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OF PLANNING PERMIT

PL-SP/05/0461/A

MARSHALL DAY
Acoustics 

LAL LAL WIND FARM
NOISE COMPLIANCE TEST PLAN
Report No. 003 R03 20170649 | 23 January 2018

Project: **LAL LAL WIND FARM**

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Report No.: **003 R03 20170649**

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1.0 INTRODUCTION

This report presents the operational noise compliance monitoring procedures for the La Lal Wind Farm.

The Lal Lal Wind Farm is a consented project located in the Moorabool Shire, approximately 17 km southeast of Ballarat, Victoria. The Planning Permit for the Lal Lal Wind Farm includes conditions which specify requirements for the control of environment noise associated with the project. This report was commissioned by Lal Lal Wind Farms Pty Ltd to address Condition 24 of the Planning Permit which requires a Noise Compliance Testing Plan (NCTP) to be prepared to the satisfaction of the Minister of Planning before the development commences. After the NCTP is approved, it will be endorsed by the Minister for Planning and form part of the Planning Permit for the wind farm.

This report includes the NCTP content specified in Condition 25 of the Planning Permit and specifies:

- Operational noise limits
- Operational noise monitoring and assessment procedures
- Operational noise compliance reporting procedures

This report has been prepared on the basis of relevant information documented in Marshall Day Acoustics (MDA) report *Lal Lal Wind Farm – Background Noise Monitoring* (report reference Rp 001 201701649) dated 6 November 2017 (referred to as the *background noise report* herein).

The basic quantities used within this document to describe noise adopt the conventions outlined in ISO 1996-1:2016 *Acoustics - Description measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures*. Accordingly, all frequency weighted sound pressure levels are expressed as decibels (dB) in this report. For example, sound pressure levels measured using an “A” frequency weighting are expressed as L_A dB. Alternative ways of expressing A-weighted decibels such as dBA or dB(A) are therefore not used within this report.

Acoustic terminology used in this report is presented in Appendix A.

A description of the project and the wind turbines to be used at the site is provided Appendix B.

The NCTP has been prepared on the basis of the wind farm configuration described in Appendix B. Any changes to the type, hub height or layout of the wind turbines to be used at site will necessitate a review and possible amendment of the testing plan detailed herein.

General management measures for the control of construction noise are separately addressed in the Environmental Management Plan for the Lal Lal Wind Farm. The Planning Permit stipulates requirements for the control of noise during construction of the project, based on Victorian EPA Publication 1254 *Noise Control Guidelines* (EPA 1254). However, EPA 1254 does not stipulate objective noise criteria for normal working hours when most of the construction work would occur. Accordingly, this NCTP does not specify monitoring procedures for construction noise.

In addition, matters relating to complaint evaluation and compliance enforcement for the Lal Lal Wind Farm are addressed in a separate report prepared by Lal Lal Wind Farms Pty Ltd.

2.0 PLANNING PERMIT

An amended Planning Permit for the Lal Lal Wind Farm was issued in March 2017 (Planning Permit No. PL-SP/05/0461/A).

Conditions 22 to 27 of the Planning Permit establish requirements for the control of noise during construction and operation of the Lal Lal Wind Farm. The conditions are reproduced in full in Appendix A. The key requirements are summarised in Table 1.

Table 1: Planning permit – summary of operational noise related requirements

Condition	Summary of key requirements
22	Defines noise limits which apply to noise associated with construction of the wind farm, based on EPA guidelines.
23	Defines operational noise limits based on the New Zealand Standard NZS 6808
24	Specifies that a Noise Compliance Test Plan (NCTP) must be prepared prior to commencement of development of the wind farm.
25	Defines a requirement for the NCTP to be reviewed by an EPA accredited auditor, and their review findings must be included in the NCTP. The plan must be approved by the Minister for Planning and published on the wind farm operator's website. Also requires a compliance report to be submitted to the Minister for Planning within 12 months of the wind farm commencing full operation. The compliance report must be reviewed by an EPA accredited auditor and their findings must be submitted to the Minister for Planning in a separate report accompanying the compliance report.
26	Defines complaint evaluation requirements, including monitoring and response procedures.
27	Requires a Noise Complaint Investigation and Response Plan to be prepared before the first wind turbine is commissioned at the site. The plan must be approved by the Minister for Planning and published on the wind farm operator's website.

Condition 23 requires operational noise levels to be measured and assessed in accordance with New Zealand Standard NZS 6808:2010 *Acoustics – Wind farm noise* (NZS 6808:2010), subject to the following project-specific definitions:

- Noise limits are defined as 40 dB L_{A90} or the background noise level $L_{A90} + 5\text{dB}$, whichever is higher
- Noise limits and operational noise levels are to be determined separately for all-time periods (i.e. day and night combined) and night-time periods (10 pm to 7 am)
- A dwelling may be exempted from the noise limits if a suitable written agreement is established with the landowner of the dwelling (subject to evidence of the agreement being provided to the satisfaction of the responsible authority).

3.0 OPERATIONAL NOISE LIMITS

Operational noise limits apply at noise sensitive receivers in the vicinity of the Lal Lal Wind Farm. The coordinates of the noise sensitive receivers around the wind farm which have been considered in this NCTP are tabulated in Appendix D.

Background noise dependent limits have been determined in accordance with the Planning Permit (Condition 23) and NZS 6808:2010 on the basis of updated background noise data obtained in 2016 and 2017 for the following:

- A single receiver location (K34aa) which was surveyed in April to June 2016
- Five receiver location locations surveyed between August and September 2017.

The results of the monitoring, and the noise limits derived in accordance with the Planning Permit, are documented in the background noise report.

The operational noise limits for these locations are tabulated in Table 2 and Table 3 for the all-time (day and night combined) and night-time periods respectively. These limits apply solely to the noise associated with operation of the Lal Lal Wind Farm.

In addition to the monitoring locations detailed in Table 2 and Table 3, a seventh receiver location, K15aa, was also surveyed between August and September 2017. However, the data obtained at that time was significantly affected by a local source of noise which is believed to relate to a domestic air-conditioning system. The data is therefore not considered suitable for representing typical background noise levels around the dwelling. Repeat monitoring at K15aa was subsequently carried out between October and December 2017. At the time of preparing this NCTP, analysis of the additional background noise data, and incorporation of the data into an updated version of the background noise report, remains to be completed. For this reason, data for K15aa is not presented within this NCTP. Prior to commencement of operation of the wind farm, an updated background noise report is to be submitted to the responsible authority, detailing the monitoring results for K15aa, along with the results of any additional background noise monitoring conducted at other receiver locations around the Lal Lal wind farm.

Table 2: All-time period (day and night combined) – non-stakeholder wind farm noise limits, dB L_{A90}

Receiver	Site wind speed (m/s) at 93 m AGL at reference mast locations									
	≤6	7	8	9	10	11	12	13	14	15
H18aa	40.0	40.0	40.9	43.4	46.0	48.6	51.2	53.6	55.9	57.9
K34aa	40.0	40.0	40.0	42.0	44.1	46.2	48.2	50.2	52.0	53.6
L18aa	40.0	40.0	40.0	40.0	40.9	42.9	44.9	47.0	49.1	51.1
M29aa	40.0	40.0	40.0	40.0	41.4	43.4	45.3	47.2	49.0	50.6
N31ab	40.0	40.0	40.0	41.7	44.2	46.7	49.2	51.6	53.9	56.1
P30aa	40.0	40.0	40.9	43.4	46.0	48.6	51.2	53.6	55.9	57.9

Table 3: Night-time period - non-stakeholder wind farm noise limits, dB L_{A90}

Receiver	Site wind speed (m/s) at 93 m AGL at reference mast locations									
	≤6	7	8	9	10	11	12	13	14	15
H18aa	40.0	40.0	40.0	40.3	43.4	46.6	49.7	52.7	55.4	57.9
K34aa	40.0	40.0	40.0	40.0	42.2	44.6	46.9	49.2	51.4	53.3
L18aa	40.0	40.0	40.0	40.0	40.0	40.2	42.5	44.9	47.4	49.8
M29aa	40.0	40.0	40.0	40.0	40.0	40.4	42.7	45.0	47.2	49.3
N31ab	40.0	40.0	40.0	40.0	40.7	43.5	46.4	49.2	51.9	54.5
P30aa	40.0	40.0	40.0	40.3	43.4	46.6	49.7	52.7	55.4	57.9

At all non-stakeholder receivers where a representation of background noise data is not available, compliance may be demonstrated by determining that operational wind farm noise levels are below the minimum noise limit of 40 dB L_{A90} . However, where operational noise levels are determined to potentially be higher than 40 dB L_{A90} at a non-stakeholder receiver, background noise data will be required in order to assess compliance.

The locations of the reference masts for the wind speeds used to derive the noise limits in Table 2 and Table 3 are listed in Table 4.

Table 4: Site wind speed - reference masts

Receiver	Reference mast	Reference mast coordinates MGA 94 Zone 55	
		Easting	Northing
H18aa L18aa	Elaine	234574	5817575
K34aa M29aa N31ab P30aa	Yendon	238268	5830852

4.0 OPERATIONAL NOISE TESTING PROCEDURES

4.1 Operational noise measurement locations

Operational noise measurements shall be carried out at the following six (6) preferred noise sensitive receiver locations, subject to permission being granted by the landowners:

- H18aa
- K15aa
- K34aa
- L18aa
- M29aa
- N31ab

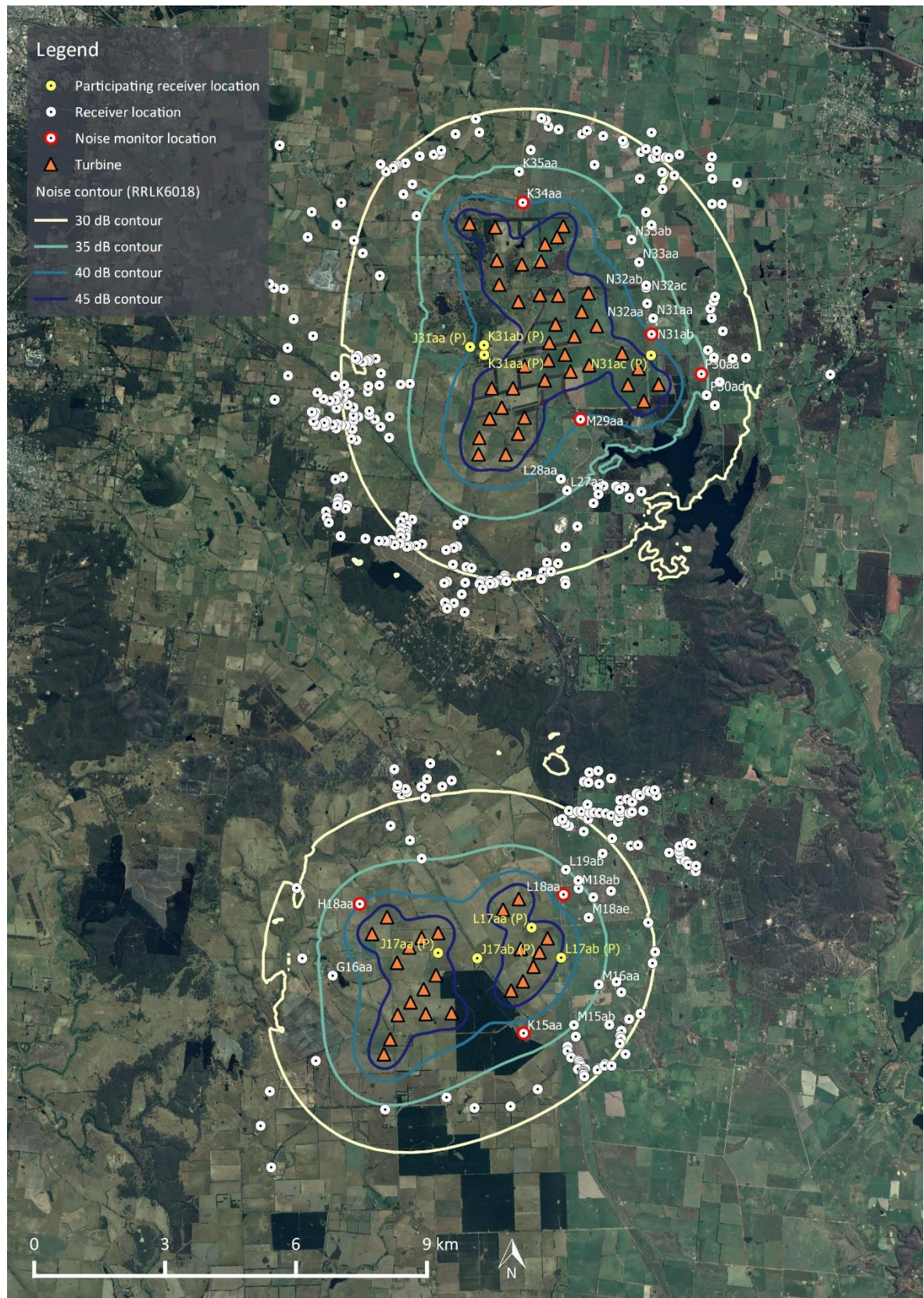
These locations have been selected to represent a range of noise sensitive receivers around the Lal Lal Wind farm where predicted noise levels are comparable to the 40 dB minimum operational noise limit. The locations are identified in Figure 1 along with the location of the 40 dB L_{A90} predicted noise level contour for the wind farm.

In the event that permission is not able to be obtained for conducting compliance measurements at the preferred noise sensitive receiver locations, alternative locations shall be considered.

The measurement systems shall be positioned in the vicinity of the dwelling at each of the preferred noise sensitive receivers for compliance monitoring. The following confirms the key aspects of NZS 6808:2010 with respect to measurement locations:

- The measurements shall not occur within 3.5 m of a vertical reflecting surface
- The measurements shall occur within 20 m of the dwelling
- The measurements shall occur as close as practically possible to the location of the background noise monitoring (see Appendix I for the coordinates of the background noise monitoring locations and Appendix F to Appendix L of the background noise monitoring report for photographs of the preferred monitoring locations).

