



# INFORMATION REGARDING ENVIRONMENTAL AUDIT REPORTS

August 2007

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An environmental audit system has operated in Victoria since 1989. The *Environment Protection Act 1970* (the Act) provides for the appointment by the Environment Protection Authority (EPA Victoria) of environmental auditors and the conduct of independent, high quality and rigorous environmental audits.

An environmental audit is an assessment of the condition of the environment, or the nature and extent of harm (or risk of harm) posed by an industrial process or activity, waste, substance or noise. Environmental audit reports are prepared by EPA-appointed environmental auditors who are highly qualified and skilled individuals.

Under the Act, the function of an environmental auditor is to conduct environmental audits and prepare environmental audit reports. Where an environmental audit is conducted to determine the condition of a site or its suitability for certain uses, an environmental auditor may issue either a certificate or statement of environmental audit.

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## **Environmental Noise Assessment Audit**

**Delburn Wind Farm, Delburn, Victoria 3871**  
**Senversa Project Number M17978**

Prepared for:  
Delburn Wind Farm Pty Ltd

26 October 2020





## Distribution

### Environmental Noise Audit Report, Delburn Wind Farm, Delburn, VIC 3871

26 October 2020

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#### David Spink

Environmental Auditor (Industrial Facilities)

Appointed pursuant to the *Environment Protection Act 1970*



## Executive Summary

An environmental audit ('the audit') was conducted in accordance with s.53V of the *Environment Protection Act 1970* of the environmental noise assessment undertaken by Marshall Day Acoustics Pty Ltd (MDA), of the proposed Delburn Wind Farm to be located near Delburn, Victoria (the site). Hereinafter, the proposed wind farm will be referred to as the Wind Energy Facility (WEF) which is consistent with Victorian Government terminology.

Delburn Wind Farm Pty Ltd, part of the OSMI Australia group of companies (OSMI), is proposing to construct the WEF. The proposed site is centred in the Hancock Victorian Plantations (HVP) Thorpdale Tree Farm in the Strzelecki Ranges to the south of the Latrobe Valley. The site is generally bounded by Coalville to the north, Thorpdale to the west, Darlimurla to the south, and Boolarra and Yinnar to the east. Morwell is approximately 5 km to the north east of the site (as measured from the outer boundaries of both the township and site), and Moe is approximately 5 km to the north.

It is understood that the initial concept plan has been scaled down from 53 turbines to 33 turbines, in response to a number of factors such as additional technical inputs and community feedback on the initial concept plan.

Recent information from OSMI indicates that the Minister for Planning has decided that the proposed WEF will not be required to undergo an approval process under the *Environment Effects Act 1978* (i.e. no Environmental Effects Statement is required); however, a planning approval process will be required. The proposed WEF straddles across the Latrobe, Baw Baw and South Gippsland local government areas; therefore, an application for a planning permit will be required for each council, and potentially assessed collectively through a process controlled under the powers of the Minister for Planning.

It is understood that OSMI sought advice from the Department of Environment, Land, Water and Planning (DELWP) on the process required for the planning permits. DELWP has advised that the permit applications must satisfy the requirements of the *Development of Wind Farm Facilities in Victoria – Policy and Planning Guidelines* (DELWP, March 2019) (DELWP Guideline).

Specifically in regard to noise generation, the application for the planning permits must include an environmental audit prepared under Part IXD, Section 53V of the *Environment Protection Act 1970* (the Act) by an Environmental Auditor appointed under Part IXD of the Act, with an assessment of compliance of the predictive noise assessment demonstrating that the proposal can comply with the *New Zealand Standard NZS 6808:2010, Acoustics – Wind Farm Noise* (Standard).

EPA Victoria has issued *Wind Energy Facility Noise Auditor Guidelines* (Publication 1692, October 2018) (EPA Guideline) to complement the DELWP Guideline, that sets out the requirements for an audit of pre-construction noise (Section 2.4.1). The EPA Guideline refers to a number of EPA requirements, primarily *Environmental Auditor Guidelines for the Preparation of Environmental Audit Reports on Risk to The Environment* (Publication 952) and *Environmental Auditor Guidelines for Conducting Environmental Audits* (Publication 953).

The audit of the proposed Delburn WEF was consistent with these requirements of the EPA Guideline.

A summary of the audit and its findings are outlined in **Tables 1 to 2** below, consistent with *Environmental Auditor Guidelines - Provision of Environmental Audit Reports, Certificates and Statements* (EPA Publication 1147.2, December 2012).

**Table 1: Summary of Audit Information**

Summary Information	Details
EPA File Reference No.	CARMS No. 78720-1
Auditor	David Spink
Auditor account number	43572
Auditor appointment end date	24 October 2021
Audit service order number	8006699
Name of person requesting audit	Peter Marriott
Relationship of person requesting audit to site	Director Delburn Wind Farm Pty Ltd Level 3, 150 Chestnut St, Cremorne VIC 3121
Name of premises owner	Various
Date of auditor engagement	28 May 2020
Completion date of audit	26 October 2020
Reason for audit	Environmental noise audit for Delburn WEF – a requirement from DELWP for submission of the planning permit applications
Audit categorisation	Noise compliance with New Zealand Standard NZS6808:2010 Acoustics – Wind Farm Noise
Environmental segments	Residential properties within the neighbourhood, noise and air
EPA notice, licence or other reference number	N/A
Current land use zoning	FZ – Farming Zone
EPA region	Gippsland
Municipality	Latrobe, Baw Baw and South Gippsland Shire Councils
Dominant – Lot on plan	N/A
Additional – Lot on plan	N/A
Site/ premises name	Delburn Wind Farm
Building/complex sub-unit No.	N/A
Street/Lot – Lower No.	N/A
Street/Lot – Upper No.	
Street Name	



Summary Information	Details
<b>Street Type (road, court, etc)</b>	
<b>Suburb</b>	Delburn
<b>Postcode</b>	3871
<b>GIS coordinates of site centroid</b>	
Latitude (GDA94)	146.268
Longitude (GDA94)	-38.304
<b>Members and categories of support team utilised</b>	Dr Kym Burgemeister Arup Pty Ltd – Principal and Australasian Acoustics Skills Leader Acoustics subject matter expert
<b>Further work or requirements</b>	<ul style="list-style-type: none"> <li>Measurements of the tonality of the preferred turbine(s) (in accordance with IEC 61400-11:2012<sup>1</sup>) should be reviewed as they become available, or verified by on-site emission testing of the first turbines commissioned on the site.</li> <li>The post-construction noise level monitoring specified under the Noise Compliance Test Plan (NCTP) should be undertaken by an independent acoustic consultant in line with recent recommendations of the Office of the National Wind Farm Commissioner<sup>2</sup></li> </ul>
<b>Nature and extent of continuing risk</b>	<p>A risk of noncompliance with the noise limits specified in the <i>New Zealand Standard NZS 6808:2010 Acoustics – Wind Farm Noise</i> (the Standard) is taken to be a risk to the beneficial use of the environment, specifically with respect to the amenity of residents in the noise sensitive locations. Based on the predicted noise levels, it is expected that the risk to this beneficial use will be low, due to compliance with the Standard.</p> <p>The auditor notes that in the event that planning permits are issued for the proposed WEF, it is likely to require a further pre-construction noise impact assessment (updated to reflect the sound power levels of the final selected wind turbine, and any micro-siting), as well as an independent post-construction noise monitoring program, as referred to in the Standard. Specifically, it is anticipated that a Noise Compliance Testing Plan (NCTP) will be developed, consistent with the <i>Development of Wind Farm Facilities in Victoria – Policy and Planning Guidelines</i> (DELWP, March 2019) (DELWP Guideline) and <i>Wind Energy Facility Noise Auditor Guidelines</i> (Publication 1692, October 2018) (EPA Guideline). Recommendations are made above concerning this issue.</p>
<b>Outcome of Audit</b>	<p><b>Background Noise Assessment</b></p> <p>Refer to report entitled Marshall Day Acoustics - Delburn Wind Farm – Background Noise Monitoring (Rpt 002 20190463, dated 20 October 2020) (Background Noise Report).</p> <ol style="list-style-type: none"> <li>Notwithstanding the background noise level information documented in the Background Noise Report, the noise assessment adopts the minimum baseline criterion value of 40 dB(A) at all wind speeds at all noise sensitive receivers. This is a conservative approach. Therefore, the background noise level data is considered less critical than it would otherwise be.</li> <li>The background noise monitoring locations are generally at, or representative of, sensitive receivers that are within the predicted 35 dB(A) wind farm sound contour, in accordance with Section 7.1.4 of the Standard. The Background Noise Report</li> </ol>

<sup>1</sup> IEC 61400-11: 2012 Wind turbines – Part 11: Acoustic noise measurement techniques, International Electrotechnical Commission

<sup>2</sup> Annual Report to the Parliament of Australia, Office of the National Wind Farm Commissioner, 31 March 2017.



