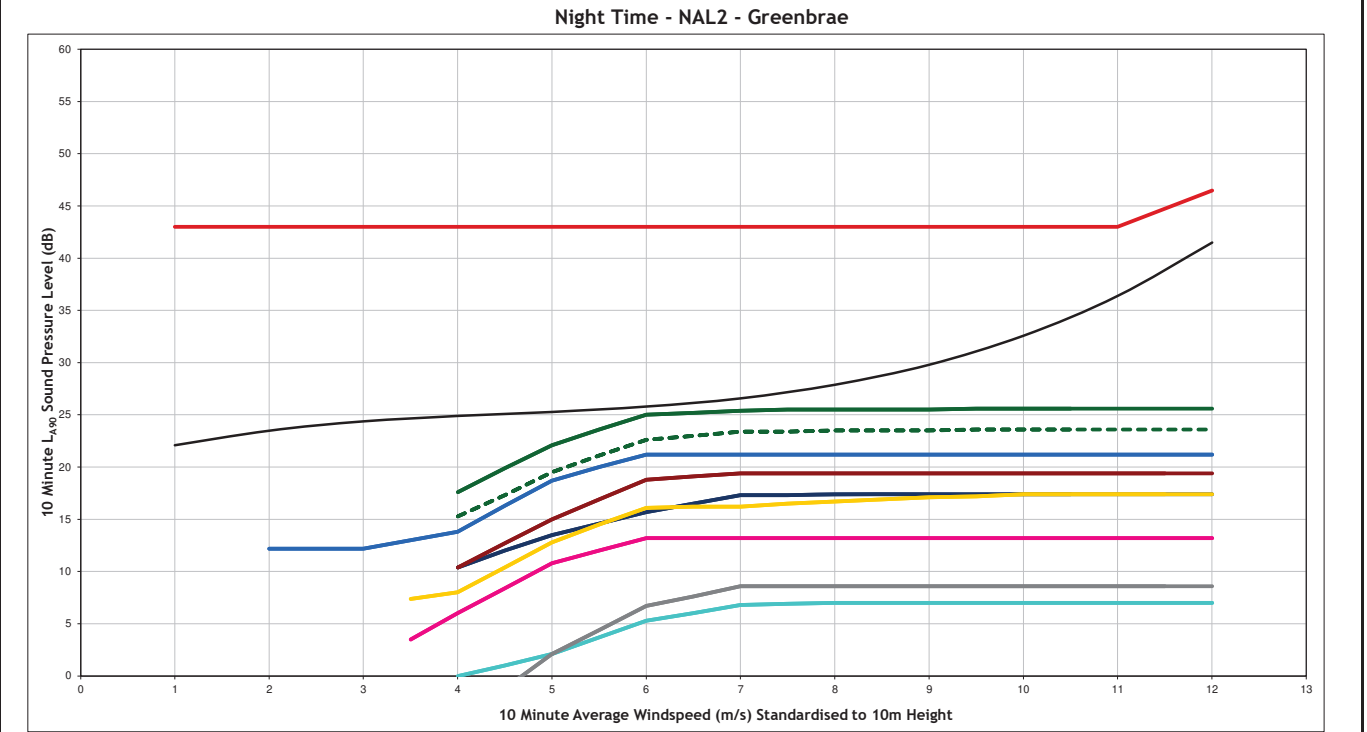
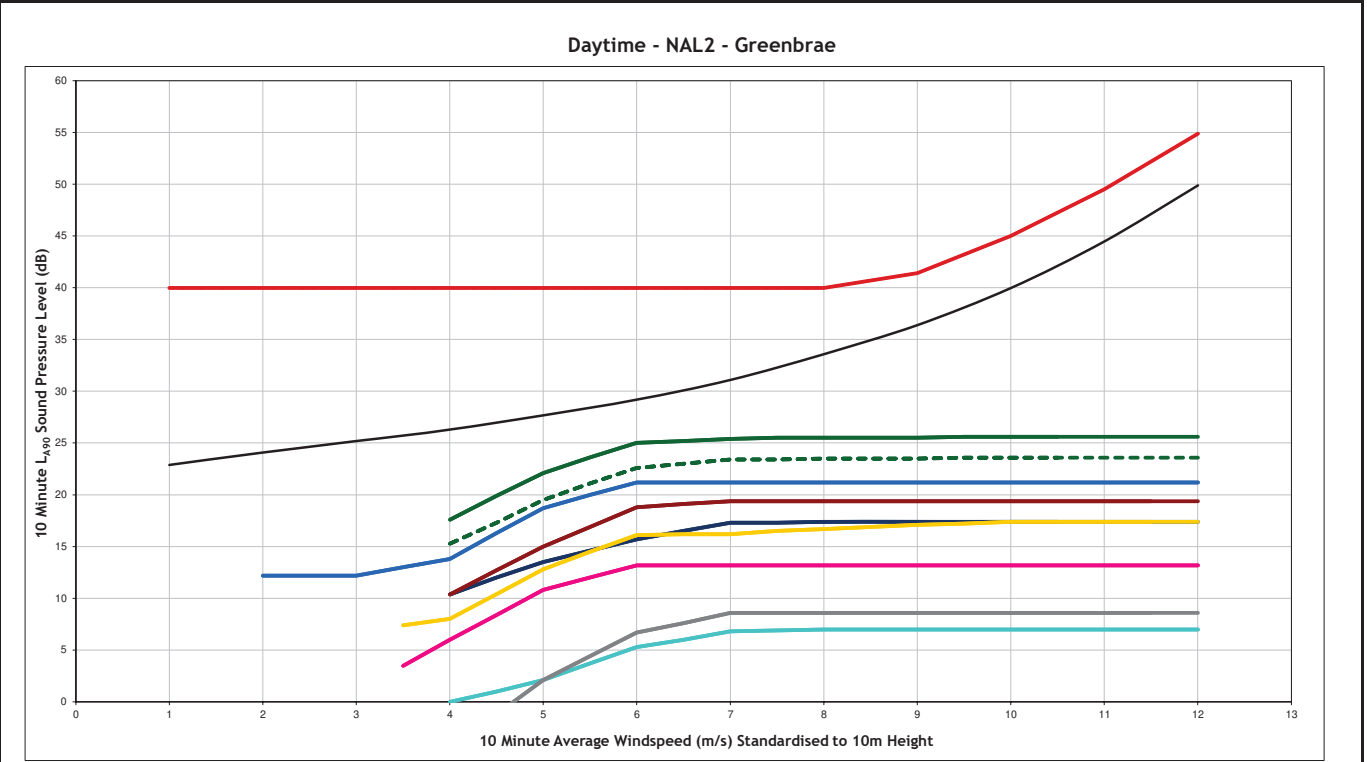
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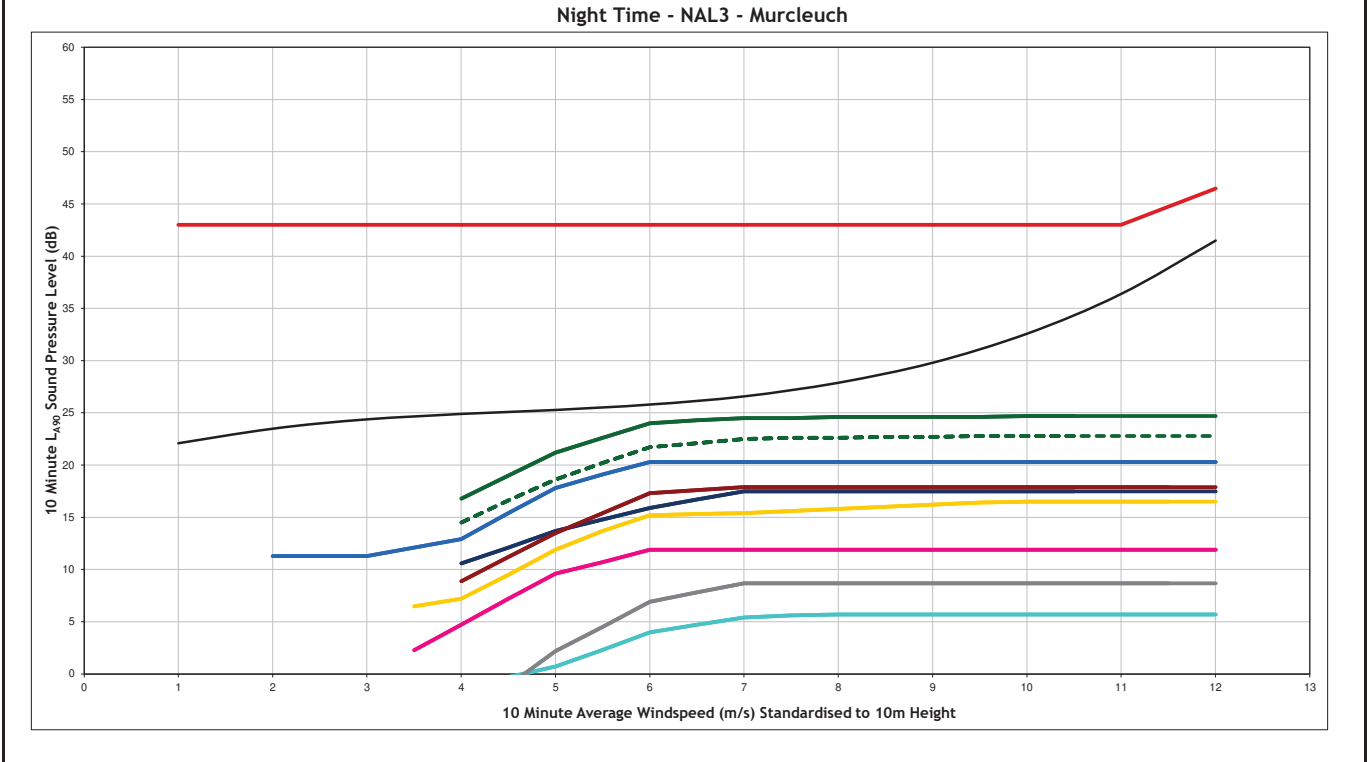
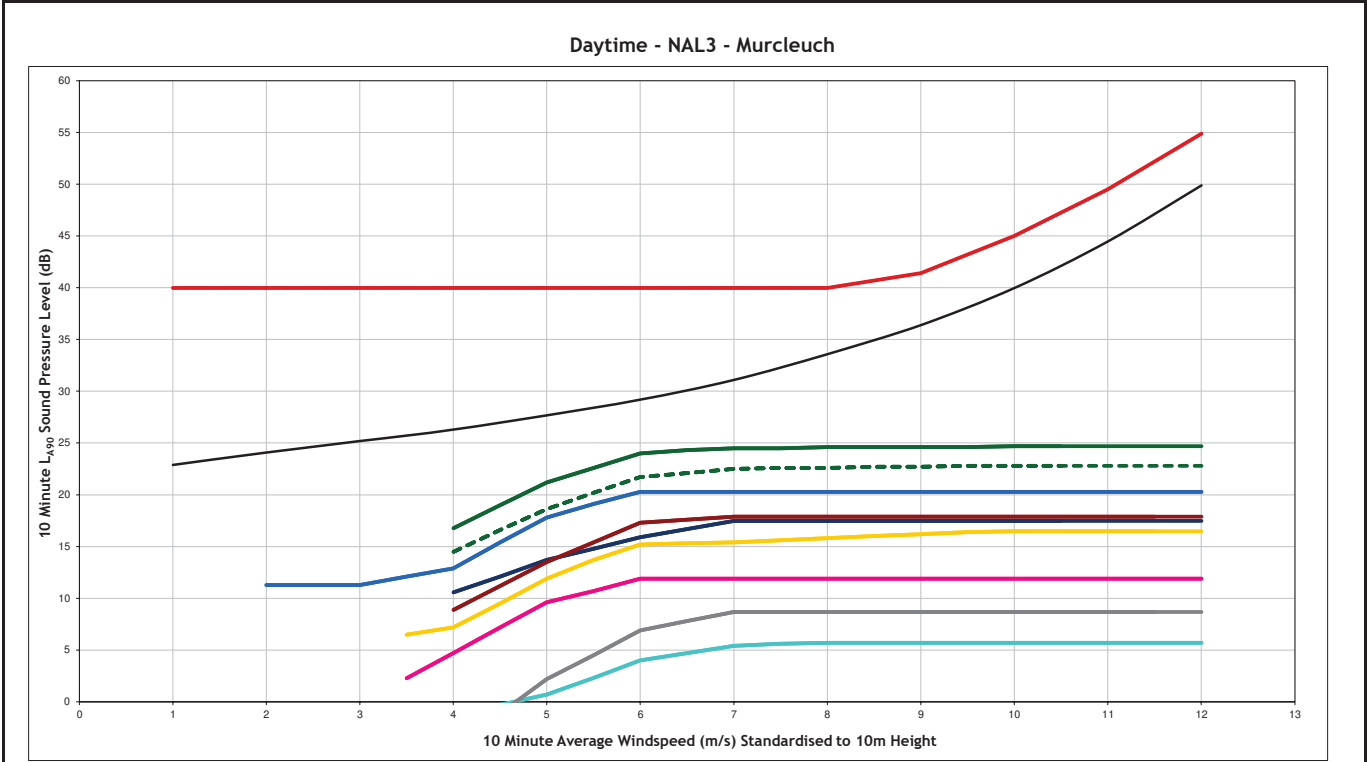




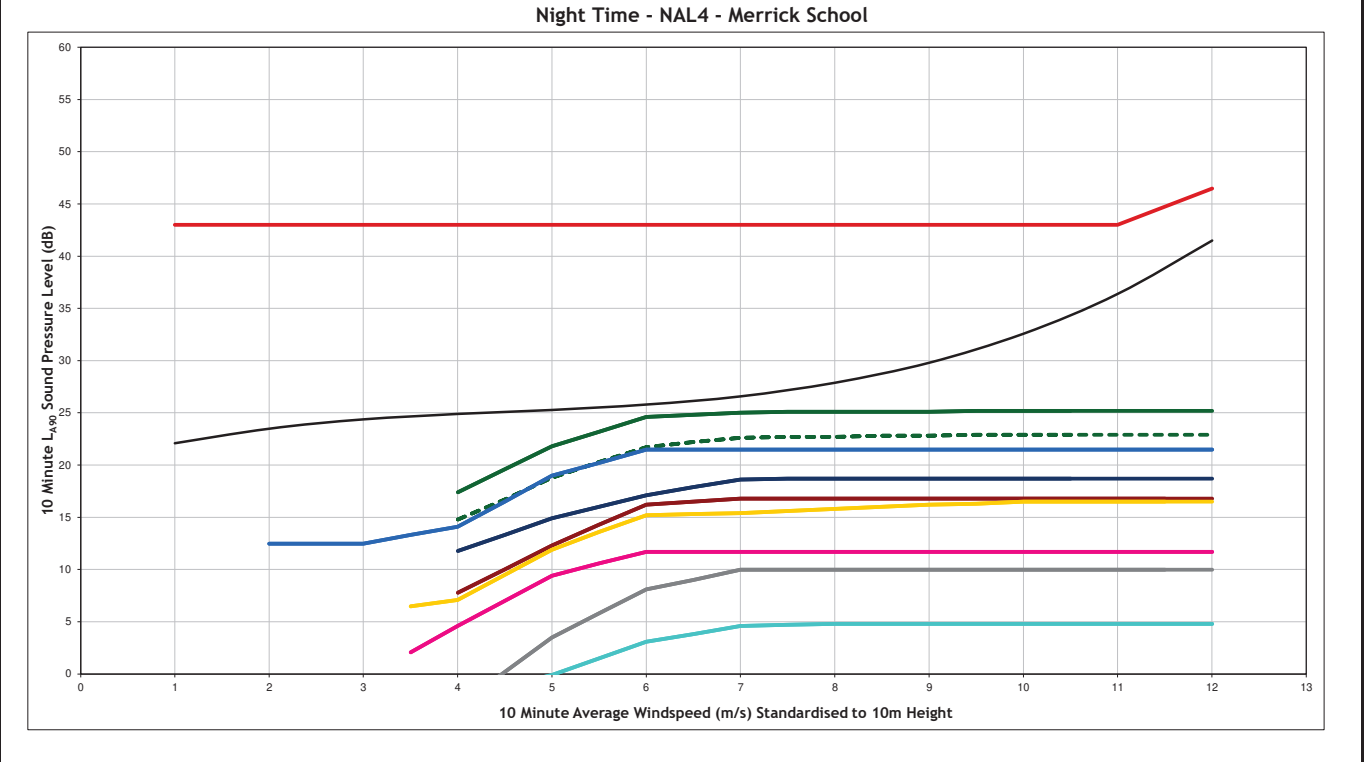
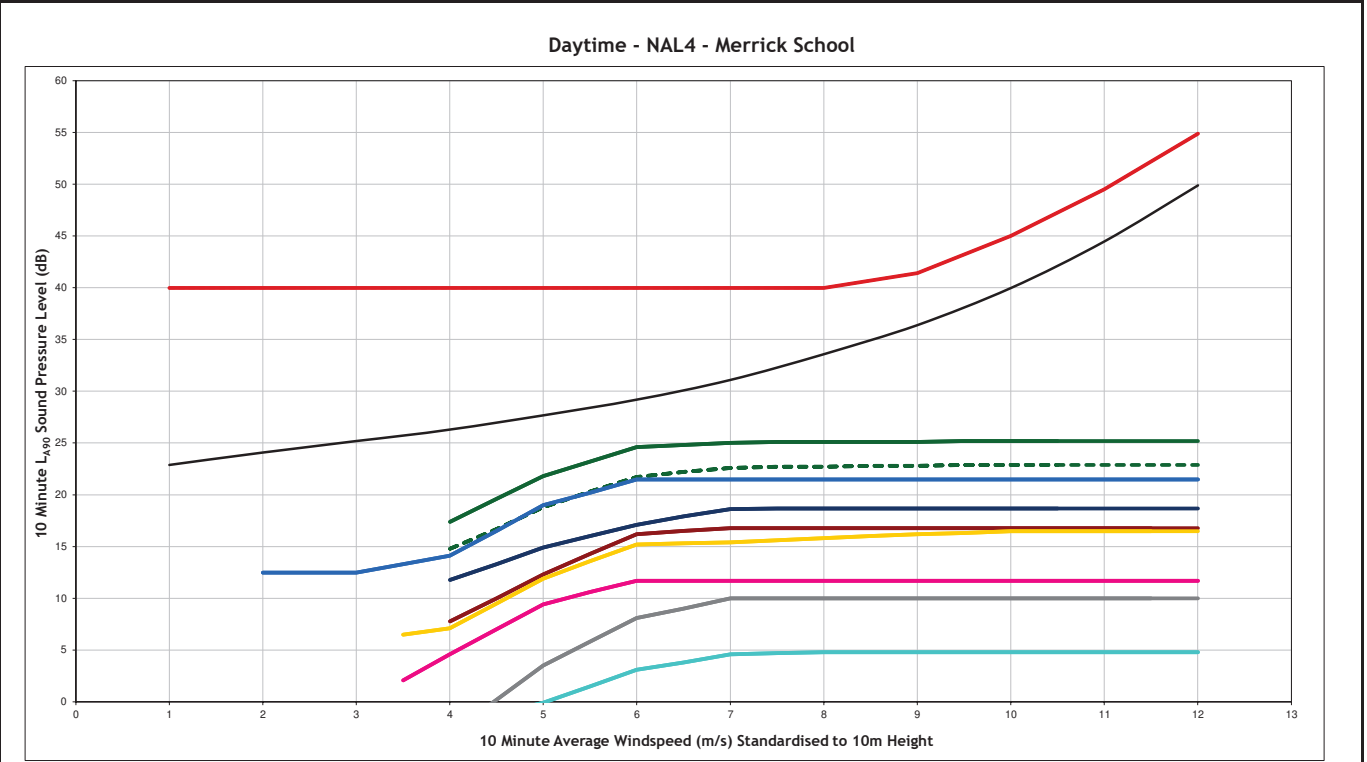
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	Client	Watchman Energy Park Limited
Background Noise Trendline Total ETSU-R-97-Limit Cumulative (Including the Proposed Development) Cumulative (Excluding the Proposed Development) Proposed Development Clyde & Clyde Extension Daer Harestanes (inc. South & West) Minnygap Rivox Wind Energy Hub Crookedstane & Lion Hill	Title	Likely Noise Predictions NAL1 - High Gateslack
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	Scale	NTS
	Drawn	AD
	Checked	GC
	Date	29/09/2025
	Document Reference	16380 - Models



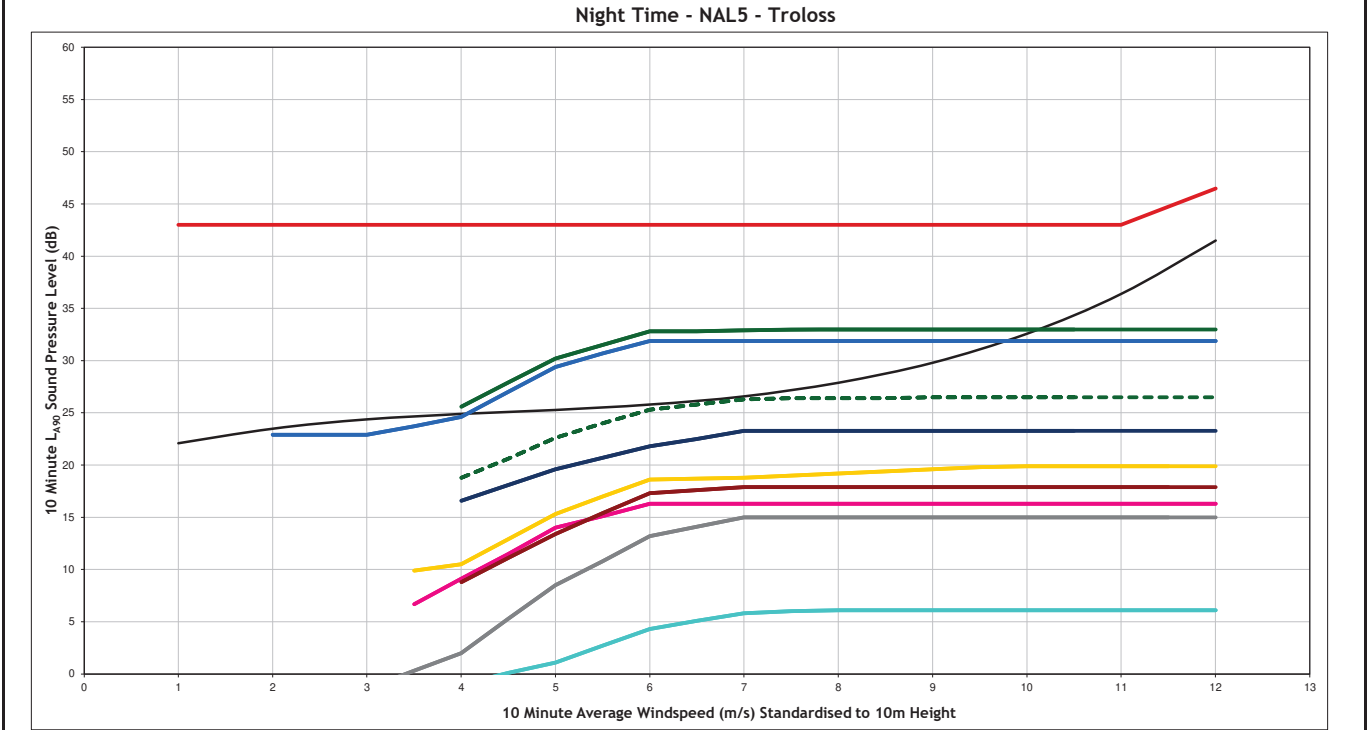
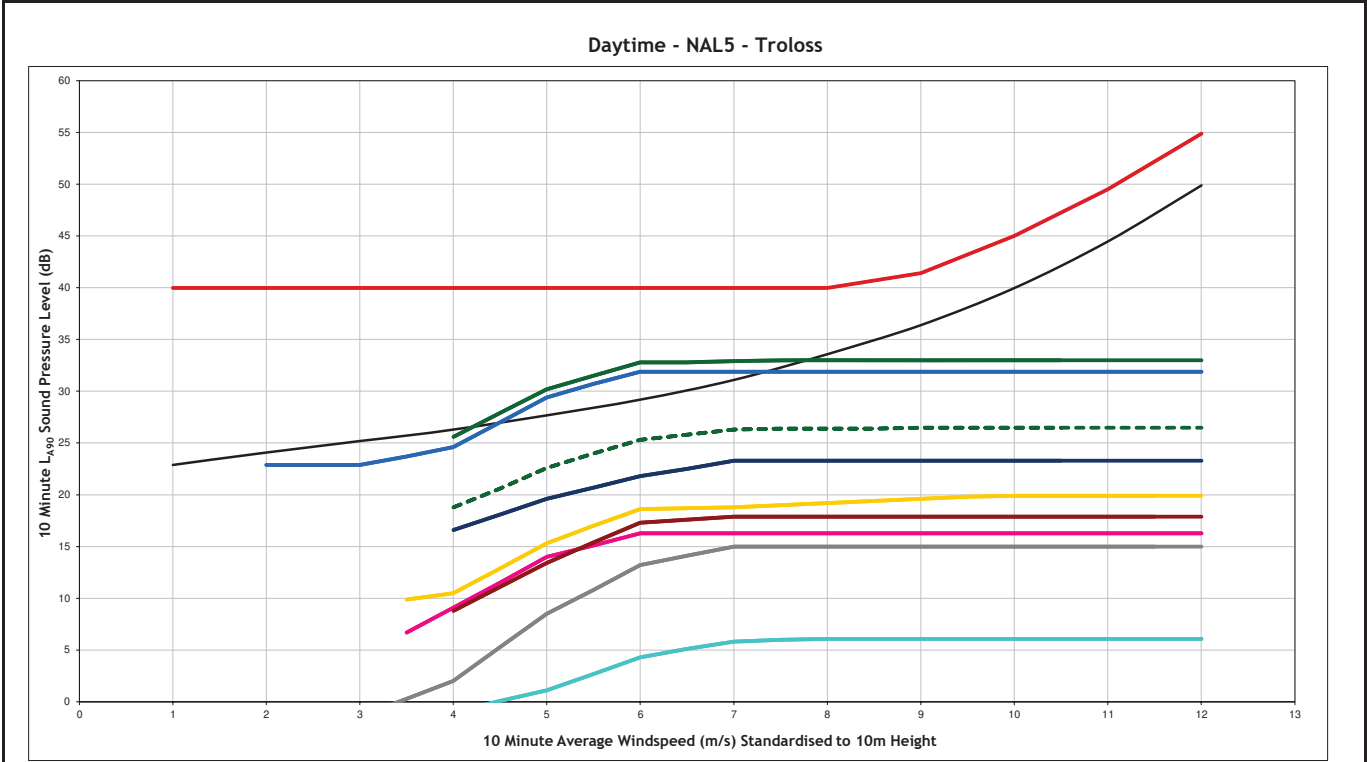
Legend:	Project	Watchman Energy Park
	Client	Watchman Energy Park Limited
Background Noise Trendline Total ETSU-R-97-Limit Cumulative (Including the Proposed Development) Cumulative (Excluding the Proposed Development) Proposed Development Clyde & Clyde Extension Daer Harestanes (inc. South & West) Minnygap Rivox Wind Energy Hub Crookedstane & Lion Hill	Title	Likely Noise Predictions NAL2 - Greenbrae
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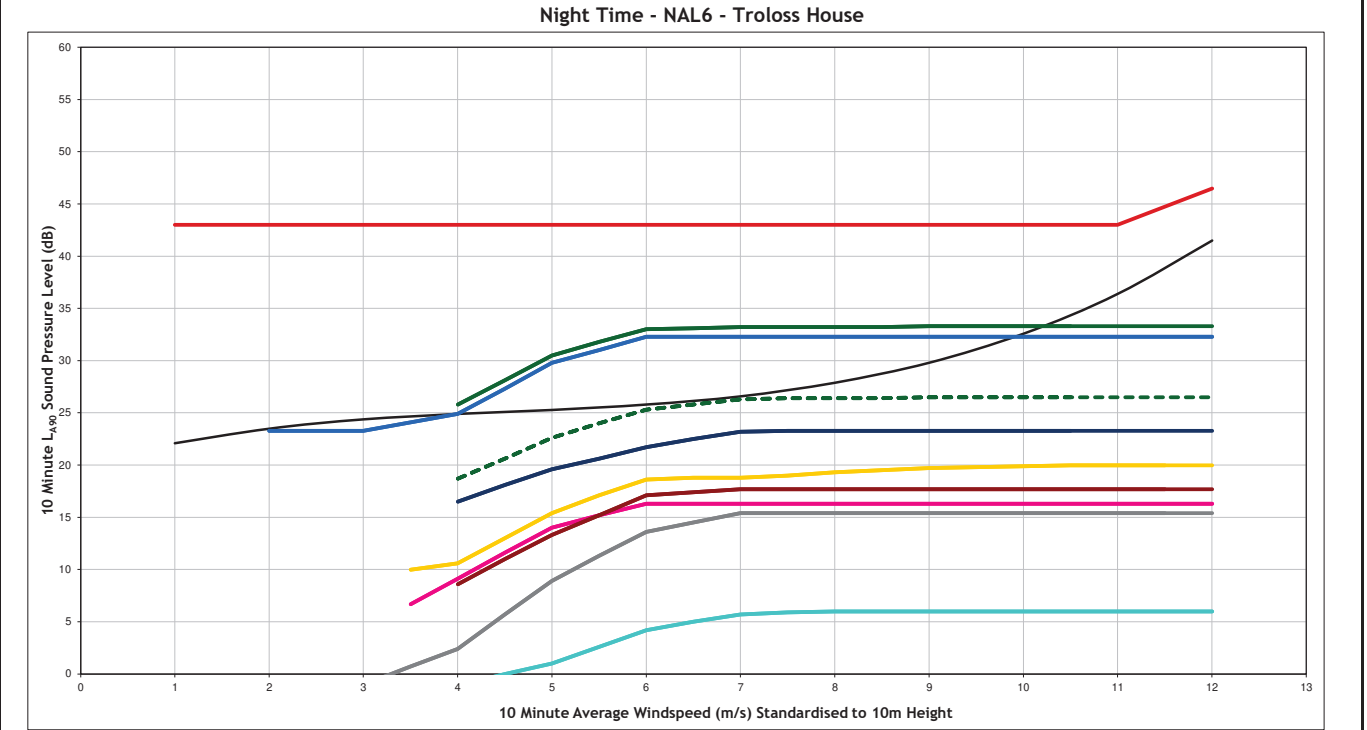
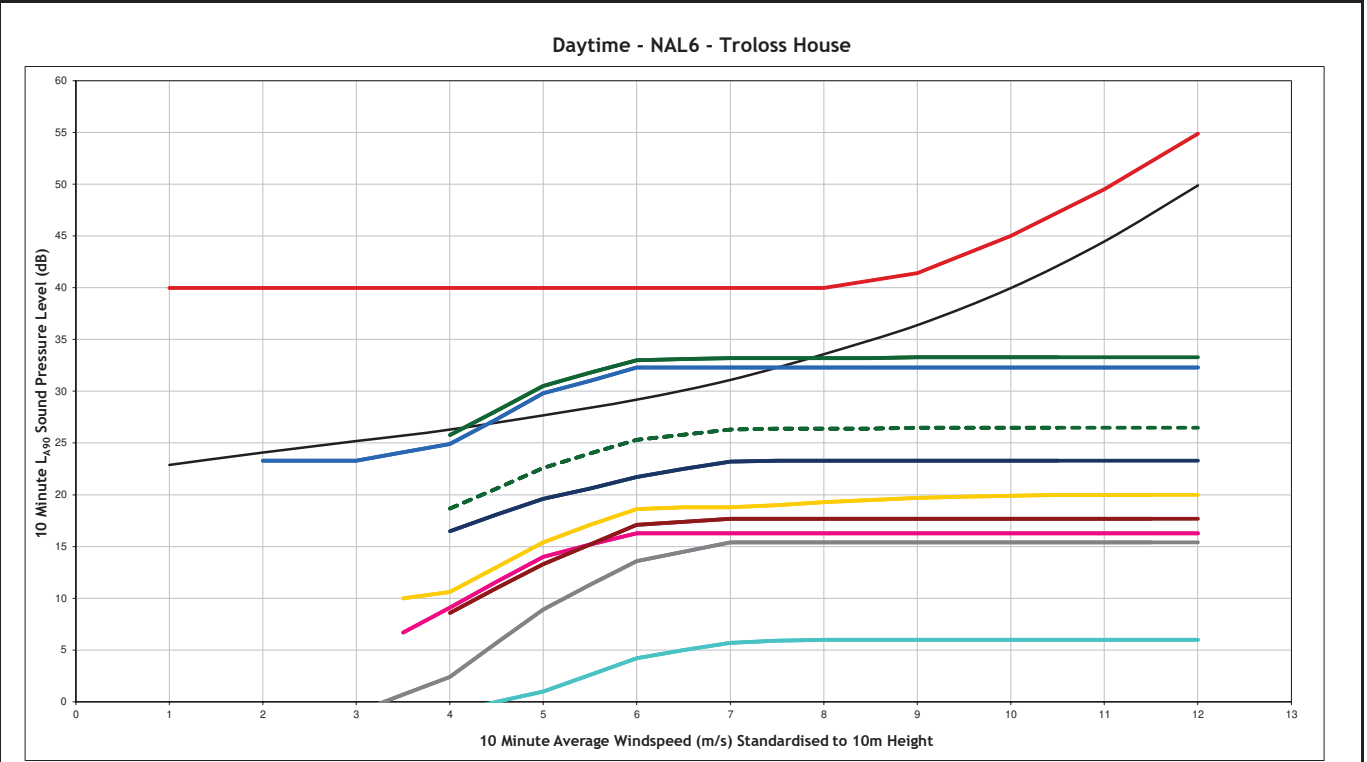
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	Client	Watchman Energy Park Limited
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	Date	29/09/2025
Document Reference 16380 - Models		



