ARUP

Synergy Wind Pty Ltd

Proposed Gelliondale Wind Farm

Verification of Proposed Gelliondale Wind Farm Environmental (Predictive) Noise Assessment

Reference: R01

Final | 18 July 2023

Job number 295007-00

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Issue Document Verification with Document ✓

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Auditor Verification Statement

Verification Statement of Environmental (Predictive) Noise Assessment – Proposed Gelliondale Wind Farm

I, David W Spink, an environmental auditor appointed under Part 8.3 of the *Environmental Protection Act 2017*, having:

1. Been requested by Synergy Wind Pty Ltd to undertake a verification process and produce a Verification Report for the environmental (predictive) noise assessment for the proposed Gelliondale Wind Farm, undertaken by Marshall Day Acoustics Pty Ltd.

2. Specifically, I have been requested to independently verify whether or not the environmental (predictive) noise assessment as provided in the report entitled Gelliondale Wind Farm Environmental Noise Assessment (Marshall Day Acoustics Pty Ltd Report Rp 002 R02 2021133, dated 14 July 2023) has been conducted in accordance with New Zealand Standard 6808:2010 Acoustics – Wind Farm Noise (NZS 6808:2010).

   The verification also included the associated report entitled Gelliondale Wind Farm – Background Noise Monitoring (Marshall Day Acoustics Pty Ltd Report Rp 001 20211133, dated 9 June 2023).

3. This verification is required under Clause 52.32-4 of the Victorian Planning Provisions (*Planning and Environment Act 1987*), and the guidance document - Development of Wind Energy Facilities in Victoria - Policy and Planning Guidelines (Department of Environment, Land, Water and Planning, dated November 2021).

4. Having regard to:

   - New Zealand Standard 6808:2010 Acoustics – Wind Farm Noise (NZS 6808:2010)
   - Development of Wind Energy Facilities in Victoria - Policy and Planning Guidelines (Department of Environment, Land, Water and Planning, dated November 2021) (DELWP Guidelines)
   - Victoria Planning Provisions Clause 52.32 (including Amendments VC199, VC212, VC206 and VC234)
   - *Environment Protection Act 2017* as amended by the *Environment Protection Amendment Act 2018*
   - Environment Protection Amendment (Wind Turbine Noise) Regulations 2022

   and the following relevant documents:

   - International Standards Organisation ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation, International Organisation for Standardisation, 1996
   - International Standards Organisation ISO 1996.2:2017 Acoustics – Description, measurement and assessment of environmental noise – Part 2: Determination of sound pressure levels
   - IEC 61400-11 (Ed 3, 2012) Wind Turbines – Acoustic noise measurement techniques
   - A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise, UK Institute of Acoustics, dated May 2013
   - Wind Energy Facility Turbine Noise Regulation Guidelines (EPA Publication, dated November 2022) (EPA Guidelines)
   - Wind Energy Facility Noise Auditor Guidelines (EPA Publication 1692, dated October 2018)

- Guidelines for Conducting Environmental Audits (EPA Publication 2041, dated February 2022)
- Environmental Auditor Guidelines – Provision of statements and reports for environmental audits and preliminary risk screen assessments (EPA Publication 2022, dated August 2021)

5. Hereby declare that I am able to verify that the environmental (predictive) noise assessment for the proposed Gelliondale Wind Farm, as provided in the reports:

    - Gelliondale Wind Farm Environmental Noise Assessment (Marshall Day Acoustics Pty Ltd Report Rp 002 R02 2021133, dated 14 July 2023)
    - Gelliondale Wind Farm – Background Noise Monitoring (Marshall Day Acoustics Pty Ltd Report Rp 001 20211133, dated 9 June 2023)

    has been conducted in accordance with NZS 6808:2010. Details on relevant specific issues are provided in this Verification Report, and Appendix A.

Dated: 18 July 2023

Signed

David W Spink

Environment Auditor (Industrial Facilities) – Appointed pursuant to the *Environment Protection Act 2017*

List of Acronyms

Acronym	Definition
AGL	Above Ground level
BESS	Battery Energy Storage System
dB(A)	A-weighted decibels, unit for the measurement of sound. The A-weighting is an adjustment to reflect how humans hear sound.
DELWP	Department of Environment, Land, Water, and Planning Victoria
DTP	Department of Transport and Planning Victoria
EPA	Environment Protection Authority Victoria
EP Act	*Environment Protection Act 2017*
EP Regulations	Environment Protection Amendment (Wind Turbine Noise) Regulations 2022
ERS	Environment Reference Standard
GED	General Environmental Duty (requirement under Section 25 of the EP Act)
IEC 61400-11:2012	International Standard IEC61400-11:2012 Wind turbines – Part 11: Acoustic noise measurement techniques
ISO 1996.2:2017	International Standards Organisation ISO 1996.2:2017 Acoustics – Description, measurement and assessment of environmental noise – Part 2: Determination of sound pressure levels
ISO 9613-2:1996	ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation, International Organisation for Standardisation, 1996
$L_{A90(10\ min)}$	A-weighted noise level exceeded for 90% of the measurement period, where the measurement period is 10 minutes
LGA	Local Government Area
MDA	Marshall Day Acoustics Pty Ltd
NMP	Noise Management Plan
NZS 6808:2010	New Zealand Standard 6808:2010 Acoustics – Wind Farm Noise
SAC	Special Audible Characteristic
Standard	New Zealand Standard 6808:2010 Acoustics – Wind Farm Noise
Synergy	Synergy Wind Pty Ltd
UK IofA Guidance	A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise (dated May 2013)
WEF	Wind Energy Facility
WEF Proponent	Synergy Wind Pty Ltd
WTG	Wind Turbine Generator

1. Introduction

1.1 Purpose of the Verification Report

Synergy Wind Pty Ltd (Synergy, the Proponent) is seeking approval for the construction and operation of the proposed Gelliondale Wind Farm (GWF), comprising 13 wind turbines and related infrastructure on a site located approximately 7 km southwest of Yarram Victoria. The wind turbines are referred to as Wind Turbine Generators (WTGs), and the wind farm variously referred to as the Wind Energy Facility (WEF), in this report, consistent with Victorian Government terminology.

- The approval pathway for the proposed GWF involves the submission of an application for a Planning Permit, that addresses the requirements of Clause 52.32 of the Victorian Planning Provisions (VPP). In accordance with the latest amendment Clause 52.32-4 (VC234, dated 04 July 2023), the Proponent is required to submit *a pre-construction (predictive) noise assessment report prepared by a suitably qualified and experienced acoustician that* (in part) *reports on a pre-construction (predictive) noise assessment conducted in accordance with the New Zealand Standard NZS 6808:2010 Acoustics – Wind Farm Noise (NZS 6808:2010)*

Clause 52.32-4 of the VPP also states:

An application must be accompanied by:

A report prepared by an environmental auditor appointed under Part 8.3 of the Environment Protection Act 2017 that verifies whether or not the pre-construction (predictive) noise assessment was conducted in accordance with the New Zealand Standard NZS 6808:2010, Acoustics – Wind Farm Noise.