Figure 1: Preferred monitoring locations and predicted noise level contours (dB LA90)



4.2 Operational noise measurement procedures

4.2.1 Acoustic data

The measurements shall be conducted in accordance with NZS 6808:2010, subject to the following project-specific procedural clarifications and requirements:

- The measurements shall comprise unattended monitoring for the measurement durations defined in Section 4.3 of this report
- The L_{A90} noise level shall be determined in consecutive ten (10) minute intervals synchronised with the interval commencing on the hour and each 10 minute increment following the start of each hour
- All noise measurements shall be conducted using low noise floor (≤ 20 dB) instrumentation that is certified to Class 1 standards (highest standard of instrumentation for field measurements) in accordance with IEC 61672-1:2013 *Electroacoustics - Sound level meters - Part 1: Specifications*
- The independent (laboratory) calibration date of the sound level measurement instrumentation must be within 2 years of the measurement period, as specified in Section 5.5 of Australian Standard AS 1055-1:1997 *Acoustics – Description and measurement of environmental noise – Part 1: General Procedures*
- Microphones shall be fitted with enhanced wind shield systems (enlarged primary wind shields or secondary wind shields) designed on the basis of the guidance contained in the UK Institute of Acoustics publication *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* dated May 2013 (the IOA GPG)
- Subject to the consent of the residents, two (2) minute uncompressed audio recordings shall be obtained for every ten (10) minute interval of the survey. The sampling rate for audio recordings shall be sufficient to allow assessment of tonality, if required, across the frequency range 10-5000 Hz
- Instantaneous one-third octave band sound pressure levels (fast response) shall be recorded in 100 ms intervals to enable an analysis of amplitude modulation if required.

Further information and guidance about data to be obtained during attended observations is provided in Section 4.4.

4.2.2 Site wind speeds

Site wind speeds shall be collected in ten (10) minute intervals throughout the noise measurement period. The timing of each ten (10) minute interval shall be synchronised with the interval commencing on the hour and each 10 minute increment following the start of each hour.

This data shall be used to determine the wind speed at 93 m AGL (the reference wind speed height) corresponding to free-field conditions (i.e. free from turbine wake effects) at the reference mast locations listed in Table 4 of Section 3.0 (and any other reference mast locations used for additional background noise monitoring conducted prior to commencement of operation of the wind farm).

Wind speeds at 93 m AGL which are determined from wind speed measurements at heights below 93 m shall be determined using the procedures outlined in the IOA GPG *Supplementary Guidance Note 4: Wind Shear*, or an alternative method deemed appropriate by the wind engineer responsible for the supply of the data

Wind speeds may need to be measured at different locations for different wind directions in order to obtain data that is not influenced by the wake effects of upwind turbines (e.g. collection of wind data at upwind locations around the perimeter of the wind farm). Wind speeds measured at different locations will need to be translated to the wind speed at the reference mast locations (i.e. to determine the wind speed which would have been measured at the reference masts in the absence of the effect of the wind farm).

All procedures used to determine 93 m AGL wind speeds at the reference mast locations shall be validated and documented by the wind engineer for the project (see reporting requirements in Section 6.0).

4.2.3 Other data

The following additional data requirements are noted:

- Local wind speeds: wind speeds at 1.5 m AGL shall be measured in ten (10) minute intervals at a minimum of one (1) receiver location during each stage of noise measurements. The use of enhanced wind shield systems (detailed in Section 4.2.1) shall be the primary method of addressing the potential for wind-induced extraneous noise across the measurement microphones. However, local wind speeds in the vicinity of the noise measurement systems shall be obtained to provide a secondary reference when reviewing the trends of the measured noise data
- Rainfall: rainfall shall be measured in ten (10) minute intervals at a minimum of one (1) receiver location during the survey
- Site operational data: the operational status of each turbine shall be recorded in ten (10) minute intervals and shall contain sufficient detail to differentiate whether a turbine was operating (including its mode of operation), available to operate, configured in an atypical mode of operation or shutdown
- Site records: site personnel shall be advised of the noise monitoring and shall be requested to record any observations with respect to atypical operations or noise levels (related to both the wind farm and ambient environment) which may influence the measurements. These observations, as well as any noise complaints independently recorded via the site's complaint handling and management system, shall be provided to the acoustic consultant. As a minimum, each record shall include details of the time, duration and location of the observation.

The timing of each ten (10) minute interval for the above data shall be synchronised with the interval commencing on the hour and each 10 minute increment following the start of each hour.

4.3 Operational noise measurement timing and duration

Compliance measurements shall be conducted in two (2) stages of monitoring for each measurement location.

Each stage shall comprise a minimum of four (4) weeks continuous monitoring, extended by up to four (4) weeks if required to obtain sufficient data, accounting for the recommendations detailed in clauses 7.2.1 and C7.2.1 of NZS 6808:2010. Specifically, extended surveys may be required to:

- Obtain data for wind speeds and conditions that are:
 - representative of the range generally expected at the wind farm site (long term wind speed and direction trends are provided in Appendix H for reference)
 - representative of the normal operating range of the turbines (the target minimum wind speed range is 3 m/s to 10 m/s at hub height, based on the notional wind speeds when the turbines commence operating and reach their maximum rated power)
- Address non-uniform distributions or a sparsity of noise measurement data in certain wind speeds or directions that may be consequential to the assessment outcome
- Address significant variations in measurement data which may be the result of seasonal factors or contaminating sounds, and which cannot be addressed with selective data filtering.

A preliminary analysis of the data may be required to assess the suitability of the data prior to completion of the measurements (refer to Section 5.0 of this NCTP for details of analysis procedures).

If significant data limitations remain evident after the surveys have been extended by four (4) weeks, the merits of an additional survey extension shall be reviewed by the acoustic consultant responsible for conducting the testing. If further extensions are not considered to be warranted, the compliance assessment strategy for the location(s) in question shall be reviewed and the responsible authority consulted.

The first stage of monitoring shall be commenced within two (2) months following the commissioning of the last turbine of the Lal Lal Wind Farm.

The second stage shall commence between 10 and 12 months following the commissioning of the last turbine of the Lal Lal Wind Farm.

This program of monitoring has been selected to:

- Exceed the ten (10) day minimum survey duration stated in NZS 6808:2010
- Enable data to be captured over a range of conditions during the first 12 months of the wind farm's operation
- Enable a final compliance report must be submitted to the Minister for Planning after a 12 month period following full operation of the facility, as required by condition 25 c) of the Planning Permit.

Adhering to the program will be dependent on the consent of the landowners of the preferred noise sensitive receiver locations for conducting the monitoring.

Details of the timing and scheduling of the attended observations that are to occur as part of the testing are provided in Section 4.4.

4.4 Special Audible Characteristics

4.4.1 General assessment procedures

The presence of Special Audible Characteristics (SACs) in the noise associated with the wind farm shall be reviewed.

In instances where SACs comprising amplitude modulation, impulsiveness or tonality are identified, an objective assessment of the sound's character shall be undertaken to determine if penalties should be applied to the measured noise levels.

4.4.2 Identification of SACs

The identification of SACs shall be based on attended observations undertaken by a qualified acoustic engineer with experience in the assessment of wind farm sound.

Three (3) sets of attended observations shall be undertaken during each stage of the monitoring as follows:

- During deployment of the monitoring instrumentation
- During an interim visit to the site
- During retrieval of the monitoring installation.

Scheduling of the deployment and retrieval of the monitoring is dependent on practical considerations including timing of access to residential properties. However, the wind farm must be operating at the time of the attended observations, and attempts shall be made to arrange the periods of attendance to coincide with suitable weather conditions for conducting wind farm observations.

Suitable conditions are generally considered to be:

- Winds between approximately 5 m/s and 10 m/s at the turbine hub-height
- Little or no rainfall
- Times when background noise levels are expected to be lower.

At least one (1) set of attended observations per stage of monitoring shall be conducted during the night.

Each set of attended observations in the vicinity of the compliance monitoring locations shall comprise observations for at least ten (10) minutes at a minimum of six (6) locations around the wind farm, in the vicinity of the compliance monitoring locations. The minimum duration of the observations shall be increased to thirty (30) minutes per observation location when the sound of the wind farm is clearly audible.

The assessment of SACs strictly applies to the sound of the wind farm at the compliance monitoring locations. However, for informative purposes, observations shall also be undertaken in proximity of the turbines during at least one (1) of the three (3) sets of attended observations. The observations shall take place at distances typically between 100 m and 300 m from the turbines that are nearest to each compliance monitoring location. The wind farm must be operating at the time of the attended observations. The primary purpose of the observations near the turbines is to obtain information about tonal or impulsive sound emissions that can be used to guide the observation of potential SACs at the compliance monitoring locations. Data obtained near to the turbines shall not be used as the basis for applying SAC penalties, nor shall near field observations be used as a reference for SACs related to amplitude modulation (amplitude modulation of audible sound in the vicinity of turbines generally relates to blade swish noise which is highly directional and therefore does not represent the type of sound which may be expected at distant receiver locations).

During each attended observation, and at all locations, audio samples shall be obtained to provide a record of the sound environment at the time of the inspection and provide a basis for further objective assessment if required.

4.4.3 Objective assessment methods

In accordance with NZS 6808:2010, the results of the subjective assessments made during the attended observation are the determining factor on whether to conduct an objective assessment. Further, Appendix B1 of NZS 6808:2010 also states that subjective assessment can be sufficient in some circumstances to assess SACs.

If one or more SACs are identified during the attended observations, the identified SAC(s) shall be analysed using the procedures defined in Table 5. The results shall be used to assist the decision to apply penalties, and if so, the magnitude of the penalties to be applied. Objective assessment methods can produce false positives and false negatives, particularly when applied to large volumes of unattended measurement results which are affected by a combination of ambient and wind farm related sounds. The results of objective assessments must therefore always be considered in conjunction with the findings of the subjective assessments.

Table 5: SAC objective assessment procedures

SAC	Objective assessment procedure
Amplitude modulation	UK Institute of Acoustics' Amplitude Modulation Working Group publication <i>Final Report - A Method for Rating Amplitude Modulation in Wind Turbine Noise Version 1</i> dated 9 Aug 2016 (UK IOA AM procedure)
Impulsiveness	British Standard <i>BS 4142:2014 Methods for rating and assessing industrial and commercial sound</i> (BS 4142:2014)
Tonality	International Standard ISO 1996-2:2017 <i>Acoustics — Description, measurement and assessment of environmental noise — Part 2: Determination of sound pressure levels</i> 2017 (ISO 1996-2:2017) The narrow band method defined in ISO 1996-2:2017 Annex J <i>Objective method for assessing the audibility of tones in noise — Engineering method</i> (Annex J) is to be used.

The procedure for amplitude modulation is specified in lieu of the interim procedure noted in Appendix B of NZS 6808:2010, consistent with the commentary in NZS 6808:2010 which indicated that more robust methods were expected to become available for amplitude modulation. Note that the UK IOA AM procedure does not define a scheme for determining the penalty which should be applied when amplitude modulation is assessed to be present. Relevant guidance on a penalty scheme to be used with the UK IOA AM procedure is provided by the UK government commissioned research project *Review of the evidence on the response to amplitude modulation from wind turbines and the findings* documented in the report *Wind Turbine AM Review Phase 2 Report* dated August 2016 (the UK government AM review). The UK government AM review shall be referenced in determining the appropriate penalty to be applied, unless updated research concerning penalty schemes for amplitude modulation is published by the UK IOA.

The procedure specified for impulsiveness has been selected in the absence of any defined procedure in either NZS 6808:2010 or ISO 1996-2:2017. The procedure documented in BS 4142:2014 was derived from the NORDTEST publication *Acoustics: Prominence of impulsive sounds and for adjustment of L_{Aeq}* (NT ACOU 112).

The procedure for tonality is based on Appendix B of NZS 6808:2010 which specifies narrow band tonality procedures as follows:

The reference method shall be that prescribed in Annex C to ISO 1996-2:2007 or an equivalent method.

Given that ISO 1996-2:2007 was superseded, the narrow band tonality procedures documented in the updated version ISO 1996-2:2017 have been referenced as the appropriate “equivalent method” in accordance with NZS 6808:2010. Specifically, as per Annex J of ISO 1996-2:2017, tonal audibility levels are to be determined in accordance with ISO/PAS 20065:2016 *Acoustics - Objective method for assessing the audibility of tones in noise – Engineering Method* (ISO/PAS 20065:2016). The value of the adjustments to be applied to the noise level of the wind farm, where applicable, are to be determined on the basis of Table J.1 in Annex J of ISO 1996-2:2017, using the tonal audibility level determined in accordance with ISO/PAS 20065:2017.

The objective assessment shall be applied to the audio recording obtained during the attended observation in which one or more potential SACs were identified. The objective assessment shall be undertaken for the type of potential SAC which has been observed.

Additionally, if the records provided by site personnel (see earlier description in Section update 4.2.3) are indicative of potential SACs, an objective assessment shall be undertaken for the audio recording obtained during the corresponding period. The objective assessment shall be undertaken for the type of potential SAC which is indicated by the records.

If the objective assessment indicates the presence of the SAC(s) at a level which warrants the application of a penalty, the objective assessment shall be carried out for the unattended audio records (where available) obtained from the unattended compliance monitoring.

If the objective assessment does not indicate the presence of the SAC(s) at a level which warrants the application of a penalty, the objective assessment may still need to be carried out for the unattended audio records (where available), to determine the potential for a penalty to be warranted at other times. In such instances, the acoustic engineer responsible for conducting the objective assessment shall determine the need for further investigation of the unattended audio records and shall document the determination in the reporting for the compliance assessment (see reporting requirements subsequently in Section 6.0).

Caution must be exercised when conducting objective assessment of unattended audio recordings. Applying the objective assessment methods to the total sound of the wind farm and ambient environment will inevitably produce false-positives caused by sound sources that are unrelated to the operation of the wind farm (e.g. bird or insect noise in an audio sample may result in a tone being determined in the sound recording). Penalties shall only be applied when the wind farm is confirmed as the source of the identified character. Penalties are also strictly only applicable to the component of the sound that is solely attributable to the operation of the wind farm. The results of automated analysis of unattended audio recordings will therefore likely require the application of data filtering measures to remove false positives for periods with attributes that are most likely related to ambient sounds (e.g. tonality as a result of birds or insects). Further guidance is provided in Section 5.8.

