MT FYANS
WIND FARM

APPENDIX M

NOISE AUDIT

ENVIRORISK

NOVEMBER 2022

EnviroRisk

APPROVALS - SUSTAINABILITY - COMPLIANCE

Verification Report

of the

Mt Fyans Wind Energy Facility

Pre- Construction Noise Assessment

August 2022

for

Entura (a Hydro Tasmania company)

GENERAL INFORMATION

Report Descriptor:	Descriptor: r_HydroTas_MtFyans_PreConstruction_Verify_220812_R1
Title:	Verification Report of the Mt Fyans WEF Pre-construction Noise Assessment
Completed By:	
Name:	Stephen Jenkins BAppSci GradDipMgt. CEnvP, MAAS, FEIANZ
Company Details:	EnviroRisk Management Pty Ltd ABN 24 069 947 904 www.envirorisk.com.au
Appointments:	Auditor appointed under Part 8.3 of the Environment Protection Act 2017
Report(s) Verified	
Pre-construction Noise Assessment	Mt Fyans Wind Farm Environmental Noise Assessment Rp 001 R01 20190964, dated 15 August 2022
Report Distribution:	
Stephen Jenkins	EnviroRisk Management Pty Ltd (Master Copy)
David Procter	Senior Environmental Consultant, Entura

Revision	Summary of Amendments	Reviewed by	Issued by	Issue Date
0		L Nethercott	S Jenkins	16 Aug 22
1	added 'under Part 8.3' to 'Appointments'	L Nethercott	S Jenkins	20 Oct 22

VERIFICATION APPROACH AND COVERAGE

This verification report is based on a systematic examination of a pre-construction noise assessment report. It specifically reviews wind turbine noise and does not review site construction noise nor external to turbine sub-station generated noise. The verification therefore, is confined to the sections of the subject report associated with wind turbine noise, and not the report in its entirety that includes other industrial type noise compliance predictions.

The Auditor has used an *'evidence-based approach'* as provided for in AS/NZS ISO 19011:2019 Guidelines for Auditing Management Systems, predominantly via interrogation of information and data provided within the provided report, the supplementary information provided upon request and from communications with the subject report's author and the proponent's representative.

Information presented within this report relies on:

- the completeness and accuracy of records, information, plans, data and discussion contained within the report or made available to support review enquiries; and
- the accuracy and completeness of subsequent information provided during communications with the proponent's representative and the subject report's authors.

The Auditor has not conducted monitoring themselves nor performed any data analysis from simulation modelling. There was, however, interrogation of the technical content within the subject report, enquiries relating to modelling input and quality assurance processes, and communications with the proponent and specialist personnel who prepared the acoustic report to verify against the specifications within the NZS6808:2010.

The report should only be reproduced and distributed in full.

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ABBREVIATIONS

ABBREVIATION	WORD/PHRASE
AS/NZS	Australian and New Zealand Standard
EPA	Environment Protection Authority
DELWP	Department of Environment Land Water and Planning, Victoria
m/sec	meters per second
NMP	Noise Management Plan
NSL	Noise Sensitive Locations
NZS	New Zealand Standard
SAC	Special Audible Characteristics
SPL	Sound Power Level
WEF	Wind Energy Facility
WTG	Wind Turbine Generator

DEFINITIONS

Standard:

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

Noise Sensitive Location (source NZS 6808:2010):

The location of a noise sensitive activity, associated with a habitable space or education space in a building not on the wind farm site. Noise sensitive locations include:

(a) Any part of land zoned predominantly for residential use in a district plan;
(b) Any point within the notional boundary of buildings containing spaces defined in (c) to (f)
(c) Any habitable space in a residential building including rest homes or groups of buildings for the elderly or people with disabilities, papakainga and marae, excluding habitable spaces in buildings where the predominant activity is commercial or industrial. (Residential buildings designed for permanent habitation on land zoned for predominantly rural or rural-residential use are not classified as commercial or industrial for the purposes of this Standard);
(d) Teaching areas and sleeping rooms in educational institutions, including public and private primary, intermediate, and secondary schools, universities, polytechnics, and other tertiary institutions;
(e) Teaching areas and sleeping rooms in buildings used for licensed kindergartens, childcare, and day-care centres; and
(f) Temporary accommodation including in hotels, motels, hostels, halls of residence, boarding houses, and guest houses.

Stakeholder dwelling – a dwelling on the wind energy facility site, or one that has a written agreement with the WEF to exceed the noise limit as specified under the Standard.

Micro-siting:

- within 100m in any direction from the centre of the turbine at ground level as shown on the development plans.

EXECUTIVE SUMMARY

Table 1: Summary of Information and Outcome

Auditor	Stephen Jenkins
Auditor account number	EXT001152
Date EPA notified	N/A (Pre-construction verification report)
Name of person requesting report	David Procter
Relationship of person to site	Senior Environmental Consultant
Name of site owner(s)/ proponent	Mt Fyans Wind Farm Pty Ltd
Date of Auditor engagement	4/08/22
Reason for the review	Verification of the pre-construction report titled 'Mt Fyans Wind Farm Environmental Noise Assessment R001 R01 20190964'
Elements of the environment assessed	Wind turbine noise at a noise sensitive location
Planning Permit number or requirement	Not applicable
EPA Region	South-West
Municipality	Moyne Shire
Site / Premises name	North of Mortlake township
Plan of site/premises/location showing the site boundary	WTG locations provided in the noise assessment report
Further work or requirements	N/A (Pre-construction verification report).
Nature and extent of continuing risk of harm	Nil (the wind energy facility is yet to be commissioned and operated).
Outcome of the verification review	Refer below

Table 2: Physical Site Information

Historic land use	Farming
Current land use	Farming
Current land use zoning	Farming
Proposed land use and zoning	To remain as Farming (within the 35dB LA90 contour)
Surrounding Land Use (N, S, E, W)	Farming; further south Rural Living & General Residential zones within Mortlake

Outcome

I have reviewed the pre-construction noise compliance assessment report (i.e. the subject report) against the compliance criteria specified in NZS6808:2010 Acoustics - Wind farm noise (the Standard), and with reference to Victorian guidelines on wind energy facilities and relevant EPA advice.

The noise assessment report has made predictions against a base standard noise amenity limit of 40 dB L_{A90} given noise sensitive locations within the predicted 35 dB L_{A90} contour fall within a Farming Zone, as defined within the local planning scheme.

This compliance limit is deemed appropriate considering EPA guidelines support that a Farming Zone does not attract a high noise amenity limit unless there is a plan made under the planning scheme that specifies otherwise.

Compliance was also assessed against a more conservative noise limit of 35 dB L_{A90} at the more distant Rural Living and General Residential zones as such land use zoning would appear to attract a higher noise amenity expectation.

This verification report has assessed noise predictions from three (3) candidate wind turbine generators (WTGs) namely: Vestas V162-6.8MW, GE 6.0-164 and SG 6.6-170. The auditor has reviewed the manufacturer's technical reports on noise from the candidate turbines, reviewed compliance limits specified in the noise assessment report, interrogated the rigor of the modelling

selected parameters and processes, assessed considerations on uncertainties, sought clarifications on report content within the subject report, noted background noise monitoring reports, sought clarification on mapped noise sensitive locations (NSLs), and obtained an appreciation of the locality based on a site inspection, topography maps and aerial imagery.

The verification process has considered cumulative noise from nearby approved and operational wind energy facilities including the Salt Creek, Mortlake South and Dundonnell wind energy facilities.

I verify the noise assessment report has been prepared in accordance with the Standard and that compliance is predicted against the noise limit of 40 dB L_{A90} at non-stakeholder noise sensitive locations in the Farming Zone. Compliance against a high amenity noise limit of 35 dB L_{A90} is also predicted to be achieved within the more distance Rural Living and General Residential zones.

A compliant outcome against the Standard supports the regulatory position that noise does not represent an unacceptable risk of harm.

Best practice noise control is specified in the EPA guidelines as warranting consideration. It is recognised that various factors contribute to a best practice evaluation. However, on the data presented including the specified octave band sound power levels, of the presented candidate WTGs, the Vestas V162-6.8 MW PO6800 turbine, operating in the absence of special audible characteristics, and adopting serrated trailing edges (with the option for a sound optimization mode if required), is likely to represent an example of best practice noise control technology. Best practice considerations will be relevant during the final turbine selection process, and approval considerations by the Responsible Authority.

It needs to be emphasised that wind turbine noise approaching the 40 dB L_{A90} noise limit at any NSL, as is specified in the Standard as the base compliance limit, means the noise may be readily audible; particularly during moderate hub height wind speeds that align with low background noise conditions.

Signed

Stephen Jenkins,
ENVIRONMENTAL AUDITOR (APPOINTED PURSUANT TO THE EP ACT 2017)

1.0 Introduction

This verification report describes the outcome of a review of the pre-construction noise compliance assessment report prepared by Marshall Day Acoustics (i.e. the subject noise assessment report) for the Mt Fyans wind energy facility, located north of Mortlake, south-west Victoria.

The verification was commissioned by Entura, a Hydro-Electric Corporation company on behalf of Mt Fyans Wind Farm Pty Ltd (the proponent), to fulfil obligations under Clause 52.32-4 of the Victorian Planning Provisions (Amendment Feb 2022) 'Mandatory noise assessment' i.e.

'An environmental auditor appointed under Part 8.3 of the *Environment Protection Act 2017* must prepare a report that verifies if the acoustic assessment undertaken for the purpose of the pre-construction (predictive) noise assessment report has been conducted in accordance with the Standard.'

The specific items being verified are the noise assessment report prepared to demonstrate that the proposed wind energy facility (WEF) can comply with the noise limits specified in the New Zealand Standard NZS6808:2010, Acoustics - Wind farm noise (the Standard), including an assessment of whether a high amenity noise limit is applicable under Section 5.3 of the Standard.

The WEF is reported to comprise 81 turbines and has adopted as the pre-construction candidate turbines:

- Vestas V162-6.8MW model PO6800 (hub height of 115m and blade diameter of 162m)
- Siemens Gamesa mode AM0 (hub height of 115m and blade diameter of 170m)
- General Electric Cyprus (hub height of 115m and blade diameter of 164m).

2.0 Verification Review Components

2.1 Objectives

The objectives of the review are to assess the noise assessment report and verify the assessment:

1. has been conducted in accordance with the Standard;
2. meets the requirements of the DELWP guidelines (with respect to noise compliance); and
3. provides sufficient data to establish that best practice has been integrated into the design and that noise, when generated, is likely to represent an acceptable risk of harm.

The Environment Protection Amendment (Interim) Regulations 2021[1], provide a definition in Section 131H that wind turbine noise is unreasonable '*if it exceeds the noise limit set out in the relevant noise standard*'. Conversely, when achieving the Standard, noise is not considered unreasonable.

It also provides a note under Section 131C whereby '*compliance with the noise limits set out in the relevant noise standard*' coupled with '*taking all applicable actions set out in this Division to manage and review the wind turbine noise from the facility*' are likely to equate to '*Act compliance – section 25(1) (see regulation 6)*'[2].

[1] The Interim Regulations are to be revoked on 25 October 2022.
[2] This section appears to reference the General Environmental Duty (GED).

For the purpose of this pre-construction verification review, predicting compliance with the Standard is therefore considered to equate to an acceptable risk of harm from wind turbine noise, as specified under the EP Amendment (Interim) Regulations 2021.

EPA Victoria publication 1692[3] has also been referenced and provides the following definition:

'Risk of harm in relation to WEFs is defined herein as the potential for noise generated by WEFs to impact upon nearby noise sensitive locations.'

Impact is taken to be noise that exceeds the compliance limits specified in the Standard.

In accordance with the Standard, a noise sensitive location (NSL) is not located on the wind farm site. For the purposes of this verification review, a stakeholder property is deemed to be located on the wind farm site and is therefore not captured by the Standard's noise compliance limits. A stakeholder/ involved party property is not considered a noise sensitive location and as such, has not been subjected to a risk of harm assessment as is required under currently available auditor guidelines.

2.2 Scope

The scope is to verify whether the predicted compliance determination provided within the noise assessment report *Mt Fyans Wind Farm Environmental Noise Assessment Rp 001 R01 20190964 / 15 August 2022,* has been conducted in accordance with the Standard.

A site inspection of the WEF's locality was conducted by the auditor during August 2018, June 2020 and again in February 2022.

2.2.1 Activity

The activity is the noise generated by wind turbine operation, as defined within the Standard, including any cumulative noise from adjacent wind energy facilities; either operating or under planning approval to develop.