The Department of Transport and Planning (DTP)[1] has provided further clarity on this requirement in the publication entitled publication *Development of Wind Energy Facilities in Victoria, Policy and Planning Guidelines* (Department of Environment, Land, Water and Planning, November 2021) (DELWP Guidelines), stating that a Verification Report be provided by the environmental auditor, *to verify that the pre-construction (predictive) noise assessment report has been conducted in accordance with the Standard. The report issued by the EPA appointed auditor is a declaration that the noise assessments have been conducted in accordance with the Standard.*

NZS 6808:2010 is also referred to as the Standard.

David Spink, an environmental auditor appointed under Part 8.3 of the *Environmental Protection Act 2017*, has been requested by Synergy to undertake a verification process and produce a Verification Report against NZS 6808:2010 for the environmental (predictive) noise assessment for the proposed GWF, undertaken by Marshall Day Acoustics Pty Ltd (MDA). Specifically, the verification was undertaken to assess whether the pre-construction noise assessment as provided in the report entitled *Gelliondale Wind Farm Environmental Noise Assessment (Marshall Day Acoustics Pty Report Rp 002 R02 2021133, dated 14 July 2023)* (Proposed GWF Predictive Noise Assessment Report) has been conducted in accordance with NZS 6808:2010. Note that the Proposed GWF Predictive Noise Assessment Report has included the additional requirements of the VC234 amendment (04 July 2023), and also an assessment of construction and operational noise aspects of proposed additional infrastructure including a transformer station and battery energy storage system (BESS); however, the scope of this verification is restricted to the predicted operational noise generated by the WTGs, as per NZS 6808:2010.

MDA has also undertaken an assessment of background noise levels to assist establishment of noise limits that will apply to the proposed GWF. The report entitled *Gelliondale Wind Farm – Background Noise Monitoring (Marshall Day Acoustics Pty Ltd Report Rp 001 20211133, dated 9 June 2023)* (Proposed GWF Background Noise Monitoring Report) was included in the verification process, to assess whether this assessment had been consistent with NZS 6808:2010.

[1] The Department of Environment, Land, Water and Planning (DELWP) morphed into the Department of Energy, Environment and Climate Action (DEECA) with certain functions also going into a new Department of Transport and Planning (DTP) on 01 January 2023. The planning functions for wind farms was transferred to DTP.

Technical support was provided to the environmental auditor from his Expert Support Team member Dr Kym Burgemeister (as provided for under EPA Publication 865.13 *Environmental Auditor Guidelines for Appointment and Conduct*, dated March 2022).

It is noted that a further pre-construction (predictive) noise assessment is required before any construction can commence, to model the final wind farm layout and selected WTG model(s) to assess compliance with NZS 6808:2010. Additional requirements under the Environment Protection Amendment (Wind Turbine Noise) Regulations 2022 (EP Regulations) will also apply, namely requirements to ensure compliance with the noise limits (Regulation 131C), undertake a post-construction noise assessment (Regulation 131D) and the development of a Noise Management Plan (Regulation 131E) (both including independent review/ verification by an Environmental Auditor appointed under Part 8.3 of the *Environmental Protection Act 2017*).

1.2 Project description

For the purposes of the Verification Report, the following elements of the proposed GWF are noted:

- The proposed GWF is to be located within the Wellington Shire local government area (Wellington LGA), approximately 7 km southwest of Yarram.
- The application is for construction and operation of 13 WTGs.
- The GE Cypress 6.0-164, with a power output of 6.0MW has been selected as the candidate WTG for the assessment. This WTG model has a rotor diameter of 164 m, with a hub height of 128 m.
- The proponent has identified a total of 227 noise sensitive receivers located within 5 km of the proposed GWF (referred to as receivers in the Proposed GWF Predictive Noise Assessment Report), including 12 where a noise agreement is in place or proposed between the landowners and Synergy (involved receivers).
- A site plan with the proposed WTG layout, transformer station, BESS, and receivers is provided in Appendix D of the GWF Predictive Noise Assessment Report.

2. Regulatory Considerations

Regulatory considerations are appropriately discussed in Proposed GWF Predictive Noise Assessment Report, Section 3.0. The following issues are relevant considerations in regard to the verification process.

2.1 Environment Protection Act 2017

The *Environment Protection Act 2017* (EP Act) provides the following general requirements for the proposed GWF.

- General Environmental Duty (GED) (EP Act, Section 25)

  A person who is engaging in an activity that may give rise to risks of harm to human health or the environment from pollution or waste must minimise these risks, so far as is reasonably practicable.

- Unreasonable Noise (EP Act, Section 166)

  A person must not, from a place or premises that are not residential premises –

  - Emit an unreasonable noise; or
  - Permit an unreasonable noise to be emitted

The Wind Energy Facility Turbine Noise Regulation Guidelines (EPA, published November 2022) (EPA Guidelines) refer to the General Environmental Duty (GED) under the EP Act. Application of the GED requires engagement in any activity that may give rise to risks of harm to human health or the environment

from pollution or waste to minimise those risks, so far as reasonably possible (SFARP) (Section 25). Specifically with respect to operation of WEFs: the EP Act (Section 166) imposes an obligation not to emit an unreasonable noise or permit an unreasonable noise to be emitted. Regulation 131CA (Refer to S2.2 below) states that an operator of WEFs must ensure that wind turbine noise complies with the noise limits for that facility. Regulation 131B sets the relevant noise standard for a WEF. . For the proposed GWF, the standard referred to is NZS 6808:2010. Providing the wind farm complies with the requirements of Regulation 131CA, the operator is deemed to have appropriately addressed their duty in respect of the GED. Noise levels from a wind farm are considered to be unreasonable for the purposes of compliance with the GED, if they exceed the relevant applicable noise limits.

2.2 Environment Protection Regulations 2021

The *Environment Protection Regulations 2021* were introduced under the EP Act, and came into effect in mid-2021, focusing regulatory control of WEFs to the Environment Protection Authority (EPA). The current amendment *Environment Protection Amendment (Wind Turbine Noise) Regulations* 2022 (EP Regulations) was made in October 2022. Division 5 – Wind turbine noise (Regulation 131) provides requirements for assessment and management of operational turbine noise; however, it does not specifically address requirements for pre-construction (predictive) noise assessments, or for review by an environmental auditor.

Regulation 131 identifies NZS 6808 as the relevant standard for assessing operational wind turbine noise, and for setting noise limits at premises for both involved and non-involved receivers. The EP Regulations state that noise from a wind farm is prescribed to be unreasonable (as per the EP Act) if they exceed the applicable noise limit. Regulation 131 also includes additional requirements on wind farm operators during the operational phase.

2.3 Environmental Reference Standard

The Environmental Reference Standard (ERS) provide noise indicators and objectives for various land use categories (Reference: Guide to the Environment Reference Standard, EPA Publication 1992, dated June 2021). However, assessment of noise from WTGs is directly addressed in the EP Regulations.

Further discussion of this issue with respect to the proposed GWF is provided in Section 6.4.2 of this report.