## Summary Information

## Details

provides helpful details regarding the individual measurement locations, with aerial photography, maps and photographs of each site which indicate appropriate positioning of the noise loggers at each site.

It is noted, however, that there are no measurements undertaken at property 875, or properties 605, 606 and 4155 which are all within the 35 dB(A) contour (and note that properties 605 and 4155 are within the Rural Living Zone, which is identified in the Assessment Report as possibly being subject to the High Amenity Zone). This is not fundamentally problematic since the minimum baseline criterion value of 40 dB(A) has been adopted at all sensitive receiver locations (and 35 dB(A) at properties 605 and 4155), rather than the Background + 5dB limit for levels > 35 dB(A). However, it does mean that, should issues arise in the future, there are no recorded background noise levels at some sensitive receivers – and the measured levels at other locations may not be considered representative.

3. The background noise level data has been undertaken over a time period of approximately 6 weeks which is considerably more than the minimum recommended requirement of 2 weeks (1,440 data points). The background measurements have been undertaken using appropriate measurement equipment (including windshields) and included a traceable calibration.
4. Periods with extraneous noise levels, identified in accordance with research by Griffin et. al.<sup>3</sup>, have been removed from the analysis. While this is not strictly required by the Standard, it is shown to remove data pairs with generally higher noise levels from the regression analysis, and so will result in a conservative assessment of the background noise level.
5. The background noise level data has been referenced to wind speed measurements undertaken at a meteorological mast and two LiDAR units installed on the site. The mast has an anemometer at the proposed turbine hub height of 160 m.
6. The background noise level and filtered wind speed data has been analysed using a 3<sup>rd</sup> order polynomial regression, which is appropriate.

### Environmental Noise Assessment

Refer to report entitled Marshall Day Acoustics - Delburn Wind Farm – Environmental Noise Assessment (Rpt 003 20190463, dated 20 October 2020) (Assessment Report).

7. The pre-construction noise assessment methodology generally complies with the requirements of the Standard. The noise predictions were conducted in accordance with the appropriate standards and guidelines.
8. General Noise Limits: The baseline criterion value of 40 dB(A) has been complied with at all Non-Participant Landholder (sensitive receiver) locations, rather than the Background + 5 dB limit for levels > 35 dB(A), regardless of whether higher noise levels might be allowable at high wind speeds using the 'background +5' approach. This is a conservative approach, and is being increasingly adopted in wind farm noise assessments.
9. High Amenity: Section 6.1.1 of the Assessment Report considers the application of a High Amenity Noise Limit at two receivers (605, 4155) representative of properties located within a Rural Living Zone (RLZ) northwest of the Boolarra township. However, applying the test comparing the predicted wind farm level to the prevailing background level outlined in Section 5.3.1 of the Standard (and referred to in the Assessment Report as

<sup>3</sup> Griffin, D., Delaire, C. and Pischedda, P., 2013, *Methods of identifying extraneous noise during unattended noise measurements*, 20<sup>th</sup> International Congress of Sound & Vibration.





## Summary Information

## Details

the Noise Perception Index (NPI)), indicates that a high amenity noise limit is unlikely to be justified. On the basis that Section 5.3.2 of the Standard states that the High Amenity Noise Limit would only be applied when the wind speed is 6 m/s or lower, it is noted that these locations are predicted to comply with a High Amenity Noise Limit at these wind speeds by a considerable margin, even if it did apply.

10. Special Audible Characteristics: Wind farm sound that exhibits special audible characteristics, such as tonality, impulsiveness or amplitude modulation is subject to penalties of between 1 to 6 dB to account for the additional audibility and annoyance caused by sound with these characteristics. However, as noted in Section 5.4 of the Standard, special audible characteristics cannot always be predicted in advance. Therefore, MDA have assumed that the candidate turbines will not result in tonal noise emission, and no penalties are applied. However, test data in accordance with IEC 61400-11:2012<sup>4</sup> is not currently available. This approach is considered to be reasonable at this stage. A recommendation is made concerning this issue.
11. Cumulative Noise Impacts: The Assessment Report addresses cumulative noise assessment and concludes that there are no other nearby wind farms that would warrant consideration of cumulative noise impacts. The auditor is satisfied that there are no other existing or proposed WEFs in the general area of the proposed WEF.
12. Noise propagation model: The noise level predictions have been undertaken using the ISO 9613-2:1996<sup>5</sup> noise propagation model, which has been shown in national and international studies<sup>6,7,8,9</sup> to provide good results for wind farm noise level predictions. In the opinion of the auditor and his team, the calculation parameters that have been adopted for temperature, humidity and ground absorption are reasonable, and correspond to best practice.
13. Choice of turbine for assessment: The assessment considers three candidate turbine models (Vestas V162-5.6MW, GE Renewable Energy 5.5-158, Siemens Gamesa SG 6.0-170), determined in accordance with IEC 61400-11<sup>10</sup> as required by Section 6.2.1 of the Standard, for the standard configuration incorporating serrated turbine blades and without sound management modes. It includes an additional +1 dB adjustment to account for source measurement uncertainty. These and some other considerations in the modelling noted in the Assessment Report are not explicitly required by the Standard or implemented in ISO 9613-2:1996<sup>11</sup>; however, they are commonly adopted as good practice for wind farm noise assessment.

<sup>4</sup> IEC 61400-11: 2012 Wind turbines – Part 11: Acoustic noise measurement techniques, International Electrotechnical Commission

<sup>5</sup> International Standard ISO 9613-2:1996 Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation (ISO 9613-2)

<sup>6</sup> Bass, J.H., Bullmore, A.J. and Sloth, E. *Development of a Wind Farm Noise Propagation Model*, Final Report for European Commission Contract JOR-3-CT95-0051, 1998.

<sup>7</sup> Bullmore, A., Adcock, J., Jiggins, M. and Cand, M., *Wind Farm Noise Predictions and Comparison with Measurements*, Wind Turbine Noise 2009, Aalborg, Denmark, 2009.

<sup>8</sup> Delaire, C., Griffin, D. and Walsh, D., *Comparison of predicted wind farm noise emission and measured post-construction noise levels at the Portland Wind Energy Project in Victoria, Australia*, Proc. 4<sup>th</sup> International Meeting on Wind Turbine Noise, Rome, Italy, 11-14 April 2011.

<sup>9</sup> Evans, T. and Cooper, J., *Comparison of predicted and measured wind farm noise levels and implications for assessments of new wind farms*, Proc. Acoustics 2011, Gold Coast, Australia, 2011.