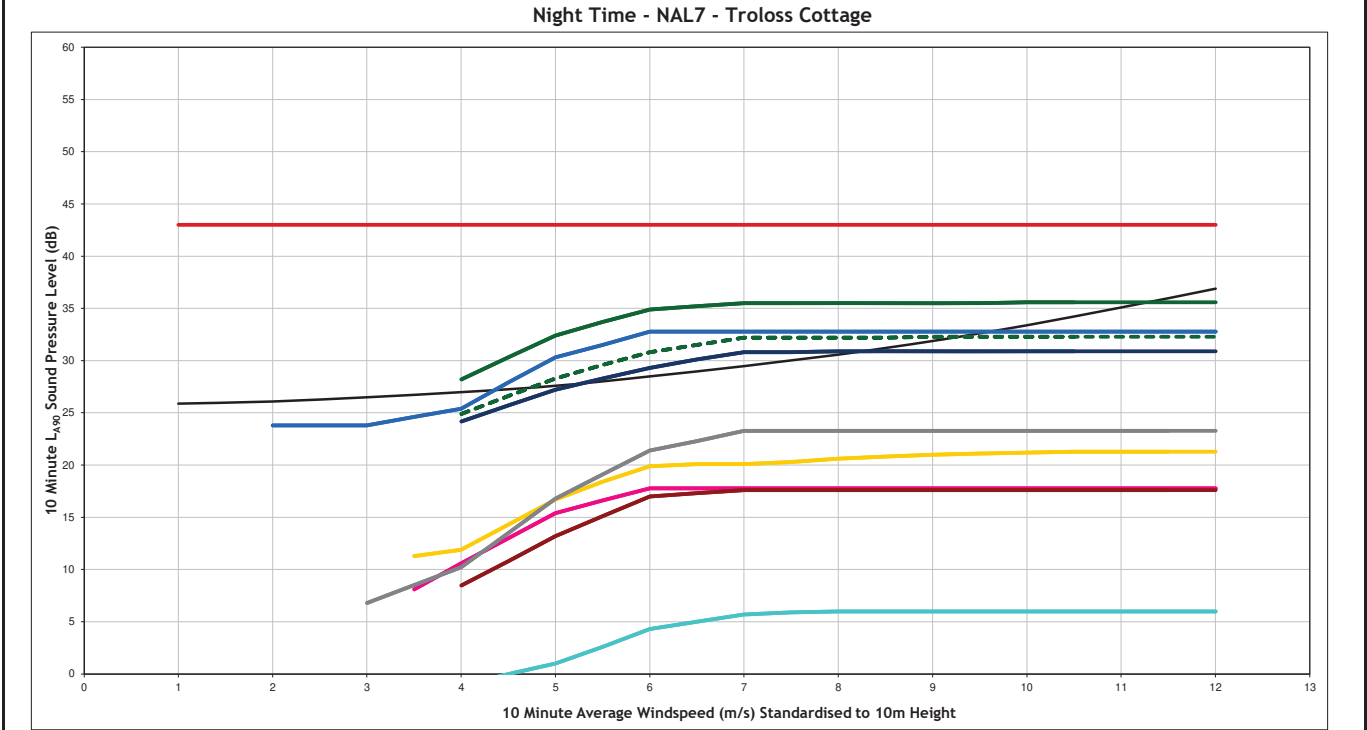
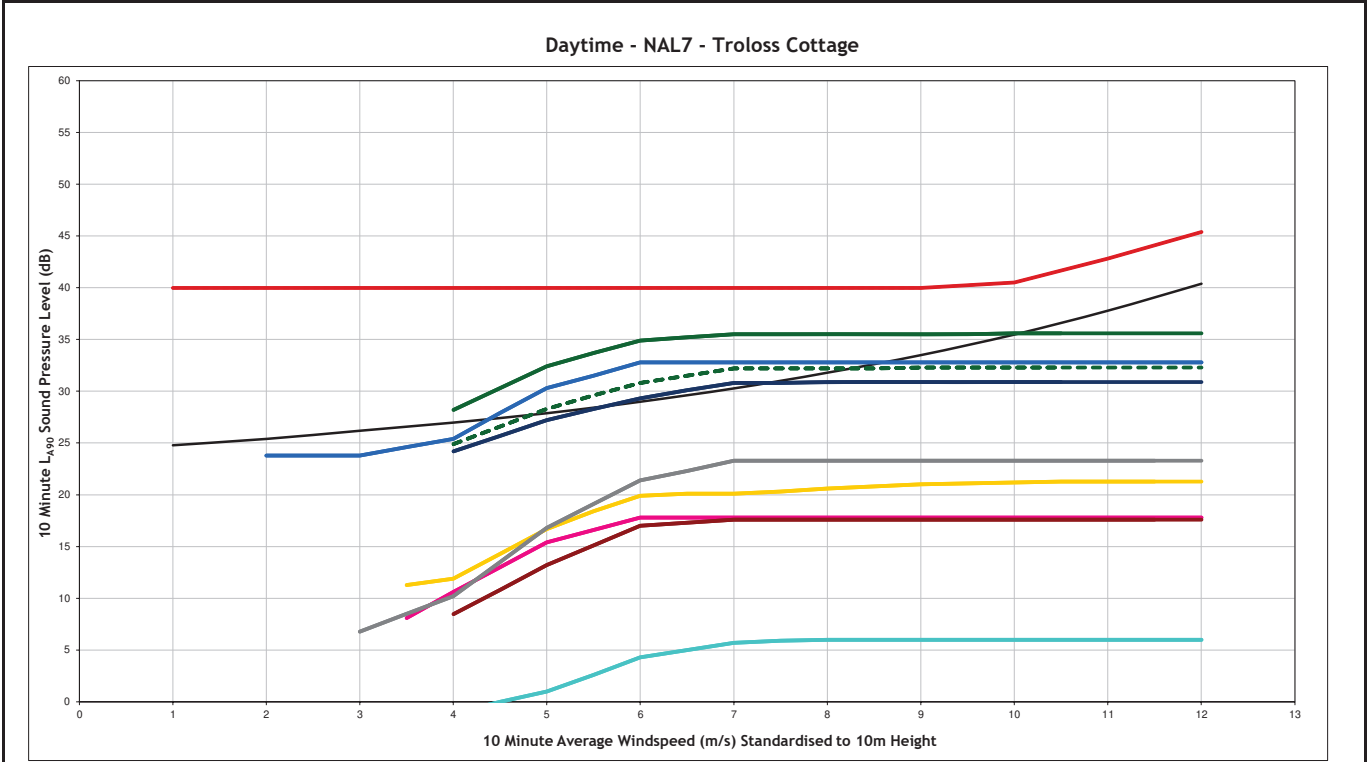
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	Client	Watchman Energy Park Limited
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Document Reference 16380 - Models		



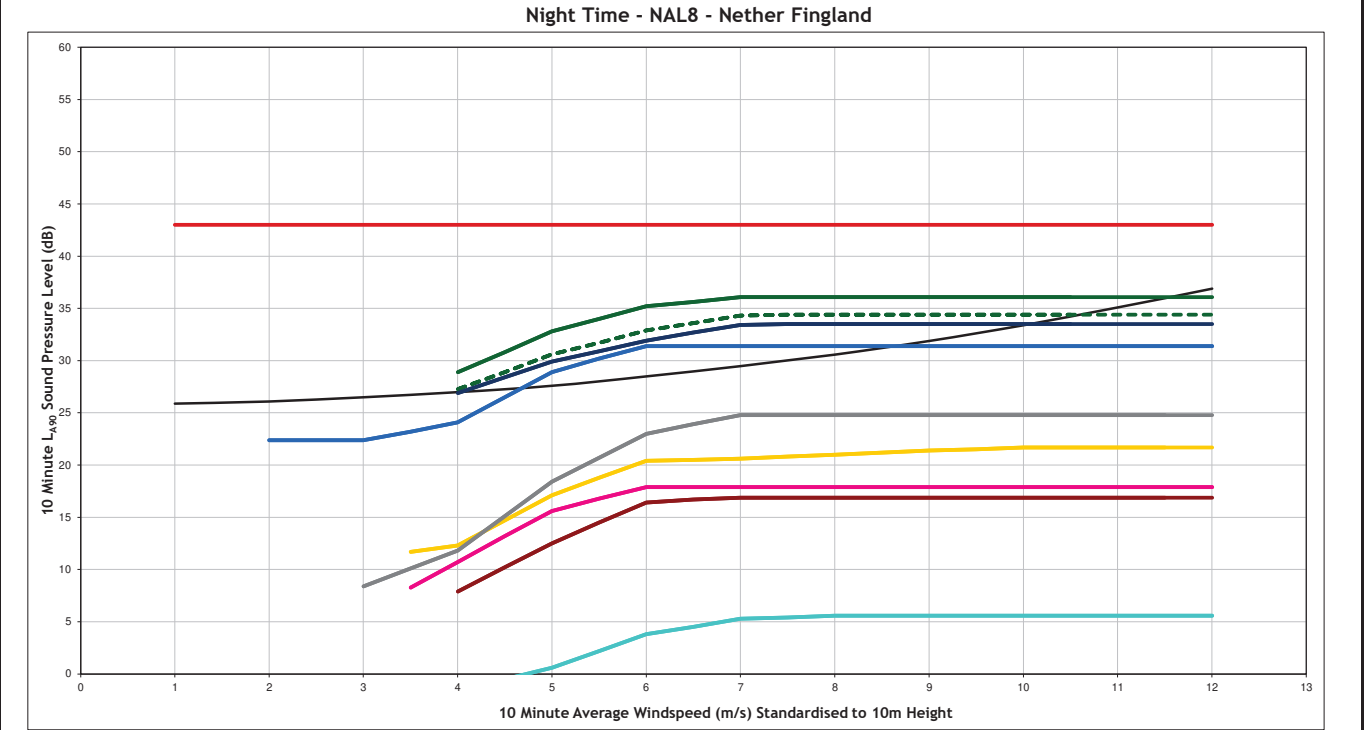
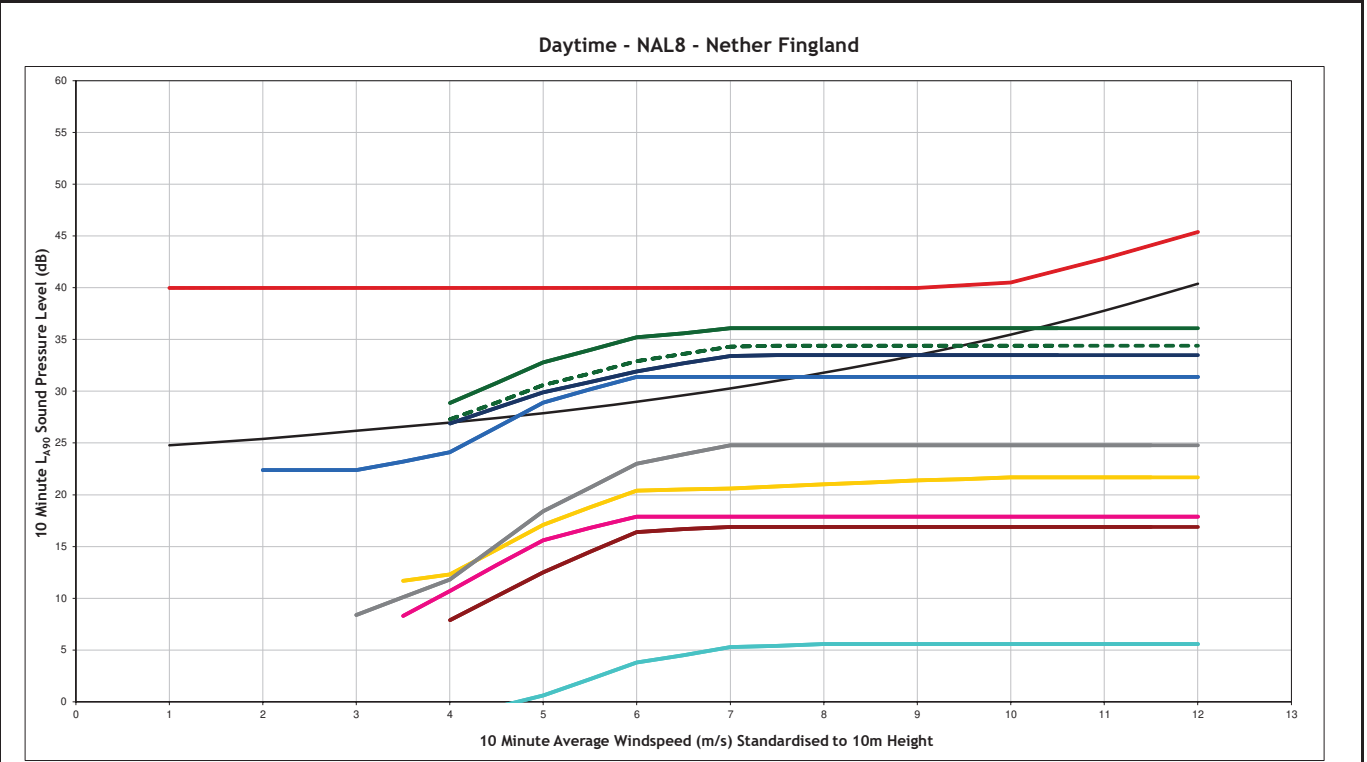
Legend:	Project	Watchman Energy Park
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Background Noise Trendline Total ETSU-R-97-Limit Cumulative (Including the Proposed Development) Cumulative (Excluding the Proposed Development) Proposed Development Clyde & Clyde Extension Daer Harestanes (inc. South & West) Minnygap Rivox Wind Energy Hub Crookedstane & Lion Hill	Title	Likely Noise Predictions
	Figure Number	Figure A1.3e
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Date	29/09/2025	
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Renewco POWER tnei		



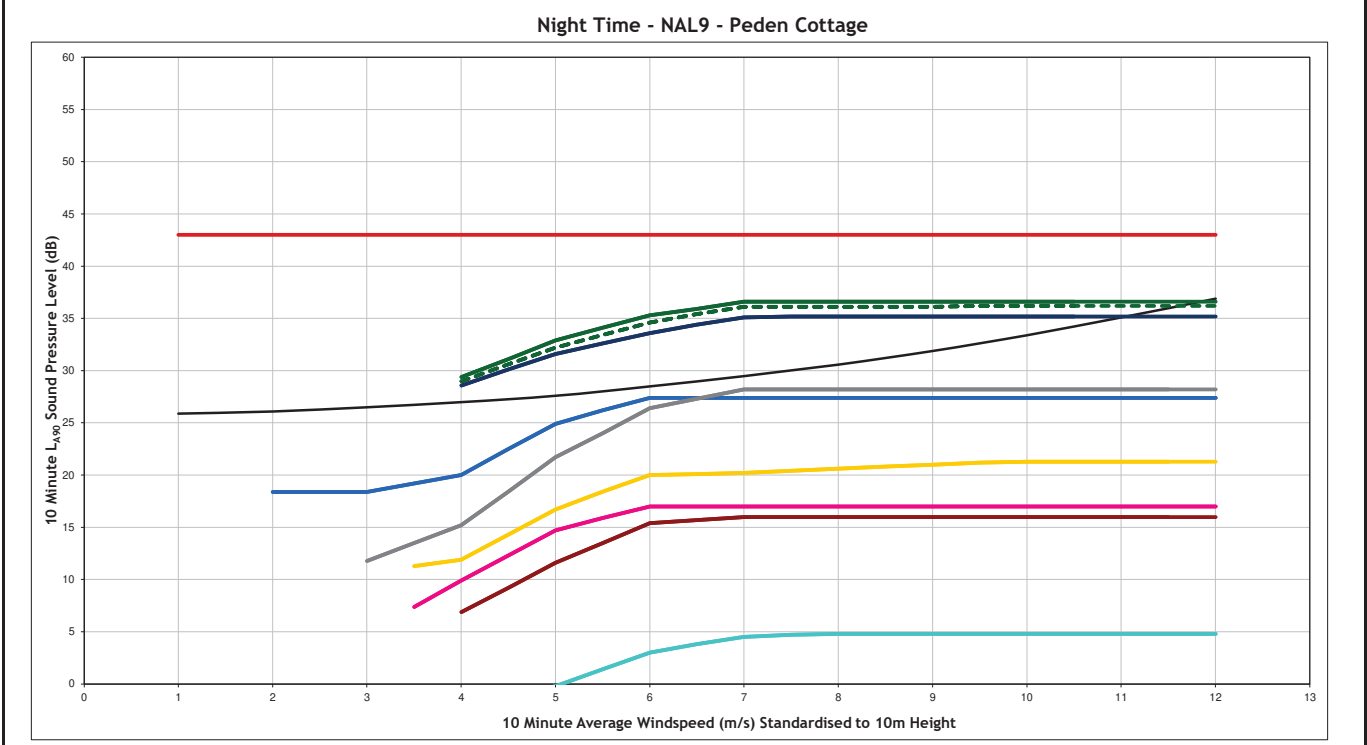
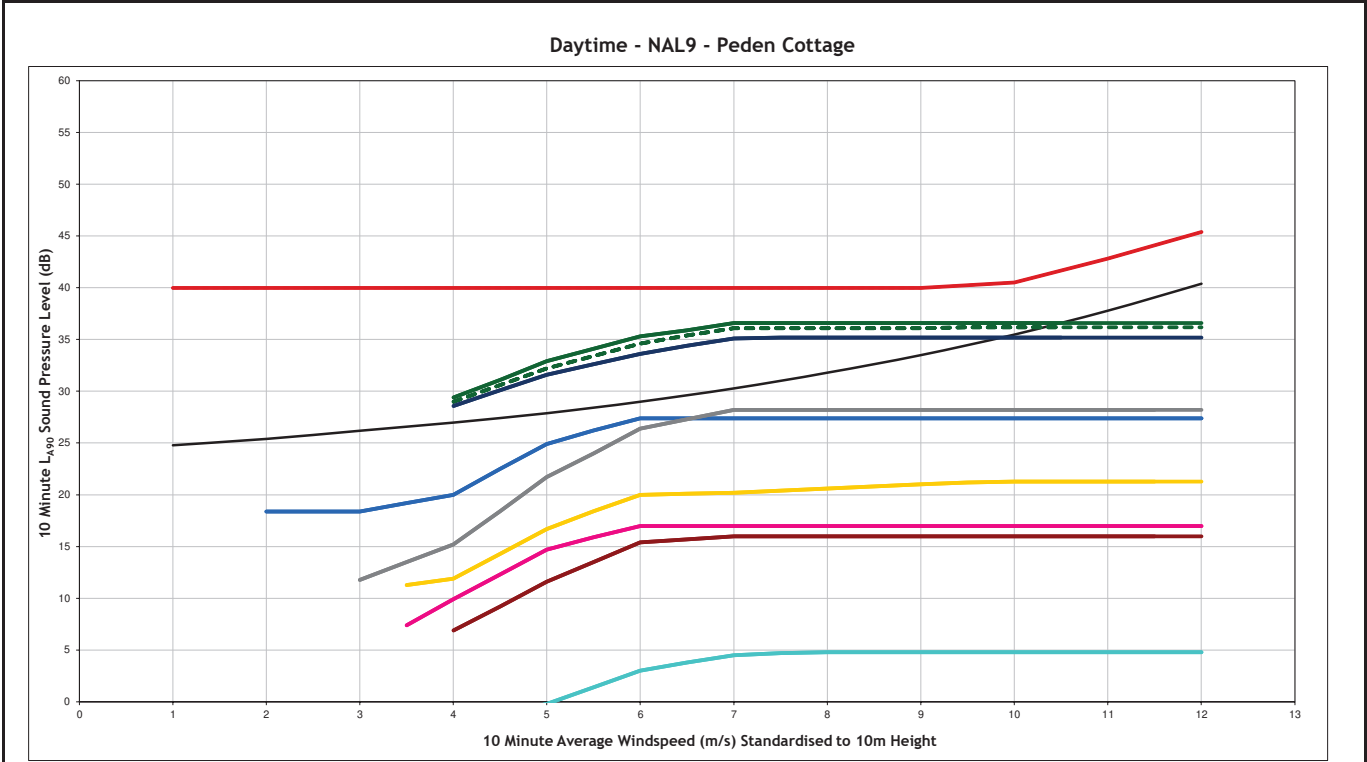
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Background Noise Trendline Total ETSU-R-97-Limit Cumulative (Including the Proposed Development) Cumulative (Excluding the Proposed Development) Proposed Development Clyde & Clyde Extension Daer Harestanes (inc. South & West) Minnygap Rivox Wind Energy Hub Crookedstane & Lion Hill	Title	Likely Noise Predictions
	Figure Number	Figure A1.3f
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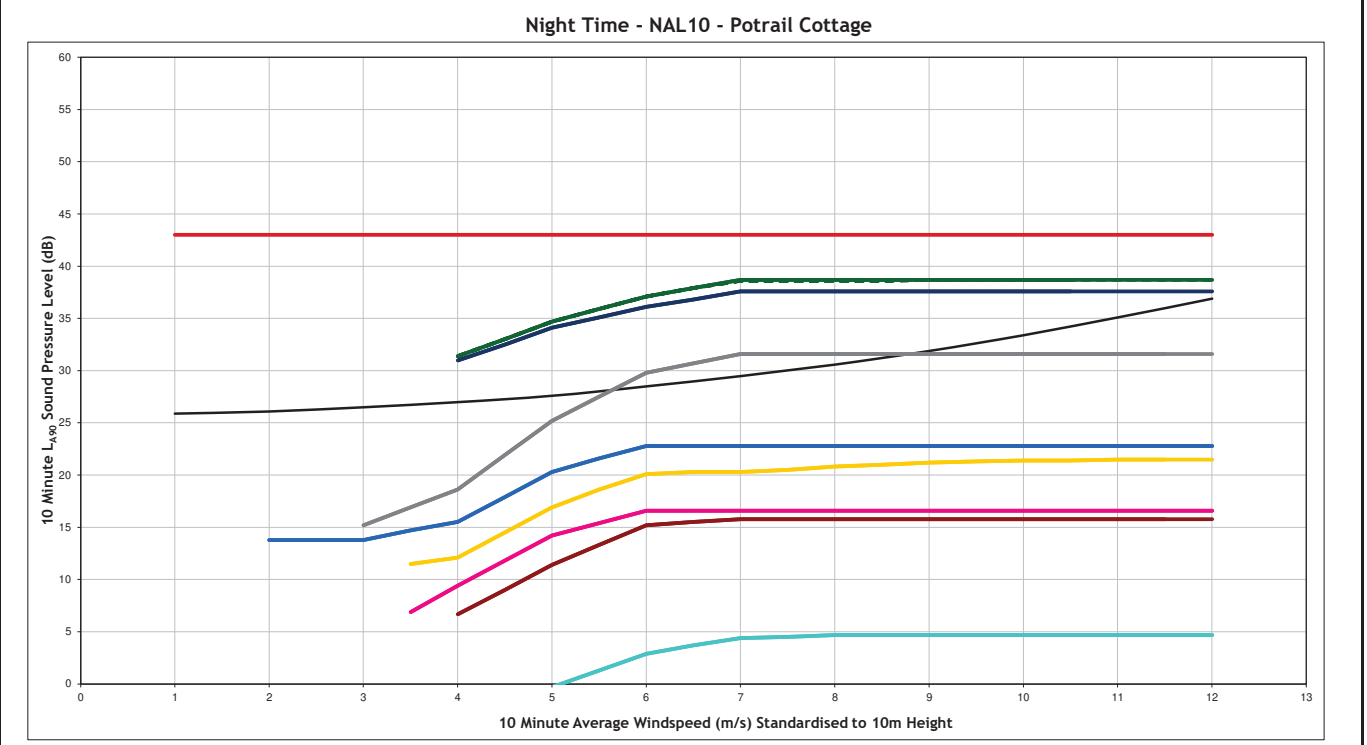
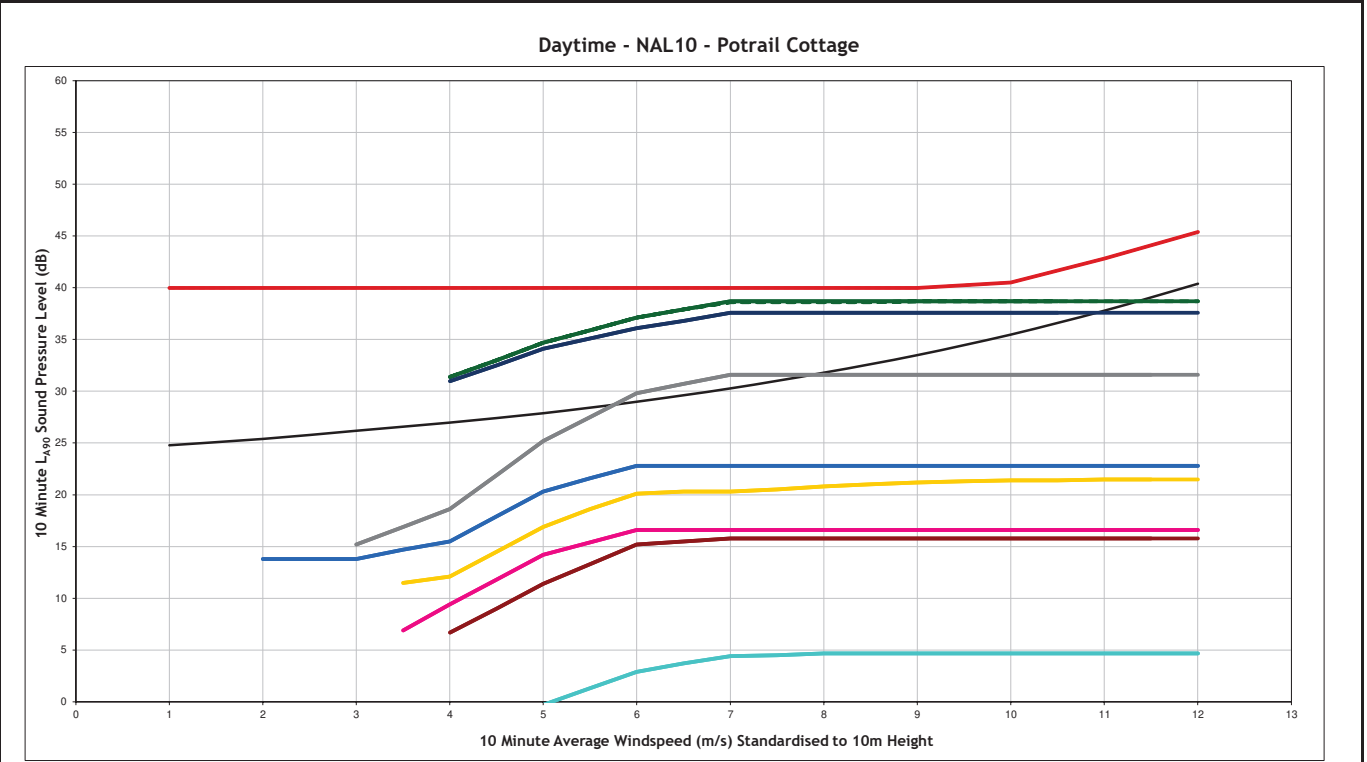
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	Client	Watchman Energy Park Limited
Background Noise Trendline Total ETSU-R-97-Limit Cumulative (Including the Proposed Development) Cumulative (Excluding the Proposed Development) Proposed Development Clyde & Clyde Extension Daer Harestanes (inc. South & West) Minnygap Rivox Wind Energy Hub Crookedstane & Lion Hill	Title	Likely Noise Predictions
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Date	29/09/2025	
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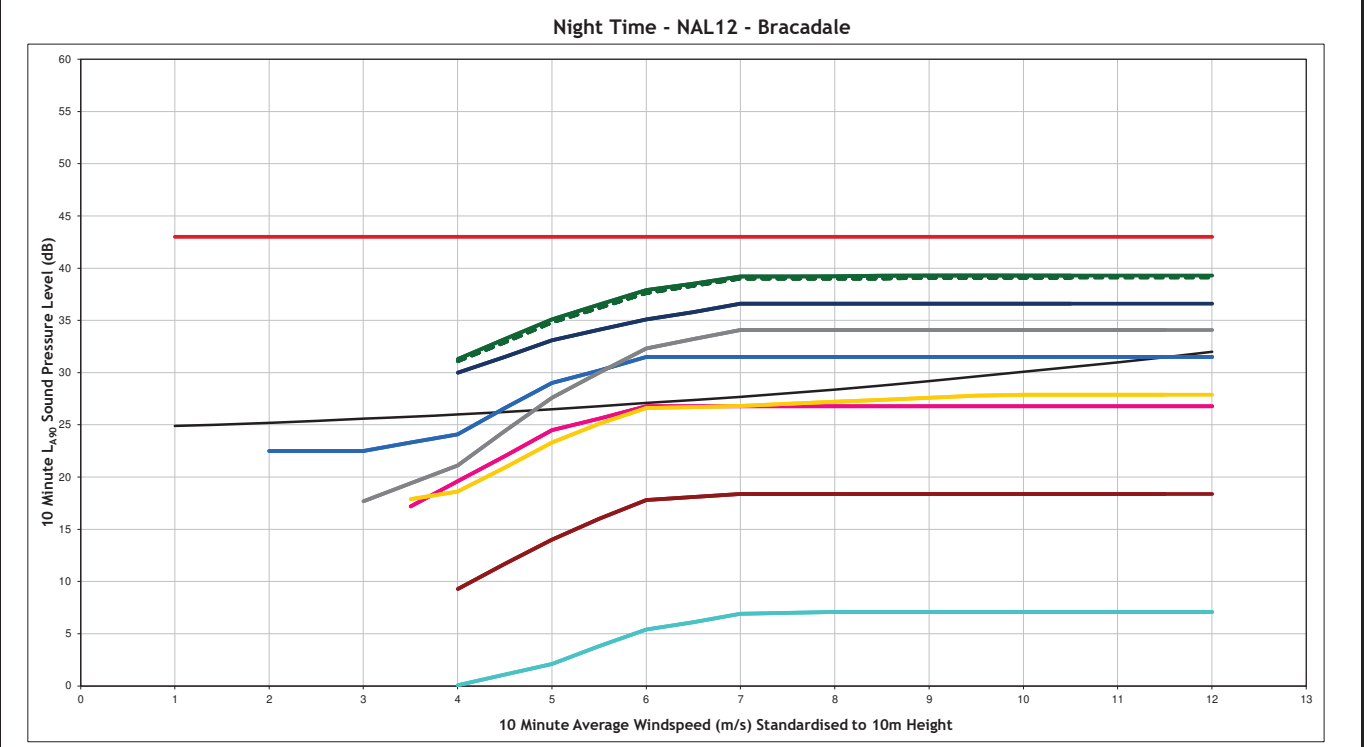
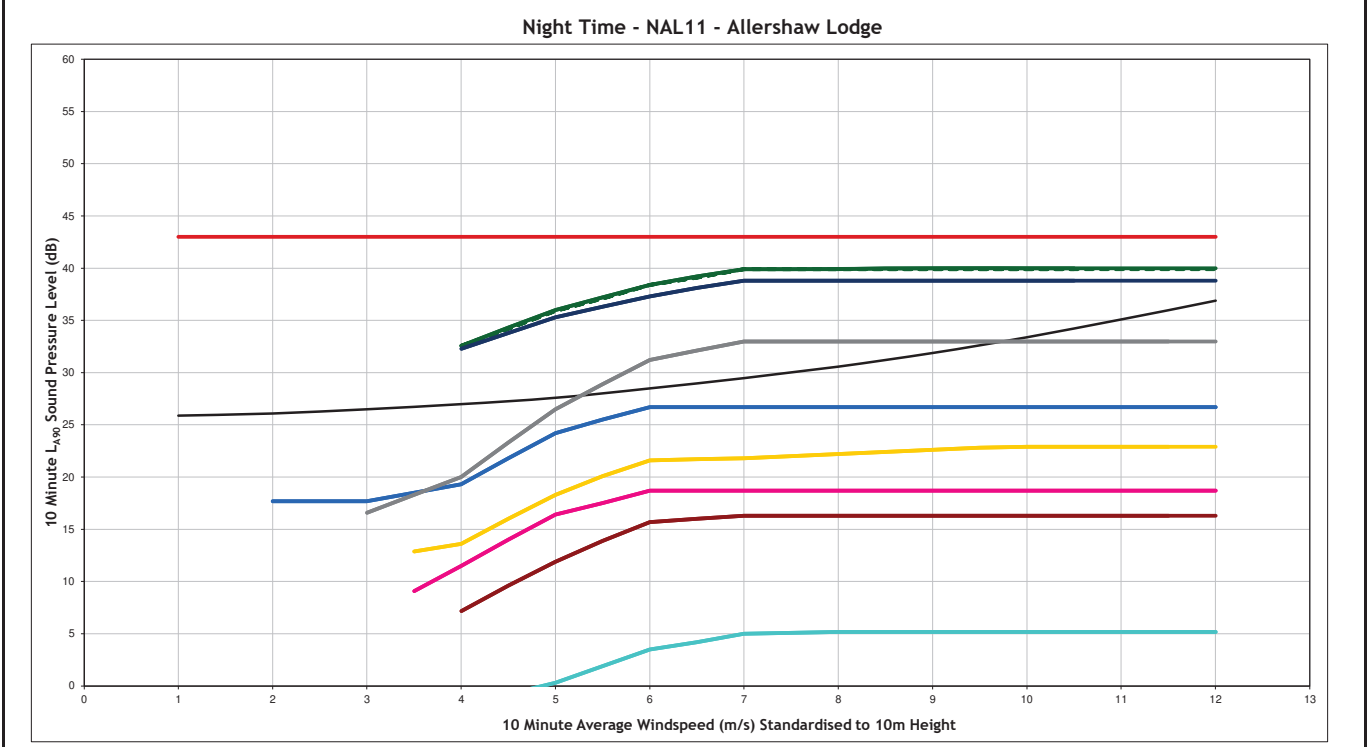
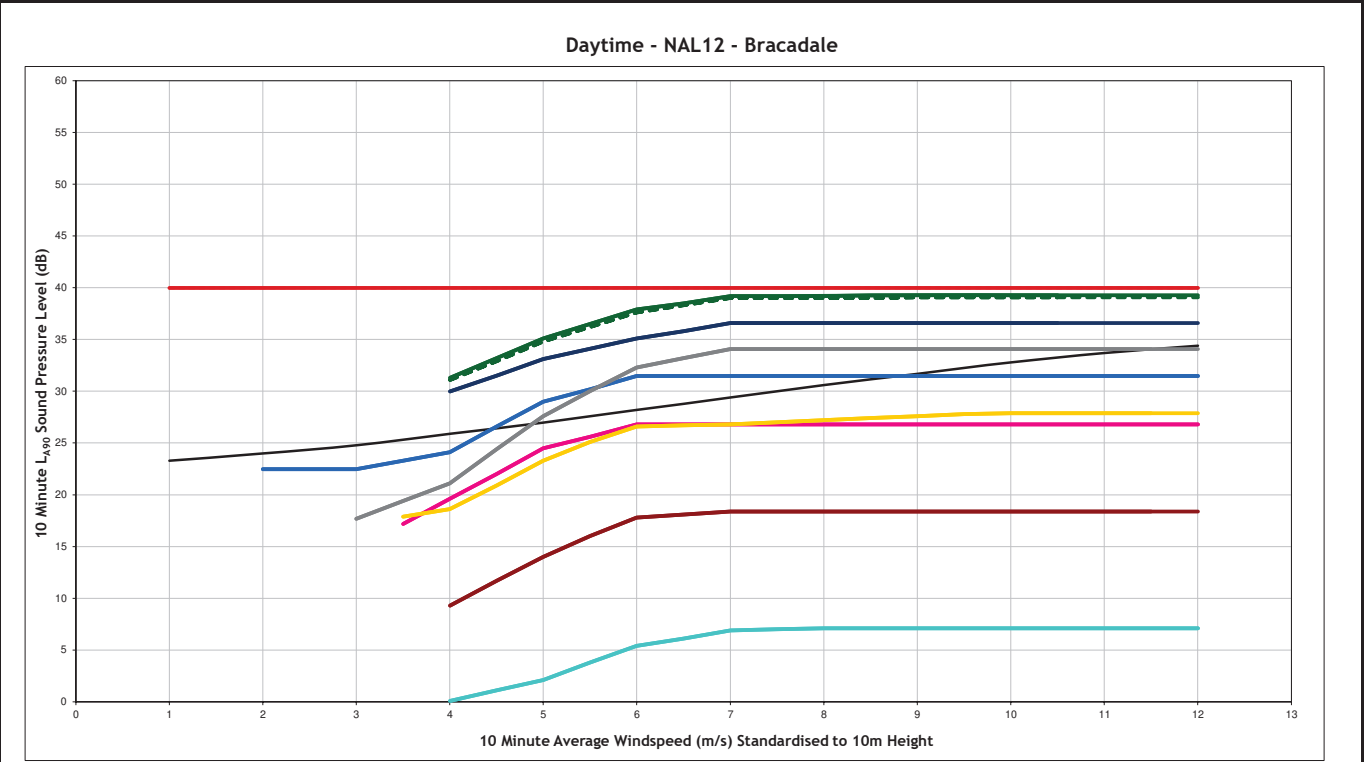
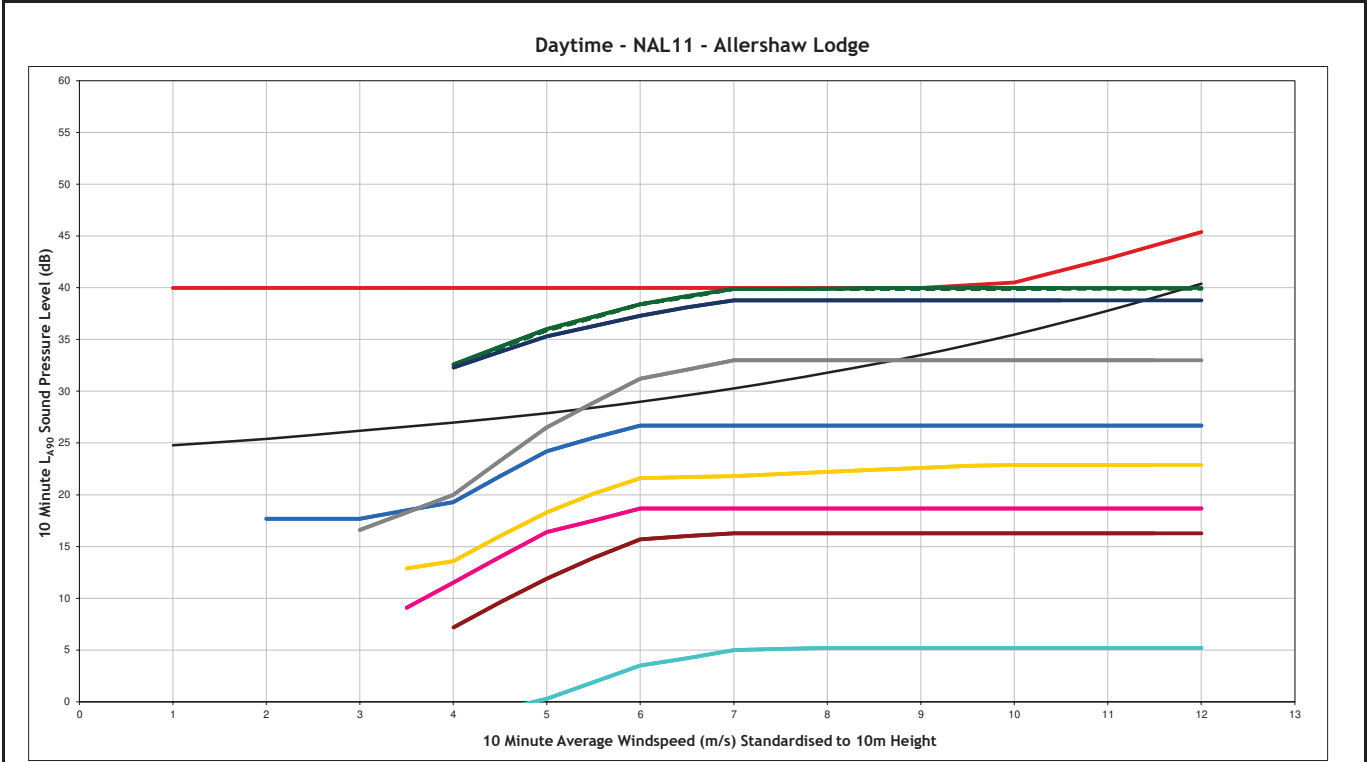
Legend:	Project	Watchman Energy Park
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Background Noise Trendline Total ETSU-R-97-Limit Cumulative (Including the Proposed Development) Cumulative (Excluding the Proposed Development) Proposed Development Clyde & Clyde Extension Daer Harestanes (inc. South & West) Minnygap Rivox Wind Energy Hub Crookedstane & Lion Hill	Title	Likely Noise Predictions
	Figure Number	Figure A1.3h
Scale	NTS	
Drawn	AD	
Checked	GC	
Date	29/09/2025	
Document Reference	16380 - Models	