2.4 Victorian Planning Provisions

Changes were made to the Victorian Planning Provisions (VPP) to align with the introduction of the EP Regulations. However, the EP Regulations do not address pre-construction (predictive) noise assessments. The VPP was subsequently amended (Amendment VC199, gazetted 03 February 2022) to require an application for a Planning Permit for a WEF to include a mandatory preconstruction (predictive) noise assessment under VPP Clause 52.32-4, accompanied by a report by an environmental auditor appointed under Part 8.3 of the *Environmental Protection Act 2017* that verifies (or not) that the assessment was conducted in accordance with NZS 6808:2010.

A further amendment (VC234, dated 04 July 2023) was made to VPP Clause 52.32, that clarified additional mandatory requirements to be included in the preconstruction (predictive) noise assessment report.

Specifically, Clause 52.32-4 (VC234, dated 04 July 2023), states that the Proponent is required to submit *a pre-construction (predictive) noise assessment report prepared by a suitably qualified and experienced acoustician that:*

- *Reports on a pre-construction (predictive) noise assessment conducted in accordance with the New Zealand Standard NZS 6808:2010 Acoustics – Wind Farm Noise (NZS 6808:2010)*
- *Provides an assessment of whether the proposed wind energy facility will comply with the noise limit for the facility under Division5 Part 5.3 of the Environment Protection Regulations 2021.*
- *Where the proposed wind energy facility will be the subject of a wind turbine noise agreement under Division 5 of Part 5.3 of the Environment Protection Regulations, specifies the premises of the relevant landowner (including any particular building) to which the agreement relates and provides*

an assessment of whether the proposed wind energy facility will comply with the modified noise limit for that facility specified in the agreement.

- *Is prepared on the basis that the relevant noise standard under Division 5 of Part 5.3 of the Environment Protection Regulations 2021 will be New Zealand Standard NZS 6808:2010 Acoustics – Wind Farm Noise, and includes an assessment of whether a high amenity noise limit is applicable under Section 5.3 of the Standard.*

New Zealand Standard NZS 6808:2010 Acoustics – Wind Farm Noise (NZS 6808:2010) is also referred to as the Standard.

Clause 52.32-4 of the VPP also states:

An application must be accompanied by:

A report prepared by an environmental auditor appointed under Part 8.3 of the Environment Protection Act 2017 that verifies whether or not the pre-construction (predictive) noise assessment was conducted in accordance with the New Zealand Standard NZS 6808:2010, Acoustics – Wind Farm Noise. For the purposes of this Verification Report, the verification process must assess whether the pre-construction (predictive) noise assessment for the proposed GWF complies with NZS 6808:2010.

2.5 Auditor's additional comments

Specific guidelines such as NZS 6808:2010 have been developed to address the unique requirements for the prediction, measurement and assessment of turbine noise, because the usual measurement and assessment standards adopted in Victoria (such as *Australian Standard AS 1055:2018 Acoustics: Description and Measurement of Environmental Noise* and the new Noise Protocol (*EPA Publication 1862.4 Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues*) are unsuitable. In addition, the Environment Reference Standard (ERS) (Victorian Government Gazette No S 245, 26 May 2021) does not provide specific guidance on noise from wind farms. Consideration of the ERS is discussed further in Section 6.4.2 of this report.

There are other standards and guidelines such as Australian Standard AS4959:2010 Acoustics – Measurement, prediction and assessment of noise from wind turbine generators, the UK Government Assessment and rating of noise from wind farms (ETSU-R-97, 2008) and the Annual Reports of the National Wind Farm Commissioner that can provide helpful background information and secondary guidance that can also assist with the assessment of projects where NZS 6808:2010 does not provide detailed or explicit guidance.

In particular, NZS 6808:2010 states that it does not set limits that provide absolute protection for residents from audible wind farm sound, but rather provides guidance on noise limits that are considered reasonable for protecting sleep and amenity from wind farm sound at noise sensitive locations.

Guidance on the audit of pre-construction noise is provided in Section 2.4.1 of *Wind Energy Facility Noise Auditor Guidelines* (EPA Publication 1692, October 2018). This does provide some general guidance that has been utilised in the verification process.

While this verification is strictly not an audit process, reference has also been made to the following EPA publications:

- *Guidelines for Conducting Environmental Audits* (EPA Publication 2041, dated February 2022)
- *Environmental Auditor Guidelines for Appointment and Conduct* (Publication 865.13, dated March 2022)

3. Objective of the verification

The objective of the verification was to assess whether or not the Environmental (Predictive) Noise Assessment, provided in the MDA report entitled *Gelliondale Wind Farm Environmental Noise Assessment*

(Marshall Day Acoustics Pty Report Rp 002 R02 2021133, dated 14 July 2023) (Proposed GWF Predictive Noise Assessment Report) has been conducted in accordance with NZS 6808:2010.

The verification process has included the background assessment, provided in the MDA report entitled *Gelliondale Wind Farm – Background Noise Monitoring* (Marshall Day Acoustics Pty Ltd Report Rp 001 20211133, dated 9 June 2023). (Proposed GWF Background Monitoring Report), to verify whether or not this assessment had been conducted in accordance with NZS 6808:2010.

This verification process has been limited to the predictive noise issues associated with the operational WTGs at the proposed GWF, for assessment against NZS 6808:2010. It excludes the assessment of the construction noise, and the operational noise from the transformer substation and the BESS (these issues are addressed separately by other regulatory requirements beyond the scope of this verification).

4. Approach to verification process

As stated above, there is only general published guidance on undertaking verification processes for pre-construction (predictive) wind farm assessments. EPA has provided some guidance for requirements under Regulation 131D of the EP Regulations for post-construction noise assessments; however, this does not include pre-construction (predictive) assessments.

Reference has therefore been made to the guidance provided in the previous EPA publication Wind Energy Facility Noise Auditor Guidelines (Publication 1692, dated October 2018). The verification process is generally consistent with Section 2.4.1 of Publication 1692, and included:

1. Inception meeting with Synergy management.
2. Familiarisation of the proposed GWF development and planned operation.
3. General inspection of the proposed project site and surrounding environment, including the rigour of the process used in identifying surrounding noise sensitive locations.
4. Review of background noise monitoring assessment, provided in the Proposed GWF Background Monitoring Report
5. Review of the environmental (predicted) noise assessment provided in the Proposed GWF Predictive Noise Assessment Report, against the requirements of NZS 6808:2010. A summary checklist of issues to be addressed has also been developed.
6. Preparation of draft and final versions of the Verification Report (this report).