In instances where there is uncertainty about whether penalties are warranted at the compliance monitoring locations, data or observations at intermediate locations (between the wind farm and the compliance monitoring locations) may be referenced where available.

The absence of impulsiveness or tonality in the sound of the wind farm at intermediate locations is sufficient to conclude an absence of these SACs at receiver locations. However, due to the complex mechanisms associated with potential amplitude modulation, the assessment of amplitude modulation must always be undertaken at locations that are representative of the compliance monitoring locations being assessed.

5.0 OPERATIONAL NOISE ANALYSIS

The analysis shall be conducted in accordance NZS 6808:2010, subject to the clarifications and project-specific requirements detailed in the following subsections.

5.1 Rainfall

Any ten (10) minute in which rainfall occurred shall be filtered and therefore removed from the analysis. The measurement data shall also be reviewed to identify and filter periods following rainfall in which noise levels may be elevated as a result of wet roads or flow noise associated with local watercourses.

5.2 Extraneous noise screening

The measured noise data shall be reviewed to identify and filter periods in which extraneous noise sources are likely to have affected the measurements. Extraneous noise sources include domestic machinery, agricultural operations, construction noise or elevated bird/frog/insect noise.

Individual ten (10) minute measurement samples that are likely to have been affected by high frequency extraneous noise shall be identified and filtered from the analysis when the following conditions¹ are satisfied:

- The highest A-weighted one-third octave band noise level is greater than 1 kHz; and
- The identified one-third octave band A-weighted noise level is greater than a level of 20 dB L_{A90} and is within 5 dB of the broadband A-weighted noise level for the ten (10) minute sample in question.

The above procedure is identical to the screening process applied to the analysis of the background noise monitoring data for the Lal Lal Wind Farm.

The sound of a wind farm is unlikely to result in tones above 1 kHz (due to high levels of atmospheric sound absorption at frequencies above 1 kHz) and, in the unlikely event of such a tone occurring, is unlikely to dominate the level of a one-third octave band. However, the procedure outlined above shall not be used to remove any measurement sample where the identified one-third octave band corresponds to a frequency in which the attended observations have indicate the potential for tones related the operation of the wind farm. Further discussion of extraneous noise screening related to seasonal variations is provides in Section 5.4.

¹ Griffin, D., Delaire, C., & Pischedda, P. (2013). Methods of identifying extraneous noise during unattended noise measurements. *20th International Congress of Sound & Vibration*.

5.3 Atypical wind farm operation screening

The compliance assessment shall be based on data obtained during periods that are representative of the normal operating conditions of the wind farm.

The operational records for each turbine for each ten (10) minute period shall be reviewed to identify any periods of atypical operation or shutdown that are to be excluded from the analysis.

As a minimum, any ten (10) minute period in which the relevant turbines identified in Appendix G are not available to generate power, or operate in an atypical mode of operation, shall be identified and removed from the analysis for the relevant monitoring location being considered.

The turbines that are considered not relevant for each receiver location were identified as the turbines with the lowest predicted noise levels which collectively result in a predicted noise level 15 dB² lower than the predicted noise level of the turbine which contributes the highest level at the receiver. This means that if any or all of the non-relevant turbines were to not operate during a given measurement period, the reduction in total noise level would be 0.1 dB or less and would therefore generally be inconsequential to the assessment outcome

5.4 Review of seasonal considerations

Seasonal variations can affect both the level of background sound and operational wind farm noise.

5.4.1 Background sound

The main potential sources of seasonal variations in background sound are:

- rainfall (see data filtering procedures in Section 5.1)
- insect and bird noise (see data filtering procedures in Section 5.2)
- local domestic plant such as air-condition or heating
- changes in domestic or agricultural activity in the vicinity of the monitoring location.

Other sources of background sound variation may relate to changes in vegetation, wind direction and wind shear.

The data shall be reviewed to identify any anomalous trends that are indicative of significant seasonal variations. These types of effects may be evident as elevated noise levels (in relation to the data contained in the background noise report) at low wind speeds (0 to 3 m/s at hub height), or striations in the data characterised by relatively constant levels across a range of wind speeds (e.g. as would occur if domestic or agricultural machinery significantly influences the measurements).

Any identified variations in the measured levels that are considered to have been attributed to seasonal changes in background sound levels shall be filtered from the analysis where possible. If the effect cannot be reliably filtered, and the effect is sufficient to preclude an assessment of the wind farm's compliance, supplementary procedures (see Section 5.7) or repeat measurements will be required.

² A level that is 10 dB below the noise source under investigation is generally used for environmental noise assessment work considered (e.g. see NZS 6808:2010 on/off testing procedures which refers to a 10 dB down threshold). However, a source of noise that is 10 dB lower in level will contribute 0.4 dB to the total noise level. A 0.4 dB level variation may alter a wind farm compliance assessment outcome. Hence the selection of a lower threshold based on being 15 dB lower than the level of the highest turbine contribution.

5.4.2 Wind farm noise

The main potential source of seasonal variation in wind farm noise levels is wind direction and wind speed.

The wind directions and wind speeds that occurred during the survey shall be reviewed to determine whether the conditions were representative of the range generally expected at the wind farm site, having regard to the long term trend data provided in Appendix H. In particular, if upwind or crosswind conditions are found to have occurred more regularly than is generally expected at the site, repeat measurements will generally be required.

In some cases, a sensitivity analysis or supplementary assessment procedures (see Section 5.7) may be sufficient to enable an assessment of compliance without further measurement extensions.

For example, while NZS 6808:2010 is based on evaluating compliance for the aggregated measurement data for the range of conditions normally expected at the site (subject to subset considerations noted in Section 5.5), an analysis limited to data obtained under downwind conditions may be sufficient to demonstrate compliance. Additionally, the availability of limited data for high wind speeds may be addressed by reference to other information relating to the change in the wind farm's sound emission with increasing wind speed (e.g. manufacturer sound power level documentation in accordance with IEC 61400-11:2012 or measurement data obtained at intermediation locations or other compliance monitoring locations around the wind farm – see supplementary procedures in Section 5.7).

The assessment is referenced to hub height wind speeds and therefore seasonal wind shear variations are primarily relevant to potential variations in background noise levels rather than wind farm noise levels. However, wind shear may be relevant to the assessment of SACs. This is due to increased wind shear having the potential to result in lower background noise levels and the potential for wind shear to affect the sound characteristics of the wind farm. Attended observations must therefore include time periods when increased wind shear could be expected (note the requirement in Section 4.3 for at least one set of attended observations to occur during the night for each stage of the surveys).

5.5 Identification of potential data subsets

The measurement data shall be reviewed in accordance with NZS 6808:2010 to identify any distinctive trends or large variations in level which warrant definition and analysis of a subset of the data. These subsets may be defined by wind direction, time of day or a combination of the two.

Any identified subsets that our found to warrant analysis shall be assessed separately when comparing the measured noise levels with the compliance limits.

5.6 Adjustment for background noise levels

The background noise levels documented in the background noise monitoring report (and any other background noise monitoring data obtained prior to commencement of operation of the wind farm) shall be used to adjust compliance monitoring results for the influence of background noise levels.

The adjustment shall be applied to the regression analysis of the compliance monitoring data, using the method described in clause 7.5.3 of NZS 6808:2010.

The tabulated background data to be used for this analysis is reproduced in Appendix I.

5.7 Supplementary procedures

The data filtering and background noise adjustment procedures detailed in Section 5.1 to Section 5.4 shall be used to reduce the influence of background noise levels.

If the residual influence of background noise precludes a definitive assessment of compliance, supplementary procedures shall be used to reduce the uncertainty.

A supplementary analysis shall be undertaken by comparing data measured at the compliance monitoring locations during upwind and downwind conditions. Higher noise levels during downwind conditions are indicative of the results being influenced by the operation of the wind farm. Conversely, comparable noise levels during upwind and downwind conditions are indicative of an environment dominated by the influence of sources that are not related to the operation of the wind farm.

If noise measurement data obtained at an intermediate location between the wind farm and the noise sensitive receiver locations is available, this may be used to inform an assessment of the wind farm at the compliance monitoring locations.

Intermediate locations, where used, and subject to practical access constraints, shall generally be located:

- In the vicinity of the predicted 45 dB L_{A90} contour associated with the wind farm
- At positions that are suitable for measuring conditions that are representative of downwind propagation from the wind farm to the noise sensitive receiver location, accounting for all turbines that significantly contribute to the total wind farm noise levels at the noise sensitive receiver location.

Noise measurement data obtained at intermediate locations shall be used as follows:

- Noise level versus wind speed profile: data obtained at an intermediate location shall be used to define the profile of the change in measured wind turbine noise levels with increasing wind speeds. This profile shall then be compared to the profile measured at the compliance monitoring location to determine if increasing noise levels at the receiver location are attributable to the wind farm (i.e. the profiles at the intermediate and the compliance monitoring location are equivalent) or the influence of wind related background noise levels (i.e. the profiles at the intermediate and the compliance monitoring location are not equivalent)
- Data filtering: any ten (10) minute period in which the measured noise level at the noise sensitive receiver location is higher than the simultaneously measured level at the intermediate location shall be considered background noise affected and may be removed from the analysis
- Extrapolation: data obtained at an intermediate location shall be extrapolated to the compliance monitoring location in accordance with the procedure documented in Section 11.2 of ISO 1996-2 *Acoustics — Description, measurement and assessment of environmental noise — Part 2: Determination of environmental noise levels* 2017 (ISO 1996-2:2017). The extrapolation shall be undertaken on the basis of the same prediction methodology utilised for the pre-development noise report, subject to the addition of a 1 dB uncertainty margin to the predictions to account for variations in the tolerance of the calculations at intermediate and receptor distances.

The extrapolation of data measured at intermediate locations is consistent with current wind farm noise guidance in NSW³. The procedure may also be used to assess noise levels at other noise sensitive receiver locations where compliance monitoring has not been undertaken.

³ NSW Government Planning & Environment *Wind energy: Noise Assessment Bulletin For State significant wind energy development*, dated December 2016

If noise measurement data at an intermediate location is not available, an alternative method of enabling an assessment of the wind farm at the compliance monitoring locations will need to be defined. This may involve a targeted assessment of specific conditions (i.e. wind speeds and times of day) and consideration of additional measurements at a representative location where background noise levels are lower or on/off testing in accordance with the procedures defined in Section 7.7 of NZS 6808:2010. However, as noted in NZS 6808:2010, on/off testing of large wind farms introduces practical complications related to variations in power supply to the grid, and the problem of obtaining suitable wind conditions for noise assessment purposes at times when the power variation can be practically accommodated.

5.8 Application of penalties for SACs

If penalties for SACs are found to be warranted, the penalties shall be applied to the noise of the wind farm in accordance with NZS 6808:2010. The following aspects of the NZS 6808:2010 are clarified as follows:

- The penalties shall be applied to the individual ten (10) minute samples in which SAC(s) are identified, prior to conducting a regression analysis of the complete measurement data set
- A maximum penalty of up to + 6 dB shall be applied for the presence of one or more SACs (i.e. the penalties do not apply cumulatively, consistent with clause 5.4.3 of NZS 6808:2010)
- A fixed value penalty of +5 dB shall be added to the measured noise level when amplitude modulation and/or impulsivity are identified at levels that are sufficient to warrant the application of a penalty (consistent with Appendix B4 of NZS 6808:2010)
- A penalty of up to + 6 dB shall be added to the measured noise level for tonality, the precise value being determined on the basis of Table J.1 in Annex J of ISO 1996-2:2017, using the tonal audibility level determined in accordance with ISO/PAS 20065:2017.

If penalties are to be applied to the results of unattended noise measurement data, based on the results of analysis of the audio recordings during the survey, caution must be applied to avoid the application of penalties as a result of false-positive results from objective assessment methods. For example, penalties should not be applied to individual measurement samples in which an objective assessment has identified a potential SAC which has not been observed (e.g. tones identified in the unattended data at frequencies other than those that have been observed from the operation of the wind farm). Some level of data filtering is therefore expected to be implemented when applying SAC related penalties to the results of unattended noise measurement data.

The assessment method in NZS 6808 is primarily based on regression analysis of the relationship between noise levels and wind speeds. However, if SACs are identified at a specific range of wind speeds, a binned analysis of the penalty adjusted data for the relevant wind speeds shall be carried out for informative purposes only.

6.0 OPERATIONAL NOISE REPORTING

Compliance reports shall be submitted to the Minister for Planning within six (6) weeks of completing each stage of the compliance monitoring.

The reporting shall adhere to the documentation requirements detailed in Section 8.3 of NZS 6808:2010, and shall include the following:

- Supporting documentation for the site wind speed data referenced in the compliance assessment
- Charts illustrating the noise measurement results shall clearly identify all samples that have been filtered from the analysis due to rainfall or the identification of extraneous noise influences. The analysis shall be supplemented by a summary table for each noise monitoring location detailing the total number of measurements points, the number of points that have been removed, and the final number of data points that the analysis has been based on
- Full details of all attended observations conducted for the purpose of identifying where SACs are potentially present in the sound of the wind farm
- Full details of any supplementary procedures that have been adopted as part of conducting the compliance assessment.

7.0 ORGANISATIONS & RESPONSIBILITIES

Operational noise compliance testing in accordance with the requirements of the planning permit will involve a number of organisations. Their roles and responsibilities are summarised in Table 6. It is ultimately the responsibility of the windfarm operator to ensure these tasks are carried out by personnel suitably qualified and experienced in the assessments they are undertaking.