Legend:	Project	Watchman Energy Park
	Client	Watchman Energy Park Limited
Background Noise Trendline Total ETSU-R-97-Limit Cumulative (Including the Proposed Development) Cumulative (Excluding the Proposed Development) Proposed Development Clyde & Clyde Extension Daer Harestanes (inc. South & West) Minnygap Rivox Wind Energy Hub Crookedstane & Lion Hill	Title	Likely Noise Predictions
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	Document Reference	16380 - Models

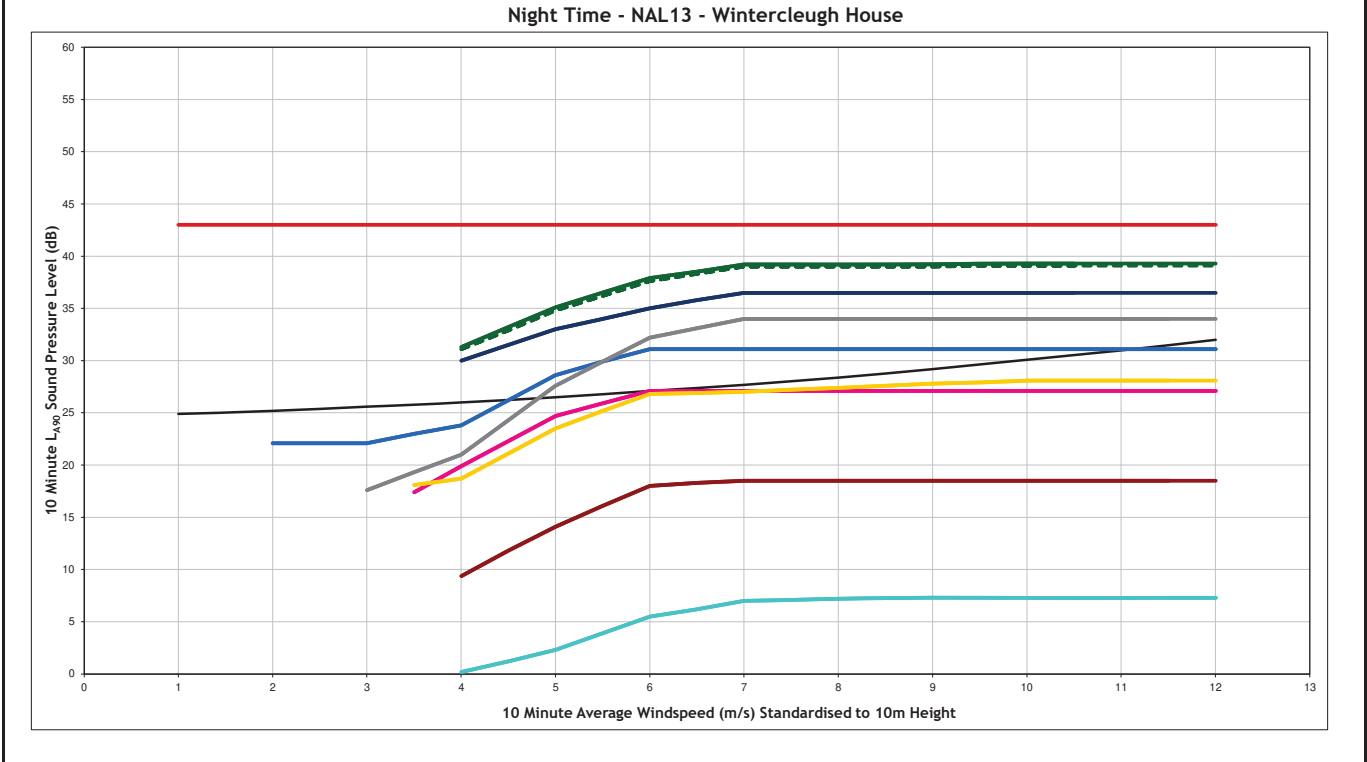
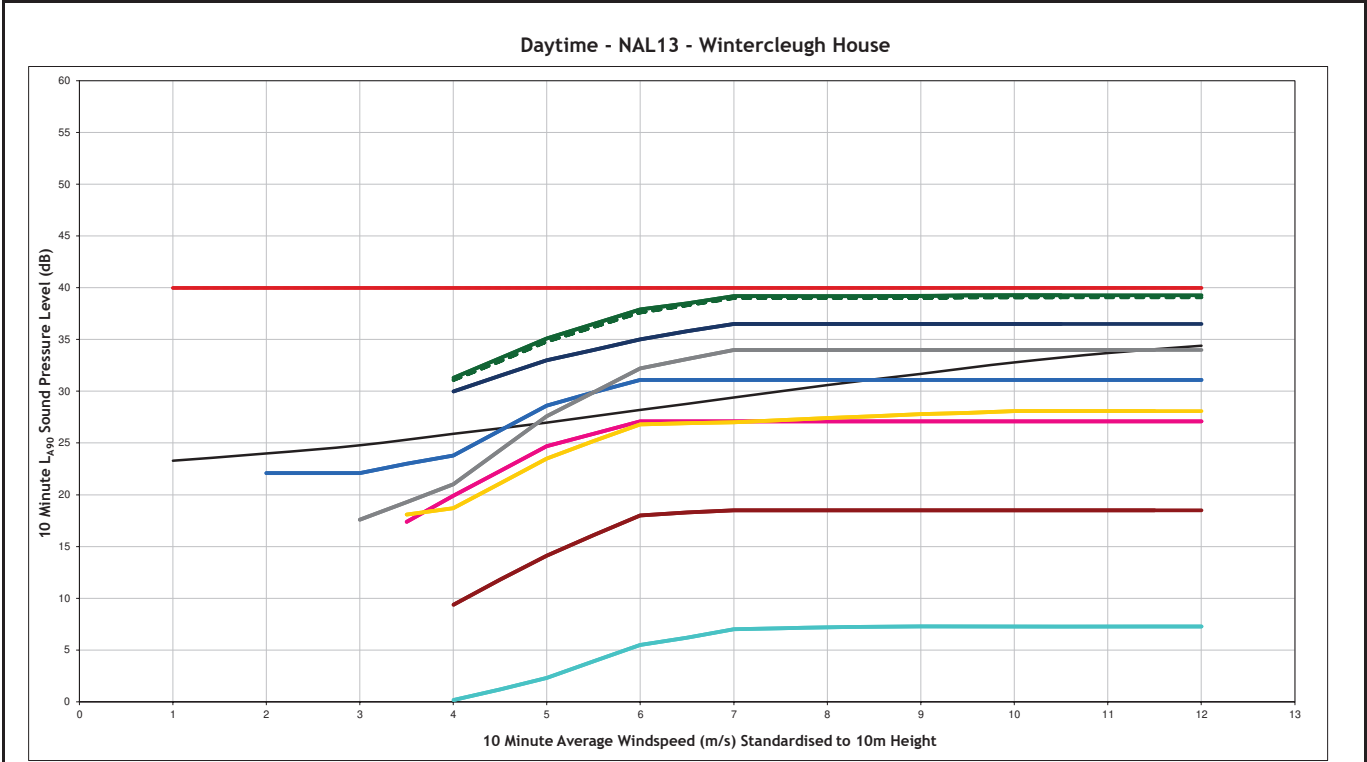


Legend:	Project	Watchman Energy Park
	Client	Watchman Energy Park Limited
Background Noise Trendline Total ETSU-R-97-Limit Cumulative (Including the Proposed Development) Cumulative (Excluding the Proposed Development) Proposed Development Clyde & Clyde Extension Daer Harestanes (inc. South & West) Minnygap Rivox Wind Energy Hub Crookedstane & Lion Hill	Title	Likely Noise Predictions
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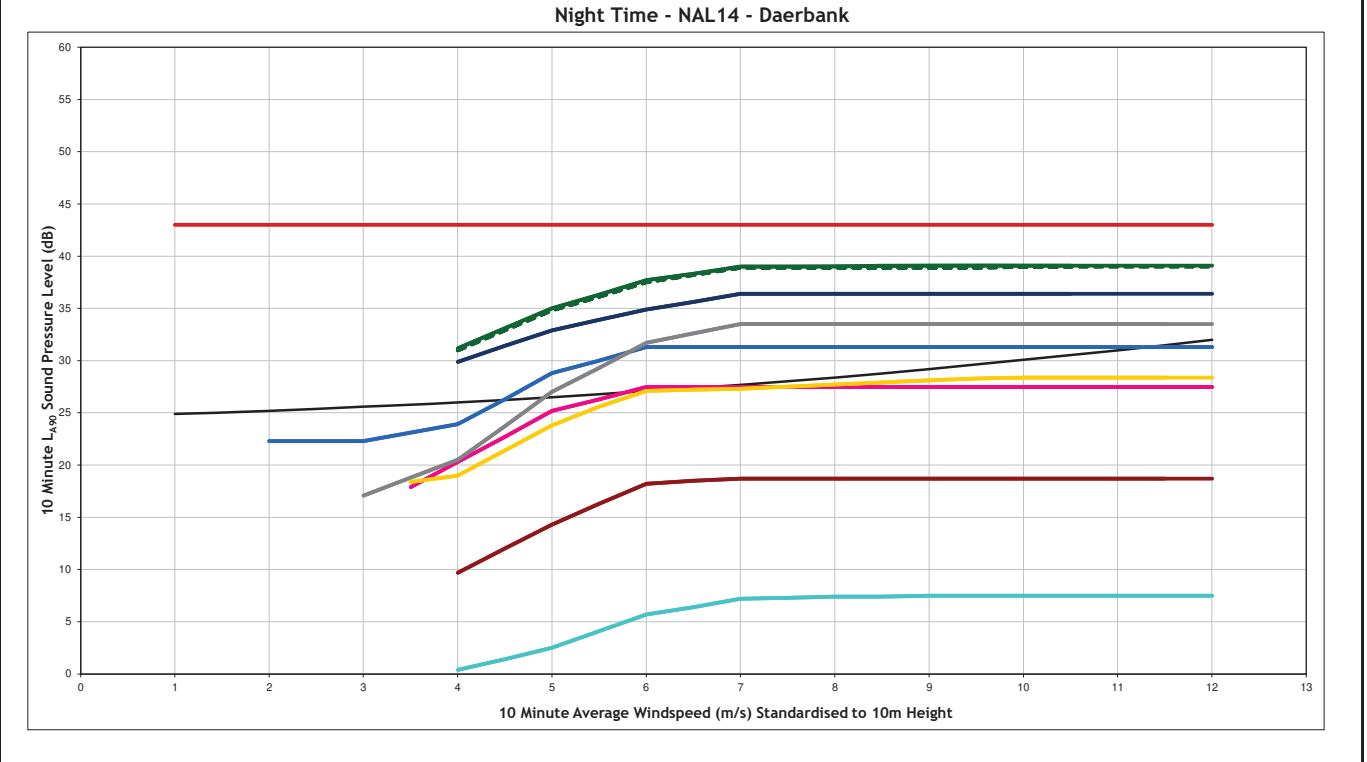
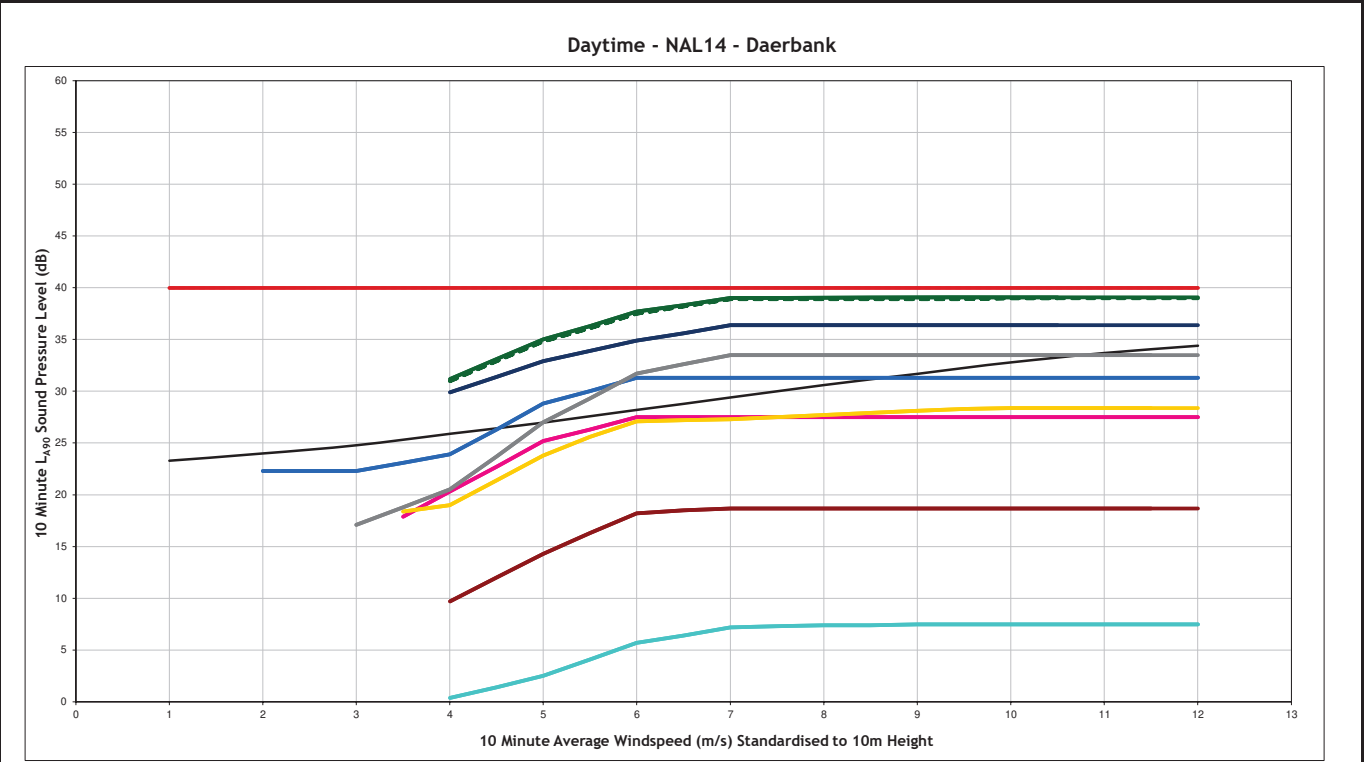


Legend:	Project	Watchman Energy Park
	Client	Watchman Energy Park Limited
Background Noise Trendline Total ETSU-R-97-Limit Cumulative (Including the Proposed Development) Cumulative (Excluding the Proposed Development) Proposed Development Clyde & Clyde Extension Daer Harestanes (inc. South & West) Minnygap Rivox Wind Energy Hub Crookedstane & Lion Hill	Title	Likely Noise Predictions
	Figure Number	Figure A1.3k
	Scale	NTS
	Drawn	AD
	Checked	GC
	Date	29/09/2025
	Document Reference	16380 - Models
Renewco POWER tnei		

Legend:	Project	Watchman Energy Park
	Client	Watchman Energy Park Limited
Background Noise Trendline Total ETSU-R-97-Limit Cumulative (Including the Proposed Development) Cumulative (Excluding the Proposed Development) Proposed Development Clyde & Clyde Extension Daer Harestanes (inc. South & West) Minnygap Rivox Wind Energy Hub Crookedstane & Lion Hill	Title	Likely Noise Predictions
	Figure Number	Figure A1.3l
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Renewco POWER tnei		

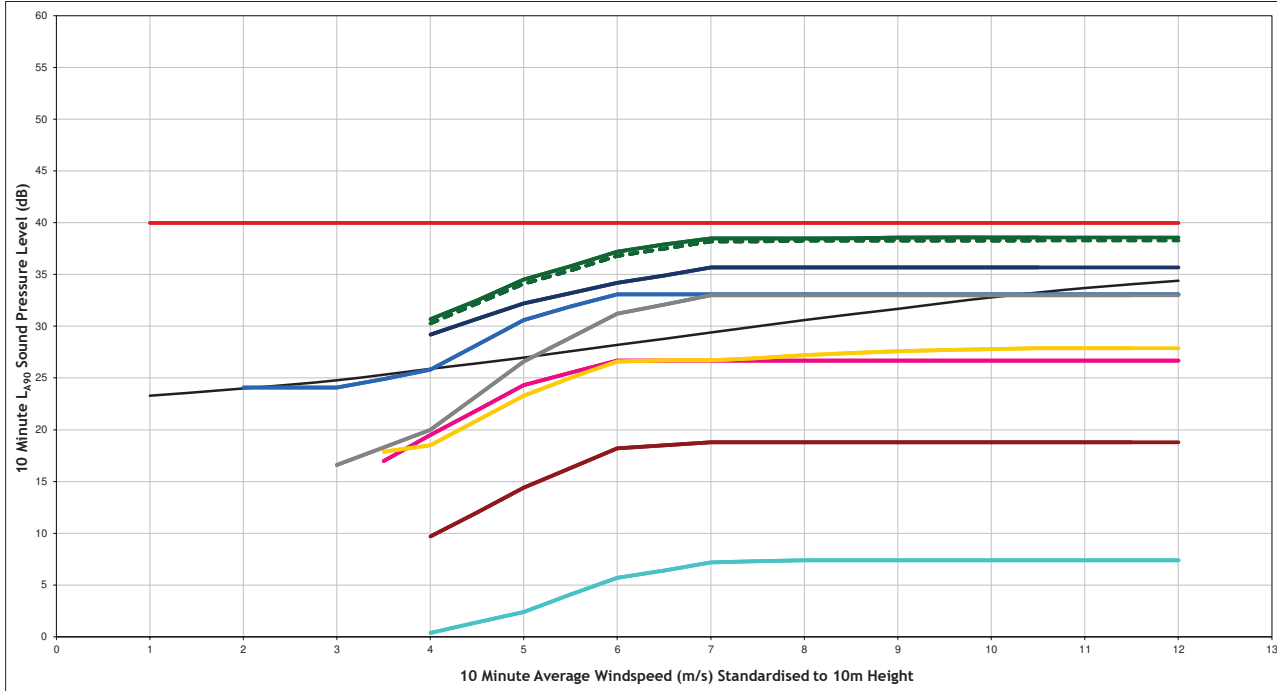


Legend:	Project	Watchman Energy Park
	Client	Watchman Energy Park Limited
Background Noise Trendline Total ETSU-R-97-Limit Cumulative (Including the Proposed Development) Cumulative (Excluding the Proposed Development) Proposed Development Clyde & Clyde Extension Daer Harestanes (inc. South & West) Minnygap Rivox Wind Energy Hub Crookedstane & Lion Hill	Title	Likely Noise Predictions
	Figure Number	Figure A1.3m
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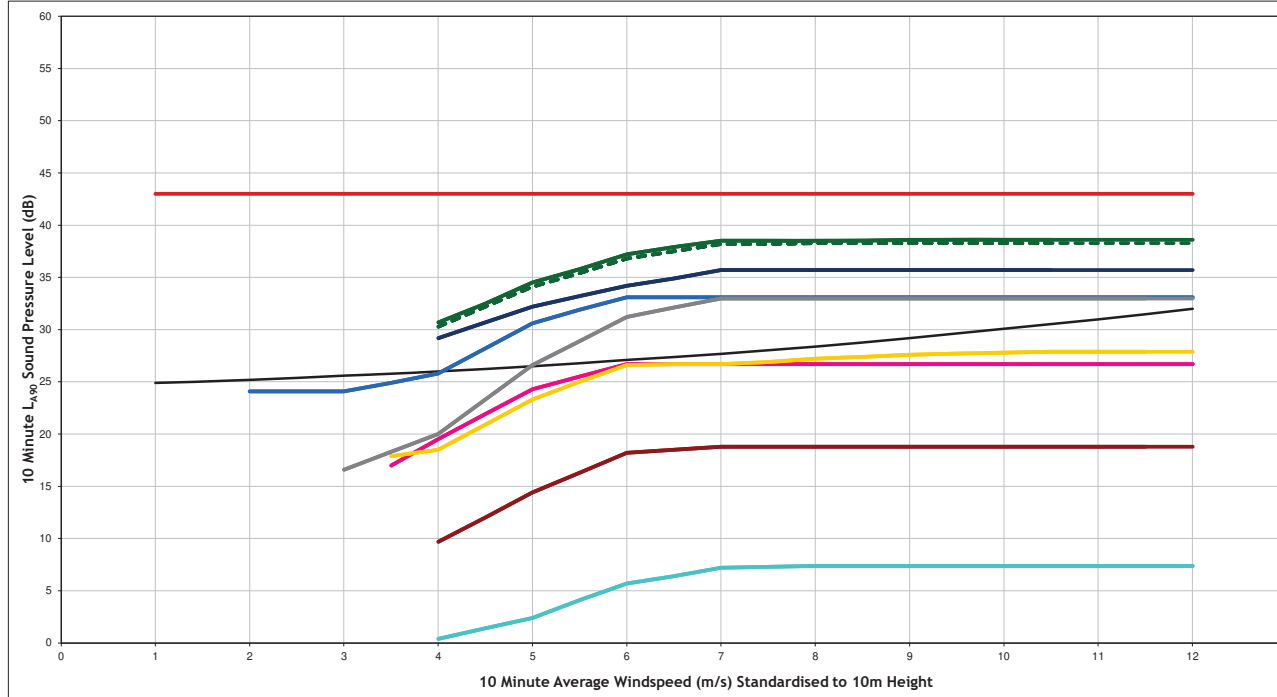


Legend:	Project	Watchman Energy Park
	Client	Watchman Energy Park Limited
Background Noise Trendline Total ETSU-R-97-Limit Cumulative (Including the Proposed Development) Cumulative (Excluding the Proposed Development) Proposed Development Clyde & Clyde Extension Daer Harestanes (inc. South & West) Minnygap Rivox Wind Energy Hub Crookedstane & Lion Hill	Title	Likely Noise Predictions
	Figure Number	Figure A1.3n
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	Document Reference	16380 - Models
Renewco POWER tnei		

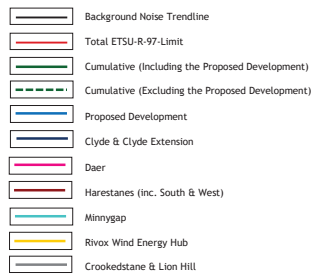
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Night Time - NAL15 - Hitteril



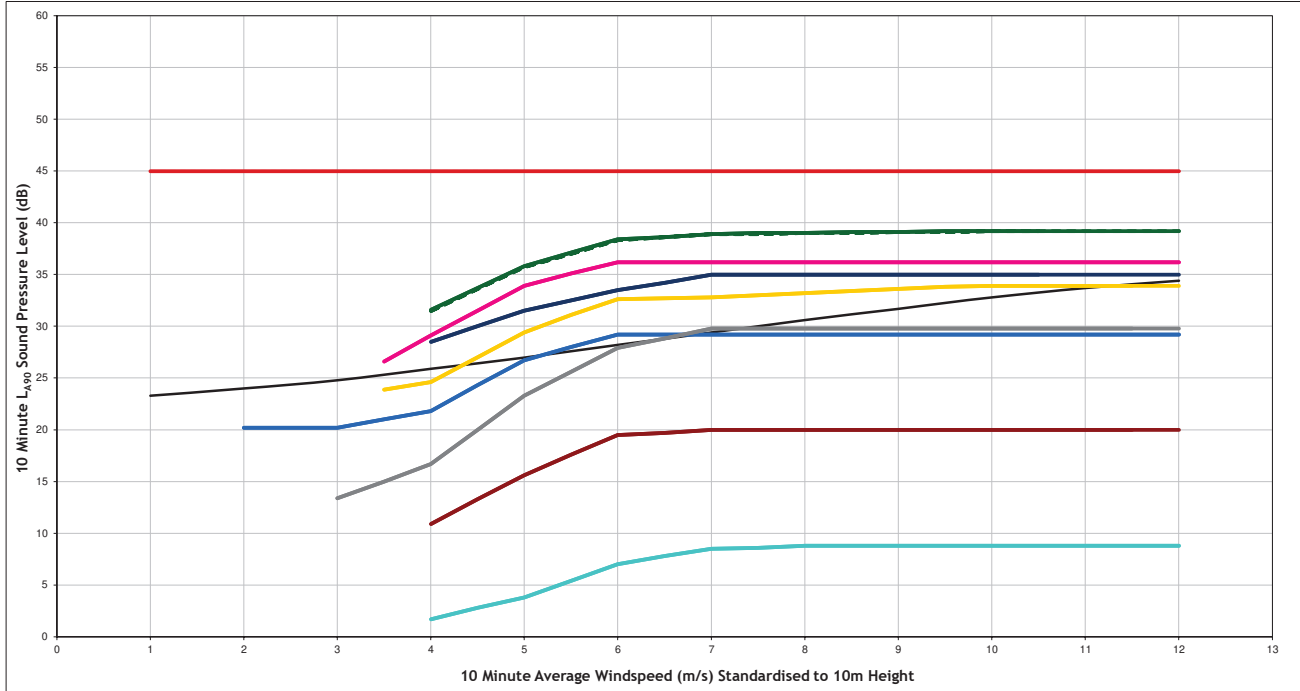
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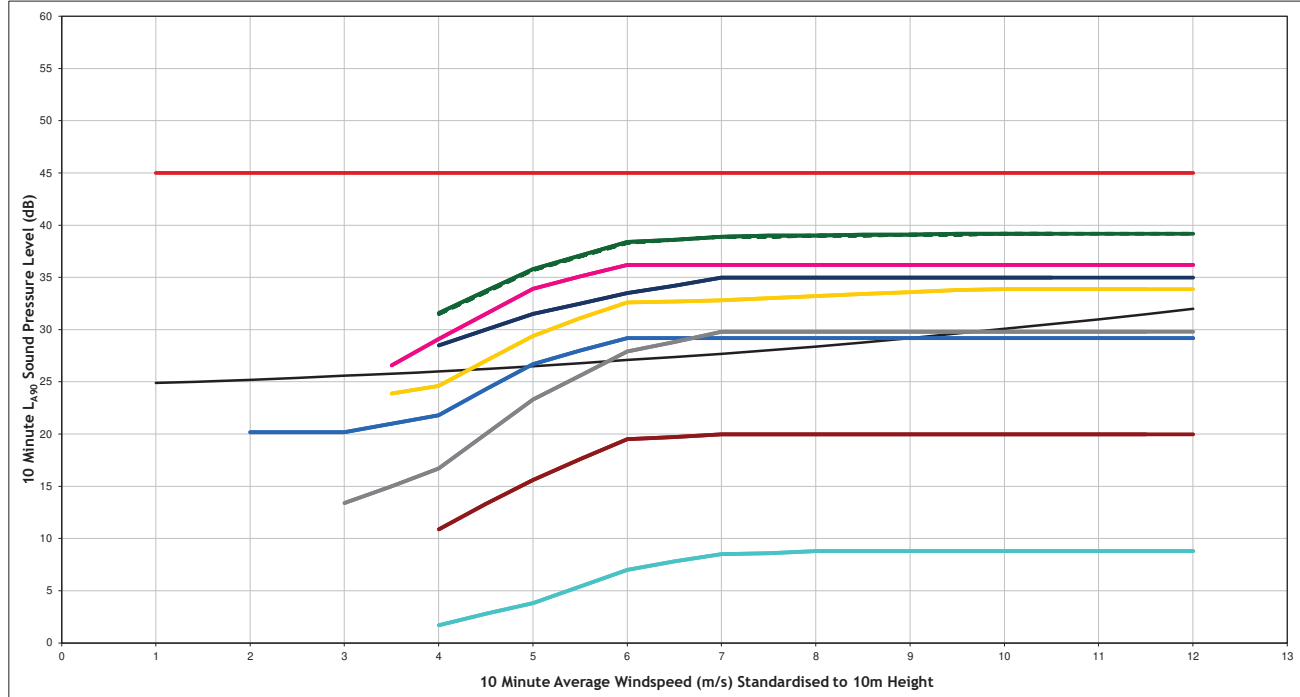
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Client Watchman Energy Park Limited
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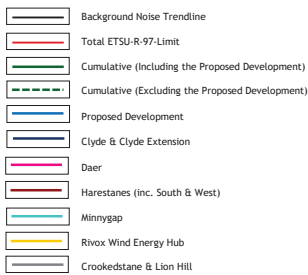
Daytime - NAL16 - Sweetshaw Foot



Night Time - NAL16 - Sweetshaw Foot

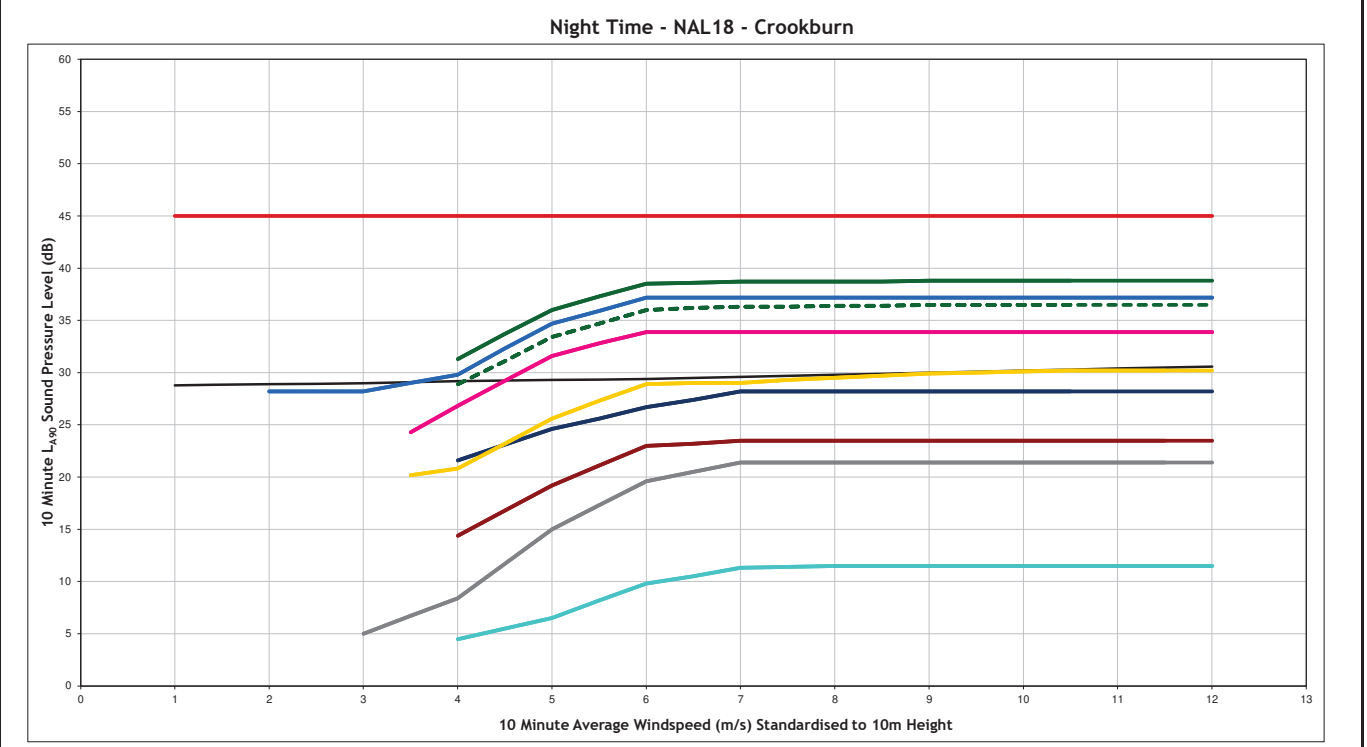
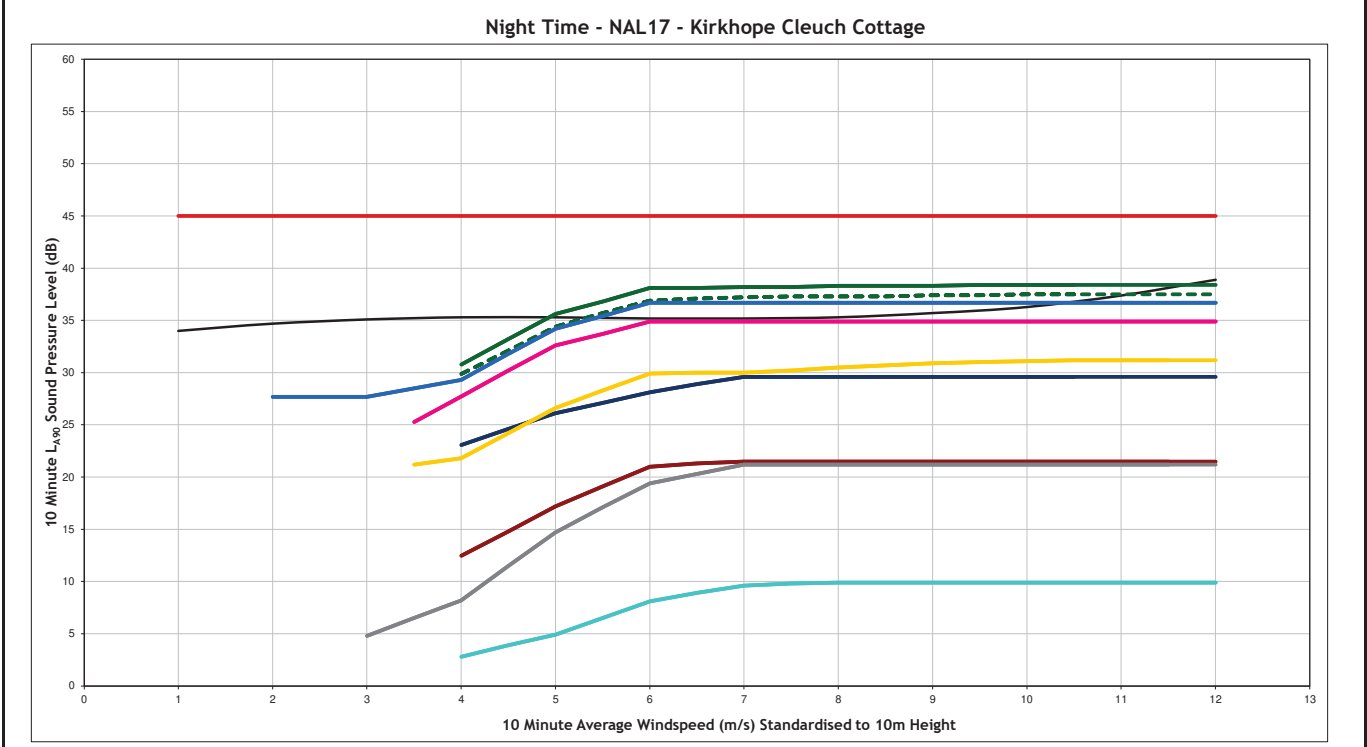
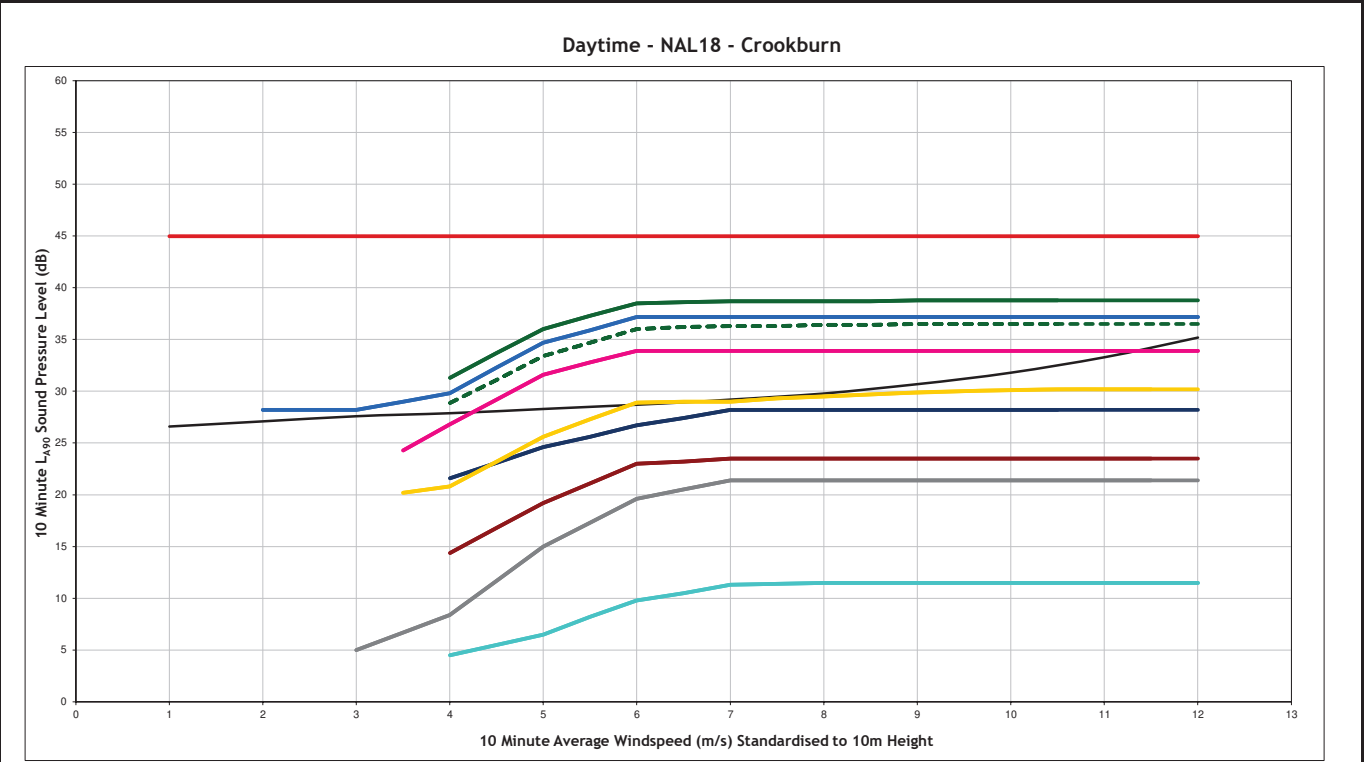
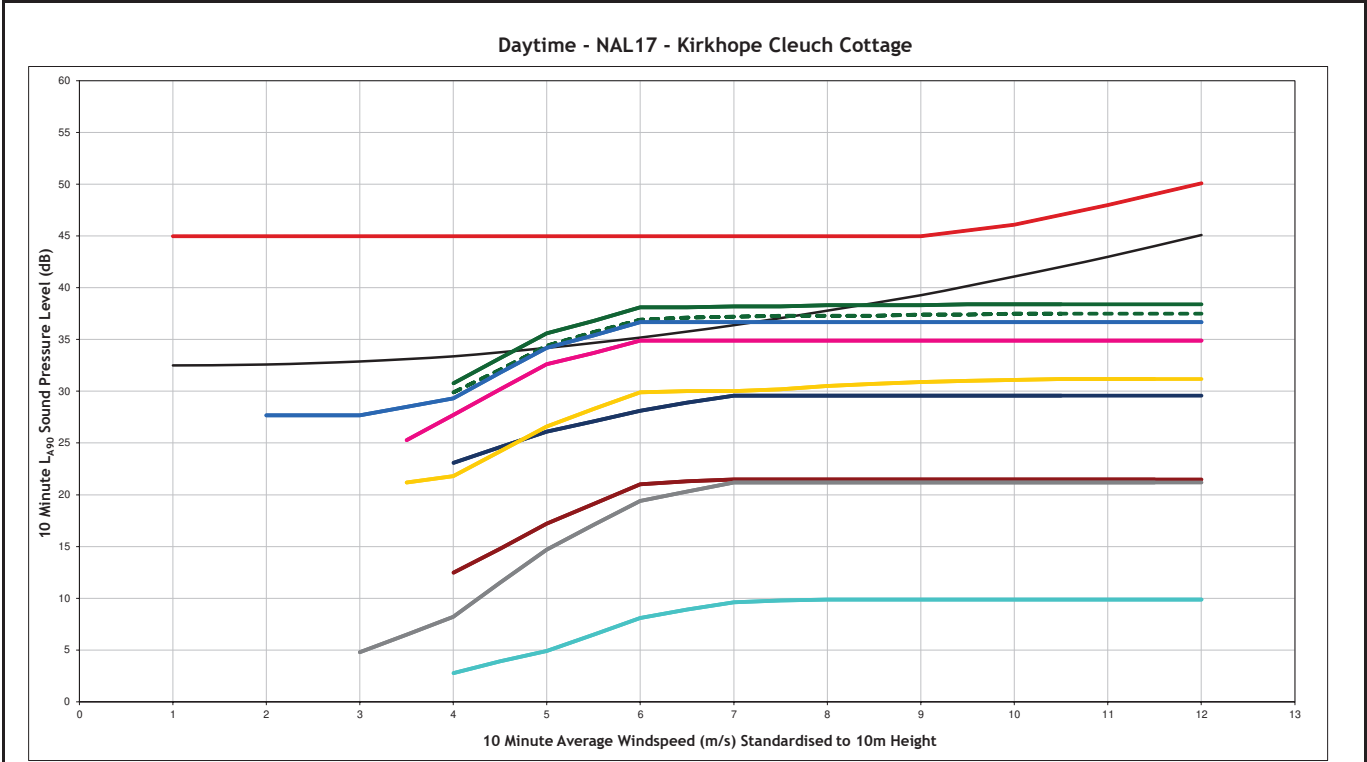