5. Documents reviewed for the verification

5.1 Documents specific to the Gelliondale Wind Farm

- Gelliondale Wind Farm Environmental Noise Assessment (Marshall Day Acoustics Pty Report Rp 002 R02 2021133, dated 14 July 2023)
- Gelliondale Wind Farm – Background Noise Monitoring (Marshall Day Acoustics Pty Ltd Report Rp 001 20211133, dated 9 June 2023)

5.2 General references

- New Zealand Standard 6808:2010: Acoustics – Wind Farm Noise (NZS 6808:2010)
- Development of Wind Energy Facilities in Victoria, Policy and Planning Guidelines (Department of Environment, Land, Water and Planning, dated November 2021)

- Victoria Planning Provisions Clause 52.32 (including Amendments VC199, VC212, VC206 and VC234)
- *Environment Protection Act 2017* as amended by the *Environment Protection Amendment Act 2018*
- Environment Protection Amendment (Wind Turbine Noise) Regulations 2022
- Wind Energy Facility Turbine Noise Regulation Guidelines (EPA Publication, dated November 2022)
- Wind Energy Facility Noise Auditor Guidelines (EPA Publication 1692, dated October 2018)
- ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation, International Organisation for Standardisation, 1996
- International Standards Organisation ISO 1996.2:2017 Acoustics – Description, measurement and assessment of environmental noise – Part 2: Determination of sound pressure levels
- IEC 61400-11 (Ed 3, 2012) Wind Turbines – Acoustic noise measurement techniques
- A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise, UK Institute of Acoustics, dated May 2013
- Guidelines for Conducting Environmental Audits (EPA Publication 2041, dated February 2022)
- Environmental Auditor Guidelines – Provision of statements and reports for environmental audits and preliminary risk screen assessments (EPA Publication 2022, dated August 2021)
- Environmental Auditor Guidelines for Appointment and Conduct (EPA Publication 865.13, dated March 2022)

6. Findings of the verification process

The key findings of the verification process outlined in Section 4 are provided in this section, and address the objective set out in Section 3.

6.1 Review of the proposed GWF site

An inspection of the general area in which it is proposed to locate the GWF was undertaken by the Environmental Auditor (auditor) on 26 May 2023, in conjunction with a Synergy employee. The intent of the site inspection was to gain an appreciation of the environmental and community context, the proposed WTG placements in relation to the location of identified noise sensitive receiver locations, and the locations used for background noise monitoring. The scope of the verification did not include confirming GPS locations of individual proposed WTGs.

6.2 Background noise monitoring and determination of noise limits

While a review of the background noise monitoring is not strictly required as part of this verification process, the measured background noise levels are used to set the noise limits at some wind speeds, for some of the noise sensitive receiver locations. It is therefore appropriate to review the methodology and findings of the background noise monitoring to confirm that the approach used complied with NZS 6808:2010.

The background noise monitoring was undertaken by MDA, as documented in the report entitled *Gelliondale Wind Farm – Background Noise Monitoring* (Marshall Day Acoustics Pty Ltd Report Rp 001 20211133, dated 9 June 2023) (Proposed GWF Background Monitoring Report).

The following key points were noted from a review of the Proposed GWF Background Monitoring Report.

6.2.1 Selection of monitoring locations

Key points noted:

- MDA identified a total of 227 noise sensitive receiver locations (receivers) within 5 km of the proposed WTGs; of these, 12 are involved receivers (ie "stakeholders" who it is understood have or proposed to have a contractual arrangement with Synergy). For the purposes of the EP Regulations, the remainder of these receivers are considered to be non-involved receivers.
- The selection of appropriate monitoring locations for assessment of potential noise levels on sensitive receivers is dependent on a number of factors, including the proposed configuration of the WTGs, topography and other local features, and agreement to monitor at preferred receiver locations. In regard to the latter issue, MDA indicated *consent to undertake background noise monitoring was not granted at all preferred receivers. Prior to construction of the wind farm, background noise monitoring may be undertaken at additional receivers, should consent be provided* (Section 2.1 & Appendix C).
- A total of 5 monitoring locations (H02, H05, H06, N048 – all proxy or representative locations, and H11) were identified by MDA (Refer to Proposed GWF Background Noise Monitoring Report, Table 1 and Figure 1). This approach is consistent with NZS 6808:2010 Section 7.1.5 which states (in part) that *when considering a group of noise sensitive locations, it is acceptable to conduct background sound measurements at a representative location. These measurements shall then be used to define noise limits that apply to every noise sensitive location in that group. The sound generating features at the representative location shall be similar in proximity and character to those at other noise sensitive locations represented by that location.*

  A summary of the proposed (preferred) and actual (potentially proxy) locations used for the background noise monitoring are provided in the following table. Further details have been provided by MDA in Proposed GWF Background Noise Monitoring Report, Section 2.1 and Appendix C.

Proposed (Preferred) monitoring location	Actual (potentially Proxy) Location
N121	H06 - proxy
N119	H06 - proxy
N068	H05 - proxy
N088	H05 - proxy
N046	H02 - proxy, N048 - proxy
H11	H11 - same

  It is noted that the use of proxy locations is consistent with the EP Regulations - Regulation 131BB does allow the use of *alternative monitoring points* for noise measurements:
  (a) if a monitoring point for the WEF is not readily accessible; or
  (b) if-
  (i) an assessment of wind turbine noise at a monitoring point for the WEF would be affected by extraneous noise to a greater extent than an assessment of wind turbine noise at the alternative monitoring point; and
  (ii) the alternative monitoring point is closer to a wind turbine or group of wind turbines in the WEF than that monitoring point.

  However, *alternative monitoring points* are not intended for use for the assessment of wind turbine noise during the post-construction noise assessment under Regulation 131D.

6.2.2 Monitoring survey methodology

The monitoring methodology used by MDA is provided in the Proposed GWF Background Noise Monitoring Report, Section 2.2, Table 2 and Appendix D.

Key points noted:

- Detailed information regarding the microphone location at each monitoring location is provided, including individual aerial and site photographs showing specific measurement locations. This indicates that the measurement locations were located at appropriate positions relative to nearby sensitive receiver locations and the proposed locations of the wind turbines.
- The equipment adopted for the background noise level measurements (provided in Appendix D), and wind shielding appears to be appropriate.
- The background noise monitoring has been undertaken over approximately 7 weeks between July and September 2002. Between 4,200–5,000 data points were measured at each receiver location, which is greater than the minimum requirement of 1,440 in NZS 6808:2010.
- Local wind speed and rainfall data has been measured at one of the receiver locations to allow for exclusion of rain-affected data.
- The site wind-speed measurements have been undertaken using a SoDAR anemometer. The wind speed measurement location is indicated on the site plan (Appendix G). The hub-height (128 m AGL) wind speed has been based on an analysis of the measured wind-shear coefficients undertaken by WSP Australia Pty Ltd. This method is appropriate and undertaken in accordance with S7.3.2 of NZS 6808:2010.

In summary, the background noise level measurements have been undertaken in accordance with NZS 6808:2010, and adopted the supplementary guidance in the UK Institute of Acoustics publication A *good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise* (dated May 2013) (UK IoA Guidance). A detailed comparison between the measurement methodology and the requirements of NZS 6808:2010 is provided in the table in Appendix A1 of this Verification Report.

6.2.3 Data analysis

The data analysis methodology used by MDA is provided in the Proposed GWF Background Noise Monitoring Report, Section 2.3, Table 2. Background noise levels and derived noise limits (both all-time and night-time) are provided in Sections 3.1 and 3.2 respectively. The results for all monitoring locations are provided in Appendices G-K.