Table 6: Summary of organisations and their responsibilities

Organisation	Responsibility
Lal Lal Wind Farms Pty Ltd (i.e. the developer)	- Commissioning the relevant organisations as follows - Acoustic consultant - Wind engineering consultant - EPA accredited auditor - Liaising with residents to obtain permission to conduct the compliance monitoring - Supply of the wind farm's operating records for the duration of the compliance surveys
Acoustic consultant	- Conducting testing, analysis and reporting in accordance with the planning permit and the endorsed NCTP - Preparing supplementary information for submission to the Minister for Planning in any instances where a deviation from the NCTP is found to be required (e.g. in relation to accessible survey locations or the survey duration)
Wind engineering consultant	- Verify the sources of wind data to be referenced in the compliance monitoring, prior to the commencement of the noise surveys - Supply of preliminary wind speed data sets prior to completion of each stage of measurements (primarily for assessing the adequacy of conditions during the survey period) - Supply of the assessment wind speed data sets, comprising hub height wind speed data that is representative of wake-free conditions at the reference mast locations - Supply of a statement for inclusion in the operational noise compliance reports detailing all measurement and analysis procedures used to synthesise the assessment wind speed data set
EPA accredited auditor	- Review of the NCTP to determine whether the NCTP meets the requirements of the planning permit - Review of the Stage 1 and Stage 2 reports to determine whether the testing and analysis and reporting was undertaken in accordance with planning permit and the endorsed NCTP
Minister for Planning	- Endorsement of the NCTP - Review of the Stage 1 and Stage 2 compliance reports - Determining whether the planning permit requirements for post construction compliance monitoring and compliance assessment have been addressed

APPENDIX A GLOSSARY OF TERMINOLOGY

Frequency	The number of pressure fluctuation cycles per second of a sound wave. Measured in units of Hertz (Hz).
Hertz (Hz)	Hertz is the unit of frequency. One hertz is one cycle per second. One thousand hertz is a kilohertz (kHz).
dB	Decibel. The unit of sound level.
L_w	The sound power level. The level of total sound power radiated by a sound source.
L_{WA}	The “A” weighted sound power level.
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
L_{A90} (t)	The A-weighted noise level equalled or exceeded for 90% of the measurement period. This is commonly referred to as the background noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
L_{Aeq} (t)	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
Special Audible Characteristics	Features of a sound which, when present, increase the likelihood of adverse reaction the sound. These characteristics include tonality, impulsiveness and amplitude modulation.
Tonality	Sound characterized by a single frequency component or narrow-band components that emerge audibly from the total sound (e.g. whines or hissing sounds)
Impulsiveness	Sound that is characterised by a distinct and very rapid rise in sound level (e.g. a car door closing or the impact sound of a hammer)
Amplitude Modulation	Sound that is characterised by a rhythmic and higher than normal rise and fall in sound level at regular intervals.

APPENDIX B LAL LAL WIND FARM DESCRIPTION

B1 Overview

The Lal Lal Wind Farm is a consented project located in the Moorabool Shire, approximately 17 km southeast of Ballarat, Victoria.

Planning Permit No. PL-SP/05/0461/A as amended 20 March 2017 allows for the use and development of a wind energy facility comprising a maximum of sixty (60) wind turbines, subject to a set of conditions relating to matters including environmental noise levels.

The Lal Lal Wind Farm turbine layout extends over an area spanning approximately 19 km from north to south and 7 km east to west.

B2 Wind turbine model

Table 7: Proposed wind turbines

Detail	Turbine model
Rotor diameter	136 m
Hub height	93 m
Blade orientation	Upwind
Turbine regulation method	Variable blade pitch
Maximum rated power generating capacity	3.6 MW
Cut-in wind speed (hub height)	3 m/s
Rated power wind speed (hub height)	12 m/s
Cut-out wind speed (hub height)	22.5 m/s

APPENDIX C TURBINE COORDINATES

The following table sets out the coordinates of the sixty (60) turbine layout of the Lal Lal Wind Farm (Rev. 11 layout supplied by Lal Lal Wind Farms Pty Ltd on 17 January 2018).

Table 8: Lal Lal Wind Farm turbine coordinates – MGA 94 zone 55

Turbine	Easting	Northing	Turbine	Easting	Northing
ESWT01	233512	5817821	YSWT10	236427	5832689
ESWT02	233856	5818204	YSWT11	236867	5832295
ESWT03	234084	5817161	YSWT12	237362	5832449
ESWT04	234368	5817513	YSWT13	237778	5832435
ESWT05	234648	5817731	YSWT14	237721	5831776
ESWT06	235028	5817842	YSWT15	237577	5831353
ESWT07	236515	5818378	YSWT16	238475	5832492
ESWT08	236876	5818621	YSWT17	238318	5832069
ESWT10	234101	5815965	YSWT18	238663	5831739
ESWT11	234393	5816255	YSWT19	238151	5831503
ESWT12	234695	5816555	YSWT20	237011	5830822
ESWT13	234979	5816876	YSWT21	236257	5830315
ESWT14	234744	5815988	YSWT22	236743	5830314
ESWT15	235337	5816007	YSWT23	236485	5829872
ESWT16	236922	5817477	YSWT24	236209	5829620
ESWT17	236699	5816524	YSWT25	237009	5829643
ESWT18	236972	5816736	YSWT26	235970	5829179
ESWT19	237212	5817071	YSWT27	236860	5829275
ESWT20	237353	5817401	YSWT28	235952	5828802
ESWT21	237536	5817719	YSWT29	236579	5828800
ESWT23	233785	5815068	YSWT30	237553	5830953
ESWT24	233928	5815408	YSWT31	237935	5831086
YSWT01	235749	5834082	YSWT32	239245	5831116
YSWT02	236335	5834001	YSWT33	237473	5830494
YSWT03	237895	5834026	YSWT34	238063	5830698
YSWT05	237479	5833611	YSWT35	238489	5830840
YSWT06	237758	5833776	YSWT36	239624	5830764
YSWT07	236374	5833239	YSWT38	239378	5830392
YSWT08	236947	5833151	YSWT39	240083	5830399
YSWT09	237383	5833222	YSWT40	239743	5830020

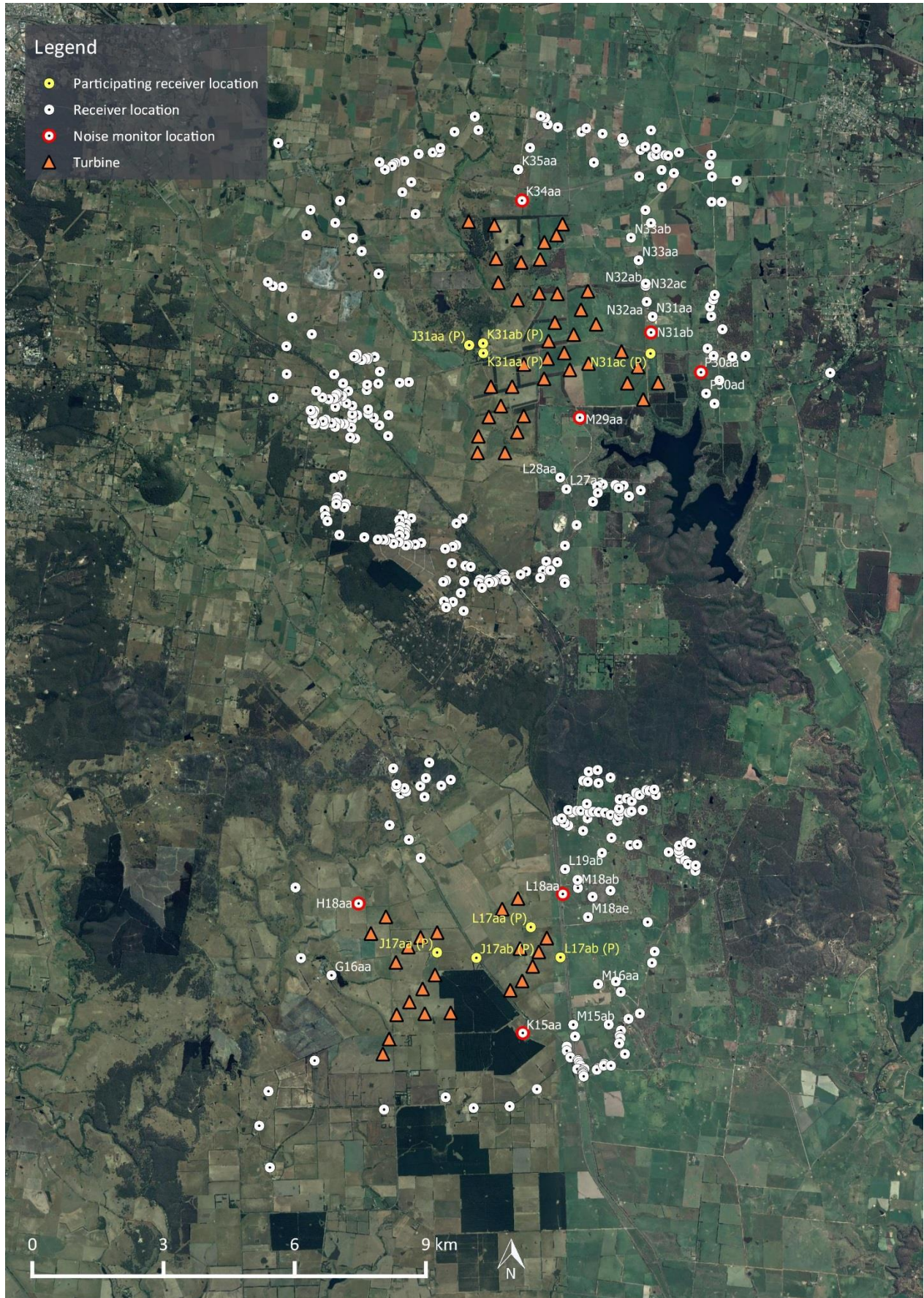
APPENDIX D RECEIVER COORDINATES

The following table sets out the coordinates of the noise sensitive receiver locations considered in the preparation of the Lal Lal Wind Farm NCTP, where wind farm noise levels have been predicted at or above 35 dB L_{A90} .

Table 9: Lal Lal Wind Farm – noise sensitive receiver locations – MGA 94 zone 55

Receiver ID	Easting	Northing	Distance to the nearest turbine (m)
G16aa	232610	5816865	1,318
H18aa	233207	5818510	723
J17aa (P)	235026	5817386	465
J17ab (P)	235924	5817263	1,025
J31aa (P)	235760	5831259	1,071
K15aa	236990	5815534	1,036
K31aa (P)	236084	5831076	786
K31ab (P)	236079	5831300	1,005
K34aa	236976	5834575	865
K35aa	236884	5835273	1,388
L17aa (P)	237170	5817965	450
L17ab (P)	237848	5817275	519
L18aa	237913	5818705	1,044
L19ab	237955	5819290	1,273
L27aa	237982	5827972	1,632
L28aa	237842	5828237	1,386
M15ab	238142	5815735	1,542
M16aa	238711	5816662	1,549
M18ab	238248	5818860	1,348
M18ae	238478	5818196	1,060
M29aa	238304	5829565	1,162
N31aa	239957	5831913	1,073
N31ab	239934	5831553	821
N31ac (P)	239908	5831068	426
N32aa	239820	5832252	1,269
N32ab	239795	5832616	1,329
N32ac	239798	5832667	1,338
N33aa	239635	5833198	1,361
N33ab	239461	5833716	1,574
P30aa	241059	5830668	1,016
P30ad	241181	5830156	1,128

APPENDIX E SITE LAYOUT PLAN



APPENDIX F PLANNING PERMIT – NOISE REQUIREMENTS

The following noise related conditions are defined in Planning Permit No. PL-SP/05/0461/A as amended 20 March 2017.

NOISE LIMITS

22. *Construction of the wind energy facility must comply with noise criteria specified in the EPA Noise Control Guidelines, Construction and Demolition Site Noise, Publication 1254, October 2008 at any dwelling existing on land in the vicinity of the proposed wind energy facility as at the date of the issue of this permit to the satisfaction of the Minister for Planning.*
23. *Except as provided below in this condition, the operation of the wind energy facility must comply with New Zealand Standard 6808:2010, Acoustics – Wind Farm Noise (the Standard) as modified by this condition to the satisfaction of the Minister for Planning.*

In determining compliance the following requirements apply:

- a) *The operator must ensure that at any wind speed, wind farm sound levels, determined in accordance with the Standard at noise sensitive locations (as defined in the Standard) do not exceed a noise limit of 40dB LA90,10min or background (LA90,10min) plus 5dB, whichever is greater.*
- b) *Compliance must be assessed separately for all-time and night time. For the purpose of this requirement, night time is defined as 10.00pm to 7.00am, and*
- c) *Where special audible characteristics, including tonality, impulsive sound or excessive amplitude modulation occur, the measured noise level with the identified special audible characteristics will be modified by applying a penalty of up to + 6 dB L90 in accordance with section 5.4 of the Standard.*

Any dwelling on the subject land may be exempt from this condition. This exemption will be given effect through an agreement with the landowner and must be registered on title, unless varied through the written consent of the Minister for Planning. Such dwellings will be known as host dwellings.

NOISE COMPLIANCE ASSESSMENT

24. *Before the development starts, a noise compliance testing plan must be prepared by a suitably qualified acoustics expert to the satisfaction of the Minister for Planning.*
25. *The noise compliance testing plan must be accompanied by a report from an auditor accredited under the Environment Protection Act 1970 with the auditor's opinion on the methodology contained in the noise compliance testing plan.*

When approved, the noise compliance testing plan will be endorsed by the Minister for Planning and will then form part of this permit.

The use must be carried out in accordance with the noise compliance testing plan to the satisfaction of the Minister for Planning.

For the purposes of determining compliance, the following requirements apply:

- a) *Acoustic compliance reports shall be prepared by a suitably qualified and experienced independent acoustic engineer to demonstrate compliance with the noise limits specified in the Standard.*
- b) *Noise assessment positions must be located according to the Standard, and shown on a map.*
- c) *A final compliance report must be submitted to the Minister for Planning after a 12 month period following full operation of the facility.*
- d) *The final compliance report must be accompanied by a report from an auditor accredited under the Environment Protection Act 1970 with the auditor's opinion on the methodology and results contained in the noise compliance testing plan.*
- e) *Compliance reports must be publicly available and published on the wind farm operator's website.*

- f) Following facility commissioning, all complaints shall be managed following procedures set out in the noise complaints management plan.