Legend:



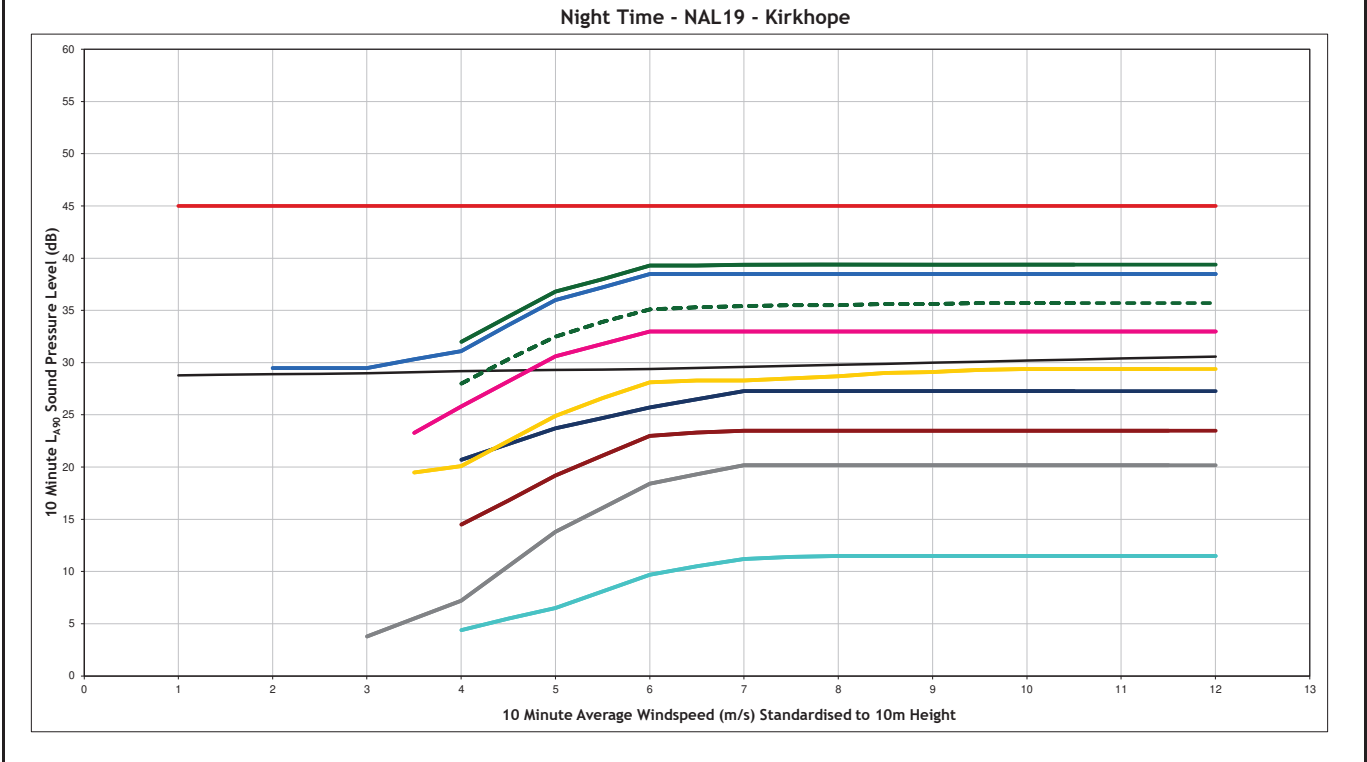
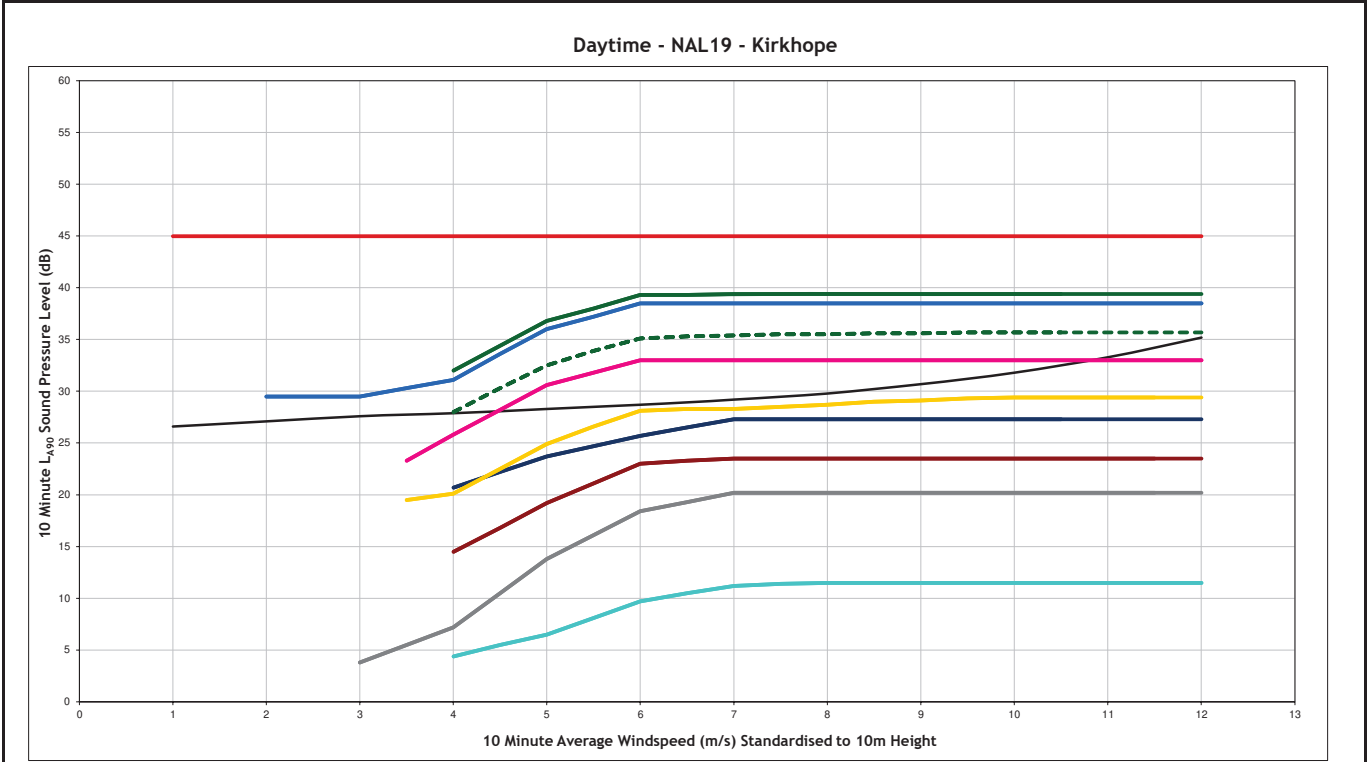
Project Watchman Energy Park
Client Watchman Energy Park Limited
Title Likely Noise Predictions
NAL16 - Sweetshaw Foot
Figure Number Figure A1.3p
Scale NTS
Drawn AD
Checked GC
Date 29/09/2025
Document Reference 16380 - Models



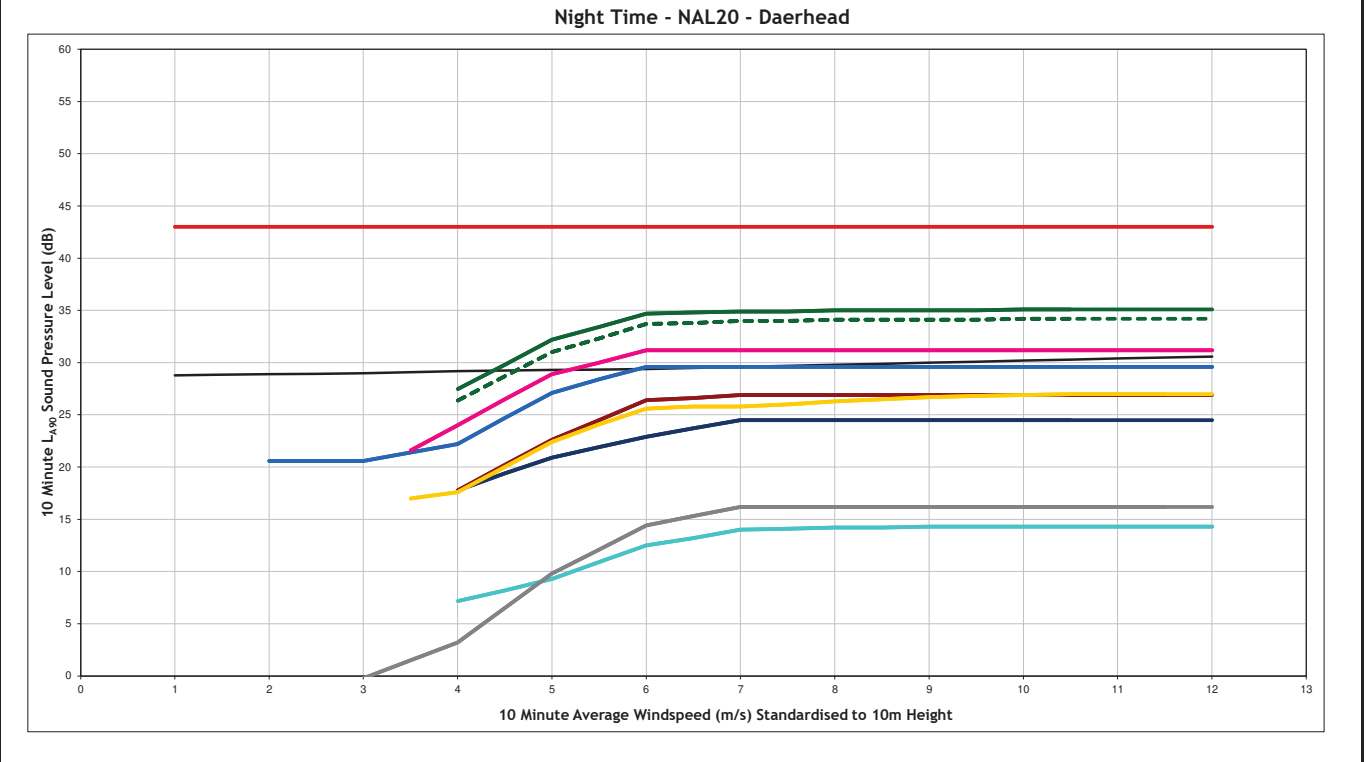
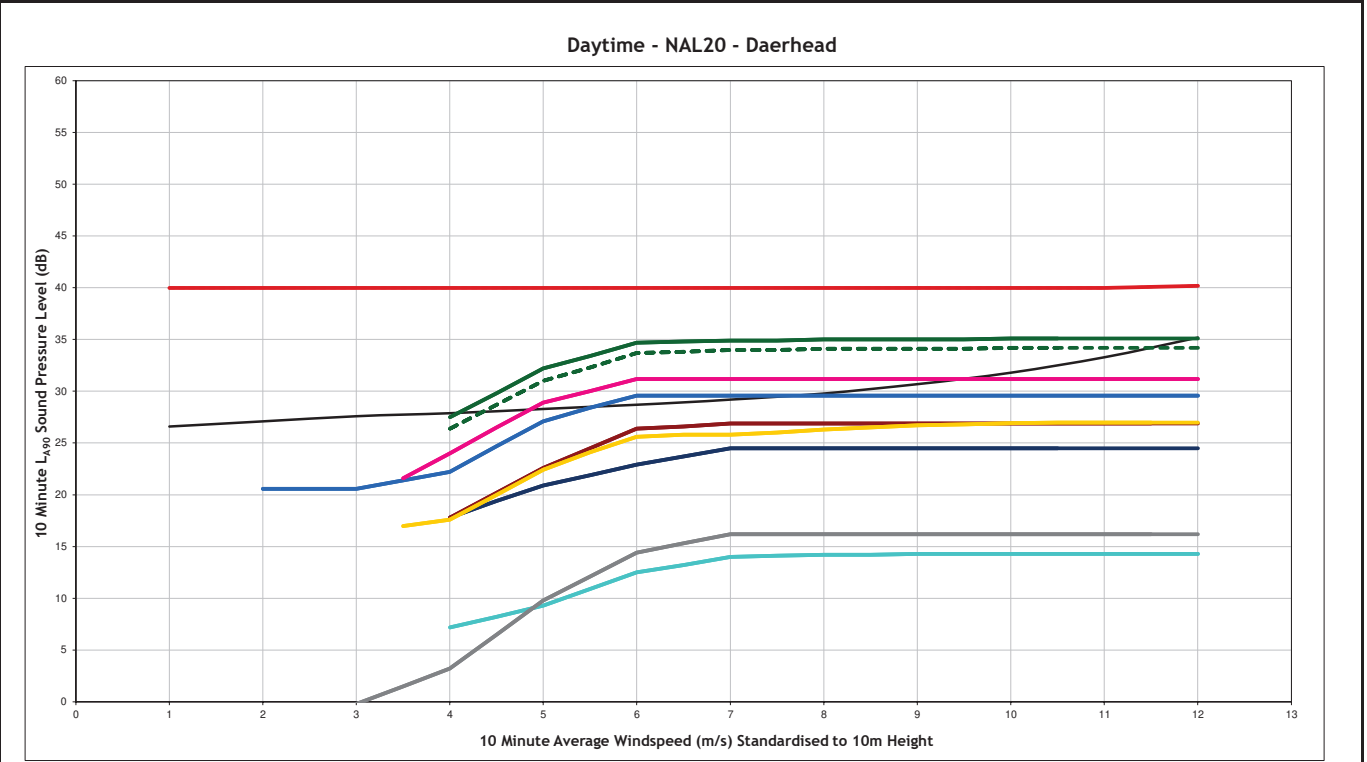


Legend:	Project	Watchman Energy Park
	Client	Watchman Energy Park Limited
Background Noise Trendline Total ETSU-R-97-Limit Cumulative (Including the Proposed Development) Cumulative (Excluding the Proposed Development) Proposed Development Clyde & Clyde Extension Daer Harestanes (inc. South & West) Minnygap Rivox Wind Energy Hub Crookedstane & Lion Hill	Title	Likely Noise Predictions NAL17 - Kirkhope Cleuch Cottage
	Figure Number	Figure A1.3q
	Scale	NTS
	Drawn	AD
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	Date	29/09/2025
	Document Reference	16380 - Models

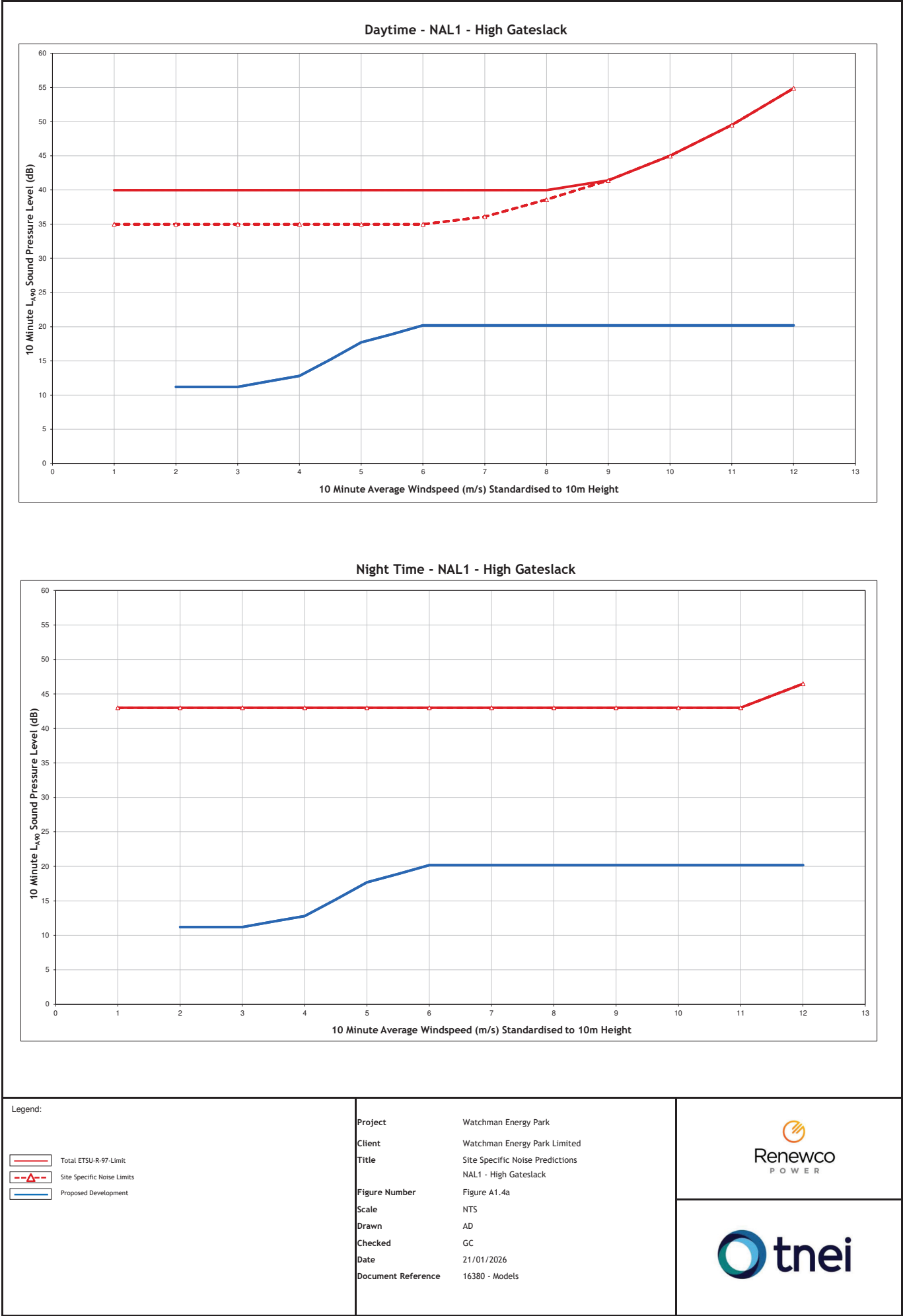
Legend:	Project	Watchman Energy Park
	Client	Watchman Energy Park Limited
Background Noise Trendline Total ETSU-R-97-Limit Cumulative (Including the Proposed Development) Cumulative (Excluding the Proposed Development) Proposed Development Clyde & Clyde Extension Daer Harestanes (inc. South & West) Minnygap Rivox Wind Energy Hub Crookedstane & Lion Hill	Title	Likely Noise Predictions NAL18 - Crookburn
	Figure Number	Figure A1.3r
	Scale	NTS
	Drawn	AD
	Checked	GC
	Date	29/09/2025
	Document Reference	16380 - Models

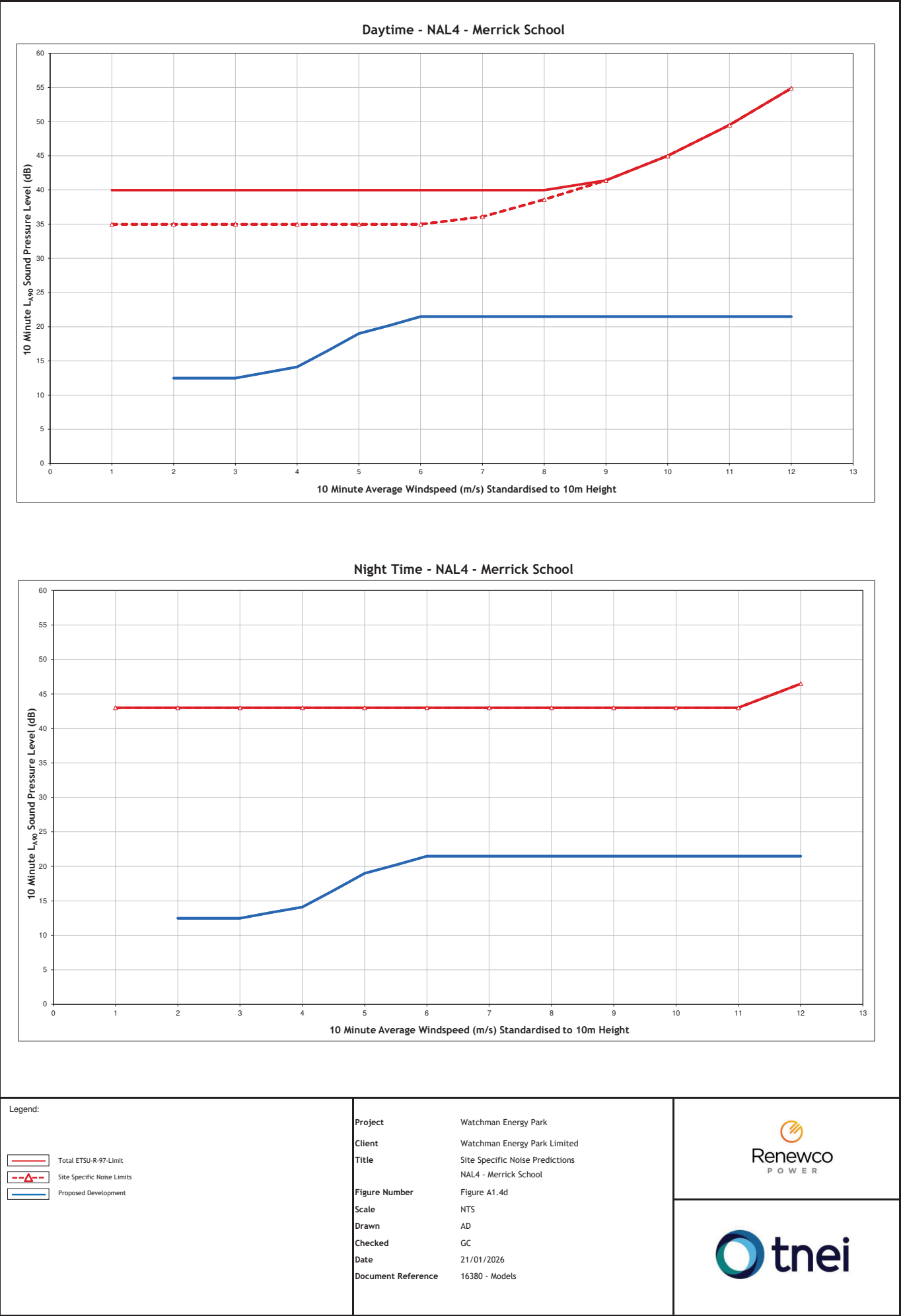
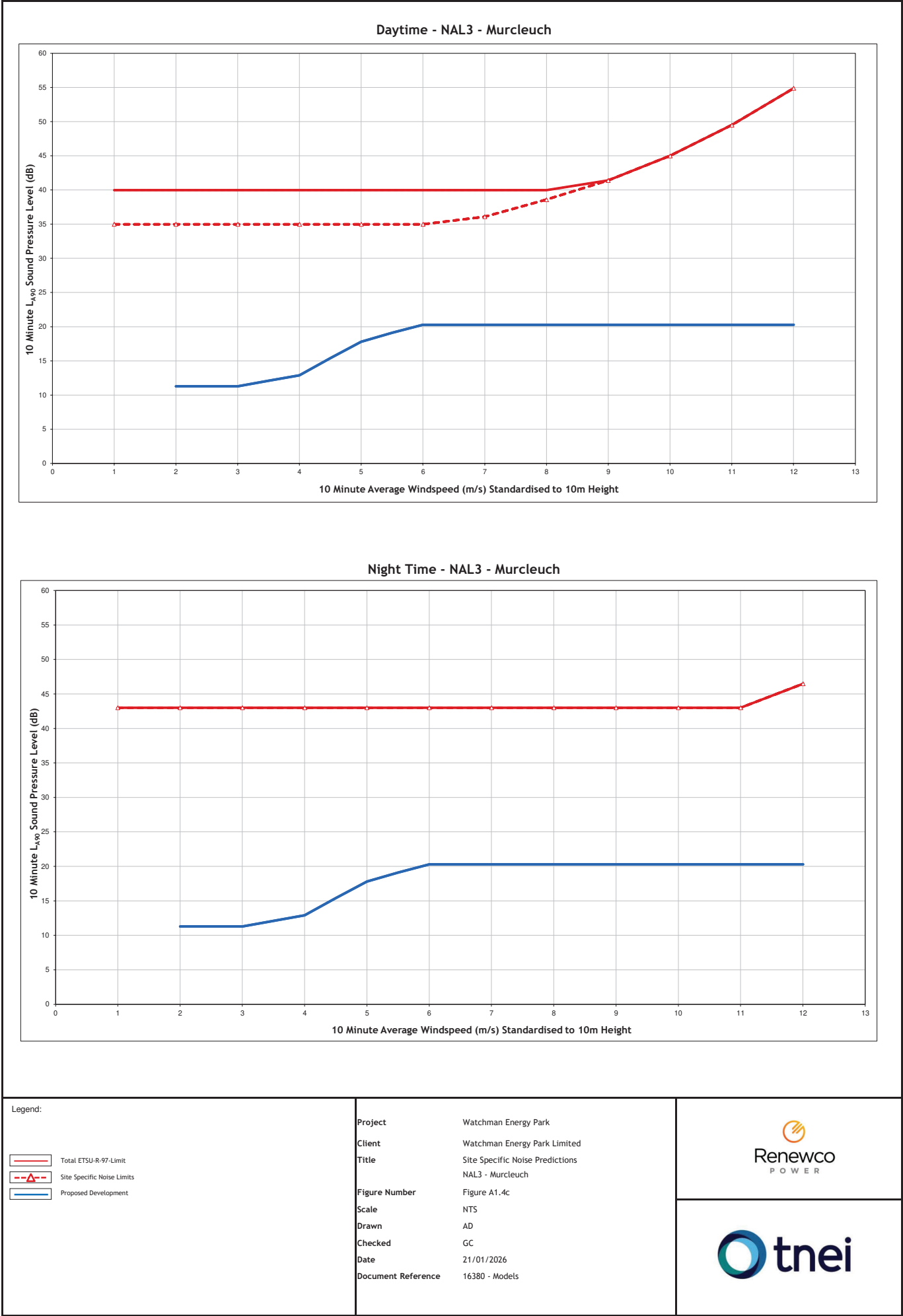


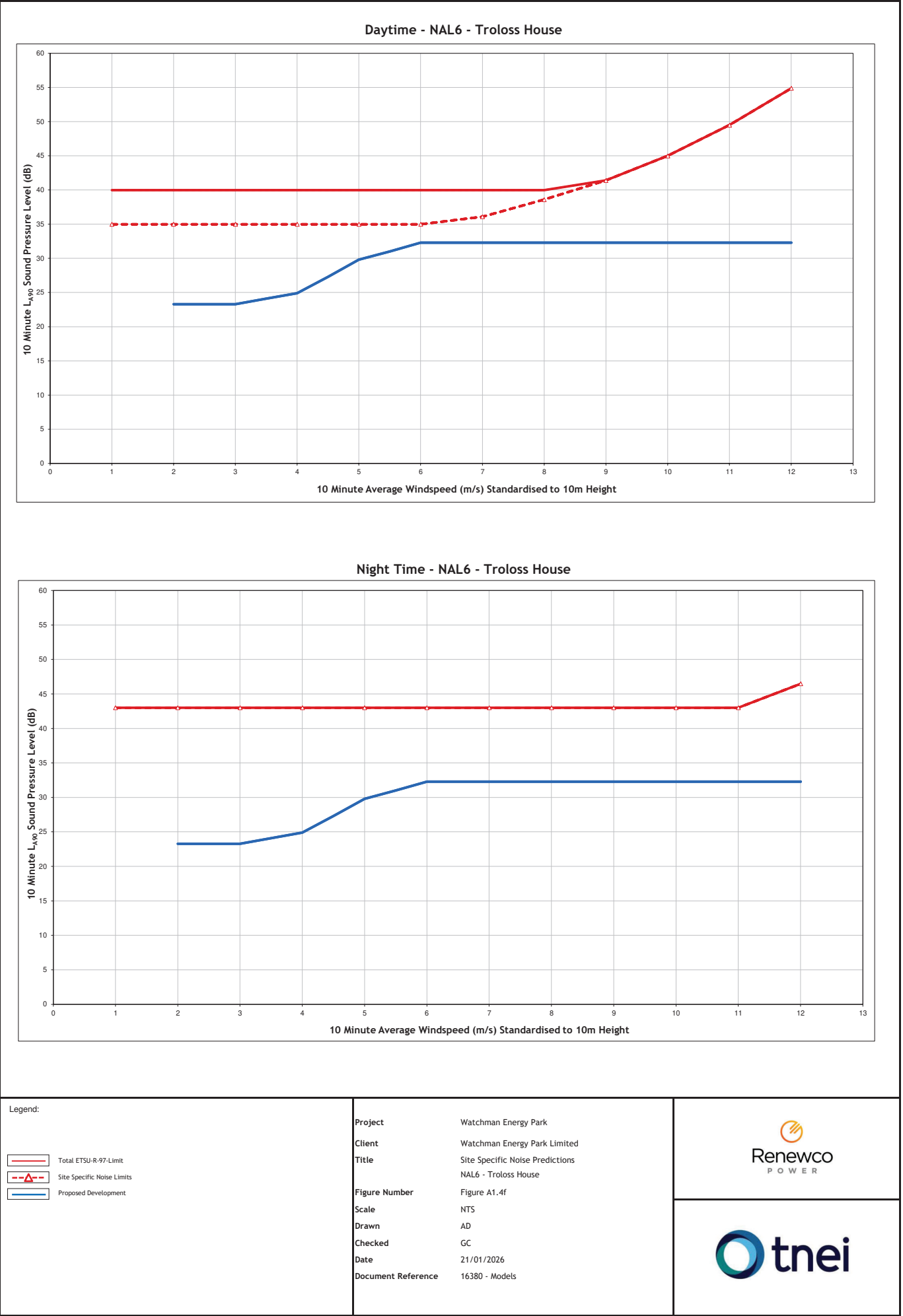
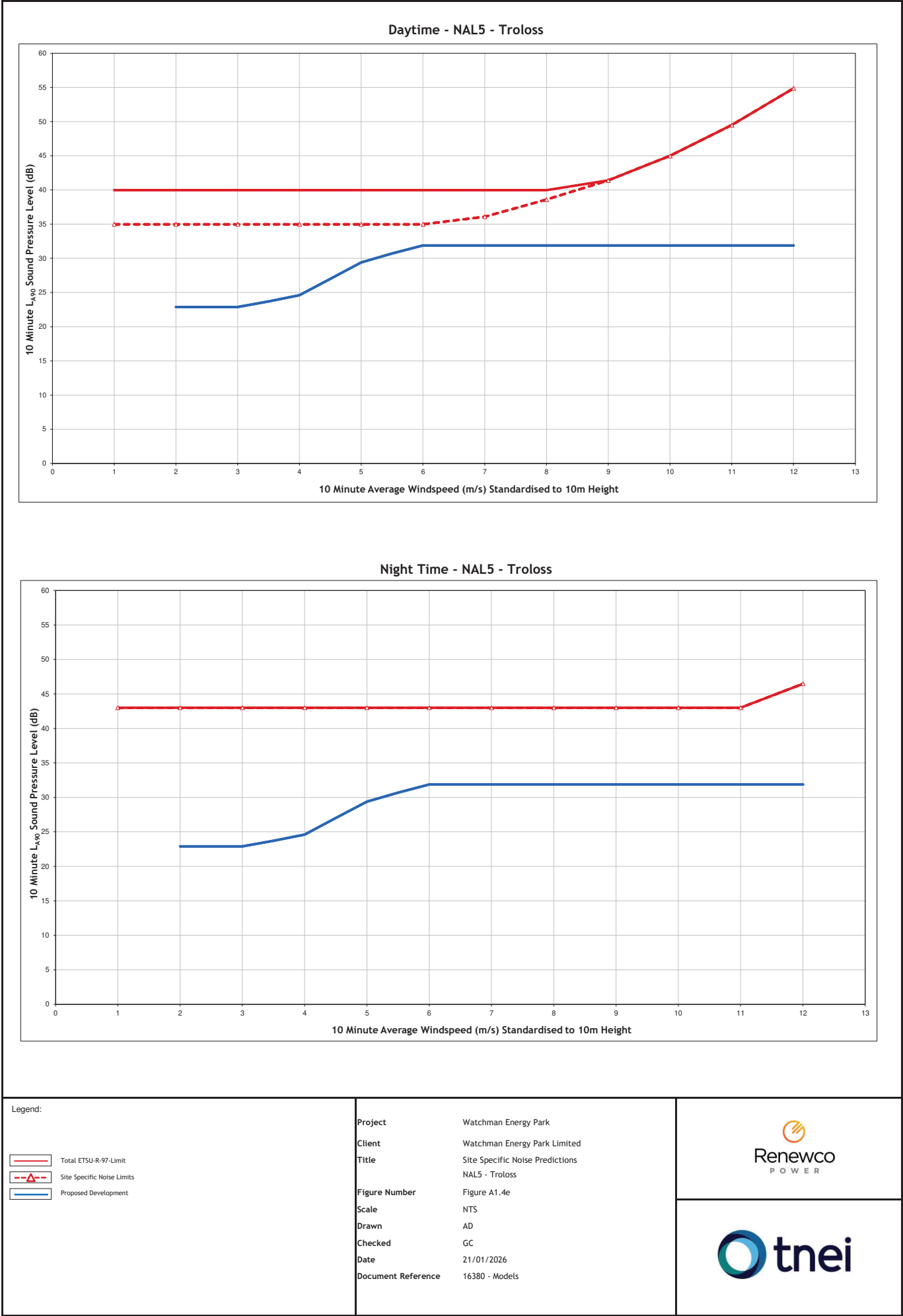
Legend:	Project	Watchman Energy Park
	Client	Watchman Energy Park Limited
— Background Noise Trendline — Total ETSU-R-97-Limit — Cumulative (Including the Proposed Development) - - - Cumulative (Excluding the Proposed Development) — Proposed Development — Clyde & Clyde Extension — Daer — Harestanes (inc. South & West) — Minnygap — Rivox Wind Energy Hub — Crookedstane & Lion Hill	Title	Likely Noise Predictions
	Figure Number	Figure A1.3s
	Scale	NTS
	Drawn	AD
	Checked	GC
	Date	29/09/2025
	Document Reference	16380 - Models