Key points noted:

- The data analysis includes filtering out data that is affected by rainfall or extraneous noise (eg in accordance with S7.2.4 of NZS 6808:2010. Periods with likely extraneous noise (eg periods that are significantly affected by bird or insect sounds) have been identified using the one-third octave band methodology documented by Griffin et. al[2]. This approach has been shown to remove data pairs with generally higher noise levels from the regression analysis, and so will result in a conservative assessment of the background noise level.
- The background noise level and filtered wind speed data has been analysed using a 3rd order polynomial regression generally between the cut-in wind speed (3 m/s) and the maximum expected operational speed (15 m/s), which is appropriate. The regression has been truncated at some locations at low wind speeds, where the polynomial regression would result in an increase in noise level with reducing wind speed, in accordance with the UK IoA Guidance.
- Regression analysis was undertaken for both the 24-hour data, and night-period data only, which appears reasonable.

[2] Griffin, D., Delaire, C. and Pischedda, P. (2013) *Methods of identifying extraneous noise during unattended noise measurements*. 20th International Congress of Sound and Vibration.

- The reported square of the correlation coefficient (r^2) is generally 0.0.087–0.460 considering all time data, and between 0.153–0.580 for the night-period data only. This is not particularly high, and representative of a relatively wide range of results, rather than highly correlated data.
- It is noted that the sound measurements undertaken at receiver H11 have been impacted by nearby plant noise and therefore that the measurements at that location should not be used for the determination of noise limits.

6.3 Environmental (Predictive) Noise Assessment

The following assessment is based on information provided in the Proposed GWF Predictive Noise Assessment Report, and associated appendices.

A checklist (Appendix A) has been prepared to summarise compliance against the requirements of NZS 6808:2010, for undertaking the environmental (predictive) noise assessment. This should be referred to, in addition to the discussion of key issues in the following sections (which typically follow the general content of the above report for ease of reference).

6.3.1 Assessment criteria

Key points noted:

- Noise sensitive locations

  This issue was discussed in Section 6.2.1 above. It was concluded that the use of proxy locations was consistent with NZS 6808:2010 and the EP Regulations, for the purpose of this predictive model assessment. The auditor noted that MDA suggested that further background noise monitoring may be undertaken at additional receivers, should consent be provided (Proposed GWF Background Monitoring Report, Section 2.1).

- Consideration of high amenity area noise limit

  NZS 6808:2010 Section 5.3.1 states (in part):

  "The wind farm noise limit of 40 dB $L_{A90(10\ min)}$ … is appropriate for protection of sleep, health, and amenity of residents at noise sensitive locations. In special circumstances, at some noise sensitive locations a more stringent noise limit may be justified to afford a greater degree of protection of amenity during evening or night-time."

  NZS 6808:2010 Section 5.3.1 provides guidance as to whether a high amenity noise limit may be justified. The auditor accepts that MDA has documented an appropriate assessment of this issue in the Proposed GWF Predictive Noise Assessment Report, Section 3.4.4 and 6.1.1, including acknowledgement of precedents set by the Victorian Civil and Administrative Tribunal (VCAT) determination of the Cherry Tree Wind Farm as required by the DELWP Wind Farm Guidelines (Section 5.1.2).

  Based on this information, the auditor further accepts that a high amenity limit is not justified for the GWF – although noting that the application remains the subject of a separate planning process.

- Stakeholders

  Stakeholders can either be involved receivers (ie have a noise agreement with the Proponent of the wind farm), or non-involved receivers (ie do not have an agreement with the Proponent of the wind farm).

  The noise limits that apply will depend on whether stakeholders are involved or non-involved receivers. Written evidence will need to be provided ideally during the planning approval process, to confirm the status of involved receivers as these agreements allow a potential increased noise limit as is discussed below.

  The locations of these receivers are provided in the Proposed GWF Predictive Noise Assessment Report, Appendix D.

- Noise limits

  DELWP Guidelines, Section 5.1.2 states that the wind energy facility must comply with the noise limits in NZS 6808:2010.

  NZS 6808:2010, Sections 5.2 states that as a guide:

  "…at a sensitive receiver location, at any wind speed, wind farm sound levels (L A90(10 min) should not exceed the background sound level by more than 5 dB, or a level of 40 dB LA90(10 min), whichever is the greater."

  The noise limits proposed in the Proposed GWF Predictive Assessment Report, Section 6.1.3 for non-involved receivers comply with this guidance.

  DELWP Section 5.2 also recommends a 45 dBA limit for involved receivers (stakeholders). The noise limits that apply to involved receivers has been clarified with the introduction of the EP Regulations. Reg 131BA(2)(b) specifies as per the above, except that the limit is defined as the greater of 45 dBL_{A90} or the background sound level plus 5 dB.

  The assessment allows for separate night-time noise limits to be established.

6.3.2 Candidate wind turbines

- Choice of representative turbine

  NZS 6808:2010 does not provide any requirements on the choice of WTG. The choice of WTG options selected for the predictive noise assessment should be consistent with the likely option to be finally selected. Specifically, the assessment can then take into account sound power levels and any Special Audible Characteristics (SACs) of the turbine options.

  The auditor considers that the assessment of the General Electric (GE) Cypress 6.0-164 in the Proposed GWF Predictive Assessment Report, Section 6.2 provides appropriate confidence in the potential range of noise that will be emitted from the proposed GWF. It is also noted that a further pre-development noise assessment is to be undertaken, based on the final selected turbine model and site layout (Proposed GWF Predictive Assessment Report, Section 8.0).

  Note: MDA indicate that the final hub height of the selected turbine model may differ slightly from the Cypress 6.0-164. They consider that *the magnitude of the potential changes is expected to be minor and inconsequential with respect to predicted noise levels* (Section 6.2). There is no way at this point in time for the auditor to test the validity of this statement; however, the predictive model will need to be re-run using the final selected WTG as part of the planning approval process before construction can commence.

- Sound power levels

  MDA state that the source sound power levels used in the noise predictions are based on the documented sound power level data and spectral (octave band) data for the candidate wind turbine model that was sourced from the GE Renewables Energy Technical Documentation Wind Turbine Generator Systems Cypress 6.0-164-50hz (GE Document dated 16 March 2021). Further, for the noise modelling undertaken for this assessment, MDA included an adjustment of +1.0 dB at each wind speed to provide a margin for typical uncertainty.

  It is unclear whether the source levels have been determined by the manufacturer in accordance with IEC 61400-11 (Ed 3, 2012) Wind Turbines – Acoustic noise measurement techniques (IEC 61400-11: 2012), or are estimates or predictions made by the manufacturers (either are acceptable under NZS 6808:2010). Nevertheless, the reported noise emission levels appear consistent with the levels that would be expected from large wind turbines of this type.

- Consideration of Special Audible Characteristics

  Wind farm sound that exhibits Special Audible Characteristics (SACs), such as tonality, impulsiveness or amplitude modulation, is subject to penalties between 1–6 dB to account for the

additional audibility and annoyance caused by sound with these characteristics. However, as noted in Section 5.4 of NZS 6808:2010, special audible characteristics cannot always be predicted in advance.

Therefore, MDA have assessed the likelihood that the turbines will result in tonal noise emission and noted that the occurrence of tonality is unusual.

This approach is considered to be reasonable at this stage. However, it is recommended that measurements of the tonality of the turbine selected for installation (in accordance with IEC 61400-11:2012) are reviewed as they become available, or verified by on-site emission testing of the first turbines commissioned on the site.