NOISE COMPLIANCE ENFORCEMENT

26. For the purposes of complaints evaluation, the following requirements apply:

- a) Post installation sound levels shall, where practical, be measured at the same locations where the background sound levels were determined (GPS coordinates and a map showing these locations are to be provided).
- b) If a non-compliance with condition 23 is detected, or an acoustic investigation is required under the noise complaint investigation and response plan endorsed under condition 26, an independent assessment report must be prepared by a suitably qualified and experienced independent acoustic engineer to:
- identify the weather or operational conditions associated with the complaint / breach
 - analyse the uncertainty and confidence levels in the monitoring, and the steps taken to reduce uncertainty
 - target assessment to identify the cause and remediation actions
 - submit a remediation plan to the satisfaction of the Minister for Planning outlining the investigation process, complainant communications, actions and timelines to resolve the complaint/breach
 - if the complaint is not resolved through the processes outlined above, the Minister for Planning may request an independent peer review at the cost of the permit holder and on/off shut down testing to resolve uncertainty
- c) Following the initial post-construction reporting process, additional independent assessment may be requested by the Minister for Planning at any time, where complaints are received and are considered to reasonably warrant investigation.
- d) If investigations indicate special audible characteristics are potentially occurring, procedures outlined in Appendix B of the Standard should be applied.

27. Before the first wind turbine is commissioned, the permit holder must prepare a Noise Complaint Investigation and Response Plan to the satisfaction of the Minister for Planning. The approved plan must be published on the wind farm operator's website.

The plan shall be designed in accordance with the Australian/New Zealand Standard AS/NZS 10002:2014 – Guidelines for complaint management in organisations and include:

- a process of investigation to resolve a complaint
- a requirement that all complaints will be recorded in an incidents register
- how contact details will be communicated to the public
- telephone number and email contact for complaints and queries
- details of the appropriate council contact telephone number and email address (where available)
- a table outlining complaint information for each complaint received, including:
 - the complainant's name
 - any applicable property reference number if connected to a background testing location
 - the complainant's address
 - a receipt number for each complaint which is to be communicated to the complainant

- *the time, prevailing conditions and description of the complainant's concerns including the potential incidence of special audible characteristics*
- *the processes of investigation to resolve the complaint.*

A report including a reference map of complaint locations, and outlining complaints, investigation and remediation actions is to be provided on an annual basis to the satisfaction of the Minister for Planning.

The register and complaints response process shall continue for the duration of the operation of the wind energy facility and must be made available to the Minister for Planning on request.

The wind energy facility operator must implement and comply with the Approved Noise Complaint, Investigation and Response Plan for the duration of the operation of the wind energy facility.

APPENDIX G RELEVANT TURBINES

Table 10: Relevant turbines for each receiver location

Turbine	H18aa	K15aa	K34aa	L18aa	M29aa	N31ab
ESWT01	Yes	Yes	No	Yes	No	No
ESWT02	Yes	No	No	Yes	No	No
ESWT03	Yes	Yes	No	Yes	No	No
ESWT04	Yes	Yes	No	Yes	No	No
ESWT05	Yes	Yes	No	Yes	No	No
ESWT06	Yes	Yes	No	Yes	Yes	No
ESWT07	Yes	Yes	No	Yes	Yes	No
ESWT08	Yes	Yes	No	Yes	Yes	No
ESWT10	Yes	Yes	No	Yes	No	No
ESWT11	Yes	Yes	No	Yes	No	No
ESWT12	Yes	Yes	No	Yes	No	No
ESWT13	Yes	Yes	No	Yes	No	No
ESWT14	Yes	Yes	No	Yes	No	No
ESWT15	Yes	Yes	No	Yes	No	No
ESWT16	Yes	Yes	No	Yes	Yes	No
ESWT17	Yes	Yes	No	Yes	No	No
ESWT18	Yes	Yes	No	Yes	No	No
ESWT19	Yes	Yes	No	Yes	No	No
ESWT20	Yes	Yes	No	Yes	No	No
ESWT21	No	Yes	No	Yes	Yes	No
ESWT23	Yes	Yes	No	Yes	No	No
ESWT24	Yes	Yes	No	Yes	No	No
YSWT01	No	No	Yes	No	Yes	Yes
YSWT02	No	No	Yes	No	Yes	No
YSWT03	No	No	Yes	No	Yes	Yes
YSWT05	No	No	Yes	No	Yes	Yes
YSWT06	No	No	Yes	No	Yes	Yes
YSWT07	No	No	Yes	No	Yes	Yes
YSWT08	No	No	Yes	No	Yes	Yes
YSWT09	No	No	Yes	No	Yes	Yes
YSWT10	No	No	Yes	No	Yes	Yes

Turbine	H18aa	K15aa	K34aa	L18aa	M29aa	N31ab
YSWT11	No	No	Yes	No	Yes	Yes
YSWT12	No	No	Yes	No	Yes	Yes
YSWT13	No	No	Yes	No	Yes	Yes
YSWT14	No	No	Yes	No	Yes	Yes
YSWT15	No	No	Yes	No	Yes	Yes
YSWT16	No	No	Yes	No	Yes	Yes
YSWT17	No	No	Yes	No	Yes	Yes
YSWT18	No	No	Yes	No	Yes	Yes
YSWT19	No	No	Yes	No	Yes	Yes
YSWT20	No	No	Yes	No	Yes	Yes
YSWT21	No	No	Yes	No	Yes	Yes
YSWT22	No	No	Yes	No	Yes	Yes
YSWT23	No	No	Yes	No	Yes	Yes
YSWT24	No	No	Yes	No	Yes	Yes
YSWT25	No	No	Yes	No	Yes	Yes
YSWT26	No	No	Yes	No	Yes	Yes
YSWT27	No	No	Yes	No	Yes	Yes
YSWT28	No	No	No	No	Yes	Yes
YSWT29	No	No	Yes	No	Yes	Yes
YSWT30	No	No	Yes	No	Yes	Yes
YSWT31	No	No	Yes	No	Yes	Yes
YSWT32	No	No	Yes	No	Yes	Yes
YSWT33	No	No	Yes	No	Yes	Yes
YSWT34	No	No	Yes	No	Yes	Yes
YSWT35	No	No	Yes	No	Yes	Yes
YSWT36	No	No	Yes	No	Yes	Yes
YSWT38	No	No	Yes	No	Yes	Yes
YSWT39	No	No	No	No	Yes	Yes
YSWT40	No	No	Yes	No	Yes	Yes

APPENDIX H SITE WIND SPEED AND DIRECTION TRENDS

Long term wind trend data for the Lal Lal Wind Farm was provided by Aurecon on 24 October 2017 and is reproduced within this Appendix.