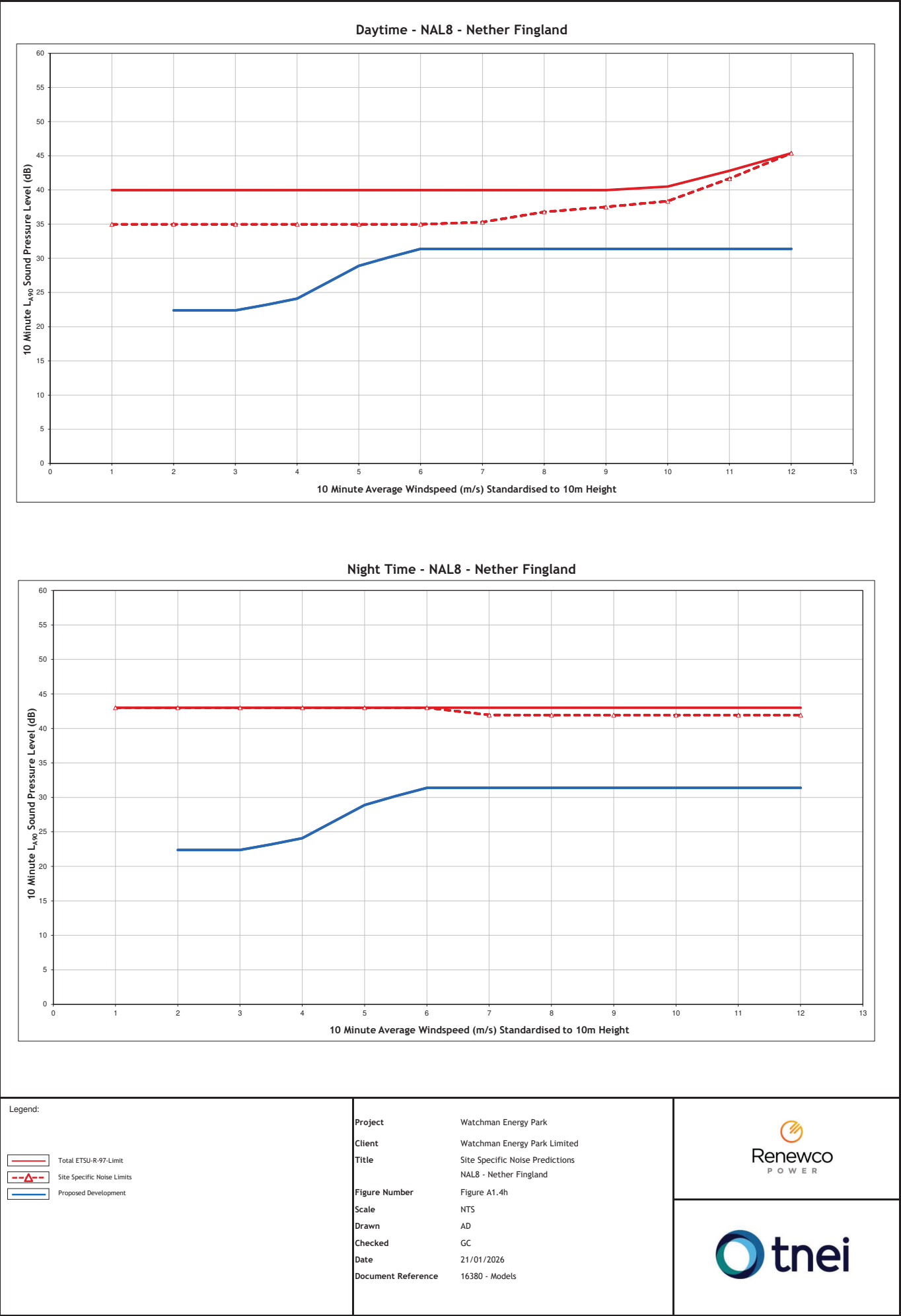
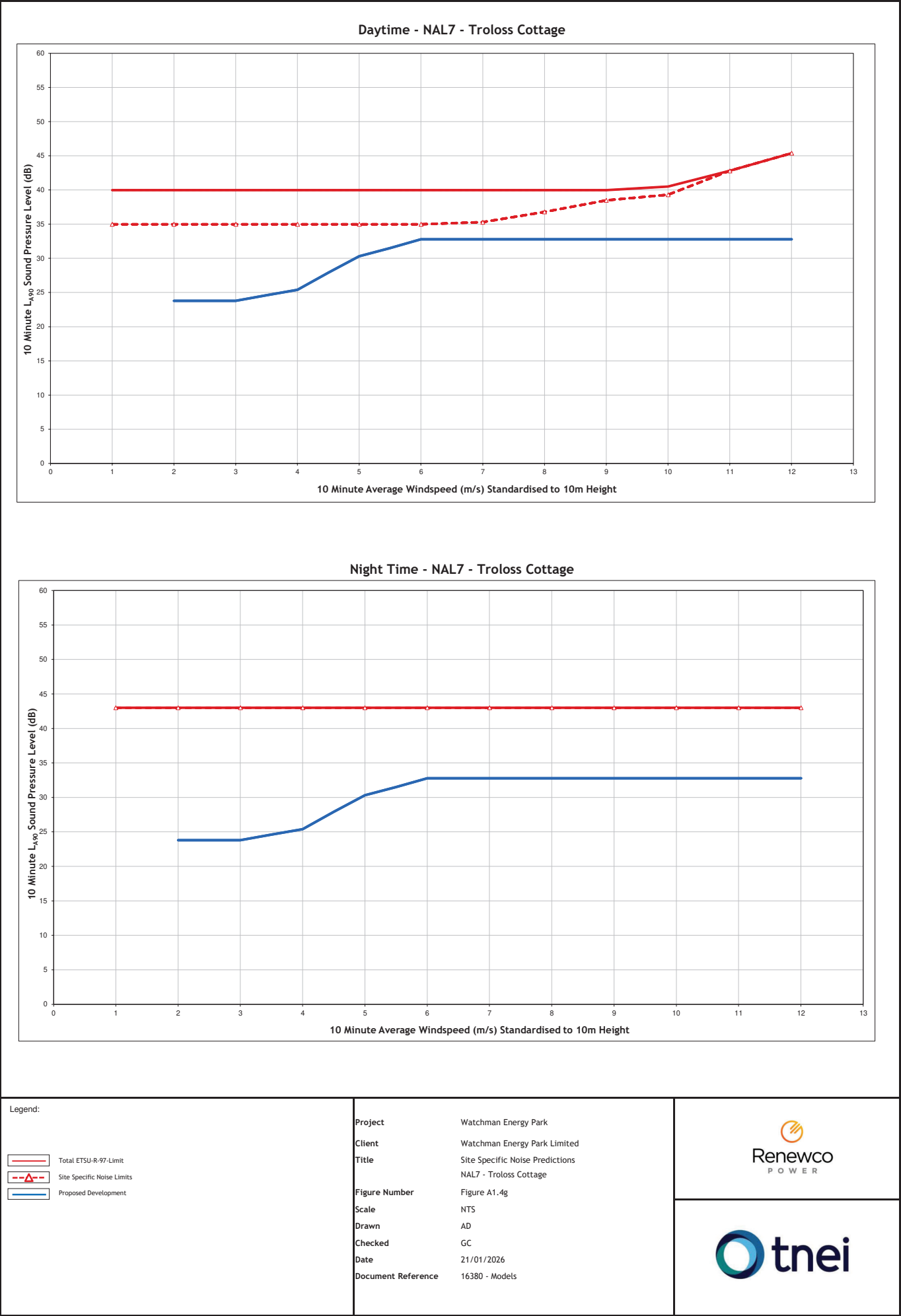


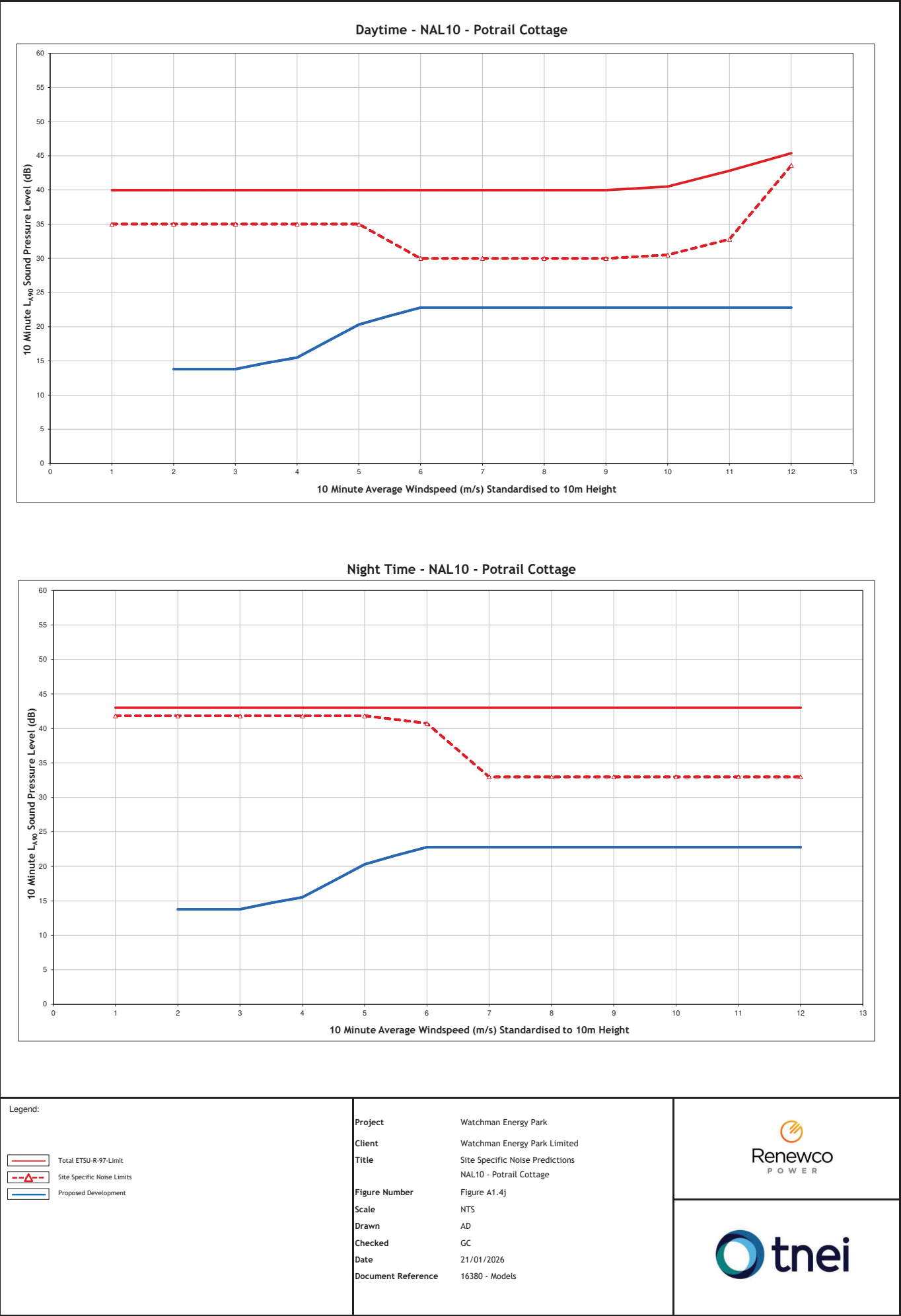
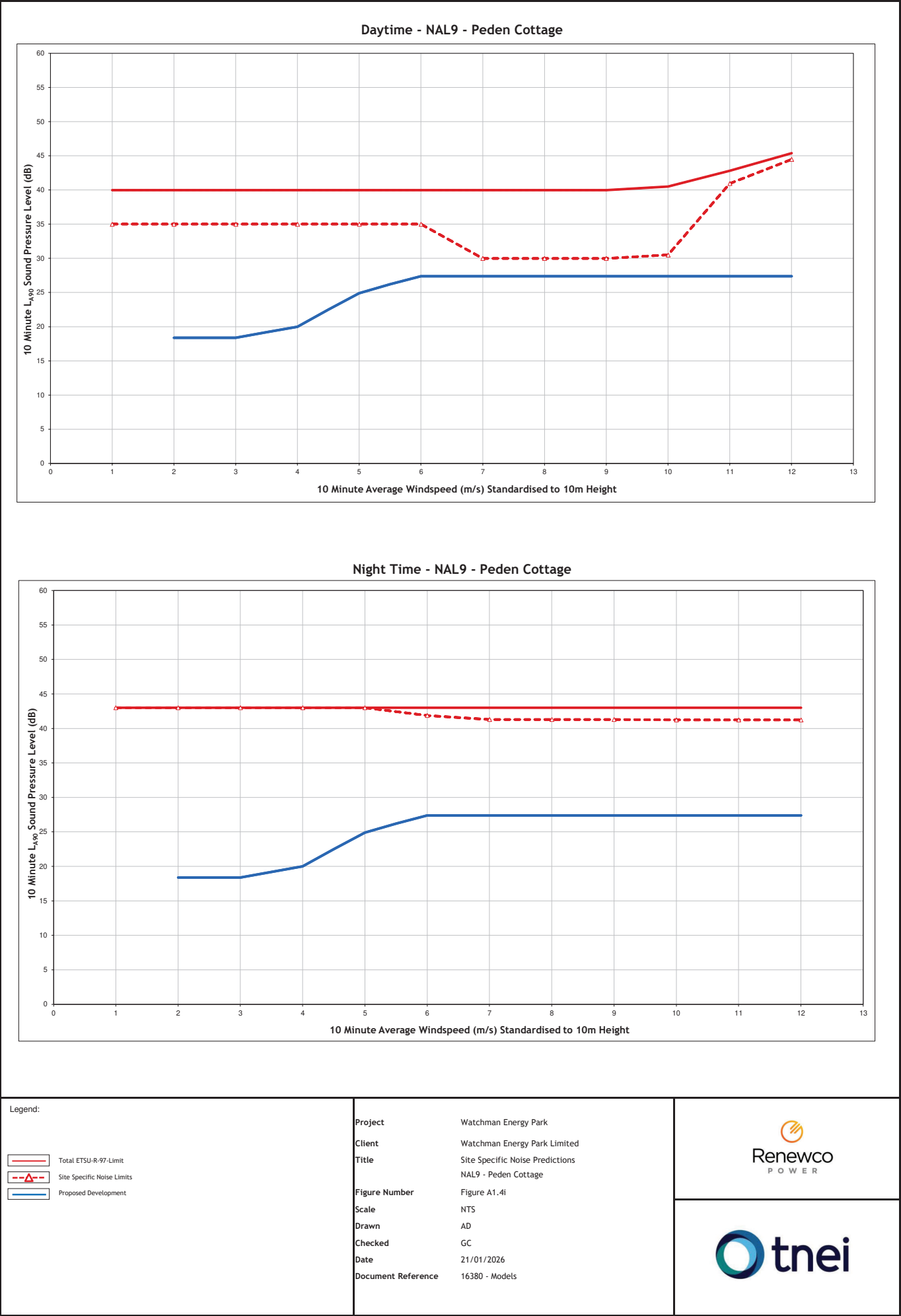
Legend:	Project	Watchman Energy Park
	Client	Watchman Energy Park Limited
— Background Noise Trendline — Total ETSU-R-97-Limit — Cumulative (Including the Proposed Development) - - - Cumulative (Excluding the Proposed Development) — Proposed Development — Clyde & Clyde Extension — Daer — Harestanes (inc. South & West) — Minnygap — Rivox Wind Energy Hub — Crookedstane & Lion Hill	Title	Likely Noise Predictions
	Figure Number	Figure A1.3t
	Scale	NTS
	Drawn	AD
	Checked	GC
	Date	29/09/2025
	Document Reference	16380 - Models

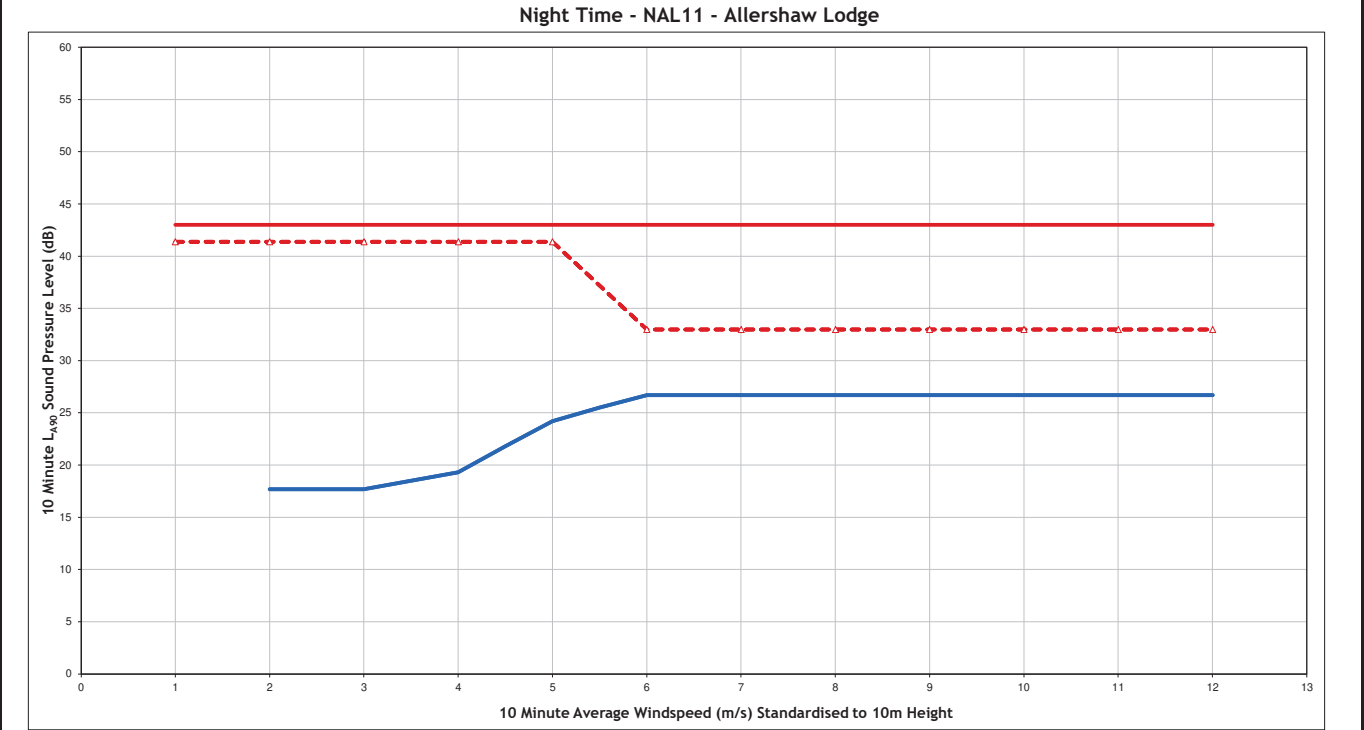
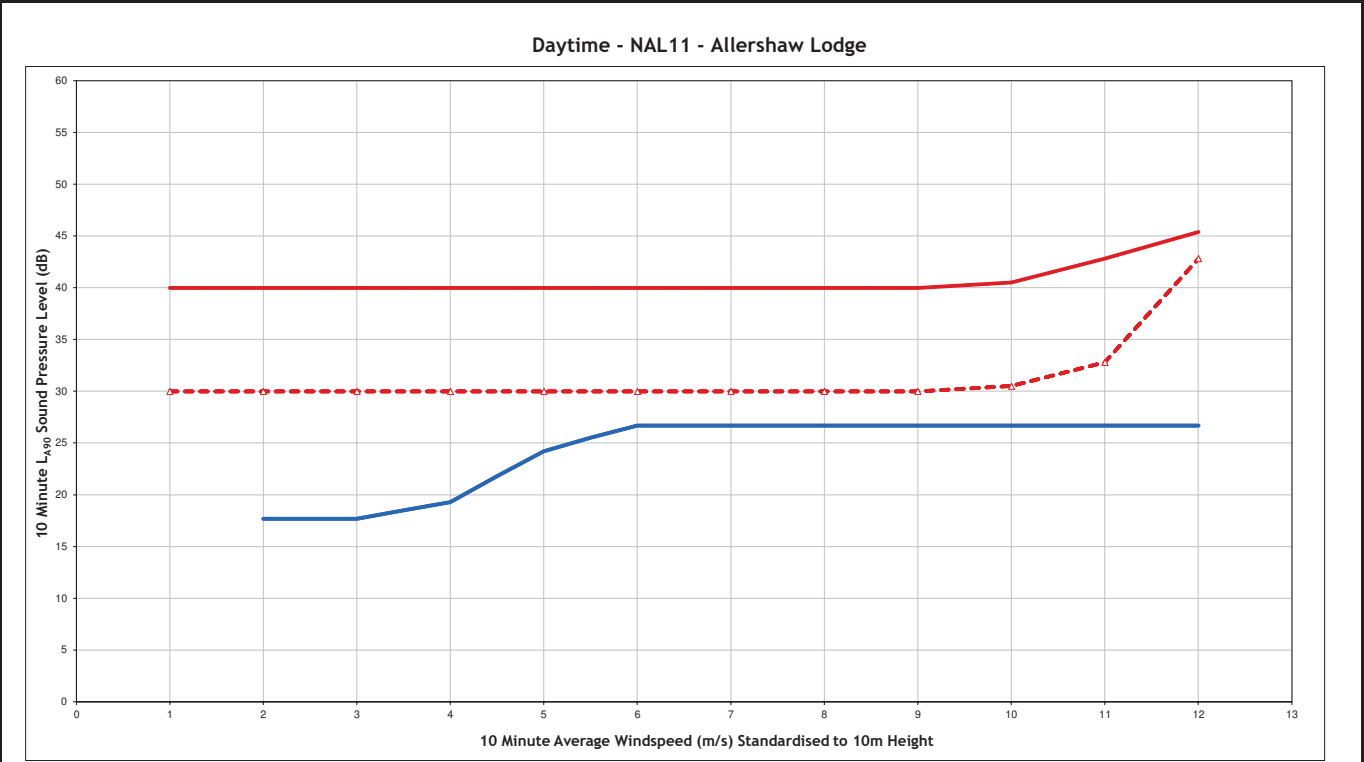




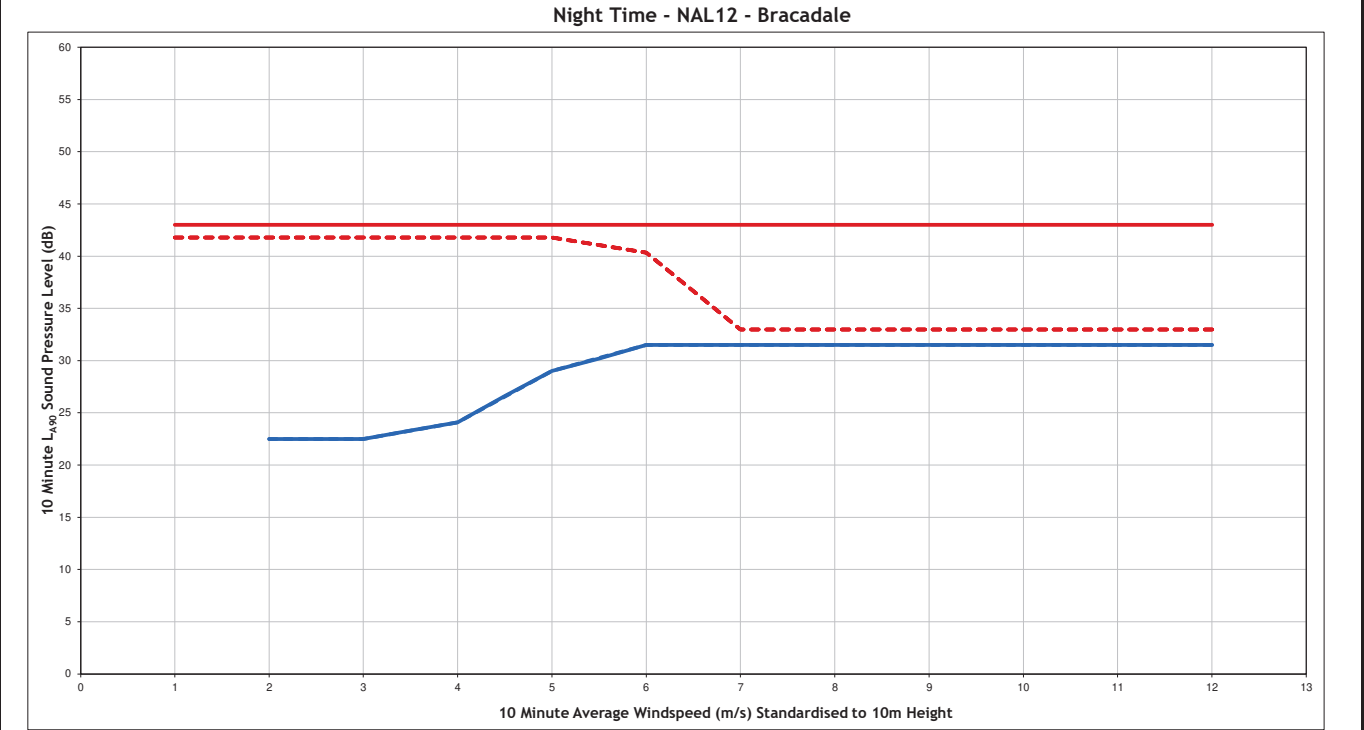
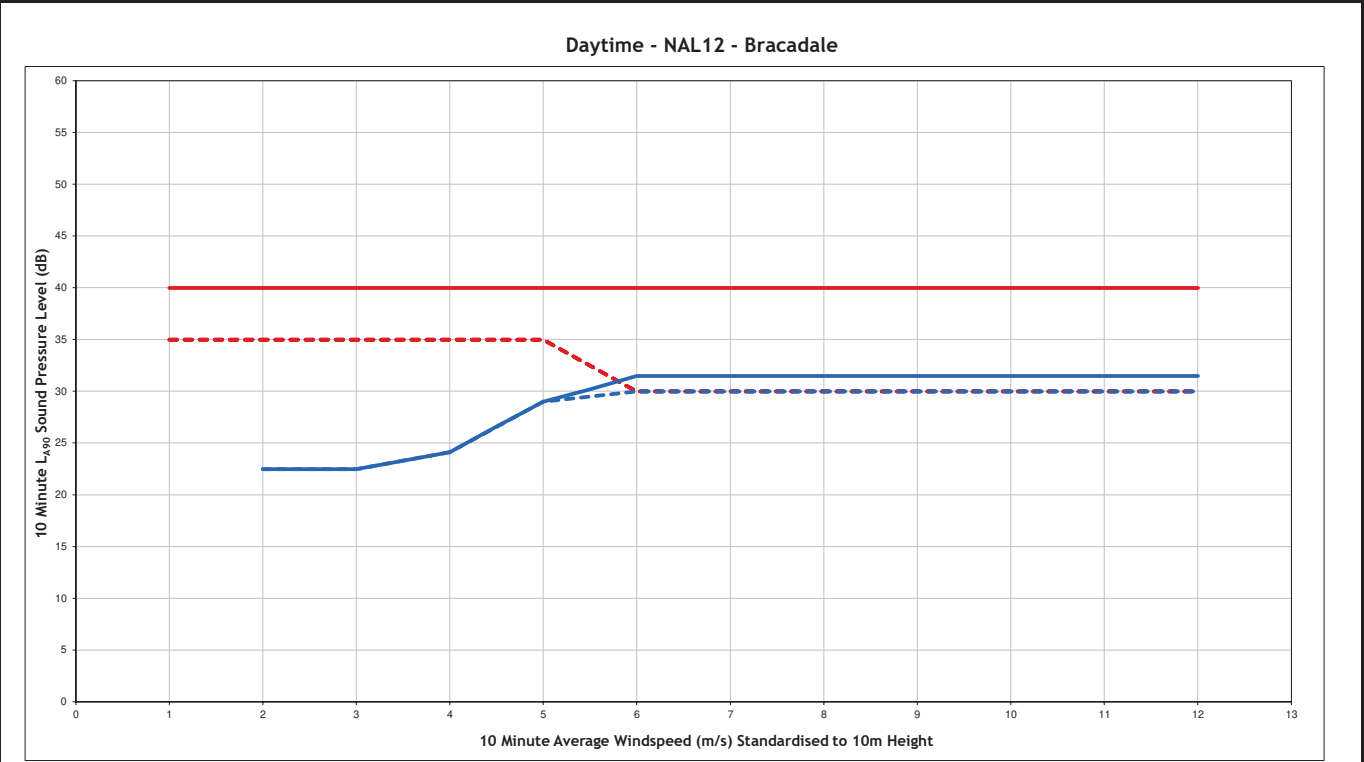




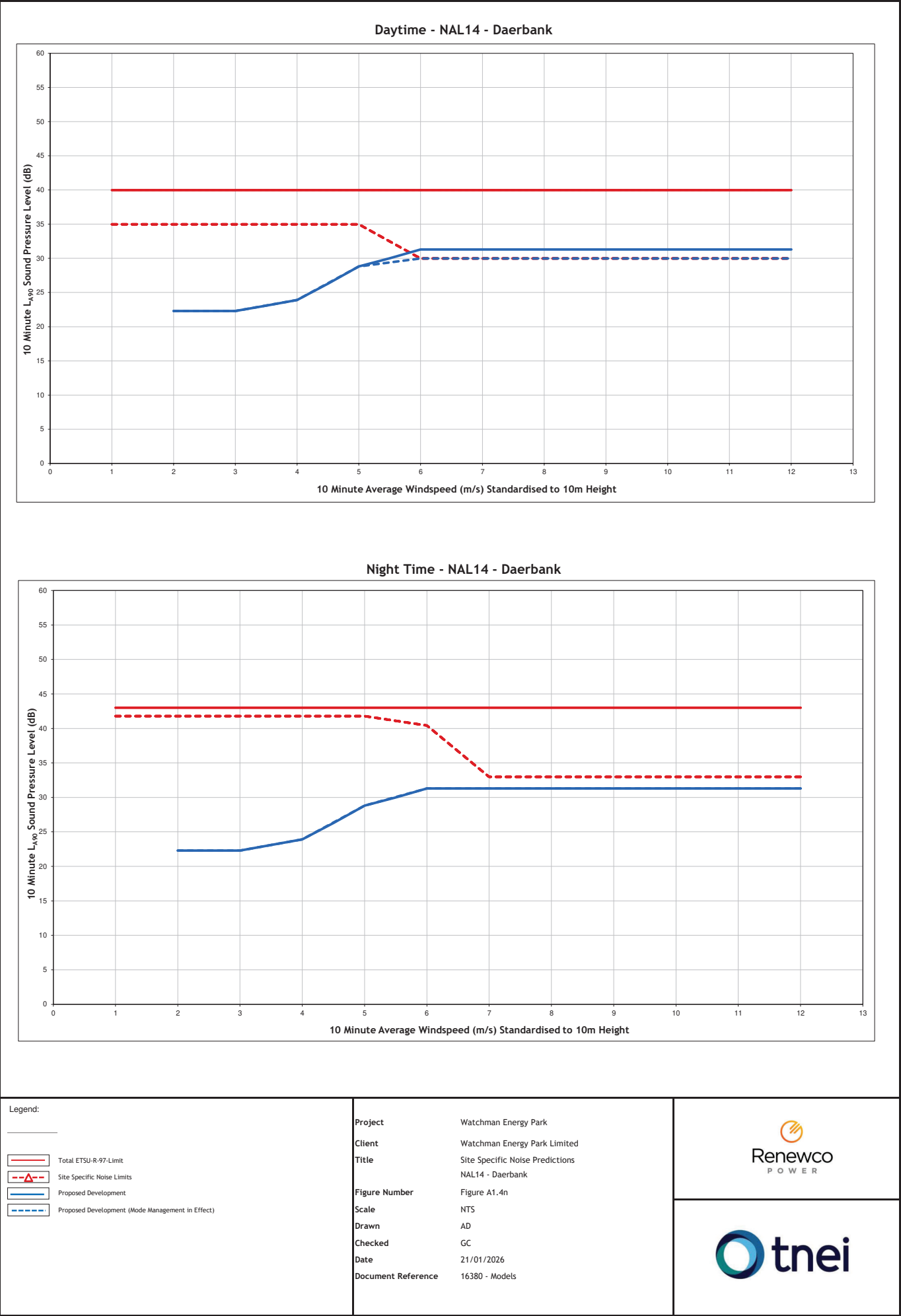
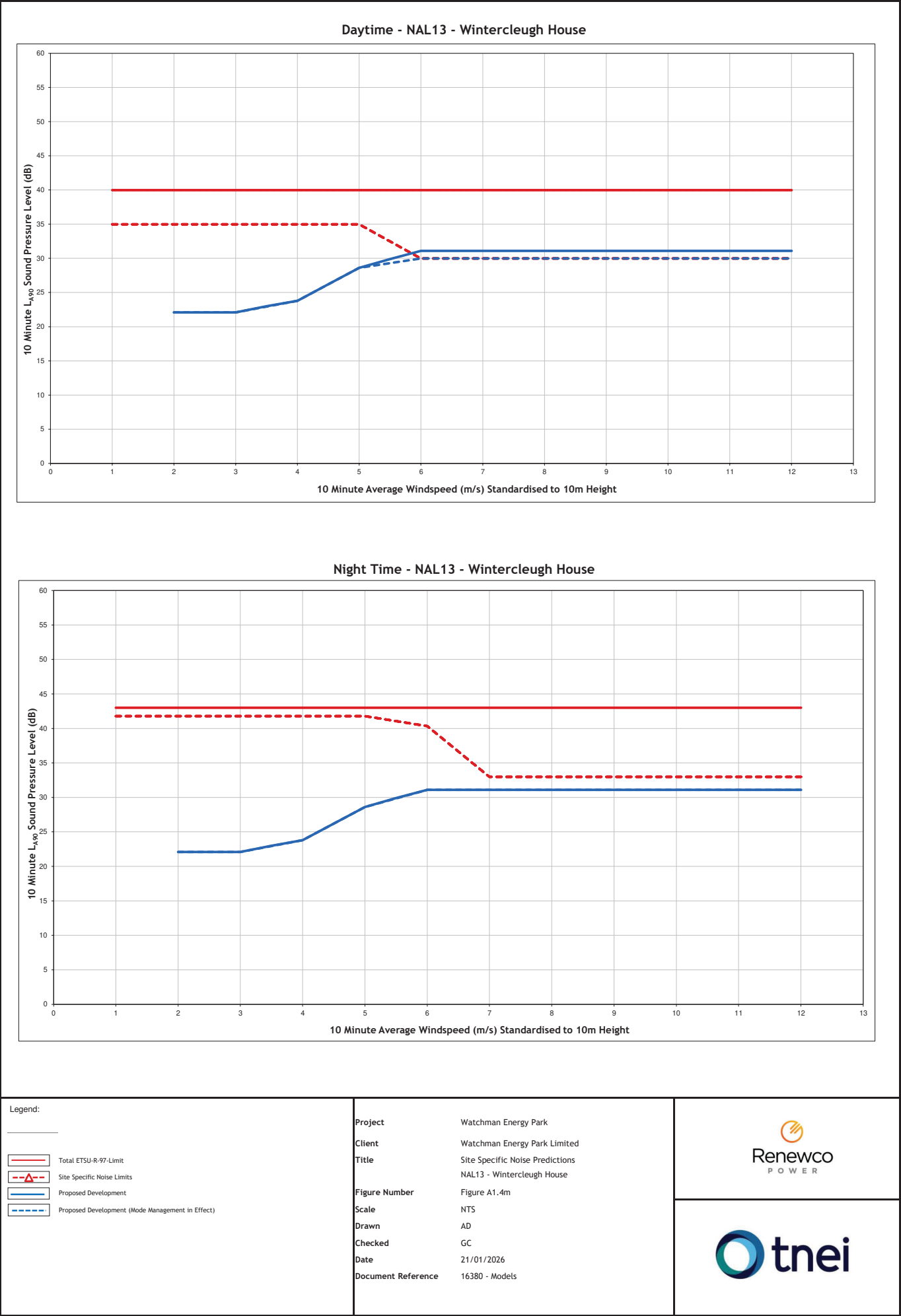