2.2.2 Segment & Boundary

The segment being assessed specifically relates to the noise being generated by the WEF with the potential to impact on nearby noise sensitive locations.

The boundaries of the review are the noise sensitive locations as identified in the subject noise assessment report within, and in reasonable proximity to, the 35 dB L_{A90} prediction contour. Locations beyond this contour are not considered to be at risk of harm from noise within a standard noise amenity zone.

Under best practice turbine design, operation and maintenance, and with consideration of the number and layout of the turbines, the boundaries under review generally lie within a 2km radius of the nearest wind turbine's centroid point to a noise sensitive location.

[3] EPA (pers comm. A.McRae, 4 March 2022) informs that EPA guideline 1692 *Wind energy facility noise auditor guidelines, October 2018* may be referenced in the absence of specific EPA guidance on verification reports.

2.2.3 Element & Environmental Values

The element of the environment under consideration is the protection of human health and well-being as a result of noise annoyance and amenity loss.

The environmental values being protected are the normal domestic and recreational activities within a habitable space including sleep, or an education space in a building not on the WEF site.

2.2.4 Verification Period

The review was conducted over the period: 8 August 2022 to 15 August 2022.

2.2.5 Criteria

The criteria used for the verification review are specified in the New Zealand Standard, 6808:2010 Acoustics – Wind farm noise (NZS 6808:2010), which forms the 'relevant noise standard[4]'.

Noise limits are defined in Table 2 of the Standard as:

Background sound level	Noise limit ($L_{A90(10\ min)}$)	High amenity noise limit ($L_{A90(10\ min)}$)
> 35 dB	background + 5 dB	background + 5 dB
30 – 35 dB	40 dB	
< 30 dB		35 dB

Notes:

Where a high amenity noise limit is shown to be justified in accordance with 5.3.1 (of the Standard), under wind conditions determined in accordance with 5.3.2, wind farm sound levels ($L_{A90(10\ min)}$) during evening and night-time should not exceed the background sound level by more than 5 dB or a level of 35 dB $L_{A90(10min)}$, whichever is the greater. During daytime the noise limit in (section) 5.2 should always apply.

The Standard recommends that the wind farm noise limits should not be set lower than 35 dB $L_{A90(10min)}$ at any time.

Under section 5.3.2. 'A high amenity noise limit should only be applied, and can only be maintained, under wind conditions when low background sound levels are common at a noise sensitive location, while the wind farm is operating. Therefore, even when a high amenity noise limit is justified in accordance with 5.3.1 it is appropriate to restrict application of that limit by conditions of consent to wind conditions when the wind farm wind speed falls below a fixed threshold. It is recommended that the high amenity noise limit should apply when the wind farm wind speed is 6 m/s and lower[5]. An alternative wind farm wind speed threshold may be applied where justified on meteorological, topographical, and acoustical grounds.

[4] Definition '***relevant noise standard,*** for the purposes of Division 5 of Part 5.3 (of the principal Regulations), means the noise standard that applies to wind turbine noise from a wind energy facility, determined in accordance with regulation 131B.

[5] Note: the relevance of high amenity is specified in EPA guidelines as being up to and including 6 m/sec with no alternative wind speed threshold specified.

Reference has also been made to Regulations and guidelines on windfarm noise including:

- *Environment Protection Amendment (Interim) Regulations 2021.*
- EPA publication 1692, *Wind energy facility noise auditor guidelines, October 2018* (i.e. the default verification report guidance); and
- DELWP Publication: *Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria, November 2021.*
- EPA Victoria, Wind Energy Facility Turbine Noise Regulation Guidelines (available on EPA website)
- EPA publication *2022: Environmental auditor guidelines – Provision of statements and reports for environmental audits and preliminary risk screen assessments.*

EPA guidelines relating to the application/ assessment of a '*high amenity area noise limit*' as applicable under the planning framework, have been adopted when assessing derived noise limits.

Under the EP Amendment (Interim) Regulations 2021 a 45 dB $L_{A90\ (10min)}$ limit is specified for '*relevant landowners with a wind turbine noise agreement*'. However, the risk of harm to such dwellings is not considered within the scope of this compliance verification report as:

i. a wind turbine noise agreement is considered to render the owner as a 'stakeholder' and stakeholder noise limit falls outside the 'Auditor Guidelines' (EPA Publication 1692),
ii. the stakeholder noise limit, which is above the limit specified in the Standard, appears to have no technical basis to verify it represents an acceptable risk of harm from noise, and
iii. the auditor understands stakeholder agreements are confidential, and that agreements in force prior to 2021 may include provisions for acceptance of noise levels that are not be consistent with the 'stakeholder recommended' limit under the EP Amendment (Interim) Regulations 2021.

The Standard specifies a level of 40 dB $_{LA90}$ being the 'limit' to protect from noise in the absence of background influence. A noise level of 45 dB $_{LA90}$ will therefore, at times be clearly audible and capable of causing annoyance and holding potential for sleep disturbance. Noise at this level may therefore not protect the receptor from a risk of harm from noise and therefore cannot reasonably be included within a report that incorporates a 'risk of harm' component (as is required under the current EPA wind energy facility auditor guidelines). Comment as to whether the subject report predicts compliance with the 45 dB $_{LA90}$ noise criteria at a stakeholder's premises (note: the subject report refers to these as 'involved receivers') has however been provided in the assessment protocol (refer Appendix 1).

Additional standards referenced during the verification include:

- ISO 1996-1:2016 Preview. Acoustics– Description, measurement and assessment of environmental noise.
- ISO 1996-2:2017 Acoustics– Description, measurement and assessment of environmental noise.
- AS 1055.1:1997 Acoustics– Description and measurement of environmental noise.

2.2.6 Exclusions

The verification only includes operational wind turbine noise assessed against the requirements of NZS 6808:2010.

As such, it does not include other noise sources such as off-turbine substations, transformers, construction and maintenance activities that are not integral with the wind turbine operation. These are better assessed against different standards and criteria (e.g. EPA Publication 1834, *Civil construction, building and demolition guide*, Publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues*, and the Environment Reference Standard).

The review is specific to the detail contained in the noise assessment report and the subsidiary reports that are referenced.

It relates to the number and configuration of wind turbines, the turbine candidate variant, the sound power ratings at respective octave frequency specifications and hub height wind speeds as detailed within the reports reviewed.

The auditor has, as far as is reasonably practicable, interrogated the process to identify relevant non-stakeholder noise sensitive locations (NSL) to ensure they are appropriately represented within the noise assessment reports; including reviewing the figures and tables that illustrate noise modelling compliance predictions, sampling the GPS locations of a few non-stakeholder properties and also obtaining written confirmation from the proponent that all NSL including non-stakeholder dwellings are accurately represented. Correspondence that they have been appropriately identified and referenced in the subject report was received from the proponent and is included in Appendix 2. A site visit was also previously undertaken, and noise sensitive areas were observed surrounding the proposed development.

As detailed above, stakeholder properties are excluded from the review as they are not considered to be a NSL under the Standard.

An Environment Reference Standard has been proclaimed under the EP Act 2017. This includes ambient sound objectives for a Farming Zone (i.e. Category IV), i.e.

- Outdoor $L_{Aeq,16h}$ from 6am to 10pm = 40 dB(A)
- Outdoor $L_{Aeq,8h}$ from 10pm to 6am = 35 dB(A)

It is noted the subject report discusses noise impact on natural areas. In addition to these natural areas, Category II (General residential) and Category IV (Rural Living and Farming) land use categories may also be relevant.

It is stated that the ERS '*is not a compliance standard*'. As such, under current EPA guidance and the EP Amendment (Interim) Regulations, this is considered to exclude the adoption of ERS objectives for wind turbine noise compliance.

2.3 Methodology

The following method was adopted for the review:

1. Communications with the client as to the verification process.
2. Obtaining a complete copy of the noise assessment report subject to verification (the subject report).
3. Aerial photography check of potential receptors using NearMap™ and Google Earth.
4. Adopting information from a previous site inspection of the proposed WEF area (Appendix 3).
5. Detailed review of the noise assessment report's modelling methodology, source data, predictions and methods adopted against the Standard.
6. Review of EPA advice and guidelines in relation to planning based high amenity areas and their associated noise limit.
7. Communications with the proponent as to the identification and mapping of all relevant noise sensitive locations.
8. Data interrogation, review of the locality of noise sensitive locations in reasonable proximity to the predicted 40 dB L_{A90} contour in the Farming Zone and 35 dB L_{A90} in the Rural Living Zone (applicable to one NSL only).
9. Interviews with the proponent and communications with their acoustic consultant to clarify noise assessment report content with respect to modelled blade tip height, third octave SPLs, and use of the term 'proposed involved receivers'. Considerations relating to quality assurance were also previously discussed during an initial audit of the previous Mt Fyans WEF design and outcomes carried over to this verification.
10. Attainment of an updated report from the acoustic consultant.
11. Completion of the verification protocol.
12. Undertaking a qualitative risk of harm assessment.
13. Preparation and issue of the verification report.

2.4 Process

The verification was conducted in general accordance with auditing techniques specified within AS/NZS ISO19011:2019 *Guidelines for auditing management systems*.

The process included a review of the subject noise assessment report, an evaluation of available material to assist with a determination as to whether a high amenity noise area is justified (e.g. EPA guidelines, review of background noise monitoring data levels, evaluation of previously written advice received from the EPA, planning decisions including the Cherry Tree Wind Farm decision), assessment of the veracity of the modelling process and predicted noise levels, and a risk of harm assessment. The process aimed to establish whether the noise assessment report provides sufficient detail to support a verification of predicted compliance against the Standard.

A determination of the risk of harm from noise has been formed from both:

i. a direct conformance reference against the review protocol 'criteria' contained in the tables provided within Appendix 1; and
ii. a risk assessment (refer to Section 5).

The protocol used to assess conformance against the Standard is provided in Appendix 1 of this report. The appended spreadsheets list the criteria specified in the Standard and DELWP guidelines[6], and the auditor's findings and make comments to substantiate (as needed) determinations of compliance or non-compliance against each criterion.

The protocol content should be read with reference to the relevant sections of the Standard (i.e. NZ6808:2010), DELWP and EPA guidelines, and the Environment Protection Amendment (Interim) Regulations 2021.

Compliance with the condition or requirement is rated Yes, No or other: whereby 'other' can include an item being 'Not Applicable (NA)' as it is not within the scope, 'Not Determined (ND)' based on information made available in the report and ambiguities between the Standards, Guidelines and information within noise reports, or 'Part Compliant (PC)' where the requirement has inherently several parts to it.

Where any qualification for a determination is required, it has been captured in the comments section of the spreadsheet. Where an issue has been identified with respect to content within the subject noise assessment report, a recommendation has been provided. Sections that are not in the scope of this pre-construction compliance and risk of harm assessment are identified as such. The rationale for exclusion from the scope is provided in the comments column where required, or in Section 2.2.6 above.

The verification process has included communications with the proponent's representative, and the acoustic consultants who prepared the predictive noise modelling report.

3.0 Noise Limits

The noise assessment report has adopted a 40 dB $L_{A90\,(10min)}$ base noise limit for non-stakeholder NSLs in a Farming Zone. A compliance limit for 'involved receivers' (i.e. stakeholders) of 45 dB $L_{A90\,(10min)}$ has been nominated in the subject report.

Background monitoring data is referenced in the subject report that may result in an increase in the compliance limits at certain NSL (i.e. background + 5 dB $L_{A90\,(10min)}$). However, the predictive modelling has assessed only against the base noise limit. This results in potentially conservative compliance limits for the Vestas V162-6.8MW candidate model as the maximum sound power (i.e. 105.5 dB L_{WA}) is reached at a hub height wind speed of 15 m/sec. The use of the base noise limit as a compliance standard is relevant for the GE 6.0-164 and SG 6.6-170 candidate turbines models as these WTG reach maximum SPL at, or

[6] The EP Amendment (Interim) Regulations 2021 are not directed towards a pre-construction noise verification but assist to inform the noise compliance limit criteria components within the protocol.

before, 10 m/sec and their maximum SPL is greater than the Vestas model (i.e. 107 & 106 dB L_{WA} respectively according to the manufacturer's data).

The noise assessment has reported maximum noise predictions at all non-stakeholder NSL are below the base noise limit of 40 dB L_{A90}. Therefore, the verification can progress against a risk of harm against a base noise limit being achieved at all NSLs.