<sup>10</sup> IEC 61400-11: 2012 Wind turbines – Part 11: Acoustic noise measurement techniques, International Electrotechnical Commission

<sup>11</sup> International Standard ISO 9613-2:1996 Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation (ISO 9613-2)





## Summary Information

## Details

14. The predicted wind farm sound levels comply with the base noise limit set in the Standard and demonstrates that the predicted sound levels for the WEF will achieve the noise criteria established by the Standard. Specifically:
  - a. Table 12 of the Assessment Report indicates that the WEF sound levels are predicted to comply with the baseline criterion value of 40 dB(A) at all of the Non-Participant Landholder noise sensitive receivers.
  - b. The assessment also indicates that the WEF sound levels would also comply with the 35 dB(A) High Amenity limit at Receivers 605 and 4155 for wind speeds of 6 m/s and below.
15. Management of uncertainty: MDA used SoundPlan 8.0 software, adopting the international standard ISO 9613<sup>12</sup> sound propagation model (as mentioned above) as the method to calculate the level of broadband A-weighted wind farm noise expected to occur at surrounding receptor locations. The software in conjunction with the digital terrain model of the site, has been used to evaluate the path between each turbine and receiver pairing, and then subsequently applies the adjustments to each turbine's predicted noise contribution where appropriate. The ISO 9613 sound propagation model has been demonstrated to generally result in conservative noise predictions. While MDA's analysis is not subject to a detailed Uncertainty Analysis, it does generally adopt conservative assumptions and applies an explicit contingency of + 1 dB to the source noise level. We agree with this approach for modelling noise from WEFs.
16. Risk Assessment: This audit focussed on risk to sensitive receivers, at locations defined as Non-Participant Landholders. The criteria applied were those specified in the Standard (refer to Section 1.4 of this audit report). A risk of noncompliance with the noise limits specified in the Standard is taken to be a risk to the beneficial use of the environment, specifically with respect to the amenity of residents in the noise sensitive locations. Based on the predicted sound levels, it is expected that the risk to this beneficial use will be low due to compliance with the Standard.

The auditor notes that in the event that planning permits are issued for the proposed WEF, it is likely to require a further pre-construction noise impact assessment, updated to reflect the sound power levels of the final selected wind turbine, and any micro-siting, and an independent post-construction noise monitoring program, as referred to in the Standard. Specifically, it is anticipated that a Noise Compliance Testing Plan (NCTP) will be developed, consistent with the DELWP Guideline and EPA Guideline. A recommendation is made concerning this issue.

<sup>12</sup> Ibid

**Table 2: Physical Site Information**

<b>Historical land use</b>	<b>Farming Zone</b>
<b>Current land use</b>	Forest Plantation
<b>Surrounding land use – north</b>	Farming Zone
<b>Surrounding land use – south</b>	Farming Zone & Rural Living Zone
<b>Surrounding land use – east</b>	Farming Zone & Special Use Zone
<b>Surrounding land use - west</b>	Farming Zone
<b>Proposed land use zoning</b>	No change
<b>Nearest surface water receptor – name</b>	Not relevant for this audit
<b>Nearest surface water receptor – direction</b>	Not relevant for this audit
<b>Groundwater segment</b>	Not relevant for this audit

**Signed**

**David Spink**  
Environmental Auditor (Industrial Facilities)  
Appointed pursuant to the *Environment Protection Act 1970*



## List of Acronyms

Acronym	Definition
<b>AS/NZS</b>	Australian and New Zealand Standard
<b>EPA Victoria</b>	Environment Protection Authority, Victoria
<b>DELWP</b>	Department of Environment, Land, Water, and Planning (Victoria)
<b>MDA</b>	Marshall Day Acoustics Pty Ltd
<b>NCTP</b>	Noise Compliance Test Plan
<b>NMP</b>	Noise Management Plan
<b>NZS</b>	New Zealand Standard
<b>SAC</b>	Special Audible Characteristic
<b>Standard</b>	NZS 6808:2010 Acoustics – Wind Farm Noise
<b>WEF</b>	Wind Energy Facility



# Contents

<b>List of Acronyms.....</b>	<b>ix</b>
<b>1.0 Overview of environmental audit.....</b>	<b>1</b>
1.1 Background.....	1
1.2 Audit Objectives .....	2
1.3 Audit Scope.....	2
1.4 Audit Criteria.....	3
1.4.1 DELWP Guideline .....	3
1.4.2 EPA Guideline .....	3
1.4.3 Planning Guideline.....	3
1.5 Audit Methodology .....	4
1.6 Documents reviewed for the audit.....	4
<b>2.0 Key Audit Findings .....</b>	<b>5</b>
2.1 Review of the site development.....	5
2.2 Background Noise Assessment .....	5
2.2.1 Noise monitoring locations .....	6
2.2.2 Noise monitoring.....	6
2.3 Environmental Noise Assessment .....	7
2.3.1 Noise Limits.....	7
2.3.2 Noise prediction methodology .....	8
2.3.3 Predicted Noise Levels .....	8
2.3.4 Potential Uncertainty in Noise levels .....	9
2.4 Risk Assessment.....	9
<b>3.0 Audit Conclusions and Recommendations .....</b>	<b>10</b>
3.1 Conclusions.....	10
3.2 Recommendations.....	12

## Appendices

Appendix 1: Site visit notes

Appendix 2: NZS 6808:2010 checklist



## 1.0 Overview of environmental audit

### 1.1 Background

Delburn Wind Farm Pty Ltd, part of the OSMI Australia group of companies (OSMI), is proposing to construct a wind farm in the Strzelecki Ranges to the south of the Latrobe Valley. The proposed development site is within a plantation area centred in the Delburn area, covering the Hancock Victorian Plantations (HVP) Thorpdale Tree Farm (the site). The site is generally bounded by Coalville to the north, Thorpdale to the west, Darlimurla to the south, and Boolarra and Yinnar to the east. Morwell is approximately 5 km to the north east of the site (as measured from the outer boundaries of both the township and site), and Moe is approximately 5 km to the north. Hereinafter, the proposed wind farm will be referred to as the Wind Energy Facility (WEF) which is consistent with Victorian Government terminology.

It is understood that the initial concept plan has been scaled down from 53 turbines to 33 turbines, in response to a number of factors such as additional technical inputs and community feedback on the initial concept plan.

Recent information from OSMI indicates that the Minister for Planning has decided that the proposed WEF will not be required to undergo an approval process under the *Environment Effects Act 1978* (ie no Environmental Effects Statement is required); however, a planning approval process will be required. The proposed WEF straddles across the Latrobe, Baw Baw and South Gippsland local government areas; therefore, an application for a planning permit will be required for each council, and potentially assessed collectively through a process controlled under the powers of the Minister for Planning.

It is understood that OSMI sought advice from the Department of Environment, Land, Water and Planning (DELWP) on the process required for the planning permits. DELWP has advised that the permit applications must satisfy the requirements of the *Development of Wind Farm Facilities in Victoria – Policy and Planning Guidelines* (DELWP, March 2019) (DELWP Guideline).

Specifically, in regard to noise generation, OSMI must comply with Section 4.3.3 (c) of the DELWP Guideline:

*Design responses – Noise assessment:*

*The proponent is required to submit a pre-construction (predictive) noise assessment report demonstrating that the proposal can comply with the New Zealand Standard NZS6808:2010, Acoustics – Wind Farm Noise, including an assessment of whether a high amenity noise limit is applicable under Section 5.3 of the Standard.*

*The pre-construction (predictive) noise assessment report must be accompanied by an environmental audit prepared under Part IXD, Section 53V of the Environment Protection Act 1970 by an Environmental Auditor appointed under Part IXD of the Environment Protection Act 1970. The environmental audit report must verify that the acoustic assessment undertaken for the pre-construction (predictive) noise assessment report has been conducted in accordance with the New Zealand Standard NZS6808:2010, Acoustics – Wind Farm Noise.*

Note: Hereinafter the *New Zealand Standard 6808:2010 Acoustics – Wind Farm Noise* will be referred to as the Standard, consistent with the terminology used in the EPA Guideline (refer below).

It is noted that this request from DELWP is consistent with Section 52.32 of the Victorian Planning Provisions (VC148), and in particular, Sections 52.32-4 and 52.32-5 (24/01/2020, VC160), which explicitly require a mandatory pre-construction (predictive) noise assessment demonstrating that the proposal can comply with the Standard, and an environmental audit report (this report) of the pre-construction (predictive) noise assessment report prepared under Part IXD, Section 53V of the *Environment Protection Act 1970*, verifying that the noise assessment report has been prepared in accordance with the Standard.



EPA Victoria has issued *Wind Energy Facility Noise Auditor Guidelines* (Publication 1692, October 2018) (EPA Guideline) to complement the DELWP Guideline, that sets out the requirements for an audit of pre-construction noise (Section 2.4.1). The EPA Guideline refers to several EPA requirements, primarily:

- *Environmental Auditor Guidelines for the Preparation of Environmental Audit Reports on Risk to The Environment* (Publication 952).
- *Environmental Auditor Guidelines for Conducting Environmental Audits* (Publication 953)

The audit of the Delburn WEF was consistent with the relevant requirements of the EPA Guideline.