6.3.3 Noise prediction model

The noise prediction model is described in Appendix G of the Proposed GWF Predictive Noise Assessment Report.

- The noise level predictions have been undertaken using the noise propagation model provided in ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation, International Organisation for Standardisation, 1996 (ISO 9613-2:1996), which has been shown in national and international studies to provide reasonable results for wind farm noise level predictions. NZS 6808:2010 (Section 6.1.3) refers to ISO 9613-2:1996 as *an example of a prediction method that has been shown to correlate well with measured data for wind farms.*
- In the opinion of the auditor and his team, the calculation parameters that have been adopted for temperature, humidity and ground absorption are reasonable, and correspond to best practice.
- The noise level predictions have adopted the following conservative assumptions:
    - Barrier effect limited to 2 dB
    - Screening based on turbine tip height, not hub height
    - +3 dB penalty for ‘concave’ ground topography (‘valley’ effects).

  These considerations are not explicitly required by NZS 6808:2010 or implemented in ISO 9613-2:1996; however, they are commonly adopted as good practice for wind farm noise assessment based on the UK IoA Guidance.

6.3.4 Predicted noise levels

The predicted noise levels are discussed in Section 6.4 of the Proposed GWF Predictive Noise Assessment Report, with predicted noise level date at all receiver locations tabulated in Appendix H. The highest predicted noise levels are provided in Section 6.4 Table 11, with contours provided in Figure 1.

It is accepted that the assessment has been undertaken in accordance with the requirements of NZS 6808:2010, and the resulting assessment demonstrates that the predicted noise levels for the WEF will achieve the noise criteria established by NZS 6806:2010, Specifically, Table 6 indicates that:

- The sound levels are predicted to comply with the required noise level criteria at all of the non-involved receiver locations. Specifically, the highest predicted noise levels at all the non-involved receivers are at least 1.8 dB below the base noise limit of 40 dB $L_{A90(10\ min)}$, which is in compliance with the noise limit recommended in NZS 6808:2010, Section 5.2.
- The predicted sound levels comply with the 45 dB $L_{A90(10\ min)}$ base noise criteria at the involved receivers.
- The highest predicted sound level at the synergy-owned property (H09) is 46.6 dB $L_{A90(10\ min)}$.

6.4 Other matters for consideration

6.4.1 NZS 6808:2010

There are a number of other matters potentially required to comply with the requirements of NZS 6808:2010 for a pre-construction (predictive) noise assessment.

Cumulative Impacts

NZS 6808:2010 Section 5.6 requires that:

… the noise limits in Sections 5.2 and 5.3 should apply to the cumulative sound level of all wind farms affecting any noise sensitive location.

The Proposed GWF Predictive Assessment Report states that the nearest approved and/or operating wind farm is the Toora Wind Farm (approximately 15 km to the west) (Section 6.5).

The auditor agrees with MDA, given this is the case, that cumulative assessment of noise levels is not warranted. It is expected that this situation would be confirmed during the planning approval process.

Uncertainty

NZS 6808:2010 Section 5.7 states that:

Prediction and measurement of sound levels from wind farms involve values of a range of parameters that can be known or predicted only within a certain tolerance. The size of such uncertainties determine the level of confidence in the overall results.

NZS 6808:2010 Appendix C – Uncertainty states that:

It is good practice the state the uncertainty and confidence level for any sound levels determined in accordance with this Standard. Uncertainty should be determined in accordance with the procedures of Craven and Kerry (2001)

No information has been provided on the uncertainty of the predictive assessment undertaken in the Proposed GWF Predictive Noise Assessment Report, although a +1 dB contingency has been adopted in the calculation, in addition to other conservative prediction assumptions.

MDA used SoundPlan v8.2 software, utilising the international standard ISO 9613-2:1996 sound propagation model as the method to calculate the level of broadband A-weighted wind farm noise expected to occur at surrounding sensitive receiver locations.

The software in conjunction with the digital terrain model of the site, has been used to evaluate the path between each turbine and receiver pairing, and then subsequently applies the adjustments to each turbine's predicted noise contribution where appropriate. As mentioned above, NZS 6808:2010 notes that the ISO 9613-2:1996 sound propagation model has been demonstrated to generally result in conservative noise predictions.

All acoustic measurements and noise predictions are subject to measurement and calculation uncertainty. While MDA's analysis is not subject to a detailed Uncertainty Analysis, it does generally adopt conservative assumptions, including a +1 dB contingency to account for input data uncertainty. The auditor and his team agree with this approach for modelling noise from WEFs is appropriately conservative.

6.4.2 Environment Protection Act 2017

Compliance with GED

As stated in Section 2, if approved the proposed GWF will be subject to relevant provisions of the EP Act and EP Regulations. Ongoing compliance with the requirements of Regulation 131 will be a responsibility of the Operator, and if this is achieved, will be deemed to have appropriately addressed their duty in respect of the GED.

The potential application of the ERS

As stated in Section 2, the WTG noise emissions of the proposed GWF are controlled by the EP Regulations. The EP Regulations reference NZS 6808:2010 Section 2.4 for a definition of noise sensitive locations, such as residences, other forms of accommodation (eg motels), schools and the like. NZS 68608:2010 also states that *in some circumstances, holiday cabins and camping grounds might be considered as noise sensitive locations. Matters to be considered include whether it is an established activity with existing rights*.

In regard to the proposed GWF, the ERS is primarily relevant to aspects that are not controlled by the EP Regulations. One particular aspect is the consideration of identified natural areas located in the vicinity of the proposed GWF. MDA has provided some relevant information in the Proposed GWF Predictive Noise Assessment Report, Sections 3.6 and 8.0. Several natural areas were identified where an environmental value (Human tranquillity and enjoyment outdoors in natural areas) were assessed. The assessment concluded that *with respect to operational noise of the project in natural areas, the primary consideration is noise from wind farms. In contrast, the extent of natural areas potentially affected by the proposed related infrastructure is relatively limited.….*

The project will most likely be audible on some occasions where wind turbine noise levels are above 30 dBL_{A90}.

Where predicted wind turbine noise levels are higher than 40 dB L_{A90}, the project is expected to be readily audible.

This matter is beyond the scope of the verification (ie consistency of the assessment with NZS 6808:2010); however, the auditor notes that this will likely need to be addressed during the planning approval application process.

7. Conclusion

David Spink, an Environmental Auditor appointed under the *Environment Protection Act 2017*, has completed an independent verification of the environmental (predictive) noise assessment of the proposed Gelliondale Wind Farm. Specifically, the objective was to independently verify whether or not the environmental (predictive) noise assessment has been conducted in accordance with New Zealand Standard NZS 6808:2010 Acoustics – Wind Farm Noise NZS 6808:2010 (NZS 6808:2010 or Standard).

This verification is required under Clause 52.32-4 of the Victorian Planning Provisions (*Planning and Environment Act 1987*), and the guidance document Development of Wind Energy Facilities in Victoria-Policy and Planning Guidelines (Department of Environment, Land, Water and Planning, dated November 2021).