H1 Elaine meteorological mast

Figure 2: Elaine – annual average data

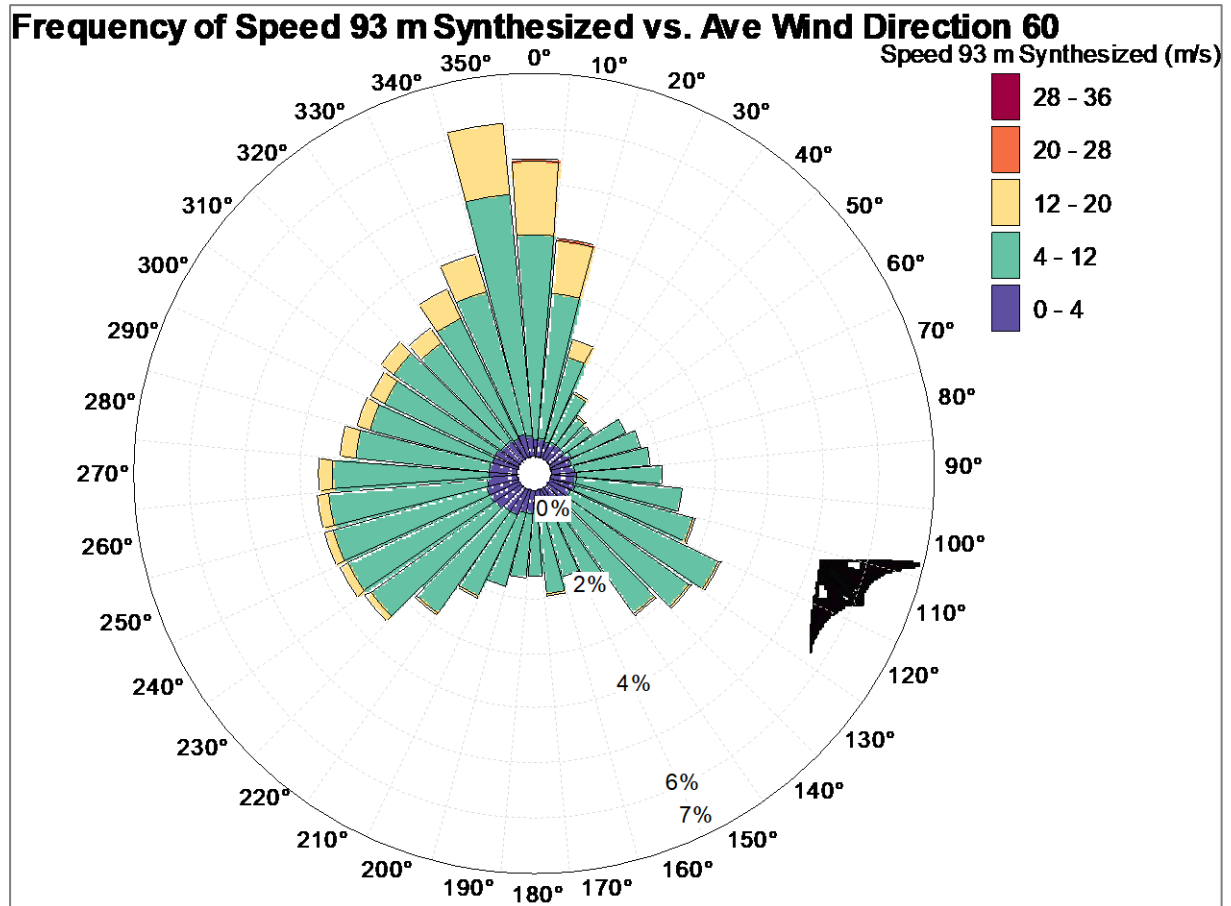


Figure 3: Elaine – monthly average data – January to June

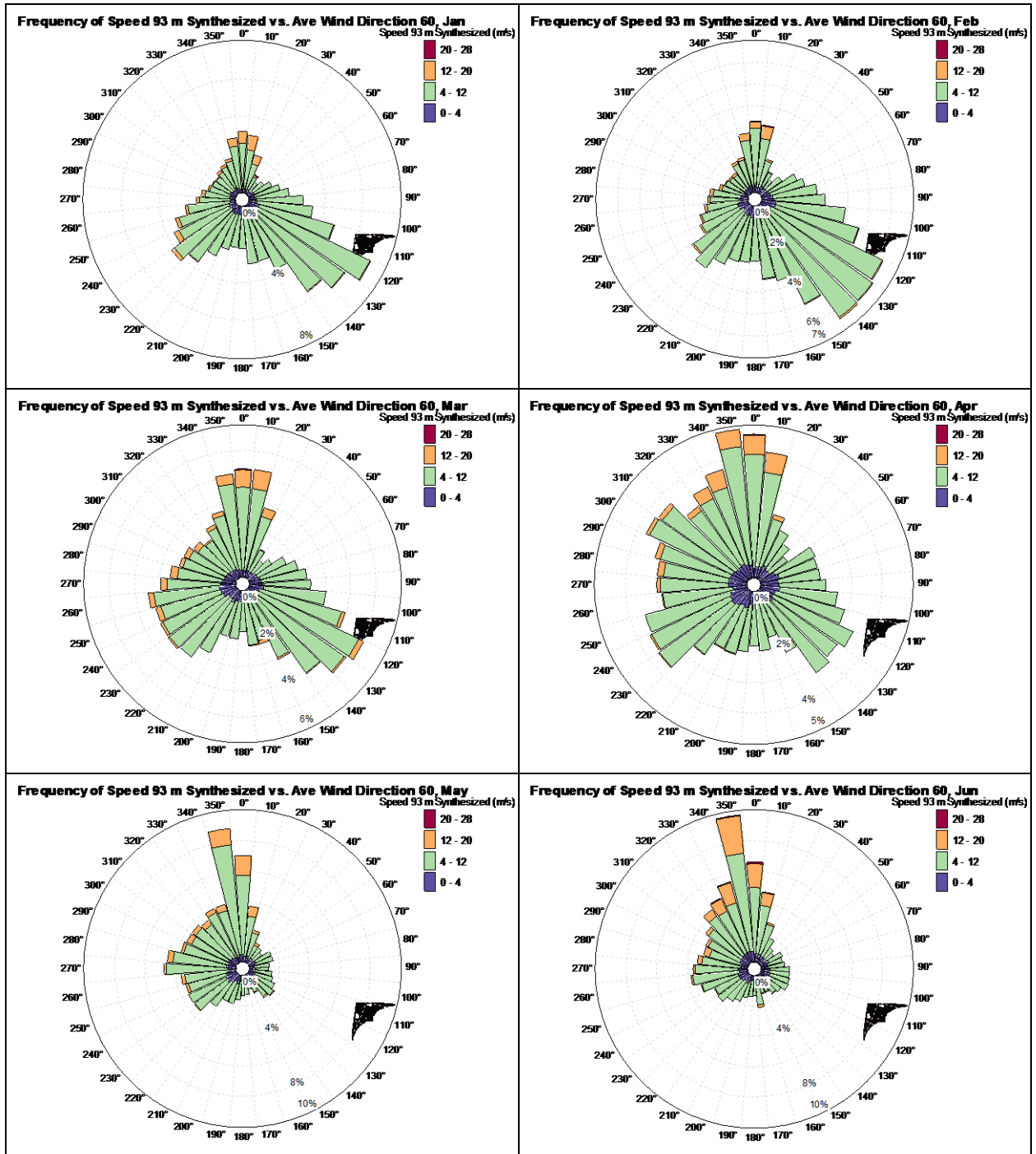
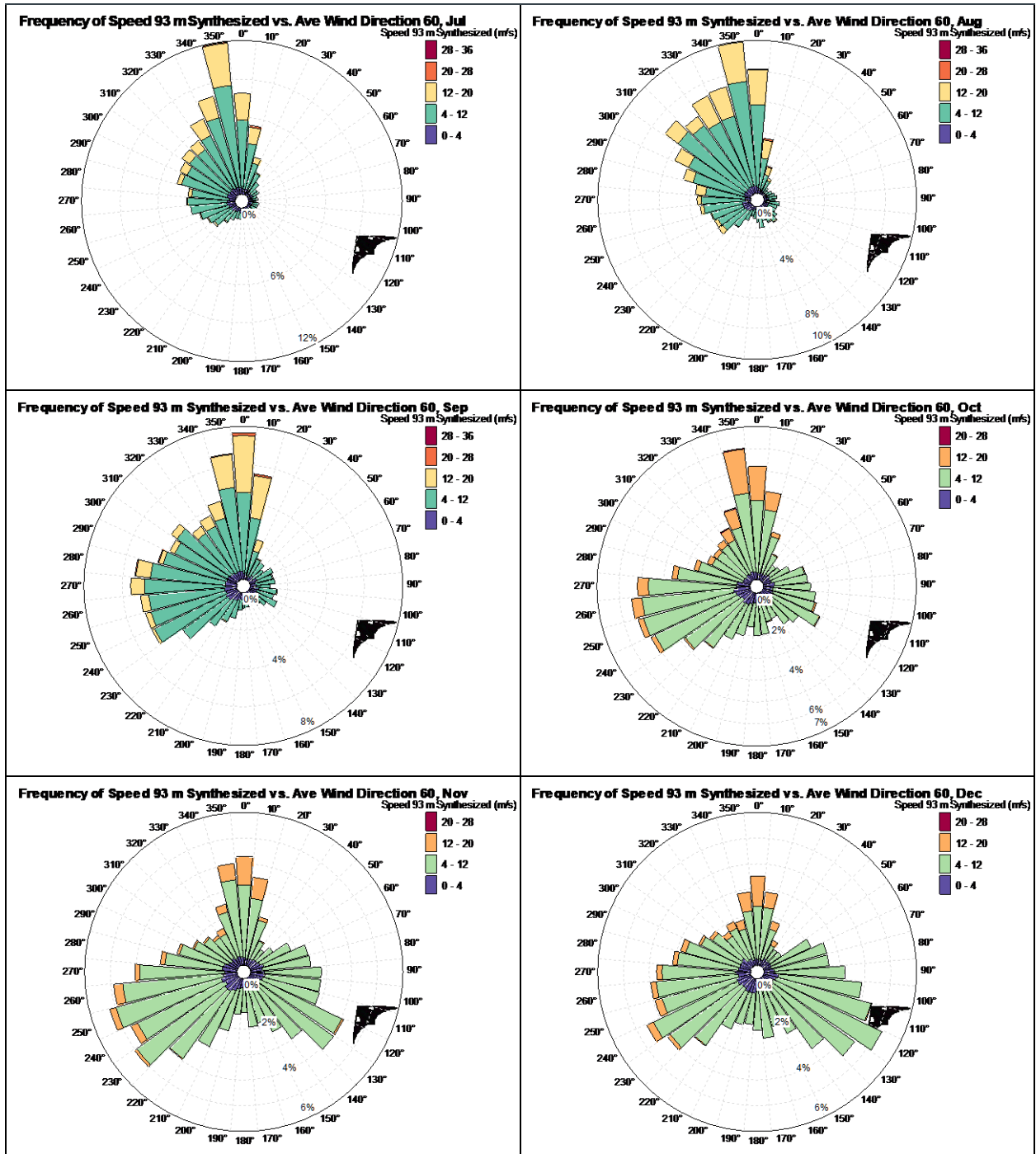


Figure 4: Elaine – monthly average data – July to December



H2 Yendon meteorological mast

Figure 5: Elaine – annual average data

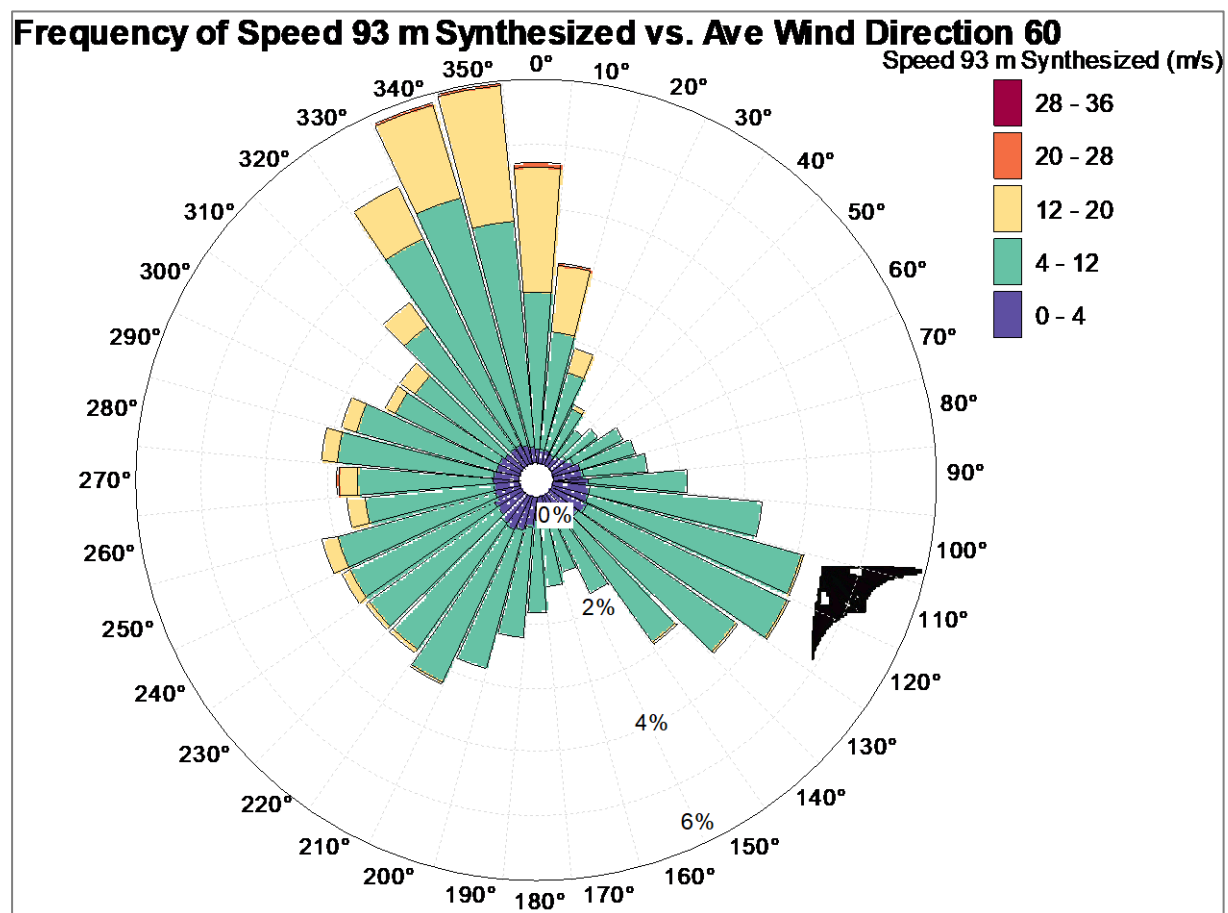


Figure 6: Yendon – monthly average data – January to June

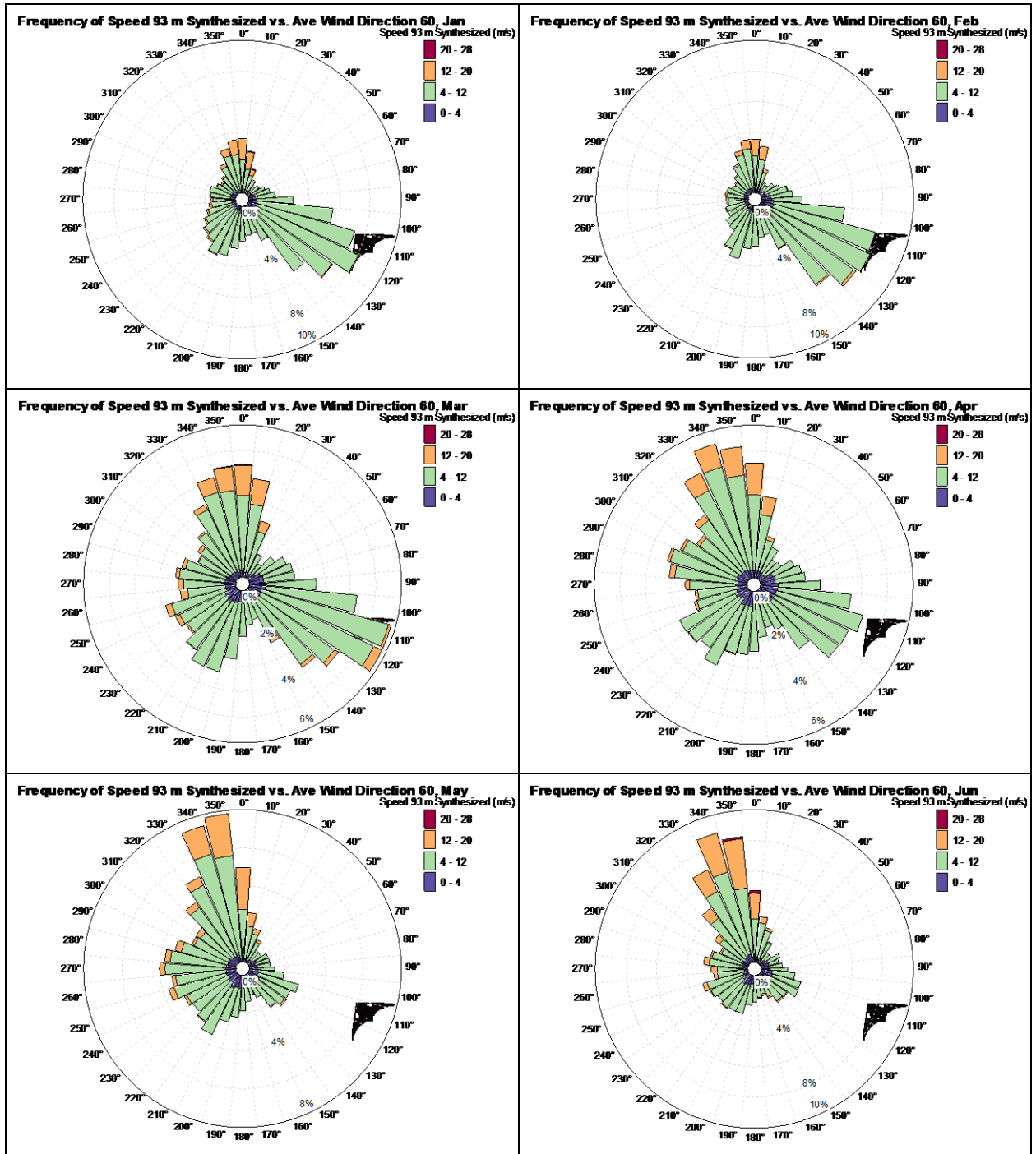
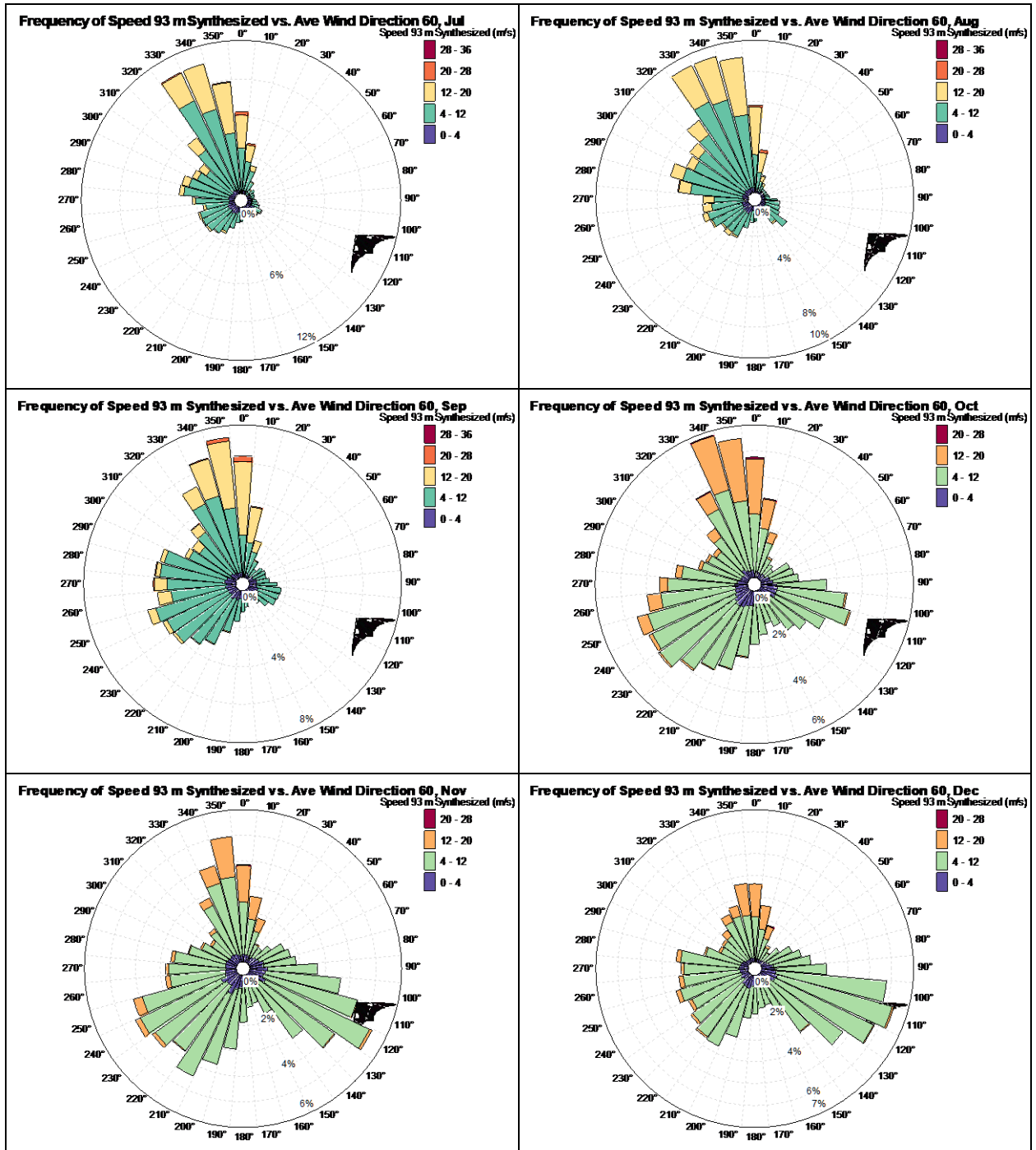


Figure 7: Yendon – monthly average data – July to December



APPENDIX I BACKGROUND NOISE DATA

The following background noise data shall be referenced for adjusting compliance monitoring results for the potential influence of background noise levels. This data is reproduced from Appendix H of the background noise monitoring report.