## 1.2 Audit Objectives

The objective of the audit was to assess compliance of the Delburn WEF noise assessment undertaken by MDA (Report entitled Marshall Day Acoustics - Delburn Wind Farm – Environmental Noise Assessment (Rpt 003 20190463, dated 20 October 2020)) with the requirements set out in:

1. New Zealand Standard NZS 6808:2010 Acoustics – Wind Farm Noise (Standard).  
Specifically, that:
  - a. The assessment has been conducted in accordance with the Standard
  - b. The predicted noise impacts comply with the limits set in the Standard
2. Sections 4.3.3 (c) and 5.1.2 (a) of the DELWP Guideline
3. Audit requirements of the EPA Guideline

In essence, the audit was to assess the risk of amenity impact to the nearby residents from noise generated from the WEF.

## 1.3 Audit Scope

The following table is directly responding to the additional requirements of the EPA's Guideline *Preparation of environmental audit reports on risk to the environment* (Publication 952).

<b>Activity undertaken (in respect of which the environmental audit is to be conducted)</b>	Wind Energy Facility (WEF)
<b>Components of the activity to be considered</b>	Noise from turbine blades, generators, gear boxes and hydraulic systems
<b>Segment(s) of the environment to be considered</b>	Delburn environs surrounding the WEF. WEF centred at GPS Coordinates: Latitude: 146.268 Longitude: -38.304
<b>Element(s) to be considered</b>	Atmosphere/ aesthetics
<b>Beneficial Use(s) to be considered</b>	Residential accommodation
<b>Risk Assessment</b>	Effect of amenity of sensitive receiver sites applicable to operational noise of the WEF
<b>Time Period</b>	Indefinite, from commencement of the WEF operation
<b>Exclusions</b>	Construction noise Sub-station noise Compliance with other potential noise requirements of Latrobe, Baw Baw and South Gippsland planning permits



## 1.4 Audit Criteria

### 1.4.1 DELWP Guideline

The DELWP Guideline states that the WEF must comply with the noise limits recommended for dwellings and other noise sensitive locations, set out in the Standard.

The noise limits specified in the Standard are:

- Acceptable limit (40 dB LA90(10min), or background + 5 dB - whichever is higher (Section 5.2)
- High Amenity Areas (35 dB LA90(10min), or background + 5 dB - whichever is higher (Section 5.3)
- Special Audible Characteristics (tonal, impulsiveness, or amplitude modulation) receive a penalty between 1 to 6 dB added to the noise level (Section 5.4.2).

These noise limits produced in the Standard apply to all times of the day and night.

### 1.4.2 EPA Guideline

The EPA Guideline (Publication 1692) includes the following definition:

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

Publication 1692 further states that *Victoria has adopted ... NZS 6808:2010 (the Standard) ... as the standard which defines the assessment criteria, methodology and noise limits for WEFs.*

### 1.4.3 Planning Guideline

The planning provisions require the noise assessment for wind farm projects to be undertaken in accordance with the Standard (amendment VC78<sup>13</sup>, 15 March 2011).

Specific guidelines such as the Standard have been developed to address the unique requirements for the prediction, measurement and assessment of sound from wind farms because the usual measurement and assessment standards adopted in Victoria (such as AS 1055<sup>14</sup> and SEPP N-1<sup>15</sup>) are unsuitable.

There are other standards and guidelines such as AS4959:2010<sup>16</sup>, the draft National Guidelines<sup>17</sup>, the UK ETSU-R-97<sup>18</sup> and the Annual Report of the National Wind Farm Commissioner<sup>19</sup> that can provide helpful background information and secondary guidance that can also assist with the assessment of projects where the Standard does not provide detailed or explicit guidance.

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

<sup>13</sup> Advisory Note 35, Amendment VC 78 Wind energy facility provisions – Clause 52.32, March 2011.

<sup>14</sup> AS 1055.1-1997 *Acoustics - Description and measurement of environmental noise - General procedures*, Standards Australia, 1997.

<sup>15</sup> *State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) No. N-1*, Victoria Government Gazette No. S31, 1989.

<sup>16</sup> AS4959:2010 *Acoustics – Measurement prediction and assessment of noise from wind turbine generators*.

<sup>17</sup> *National Wind Farm Development Guidelines – Draft*, Environment Protection and Heritage Council, July 2010.

<sup>18</sup> *The Assessment and Rating of Noise from Wind Farms*, UK Department of Trade and Industry, ETSU-R-97, September 1996.

<sup>19</sup> *Annual Report to the Parliament of Australia*, Office of the National Wind Farm Commissioner, 31 March, 2017.





## 1.5 Audit Methodology

The audit methodology was consistent with Section 2.4.1 of the EPA Guideline, and included:

- Inception meeting with OSMI management.
- Review of the proposed Delburn WEF development and planned operation.
- Review of relevant documentation (refer to section 1.6).
- Site inspection of the proposed Delburn WEF project area and the surrounding environment.
- Assessment of the rigour of the approach to identifying surrounding noise sensitive locations, including background noise assessments.
- Review of the pre-construction noise assessment, including site-specific issues and technical details (overall methodology, baseline noise monitoring equipment, modelling program, alignment with the Standard).
- Review of predicted potential noise impacts (and if applicable, any operational plans to manage potentially adverse impacts).
- Residual risk assessment, including a qualitative statement on the risk of non-compliance.
- Preparation of the environmental audit report.

## 1.6 Documents reviewed for the audit

Documents specific to the Delburn Wind Farm:

- Marshall Day Acoustics - Delburn Wind Farm – Environmental Noise Assessment (Rp 003 20190463, dated 20 October 2020).
- Marshall Day Acoustics - Delburn Wind Farm – Background Noise Monitoring (Rp 002 20190463, dated 20 October 2020).
- OSMI Australia - Delburn Wind Farm – Preliminary Layout (Ref DWF\_OVR\_018\_03.4, dated 24 April 2020).
- OSMI Australia– Background noise monitoring locations (Pers. Com. from Elizabeth Radcliffe, OSMI Australia Development Strategy and Compliance Manager, email dated 30 June 2020).

General references:

- New Zealand Standard NZS6808:2010 Acoustics – Wind Farm Noise.
- DELWP - Development of Wind Farm Facilities in Victoria – Policy and Planning Guidelines (March 2019)
- EPA Victoria - Wind Energy Facility Noise Auditor Guidelines (Publication 1692, October 2018).
- EPA Victoria - Environmental Auditor Guidelines for the Preparation of Environmental Audit Reports on Risk to The Environment (Publication 952).
- EPA Victoria - Environmental Auditor Guidelines for Conducting Environmental Audits (Publication 953).
- Victoria Planning Policy (Amendment VC124 – 2015) Clause 52-32-5.



## 2.0 Key Audit Findings

The following key audit findings address the objectives of the audit set out in Section 1.2. The methodology used was consistent with Section 1.5.

### 2.1 Review of the site development

A telephone conference meeting was held with OSMI management on 26 May 2020, to confirm the scope of the audit including site access and data requirements.

The auditor undertook an inspection of the site on 29 May 2020. More specifically, the areas accessible by public roads adjacent to the perimeter of the proposed site were visited. The actual locations of the wind turbines could not be accessed as they are located within the HVP Plantation, which is in an advanced state of growth. Brief notes are provided in Appendix 1.

One of the key objectives of the site visit was to review the locations used by MDA for the background monitoring assessment - the table included in Appendix 1 summarises this information. It was understood that no Neighbourhood Stakeholder Agreements (defined as “Participant Landholders”, under the Standard) had been established with any landholders. The only agreements OSMI has with some neighbours was to consent to the background noise monitoring being undertaken and to provide the raw data captured to the landholder. There are two dwellings located within the site boundary on the western edge of the site (on Ten Mile Creek Rd, location references 828 and 829 – refer below) which are treated as Participant Landholders under the Standard; otherwise, all sensitive receivers are Non-Participant Landholders.

In regard to the suitability of the sites selected by MDA for background monitoring, please refer to the comments provided in Section 2.2.1 of this report.