The validity of whether background noise monitoring is sufficient to derive compliance limits that are influenced or otherwise by background conditions for wind speeds at and above 8 m/s is beyond the scope of this verification. Whether the background data is representative and complete for all NSLs will need to be addressed by the Responsible Authority during planning permit considerations.

3.1 Consideration of a High Amenity Noise Limit

A determination as to whether a high amenity area noise limit was applicable is made within the subject report (i.e. Section 6.1.1 High amenity) which states:

"Based on the predicted noise level contours presented subsequently in Figure 2 of Section 6.4, and the zoning map for the area presented in Appendix G, the area within the predicted 35 dB LA90 contour is identified as Farming Zone….

Based on the above, the high amenity noise limit is not justified for the proposed wind farm."

In assessing whether this is a reasonable deduction, the auditor has referred to relevant guidelines and advisory notes on the applicability of a high noise amenity.

EPA guideline (Pub. 1692, 2018) state:

'The audit should include review of the assessment as it relates to:
- whether a high amenity noise limit is applicable, as assessed under Section 5.3 of the Standard following procedures outlined in clause C5.3.1 of the Standard. Where the Standard refers to a District Plan (or Plan) this shall be taken to mean a Scheme as defined within the VPPs."

Section 5.3 of the Standard is applied to determine whether a '*high amenity noise limit' of 35 decibels may be justified in special circumstances*. This section further states '*All wind energy facility applications must be assessed using Section 5.3 of the Standard to determine whether a high amenity noise limit is justified for special locations, following procedures outlined in 5.3.1 of the Standard*'.

The terms 'special circumstances' and 'special locations' are not defined either within the DELWP guidelines (DELWP 2021), the EPA noise auditor guidelines (EPA 2018; EPA 2022), nor the Standard (NZS 2010).

Furthermore, these guidelines reference a Tribunal report in that '*Guidance can be found on this issue in the VCAT determination for the Cherry Tree Wind Farm*'.

Taking wording directly from this report:

"The Mitchell Planning Scheme does not anywhere expressly or by implication "promote a higher degree of protection of amenity related to the sound environment of a particular area".

Approaching the matter by a process of elimination it can be seen with certainty that the controls contained within the Farming zone, which includes most of the locality, do not answer this description. The purpose of the Farming zone is to encourage agricultural use, which is not an inherently quiet land use. In fact reference to the zone purposes confirm that agricultural use is to be preferred to residential use if there is potential conflict between the two.

Accordingly, the Tribunal concludes that the subject land and its locality is not capable of designation as a high amenity area because it does not possess the necessary characteristics of such an area as specified in the NZ standard.[7]"

Under this outcome, land within a Farming Zone would appear to not fall within a 'high amenity area'.

The auditor's opinion as to the relevance of a high amenity area is provided against each relevant element of the Standard below (*Note*: Clauses taken directly from Section 5.3 of the Standard: High Amenity Areas):

> *"5.3.1*
>
> *The wind farm noise limit of 40 dB LA90(10 min) in 5.2 is appropriate for protection of sleep, health, and amenity of residents at most 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 and night- time.'*
>
> High amenity protection is therefore only relevant in 'special circumstances' during the evening and night period.
>
> *"A high amenity noise limit should be considered where a plan promotes a higher degree of protection of amenity related to the sound environment of a particular area, for example where evening and night-time noise limits in the plan for general sound sources are more stringent than 40 dB LAeq(15 min) or 40 dBA L10."*
>
> The plan being referenced refers to the New Zealand planning schemes under the NZ Resource Management Act (as the Standard is taken from New Zealand). To interpret Australian planning schemes' promotion of high amenity, the auditor sought and received advice from the EPA. EPA's email 'Advice and Supplementary to Advice' dated 25 October 2019 was referenced on how EPA-appointed auditors are to interpret the Victorian planning schemes, namely:
>
> "*For proposed wind energy facilities:*
> *When auditing an acoustic consultant's determination as to whether a high amenity limit ought to or not apply to an area, the following steps should be taken:*
> *1. First determine whether there are zones associated with an expectation of acoustical amenity (i.e. used predominately for residential purposes), including Township Zone, present within the 35 dB LA90 (10 min).*
> *2. Secondly, where the above zones are present, as per guidance in Section 5.3 of the NZS, confirm that background noise levels of the area are not affected by other*

[7] Cherry Tree Wind Farm Pty Ltd v Mitchell SC & Ors (Includes Summary) (Red Dot) [2013] VCAT 521 [108 - 109].

specific sources, such as traffic noise. Additionally, check there are no agreements in place between stakeholders and WEF proponent in which case the HAL would not apply."

The relevant zone for all noise sensitive locations within the predicted 35 dB L_{A90} in this case is a Farming Zone, which is not 'predominantly used for residential purposes.' As such, noise sensitive locations within the Farming Zone are not specifically within a high amenity area and therefore no high amenity noise limit warrants consideration unless it is specifically included under the planning scheme. Interrogation of the Moyne Planning Scheme (refer to Figure 1 zoning map) by the Auditor did not identify any overlay nor reference to a high noise amenity area in the Farming Zone.

It is noted that both NZS 6808:2010 and the Guidelines state that the high amenity limit would only be justified in 'special circumstances'. Considering large areas of Moyne Shire, and across Victoria more generally, are Farming Zones, application of the high amenity limit to a Farming Zone would appear to contradict the requirement that it only apply in special circumstances.

EPA website-based guideline states:

'In Victoria the HAA limit is only intended to apply in the following circumstances.

An HAA limit:

- *should apply to a dwelling located in the following zones predominantly intended for residential development: Low Density Residential Zone (LDRZ), Township Zone (TZ), Rural Living Zone (RLZ), Green Wedge A Zone (GWAZ) and Rural Conservation Zone (RCZ)*
- *should not apply to the Farming Zone (FZ)*
- *should not be applied in any location where background sound levels are already affected by other specific sources such as road traffic noise*
- *only applies for WEF wind speeds up to and including 6 m/s*
- *is applicable only when there is no agreement made in accordance with regulation 131A.*

Consistent with section 5.3 of the 2010 Standard, where an HAA noise limit applies, the base wind turbine noise limit should be 35 dB(A) for wind speeds ≤ 6 m/s at hub height. Above 6 m/s the base wind turbine noise limit should be 40 dB(A) (i.e. the standard acceptable noise limit).

On this basis, with particular consideration of the VCAT determination for the Cherry Tree Wind Farm proposal, it is apparent that the Moyne Planning Scheme does not envisage a higher level of amenity for the subject site and surrounding land containing the nearest noise-sensitive locations. Therefore, the high amenity limit has not been applied to noise sensitive land uses in the Farming Zone.

The auditor therefore, concurs with the determination within the noise assessment report that a standard noise limit of 40 dB L_{A90} applies for noise sensitive locations within the Farming Zone.

It is noted that a number of noise-sensitive locations in the Mortlake township are located in other zones i.e. Rural Living and General Residential. The Cherry Tree Wind Farm VCAT decision does not advise on these zones but the recent Planning Panel decision for the Golden Plains Wind Farm indicated that at least the General Residential zoning is likely to be

of 'High Amenity' (i.e. *'… zoned Township Zone and Low Density Residential Zone are a high amenity for the purposes of the Standard'* (ref PA1700266, 29 April 2019).

Therefore the Rural Living and Residential zones situated approximately 2.5 km from the nearest turbine to the south are potential high noise amenity areas (refer Figure 1).

A conservative approach has been adopted and a limit of 35 dB L_{A90} has been assessed against for compliance purposes at noise sensitive locations in these zones. Only one location (i.e. location U171) falls within the predicted 30 dBA(A) mapped contour, and only against the GE candidate model WTG. The predictions are made at maximum SPL where hub height wind speeds approach 10 m/sec, well above the 6 m/sec maximum applicable wind speed specified in EPA guidelines. Therefore at wind speeds applicable to high amenity noise conditions, levels will be even lower. Modelling therefore predicts compliance against a possible high amenity limit within the Mortlake township.

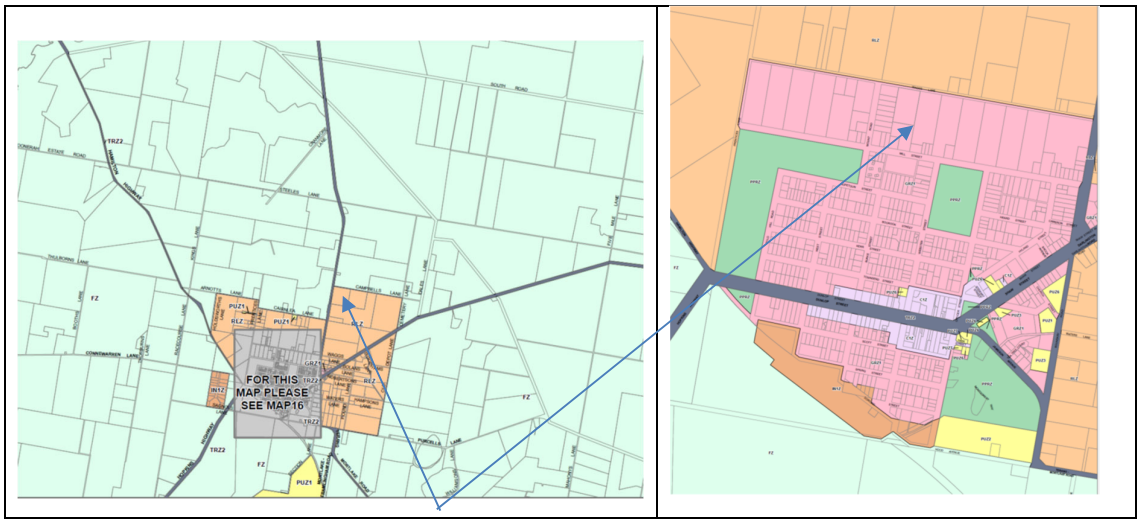

Figure 1: Moyne Shire Planning Scheme (nearest High Amenity zoned areas)

4.0 Evidence

The evidence used to form conclusions is summarised within the completed compliance protocol that is provided in Appendix 1.

Specific comments against the conditions of the guidelines are discussed below.

4.1 Assessment Against EPA Guidelines

4.1.1 Familiarisation with the WEF development proposal and planned operation

Details of the development proposal were specified within the subject report including sound power data provided by the manufacturer, details of test reports for a range of audible octave band Sound Power Levels (SPLs) and the reported specification of an absence of any tonal noise or a special audible characteristic (SAC) associated with the turbines.

To confirm the reported SPLs used in the modelling reflected manufacturers' data, copies of the manufacturers third octave SPL test reports on the WTG were received. The auditor has

confirmed the data specified in the subject report reflected manufacturers information with a 1 dB(A) addition to account for test uncertainties.

A map of the proposed turbine locations with predicted noise contours for the candidate turbine and cumulative impact from the adjoining WEFs, including the nearest Dundonnell wind energy facility, has been taken from the subject report and reproduced in Figure 2.

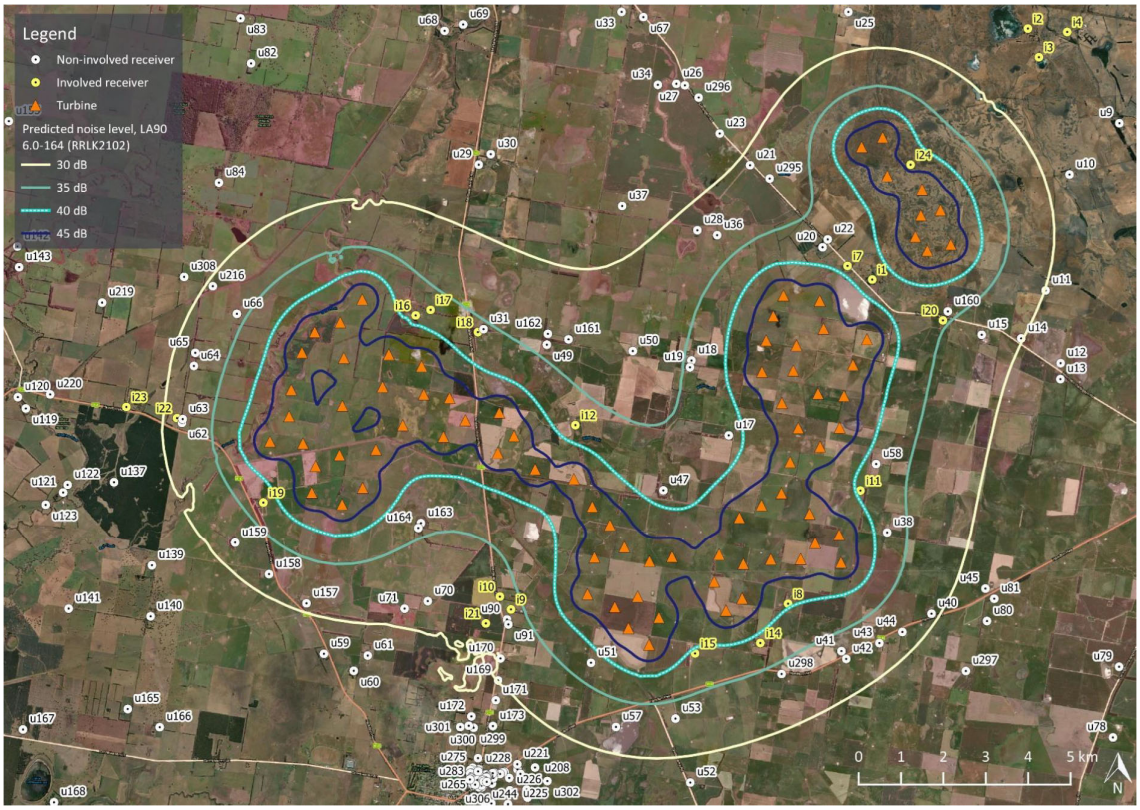

Figure 2: Predicted noise contours of GE candidate turbines (from Figure 2 MDA, August 2022)

A review of the proposed development locality was made using ground surveillance, Google Earth and Google Maps, NearMap imaging and communications with the proponent's personnel and their acoustic consultants.