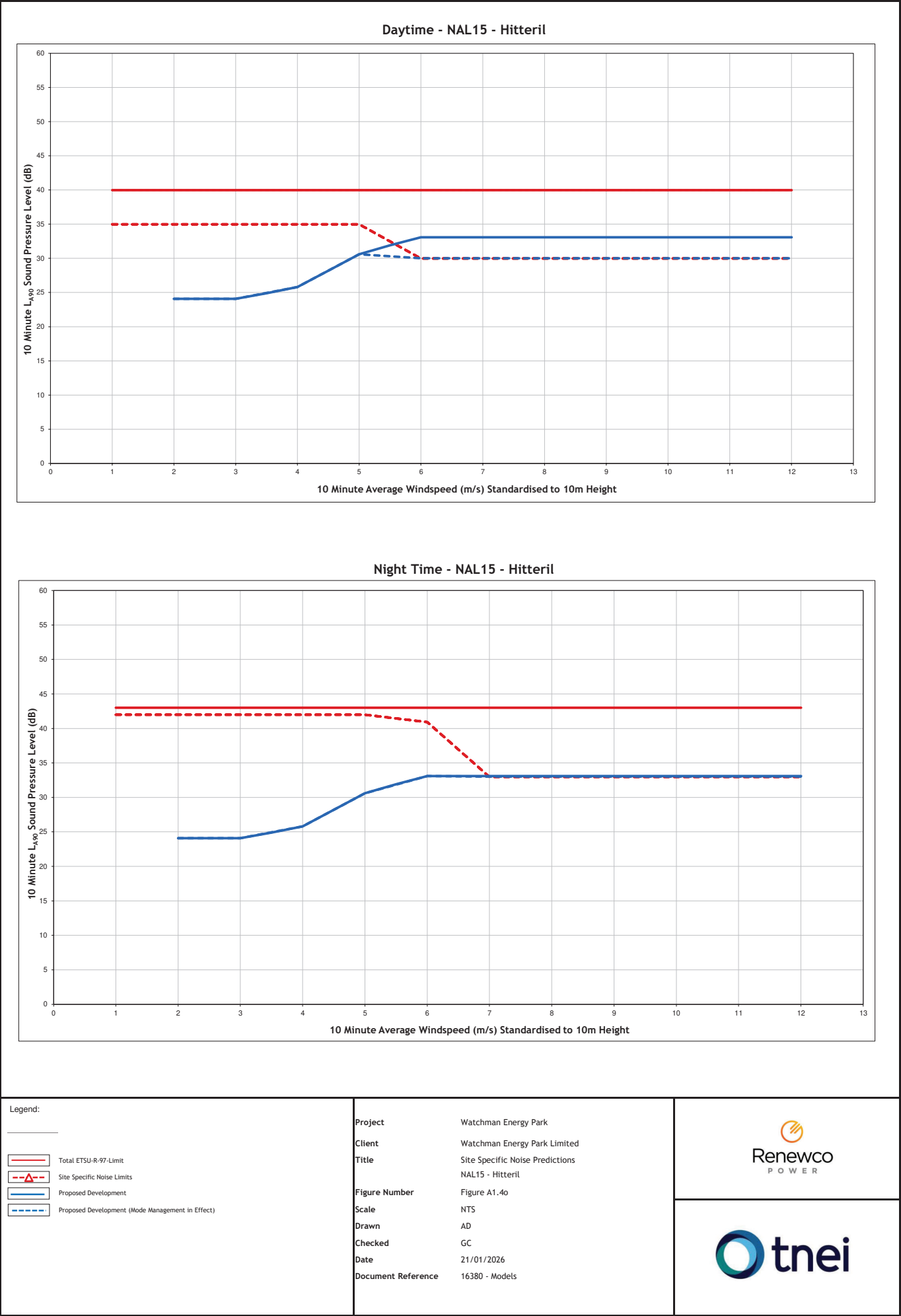


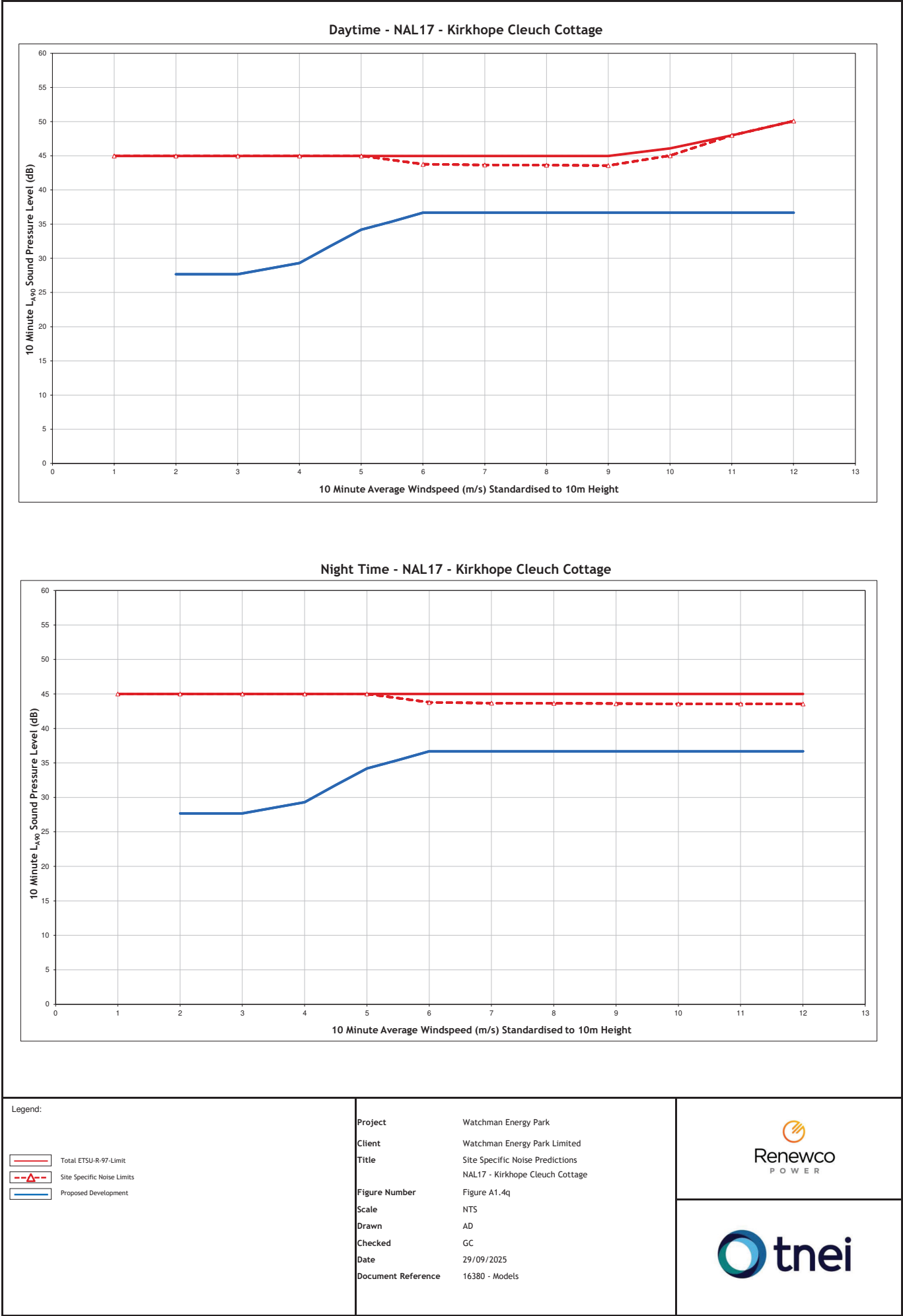
Legend: Total ETSU-R-97-Limit Site Specific Noise Limits Proposed Development	Project Watchman Energy Park	Renewco POWER tnei
	Client Watchman Energy Park Limited	
	Title Site Specific Noise Predictions NAL11 - Allershaw Lodge	
	Figure Number Figure A1.4k	
	Scale NTS	
	Drawn AD	
	Checked GC	
	Date 21/01/2026	
	Document Reference 16380 - Models	

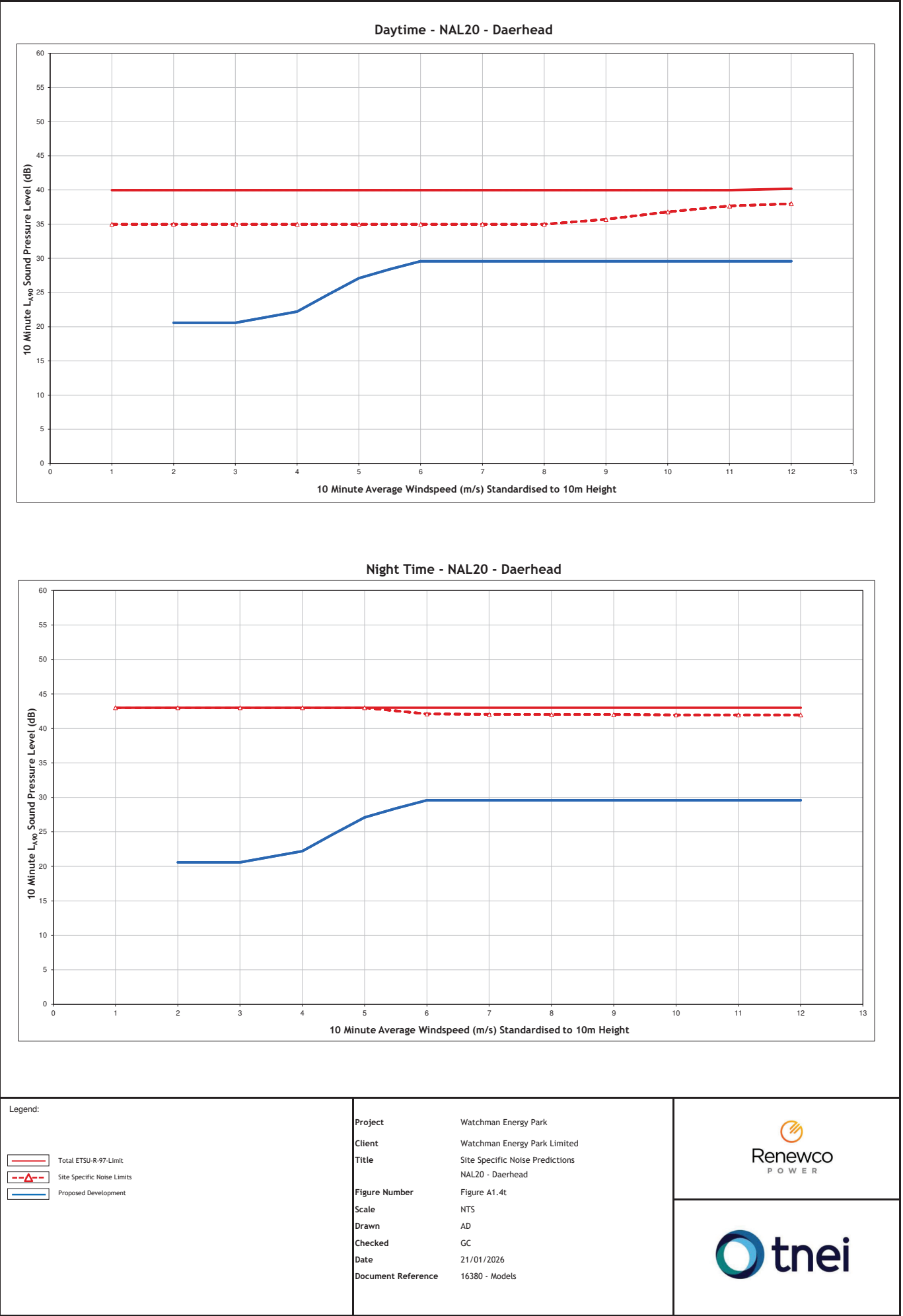
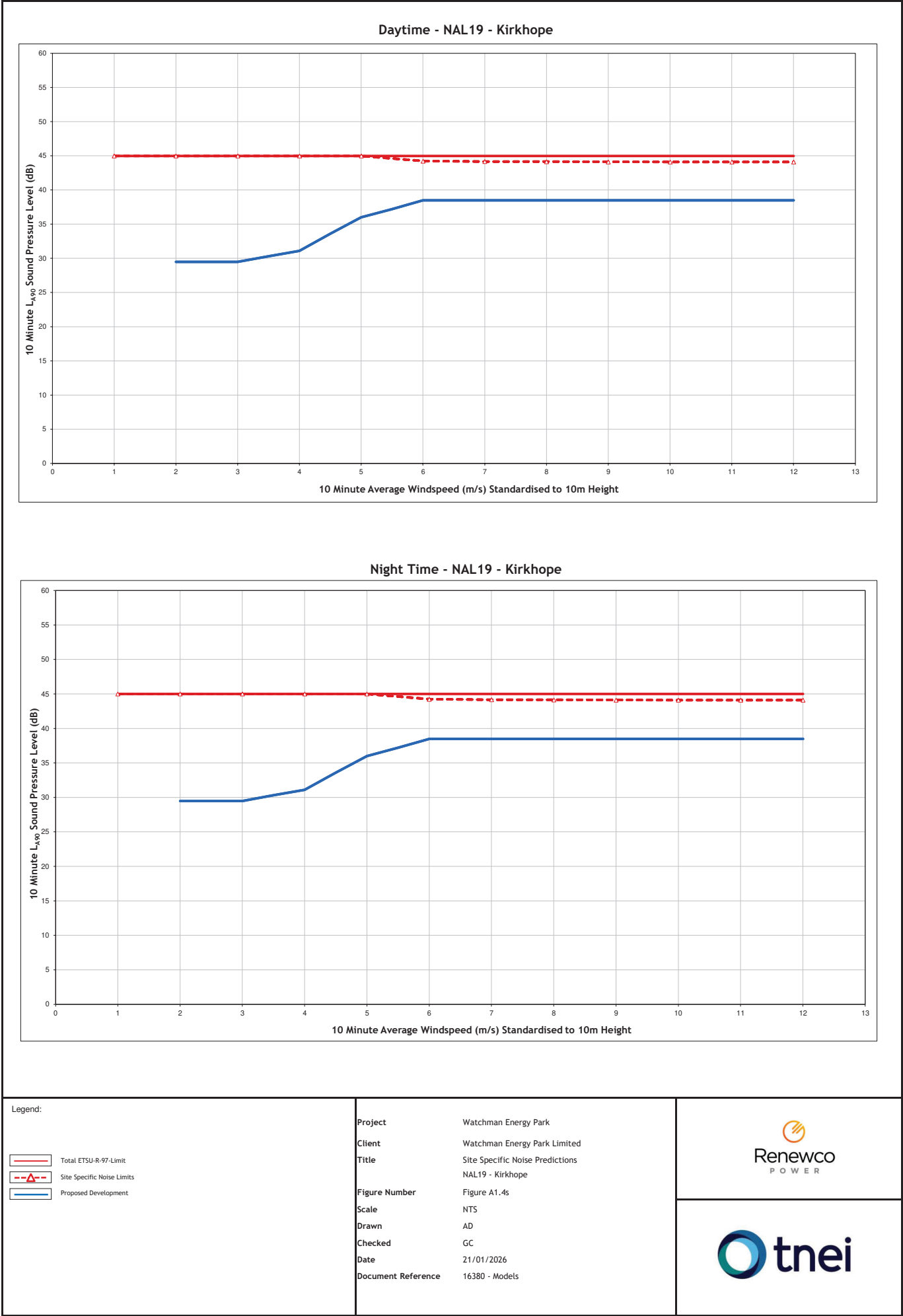


Legend: Total ETSU-R-97-Limit Site Specific Noise Limits Proposed Development Proposed Development (Mode Management in Effect)	Project Watchman Energy Park	Renewco POWER tnei
	Client Watchman Energy Park Limited	
	Title Site Specific Noise Predictions NAL12 - Bracadale	
	Figure Number Figure A1.4l	
	Scale NTS	
	Drawn AD	
	Checked GC	
	Date 21/01/2026	
	Document Reference 16380 - Models	









Annex 2 – Correspondence with the Environmental Health Department at the Council

17 February, 2025

Ref: 16380-002 R1

Kenny Joyce
Environmental Health Officer
South Lanarkshire Council

Copy: Sent by email only

Dear Mr Joyce,

PROPOSED WATCHMAN ENERGY PARK ON LAND APPROXIMATELY 13 KM WEST OF MOFFAT AND 8 KM SOUTH-EAST OF WANLOCKHEAD, SOUTH LANARKSHIRE: NOISE ASSESSMENT

Watchman Energy Park Limited ('the Applicant') is proposing to submit an application for consent to the Scottish Ministers under Section 36 (S36) of the Electricity Act 1989 (including deemed planning permission) to construct and operate Watchman Energy Park ('the proposed development') on land located approximately 13 km west of Moffat and 8 km southeast of Wanlockhead. An indicative turbine layout is shown on the enclosed Figure 1. The proposed development is primarily a wind turbine development but it will also accommodate a battery energy storage system (BESS).

TNEI Services Ltd (TNEI) has been appointed by the Applicant to undertake noise assessment work for the Proposed Development. Prior to commencing the noise assessment, we would like to agree the noise assessment methodology locations with South Lanarkshire Council (SLC).

Construction Noise Assessment

A construction noise assessment will be undertaken to determine the potential for noise impacts during the construction phase of the Proposed Development. The assessment would be undertaken in accordance with the methodology outlined in British Standard (BS) 5228 1:2009+A1:2014 '*Code of practice for noise and vibration control on construction and open sites. Noise*' and ISO 9613-2 '*Acoustics - Attenuation of sound during propagation outdoors -Part 2: General method of calculation*'. Impacts will be assessed using criteria contained within BS 5228 and, where appropriate, mitigation measures will be proposed.

Activities associated with the decommissioning of the Proposed Development are assumed to generate similar or lower noise levels to those occurring during construction. As such, an assessment of decommissioning noise will be scoped out. This is on the assumption that if construction noise limits can be met, they should also be met during decommissioning.

Wind Turbine Operational Noise Assessment

An operational wind turbine noise assessment will be undertaken in accordance with ETSU-R-97 '*The Assessment and Rating of Noise from Wind Farms*' (ETSU-R-97) and the Institute of Acoustics document '*A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise*' (IOA GPG). In relation to wind turbine noise, PAN 1/2011 '*Planning and Noise*' refers to the Scottish Governments 'Onshore Wind Turbines' web-based document, which states that:

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“ETSU-R-97 describes a framework for the measurement of wind farm noise, which should be followed by applicants and consultees, and used by planning authorities to assess and rate noise from wind energy developments, until such time as an update is available”.

and;

“The Institute of Acoustics (IOA) has since published Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise. The document provides significant support on technical issues to all users of the ETSU-R-97 method for rating and assessing wind turbine noise, and should be used by all IOA members and those undertaking assessments to ETSU-R-97. The Scottish Government accepts that the guide represents current industry good practice.”

ETSU-R-97 – Deriving Noise Limits

ETSU-R-97 describes the findings of the Working Group on Noise from Wind Turbines, the aim of which was to provide information and advice to developers and planners on the environmental assessment of operational noise from wind turbines.

ETSU-R-97 recommends noise limits should be set at 5 dB above existing background noise levels, or a fixed minimum limit of 35-40 dB(A) LA90 during the daytime and 43 dB(A) LA90 during the night-time periods where background noise levels are low, and that these limits should reflect the variation in background noise with wind speed. Different limits apply to those properties that have a financial interest in the wind energy development (45 dB(A) LA90 or background plus 5 dB, whichever is the greater, for both daytime and night-time).

The choice of quiet daytime fixed minimum limits should be considered in light of the guidance contained within ETSU-R-97 and the IOA GPG. Extracts of the guidance contained within ETSU-R-97 and the IOA GPG are included in Annex 1. Noise limits established at properties in accordance with ETSU-R-97 shall be applicable to all existing / proposed (in planning) wind farms in the area and will henceforth be referred to as the ‘Total ETSU-R-97 Noise Limits’.

TNEI propose to set the Total ETSU-R-97 Noise Limits and Site Specific Noise Limits based on the upper daytime fixed minimum noise limit of 40 dB(A). This limit has been afforded to the other developments in the area and therefore this is deemed appropriate.

The Site Specific Noise Limits would be derived, taking account of the other wind farm developments in the area. The Site Specific Noise Limits will be derived using the principles contained within the IOA GPG, which may include the use of the controlling property principal or determining if there is significant headroom etc. The Site Specific Noise Limits will be the limits that the proposed development would have to operate within, should planning permission be granted.

Where there is significant headroom, we propose to utilise the available headroom to derive the Site Specific Noise Limits for the proposed development. We would be grateful if SLC would confirm its agreement to this approach.

Operational Battery Storage Noise Assessment

In respect to operational noise from non-wind developments, such as BESS, PAN 1/2011 refers to Assessment of Noise: Technical Advice Note (TAN). The TAN identifies BS 4142:2014+A1:2019 ‘Methods for Rating and Assessing Industrial and Commercial Sound’ and BS 8233:2014 ‘Guidance on sound insulation and noise reduction for buildings’ as appropriate methodologies for the assessment of environmental noise from proposed new developments or activities.

Noise from the operation of a BESS facility is generated from the use of multiple inverter units, transformers and battery cooling requirements. Depending on the final location of the BESS, an operational noise assessment may be required. Where necessary, an assessment will be undertaken in line with BS 4142:2014+A1:2019 and BS 8233:2014.

Should SLC have specific assessment criteria (relating to BS 4142 or otherwise) that they wish to be included, feedback on this would be much appreciated.

Background Noise Monitoring

In order to establish the Total ETSU-R-97 Noise Limits 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. This requires the installation of noise monitoring equipment at representative properties surrounding the site as well as the installation of wind monitoring equipment on the site itself. The measured background noise levels will also be used to inform the BS 4142 assessment for the operation of the BESS, if required.

It is proposed that a LiDAR unit will be in place on-site for the duration of the noise survey, which will be used to collect wind speed and direction data at various heights. Data from the LiDAR will be used to determine the wind speed at turbine hub height which will then be adjusted to a height of 10 m using a standardised roughness length of 0.05 m to derive ‘wind speed as standardised to 10 m height’. Wind speed as standardised to 10 m height will be used in the assessment. This is consistent with method A or B as outlined in the IOA GPG (on page 10 of 40). At least one rain logger will be installed at one of the noise monitoring locations to record any periods of rainfall. A series of simultaneous ten-minute measurements will be taken by each piece of equipment over a period of at least two weeks.

Background noise levels will be monitored at a height of between 1.2 m and 1.5 m above the ground, in line with the ETSU-R-97 / IOA GPG guidance. The noise monitoring equipment will be located in a free-field position at least 3.5 m away from hard reflective surfaces where practicable and within the residential amenity area.

The following steps summarise the proposed noise assessment process for the scheme:

- measure the background noise levels at each receptor. This will involve the continuous logging of the $L_{A90, 10min}$ values at each receptor for a minimum period of two weeks;
- obtain simultaneous ten-minute average wind speed data from the Proposed Development ;
- filter baseline noise data to remove any unrepresentative readings (such as periods of rainfall) and split the data into quiet daytime and night-time hours;
- determine the daytime and night-time criterion curves from the measured background noise levels at the nearest neighbours using regression analysis and recommendations within ETSU-R-97 and the IOA GPG;
- specify the type and noise emission characteristics of all existing / proposed wind farms using candidate / installed wind turbine noise data, and undertake predictions and compare the total cumulative predicted noise levels to the Total ETSU-R-97 Noise Limits;
- derive suitable Site-Specific Noise Limits for the Proposed Development using the guidance in the IOA GPG; and
- compare the predicted wind farm noise immission levels for the Proposed Development with the Site-Specific Noise Limits.

We have undertaken some initial modelling based on an initial 16-turbine layout presented in Figure 1. In line with current good practice, noise predictions have been undertaken using the propagation model contained within Part 2 of International Standard ISO 9613, Acoustics – Attenuation of sound during propagation outdoors – Part 2 General method of calculation. The model assumes mixed ground conditions, G = 0.5, and data for an indicative candidate turbine, the Vestas V172 7.2 MW, which was chosen to be representative of the turbine that will be assessed at the planning stage and could also be installed at the site. The candidate turbine may be different for the subsequent planning application, but the noise levels demonstrated on Figure 1 are still useful in providing context to the NMLs. Figure 1 shows the neighbouring properties to the Proposed Development that may fall within the 35 dB(A) L₉₀ contour.

Noise monitoring equipment installed at (or in the proximity of) six dwellings, which will provide a sufficient sample of representative background noise data for the area. The monitoring locations are detailed in Table 1 and shown on Figure 1, with a noise contour plot of the Proposed Development also included on Figure 1 for context.

The properties identified for the assessment are deemed representative of the closest receptors to the west, northwest, north, northeast and east of the site and have been chosen following consideration of nearby watercourses and the operational Clyde Extension Wind Farm.

Table 1 - Suggested Noise Monitoring Locations (NMLs) for the Proposed Development

Property/Approximate OS Co-ordinates	Justification
NML1 - Troloss House (291625, 608463)	Nearest receptor to west of the Proposed Development and deemed representative of the dwellings in that area.
NML2 – Fingland (292719, 609554)	One of the closest receptors to the northwest of the site to provide representative data for the dwellings in that area.
NML3 - Peden Gill (294805, 612845)	One of the closest receptors to the north of the site to provide representative data for the dwellings in that area. Downwind predictions from the operational Clyde Extension Wind Farm are such that consideration of directional filtering and/ or subtraction of predictions to the measured background noise dataset, as presented within the IOA GPG, will need to be considered here.
NML4 - Hitteril (296165, 609649)	One of the closest receptors to the northeast of the site to provide representative data for the dwellings in that area. Downwind predictions from the operational Clyde Extension Wind Farm are such that consideration of directional filtering and/ or subtraction of predictions to the measured background noise dataset, as presented within the IOA GPG, will need to be considered here.
NML5 - Kirkhope Cleuch Cottage (296641, 607221)	Closest receptor to the east of the site to provide representative data for the dwellings in that area.

Property/Approximate OS Co-ordinates	Justification
NML6 - Kirkhope (296320, 605453)	Single receptor located directly to the east of the Proposed Development.

We will review the background noise datasets collected to ensure that we can adequately account for the contribution of existing operational wind farms as per the IOA GPG. This will only be possible once we have collected and analysed the data.

Table 2 details a building that is not considered to be a noise sensitive receptor as it is non-residential. If you have any further information regarding the status of this building or would like to discuss these further, we would be grateful if you could let us know. This building is shown as a red house symbol on Figure 1.

Table 2 - Buildings/Dwellings not Considered as Noise Sensitive Receptors (NSRs)

Property/Approximate OS Co-ordinates	Justification
Assumed Uninhabited (292774, 607968)	Appears to be a farm building and not residential.

Cumulative Noise Assessment

TNEI is aware that there are a number of wind farms which are operational, consented, and in planning in the vicinity of the Proposed Development. These are Clyde (Operational), Clyde Extension (Operational), Harestanes (Operational), Minnygap (Operational), Crookedstane (Consented), Lion Hill (Consented), Daer (In Planning), Harestanes South (In Planning), and RivoX Wind Energy Hub (In Planning). It is noted that the consent for Crookedstane and Lion Hill has expired, and they will therefore not be considered as part of the cumulative assessment.

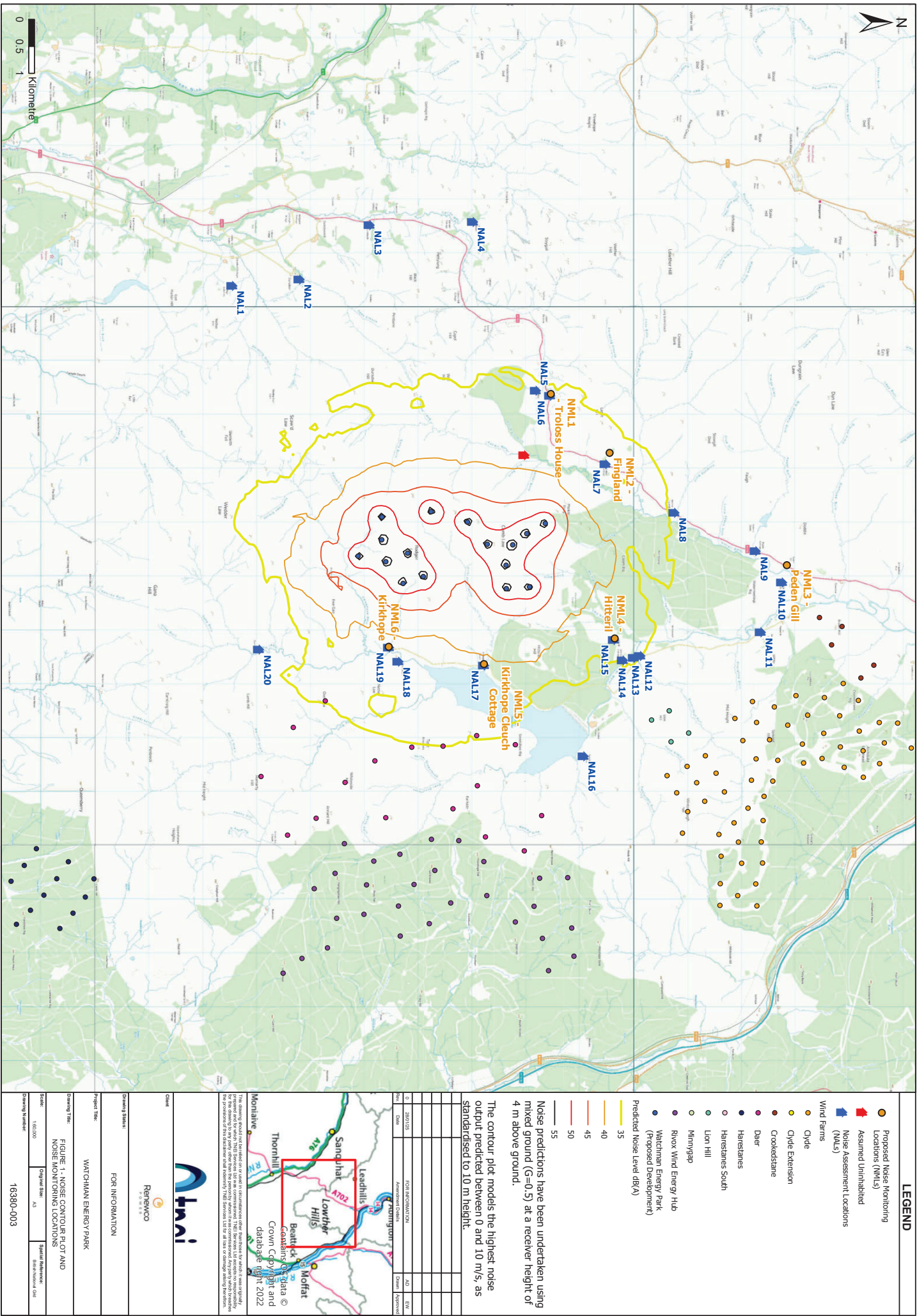
We would be grateful if you could bring to our attention any other wind farm developments that you are aware of in the area that may merit consideration within the cumulative noise assessment.

Summary

To enable us to progress the assessment, we would be very grateful if you confirm whether:

1. You are happy with the proposed assessment methods outlined above (ETSU-R-97, BS 4142, BS 5228, and the IOA GPG);
2. You agree with the use of a daytime fixed minimum total noise limit of 40 dB(A), subject to the relevant justifications within the Environmental Impact Assessment Report (EIAR);
3. You agree with the proposed approach that, in line with IOA GPG, the cumulative assessment and derivation of Site Specific Noise Limits for the Proposed Development will utilise available significant headroom;
4. You agree with the reuse of the background noise levels to inform the BS 4142 assessment, if required; and
5. If SLC is aware of any schemes that should be included in the cumulative noise assessment or any other dwellings that should be considered in the assessment of noise impacts.

If you have any immediate concerns or queries, please do not hesitate to contact us.



Reviewed and approved by:

Ewan Watson
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Principal Consultant
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Yours sincerely,

Alex Dell
MEng, PhD, MIOA

Senior Consultant
alex.dell@tneigroup.com
Tel: 0191 211 1403

Enc. Figure 1 – Noise Contour Plot and Proposed Noise Monitoring Locations
Annex 1 - Determining the Fixed Part of the Daytime Amenity Noise Limit

Annex 1: Determining the Fixed Part of the Daytime Amenity Noise Limit

In relation to determining the fixed part of the Daytime Amenity Noise Limit the ETSU-R-97 notes (on page 65) that:

“The actual value chosen for the daytime lower limit, within the range of 35-40 dB(A), should depend upon a number of factors:

- *Number of dwellings in the neighbourhood of the wind farm.*

The planning process is trying to balance the benefits arising out of the development of renewable energy sources against the local environmental impact. The more dwellings that are in the vicinity of a wind farm the tighter the limits should be as the total environmental impact will be greater. Conversely if only a few dwellings are affected, then the environmental impact is less and noise limits towards the upper end of the range may be appropriate. Developers still have to consider the interests of individuals as protected under the Environmental Protection Act 1990. It is our belief however, in accordance with the report of the Welsh Affairs Committee [23], that there have been no cases of complaints of noise at levels similar to those caused by wind farms leading to a successful prosecution as a statutory nuisance. It should be noted however that the Welsh Affairs Committee also reports that although the noise may not be a statutory nuisance it can clearly be a cause for distress and disturbance, particularly if residents have been promised inaudibility and the noise has a particular quality leading to complaints.

- *The effect of noise limits on the number of kWh generated.*

Similar arguments can be made when considering the effect of noise limits on uptake of wind energy generated. A single wind turbine causing noise levels of 40 dB(A) at several nearby residences would have less planning merit (noise considerations only) than 30 wind turbines also causing the same amount of noise at several nearby residences.

- *Duration and level of exposure.*

The proportion of the time at which background noise levels are low and how low the background noise level gets are both recognised as factors which could affect the setting of an appropriate lower limit. For example, a property which experienced background noise levels below 30 dB(A) for a substantial proportion of the time in which the turbines would be operating could be expected to receive tighter noise limits than a property at which the background noise levels soon increased to levels above 35 dB(A). This approach is difficult to formulate precisely and a degree of judgement should be exercised.”

The IOA GPG adds some further guidance:

“3.2.2 The day amenity noise limits have been set in ETSU-R-97 on the basis of protecting the amenity of residents whilst outside their dwellings in garden areas. The daytime amenity noise limits are formed in two parts: Part 1 is a simple relationship between the prevailing background noise level (with wind speed) with an allowance of +5 dB; Part 2 is a fixed limit during periods of quiet. ETSU-R-97 describes three criteria to consider when determining the fixed part of the limit in the range of 35 dB to 40 dB L_{A90}, all of which should be considered. They are:

- 1) the number of noise-affected properties;*
- 2) the potential impact on the power output of the wind farm; and*
- 3) the likely duration and level of exposure.*

3.2.3 The rationale for a choice of this limit, or factors which would assist the determining authority in this respect should be set out in the assessment. It is beneficial to the decision maker to display both sets of limits to illustrate the range available and/or the noise limit for the development if agreed previously with the LPA.

3.2.4 Current practice on the three criteria is as follows:

1. The number of neighbouring properties will depend on the nature of the area, (rural, semi-rural, urban) and is sometimes considered in relation to the size of the scheme and study area. The predicted 35 dB L_{A90} contour (at maximum noise output up to 12 m/s) can provide a guide to the dwellings to be considered in this respect.