### 2.2 Background Noise Assessment

This component is not strictly a requirement of the audit (or S52.32 of the Victorian Planning Provisions); however, the assessment of predicted operational noise levels requires appropriate confidence in the methodology and outcomes of the background noise monitoring which may form the basis of the noise level criteria at individual sensitive receiver locations.

The audit therefore included a review of the assessment in the report entitled Marshall Day Acoustics – Delburn Wind Farm – Background Noise Monitoring (Rp 002 20190463, dated 20 October 2020) (Background Noise Report).

It is noted at the outset that, notwithstanding the background noise level information documented in the Background Noise Report, that the noise assessment adopts the minimum baseline criterion value of 40 dB(A) at all wind speeds at all noise sensitive receivers. Further assessment was undertaken for two receivers (605, 4155) representative of locations within the nearby Rural Living Zone which may be subject to a 35 dB(A) ‘high amenity’ noise limit depending on the outcome of tests prescribed under the Standard (Refer to Section 2.3.1 of this report for further discussion on this issue). This is a conservative approach, and is considered to be prudent, as it helps remove uncertainty regarding variable background noise levels into the future as local features change (eg. removal or growth of trees, seasonal effects). Therefore, the background noise level data is considered less critical than it would otherwise be.



### 2.2.1 Noise monitoring locations

Background noise monitoring was undertaken by MDA at 9 noise sensitive receivers representative of locations within or just outside the predicted 35 dB(A) wind farm sound contour. The locations just outside the predicted 35 dB(A) contour replaced nearby sensitive receivers locations within the 35 dB(A) contour where landowner consent for access was denied, or where the location provided alternative land use context for testing the applicability of the “high amenity” section of the Standard. It is understood that none of these locations are Participant Landholders (Stakeholders), i.e. all locations are at premises of Non-Participant Landholders.

The background noise measurement locations are shown on a map in Figure 1 of the Background Noise Report. This indicates that the selected locations are generally at, or representative of, sensitive receivers that are within the predicted 35 dB(A) wind farm sound contour, in accordance with Section 7.1.4 of the Standard. The measurements were undertaken between March and June 2020.

Specifically, it is noted that there are no measurements undertaken at property 875, or properties 605, 606 and 4155 which are all within the 35 dB(A) contour (and note that properties 605 and 4155 are within the Rural Living Zone north-west of the Boolarra township, which is identified in the Noise Assessment Report as possibly being subject to the High Amenity Zone – refer to Section 2.3). This is not fundamentally problematic since, as noted above, the minimum criteria value of 40 dB(A) has been adopted at all sensitive receiver locations (rather than the Background + 5dB limit for levels > 35 dB(A)). However, it does mean that, should issues arise in the future, there are no recorded background noise levels at some sensitive receivers – and the measured levels at other locations may not be considered representative.

### 2.2.2 Noise monitoring

The background noise level data has been collected over a time period of approximately 6 weeks which is considerably more than the minimum recommended requirement of 2 weeks (1,440 data points). The background measurements have been undertaken using appropriate measurement equipment (including windshields) and included a traceable calibration. The Background Noise Report provides helpful details regarding the individual measurement locations, with aerial photography, maps and photographs of each site which indicate appropriate positioning of the noise loggers at each site.

Periods with extraneous noise levels, identified in accordance with research by Griffin et. al.<sup>20</sup>, have been removed from the analysis. While this is not strictly required by the Standard, it is shown to remove data pairs with generally higher noise levels from the regression analysis, and so will result in a conservative assessment of the background noise level.

The background noise level data has been referenced to wind speed measurements undertaken at a meteorological mast and two LiDAR units installed on the site. The mast has an anemometer at the proposed turbine hub height of 160 m. The LiDAR units are able to provide wind speed and direction measurements at a range of different heights up to 200 m above ground level. However, the LiDAR units are sometimes unable to collect data during certain periods, at particular heights. During those periods, the data has been extrapolated from other heights, and supplemented by data from nearby anemometry.

The background noise level and filtered wind speed data has been analysed using a 3<sup>rd</sup> order polynomial regression, which is appropriate. Regression analysis was undertaken for both the 24-hour data and night-period data only.

The reported square of the correlation coefficient ( $r^2$ ) is generally 0.17–0.62 considering all time data, and improves to 0.38–0.73 for the night-period data only. At some receivers, this is not particularly high, and representative of a relatively wide range of results, rather than highly correlated data.

It is noted that the measured noise levels correspond to the noise floor of the measurement equipment at several locations (600, 1171), which is likely to influence the regression curve at low wind speeds

<sup>20</sup> Griffin, D., Delaire, C. and Pischedda, P., 2013, *Methods of identifying extraneous noise during unattended noise measurements*, 20<sup>th</sup> International Congress of Sound & Vibration.



for these locations. Again, this is of no practical consequence, since the minimum criteria, 40 dB(A), has been adopted at all sensitive receivers, regardless of the measured background noise level.

Location 824 noise was highly variable, and had a large number of samples rejected due to what is understood to be seasonal insect noise.

## 2.3 Environmental Noise Assessment

MDA has undertaken an environmental noise assessment, as provided in the report entitled Marshall Day Acoustics – Delburn Wind Farm – Environmental Noise Assessment (Rp 003 20190463, dated 20 October 2020) (Assessment Report).

Note that if planning approval is granted for the WEF, it is likely that that a pre-construction noise assessment will also be required (updated to reflect the sound power levels of the final selected wind turbine, and micro-siting), but prior to construction beginning.

The assessment is generally undertaken in accordance with the Standard. Key findings are discussed below.

### 2.3.1 Noise Limits

#### Consideration of General Noise Limits

While background noise level measurements have been undertaken for the proposed WEF, as noted above, the approach used in the assessment demonstrate compliance against the minimum baseline criterion value of 40 dB(A), at all receivers regardless of whether higher noise levels might be allowable at high wind speeds using the 'background +5' approach. This is a conservative approach, and is being increasingly adopted in wind farm noise assessments.

Properties 828 and 829 are owned by HVP (the plantation) and are within the site boundary. While a limit of 45 dB(A) is often applied to Participant Landholder dwellings, the assessment conservatively adopts the minimum baseline criterion value of 40 dB(A) at these properties (Section 6.1.2 of the Assessment Report).

#### Consideration of High Amenity Noise Limit

Section 6.1.1 of the Assessment Report considers the application of a High Amenity Noise Limit at two receivers (605, 4155), representative of receivers located within a Rural Living Zone (RLZ) northwest of the Boolarra township.

However, applying the test comparing the predicted wind farm level to the prevailing background level outlined in Section 5.3.1 of the Standard (and referred to in the Assessment Report as the Noise Perception Index (NPI)), indicates that a High Amenity Noise Limit is unlikely to be justified.

On the basis that Section 5.3.2 of the Standard states that the High Amenity Noise Limit would only be applied when the wind speed is 6 m/s or lower, it is noted that these locations are predicted to comply with a High Amenity Noise Limit at these wind speeds by a considerable margin, even if it did apply.

#### Consideration of Special Audible Characteristics (SACs)

Wind farm sound that exhibits special audible characteristics, such as tonality, impulsiveness or amplitude modulation is subject to penalties of between 1 to 6 dB to account for the additional audibility and annoyance caused by sound with these characteristics. However, as noted in Section 5.4 of the Standard, SACs cannot always be predicted in advance.

Therefore, MDA have assumed that the candidate turbines will not result in tonal noise emission, and no penalties are applied. However, test data in accordance with IEC 61400-11:2012<sup>21</sup> is not currently available. This approach is considered to be reasonable at this stage. It is recommended that

<sup>21</sup> IEC 61400-11: 2012 Wind turbines – Part 11: Acoustic noise measurement techniques, International Electrotechnical Commission



measurements of the tonality of the proposed turbines (in accordance with IEC 61400-11:2012<sup>22</sup>) are reviewed as they become available, or verified by on-site emission testing of the first turbines commissioned on the site.

### Consideration of Cumulative Noise Levels

Section 6.5 of the Assessment Report notes that the nearest wind farms are greater than 10 km distance away, and therefore will not contribute cumulative noise emissions at the nearby sensitive receivers. The auditor is satisfied that there are no other existing or proposed WEFs in the general area of the proposed Delburn WEF that need to be considered in this assessment.