4.1.2 Inspection of the WEF project site and the surrounding environment

A detailed site inspection was made by the auditor to appreciate the project site and surrounds during August 2018 and June 2020 as part of a previous audit process. A subsequent site visit was made during 2022.

4.1.3 Assessment of the rigour of the process used to identify noise sensitive locations

The WEF covers a large area with a number of non-stakeholder properties falling within the predicted 35 dB L_{A90} to 40 dB L_{A90} noise contours (e.g. refer Figure 2). The nearest turbine to a non-stakeholder NSL is assessed to be over 1.0 km (i.e. nearest being u38 at 1.14km).

The auditor sought confirmation from the proponent that all applicable non-stakeholder noise sensitive locations were nominated and mapped within the noise assessment report.

Interviews were held with the proponent to establish the process used to identify non-stakeholder properties. Site tours were made along several accessible public roads around the proposed WEF and its surrounds. A list of locations visited is provided in Appendix 3.

Given the challenges presented by the auditor to ground truth the identification of all NSL's, the auditor requested and received a statement from the proponent's representative that the noise assessment report has appropriately captured all relevant NSL's and stakeholder dwellings. This communication is provided in Appendix 2.

Clarification was requested on the use of the phrase 'proposed involved receivers' as stated in the subject report. It was reported dwellings i18, i12, i22, i23, i16, and i17 have lapsed agreements, having had agreements with the same owners in the recent past, and that '*parties are positively engaged to sign new documents … and this process will be completed within a few months'.* For the purposes of conservatism, these dwellings have been taken to be NSL's whereby the base 40 dB L_{A90} noise limit would apply to noise compliance. All other 'involved receivers' are reported to have Agreements with landowners. Accordingly the auditor has considered these locations stakeholders and not NSL's (including location i24).

The auditor is therefore satisfied that the process followed to identify non-stakeholder properties for the purpose of noise assessment has been rigorous and is likely to be complete.

4.1.4 Review of the pre-construction noise assessment considering the WEF development proposal and operations

The guidelines specify the following items that warrant consideration during the review:
- turbine technical specifications and power ratings;
- tower locations;
- topography;
- transformer stations[8];
- any other relevant factors.

The noise assessment report identifies that the WEF's candidate turbines will comprise the Vestas 162-6.8MW (PO6800), the General Electric 6.0-164 and Siemens Gamesa 6.6-170.

All candidate turbines have been modelling with serrated tail edge (STE) blades. Noise emission data indicates the adoption of a STE reduces noise against non-STE blades by several decibels and would therefore represent best practice on blade noise control.

A terrain elevation heat map was provided in the subject report. The locality generally is relatively flat to undulating, being more elevated to the south.

[8] Discussions with the proponent during the previous audit process reveals that transformers may be integrated within the turbine structure and therefore form part of the noise curves and test data provided as source information for noise modelling. External to turbine sub-station transformers have not been included in noise predictions.

Assumptions, such as ground attenuation and the absence of tonality, appear reasonable based on the Standard's guidance and the auditor's experience with operational wind energy facilities.

Communications were held to clarify some aspects of the modelling process including adopted SPL, the maximum height of the blade tip, turbine hub height variances, tonal considerations within manufacturers' testing reports and mapping of NSLs. Previous communications were held relating to quality checks of modelling outcomes and background report relevance against compliance levels.

The source information was reportedly fed into the SoundPlan version 8.2 software model, adopting the ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors* inputs to predict noise levels surrounding the wind farm. The input parameters were specified for the model.

The Standard references the ISO 9613-2 as '*an example that has been shown to correlate well with measured data from wind farms*'.

Details of the auditor's review against the modelling process are provided within the verification protocol in Appendix 1.

4.1.5 Review of background noise assessments

Background noise was determined via monitoring in 2012, 2013 and 2017.

Background noise will be relevant in determining compliance if, and when, the wind energy facility achieves planning approval.

Background noise was found to be low at several locations during periods of wind speeds less than 10 m/sec which can correlate to the maximum sound power output from some of the candidate turbines.

Low background noise means that wind turbine noise may, at times, be clearly audible particularly when this coincides with hub height wind speeds above 8 m/sec.

The noise assessment report adopted the minimum applicable noise limit of 40dB L_{A90} under all wind speeds.

The auditor has assessed this report against a base limit of achieving 40 dB L_{A90} at all wind speeds up to and including 15 m/sec at all non-stakeholder properties within the Farming Zone.

4.1.6 Technical verification of the predictive noise assessment

The following items were evaluated by the auditor:

- methodology applied to conduct the assessment,
- base technical reports where input data was sourced,
- noise monitoring equipment and parameters used (as relevant for background),
- sound modelling programs employed, and
- verification that the assessment was conducted in line with the Standard.

A line- item review of technical considerations against items specified within the Standard is provided within the verification protocol (refer to Appendix 1).

The EPA guidelines [EPA, 2018] specify an additional item that warrants review, namely:

- *Review of identified potential noise impacts and any operational plans to manage the impacts (e.g. select turbines operating in reduced power modes during certain wind conditions) that are proposed as part of the WEF permit application*.

No operating nor management plans are attached to the noise assessment reports.

4.1.6.1 Cumulative Impact Considerations

Cumulative noise impact is relevant as there are a number of nearby existing operational WEFs and one approved and soon to be operational WEF. The nearest with potential to influence noise above the 30 dB L_{A90} contributory noise contour is the Dundonnell WEF. Modelling results indicate the predicted 30 dB L_{A90} contour lines from adjoining WEFs do not cross at any location including near any NSL. Under the Standard there is no discernible noise contribution that warrants consideration in a prediction assessment.

According to published guidance[9], if turbines are greater than 5.25x the tip height distance from a noise sensitive location, some attenuation due to wind effects would reasonably be expected (i.e. approximately 1.1 km in this instance). Beyond a 7.5x tip height distance between a noise sensitive location and a turbine, a reduction of >4 dBA would reasonably be expected for 'up wind' turbines. The modelling makes no allowances for up-wind locations and is therefore conservative for a NSL with a distance beyond 1.1 km to a turbine.

The Vestas 162-6.8MW model turbine noise is predicted to comply with the base noise limit of 40 dB L_{A90} with over 3 dB L_{A90} compliance buffer at any NSL under reasonable worst-case prediction methods. The candidate turbine with the highest noise predictions is the GE variant, which is predicted to comply by at least 1.4 dB L_{A90}.

A base noise compliance limit of 40 dB L_{A90} is therefore predicted to be achieved at all noise sensitive locations in the surrounds of the proposed WEF.

4.1.6.2 Topographical Influences

Topographical influences were reported to be integrated into the model based on the topographical information within the subject report.

The topographic map reveals a relatively flat terrain with no significant valleys nor concave environs over the majority of the areas in proximity to the WEF which may result in significant uncertainties associated with the modelling.

4.1.6.3 Noise Spectrum for Candidate Turbines

Confidential manufacturers' test data reports were provided and reviewed.

[9] UK Institute of Acoustics. A good practice guide to the application of ETSU-R-97.

The raw technical data on the turbines was confirmed to reflect data that was adopted into the modelling up to a wind speed of 15 m/sec which equates to a maximum SPL for all candidate WTGs.

Serrated tail edges are presented as an option and the proponent confirmed the selected turbine will have serrated tail edges to minimise noise. This is considered to represent best practice and has been adopted within the modelling.

Third-octave charts were provided. It was noted the data provided on two of the three candidate turbines was derived from a hub height slightly different to the nominated 115m proposed hug height. It is considered this marginal difference will not significantly impact compliance against the minimum 1 dBA margin predicted.

Noise predictive modelling has been conducted in the absence of any Special Audible Characteristics (SACs). It is noted the third-octave data suggests the potential for high frequency tones (i.e. above 2000 Hz) for some candidate turbines. The high frequency of the potential tone suggests atmospheric attenuation will render it inaudible at NSL distances. Best practice wind turbines can operate without SACs where sufficient distance is available between the turbine and an NSL.

All candidate turbines also appear to have the option of operating in a noise reduction mode if required.

4.1.6.4 Effect of Turbine Changes Should Micro-siting Occur

It is noted that micro-siting is typically permitted under planning approval. Given that this can result in turbines being repositioned closer to an NSL, micro-siting may present additional risk. A re-evaluation of compliance would become necessary if one or more turbines, in reasonable proximity to an NSL that could impact noise levels, are relocated closer as a result of micro-siting.

4.1.6.5 Uncertainties and Error Considerations

Uncertainties in the candidate turbine manufacturers data and associated modelling process become important where marginal compliance is predicted.

Within the manufacturers data no specific discussion of uncertainty is provided for the Vestas or SG candidate turbines. The GE manufacturers test data provides commentary on a possible uncertainty of 1.3 dBA, expressed as sigma T (total).

Product and testing reproducibility uncertainties were not discussed in detail in the subject report. MDA has made an allowance of 1 dBA to the SPL provided by the manufacturers to account for uncertainties in the data and modelling.

The auditor notes that modelling has predicted a compliance margin of over 1 dB L_{A90} for the GE candidate turbine, by at least 2.9 dB L_{A90} for the SG and 3.3 dB L_{A90} for the Vestas turbines.

This provides a level of confidence that compliance will be achieved even accounting for a degree of uncertainty.

From the auditor's experience, the distance to non-stakeholder noise sensitive locations being greater than 1.1 km without significant terrain effects, should provide sufficient distance to enable compliance to be achieved with the Standard's specified base noise criteria at all wind speeds when adopting a best practice WTG.

Ultimately, compliance will need to be demonstrated by actual monitoring should approval be granted.

5.0 Risk Assessment

The risk of impact on amenity was assessed qualitatively by direct reference to compliance with limits specified in the Standard. It is acknowledged that personal attitudes to noise can vary between individuals. However, the guidance provided in NZS6808:2010 has been adopted to assess whether the risk of harm from noise is unacceptable, namely:

> *Section 5.1.2. To provide a satisfactory level of protection against sleep disturbance, this Standard recommends a limit of wind turbine sound levels outdoors at noise sensitive locations of 40 dB LA90(10 min).*
>
> *Section 5.1.3. The wind farm noise limit of 40 dB LA90(10 min) outdoors recommended for protection of sleep is also appropriate for protecting the health and amenity of residents for most noise sensitive activities.*
>
> *Section 5.3.1 The wind farm noise limit of 40 dB LA90(10 min) in 5.2 is appropriate for protection of sleep, health, and amenity of residents at most 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 and night-time. A high amenity noise limit should be considered where a plan promotes a higher degree of protection of amenity related to the sound environment of a particular area.…*

Therefore, according to the Standard, noise levels that comply with the Standard are deemed to protect both human health and the amenity of a noise sensitive location.

The risk that predictive modelling outcomes were inaccurate was gauged against:
- the internal quality assurance process reported and previously discussed with the acoustic consultant,
- the experience of noise prediction modelling at other wind energy facilities,
- the level of uncertainty and confidence levels adopted in the modelling,
- technical information on monitoring, octave band SPLs and consideration of uncertainties, and
- the auditor's experience with noise levels from operational wind energy facilities elsewhere.