Table 11: All-time periods (i.e. day and night periods combined) background noise levels (dB L_{A90})

Location	Hub height wind speed (m/s)											
	4	5	6	7	8	9	10	11	12	13	14	15
H18aa ^[1]	28.3	29.7	31.5	33.6	35.9	38.4	41.0	43.6	46.2	48.6	50.9	52.9
K34aa ^[2]	24.3	25.9	27.7	29.8	32.0	34.3	36.7	39.1	41.5	43.9	46.1	48.2
L18aa ^[1]	28.0	29.4	31.1	32.9	34.9	37.0	39.1	41.2	43.2	45.2	47.0	48.6
M29aa ^[2]	27.1	28.0	29.2	30.6	32.2	34.0	35.9	37.9	39.9	42.0	44.1	46.1
N31ab ^[2]	26.3	27.6	29.1	30.8	32.6	34.5	36.4	38.4	40.3	42.2	44.0	45.6
P30aa ^[2]	26.7	28.2	30.0	32.1	34.3	36.7	39.2	41.7	44.2	46.6	48.9	51.1

Note 1: Elaine meteorological mast - 93 m above ground level at 234574 E, 5817575 N (MGA 94 Zone 55H)

Note 2: Yendon meteorological mast - 93 m above ground level at 238268 E, 5830852 N (MGA 94 Zone 55H)

Table 12: Night period background noise levels (dB L_{A90})

Location	Hub height wind speed (m/s)											
	4	5	6	7	8	9	10	11	12	13	14	15
H18aa ^[1]	24.1	25.5	27.4	29.7	32.4	35.3	38.4	41.6	44.7	47.7	50.4	52.9
K34aa ^[2]	20.7	22.0	23.8	26.0	28.5	31.2	34.1	37.0	39.9	42.6	45.1	47.3
L18aa ^[1]	25.2	26.6	28.4	30.3	32.5	34.8	37.2	39.6	41.9	44.2	46.4	48.3
M29aa ^[2]	26.1	26.2	26.8	27.8	29.2	31.0	33.0	35.2	37.5	39.9	42.4	44.8
N31ab ^[2]	22.5	23.6	25.1	26.8	28.8	30.9	33.1	35.4	37.7	40.0	42.2	44.3
P30aa ^[2]	23.2	24.4	26.0	28.1	30.4	32.9	35.7	38.5	41.4	44.2	46.9	49.5

Note 1: Elaine meteorological mast - 93 m above ground level at 234574 E, 5817575 N (MGA 94 Zone 55H)

Note 2: Yendon meteorological mast - 93 m above ground level at 238268 E, 5830852 N (MGA 94 Zone 55H)

Table 13: Dwelling and noise monitor coordinates for each receiver – MGA 94 Zone 55

Receiver	Dwelling		Background noise monitoring location	
	Easting	Northing	Easting	Northing
H18aa	233207	5818510	233231	5818507
K34aa	236976	5834575	236968	5834563
L18aa	237913	5818705	237902	5818722
M29aa	238304	5829565	238292	5829603
N31ab	239934	5831553	239917	5831551
P30aa	241059	5830668	241062	5830640



CHRISTOPHE DELAIRE

Christophe Delaire is co-CEO of the Marshall Day Acoustics Australia and specialises in environmental and industrial noise assessments.

He graduated with a Masters Degree in Engineering (French equivalent) from Ecole Supérieure d'Ingénieurs de Poitiers (France) in 2002 and joined Marshall Day Acoustics the same year.

Christophe has acquired wide-ranging experience in environmental projects and residential developments. He has particularly developed his skill set in environmental acoustics and has been involved in the noise assessment of numerous wind farms since 2005, including most Victorian projects. He has given evidence at many hearings.

Christophe has given evidence at many hearings (VCAT and Panels Victoria) and is the author of several papers presented at International Wind Turbine Noise Conferences.

Christophe also coordinates the Australian partnership with Ecotech and 01dB smart noise monitoring equipment.

QUALIFICATIONS

- MEng, Masters Degree in Engineering (French equivalent), Ecole Supérieure d'Ingénieurs de Poitiers, France (2001)
- Member of the Australian Acoustical Society

RELEVANT PROJECT EXPERIENCE

Waubra Wind Farm | Project Engineer/Project Director | 2004—2012

Noise impact assessment, including background noise monitoring
Post-construction noise monitoring assessment and associated services
Sound power level testing

Bald Hills Wind Farm | Project Director | 2008—Current

Noise impact assessment, including background noise monitoring
Post-construction noise monitoring assessment and associated services

Mt Mercer Wind Farm | Project Director | 2009—Current

Noise impact assessment, including background noise monitoring
Post-construction noise monitoring assessment and associated services
Sound power level testing

Golden Plains Wind Farm | Project Director | 2017—Current

EES Noise impact assessment, including background noise monitoring

PUBLICATIONS

- Delaire, C, 2007, 'Review of post-construction noise compliance assessment conditions included in various wind farm planning permits in Victoria', Second International Meeting on Wind Turbine Noise, Lyon, France.
- Delaire, C, Walsh, D, 2009, 'A Comparison of Background Noise Levels Collected at the Portland Wind Energy Project', Third International Meeting on Wind Turbine Noise, Aalborg, Denmark.
- Delaire, C, Griffin, D, 2011, 'Review of noise conditions from planning permits recently approved in Victoria, Australia', Fourth International Meeting on Wind Turbine Noise, Rome, Italy.
- Delaire, C, Griffin, D, Walsh, D, 2011, 'Comparison of predicted wind farm noise emission and measured post-construction noise levels at the Portland Wind Energy Project in Victoria, Australia', Fourth International Meeting on Wind Turbine Noise, Rome, Italy.
- Adcock, J., Delaire, C, Griffin, D, 'A review of the draft NSW Planning Guidelines: Wind Farms', Acoustics Australia, 40(1), April 2012, pp 72-78
- Griffin, D, Delaire, C, Pischedda, P, 'Methods of identifying extraneous noise during unattended measurements', 20th international congress on sound and vibration, Bangkok, Thailand, 7-11 July 2013.
- Delaire, C, Adcock, J, Griffin, D, McArdle, S, 2013, 'Wind farm noise commissioning methods: A review of methods based on measuring at receiver locations', Fifth International Meeting on Wind Turbine Noise, Denver, USA.
- Delaire, C, Adcock, J, Griffin, D, 2015, 'Research into a continuous wind farm noise monitoring system', Sixth International Meeting on Wind Turbine Noise, Glasgow, UK.
- Adcock, J, Griffin, D, Delaire, C, 2015, 'Study of secondary wind shield performance in the field', Sixth International Meeting on Wind Turbine Noise, Glasgow, UK.



JUSTIN ADCOCK

Justin Adcock is an Associate with Marshall Day Acoustics' (MDA) and is the manager of the environmental noise division. Justin graduated from the University of Adelaide with a Bachelor of Mechanical Engineering Degree in 1998 and has worked as an acoustic consultant with major firms in Australia and the UK since.

The focus of Justin's work has been in the field of environmental noise measurement, modelling and impact assessment. His experience in the field spans from local planning applications and nuisance investigations through to environmental impact assessments for major transport, defence and power infrastructure projects. This includes work for over 30 commercial scale wind farms in Australia and Europe, EIA studies for the Joint Strike Fighter project, major roads, international airports, industrial sites and city wide modelling to European Union directives.

Justin also provides expert witness services and has participated in several government funded research projects into noise measurement and prediction techniques.

QUALIFICATIONS

- Bachelor of Engineering, Mechanical, University of Adelaide, South Australia, 1998
- Base level security clearance with the Australian Department of Defence
- Eligible for membership with the Australian Acoustical Society and UK Institute of Acoustics

RELEVANT PROJECT EXPERIENCE

Golden Plains Wind Farm, VIC | Project Manager | 2017—Current

EES noise impact assessment and TRG engagement

Mt Emerald Wind Farm, QLD | Project Manager | 2014—Current

Environmental noise impact assessment. Post-consent monitoring & reporting.

Gunning Wind Farm, NSW | Project Engineer | 2012

Compliance monitoring.

Collector Wind Farm, NSW | Project Director | 2010 —2015

Environmental noise impact assessment. Post-consent monitoring & reporting.

Gullen Range Wind Farm, NSW | Project Director | 2011 —2015

Noise impact assessment, reporting & compliance monitoring

Rugby Wind Farm, NSW | Project Director | 2010 —2013

Environmental noise impact assessment and reporting.

F-35A Joint Strike Fighter Operations in Australia | Project Manager | 2010 — 2015

Environmental noise modelling and impact assessment of planned F-35A Joint Strike Fighter at Australian RAAF bases. The study is the largest EIA undertaken by the Australian Department, and noise was the key environmental issue for the project.

European Wind Farm Projects, UK & France | Project Engineer/Manager | 2003—2009

Baseline monitoring, impact assessment and post-construction monitoring for wind farms in England, Scotland, Wales and France. Example projects include Arechleoch Wind Farm, Black Law Wind Farm Extension, Gwynt y Mor Offshore Wind Farm and the Llandinam Wind Farm repowering project.

PUBLICATIONS

- Adcock J, Bullmore A, Flindell I, Porter N, 'Recent developments in the UK approach to environmental noise management', The 33rd International Congress and Exposition on Noise Control Engineering 2004, Prague
- Adcock J, Bullmore A, Flindell I, 'A balanced approach to managing risk in environmental noise assessment', INCE Europe: Managing Uncertainty in Noise Measurement and Prediction 2005, Le Mans, France
- Adcock J, Bullmore A, Flindell I, 'Balancing risks and uncertainties in environmental noise measurements', ForumAcusticum 2005, Budapest
- Adcock J, Bullmore A, 'The Development of Wind Energy in Urban Areas and Noise Issues', Twelfth International Congress on Sound and Vibration 2005, Lisbon, Portugal
- Adcock J, Bullmore A, Jobling B, 'Beginning at the end: A Framework to guide immission modelling for industrial noise assessment', Euronoise 2006, Tampere, Finland.
- Adcock J, Bullmore A, Cand M., Jiggins M, 'Wind Farm Noise Predictions: The Risks of Conservatism', Second International Meeting on Wind Turbine Noise 2007, Lyon
- Adcock J, 'Post Measurement Analysis: Looking Beyond the Surface', UK National Physics Laboratory Quality Measurements Conference 2007, Teddington, London
- Adcock J, Bullmore A, 'Best Practice in Environmental Noise Measurement and Assessment' The Association of Noise Consultants: Buildings – from Planning to PCT 2008, Birmingham, UK
- Adcock J, Bullmore A, Cand M, Jiggins M, 'Wind Farm Noise Predictions and Comparison with Measurements', Third International Meeting on Wind Turbine Noise 2009, Aalborg, Denmark
- Co-author of the UK National Physics Laboratory publication 'Guide to Predictive Modelling for Environmental Noise Assessment' funded by the UK Department of Trade and Industry in 2009
- Adcock J, Delaire C, Griffin, D, 'A review of the draft NSW Planning Guidelines: Wind Farms', Acoustics Australia, 40(1), April 2012, pp 72-78
- Delaire C, Adcock J, Griffin D, McArdle S, 2013, 'Wind farm noise commissioning methods: A review of methods based on measuring at receiver locations', Fifth International Meeting on Wind Turbine Noise, Denver, USA.
- Delaire C, Adcock J, Griffin D, 2015, 'Research into a continuous wind farm noise monitoring system', Sixth International Meeting on Wind Turbine Noise, Glasgow, UK.
- Adcock J, Griffin D, Delaire C, 2015, 'Study of secondary wind shield performance in the field', Sixth International Meeting on Wind Turbine Noise, Glasgow, UK.

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24 January 2018

Attention: Penny Wang
Macquarie Group Ltd
Level 23, 101 Collins Street
Melbourne VIC 3000
Australia

Project Number: IS211300

Subject: Proposed Lal Lal Wind Farm - Review of "Lal Lal Wind Farm Noise Compliance Test Plan (Report No. 003 R03 20170649, dated 23 January 2018)"

Dear Penny,

Jacobs Group (Australia) Pty Ltd was engaged by Macquarie Capital to undertake a review of a noise compliance testing plan, as required by the first paragraph of condition 25 of Planning Permit No. PL-SP/05/0461/A (the planning permit) for Lal Lal Wind Farm, a consented wind energy development located at land in Yendon and Elaine within Moorabool Shire, approximately 17 kilometres south-east of Ballarat, Victoria.