### 2.3.2 Noise prediction methodology

The approach used by MDA has been reviewed, with the following key findings:

- Noise propagation model: The noise level predictions have been undertaken using the ISO 9613-2:1996<sup>23</sup> noise propagation model, which has been shown in national and international studies<sup>24,25,26,27</sup> to provide good results for wind farm noise level predictions. In the opinion of the auditor and his team, the calculation parameters that have been adopted for temperature, humidity and ground absorption are reasonable, and correspond to best practice.
- Choice of turbine for assessment: The source levels used in the noise predictions are based on the measured sound power level data and spectral (octave band) data for the three candidate turbine models (Vestas V162-5.6MW, GE Renewable Energy 5.5-158, Siemens Gamesa SG 6.0-170), determined in accordance with IEC 61400-11<sup>28</sup> as required by Section 6.2.1 of the Standard, for the standard configuration incorporating serrated turbine blades and without sound management modes. It includes an additional +1 dB adjustment to account for source measurement uncertainty.
- The noise level predictions have adopted the following conservative assumptions:
  - Barrier effect limited to 2 dB
  - Screening based on turbine tip height, not hub height
  - +3 penalty for 'concave' ground topography ('valley' effects).

These considerations are not explicitly required by the Standard or implemented in ISO 9613-2:1996<sup>29</sup>; however, they are commonly adopted as good practice for wind farm noise assessment.

### 2.3.3 Predicted Noise Levels

It is accepted that the environmental noise assessment has been undertaken in accordance with the requirements of the Standard, and the resulting assessment demonstrates that the predicted noise levels for the WEF will achieve the noise criteria established by the Standard. Specifically:

- Table 12 of the Assessment Report indicates that the WEF sound levels are predicted to comply with the baseline criterion value of 40 dB(A) at all of the noise sensitive receivers, with a reasonable margin of at least 3 dB for the worst-case receiver (864).

<sup>22</sup> Ibid

<sup>23</sup> International Standard ISO 9613-2:1996 Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation (ISO 9613-2)

<sup>24</sup> Bass, J.H., Bullmore, A.J. and Sloth, E. *Development of a Wind Farm Noise Propagation Model*, Final Report for European Commission Contract JOR-3-CT95-0051, 1998.

<sup>25</sup> Bullmore, A., Adcock, J., Jiggins, M. and Cand, M., *Wind Farm Noise Predictions and Comparison with Measurements*, Wind Turbine Noise 2009, Aalborg, Denmark, 2009.

<sup>26</sup> Delaire, C., Griffin, D. and Walsh, D., *Comparison of predicted wind farm noise emission and measured post-construction noise levels at the Portland Wind Energy Project in Victoria, Australia*, Proc. 4<sup>th</sup> International Meeting on Wind Turbine Noise, Rome, Italy, 11-14 April 2011.

<sup>27</sup> Evans, T. and Cooper, J., *Comparison of predicted and measured wind farm noise levels and implications for assessments of new wind farms*, Proc. Acoustics 2011, Gold Coast, Australia, 2011.

<sup>28</sup> IEC 61400-11: 2012 Wind turbines – Part 11: Acoustic noise measurement techniques, International Electrotechnical Commission

<sup>29</sup> International Standard ISO 9613-2:1996 Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation (ISO 9613-2)



- The assessment also indicates that the WEF sound levels would also comply with the 35 dB(A) High Amenity limit at Receivers 605 and 4155 for wind speeds of 6 m/s and below.

### 2.3.4 Potential Uncertainty in Noise levels

MDA used SoundPlan 8.0 software, adopting the international standard ISO 9613<sup>30</sup> sound propagation model (as mentioned above) as the method to calculate the level of broadband A-weighted wind farm noise expected to occur at surrounding receptor locations. The software in conjunction with the digital terrain model of the site, has been used to evaluate the path between each turbine and receiver pairing, and then subsequently applies the adjustments to each turbine's predicted noise contribution where appropriate. The ISO 9613 sound propagation model has been demonstrated to generally result in conservative noise predictions.

All acoustic measurements and noise predictions are subject to measurement and calculation uncertainty. While MDA's analysis is not subject to a detailed uncertainty analysis, it does generally adopt conservative assumptions and applies an explicit contingency of + 1 dB to the source noise levels. We agree with this approach for modelling noise from WEFs.

## 2.4 Risk Assessment

The EPA Guideline requires a risk assessment, including a qualitative statement of the risk of non-compliance.

This audit focussed on risk to sensitive receivers, at locations identified as Non-Participant Landholders. The criteria applied were those specified in the Standard (refer to Section 1.4 of this report).

A risk of noncompliance with the noise limits specified in the Standard is taken to be a risk to the beneficial use of the environment, specifically with respect to the amenity of residents in the noise sensitive locations. Based on the predicted sound levels, it is expected that the risk to this beneficial use will be low, due to compliance with the Standard.

The auditor notes that in the event that planning permits are issued for the proposed WEF, it is likely to require a further pre-construction noise impact assessment (updated to reflect the sound power levels of the final selected wind turbine, and any micro-siting), as well as an independent post-construction noise monitoring program, as referred to in the Standard.

Specifically, it is anticipated that a Noise Compliance Testing Plan (NCTP) will be developed, consistent with the DELWP Guideline and EPA Guideline. It is our recommendation that the post-construction noise level monitoring specified under the NCTP should be undertaken by an independent acoustic consultant in line with recent recommendations of the Office of the National Wind Farm Commissioner<sup>31</sup>.

<sup>30</sup> International Standard ISO 9613-2:1996 Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation (ISO 9613-2)

<sup>31</sup> Annual Report to the Parliament of Australia, Office of the National Wind Farm Commissioner, 31 March, 2017.





## 3.0 Audit Conclusions and Recommendations

### 3.1 Conclusions

An environmental audit ('the audit') was conducted in accordance with s.53V of the *Environment Protection Act 1970* of the noise assessment undertaken by MDA of the proposed Delburn Wind Farm to be located within a plantation area centred in the Delburn area, covering the Hancock Victorian Plantations (HVP) Thorpdale Tree Farm (the site). The audit has been completed to assess compliance with the Standard, as required by the EPA Guideline.

The following is a summary of the key findings of the audit.

#### Background Noise Assessment

Refer to report entitled Marshall Day Acoustics - Delburn Wind Farm – Background Noise Monitoring (Rp 002 20190463, dated 20 October 2020) (Background Noise Report).

1. Notwithstanding the background noise level information documented in the Background Noise Report, the noise assessment adopts the minimum baseline criterion value of 40 dB(A) at all wind speeds at all noise sensitive receivers. This is a conservative approach. Therefore, the background noise level data is considered less critical than it would otherwise be.
2. The background noise monitoring locations are generally at, or representative of, sensitive receivers that are within the predicted 35 dB(A) wind farm sound contour, in accordance with Section 7.1.4 of the Standard. The Background Noise Report provides helpful details regarding the individual measurement locations, with aerial photography, maps and photographs of each site which indicate appropriate positioning of the noise loggers at each site.  
It is noted, however, that there are no measurements undertaken at property 875, or properties 605, 606 and 4155 which are all within the 35 dB(A) contour (and note that properties 605 and 4155 are within the Rural Living Zone, which is identified in the Assessment Report as possibly being subject to the High Amenity noise limit). This is not fundamentally problematic since the baseline criteria value of 40 dB(A) has been adopted at all sensitive receiver locations. However, it does mean that, should issues arise in the future, there are no recorded background noise levels at some sensitive receivers – and the measured levels at other locations may not be considered representative.
3. The background noise level data has been undertaken over a time period of approximately 6 weeks which is considerably more than the minimum recommended requirement of 2 weeks (1,440 data points). The background measurements have been undertaken using appropriate measurement equipment (including windshields) and included a traceable calibration.
4. Periods with extraneous noise levels, identified in accordance with research by Griffin et. al.<sup>32</sup>, have been removed from the analysis. While this is not strictly required by the Standard, it is shown to remove data pairs with generally higher noise levels from the regression analysis, and so will result in a conservative assessment of the background noise level.
5. The background noise level data has been referenced to wind speed measurements undertaken at a meteorological mast and two LiDAR units installed on the site. The mast has an anemometer at the proposed turbine hub height of 160 m.
6. The background noise level and filtered wind speed data has been analysed using a 3<sup>rd</sup> order polynomial regression, which is appropriate.