Predicted noise levels at the nearest NSLs were consistent with the auditor's expectations given the relatively flat to undulating terrain and the distance to the NSLs.

The low background noise as reported in the background report, means that whilst wind turbine noise may be compliant with the 40dB L_{A90} limit, it will be clearly audible at times.

Wind turbines adopting best practice design at distances beyond 1 km from a NSL can, and do, operate in the absence of special audible characteristics influencing noise compliance, including the absence of tones.

Data within the subject report was not able to definitively confirm the absence of wind turbine tonality. The data on the SG candidate suggested the potential for a high frequency tone greater than 2,000 Hz. However, high frequency noise will be attenuated within the atmosphere to non-audible levels within a few hundred meters from the turbine, and therefore not be audible at the nearest NSL. To mitigate risk, consideration should be given to selecting a turbine that is warranted not to produce a tone, as defined by NZS 6808:2010, at any non-stakeholder noise sensitive location.

In the absence of special audible characteristics, turbine noise is predicted to comply with the 40 dB L_{A90} noise limit at all NSLs (i.e. non-stakeholder dwellings) within the Farming Zone, and therefore presents an acceptably low risk of harm from noise.

A review of the Moyne Shire planning scheme (refer to Figure 1) identified that noise sensitive receptors outside the Farming Zone are also outside the predicted 30dB L_{A90} contour for all bar one location in a Rural Living Zone. Location U171 may fall within the 30 - 35 dB(A) contour under predictions against the GE candidate turbine at maximum SPL. At wind speeds of 6 m/second or less, as is required for a high amenity noise limit to be applicable (re. EPA Guidelines), these more distant NSLs are not considered to be at a compliance risk from WEF noise.

Under the DELWP guidelines, micro-siting (i.e. relatively small spatial changes in the precise location of the turbine typically by up to 100m) is permissible. Given that micro-siting changes towards a NSL have the potential to alter the noise setting, predictive monitoring is recommended prior to spatial changes that may increase noise exposure to encroach the 40 dB L_{A90} (10 min) limit at the nearest relevant noise sensitive location.

6.0 Results & Conclusions

The following conclusions are drawn based on the noise assessment report:

- I have found the process employed by the proponent designed to identify the relevant non-stakeholder properties with the potential to be impacted by wind turbine noise to have been rigorous. Reportedly, landowner agreements have been, or shortly will be issued, for all 'stakeholder' locations as marked with the prefix 'i' in the subject report.

- The noise assessment report adopts processes that are based on sound methodology and have been undertaken by skilled and experienced personnel. I have found the pre-construction noise report predicted maximum noise levels at NSL's from the wind energy facility's candidate turbines to have followed the Standard, and predictions are likely to be accurate when based on the technical information provided concerning candidate turbine type, sound power output and siting.

- Compliance with the base noise limit of 40 dB L_{A90} is therefore predicted at all non-stakeholder noise sensitive locations in the Farming Zone and 35 dB L_{A90} in more distant zones likely to be of high noise amenity, and consequently the risk of harm is deemed acceptable under the Standard and the relevant Regulation.

  This determination is relevant for the candidate turbine types, the siting plan used in the predictive modelling and the absence of special audible characteristics (SACs), including tones. It is important for compliance predictions that SACs are not present when assessed under the Standard, and the proponent should seek guarantees from the wind turbine supplier as to the same.

The auditor can therefore verify that the noise assessment report has been conducted in accordance with the Standard with respect to wind turbine noise predictions.

It needs to be emphasised that the 40 dB L_{A90} noise limit specified in the Standard (and adopted under DELWP guidelines and environmental Regulations) means that wind turbine noise may, at times, be readily audible and identifiable, particularly when moderate hub height wind speeds align with low background noise conditions.

7.0 Recommendations

It is recommended:

1. Should turbine positions vary because of micro-siting from marked locations towards a non-stakeholder's dwelling where compliance is predicted to be marginal (i.e. within 2 dB L_{A90} of the noise limit), an updated predictive noise compliance assessment should be completed before construction. This report should be independently verified prior to issue.

2. Should the landowner noise agreements not be ratified as is currently planned, the noise assessment report should be revisited and amended to accurately identify all relevant 'non-stakeholder' locations and confirm predicted compliance.

8.0 References

1. New Zealand Standard NZS 6808:2010 *'Acoustics – Wind Farm Noise'.*
2. Policy and Planning Guidelines for the Development of Wind Energy Facilities in Victoria, DELWP, November 2021.
3. EPA Publication 1692 Wind energy facility noise auditor guidelines. Conducting environmental audits of noise from wind facilities.
4. EPA Victoria, Wind Energy Facility Turbine Noise Regulation Guidelines (accessed via EPA webpage 08/08/22)
5. AS/NZS ISO19011:2019 *Guidelines for auditing management systems.*
6. ISO 1996-2:2017 *Acoustics – Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures.*
7. NZS 6801:2008 Acoustics- Measurements of environmental sound
8. Cherry Tree Wind Farm Pty Ltd v Mitchell SC & Ors (Red Dot) [2013] VCAT 521.

9. EPA, Victoria, Email Advice to Auditors 'Wind Energy Facilities – Applying/Assessing High Amenity' 25 October 2019.
10. Third octave noise emission EnVentus Vestas V162-6.8MW 50/60 Hz Document No. 0111-1246_02 (Confidential Issue)
11. Performance Specification EnVentus V162-6.8 MW 50/60 Hz Document 0114-3788 V02, 2022-03-31, Vestas. (Confidential Issue)
12. Technical Documentation Wind Turbine Generator Systems Cypress 6.0-164-50Hz Product Acoustic Specifications According to IEC 61400-11, GE Renewable Energy 2021-03-16
13. Developer Package SG 6.6-170, D2830475/016 - Restricted, Product Customer Documentation Siemens Gamesa Renewable Energy, 2022-07-08

APPENDICES

APPENDIX 1:
VERIFICATION PROTOCOL

WIND ENERGY FACILITY WIND TURBINE NOISE ASSESSMENT VERIFICATION PROTOCOL

Facility Mt Fyans Wind Farm, north of Mortlake, Victoria

Standard NZS6808:2010 Acoustics - Wind farm noise

Evidence

Mt Fyans Wind Farm Environmental Noise Assessment, Hydro Tasmania, Rp 001 R01 20190964, Marshall Day Acoustics Pty Ltd 15 Aug 2022

Mt Fyans Wind Farm Background Noise Report, Rp 002 2012102ML 20 July 2018

Audit of pre-construction noise assessment: Mt Fyans Wind Farm, G. Rinckes, Project Director Mt Fyans Wind Farm 4th August 2022 (re: noise sensitive locations confirmation)

Environmental audit report EA 001038, Pre-construction noise assessment report, Mt Fyans Wind Energy Facility, EnviroRisk, 2021

NZS specifications:

Section	Requirement	Comply	Observations/ Comments
Definitions	Measurement time: 10min accuracy 1% ie 6 secs		
	Noise Limit: not to be exceeded		
	Notional Boundary: A line 20m from any side of a noise sensitive location		
	Post-installation sound level: A weighted L90 centile level		
	Cut in speed typical: 4 m per sec. Shut down 25 m per sec		Cut in speed reported in manufacturers information range from 3 m/s, cut-out at 25 m/s. Maximum sound power levels range from 9 m/sec to 15 m/sec depending of the candidate WTG.
3.1	Metric for wind farm sound: A weighted L90 centile level i..e dB L90(10min)	Yes	This metric has been used within the noise assessment report.
3.2	Process: Figure 1		
	Determine location of 35 dB Contour	Yes	Modelling was undertaken using ISO 9613 propagation parameters within the SoundPLAN software (version 8.2). Predicted maximum noise levels were derived by the model. Predicted maximum noise levels were derived and tabulated for each NSL within at least a 3km distance from the nearest turbine and a noise contour map was plotted atop of aerial imagery. This is included in the subject report revealing all candidate turbine prediction maps modelled under the maximum SPL for each WTG.
	Determine wind farm noise limits	Yes	The report has adopted a base 40 dB LA90 limit for non-stakeholders in a Farming Zone. Background noise measurements confirm that the base limit is applicable for most NSL when the hub height wind speed is below 12 m/s. The EPA guideline confirmed by discussions with the EPA confirms there are no special circumstances nor special locations that would suggest a higher noise amenity than standard within a Farming Zone. There is a Rural Living Zone and the more distant General Residential zone within the township of Mortlake. It is noted location U171 is within the 30 dB(A) contour under predictions against the GE candidate turbine. Noise predictions elsewhere within this zone, and against other candidate turbines are <30 dB(A) and therefore would comply against a high amenity limit where it would be relevant. The noise assessment report adoption of a base standard for predictive modelling against NSL in the Farming Zone is appropriate.
	Refine predictions at each noise sensitive location	Yes	Included in the noise assessment report along with GPS locations for each NSL. A sample confirmed these as accurate. A ground truthing exercise involving aerial photos and car surveillance was conducted during a previous audit in 2020. Further confirmation was sought and received from the proponent that supports all relevant NSLs have been considered and are included in the noise assessment reports. The initial noise assessment report used the phrase that a noise agreement was being 'proposed'. The auditor sought clarification on these locations to confirm they are indeed 'stakeholders' (involved parties). The advice received was that some have agreements that have lapsed. The owners are reportedly likely to re-enter into an agreement but for the purpose of this verification, it is assumed they are NSLs and subjected to a standard noise compliance limit of 40 dB(A).

EnviroRisk

	Report	Yes	The subject report was issued by MDA in August 2022 noise assessment. An accompanying July 2018 background noise assessment report was referenced and cited by the auditor, as were candidate turbine sound power levels. Upon review of the manufacturer's information to support the noise assessment report further detail as to the SPL per octave frequency band was sought for the Vestas model and the proposed involved NSL and the planned maximum blade tip height. An updated report with this detail was provided.
	Post installation sound level measurements	NA	
4.1.1	Audibility is not an appropriate basis for setting noise limits. Limits based on Section 5.		
4.2	Reverse Sensitivity		
	Nomination of a 40dB wind farm sound level contour and the 35dB contour.	Yes	Predicted contour maps have been prepared and are included in noise assessment report.
5	**NOISE LIMITS** - designed to protect sleep disturbance whilst inside house		
5.1.2	Upper limit at residential location of 40 dB L90	Yes	This limit has been confirmed as being used for compliance predictions against the maximum sound power rating level provided from the manufacturers noise test data.
	(assumes 15 dB reduction indoors to <30 dB Leq)		
	Sleep protection also protects health and amenity.		
	C5.1.4. *The use of a background +5dB limit means that the wind farm sound may be the dominant sound heard at a noise sensitive location for a significant proportion of the time when the wind farm is operating* .		*Note: the site can have low background noise and the 40 dB LA90 limit may mean the wind energy facility is at times readily audible, particularly during low wind speeds (i.e. <9 m/s hub height) during the night period.*
5.2	Noise limit		*Note: the NZS acknowledges and states that at a noise level of BG + 5dB that 'the wind farm may be the dominant sound heard at a noise-sensitive location for a significant proportion of the time the wind farm is operating'.*
	Wind farm sounds (as L90 10 min) should not exceed background by more than 5 dB or a level of 40 dB LA90 10min, whichever is the greater at the notional boundary of any noise-sensitive location	Yes	Within the noise assessment report, 40dB LA90 10 min has been used as the compliance limit in all instances for predictions. Available background noise data for the night period indicates background noise less than 35 dB LA90 up to 8m/s and in locations with greater wind speeds (hun height). Given that maximum SPL can be experienced by 8 m/s for the GE and 10 m/s for the SG candidate turbines, it is prudent to assess all locations against the 40 dB LA90 limit and this has been undertaken within the acoustic report.
5.3	Secondary noise limit: only considered…		
	Background are commonly less than 25dB when predicted to exceed by 10dB or more	NA	40dB LA90 10 min has been used as the compliance limit for predictions within a Farming Zone. Background data suggests noise can be below 10dB lower than the base 40 dB LA90 limit at maximum power output wind speeds for some of the candidate turbines during the night period (i.e. Location U47 background noise of 30 dB(A) at 9 m/s 2017 derived night time period data with wind speed reference to 125m).
	Higher degree of protection of amenity required		All dwellings within the predicted 35 dB LA90 contour are located within a Farming Zone. There is no specific planning requirement that the auditor could identify that directly specifies a high amenity area in a Farming Zone within the Moyne Planning Scheme. A high amenity noise limit is discussed in the noise assessment report and is not considered applicable in the Farming Zone. According to the Cherry Tree VCAT decision and EPA guidelines (i.e. WEF Turbine Noise Regulation Guidelines) a Farming Zone is not considered a High Amenity Area unless the planning schemes specified otherwise e.g. provides an overlay. Accordingly, a standard noise amenity is appropriate for noise-sensitive locations within a Farming Zone and a higher degree of amenity protection is not required. There are other zones, including a Rural Living Zone, to the south outside the 35 dB LA90 contour. No detailed discussion is considered necessary in the subject report around compliance within these zones given they fall outside the predicted 35 dB LA90 contour and the limit would apply at lower wind speeds (i.e. 6 m/s or less as per EPA Guideline) where sound power outputs from the turbines are lower than that modelled.
	Planning rules dictate	Yes	No specific planning rules dictate a high amenity protection