Jacobs' letters to Macquarie Capital of 7th December 2017 and 22nd January 2018 reported our review of previous versions of "Lal Lal Wind Farm Noise Compliance Test Plan" (Report No. 003 R01 20170649; Final Rev01, dated 1 December 2017; and Report No. 003 R02 20170649; Final Rev02, dated 19 January 2018, respectively); those versions have since been superseded by the report "Lal Lal Wind Farm – Noise Compliance Test Plan" (Report No. 003 R03 20170649; Final Rev03, dated 23 January 2018" (the NCTP), prepared by Marshall Day Acoustics. This letter presents Jacobs' review of that Rev03 report, and supersedes our letters of the 7th December 2017 and 22nd January 2018.

The first paragraph of Condition 25 of the planning permit states:

The noise compliance testing plan must be accompanied by a report from the auditor accredited under the Environmental Protection Act 1970 with the auditor's opinion on the methodology contained in the noise compliance testing plan.

Condition 24 of the planning permit requires that "Before the development starts, a noise compliance testing plan must be prepared by a suitably qualified acoustics expert to the satisfaction of the Minister for Planning".

Condition 25 of the planning permit goes on to state that "When approved, the noise compliance testing plan will be endorsed by the Minister for Planning and will then form part of this permit".

It is also noted that Condition 25 also requires of the wind farm that "The use must be carried out in accordance with the noise compliance testing plan to the satisfaction of the Minister for

24 January 2018

Subject: Proposed Lal Lal Wind Farm - Review of "Lal Lal Wind Farm Noise Compliance Test Plan (Report No. 003 R03 20170649, dated 23 January 2018)"

Planning", and includes further requirements to confirm compliance of the wind farm once operational.

This letter report documents the review undertaken by Philip Bayne of Jacobs Group (Australia) Pty Limited, an environmental auditor (appointed pursuant to the Environment Protection Act 1970; 'the Act'), of the report "Lal Lal Wind Farm Noise Compliance Test Plan" (Report No. 003 R03 20170649, dated 23 January 2018), prepared by Marshall Day Acoustics (MDA), to form an opinion in regards to the methodology contained in the NCTP.

This letter is intended for submission to the Minister of Planning for consideration of compliance with the first paragraph of Condition 25 of the planning permit.

Environmental Auditor's Expert Support Team Members

In accordance with EPA Publication 865.12 "Environmental auditor guidelines for appointment and conduct" (22 Dec 2016), the Auditor relied upon advice from his nominated expert support team members in conducting this review; including acoustical specialists in wind turbine noise:

- *Michel Baron* – Michel is a member of Jacobs' acoustics team in Melbourne. As an acoustic consultant, Michel specialises in environmental noise with extensive experience relating to assessing environmental noise impact of wind energy developments; and
- *Dr Stephen Chiles* - Stephen is an acoustics engineer and independent commissioner with over twenty years' professional experience; he chaired the committee that produced the 2010 version of NZS 6808 *Acoustics – Wind Farm Noise*.

The findings of this review of the NCTP are based on evidence gained from review by the auditor and his expert support team in the context of the relevant requirements of the *New Zealand Standard NZS6808:2010 (the Standard)* and the planning permit as discussed below, and on correspondence and consultation with the author(s) of the NCTP (Marshall Day Acoustics).

Criteria of Review

EPA Victoria Publication 1570 (August 2014) "Review of Victoria's State Discussion paper - Environment Protection Policies for Noise" states that "*Wind turbine noise refers to noise from rotating wind turbine blades and generators. Because both background noise levels and wind turbine noise vary with wind speed, the assessment methodologies provided in SEPP N-1¹ and NIRV² are not appropriate to assess wind turbine noise. A specialised procedure, such as provided in New Zealand Standard NZS6808:2010 is required to monitor and assess wind turbine noise. NIRV explicitly states that it does not apply to wind turbine noise although other types of noise from a wind farm such as from electrical sub stations are covered. As wind turbine noise is not listed as an excluded noise source in SEPP N-1, technically SEPP N-1 would apply to a wind farm built within the SEPP N-1 boundary.*" It is noted that the location of the proposed Lal Lal windfarm site is in regional Victoria, not within the SEPP N-1 boundary.

NIRV is a non-statutory guideline published by the EPA. It provides recommended maximum noise levels ('recommended levels') for noise from industry, applicable to regional Victoria. In

¹ SEPP N-1 (State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) No. N-1

² EPA Victoria publication 1411 (October 2011) "Noise from industry in regional Victoria: Recommended maximum noise levels from commerce, industry and trade premises in regional Victoria" (NIRV)

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respect to windfarms, NIRV states that wind farm noise is regulated via the planning system, stating; *"For wind turbine noise, see the Department of Planning and Community Development Publication Policy and planning guidelines for development of wind energy facilities in Victoria, August 2011."* The subsequent version of that document is the "Policy and planning guidelines: Development of wind energy facilities in Victoria" published by Department of Environment, Land, Water and Planning, dated November 2017 (the Policy and Planning Guidelines), which states that *"A wind energy facility should comply with the noise limits recommended for dwellings and other noise sensitive locations in the New Zealand Standard NZS 6808:2010 Acoustics – Wind Farm Noise" (the Standard).*

In accordance with requirements of Section 5.1.2 of the Policy and Planning Guidelines, the methodology of the NCTP was reviewed in the context of requirements of the following:

- 1) New Zealand Standard 6808:2010, Acoustics – Wind Farm Noise (the Standard); and
- 2) Planning Permit No: PL-SP/05/0461/A (revised 20 March 2017); granted by the minister under section 97f of the planning and environment act 1987 (the planning permit);

The planning permit designates noise limits applicable to operation of the proposed Lal Lal wind farm; Condition 23 specifies operational noise conditions, as follows:

"Condition 23:

Except as provided below in this condition, the operation of the wind energy facility must comply with New Zealand Standard 6808:2010, Acoustics – Wind Farm Noise (the Standard) as modified by this condition to the satisfaction of the Minister for Planning.

In determining compliance, the following requirements apply:

- a) *The operator must ensure that at any wind speed, wind farm sound levels, determined in accordance with the Standard at noise sensitive locations (as defined in the Standard) do not exceed a noise limit of 40dB LA90,10min or background (LA90,10min) plus 5dB, whichever is greater.*
- b) *Compliance must be assessed separately for all-time and night time. For the purpose of this requirement, night time is defined as 10.00pm to 7.00am, and*
- c) *Where special audible characteristics, including tonality, impulsive sound or excessive amplitude modulation occur, the measured noise level with the identified special audible characteristics will be modified by applying a penalty of up to + 6 dB L90 in accordance with section 5.4 of the Standard.*

Any dwelling on the subject land may be exempt from this condition. This exemption will be given effect through an agreement with the landowner and must be registered on title, unless varied through the written consent of the Minister for Planning. Such dwellings will be known as host dwellings."

Documentation Review

The following documentation was considered during the review process:

- Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria (Govt. of Victoria, November 2017);
- New Zealand Standard NZS 6808:2010 Acoustics – Wind Farm Noise (the Standard);
- A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (UK Institute of Acoustics, 2013) ("IOA GPG");

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- Planning Permit PL-SP/05/0461/A, Moorabool Planning Scheme, dated 20/03/2017;
- Lal Lal Wind Farm, Yendon Section, Noise Compliance Testing Plan (001 R02 20100178, 12 August 2010, prepared by Marshall Day Acoustics);
- List of dwellings that are financial beneficiaries of Lal Lal Wind Farm (Email from Westwind Energy Ltd, dated 25th July 2017);
- Lal Lal Wind Farm, Scope of Work and Fee Proposal (Pr 001 20170649, 9 June 2017, prepared by Marshall Day Acoustics);
- Lal Lal Wind Farm – Revised noise predictions using V136-3.6 MW, Memo (Mm 001, 1 June 2017, prepared by Marshall Day Acoustics);
- Lal Lal Wind Farm – Noise Compliance Test Plan (Rp 002 01Draft 20170649, 15th August 2017, prepared by Marshall Day Acoustics);
- Lal Lal Wind Farm – Noise Compliance Test Plan (Rp 003 02Draft 20170649, 17th October 2017, prepared by Marshall Day Acoustics).
- Lal Lal Wind Farm – Noise Compliance Test Plan (Rp 003 20170649, 7th November 2017, prepared by Marshall Day Acoustics).
- Lal Lal Wind Farm – Noise Compliance Test Plan (Report No. 003 R01 20170649, dated 1 December 2017, prepared by Marshall Day Acoustics).
- Lal Lal Wind Farm – Noise Compliance Test Plan (Report No. 003 R02 20170649, dated 19 January 2018, prepared by Marshall Day Acoustics).
- Lal Lal Wind Farm – Noise Compliance Test Plan (Report No. 003 R03 20170649, dated 23 January 2018, prepared by Marshall Day Acoustics)

It is noted that the NCTP states the operational noise limits for noise sensitive receivers (Table 2 and Table 3 of the NCTP), are based on the background noise monitoring performed by MDA. Jacobs understands that the derivation of those operational noise limits, and reporting of the background noise study undertaken, has been documented in a separate report (referred to in Section 3 of the NCTP as 'background noise report'). That report was not reviewed by Jacobs; accordingly, the background noise monitoring works conducted, and the derivation of operational noise limits stated in the NCTP, were not reviewed as part of this review. It is noted in the NCTP that *"at the time of preparing this NCTP, analysis of the additional background noise data, and incorporation of the data into an updated version of the background noise report, remains to be completed. For this reason, data for K15aa is not presented within this NCTP. Prior to commencement of operation of the wind farm, an updated background noise report is to be submitted to the responsible authority, detailing the monitoring results for K15aa, along with the results of any additional background noise monitoring conducted at other receiver locations around the Lal Lal wind farm."*

Findings of Review

A preliminary draft of the Lal Lal Wind Farm NCTP (Rp 002 01Draft 20170649, dated 15th August 2017) was received by Jacobs via email on Monday 21st of August 2017. The draft was issued to Jacobs prior to the completion of the background noise survey and its analysis, ultimately required to be implemented within the finalised NCTP. Although those aspects of the NCTP were not included, MDA indicated that the document was complete with respect to the proposed approach of the compliance monitoring; a review of the document was conducted by Jacobs on this basis.

Following the review, a number of clarifications and additions in respect to certain elements of the testing plan's proposed approach were requested by Jacobs. A conference call between

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Subject: Proposed Lal Lal Wind Farm - Review of "Lal Lal Wind Farm Noise Compliance Test Plan (Report No. 003 R03 20170649, dated 23 January 2018)"

Jacobs and MDA took place on Monday 25th of September 2017 to discuss particular aspects of the draft NCTP, and it was subsequently agreed that MDA would amend the NCTP on the basis of those discussions.

An amended draft of the NCTP was received by Jacobs on the 31st October 2017 (Rp 003 02Draft 20170649, 17th October 2017). MDA identified that although there were items of information still to be added to that draft version of the NCTP, such as the background noise data and derived noise limits, the draft was complete in terms of procedures. A review of that document was conducted by Jacobs; and a number of points requiring either further clarification or amendment identified by the acoustical specialists.

These points were addressed by MDA in a proceeding version of the Noise Compliance Testing Report (Rp 003 20170649, 7th November 2017) received by Jacobs on 17th November 2017. The 1 December 2017 and the 19 January 2018 versions were later issued by MDA; and subsequently the NCTP (R02 20170649; Final Rev03, dated 23 January 2018) was issued.

Review of the NCTP, dated 23 January 2018, by Jacobs' acoustical specialists identified that the methodology contained in the noise compliance testing plan is in accordance with the *New Zealand Standard 6808:2010, Acoustics – Wind Farm Noise (the Standard)*.

This review also recognises that the Standard allows for application of discretion/judgement in its application; and that the NCTP does not formerly acknowledge those elements of the NCTP to which the Standard identifies that such discretion/judgement is to be applied. While this is not considered an inconsistency of the NCTP with the Standard, it does constitute a reliance within the NCTP that implementation of the NCTP will be by a competent acoustic professional(s) with understanding of the requirements of the standard. The NCTP does, however, formerly recognise the requirement of planning permit condition 23 that operational noise levels are to be measured and assessed in accordance with the Standard, and as such does therefore recognise those requirements for judgement/discretion in implementation of the NCTP, although not explicitly stated in the NCTP.

Those elements of the Standard requiring application of discretion/judgement in its implementation include the following; while the requirements are stated in the background noise sub-section of the Standard, they carry-through to operational noise compliance through the cross reference in Section 7.5.2 of the Standard:

- Section 7.4.1 of the Standard states "*If there are markedly different groups within the scatter plot then separate scatter plots may be required for different conditions, including wind directions, and times-of-day*". The Standard does not however provide a definition of "*markedly different*" and therefore discretionary judgement must be made in the determination of a singular regression relationship.
- Section 7.4.2 of the Standard states "*Sparseness of data or obvious outliers should not be allowed to unreasonably influence the regression curve*". However, the Standard does not provide a definition of "*sparseness of data*" or "*obvious outliers*" and therefore discretionary judgement must be made in the determination as to whether the regression curve has been unreasonably influenced.
- Section C7.4.2 of the Standard states that in certain circumstances "*it may be more appropriate to use a 'bin' analysis procedure*" than a regression procedure and goes on to add "*Situations where this is appropriate may be determined by the assessor*".
- Section 7.4.3 of the Standard states "*If there is a poor correlation between wind speed and sound level, further investigation of wind conditions should be undertaken...*"

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However, the Standard does not provide a definition of "*poor correlation*" and therefore a discretionary judgement must be made in the further investigations to be undertaken.

Limitations

This letter report was prepared in accordance with the scope of services set out in the contract between Jacobs Group (Australia) Pty Ltd (hereafter referred to as Jacobs) and Macquarie Group Ltd (Macquarie), and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and Macquarie.

This letter report has been prepared by Philip J. M. Bayne of Jacobs, for Macquarie, and may be used and relied upon by Macquarie and the Minister of Planning for the purpose to address requirements of the first paragraph of condition 25 of Planning Permit No. PL-SP/05/0461/A (Moorabool Planning Scheme, dated 20/03/2017). The scope of work performed in preparing this letter report may not be appropriate to satisfy the needs of any other person; any third parties' use of, or reliance on, the report or the findings, conclusions, recommendations or any other material presented to them, is at their sole risk.

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Yours sincerely



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