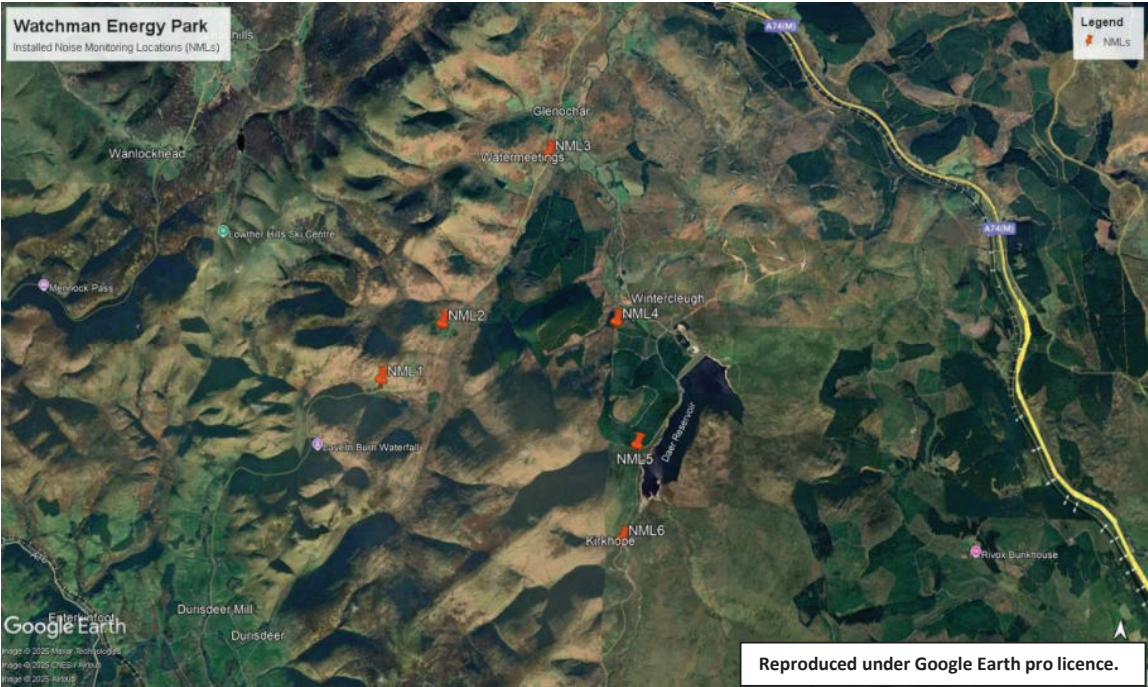
2. This is in practice mainly based on the relative generating capacity of the development, as larger schemes have relatively more planning merit (for noise) according to the description in ETSU-R-97. In cases when the amenity fixed limit has little or no impact on the generating capacity (i.e. noise is not a significant design constraint) then a reduced limit may be applied.

3. This last test is more difficult to formulate. But ETSU-R-97 notes that the likely excess of turbine noise relative to background noise levels should be a relevant consideration. In rural areas, this will often be determined by the sheltering of the property relative to the wind farm site. Account can also be taken of the effects of wind directions (including prevailing ones at the site) and likely directional effects. For cumulative developments, in some cases the effective duration of exposure may increase because of cumulative effects.

3.2.5 It can be argued that assessing these factors do not represent an acoustic consideration but ultimately a planning consideration, and therefore are difficult for noise consultants to fully determine. However this is described as part of ETSU-R-97 and therefore represents a relevant consideration when determining applicable noise limits. Furthermore, it is necessary, as part of the EIA process to evaluate the noise impacts, which is arguably not fully possible without a complete determination of the ETSU-R-97 limits. Finally, consideration of cumulative noise impacts may require the determination of partial noise limits which may be difficult to obtain unless the amenity noise limit is precisely determined.

3.2.6 Other planning considerations, such as the identification in local planning policy of areas of preferred wind farm development, may also influence or determine the choice of the absolute fixed amenity noise limit.”

Watchman Energy Park Baseline Noise Survey – Installed Noise Monitoring Locations



Present during the installation:

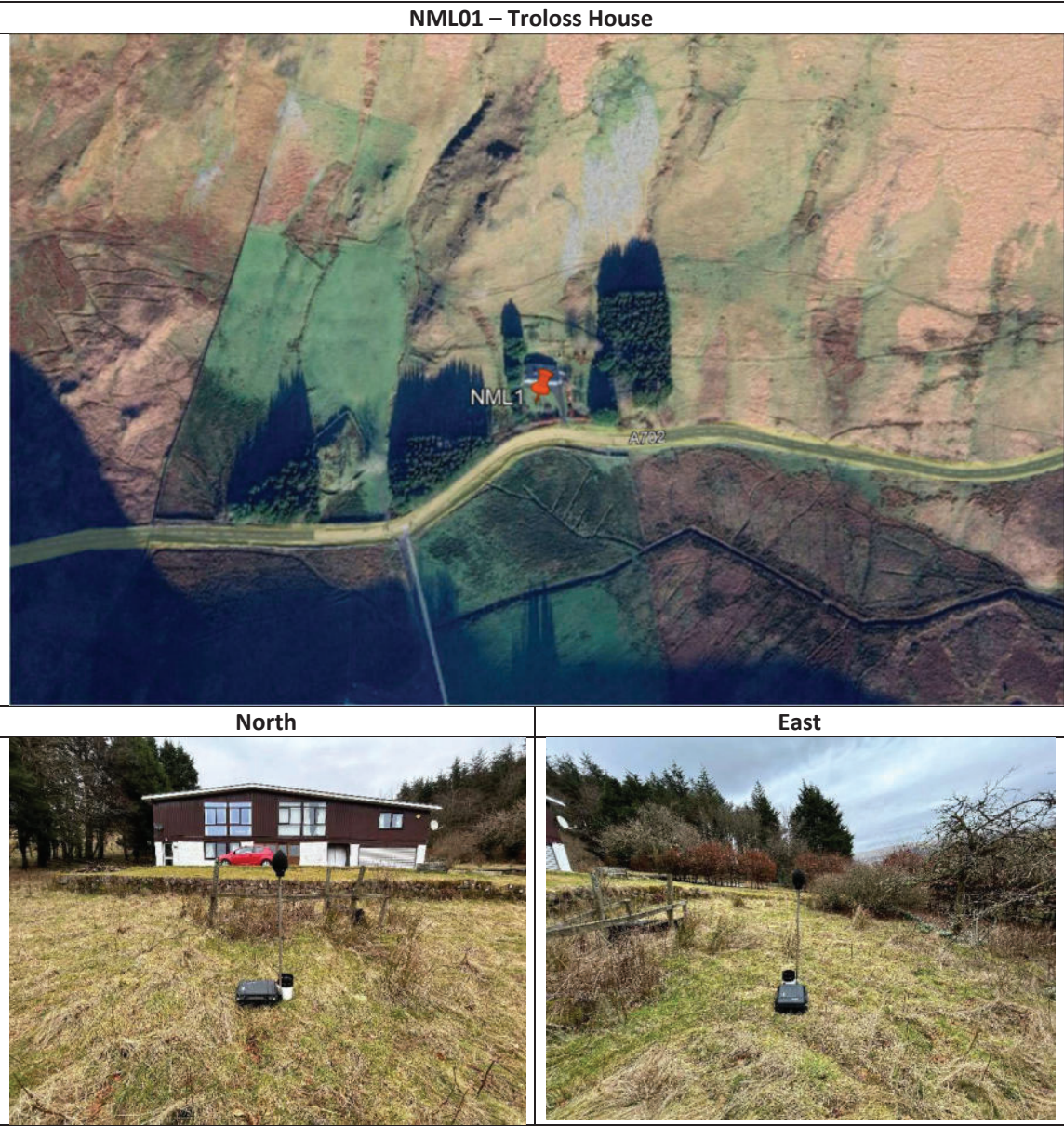
- Eleanor Howcroft, Graduate Consultant, TNEI Services Ltd (all Noise Monitoring Locations (NMLs)).

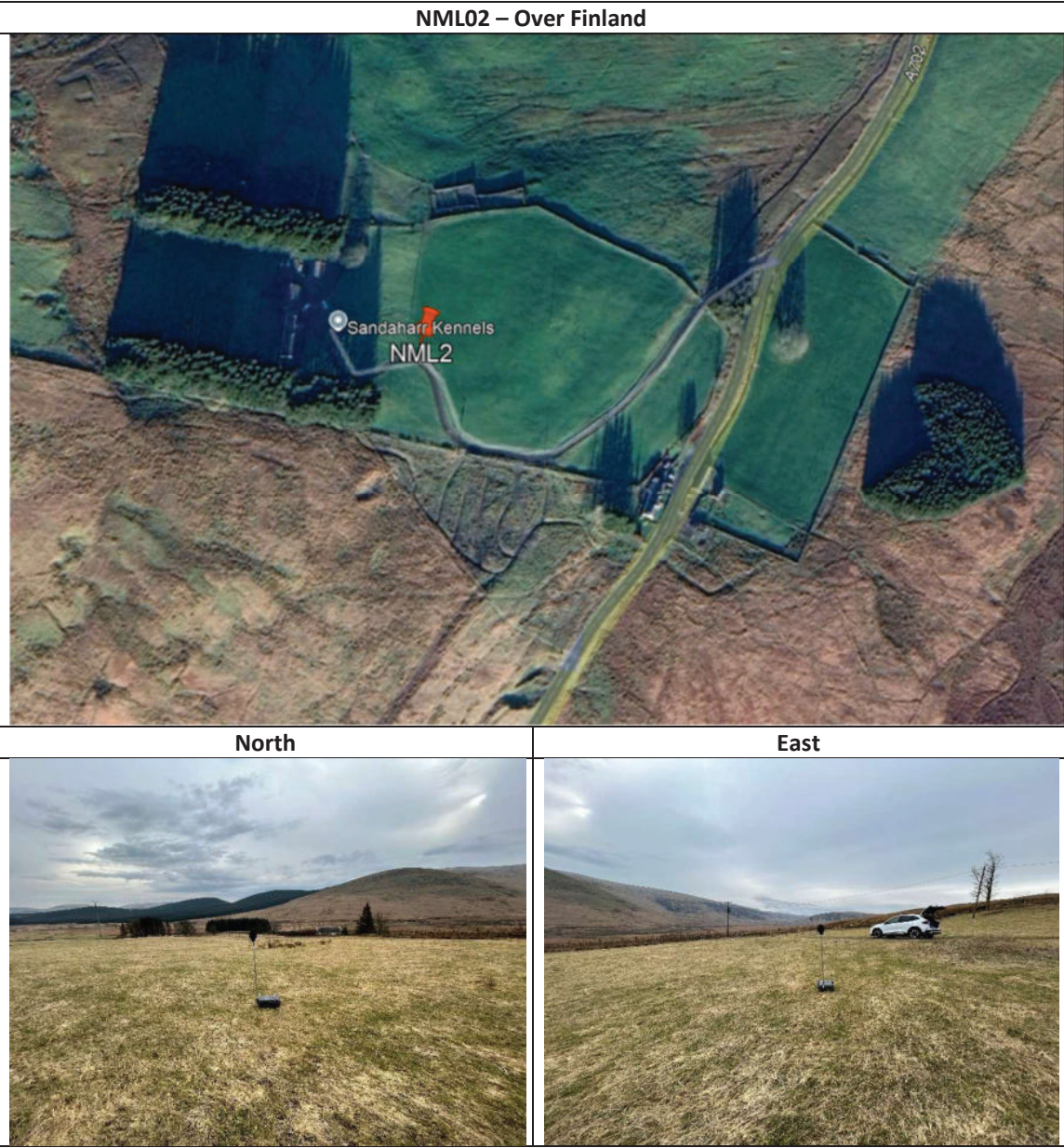
Unless specified, all noise kits were installed at least 3.5 m from any hard-reflecting surface except the ground and away from obvious noise sources, such as boiler flues.

Detailed information and pictures for each of the installed locations are provided below. The original full-size pictures are available on request. Noise monitoring equipment was installed at six locations on 18th of February 2025.

Noise Monitoring Locations (NMLs)

NML	Installation Location (BNG)
NML01 – Troloss House	291621, 608447
NML02 – Over Finland	292791, 609549
NML03 – Peden Gill	294825, 612844
NML04 – Hitteril	296158, 609613
NML05 – Kirkhope Cleuch Cottage	296574, 607230
NML06 – Kirkhope	296303, 605423

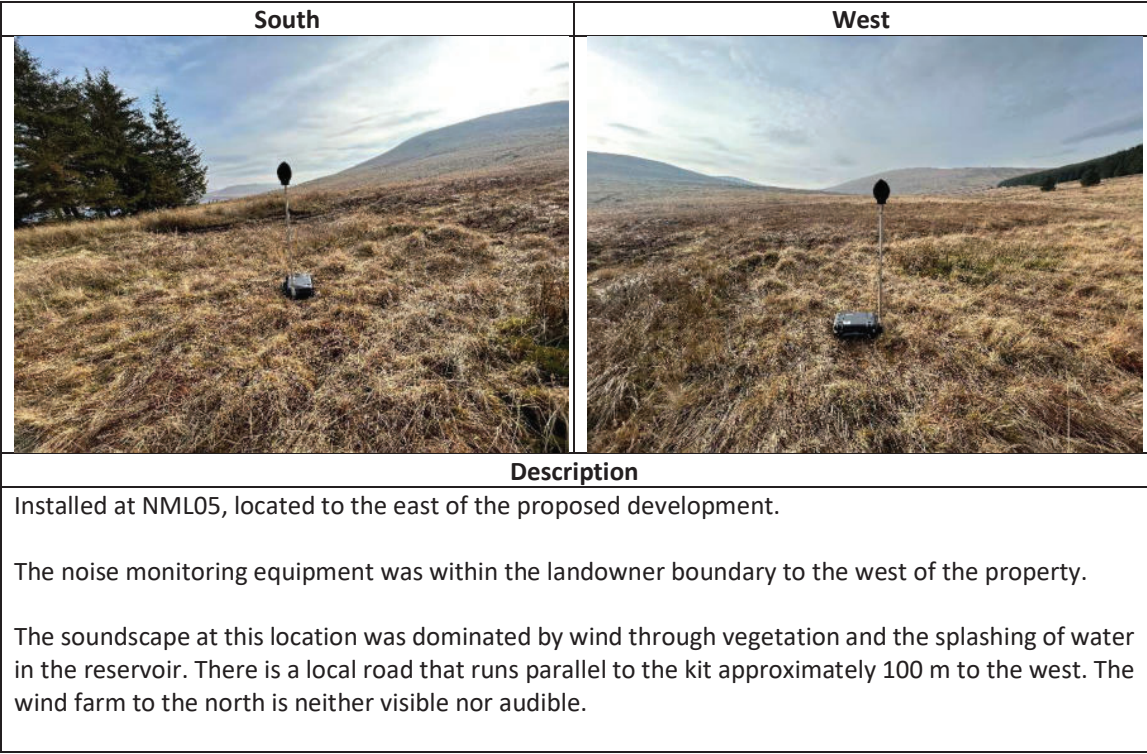


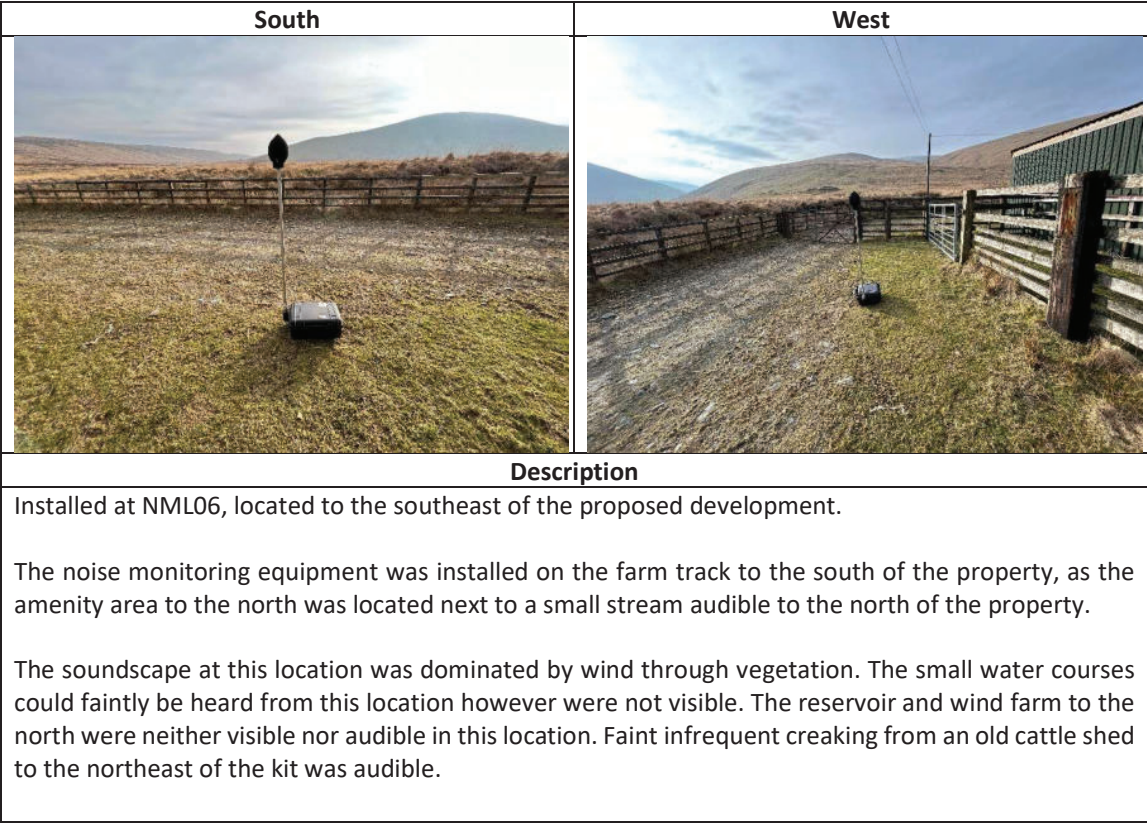
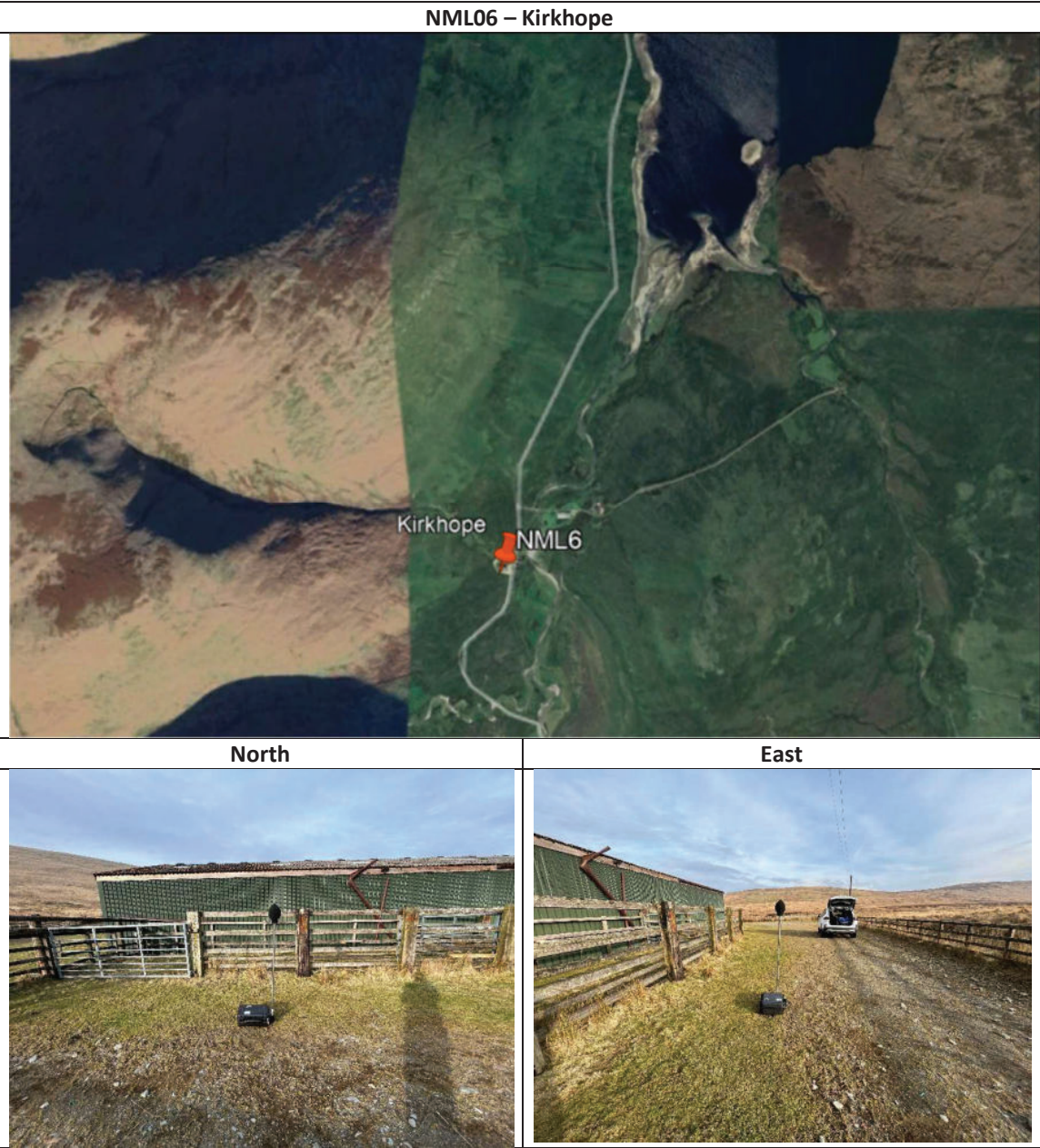




NML04 – Hitteril	
	
North	East
	

South	West
	
Description	
Installed at NML04, located to the east of the proposed development. The noise monitoring equipment was installed within the landowner boundary to the south of the property. The soundscape at this location was dominated by wind through vegetation. Birdsong was also audible along with the infrequent bray of a horse to the west of the property. The wind farm to the north was visible however it was not audible at the time of installation.	





Annex 3 – Noise Monitoring Records

Noise Monitoring Field Data Sheet

Project Title	Watchman Energy Park	Project Number	16380
Client	Wachman Energy Park Limited	Surveyor	EH

MONITORING LOCATION

Location Name	Noise Monitoring Location 1 – Troloss House
Description	The kit was sited in the garden to the south of the property. The boiler flue was on east side of house, suitably distanced from the kit. The kit was placed greater than 3.5 m away from any reflective surfaces (excluding the ground).
Approximate Location	291621, 608447
Noise sources noted during installation, inspection and removal	The soundscape at this location consisted of infrequent road traffic from the nearby local road, and birdsong. The sound of wind in the foliage was also audible.

NOISE MONITORING EQUIPMENT DETAILS

	Kit Number	Model	Serial Number	Last Calibrated/ Conformance Checked
Sound Level Meter	SLM060	Rion NL-52	00721002	22/08/2024
Pre-Amplifier	SLM060	NH-25	22108	22/08/2024
Microphone	SLM060	UC-59	21941	22/08/2024
Calibrator	CAL009	Rion NC-75	35046102	23/10/2024

NOISE MONITORING EQUIPMENT SETTINGS

	Network (A,B,Z)	Index and Time	Time Weighting (Slow, Fast)	Range (dB)	Audio
Parameters Recorded	A	LA9010min, LAeq10min	Fast	20-110	No

DATA

File Name	Start Time	End Time	Cal. at Start	Cal. at End	Drift	Observations
0101	12:20 18/02/2025	13:25 19/03/2025	94.0	93.9	0.1	<u>Installation</u> Road traffic noise was prominent when cars passed by, however this was infrequent. Also audible was the wind in the vegetation and birdsong. Dogs were barking within the property. It was noted that large trucks passed by on road. At the time of installation there was 8 oktas of cloud coverage, a light breeze, no rain, with the ground soft underfoot. <u>Maintenance</u> During the maintenance visit it was sunny with 1 okta of cloud coverage. There was no passing road traffic as the bridge connecting the road to the A74 was closed. Birdsong was the dominant noise source, along with the sounds of a light breeze through the vegetation, with geese intermittently audible from farm to the south of property.

0102	13:40 19/03/2025	12:22 15/04/2025	94.0	93.9	0.1	<u>Collection</u> Upon collection the dominant noise sources were birdsong, passing road traffic, and dogs barking. The weather was dry with 8 oktas of cloud coverage; however, the ground was damp underfoot.
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PHOTOGRAPHS

	
NML1 – North	NML1 – East
	
NML1 – South	NML1 – West

Noise Monitoring Field Data Sheet

Project Title	Watchman Energy Park	Project Number	16380
Client	Wachman Energy Park Limited	Surveyor	EH

MONITORING LOCATION

Location Name	Noise Monitoring Location 2 – Over Fingland
Description	The noise monitoring equipment was installed within the amenity area to the east of the property, away from the kennels that were situated within the property.
Approximate Location	292791, 609549
Noise sources noted during installation, inspection and removal	The soundscape at this location consisted of distant road traffic noise and was dominated by the sound of strong winds through vegetation. Birdsong and intermittent barking from dogs were also audible.

NOISE MONITORING EQUIPMENT DETAILS

	Kit Number	Model	Serial Number	Last Calibrated/ Conformance Checked
Sound Level Meter	SLM059	Rion NL-52	00721001	05/08/2024
Pre-Amplifier	SLM059	NH-25	22107	05/08/2024
Microphone	SLM059	UC-59	21939	05/08/2024
Calibrator	CAL009	Rion NC-75	35046102	23/10/2024

NOISE MONITORING EQUIPMENT SETTINGS

	Network (A,B,Z)	Index and Time	Time Weighting (Slow, Fast)	Range (dB)	Audio
Parameters Recorded	A	L _{A90} 10min, L _{Aeq} 10min	Fast	20-110	No

DATA

File Name	Start Time	End Time	Cal. at Start	Cal. at End	Drift	Observations
0201	10:10 19/02/2025	13:51 19/03/2025	94.0	94.0	0	<u>Installation</u> The dominant noise was the sound of wind through the vegetation; birdsong and road traffic noise was faintly audible, with dogs barking intermittently. The wind farm to the northeast (Clyde) was visible but not audible. <u>Maintenance</u> Dominant noise sources included dogs barking intermittently in the kennels, the sound of wind through vegetation, and birdsong. There was 1 okta of cloud coverage. Clyde wind farm was visible but not audible.
0202	14:10 19/03/2025	12:11 15/04/2025	94.0	94.0	0	<u>Collection</u> Dogs barking was dominant noise source; road traffic noise, birdsong, and the sound of wind in the vegetation were also audible. Clyde wind farm was visible but not audible. The ground was dry underfoot, with 8 oktas of cloud coverage.

PHOTOGRAPHS



NML2 – North



NML2 – East



NML2 – South



NML2 – West

Noise Monitoring Field Data Sheet

Project Title	Watchman Energy Park	Project Number	16380
Client	Wachman Energy Park Limited	Surveyor	EH

MONITORING LOCATION

Location Name	Noise Monitoring Location 3 – Peden Gill
Description	The noise monitoring equipment was installed in amenity area to the west of the property.
Approximate Location	294825, 612844
Noise sources noted during installation, inspection and removal	The soundscape at this location consisted of the sound of the nearby watercourse, wind in foliage, birdsong and infrequent road traffic. The wind turbines to the northeast of the property were visible but not audible during the visits.

NOISE MONITORING EQUIPMENT DETAILS

	Kit Number	Model	Serial Number	Last Calibrated/ Conformance Checked
Sound Level Meter	SLM040	Rion NL-52	01176428	14/02/2024
Pre-Amplifier	SLM040	NH-25	76447	14/02/2024
Microphone	SLM040	UC-59	12471	14/02/2024
Calibrator	CAL009	Rion NC-75	35046102	23/10/2024

NOISE MONITORING EQUIPMENT SETTINGS

	Network (A,B,Z)	Index and Time	Time Weighting (Slow, Fast)	Range (dB)	Audio
Parameters Recorded	A	LA9010min, LAeq10min	Fast	20-110	No

DATA

File Name	Start Time	End Time	Cal. at Start	Cal. at End	Drift	Observations
0301	10:40 19/02/2025	14:33 19/03/2025	94.0	93.9	0.1	<u>Installation</u> The nearby watercourse was audible. Other noise sources included birdsong, wind through vegetation, infrequent road traffic noise. The wind farm to the northeast (Clyde) was visible but not audible at the time of installation. The temperature during installation was 4°, with 8 oktas of cloud coverage. The ground was wet under foot. <u>Maintenance</u> Birdsong and wind through vegetation was the dominant noise source, the nearby watercourse was slightly audible. Clyde Wind Farm was visible but not audible during this visit.
0302	14:50 19/03/2025	11:58 15/04/2025	94.0	94.0	0	<u>Collection</u> The nearby watercourse, birdsong and wind through vegetation was the dominant noise sources Clyde Wind Farm was visible but not audible during this visit. The ground was damp underfoot with 8 oktas of cloud coverage.

PHOTOGRAPHS



NML3 – North



NML3 – East



NML3 – South



NML3 – West

Noise Monitoring Field Data Sheet



Project Title	Watchman Energy Park	Project Number	16380
Client	Wachman Energy Park Limited	Surveyor	EH

MONITORING LOCATION

Location Name	Noise Monitoring Location 4 – Hitteril
Description	The noise monitoring equipment was installed within the landowner boundary to the south of the property.
Approximate Location	296158, 609613
Noise sources noted during installation, inspection and removal	The soundscape at this location was dominated by the sound of wind through vegetation. Birdsong was also audible. The wind farm to the north (Clyde) was visible however it was not audible during the visits to this location.

NOISE MONITORING EQUIPMENT DETAILS

	Kit Number	Model	Serial Number	Last Calibrated/Conformance Checked
Sound Level Meter	SLM053	Rion NL-52	00410232	13/07/2023
Pre-Amplifier	SLM053	NH-25	10674	13/07/2023
Microphone	SLM053	UC-59	18946	13/07/2023
Calibrator	CAL009	Rion NC-75	35046102	23/10/2024

NOISE MONITORING EQUIPMENT SETTINGS

	Network (A,B,Z)	Index and Time	Time Weighting (Slow, Fast)	Range (dB)	Audio
Parameters Recorded	A	L _{A90} 10min, L _{Aeq} 10min	Fast	20-110	No

DATA

File Name	Start Time	End Time	Cal. at Start	Cal. at End	Drift	Observations
0401	14:20 18/02/2025	15:55 19/03/2025	94.0	94.1	0.1	<u>Installation</u> The dominant noise source was wind through vegetation. Birdsong was also present. Clyde Wind farm was visible but not audible during installation. The ground was soft under foot, with 6 oktas of cloud coverage. <u>Maintenance</u> The soundscape was quiet, with the sound of the breeze in vegetation and birdsong being the main noise sources. Clyde was not audible during this visit.
0402	16:00 19/03/2025	11:39 15/04/2025	94.0	94.1	0.1	<u>Collection</u> The soundscape included birdsong and the wind through the vegetation. There were 7 oktas of cloud coverage, and the ground was damp underfoot. Again, Clyde Wind Farm was not audible during this visit.

PHOTOGRAPHS



NML4 – North



NML4 – East



NML4 – South



NML4 – West

Noise Monitoring Field Data Sheet



Project Title	Watchman Energy Park	Project Number	16380
Client	Wachman Energy Park Limited	Surveyor	EH

MONITORING LOCATION

Location Name	Noise Monitoring Location 5 – Kirkhope Cleuch Cottage
Description	The noise monitoring equipment was within the landowner boundary to the west of the property.
Approximate Location	296574, 607230
Noise sources noted during installation, inspection and removal	The soundscape at this location was dominated by the sound of wind through vegetation.

NOISE MONITORING EQUIPMENT DETAILS

	Kit Number	Model	Serial Number	Last Calibrated/Conformance Checked
Sound Level Meter	SLM061	Rion NL-52	00721060	05/08/2024
Pre-Amplifier	SLM061	NH-25	22166	05/08/2024
Microphone	SLM061	UC-59	22048	05/08/2024
Calibrator	CAL009	Rion NC-75	35046102	23/10/2024

NOISE MONITORING EQUIPMENT SETTINGS

	Network (A,B,Z)	Index and Time	Time Weighting (Slow, Fast)	Range (dB)	Audio
Parameters Recorded	A	LA9010min, LAeq10min	Fast	20-110	No

DATA

File Name	Start Time	End Time	Cal. at Start	Cal. at End	Drift	Observations
0501	14:50 18/02/2025	15:35 19/03/2025	94.0	94.0	0	<u>Installation</u> The kit was sited within the landowners' boundaries, approximately 100 m away from Kirkhope Cleuch Cottage. The dominant noise sources included the sound of wind in vegetation, birdsong, and road traffic noise along the local road adjacent to the property. The lapping of waves on the reservoir were also audible. There were 6 oktas of cloud coverage, and the ground was wet under foot. <u>Maintenance</u> The soundscape was very quiet during this visit; audible noise sources included the sound of the breeze in vegetation and birdsong.
0502	15:40 19/03/2025	11:22 15/04/2025	94.0	94.2	0.2	<u>Collection</u> The soundscape was quiet during this visit with audible noise sources including the sound of the breeze in vegetation and birdsong. The ground was soft under foot with 7 oktas of cloud coverage.

PHOTOGRAPHS



Noise Monitoring Field Data Sheet

Project Title	Watchman Energy Park	Project Number	16380
Client	Wachman Energy Park Limited	Surveyor	EH

MONITORING LOCATION

Location Name	Noise Monitoring Location 6 – Kirkhope
Description	Unoccupied residential property along the southeast corner of the proposed development. The noise monitoring equipment was installed on the farm track to the south of the property to maximise distance to stream located to the north of the property.
Approximate Location	296303, 605423
Noise sources noted during installation, inspection and removal	The soundscape at this location was dominated by the sound of wind through vegetation. Nearby watercourses were faintly audible from this location.

NOISE MONITORING EQUIPMENT DETAILS

	Kit Number	Model	Serial Number	Last Calibrated/Conformance Checked
Sound Level Meter	SLM54	Rion NL-52	00410235	14/02/2024
Pre-Amplifier	SLM54	NH-25	10677	14/02/2024
Microphone	SLM54	UC-59	19117	14/02/2024
Calibrator	CAL009	Rion NC-75	35046102	23/10/2024

NOISE MONITORING EQUIPMENT SETTINGS

	Network (A,B,Z)	Index and Time	Time Weighting (Slow, Fast)	Range (dB)	Audio
Parameters Recorded	A	LA9010min, LAeq10min	Fast	20-110	No

DATA

File Name	Start Time	End Time	Cal. at Start	Cal. at End	Drift	Observations
0601	15:10 18/02/2025	15:13 19/03/2025	94.0	93.9	0.1	<u>Installation</u> The dominant noise source was the sound of wind in the vegetation. The sound of watercourses was faintly audible. <u>Maintenance</u> The soundscape was quiet during this visit. The only audible sounds included the sound of the breeze in the vegetation, faint sheep bleat, was a distant plane overhead.
0602	15:20 19/03/2025	11:04 15/04/2025	94.0	94.0	0	<u>Collection</u> The soundscape was quiet during this visit. The only audible sounds included the sound of the breeze in the vegetation, birdsong, and the distant sound of watercourses. The ground was damp underfoot with 6 oktas of cloud coverage.

PHOTOGRAPHS

	
NML6 – West	NML6 – North
	
NML6 – East	NML6 – South

Annex 4 – Calibration/ Conformance Certificates for Sound Level Meters and Calibrator



CERTIFICATE OF CALIBRATION



0653

Date of Issue: 23 October 2024

Certificate Number: UCRT24/2404

Calibrated at & Certificate issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk

Page 1 of 2 Pages
Approved Signatory
B. Bogdan

Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Customer TNEI Services Ltd
7th Floor
West One
Newcastle Upon Tyne
NE1 3PA

Order No. 750400

Test Procedure Procedure TP 14 Calibration of Sound Calibrators (60942:2017)

Description Acoustic Calibrator

Identification	Manufacturer Rion	Instrument Calibrator	Model NC-75	Serial No. 35046102
	Public evidence of Type Approval	Yes	Approved by PTB	

The calibrator has been tested as specified in Annex B of IEC 60942:2017. As public evidence was available, from a testing organisation responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2017, the sound calibrator tested is considered to conform to all the class 1 requirements of IEC 60942:2017.

ANV Job No. UKAS24/10760

Date Received 22 October 2024

Date Calibrated 23 October 2024

Previous Certificate	Dated	Initial Calibration
	Certificate No.	
	Laboratory	

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

CERTIFICATE OF CALIBRATION

UKAS Accredited Calibration Laboratory No. 0653

Certificate Number

UCRT24/2404

Page 2 of 2 Pages

Measurements

The sound pressure level generated by the calibrator (averaged over a 20 to 25 second period) in its WS2 configuration was measured five times (rotating the calibrator on the microphone each time) by the Insert Voltage Method using a microphone as detailed below. The mean of the results obtained is shown below.

The frequency of the sound from the calibrator was measured five times over a 20 to 25 second period and the average frequency calculated.

The total distortion + noise of the sound from the calibrator was measured, using a rejection filter distortion factor meter, five times over a 20 to 25 second period and the average distortion + noise calculated.