EnviroRisk

	Only applies to locations within 35dB contour	NA	As no Rural Living zoned locations are within the 35 dB LA90 contour under maximum sound power level predictive modelling, compliance is extrapolated in this, and the more distant residential zone.
	Arithmetically average difference for all 10 minute intervals. If less than 8 dB secondary not justified	NA	refer above
5.3.2	Lowest stated level is 35dB or 5db above background if above 35db L90 10 min.	NA	The Farming Zone land is not been considered high amenity unless specified in a planning scheme as high amenity. i.e. Cherry Tree VCAT decision and EPA Regulatuons Guideline. Background monitoring data is not required if base noise limits are selected for the predictive noise assessment - and this is the case. Accordingly the background noise monitoring report has not been reviewed in detail. If at a later date it is planned to use background noise data to raise compliance limits with increased wind speeds, it will be necessary to ensure the data attained is representative and relevant to the NSL location.
	Generally only applies when wind speed at hub height is less than 6m per sec	NA	See comments above relating to EPA Guideline confiming this.
			The subject report mentions proposed stakeholders. Clarification was sought as to these locations where an agreement entering these locations as wind farm stakeholders exists. This established the following dwellings do not currently have a current agreement: i18, i12, i22, i23, i16, i17. A review of predicted noise at these locations confirms noise levels below 40 dB(A). If agreements to not come to fuition, and these become NSLs, compliance with the base standard noise limit is still being predicted.
5.4	**SPECIAL AUDIBLE CHARACTERISTICS**		
5.4.1	Considerations to be given to and special audible characteristics of the wind farm sound when comparing levels against noise limits.	Yes	Data associated with a similar 'technology' turbine support absence of any tonal characteristics. Third-octave data has been reviewed and supports no tonality below 2,000 Hz. There is potential for a tone to be present above this frequency. However, high-frequency noise will be attenuated within the atmosphere to non-audible levels within a few hundred meters from the turbine, and therefore not audible at the nearest NSL. The auditor has access to a test report on a lower power output Vestas turbine that supports no tones present. A specification of no tonal audible characteristic needs to be confirmed and is suggested to be warranted with the manufacturer, with the final selected turbine.
5.4.2	Tonal, impulsiveness, amplitude modulation shall be adjusted by arithmetically adding up to +6dB to the measured level,	Yes	No special audible characteristics are considered applicable. This should be warranted in the turbine supplier agreement.
	If there is doubt about the presence of tonality, the following two methods provide an objective measure for tonality. The simplified test method may be carried out using one-third octave-band measurement equipment. The reference test method requires the use of narrow-band analysis. If the simplified method does not indicate tonality, it may still be necessary to use the reference method to confirm the presence or absence of tonality. In addition, the reference method can properly assess modulated tones where the tone is varying or where there are complex tones with many closely-spaced tone components. However, the method does not address wind farm amplitude modulation	NA	
	No appropriate objective test for amplitude modulation has been standardised. If a local authority enforcement officer or an acoustics advisor to a local authority considers that a wind farm creates sound with clearly audible amplitude modulation at a noise-sensitive location, an adjustment of +5 dB shall be applied to the wind farm sound level at that location for the wind conditions under which the modulation	NA	
	In making an assessment under B3.1, modulation special audible characteristics are deemed to exist if the measured A-weighted peak to trough levels exceed 5 dB on a regularly varying basis, or if the measured third-octave band peak to trough levels exceed 6 dB on a regular basis in respect of the blade pass frequency	NA	

	Where special audible characteristics are confirmed, the value of the adjustment (k2) shall be 5 dB for that sample, provided that where the reference test method for tonality is used, the value of the adjustment (k2) shall be between 1 and 6 dB where justified. The adjustment (k2) shall only be applied to samples in which special audible characteristics are present. Only one adjustment value (k2) shall be applied to each measurement, even if more than one type of special audible characteristic is present.	NA	
5.4.3	Conducted in accordance with Appendix B of the NZS.	NA	
	Cumulative adjustments shall not be made. Max adjustment is 6 dB.	NA	
5.5	**Other Factors**	NA	
5.5.1&.2	Ultrasound and infrasound frequencies considered to be outside normal range of human hearing. Paucity of evidence to set a limit more stringent that recommended in Sect. 5.2.	NA	Commentary only.
5.6	**Cumulative Effects**		
5.6.1	Limits apply to cummulative levels of all wind farms.	Yes	There are three (3) other approved nearby wind farms including the northeast Dundonnell Wind Farm. The subject report includes commentary and modelling to predict whether the 30dB contour overlaps noise prediction contours. It was found not to overlap at any NSL and therefore has no discernible influence on noise levels. Furthermore, the direction of the WEF is essentially the opposite direction which means modelling contour predictions are conservative.
5.6.2	Staging of a wind farm is not to affect pre-wind farm background readings.	NA	
5.6.3	Where a new wind farm will impact on the same noise sensitive locations as an existing wind farm, the assessment of background sound should exclude wind farm sound generated by all existing wind farms.	Yes	Background noise monitoring has been conducted prior to any wind farm being operational. However, any additional monitoring used to support increases in the compliance limit will need to consider existing WEFs.
5.6.4	If predicted wind farm sound levels for a new wind farm are at least 10dB below an existing wind farm then the cumulative effect shall not be taken into account.	Yes	Discussion on modelling outcomes provided in the report.
5.7	**Uncertainty** (refer Appendix C below)	Yes	Refer to discussion below.
6	**Predictions**		
6.1	**Methods.** Predictions to identify levels greater than 35dB LA90(10min) at 95% rated power. In octave bands from at least 63Hz-4KHz, and against wind speed (hub speed) and 35 and 40 predicted contours are shown.	Yes	A review of the subject report coupled with communications with the acoustic consultant supports the reasonable worst-case noise spectra were selected for modelling. Predictions have been made for turbines at wind speeds that correlate with maximum sound power output. This generally equated to Application Mode AM 0 turbine operations for the SG, 107 dBA mode for the GE candidate WTG and PO6800 specifications for the Vestas. A copy of each manufacturer's report was requested and reviewed by the auditor (and referenced). The frequency band spectra and a noise test report have been confirmed as that specified by the manufacturer with an additional 1 dB added to each octave band centre frequency SPL as reflected in Table 7 data within the subject report.
6.2	**Sound Power Levels.** Obtain from manufacturer obtained in accord with IEC 61400-11	Yes	Manufacturer sound power levels were reported. The test reports provided specified results were stated to be derived in accord with the IEC 61400-11 and -22 standards (Vestas) and the GE and SG (ed. 3 2012) manufacturers report reference IEC 61400-11.
	Requires SPL to be measured against a wind speed of 10m AGL converted to Hub Height	Not determined	It is not clear how the conversion progressed and it is not specified in the noise assessment report. However, modelling has assumed SPL at turbine hub height (115m) wind speeds. Manufacturers' manuals specify SPL are valid at hub height.
7	**MEASUREMENTS**		
7.1	**Locations**		
7.1.2	(a) Has the operator chosen to adopt a noise limit of 40 dB for all wind speeds?	Yes	See comments in Sect 3.2 above
	(b)Has the operator agreed to conduct on/off testing if required.	NA	
7.1.3	Have noise sensitive locations been clearly identified	Yes	The identification process was undertaken by Hydro Tasmania and involved what is considered to be a rigorous checking and verification program. A site tour during 2020 within the 35dB contour identified no habitable dwellings outside identified stakeholder properties. Due to the difficulties in ground truthing all NSLs the auditor has sought confirmation from Hydro Tasmania that the report mapping is complete and a communication has been received.

	b. Does the auditor consider all noise sensitive locations are appropriately captured	Yes	As best reasonably within or near the predicted 35dB contour. Written advice received from the proponent supports the NSLs as illustrated in the noise assessment reports are complete. This advice is Appended to this report.
7.1.4	Have background sound level measurements been appropriately established and representative of the group: proximity and character	Yes	Background noise to the south was found to have extraneous noise interference (i.e. U51). The most conservative noise limit has been adopted for the pre-construction compliance assessment (refer to the commentary in Sect 5.2 above).
	When and where were they taken.	Yes	3x north area and 1x south- yet data limitations occurred due to potential transient noise sources.
	Were predictions at 95% rated power made in deriving 35 dB LA90 (10 min.) contour background locations	Yes	Properties selected for background assessment in close proximity to the 35dB contour.
	If there are no noise sensitive locations within the 35dB LA90(10min) predicted wind farm sound level contour then background sound level measurements are not required.	Yes	There are NSL within proximity of the 35 dB LA90 predicted contour. Background noise levels were triggered and monitoring is undertaken. A low background for wind speeds <9m/s confirmed the base limit of 40 dB LA90 was appropriate for the pre-construction compliance verification.
7.1.5	If there are a group of noise-sensitive locations… locations selected are representative of the group in terms of proximity and character	Yes	Arguably the locations are representative. Southern locations are closer to town and the highway.
7.1.6	Selected on wind farm side of buildings. >3.5m from significant reflecting surfaces. Not near streams nor watercourses where possible (or substantiated if not)	Yes	Illustrations and pictures of monitoring locations were provided in the Background Noise Assessment report.
7.2	**SOUND DATA**		
7.2.1	Made during a representative range of wind speeds and durations from cut-in to rated power.	Yes	Predictions included from 4 - 15m/s. Max. SPL experienced by 9 m/s for the SG and GE candidate WTG and 15m/s for Vestas. Increased background noise is indicated in the background noise report when winds exceed 12 m/s which will potentially influence the compliance limit.
	For dual speed turbines, include cut-in wind speed for the higher generating capacity.	NA	
	The number of measurements made are to be sufficient to obtain dependable correlations between sound levels and wind speeds	Not Determined	A complete review of the background noise data was not required given the assessment is made against the minimum (base) noise limit criteria.
C7.2.1	Minimum of 10 days continuous monitoring >1440 data points to be plotted against wind data.	Yes	Overall data points for background measurements exceeded the 10-day requirement, and separation of the night period was made. Several of the background locations had over 1440 data points for the night period alone, yet U47 was marginally shy of the 1400 points for the night period (i.e. 1,151 night time; 3,368 data points all time).
	Further measurements if: data points is not uniform between min. and max. for each 1m/s interval; a lack of sparseness exists for one or more wind conditions; seasonal variations.	NA	Considered to be accurate. A limit of 40dB applies up to moderate wind speeds i.e. up to 12m/sec at location U47 during night period.
7.2.2	Sound measured in accordance with NZS6801		
	Section 7.1.5 of NZS 6801 states 'the provisions of this section do not apply for the purposes of NZS 6808'.		
	Instrument used shall meet requirements of Section 5 of NZS6801.	Yes	Type 1/ Class 1 01dB Cube & DUO reported to meet AS 1259.2-1990. Calibration details provided.
	Measurements time intervals of 10 minutes to be used.		
7.2.3	Microphone protected from extraneous wind sound by wind shield in accordance with NZS 6801.	Yes	Stated to comprise inner solid primary wind shield and outer secondary large diameter hollow wind shield.
	Cables etc. secured to avoid extraneous wind noise.	Yes	Pictorial summary indicates so.
	Class 1 meter may be necessary so that sound levels at low wind speeds can be accurately measured.	NA	
7.2.4	Extraneous sounds 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 set.	NA	Background monitoring. Rain events stated to be removed.
	Streams and tree induced background sound may be considered part of the overall background at the locations. Traffic lulls need to be included.	Yes	
	Octave band spectrum analysis and resident logs may be used.	NA	
7.3	**WIND DATA**	N/A	N/A - considered relevant only for post construction noise.
7.3.1	Concurrent measurements of wind speed and direction taken from a known height preferably the wind turbine hub.		