#### Pre-construction Noise Assessment

Refer to report entitled Marshall Day Acoustics - Delburn Wind Farm – Environmental Noise Assessment (Rp 003 20190463, dated 20 October 2020) (Assessment Report).

<sup>32</sup> Griffin, D., Delaire, C. and Pischedda, P., 2013, *Methods of identifying extraneous noise during unattended noise measurements*, 20<sup>th</sup> International Congress of Sound & Vibration.





7. The pre-construction noise assessment methodology generally complies with the requirements of the Standard. The noise predictions were conducted in accordance with the appropriate standards and guidelines.
8. General Noise Limits: The baseline criterion value of 40 dB(A) has been complied with at all Non-Participant Landholder (sensitive receiver) locations, rather than the Background + 5 dB limit for levels > 35 dB(A), regardless of whether higher noise levels might be allowable at high wind speeds using the 'background +5' approach. This is a conservative approach, and is being increasingly adopted in wind farm noise assessments.
9. High Amenity: Section 6.1.1 of the Assessment Report considers the application of a High Amenity Noise Limit at two receivers (605, 4155) representative of properties located within a Rural Living Zone (RLZ) northwest of the Boolarra township. However, applying the test comparing the predicted wind farm level to the prevailing background level outlined in Section 5.3.1 of the Standard (and referred to in the Assessment Report as the Noise Perception Index (NPI)), indicates that a high amenity noise limit is unlikely to be justified. On the basis that Section 5.3.2 of the Standard states that the High Amenity Noise Limit would only be applied when the wind speed is 6 m/s or lower, it is noted that these locations are predicted to comply with a High Amenity Noise Limit at these wind speeds by a considerable margin, even if it did apply.
10. Special Audible Characteristics: Wind farm sound that exhibits special audible characteristics, such as tonality, impulsiveness or amplitude modulation is subject to penalties between 1– 6 dB to account for the additional audibility and annoyance caused by sound with these characteristics. However, as noted in Section 5.4 of the Standard, special audible characteristics cannot always be predicted in advance. Therefore, MDA have assumed that the candidate turbines will not result in tonal noise emission, and no penalties are applied. However, test data in accordance with IEC 61400-11:2012<sup>33</sup> is not currently available. This approach is considered to be reasonable at this stage. A recommendation is made concerning this issue.
11. Cumulative Noise Impacts: The Assessment Report addresses cumulative noise assessment and concludes that there are no other nearby wind farms that would warrant consideration of cumulative noise impacts. The auditor is satisfied that there are no other existing or proposed WEFs in the general area of the proposed WEF.
12. Noise propagation model: The noise level predictions have been undertaken using the ISO 9613-2:1996<sup>34</sup> noise propagation model, which has been shown in national and international studies<sup>35,36,37,38</sup> to provide good results for wind farm noise level predictions. In the opinion of the auditor and his team, the calculation parameters that have been adopted for temperature, humidity and ground absorption are reasonable, and correspond to best practice.
13. Choice of turbine for assessment – the assessment considers three candidate turbine models (Vestas V162-5.6MW, GE Renewable Energy 5.5-158, Siemens Gamesa SG 6.0-170), determined in accordance with IEC 61400-11<sup>39</sup> as required by Section 6.2.1 of the Standard, for the standard configuration incorporating serrated turbine blades and without sound management modes. It includes an additional +1 dB adjustment to account for source measurement uncertainty. These and some other considerations in the modelling noted in the Assessment Report are not explicitly required by the Standard or implemented in ISO 9613-2:1996<sup>40</sup>; however, they are commonly adopted as good practice for wind farm noise assessment.

<sup>33</sup> IEC 61400-11: 2012 Wind turbines – Part 11: Acoustic noise measurement techniques, International Electrotechnical Commission

<sup>34</sup> International Standard ISO 9613-2:1996 Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation (ISO 9613-2)

<sup>35</sup> Bass, J.H., Bullmore, A.J. and Sloth, E. *Development of a Wind Farm Noise Propagation Model*, Final Report for European Commission Contract JOR-3-CT95-0051, 1998.

<sup>36</sup> Bullmore, A., Adcock, J., Jiggins, M. and Cand, M., *Wind Farm Noise Predictions and Comparison with Measurements*, Wind Turbine Noise 2009, Aalborg, Denmark, 2009.

<sup>37</sup> Delaire, C., Griffin, D. and Walsh, D., *Comparison of predicted wind farm noise emission and measured post-construction noise levels at the Portland Wind Energy Project in Victoria, Australia*, Proc. 4<sup>th</sup> International Meeting on Wind Turbine Noise, Rome, Italy, 11-14 April 2011.

<sup>38</sup> Evans, T. and Cooper, J., *Comparison of predicted and measured wind farm noise levels and implications for assessments of new wind farms*, Proc. Acoustics 2011, Gold Coast, Australia, 2011.

<sup>39</sup> IEC 61400-11: 2012 Wind turbines – Part 11: Acoustic noise measurement techniques, International Electrotechnical Commission

<sup>40</sup> International Standard ISO 9613-2:1996 Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation (ISO 9613-2)



14. The predicted noise levels comply with the limits set in the Standard and demonstrates that the predicted noise levels for the WEF will achieve the noise criteria established by the Standard. Specifically:
  - a. Table 12 of the Assessment Report indicates that the WEF sound levels are predicted to comply with the baseline criterion value of 40 dB(A) at all of the noise sensitive receivers.
  - b. The assessment also indicates that the WEF sound levels would also comply with the 35 dB(A) High Amenity limit at Receivers 605 and 4155 for wind speeds of 6 m/s and below.
15. Management of uncertainty: MDA used SoundPlan 8.0 software, adopting the international standard ISO 9613 sound propagation model (as mentioned above) as the method to calculate the level of broadband A-weighted wind farm noise expected to occur at surrounding receptor locations. The software in conjunction with the digital terrain model of the site, has been used to evaluate the path between each turbine and receiver pairing, and then subsequently applies the adjustments to each turbine's predicted noise contribution where appropriate. The ISO 9613 sound propagation model has been demonstrated to generally result in conservative noise predictions. While MDA's analysis is not subject to a detailed Uncertainty Analysis, it does generally adopt conservative assumptions and applies an explicit contingency of + 1 dB to the source noise level. We agree with this approach for modelling noise from WEFs.
16. Risk Assessment: This audit focussed on risk to sensitive receivers, at locations defined as Non Participant Landholders. The criteria applied were those specified in the Standard (refer to Section 1.4 of this audit report). A risk of noncompliance with the noise limits specified in the Standard is taken to be a risk to the beneficial use of the environment, specifically with respect to the amenity of residents in the noise sensitive locations. Based on the predicted sound levels, it is expected that the risk to this beneficial use will be low due to compliance with the Standard.

The auditor notes that in the event that planning permits are issued for the proposed WEF, it is likely to require a further pre-construction noise impact assessment, updated to reflect the sound power levels of the final selected wind turbine, and any micro-siting) and an independent post-construction noise monitoring program, as referred to in the Standard. Specifically, it is anticipated that a Noise Compliance Testing Plan (NCTP) will be developed, consistent with the DELWP Guideline and EPA Guideline. A recommendation is made concerning this issue.

## 3.2 Recommendations

- Measurements of the tonality of the candidate turbines (in accordance with IEC 61400-11:2012)<sup>41</sup> should be reviewed as they become available, or verified by on-site emission testing of the first turbines commissioned on the site.
- The post-construction noise level monitoring specified under the Noise Compliance Test Plan (NCTP) should be undertaken by an independent acoustic consultant in line with recent recommendations of the Office of the National Wind Farm Commissioner<sup>42</sup>

<sup>41</sup> IEC 61400-11: 2012 Wind turbines – Part 11: Acoustic noise measurement techniques, International Electrotechnical Commission

<sup>42</sup> Annual Report to the Parliament of Australia, Office of the National Wind Farm Commissioner, 31 March 2017.