The verification process was based on information provided in the following documents:

- Gelliondale Wind Farm Environmental Noise Assessment (Marshall Day Acoustics Pty Report Rp 002 R02 2021133, dated 14 July 2023)
- Gelliondale Wind Farm – Background Noise Monitoring (Marshall Day Acoustics Pty Ltd Report Rp 001 20211133, dated 9 June 2023)

The verification process concluded that the pre-construction (predictive) noise assessment for the proposed Gelliondale Wind Farm, as provided in the above reports, has been conducted in accordance with NZS 6808:2010. Details on relevant specific issues are provided in this Verification Report, and Appendix A.

Appendix A

New Zealand Standard 6808:2010: Acoustics – Wind farm noise Checklist

A.1 NZS 6808:2010 Checklist

Information Source:

1. Gelliondale Wind Farm Environmental Noise Assessment (Marshall Day Acoustics Pty Report Rp 002 R02 2021133, dated 14 July 2023)
2. Gelliondale Wind Farm – Background Noise Monitoring (Marshall Day Acoustics Pty Ltd Report Rp 001 20211133, dated 9 June 2023)

NZS6808:2010 Section/Clause	NZS 6808:2010 Requirement	Reference Section from Information Source 1.	Reference Section from Information Source 2.	Assessment	Compliance
3.1.3	Adopt A-frequency weighted L90 centile level for wind farm sound	S6.4 Table 6 Appendix G		LAeq adopted for source levels. LAeq levels will result in conservative predictions compared to L90 level.	Comply
5.2	Noise Limits – Non-involved and Involved stakeholders	S6.1.3 Table 2		Noise limits based on measured background noise level analysis.	Comply
5.3	Assessment of applicability of High Amenity Areas Noise Limits	S3.4.4		The wind farm is not in an area with zonings where the 'high amenity noise limit' would apply	Comply
5.4	Assessment for Special Audible Characteristics	S6.3.2		No quoted IEC 61400-11 test emission data for candidate turbine. Assessment based on observation that the occurrence of tonality is unusual. Amplitude modulation is impractical to determine pre-construction.	Comply
5.6	Cumulative Effects	S6.5		Nearest approved and/or operating wind farm is Toora Wind Farm, located approximately 15 km to the west. Would be reviewed as part of the planning approval process.	Comply
5.7	Uncertainty	S6.3.1		+1 dB adjustment adopted to account for typical values of test uncertainty	Comply

NZS6808:2010 Section/Clause	NZS 6808:2010 Requirement	Reference Section from Information Source 1.	Reference Section from Information Source 2.	Assessment	Compliance
6.1.1	Noise modelling method Predictions should identify all noise sensitive locations that might be exposed to > 35 dB $L_{A90(10\ min)}$), and then predictions to establish the likely wind farm sound levels at each of these locations	S5.0		Locations > 35 dBLA90(10 min) are identified.	Comply
6.1.2	Noise modelling method Factors that the predictions of wind farm sound levels should take into account a) Sound power levels and positions of wind turbines b) Directivity of propagation c) Meteorological conditions d) Attenuation due to geometric spreading e) Attenuation due to atmospheric absorption f) Ground attenuation g) Miscellaneous attenuation h) Barrier and terrain screening	S6.2 Appendix G		Appropriate modelling, propagation and attenuation parameters have been adopted	Comply
6.1.3	Noise modelling method Sound propagation calculation method (ISO 9613-2 noted, detailed in Appendix B). Other prediction methods.can be used, provided the details, assumptions, and limitations of the model are stated.	Appendix G		ISO 9613-2:1996 used with the adoption of appropriate modelling parameters	Comply

NZS6808:2010 Section/Clause	NZS 6808:2010 Requirement	Reference Section from Information Source 1.	Reference Section from Information Source 2.	Assessment	Compliance
6.1.4	Noise modelling method … the wind farm sound levels at a given noise sensitive location shall be determined by calculating the individual contributions of each wind turbine in octave-bands from at least 63 Hz to 4 Hz, and then A-weighting and energy adding these results to determine an overall predicted level at a given wind speed	S6.3.1		Octave bands from 31.5Hz–8kHz have been adopted for the noise modelling.	Comply
6.1.5	Noise modelling method A set of overall levels will be predicted covering the wind speed range for which sound power level data are available from the manufacturer. As a minimum, the wind speed range shall include the range specified by IEC 61400-11 and the wind speed corresponding to the highest sound level generated by the turbine. All predicted wind farm sound levels shall be calculated at hub-height wind speeds.	S6.3.1		Wind speeds from 4–>15 m/s adopted for prediction and assessment.	Comply
6.1.6	Noise modelling method The levels predicted for the wind speed corresponding to 95% rated power of the turbines should be used for determining the positions of the 35 dB and 40 dB sound level contours around the wind farm.	S6.3.1		Predictions based on highest source level corresponding to 100% rated power and maximum sound power output. This is more conservative than 95%.	Comply

NZS6808:2010 Section/Clause	NZS 6808:2010 Requirement	Reference Section from Information Source 1.	Reference Section from Information Source 2.	Assessment	Compliance
6.2.1	Sound Power Levels The sound power levels of a wind turbine used for predicting sound levels should be obtained from the wind turbine manufacturer. For the purposes of this Standard, it is recommended that wind farm sound level predictions be based on the apparent sound power and tonality values for the nominated wind turbine model, determined in accordance with IEC 61400-11…. Sound power LEQ emission values to be converted to received L90 sound pressure levels as part of the prediction process.	S6.3.1		MDA state that the source sound power levels used in the noise predictions are based on the documented sound power level data and spectral (octave band) data for the candidate wind turbine model that was sourced from the GE Renewables Energy Technical Documentation Wind Turbine Generator Systems Cypress 6.0-164-50hz (GE Document dated 16 March 2021).	Comply
6.2.2	Sound Power Levels IEC 61400-11 requires wind turbine sound power levels to be reported against a wind speed measured at 10 m AGL.	S6.3.1		Hub-height wind speed sound power data adopted	Comply
7.1.3	Measurement Every sound level measurement must be made at clearly identified noise sensitive locations		S2.1, Figure 1 Appendix F	Noise measurement locations clearly identified	Comply
7.1.4	Measurement Background sound level measurements and subsequent analysis to determine the relative noise limits should be carried out where wind farm sound levels of 35 dB$L_{A90(10\ min)}$ or higher are predicted for noise sensitive locations, when the wind turbines are at 95% rated power.		S2.1 Figure 1	Background noise level measurements undertaken at representative locations within the 35 dB $L_{A90(10min)}$ contour.	Comply

NZS6808:2010 Section/Clause	NZS 6808:2010 Requirement	Reference Section from Information Source 1.	Reference Section from Information Source 2.	Assessment	Compliance
7.1.5	Measurement When considering a group of noise sensitive location, it is acceptable to conduct background sound level measurements at a representative location. These measurements shall then be used to define noise limits that apply to every noise sensitive location in that group. The sound generating features at the representative location shall be similar in proximity and character to those at other noise sensitive locations represented by that location.		S2.1 Figure 1	Background noise level measurements undertaken at representative locations within the 35 dB $L_{A90(10min)}$) contour. Also refer to Section 6.2.1 for discussion of preferred and proxy locations where background monitoring was undertaken	Comply
7.1.6	Measurement Sound power measurements should be made at noise sensitive locations and where practical should be on the wind farm side of buildings. Measurement positions should be 3.5m from any significant reflecting surfaces other than the ground, and from other structures or objects…		Appendix G–K	Background noise level measurements undertaken on wind farm site of buildings, and > 3.5 m from significant reflecting surfaces	Comply