	Monitored over 10 minute intervals syncronised with SLM time intervals and average values found for every interval		
7.3.2	If wind speeds are not taken from hub height… predictions may be used from wind shear relationships: at least two heights		
	Wind flow modelling may be required since wind measurements are not representative.		
7.3.3	Same location and height used for before and after installation where not impacted by turbines.		
7.4	**BACKGROUND MEASUREMENTS**		
7.4.1	Background SLM to be plotted against the hub-height wind speeds to obtain a scatter plot	Yes	Plots provided for 4x locations based on 2018 background monitoring. However, one location has a question mark on whether it is representative due to extraneous noise.
	Plot to be examined to establish whether a singular regression relationship is evident.	Yes	
	If there are markedly diffferent groups, separate scatter plots may be required for different conditions, including wind directions and times of day.	Yes	Night period background included.
7.4.2	Find the regression curve that gives the best correlation coefficient between the sound level and wind speed for each scatter plot and use it to describe the average background sound level at different wind speeds.	Yes	
	Sparseness of data or obvious outliers should not be allowed to unreasonably influence the regression curve.	Yes	
	Removal of outliers may be required.	Yes	If influenced by extraneous noise eg diesel generator noted. Local wind speeds greater than 5 m/s were removed from the data set (due to potential wind-induced noise on the microphone). Insect noise was reportedly not removed prior to regression analysis.
	Has a bin analysis procedure IEC 61400-11 been used? If so is it reasonable and appropriate.	NA	
7.4.3	If there is a poor correlation between wind speed and sound level, further investigation of wind conditions should be undertaken e.g. wind flow modelling,local knowledge, site observations or local wind monitoring	Yes	Charts revealing the correlation between wind speed and background noise were presented in the Background noise assessment report. Correlation coefficients were provided in charts. There were no recent background data sets available for locations to the east and west. The most stringent noise limits in the central area should be used if no additional readings are taken. A 40 dB LA90 10 min limit at up to 12m/sec wind speed would be reasonable.
7.4.4	Where multiple regressions are indicated and several regression curves obtained, noise limits should be set on the basis of each regression curve derived. Where not practical, use the most stringent regression curve with lowest SL.	Yes	Multiple regression lines were not prominent during the night period data analysis for the central northern locations. Location U51 was not considered suitable to set noise limits as a result of non-background noise artificially increasing the L90 noise level.
	Where the lowest BG is when wind is blowing from the noise sensitive location to the wind farm, it is reasonable to consider additional attenuation that may occur.	acknowleged	Wind direction is not specified in the Background Monitoring report. However given the location with no high background generating source away from Hamilton Highway (e.g. no ocean nearby), the direction may not be so relevant for modelling purposes provided a conservative approach is taken.
7.5	**POST INSTALLATION MEASUREMENTS**	N/A	N/A - considered relevant for post construction
7.5.1	Measure where practical at the same locations where background SL were determined.		
7.5.2	Scatter curves shall be drawn of SL against wind speed and regression curved obtained (as per 7.4)		
7.5.3	Capture both the wind farm sound and the background sound.		
	The contribution of the background sound shall be removed from the regression curve drawn in S. 7.5.3 at each integer wind speed.		
7.5.4	An assessment for any special audible characteristics shall be undertaken (S. 5.4) covering the range of operational wind speeds.		
7.6	**COMPLIANCE ASSESSMENT**	N/A	Relevant for post construction noise assessment
7.6.1	The 35dB wind farm SL contour shall be predicted and measurements made within this contour.		The 35dB sound level contour has been predicted and included within the subject reports.

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7.6.2	Compare the best-fit regression lines of the background SLs and the regression curves of the wind farm sound levels adjusted for any special audible characteristics at each noise-sensitive location.		
	Adjustments apply to wind farm speeds at which it is assessed and applied before comparison with the noise limit.		
7.6.3	If background SLs were not measured prior to installation, it may be necessary to obtain SLM for limited periods at critical wind speeds. These may be for a limited range of end speeds and directions while the wind turbines are not operating, i.e. on/off testing to get a representative number of measurements		
	Turbines 10dB lower that the higher contribution need not be turned off for testing.		
7.6.4	Compliance at one period does not negate the need for further testing.		
	Note: Section 7.1.2 of NZ6801-2008 states: *'To demonstrate compliance, measurements should be appropriately adjusted to slightly positive propagation conditions which are the upper limits of the meteorological window* '. However, section 7.1.5 states '*the provisions of this section do not apply for the purposes of NZS 6808'*.		
7.7	**ON/OFF TESTING**	N/A	
	Often an appropriate method for measuring small wind turbine sound levels.		
8	**DOCUMENTATION**		
8.1	**Predictions**		
	Any report of wind farm sound level 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;	Yes	The topography is illustrated by a heat map (not contours). However, it does reveal elevation. The turbine locations are indicated as are noise-sensitive locations. Reportedly this topographical data was fed into the model.
	(b) Noise sensitive locations for which wind farm sound levels are calculated;	Yes	Both stakeholder dwellings and non-stakeholder noise sensitive loctaions are included on the map and are marked differently for ease of identification.
	(c) Wind turbine sound power levels;	Yes	Included for the candidate turbines selected as representative of the turbine likely to be installed.
	(d) The make and model of the wind turbines;	Part	Turbines are nominated with make and model - noted these are candidate and not the final turbine selected.
	(e) The hub-height of the wind turbines;	Yes	Specified at 115m; Data from manufacturers testing state 112m, 115m and 119m and are considered representative.
	(f) Distance of noise sensitive locations from the wind turbines;	Yes	Illustrated on a scaled map with North direction marked. A table is also provided with the distance to the nearest WTG from a NSL.
	(g) Calculation procedure used;	Yes	Attenuation of noise is reported to follow ISO 9613 Acoustics- Attenuation of sound during propagation outdoors. This is referenced in NZS 6808:2010 as an appropriate prediction method (Appendix D).
	(h) Meteorological conditions assumed;	Yes	10 degrees C and 70 percent humidity used which is reasonably representative of low atmospheric attenuation conditions.
	(i) Air absorption parameters used;	Yes	Attenuated by frequency octave band nominated to be applied as per Appendix K of subject report. Octave band attenuation factors include 0.12 dB/km for 63Hz to 3.66dB/km for 1kHz.
	(j) Ground attenuation parameters used;	Yes	G=0.5 with rationale described in Appendix H, and specified in NZS 6808:2010 as a default.
	(k) Topography/screening assumed	Yes	As per topographical terrain heat map. Limited near field adjustment at >35dB
	(l) Predicted far-field wind farm sound levels.	Yes	Predictions occur to 30dB(A) within the report and absolute predicted noise levels within Appendix J.
			The model assumes downwind +/-45 degrees. Inversions are not considered due to wind turbines unlikely to be not operating or at a low power output speed during inversion conditions.
	Detail (note: not specified in standard but applicable for modelling):		
	Turbine Sound Power Levels	Yes	SPL provided for 3x candidate turbines, Vestas V162-6.8MW, General Electric Cyprus (GE) 6.0-164 and Siemens Gamesa (SE) 6.6-170. However, the final turbine type is yet to be confirmed.

	Micro Siting Allowance (noting 'model planning permit conditions allow up to 100m change if nominated).	N/A	Likely to be 100m as per DELWP Guidelines. However, locations are reportedly not as yet fixed.
	Identification of relevant noise sensitive locations - process and outcomes	Yes	The process reportedly included: • Purchase and evaluation of very high-resolution satellite imagery showing the location of buildings/ structures (resolution sufficient to reveal buildings with external water tanks, garages, driveways etc. used to evaluate signs of a habitable dwelling). • A title search of parcels with all identified dwellings to confirm ownership. • Meeting with the majority of neighbours within 4 km of the project, including confirming the use of buildings (i.e. dwellings distinguished from sheds), the status of houses (habitable or otherwise), and future development plans for dwellings. • GIS information of the location of all buildings connected to the electricity network. The outcome reportedly being one dwelling in the area was not connected to the network.
	SACs- Tonality allowance at various wind speeds	Yes	Candidate turbine under best practice design should not have any special tonal characteristics and this is specified in the subject report.
	Noise level (SPL) with respect to varying wind speed	Yes	Provided SPL for each candidate turbine including octave band SPL.
	Best practice blade design	Yes	Modelling assumes the blade will be a serrated tail edge. If blade changes are made on the turbines (or an alternative turbine to that modelled selected), a revised noise assessment should be conducted and a discussion on best practice low noise blade design incorporated into the noise assessment report.
	Cumulative influences	Yes	The cumulative impact is considered in the subject report and found to be <30dB at the closest points. No overlap of 30dB prediction contours and therefore no cumulative contribution to the 40dB L90 limit.
	Ground absorption ratio 'G'	Yes	G ratio =0.5 reasonable approach given the terrain; particularly the southern aspects.
	Predictive model used	Yes	SoundPLAN version 8.2; an acceptable and internationally used model.
	Results discussion - non stakeholder sensitive locations	Yes	Compliance was evaluated via the 40dB L90 contour with consideration too of the locality of the 35dB contour. The auditor also evaluated the Rural Living Zone (one NSL was within the 30 dBA contour under the GE candidate under maximum SPL conditions.)
	Results discussion - Stakeholder Properties	Yes	Included in subject report, yet outside scope of the Standard.
	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;	Yes	Appendix C of background report, Calibration detail provided.
	(b) The location of sound monitoring positions;	Yes	3x to the north; north-west, north and central north-east, 1x south (although data not used due to local noise interference that would have adversely increased background).
	(c) Description of the anemometry equipment including the height AGL of the anemomometer	No	Weather station positioned at location U47 and anemometers to 79m and analysis to extrapolate wind to 125m height. (It is noted the verification hub height is at 115m and this will therefore need adjustment if it is to be used to set compliance limits outside the 40 dB LA90)
	(d) Position of wind speed measurements;	No	Earlier monitoring was using a 79m hub height. Data from low wind speeds would be used for reference. 2017 data is based on wind speeds at a 125m hub height. See comment about representativeness above. The absence of this detail does not detract from the noise assessment predicting compliance against a base noise limit of 40 dB LA90 at all wind speeds and for all candidate WTGs.
	(e) Time and duration of the monitoring period;	Yes	7 weeks nominated in total. Data charts suggest equipment operated between 10/8 - 27/9/17 at U17, U31, U51 and 10/8 - 12/9/17 at U47
	(f) Averaging period for both sound and wind speed measurements;	Yes	For the sake of conservatism, an assessment against a 40 dB LA90 should be adopted for the predictive compliance assessments. This has been the case in the acoustic reports.

	(g) Atmospheric conditions: the wind speed and direction at the wind farm position & rainfall	Not determined	Wind direction and rainfall were not reported but stated that rainfall periods were evaluated by the weather station and 'filtered' (removed) as part of the derivation of the regression line process.
	(h) Number of data pairs measured (wind speed in m/s, background sound in L90);	Yes	Provided in Tables within the Background Noise Report.
	(i) Description of the regression analysis; and	Yes	As above
	(j) Graphical plots showing the data scatter and the regression curves	Yes	Total and night period only backgrounds have been reported.
8.3	**COMPLIANCE ASSESSMENT**	NA	Relevant to a Post Construction Noise Assessment
	Any report of wind farm post-installation sound level measurements and compliance assessment, other than on/off tests, made in accordance with this Standard shall refer to this Standard and provide the following:		
	(a) Description of the sound monitoring equipment including any ancillary equipment		
	(b) A statement confirming the use of A-frequency-weighting;		
	(c) The location of sound monitoring positions;		
	(d) Description of the anemometry equipment including the height AGL of the anemometer		
	(e) Position of wind speed measurements;		
	(f) Make and model of the wind turbines;		
	(g) Number of operational wind turbines;		
	(h) Time and duration of monitoring period;		
	(i) Averaging period for both sound and wind speed measurements		
	(j) Atmospheric conditions: the wind speed and direction at the wind farm position & rainfall		
	(k) Number of data pairs measured (wind speed in m/s, sound in L90);		
	(l) Description of the regression analysis;		
	(m) Graphical plots showing the data scatter and the regression lines;		
	(n) Graphical plots showing the data scatter and the regression lines for both the background and the wind farm in operation.		
	(o) Assessment of special audible characteristics; and		
	(p) A statement that the wind farm complies with relevant limits – or not – as determined from the results of the measurements		
Other	No noise complaints have been recorded	NA	
	Previous Assessments	Yes	A previous audit of a noise assessment report was conducted by the auditor in September 2020 and updated in September 2022. This audit was on candidate WTG of 4.5 & 5.7MW ratings. This verification was made on a lower number of overall turbines but of a higher power rating and larger blade diameter for the candidate WTG.
Appendix C	**Uncertainty**		