## **Appendices**

**Appendix 1: Site visit notes**

**Appendix 2: NZS 6808:2010 checklist**



## Appendix 1

### Delburn Site Visit

**Date of site visit:** 29 May 2020

#### **General comments:**

The proposed site of the Delburn Wind Farm is located in the Strzelecki Ranges to the south of the Latrobe Valley, generally bounded by Coalville to the north, Thorpdale to the west, Darlimurla to the south, and Boolarra and Yinnar to the east. Morwell is approximately 5km to the north east of the site (as measured from the outer boundaries of both the township and site), and Moe is approximately 5km to the north.

The proposed site is situated within the plantation area centred in the Delburn area, covering the Hancock Victorian Plantations (HVP) Thorpdale Tree Farm. The topography of the site and surrounding area could generally be described as quite a “hilly” site, although there are some reasonably undulating areas. The site itself is quite elevated compared with surrounding area, with what could be described as an escarpment to the east and west of the site, leading down to areas where there are significant numbers of residences.

The general area on and adjacent to the proposed site is used for the most part for farming activities, with well-established farmhouses and associated outbuildings.

The auditor was accompanied on the site visit by Elizabeth Radcliffe, OSMI Development Strategy and Compliance Manager. Because of the social distancing restrictions in force in Victoria due to the COVID19 pandemic, the site visit involved travel in 2 vehicles, with hands free mobile telephone communication and a number of stops to review and discuss local conditions.

A total of nine locations were selected by MDA for background noise monitoring (refer to Table 1, page 5 of the report: Marshall Day Acoustics - Delburn Wind Farm – Background Noise Monitoring (Rp 002 R01 20190463, dated 20 October 2020).

It was noted that some monitoring locations were just outside the predicted 35 dB(A) contour, to replace nearby sensitive receivers locations within the 35 dB(A) contour where landowner consent for access was denied, or where the location provided alternative land use context for testing the applicability of the “high amenity” section of the Standard.

The locations used by MDA were inspected as was deemed practical from public access roads. The general route involved a drive on local roads near the perimeter of the proposed windfarm site. The inspection by the auditor of the general site and surrounding area was to (a) familiarise with the local topography and any significant features (i.e. sensitive receivers) that could be relevant to the audit and (b) seek to “ground truth” the appropriateness of the background noise monitoring locations.

No residents were contacted during the site inspection.



The visit included observations as far as practical from public access in the proximity of the following baseline monitoring sites:

Baseline monitoring location	Direction from wind farm
600	south, east
609	north, south east
824	west
832	west
853	north, west
864	west
867	west
1171	east
4585	south, east

No significant additional sensitive receiver locations were identified which could not be appropriately assessed from extrapolation of data from the background monitoring locations selected by MDA.

Discussion of the background noise monitoring assessment is included in the audit report.



## Appendix 2: NZS 6808:2010 Checklist

**Information Source:** Marshall Day Acoustics - Delburn Wind Farm – Environmental Noise Assessment (Rp 003 20190463, dated 20 October 2020)

NZS6808:2010 Section/Clause	NZS 6808:2010 Requirement	Reference from Information Source	Assessment	Compliance
S3.1.3	Adopt A-frequency weighted L90 centile level for wind farm sound	MDA S6.3.1, Table 10 and Table 11	L <sub>Aeq</sub> adopted for source levels. L <sub>Aeq</sub> levels will result in conservative predictions compared to L90 level.	Comply
S5.2	Adopt an outdoor limit of background + 5dB, or a level of 40 dBLA90(10min), whichever is the greater	MDA S6.1.3, Table 7	Baseline noise limit of 40 dB(A) achieved at all non-participant receivers at all wind speeds	Comply
S5.3	Consider a High Amenity noise limit where a plan promotes a higher degree of protection.	MDA S6.1.1	Applies Test C5.3.1	Comply
S5.4	Design the wind farm so that wind farm sound does not have Special Audible Characteristics.	MDA S6.3.2	Assumed not tonal. Amplitude modulation is impractical to determine pre-construction.	Comply
S5.5	Other factors, including ultrasound, infrasound, low frequency sound and vibration and ground-borne vibration are not required to be assessed.	-	Factors not required to be assessed	Comply
S5.6	Apply limits to the cumulative sound level of all wind farms affecting any noise sensitive location.	MDA S6.5	No wind farms are identified within 10 km of the proposed development.	Comply
S5.7	Uncertainty.	MDA S6.3.1	+1 dB adjustment adopted to account for typical values of test uncertainty	Comply
S6.1.1	Undertake predictions to determine environmental noise impact before installation takes place	MDA Report	-	Comply



NZS6808:2010 Section/Clause	NZS 6808:2010 Requirement	Reference from Information Source	Assessment	Compliance
S6.1.2	<p>Predictions to take into account</p> <ul style="list-style-type: none"> <li>a) Sound power levels and positions of wind turbines</li> <li>b) Directivity of propagation</li> <li>c) Meteorological conditions</li> <li>d) Attenuation due to geometric spreading</li> <li>e) Attenuation due to atmospheric absorption</li> <li>f) Ground attenuation</li> <li>g) Miscellaneous attenuation</li> <li>h) Barrier and terrain screening</li> </ul>	<p>MDA S6.3.1 Tab 10 &amp; 11 Appendix C</p> <p>Assumed Omni</p> <p>S4.0 and Appendix H</p> <p>S4.0 and Appendix H</p> <p>S4.0 and Appendix H</p> <p>S4.0 and Appendix H</p> <p>S4.0 and Appendix GH</p>	<p>Appropriate modelling, propagation and attenuation parameters have been adopted</p>	Comply
S6.1.3	Use an appropriate sound propagation calculation method applicable to wind turbines.	S4.0 and Appendix H	ISO 9613-2:1996 used with the adoption of appropriate modelling parameters	Comply
S6.1.4	Wind farm sound levels determined by calculating in octave-bands from at least 63 Hz to 4kHz	MDA S6.3.1 Table 11	Octave bands from 31.5Hz–8kHz have been adopted for the noise modelling.	Comply
S6.1.5	Predict levels covering the hub-height wind speed range for which power data is available from the manufacturer (including corresponding to the highest sound level generated by the turbine)	MDA S6.3.1 Tab 10	Wind speeds from 4–12 m/s adopted for prediction and assessment.	Comply
S6.1.6	Levels predicted for wind speed corresponding to 95% rated power for determining 35 and 40 dB sound level contours	MDA S6.4.1 Table 12	Predictions based on source level of 9 m/s corresponding to 100% rated power and maximum sound power output.	Comply





NZS6808:2010 Section/Clause	NZS 6808:2010 Requirement	Reference from Information Source	Assessment	Compliance
S6.2.1	Sound power levels used for predictions obtained from the wind turbine manufacturer determined in accordance with IEC 61400-11 unless otherwise stated	MDA S6.3.1 Tab 10 & 11	-	Comply
S6.2.2	Use sound power levels based on hub-height wind speeds.	MDA S6.3.1 Tab 10 & 11	Hub-height wind speed sound power data adopted	Comply
S8.1	Report of wind farm sound level predictions shall provide <ul style="list-style-type: none"> <li>a) A map showing topography in the vicinity of the wind farm, the position of the wind turbines, and noise sensitive locations</li> <li>b) Noise sensitive locations for which wind farm sound levels are calculated</li> <li>c) Wind turbine sound power levels</li> <li>d) The make and model of the wind turbines</li> <li>e) The hub height of the wind turbines</li> <li>f) Distance of noise sensitive locations from the wind turbines</li> <li>g) Calculation procedure used</li> <li>h) Meteorological conditions assumed</li> <li>i) Air absorption parameters used</li> <li>j) Ground attenuation parameters used</li> <li>k) Topography/screening assumed</li> <li>l) Predicted far-field wind farm sound levels</li> </ul>	MDA Appendix I  MDA Appendix E, F,  MDA Appendix D, E  MDA S6.3.1 Tab 10 & 11  MDA S6.2 Table 8  MDA S6.2 Table 8  MDA Appendix D Table 20  MDA S4.3 Table 2, Appendix H  MDA S4.3 Table 2, Appendix H  MDA S4.3 Table 2, Appendix H  MDA S4.3 Table 2, Appendix H		Comply



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