NZS6808:2010 Section/Clause	NZS 6808:2010 Requirement	Reference Section from Information Source 1.	Reference Section from Information Source 2.	Assessment	Compliance
7.2.1/ C7.2.1	Sound Data Sound level measurements should be made during a representative range of wind speeds and directions generally expected at the wind farm… "… a minimum of 10 days of continuous monitoring will be required to give suitable range of data. Typically, this will give in excess of 1440 data points, which should be plotted against the appropriate corresponding wind data It may require measurements to be made for extended periods of time to ensure that data includes the representative range of wind conditions….		Appendix H	Background noise levels measured in windspeeds 0–15 m/s > 1,440 data points at all measurement locations	Comply
7.2.3	Sound data The instrumentation used for the sound measurements shall meet the requirements of section 5 of NZS 6801.		Appendix D	Sound level measurement instrumentation and wind shields are appropriate.	Comply
7.2.4	Sound data Extraneous sound levels caused by events, including precipitation, insects, fauna, and so on, should, as far as is practical for an unattended monitoring exercise, be identified and removed from the data. Methods for identifying extraneous sound events include octave-band spectrum measurements and asking residents to keep an activity log during measurements.		S2.3	Extraneous noise has been identified and removed from data analysis	Comply

NZS6808:2010 Section/Clause	NZS 6808:2010 Requirement	Reference Section from Information Source 1.	Reference Section from Information Source 2.	Assessment	Compliance
7.3.1	Wind data …concurrent measurements of wind speed and direction shall be taken within the wind farm site at a known height AGL, preferable at the height of the wind turbine hub. Wind speed measurements are usually not required at the locations where the sound measurements are made		S2.2 Table 2 & Figure 1	Wind speed measurement location indicated on Figure 1.	Comply
7.3.2	Wind data If measurements have not been conducted at hub-height, then the hub-height wind speeds should be predicted from wind-shear relationships.		S2.2 Table 2 Appendix E	Wind speed and direction data at hub height has been predicted from wind-shear relationships and site analysis undertaken by WSP Australia Pty Ltd.	Comply
7.3.3	Wind data The same location and height should be used for the wind measurements before and after installation provided the wind at this position is not likely to be affected by the turbines.			Not applicable at this stage. This same condition allows for alternative monitoring position(s) where there is uncertainty about whether the original wind speed measurement position(s) by the turbines.	

NZS6808:2010 Section/Clause	NZS 6808:2010 Requirement	Reference Section from Information Source 1.	Reference Section from Information Source 2.	Assessment	Compliance
7.4.1	Background measurements Background sound level measurements should be plotted against the hub-height wind speeds existing at the time of each measurement to obtain a scatter plot. Examine this plot to determine whether a singular regression relationship is evident. If there are markedly different groups within the scatter plot, then separate scatter plots may be required for different condition, including wind directions, and times of day		Appendices G-K	Regression analysis undertaken for each measurement location.	Comply
7.4.2	Background measurements Find the regression curve that gives the best correlation coefficient between sound level and wind speed for each scatter plot and use it to describe the average background sound level at different wind speed. Sparseness of data or obvious outliers should not be allowed to unreasonable influence the regressions curve. …at extremes of the wind speed range analysed. In these cases, it may be more appropriate to use a 'bin analysis' procedure as outlined in IEC 61400-11.		Appendices G--K	Regression curves identified and used to determine average background sound levels	Comply
7.4.3	Background measurements If there is a poor correlation between wind speed and sound level, further investigation of wind conditions should be undertaken, possibly including wind-flow modelling, local knowledge, site observations or local wind monitoring.		Appendices GK	Correlation is reasonable	Comply

NZS6808:2010 Section/Clause	NZS 6808:2010 Requirement	Reference Section from Information Source 1.	Reference Section from Information Source 2.	Assessment	Compliance
7.4.4	Background measurements Where multiple regressions are indicated, and therefore several regression curves have been obtained, noise limits should be set on the basis of each regression curve derived.		Appendices G-K	24-hour and night-time only regressions have been undertaken	Comply
7.5	Post-installation measurements			Not applicable	
7.6	Compliance Assessment			Not applicable	
7.7	On –Off Testing			Not applicable	
8.1	Any report of wind farm noise predictions in accordance with this Standard shall refer to this Standard and provide the following:				
	a) A map showing the topography (contour lines) in the vicinity of the wind farm, the position of the wind turbines, and noise sensitive locations;	Appendix E			Comply
	b) Noise sensitive locations for which wind farm sound levels are calculated;	Appendix D			Comply
	c) Wind turbine sound power levels;	S6.3.1 Table 9			Comply
	d) The make and model of the wind turbines;	S6.2 Table 8			Comply
	e) The hub-height of the wind turbines;	S6.2 Table 8			Comply
	f) Distance of noise sensitive locations from the wind turbines;	Appendix C, Table 18			Comply

NZS6808:2010 Section/Clause	NZS 6808:2010 Requirement	Reference Section from Information Source 1.	Reference Section from Information Source 2.	Assessment	Compliance
	g) Calculation procedure used;	S4.3 Table 4, Appendix H			Comply
	h) Meteorological conditions assumed;	S4.3 Table 4			Comply
	i) Air absorption parameters used;	Appendix G			Comply
	j) Ground attenuation parameters used;	S4.3 Table 4 Appendix G			Comply
	k) Topography/ screening assumed;	Section 4.3 Table 4 Appendix G			Comply
	l) Predicted far-field wind farm sound levels	S6.4 Table 11 Appendix H			Comply
8.2	Any report of background sound level measurements and assessment in accordance with this Standard shall refer to this Standard and provide the following:				
	a) Description of the sound monitoring equipment including ancillary equipment;		Appendix D		Comply
	b) The location of sound monitoring positions;		Appendix G- K		Comply
	c) Description of the anemometry equipment including the height AGL of the anemometer;		S2.2 Table 2 Appendix E		Comply
	d) Positions of wind speed measurements;		Figure 1		Comply

NZS6808:2010 Section/Clause	NZS 6808:2010 Requirement	Reference Section from Information Source 1.	Reference Section from Information Source 2.	Assessment	Compliance
	e) Time and duration of the monitoring period;		S2.2 Table 2		Comply
	f) Averaging period for both sound and wind speed measurements;		S2.2 Table 2 S2.3 Table 3		Comply
	g) Atmospheric conditions: the wind speed and direction at the wind farm position and rainfall shall be recorded;		S2.2 Table 2 Appendix E		Comply
	h) Number of data pairs measured (wind speed in m/s, background sound in L90);		Appendices G - K		Comply
	i) Description of the regression analysis;		S2.3 Table 3		Comply
	j) Graphical plots showing the data scatter and the regressions curves.		Appendices G - K		Comply
8.3	Documentation Compliance Assessment			Not applicable	
8.4	Documentation Submission of Reports			Not applicable	