	It is good practice to state the uncertainty and confidence level for all sound levels determined in accordance with this Standard. Uncertainty should be determined in accordance with the procedures in Craven and Kerry (2001). These procedures involve determining the standard uncertainty for every source of uncertainty in the measurement/assessment process and summing these standard uncertainties in quadrature (root sum of squares) to obtain the combined uncertainty. If a source of uncertainty is assumed to have a normal distribution, standard uncertainty is related to standard deviation, but this is not always the case and rectangular distributions are also common. *When comparing a sound level with an applicable noise limit, the sound level should be deemed to comply if the sound level is equal to or less than the noise limit. It should be deemed not to comply if the sound level is greater than the noise limit, regardless of the uncertainty. Where compliance or non-compliance is marginal and contested, steps should be taken to reduce the uncertainty, where practical.*	Part	Appendix H of the subject report discusses aspects associated with the model. It also makes mention of uncertainty margins, although no specific discussion of uncertainties in the manufacturers supplied information used as source data is made. The auditor notes that GE provides an estimate of total uncertainties (reported as sigma T) equating to 1.3 dB. Included in the subject report is a 1 dB addition made to the SPL provided by the manufacturers on the candidate turbines as a measure of conservatism. The allowance is considered reasonable. Against this is the predicted maximum noise level under reasonably conservative assumptions (eg NSL downwind from all WTG) is over 1 dB below the compliance limit using the candidate turbine with the highest reported SPL i.e. GE, (i.e. locations U17 = 38.6 and U47 = 38.5 dBA respectively). All candidate turbines are predicted to comply with the standard noise compliance limit. Additionally, the subject report stresses the reliance on imperfect data given the turbine type has yet to be selected. A recalculation should follow the selection of a final turbine not within the candidate list or should the blades not have serrated edges. Furthermore, the assessment should be recalculated should the location of any turbine vary with micro-siting allowances towards an NSL which potentially will raise noise levels by >1dB. (i.e. maximum will be potentially increased to 39.6 dB LA90 or greater).
	Definitions (from NZS6808:2010)		
	Noise Sensitive Location: The location of a noise-sensitive activity, associated with a habitable space or education space in a building, not on the wind farm site. Noise-sensitive locations include: (a) Any part of land zoned predominantly for residential use in a district plan; (b) Any point within the notional boundary of buildings containing spaces defined in (c) to (f) (c) Any habitable space in a residential building including rest homes or groups of buildings for the elderly or people with disabilities, papakainga and marae, excluding habitable spaces in buildings where the predominant activity is commercial or industrial. (Residential buildings designed for permanent habitation on land zoned for predominantly rural or rural-residential use are not classified as commercial or industrial for the purposes of this Standard); (d) Teaching areas and sleeping rooms in educational institutions, including public and private primary, intermediate, and secondary schools, universities, polytechnics, and other tertiary institutions; (e) Teaching areas and sleeping rooms in buildings used for licensed kindergartens, childcare, and day-care centres; and (f) Temporary accommodation including in hotels, motels, hostels, halls of residence, boarding houses, and guest houses. **In some instances, holiday cabins and camping grounds might be considered noise-sensitive locations. Matters to be considered include whether it is an established activity with existing rights**.	NA	Noise has also been predicted at 'involved party' (i.e. stakeholders) dwelings. The highest noise being predicted at location i24 being approximately 640m from the nearest turbine. Noise predictions under the GE candidate turbine are 43.7 dBA, suggesting the noise will meet Regulation and planning guideline limits.
	Commentary of note in NZS: *Wind farm sound may be audible at times at noise-sensitive locations, and this Standard does not set limits that provide absolute protection for residents from audible wind farm sound. Guidance is provided on noise limits that are considered reasonable for protecting sleep and amenity from wind farm sound received at noise-sensitive locations.*		
	Other commentary of note: *Background noise is a combination of sounds including tree leaf and grass rustle, crickets, insects, frogs, birds, dogs, cattle, sheep, distance traffic (car and air) and even wave motion. When a source, such as turbine noise, is introduced the background noise level may increase.* *The addition of a new source with a noise level 10dB below the background would increase the noise to a new background 0.4dB higher.* *If the two sources have the same noise level then an increase of 3.0dB results. Therefore if the background is 35dB and the turbine is also 35dB, the resultant noise is 38dB.* *To increase the L90 by 5dB, the new turbine-based source would need to be 3.3dB above the previously confirmed background.*		

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WIND ENERGY FACILITY WIND TURBINE NOISE ASSESSMENT VERIFICATION PROTOCOL

Based on relevant Standard, Planning Permit Condition or DELWP Guideline (as applicable to the review scope).

DELWP Guideline - *Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria, November 2021*

Evidence Mt Fyans Wind Farm Environmental Noise Assessment, Hydro Tasmania, Rp 001 R01 20190964, Marshall Day Acoustics Pty Ltd 15 Aug 2022
Mt Fyans Wind Farm Background Noise Report, Rp 002 2012102ML 20 July 2018
Audit of pre-construction noise assessment: Mt Fyans Wind Farm, G. Rinckes, Project Director Mt Fyans Wind Farm 4th August 2022 (re: noise sensitive locations confirmation)

Section	Requirement	Comply	Observations/ Comments
5.1.2			
a) Noise	A wind energy facility must comply with the noise limits in the New Zealand Standard NZS 6808:2010 Acoustics – Wind Farm Noise (the Standard).	Yes	
	The Standard specifies a general 40 decibel limit (40 dB LA90(10min)) for wind energy facility sound levels outdoors at noise sensitive locations, or that the sound level should not exceed the background sound level by more than five decibels (referred to as 'background sound level +5 dB'), whichever is the greater.	Yes	
	A limit of 45 decibels is recommended for stakeholder dwellings (taken to mean LA90). A stakeholder dwelling is a dwelling located on the same land as the wind energy facility, or one that has an agreement with the wind energy facility to exceed the noise limit.	NA	Noise predictions support stakeholders are outside the 45dB contour. However, as this limit is not a NZS 6808: 2010 (i.e. Standard) requirement it is therefore not within scope of a S53V risk of harm audit.
	Under section 5.3 of the Standard, a 'high amenity noise limit' of 35 decibels applies in special circumstances. All wind farm applications must be assessed using section 5.3 of the Standard to determine whether a high amenity noise limit is justified for specific locations, following procedures outlined in clause C5.3.1 of the Standard. Guidance can be found on this issue in the VCAT determination for the Cherry Tree Wind Farm.	Yes	A high amenity noise limit is discussed in the noise assessment report and is not considered applicable in the Farming Zone. Communications with EPA on planning scheme interpretation has resulted in Advice to Auditors (25 October 2019). According to the Cherry Tree VCAT decision and EPA Advice, a Farming Zone is not considered a High Amenity Area. Accordingly the process followed in the noise assessment report against a standard noise amenity is appropriate within the Farming Zone. A high amenity limit is potentially applicable in the Rural Living, Residential and Township Zones. NSL's in these zones have however been predicted to be beyond the 35 dB contour and therefore in compliance with a high amenity limit should it be applicable.
	The assessment must be made without relying on noise reduction operation modes to achieve compliance.	Yes	
	Measurement and compliance assessment methods are set out in the Standard	Yes	Compliance predictions have been assessed to be based on sound methodology and by competent personnel. Whilst the reviewer has not undertaken any specific modelling themselves, indicative calculations performed on distance and ground attenuation aspects suggest noise predictions are realistic. All locations identified in the subject report indicate that compliance can be achieved (if the facility is constructed in locations specified and adopt a turbine type modelled).

EnviroRisk

	Clause 52.32-4 requires an environmental auditor appointed under Part 8.3 of the Environment Protection Act 2017 to prepare a report that verifies if the acoustic assessment undertaken for the purpose of the preconstruction (predictive) noise assessment report has been conducted in accordance with the Standard.	Yes	
	This report should be thorough but concise. The report must have adequate detail including an annexure listing all documents examined or relied upon to permit any reader to follow the deliberations that the auditor undertook in forming their view.	Yes	
	An EPA appointed auditor is expected in undertaking any function to apply sound engineering and audit practices, behaving in an ethical manner upholding the reputation of the "audit system" and adhere to the wording and intent of relevant guidelines. EPA has guidelines detailing the duties and responsibilities of an EPA appointed auditor.	Yes	The auditor has under the work in accordance with the Environmental Auditor Guidelines.
Auditor notes.	*Micro siting permits relocation of turbines by up to 100m. Has this been taken into consideration within modelling?*	No	Micro-siting is not specifically mentioned in the acoustic report. However, with the 1dB margin added to account for modelling uncertainties, micro-siting of the occassional turbine towards a NSL is not expected to result in a non compliant situation unless more than 1 turbine is moved closer to a NSL. If a combined noise can exceed 1dB a re-evaluation of compliance is recommended.

APPENDIX 2:

COMMUNICATION RELATING TO THE IDENTIFICATION OF NOISE SENSITIVE LOCATIONS

4 August 2022

Stephen Jenkins
EnviroRisk Management Pty Ltd
PO Box 183
Lara VIC 3212

Dear Stephen,

Audit of pre-construction noise assessment: Mt Fyans Wind Farm

Marshall Day Acoustics (MDA) was engaged by Hydro Tasmania (then the proponent of the Mount Fyans Wind Farm) to undertake preliminary and final preconstruction noise assessments for the Mt Fyans Wind Farm in 2015.

From 2015 through to the submission of the planning application for the Mt Fyans Wind Farm project in 2018 Hydro Tasmania and its consultants (including MDA) undertook a thorough process to map and refine the location of noise sensitive locations outside of the wind farm and stakeholder dwellings within the site through use of aerial imagery and site visits.

The accuracy of the locational data was updated several times as a result of this process. At the time of submitting the planning application the location of both stakeholder dwellings and noise sensitive locations outside of the wind farm was accurate and consistent with the requirements of the NZS 6808:2010.

Since the submission of the planning application in 2018, the location of any new noise sensitive activities or stakeholder dwellings has been reviewed periodically through use of more recent imagery and site surveys. As of the 4th of August 2022, no changes to the data have occurred from this review process.

The MDA Mount Fyans Wind Farm Environmental Noise Assessment (August 2022) identified and mapped all stakeholder and non-stakeholder premises that fall within the mapped 30dB(A) predicted noise level contour.

Yours sincerely

Giles Rinckes
Project Director
Mt Fyans Wind Farm
Ph: 0427 095 297
E: giles.rinckes@mtfyanswindfarm.com.au

APPENDIX 3:

LOCATIONS TOURED

Appendix 3

Site Tour of Terrain and Select Sensitive Receptors - Locations

Descriptor	Location (August 2018)	Area		Location (June 2020)	Area
U16, U160	Cnr Six Mile Lne & Woorndoo Darlington Rd	Nth East	U16, U160	Cnr Six Mile Lne & Woorndoo Darlington Rd	Nth East
U25	Woorndoo Darlington Rd - 888 Dunolly Rd	North		Woorndoo Darlington Rd - 888 Dunolly Rd	North
U20, U22	Woorndoo Darlington Rd	North-north-east		Woorndoo Darlington Rd	North-north-east
U18, U19	N Rd	Central north			Central north
U17	S Rd north run	Central north			Central north
U47	S Rd east run	Central north			Central north
U31		Central north	U31	Mortlake-Ararat Rd	Central north
U66	Hexham Woorndoo Rd	North west			North west
U63	Hamilton Hwy	West	U63	Hamilton Hwy	West
U164	off Mortlake-Ararat Rd	south -south-east	U164	off Mortlake-Ararat Rd	south -south-east
U90	Mortlake Ararat Rd	south central			south central
U51	Dayles Lane	south central			south central
U298	Hamilton Hwy	south-east	U298	Hamilton Hwy	south-east
U38	Near Cnr Prices Lane and Six Mile Lane	East			East
U58	Six mile Lane	East			East
U10					
Not Marked	Mt Fyans Lane	North	aerial 2x houses	U21	Woorndoo Darlington Rd	North
				U216	Hexham Woorndoo Rd	West
				U90	Mortlake-Ararat Rd	South

Review of WEF Area - Locations

Descriptor	Location (February 2022)	Area
U63	Hamilton Hwy	West
U298	Hamilton Hwy	south-east
general	Hamilton Hwy	South