Test Microphone	Manufacturer	Type
	Brüel & Kjær	4134

Nominal Setting dB / Hz	Mean Level dB rel 20 µPa	Frequency	Distortion + Noise
94 / 1000	94.00 ± 0.10	1000.00 ± 0.12Hz	(0.10 ± 0.02) %

Environmental conditions during tests	Start	End	
Temperature	23.10	23.10	± 0.30 °C
Humidity	49.9	51.8	± 3.0 %RH
Ambient Pressure	102.138	102.152	± 0.030 kPa

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

The uncertainties refer to the measured values only with no account being taken of the ability of the instrument to maintain its calibration.

A small correction factor may need to be applied to the sound pressure level quoted above if the device is used to calibrate a sound level meter which is fitted with a free-field response microphone. See manufacturers handbook for details.

Note: Calibrator adjusted prior to calibration? NO

Additional Comments The results on this certificate only relate to the items calibrated as identified above.
None

Calibrated by: K. Zablocki

END

R 1



CERTIFICATE OF CALIBRATION

Date of Issue: 14 February 2024

Issued by:

ANV Measurement Systems

Beaufort Court

17 Roebuck Way

Milton Keynes MK5 8HL

Telephone 01908 642846 Fax 01908 642814

E-Mail: info@noise-and-vibration.co.uk

Web: www.noise-and-vibration.co.uk

Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Certificate Number: TCRT24/1151

Page 1 of 2 Pages

Approved Signatory

K. Mistry

Customer TNEI
7th Floor West One
Forth Banks
Newcastle Upon Tyne
NE1 3PA

Order No.	5001																												
Description	Sound Level Meter / Pre-amp / Microphone / Associated Calibrator																												
Identification	<table><tr><th>Manufacturer</th><th>Instrument</th><th>Type</th><th>Serial No. / Version</th></tr><tr><td>Rion</td><td>Sound Level Meter</td><td>NL-52</td><td>01176428</td></tr><tr><td>Rion</td><td>Firmware</td><td></td><td>2.0</td></tr><tr><td>Rion</td><td>Pre Amplifier</td><td>NH-25</td><td>76447</td></tr><tr><td>Rion</td><td>Microphone</td><td>UC-59</td><td>12471</td></tr><tr><td>Rion</td><td>Calibrator</td><td>NC-74</td><td>34762316</td></tr><tr><td></td><td>Calibrator adaptor type if applicable</td><td></td><td>NC-74-002</td></tr></table>	Manufacturer	Instrument	Type	Serial No. / Version	Rion	Sound Level Meter	NL-52	01176428	Rion	Firmware		2.0	Rion	Pre Amplifier	NH-25	76447	Rion	Microphone	UC-59	12471	Rion	Calibrator	NC-74	34762316		Calibrator adaptor type if applicable		NC-74-002
Manufacturer	Instrument	Type	Serial No. / Version																										
Rion	Sound Level Meter	NL-52	01176428																										
Rion	Firmware		2.0																										
Rion	Pre Amplifier	NH-25	76447																										
Rion	Microphone	UC-59	12471																										
Rion	Calibrator	NC-74	34762316																										
	Calibrator adaptor type if applicable		NC-74-002																										

Performance Class 1

Test Procedure TP 10. SLM 61672-3:2013

Procedures from IEC 61672-3:2013 were used to perform the periodic tests.

Type Approved to IEC 61672-1:2013 Yes

If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2013

Date Received 13 February 2024

ANV Job No. TRAC24/02069

Date Calibrated 14 February 2024

The sound level meter submitted for testing has successfully completed the periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organisation responsible for approving the results of pattern-evaluation tests performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 specifications of IEC 61672-1:2013.

Previous Certificate	Dated	Certificate No.	Laboratory
	22 November 2021	214285	NSAI National Metrology Lab

This certificate provides traceability of measurement to recognised national standards, and to units of measurement realised at the National Physical Laboratory or other recognised national standards laboratories. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

CERTIFICATE OF CALIBRATION



Certificate Number

TCRT24/1151

Page 2 of 2 Pages

Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.

SLM instruction manual title	NL-52/NL-42 Description for IEC 61672-1		
SLM instruction manual ref / issue	No. 56034 21-03	Source	Rion
Date provided or internet download date	19 March 2021		
	Case Corrections	Wind Shield Corrections	Mic Pressure to Free Field Corrections
Uncertainties provided	Yes	Yes	Yes
Total expanded uncertainties within the requirements of IEC 61672-1:2013			
YES			
Specified or equivalent Calibrator	Specified		
Customer or Lab Calibrator	Customers Calibrator		
Calibrator adaptor type if applicable	NC-74-002		
Calibrator cal. date	14 February 2024		
Calibrator cert. number	UCRT24/1237		
Calibrator cal cert issued by Lab	ANV Measurement Systems		
Calibrator SPL @ STP	94.03	dB	Calibration reference sound pressure level
Calibrator frequency	1002.41	Hz	Calibration check frequency
Reference level range	Single	dB	
Accessories used or corrected for during calibration - None			

Environmental conditions during tests	Start	End	
Temperature	23.08	23.13	± 0.30 °C
Humidity	49.5	50.3	± 3.00 %RH
Ambient Pressure	100.06	100.05	± 0.03 kPa

Indication at the Calibration Check Frequency			
Initial indicated level	94.2	dB	Adjusted indicated level 94.0 dB
Uncertainty of calibrator used for Indication at the Calibration Check Frequency ± 0.10 dB			
Self Generated Noise			
Microphone installed -	Less Than	20.2	dB A Weighting
Microphone replaced with electrical input device - UR = Under Range indicated			
Weighting	A	C	Z
	12.2	16.1	21.5
	dB	dB	dB
	UR	UR	UR

Self Generated Noise reported for information only and not used to assess conformance to a requirement

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with the Guide to the Expression of Uncertainty in Measurement published by ISO.

Additional Comments

None

Calibrated by: K. Zablocki

END

R 1



CERTIFICATE OF CALIBRATION

Date of Issue: 13 July 2023

Certificate Number: TCRT23/1509

Issued by:

ANV Measurement Systems

Beaufort Court

17 Roebuck Way

Milton Keynes MK5 8HL

Telephone 01908 642846 Fax 01908 642814

E-Mail: info@noise-and-vibration.co.uk

Web: www.noise-and-vibration.co.uk

Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Page 1 of 2 Pages

Approved Signatory

K. Mistry

Customer TNEI
Floor 7
West One
Forth Banks
Newcastle upon Tyne
NE1 3PA

Order No. 5001

Description Sound Level Meter / Pre-amp / Microphone / Associated Calibrator

Identification	Manufacturer	Instrument	Type	Serial No. / Version
Rion	Rion	Sound Level Meter	NL-52	00410232
Rion	Rion	Firmware		2.0
Rion	Rion	Pre Amplifier	NH-25	10674
Rion	Rion	Microphone	UC-59	18946
Rion	Rion	Calibrator	NC-74	34536109
		Calibrator adaptor type if applicable		NC-74-002

Performance Class 1

Test Procedure TP 10. SLM 61672-3:2013

Procedures from IEC 61672-3:2013 were used to perform the periodic tests.

Type Approved to IEC 61672-1:2013 Yes

If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2013

Date Received 12 July 2023

ANV Job No. TRAC23/07313

Date Calibrated 13 July 2023

The sound level meter submitted for testing has successfully completed the periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organisation responsible for approving the results of pattern-evaluation tests performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 specifications of IEC 61672-1:2013.

Previous Certificate Dated Certificate No. Laboratory
Initial Calibration

This certificate provides traceability of measurement to recognised national standards, and to units of measurement realised at the National Physical Laboratory or other recognised national standards laboratories. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

CERTIFICATE OF CALIBRATION



Certificate Number
TCRT23/1509
Page 2 of 2 Pages

Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.

SLM instruction manual title	NL-52/NL-42 Description for IEC 61672-1		
SLM instruction manual ref / issue	No. 56034 21-03	Source	Rion
Date provided or internet download date	19 March 2021		
	Case Corrections	Wind Shield Corrections	Mic Pressure to Free Field Corrections
Uncertainties provided	Yes	Yes	Yes
Total expanded uncertainties within the requirements of IEC 61672-1:2013		YES	
Specified or equivalent Calibrator	Specified		
Customer or Lab Calibrator	Lab Calibrator		
Calibrator adaptor type if applicable	NC-74-002		
Calibrator cal. date	03 July 2023		
Calibrator cert. number	UCRT23/1863		
Calibrator cal cert issued by Lab	ANV Measurement Systems		
Calibrator SPL @ STP	93.99	dB	Calibration reference sound pressure level
Calibrator frequency	1002.01	Hz	Calibration check frequency
Reference level range	Single	dB	
Accessories used or corrected for during calibration - Extension Cable (No Wind Shield)			
Note - The Extension Cable was used between the SLM and the pre-amp for this calibration.			
Environmental conditions during tests	Start	End	
Temperature	23.24	23.43	± 0.30 °C
Humidity	40.5	41.2	± 3.00 %RH
Ambient Pressure	100.54	100.54	± 0.03 kPa
Indication at the Calibration Check Frequency			
Initial indicated level	94.2	dB	Adjusted indicated level 94.0 dB
Uncertainty of calibrator used for Indication at the Calibration Check Frequency ±	0.10 dB		
Self Generated Noise			
Microphone installed -	Less Than	16.9	dB A Weighting
Microphone replaced with electrical input device -	UR = Under Range indicated		
Weighting	A	C	Z
	10.9	dB UR	15.0 dB UR 20.4 dB UR

Self Generated Noise reported for information only and not used to assess conformance to a requirement

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with the Guide to the Expression of Uncertainty in Measurement published by ISO.

Additional Comments

None

Calibrated by: K. Zablocki
END
R 1



CERTIFICATE OF CALIBRATION



0653

Date of Issue: 05 August 2024

Certificate Number: UCRT24/2055

Calibrated at & Certificate issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Page 1 of 2 Pages

Approved Signatory

K. Mistry

Customer TNEI
7th Floor West One
Forth Banks
Newcastle Upon Tyne
NE1 3PA

Order No.	5001			
Description	Sound Level Meter / Pre-amp / Microphone / Associated Calibrator			
Identification	<i>Manufacturer</i>	<i>Instrument</i>	<i>Type</i>	<i>Serial No. / Version</i>
	Rion	Sound Level Meter	NL-52	00721001
	Rion	Firmware		2.1
	Rion	Pre Amplifier	NH-25	22107
	Rion	Microphone	UC-59	21939
	Rion	Calibrator	NC-75	34334830
		Calibrator adaptor type if applicable		

Performance Class 1
Test Procedure TP 10. SLM 61672-3:2013
Procedures from IEC 61672-3:2013 were used to perform the periodic tests.
Type Approved to IEC 61672-1:2013 Yes
If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2013
Date Received 02 August 2024 ANV Job No. UKAS24/08562
Date Calibrated 05 August 2024

The sound level meter submitted for testing has successfully completed the periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organisation responsible for approving the results of pattern-evaluation tests performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 specifications of IEC 61672-1:2013.

Previous Certificate Dated Certificate No. Laboratory
Initial Calibration

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CERTIFICATE OF CALIBRATION

Date of Issue: 22 August 2024

Certificate Number: TCRT24/1660

Issued by:

ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk

Page 1 of 2 Pages
Approved Signature~
K. Misty

Customer

TNEI Services Ltd
7th Floor
West One
Forth Banks
Newcastle Upon Tyne
NE13PA

Order No.	5001
Description	Sound Level Meter / Pre-amp / Microphone / Associated Calibrator
Identification	Manufacturer Instrument Type Serial No. / Version
	Rion Sound Level Meter NL-52 00721002
	Rion Firmware 2.1
	Rion Pre Amplifier NH-25 22108
	Rion Microphone UC-59 21941
	Rion Calibrator NC-74 34762316
	Calibrator adaptor type if applicable NC-74-002

Performance Class 1
Test Procedure TP 10. SLM 61672-3:2013
Procedures from IEC 61672-3:2013 were used to perform the periodic tests.

Type Approved to IEC 61672-1:2013 Yes

If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2013

Date Received 21 August 2024 ANV Job No. TRAC24/08373
Date Calibrated 22 August 2024

The sound level meter submitted for testing has successfully completed the periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organisation responsible for approving the results of pattern-evaluation tests performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 specifications of IEC 61672-1:2013.

Previous Certificate

Dated Initial Calibration

Certificate No.

Laboratory

This certificate provides traceability of measurement to recognised national standards, and to units of measurement realised at the National Physical Laboratory or other recognised national standards laboratories. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

CERTIFICATE OF CALIBRATION

Certificate Number
UCRT24/2055

UKAS Accredited Calibration Laboratory No. 0653

Page 2 of 2 Pages

Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.

SLM instruction manual title	NL-52/NL-42 Description for IEC 61672-1		
SLM instruction manual ref / issue	No. 56034 21-03	Source	Rion
Date provided or internet download date	19 March 2021		
	Case Corrections	Wind Shield Corrections	Mic Pressure to Free Field Corrections
Uncertainties provided	Yes	Yes	Yes
Total expanded uncertainties within the requirements of IEC 61672-1:2013		YES	
Specified or equivalent Calibrator	Specified		
Customer or Lab Calibrator	Lab Calibrator		
Calibrator adaptor type if applicable	NC-75-022		
Calibrator cal. date	10 July 2024		
Calibrator cert. number	UCRT24/1958		
Calibrator cal cert issued by Lab	0653		
Calibrator SPL @ STP	94.00	dB	Calibration reference sound pressure level
Calibrator frequency	1000.00	Hz	Calibration check frequency
Reference level range	Single	dB	
Accessories used or corrected for during calibration - Extension Cable & Wind Shield WS-15			
Note - The Extension Cable was used between the SLM and the pre-amp for this calibration.			

Environmental conditions during tests	Start	End		
Temperature	23.85	23.96	±	0.30 °C
Humidity	61.3	61.4	±	3.00 %RH
Ambient Pressure	100.19	100.18	±	0.03 kPa

Indication at the Calibration Check Frequency				
Initial indicated level	93.9	dB	Adjusted indicated level	94.0
Uncertainty of calibrator used for Indication at the Calibration Check Frequency ±				0.10
				dB

Self Generated Noise									
Microphone installed -	Less Than	20.7	dB	A Weighting					
Microphone replaced with electrical input device -	UR = Under Range indicated								
Weighting	A	C	Z						
	10.7	dB	UR	14.6	dB	UR	23.4	dB	UR

Self Generated Noise reported for information only and not used to assess conformance to a requirement

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Additional Comments The results on this certificate only relate to the items calibrated as identified above.

None

Calibrated by: B. Bogdan

END

R 2



CERTIFICATE
OF
CALIBRATION



Certificate Number: UCRT24/2053

Page 1 of 2 Pages
Approved Signatory
K. Mistry

Date of Issue: 05 August 2024
Calibrated at & Certificate issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Customer TNEI
7th Floor West One
Forth Banks
Newcastle Upon Tyne
NE1 3PA

Order No.	5001			
Description	Sound Level Meter / Pre-amp / Microphone / Associated Calibrator			
Identification	<i>Manufacturer</i>	<i>Instrument</i>	<i>Type</i>	<i>Serial No. / Version</i>
	Rion	Sound Level Meter	NL-52	00721060
	Rion	Firmware		2.1
	Rion	Pre Amplifier	NH-25	22166
	Rion	Microphone	UC-59	22048
	Rion	Calibrator	NC-75	34334830
		Calibrator adaptor type if applicable		

Performance Class 1
Test Procedure TP 10. SLM 61672-3:2013
Procedures from IEC 61672-3:2013 were used to perform the periodic tests.

Type Approved to IEC 61672-1:2013 Yes
If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2013

Date Received 02 August 2024 ANV Job No. UKAS24/08562
Date Calibrated 05 August 2024

The sound level meter submitted for testing has successfully completed the periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organisation responsible for approving the results of pattern-evaluation tests performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 specifications of IEC 61672-1:2013.

Previous Certificate Dated Certificate No. Laboratory
Initial Calibration

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

CERTIFICATE OF CALIBRATION

Certificate Number
TCRT24/1660
Page 2 of 2 Pages

Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.	
SLM instruction manual title	NL-52/NL-42 Description for IEC 61672-1
SLM instruction manual ref / issue	No. 56034 21-03 Source Rion
Date provided or internet download date	19 March 2021
Case Corrections	Wind Shield Corrections Mic Pressure to Free Field Corrections
Yes	Yes Yes
Total expanded uncertainties within the requirements of IEC 61672-1:2013 YES	
Specified or equivalent Calibrator Customers Calibrator	
Customer or Lab Calibrator	NC-74-002
Calibrator adaptor type if applicable	14 February 2024
Calibrator cert. number	UCRT24/1237
Calibrator cal cert issued by Lab	ANV Measurement Systems
Calibrator SPL @ STP	94.03 dB Calibration reference sound pressure level
Calibrator frequency	1002.41 Hz Calibration check frequency
Reference level range	Single dB
Accessories used or corrected for during calibration - Extension Cable & Wind Shield WS-15	
Note - The Extension Cable was used between the SLM and the pre-amp for this calibration.	
Environmental conditions during tests	
Temperature	Start End
Humidity	53.3 53.0
Ambient Pressure	99.47 99.41
	± 0.30 °C
	± 3.00 %RH
	± 0.03 kPa
Indication at the Calibration Check Frequency	
Initial indicated level	94.1 dB Adjusted indicated level
Uncertainty of calibrator used for indication at the Calibration Check Frequency ±	0.10 dB
Self Generated Noise	
Microphone replaced with electrical input device -	Less Than 20.0 dB A Weighting
	UR = Under Range indicated
Weighting	A 10.5 dB UR C 14.9 dB UR Z 22.3 dB UR

Self Generated Noise reported for information only and not used to assess conformance to a requirement

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with the Guide to the Expression of Uncertainty in Measurement published by ISO.

Additional Comments

None

Calibrated by: B. Bogdan
END
R 2

CERTIFICATE OF CALIBRATION

Certificate Number

UCRT24/2053

UKAS Accredited Calibration Laboratory No. 0653

Page 2 of 2 Pages

Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.

SLM instruction manual title NL-52/NL-42 Description for IEC 61672-1

SLM instruction manual ref / issue No. 56034 21-03 Source Rion

Date provided or internet download date 19 March 2021

	Case Corrections	Wind Shield Corrections	Mic Pressure to Free Field Corrections
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Uncertainties provided	Yes	Yes	Yes
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Total expanded uncertainties within the requirements of IEC 61672-1:2013 YES

Specified or equivalent Calibrator Specified

Customer or Lab Calibrator Lab Calibrator

Calibrator adaptor type if applicable NC-75-022

Calibrator cal. date 10 July 2024

Calibrator cert. number UCRT24/1958

Calibrator cal cert issued by Lab 0653

Calibrator SPL @ STP 94.00 dB Calibration reference sound pressure level

Calibrator frequency 1000.00 Hz Calibration check frequency

Reference level range Single dB

Accessories used or corrected for during calibration - Extension Cable & Wind Shield WS-15

Note - The Extension Cable was used between the SLM and the pre-amp for this calibration.

Environmental conditions during tests	Start	End	
Temperature	23.85	23.70	± 0.30 °C
Humidity	60.1	59.8	± 3.00 %RH
Ambient Pressure	100.19	100.19	± 0.03 kPa

Indication at the Calibration Check Frequency

Initial indicated level	94.0 dB	Adjusted indicated level	94.0 dB
-------------------------	---------	--------------------------	---------

Uncertainty of calibrator used for Indication at the Calibration Check Frequency ± 0.10 dB

Self Generated Noise

Microphone installed - Less Than 22.2 dB A Weighting

Microphone replaced with electrical input device - UR = Under Range indicated

Weighting	A	C	Z
	10.6 dB UR	15.3 dB UR	22.9 dB UR

Self Generated Noise reported for information only and not used to assess conformance to a requirement

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Additional Comments The results on this certificate only relate to the items calibrated as identified above.

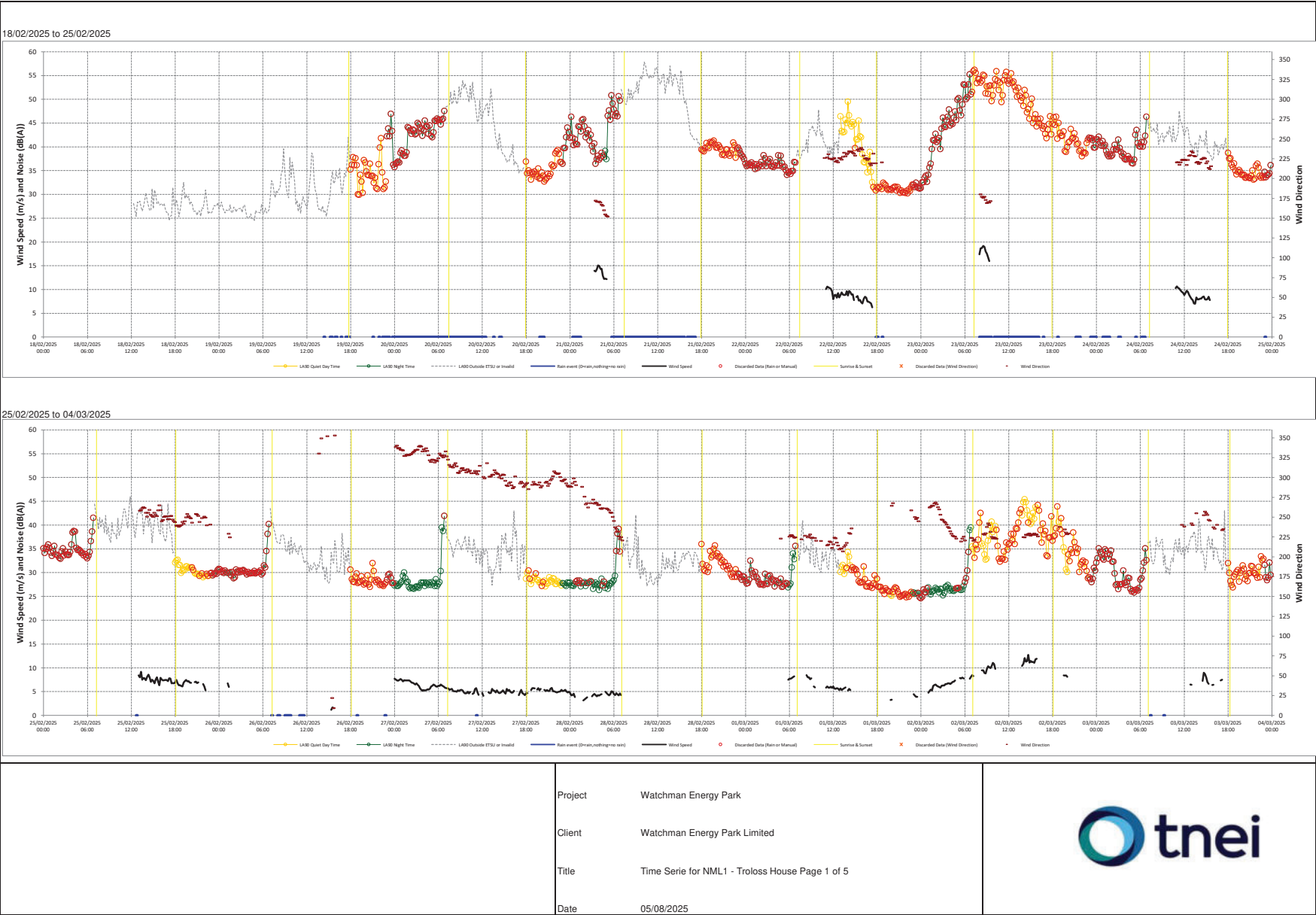
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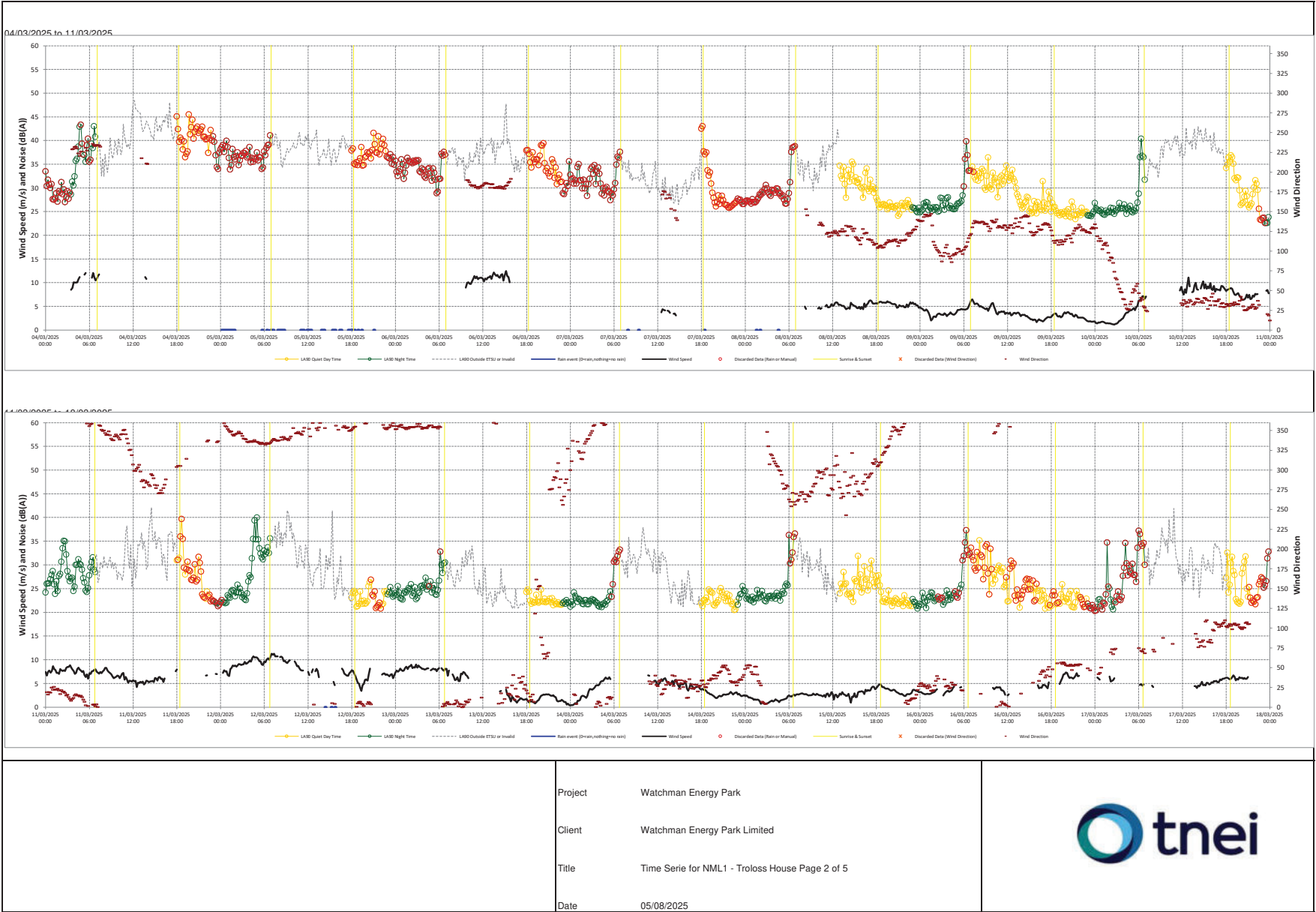
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Calibrated by: B. Bogdan

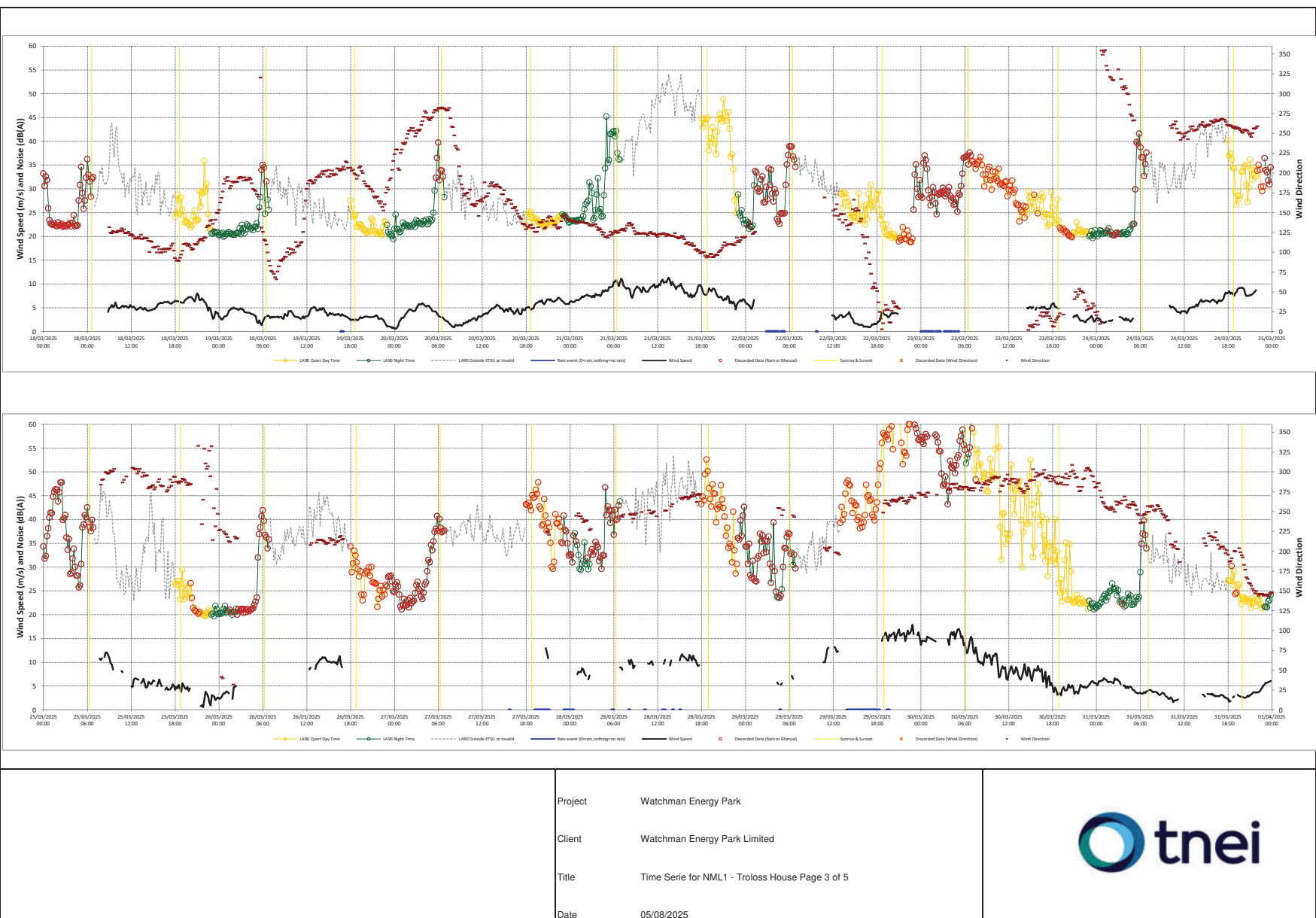
R 2

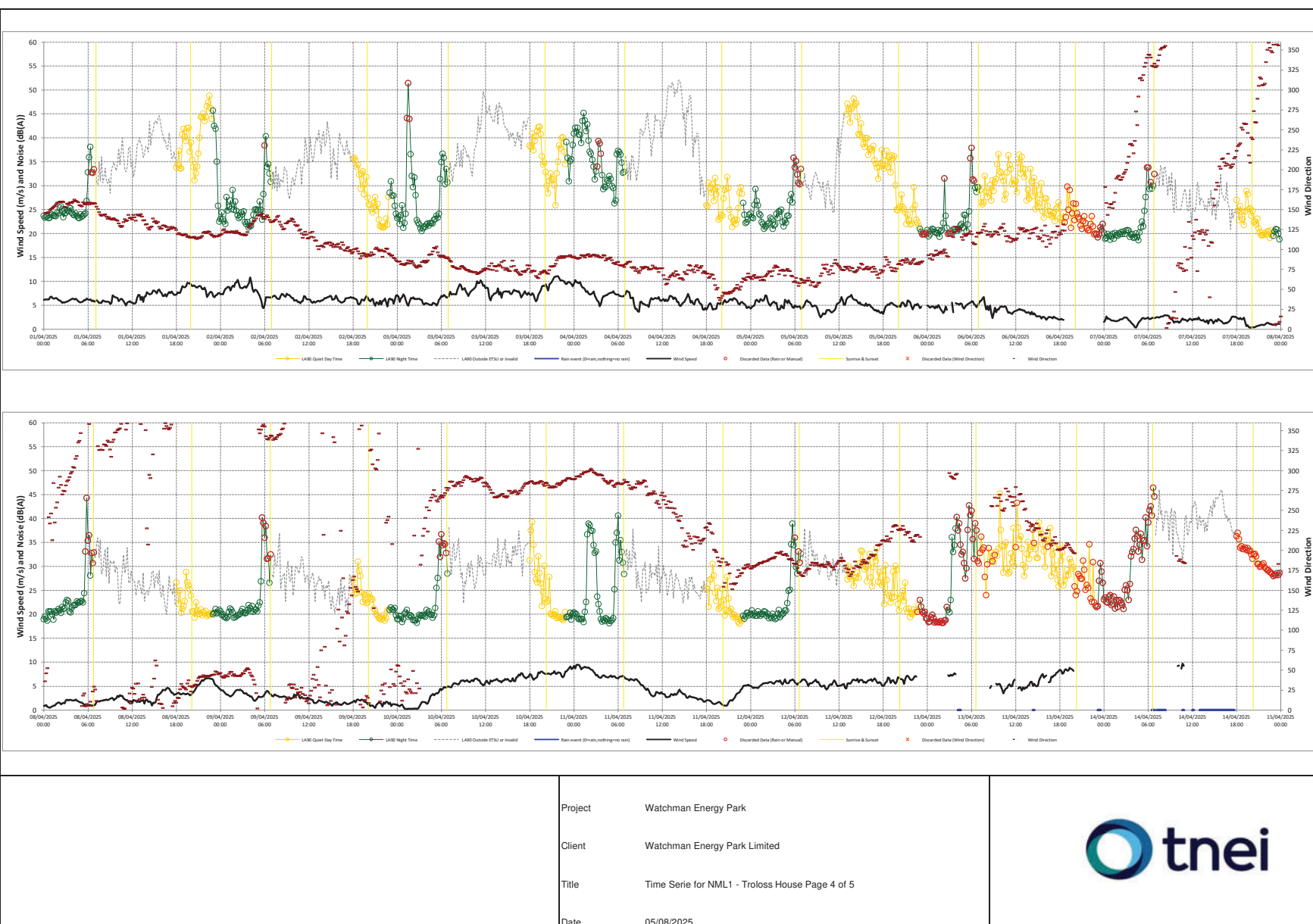
Annex 5 – Time Series Graphs

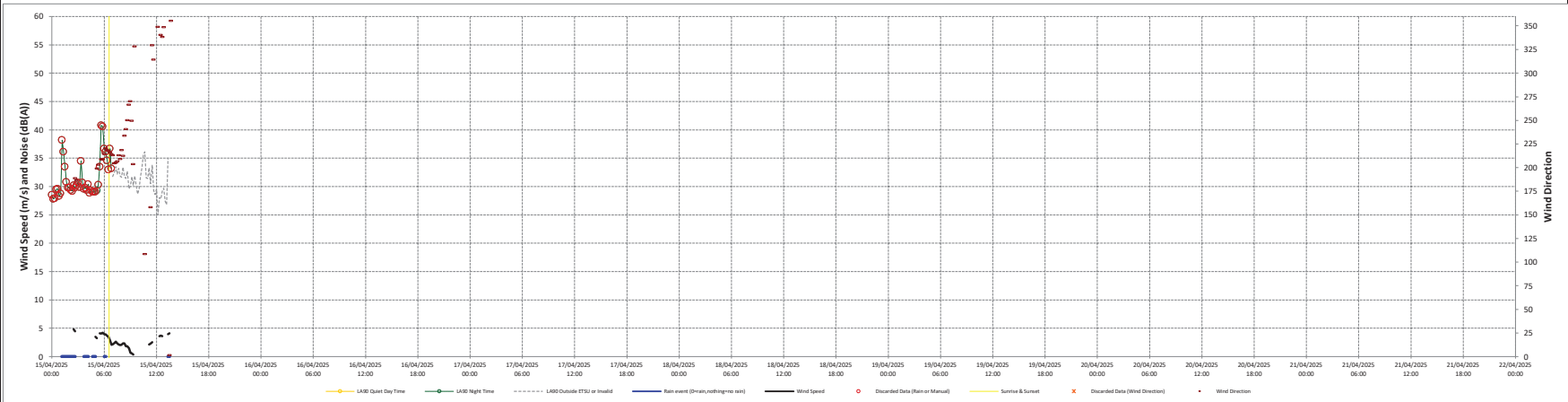




Project	Watchman Energy Park	
Client	Watchman Energy Park Limited	
Title	Time Serie for NML1 - Trolloss House Page 2 of 5	
Date	05/08/2025	







Project	Watchman Energy Park
Client	Watchman Energy Park Limited
Title	Time Serie for NML1 - Troloss House Page 5 of 5
Date	05/08/2025



