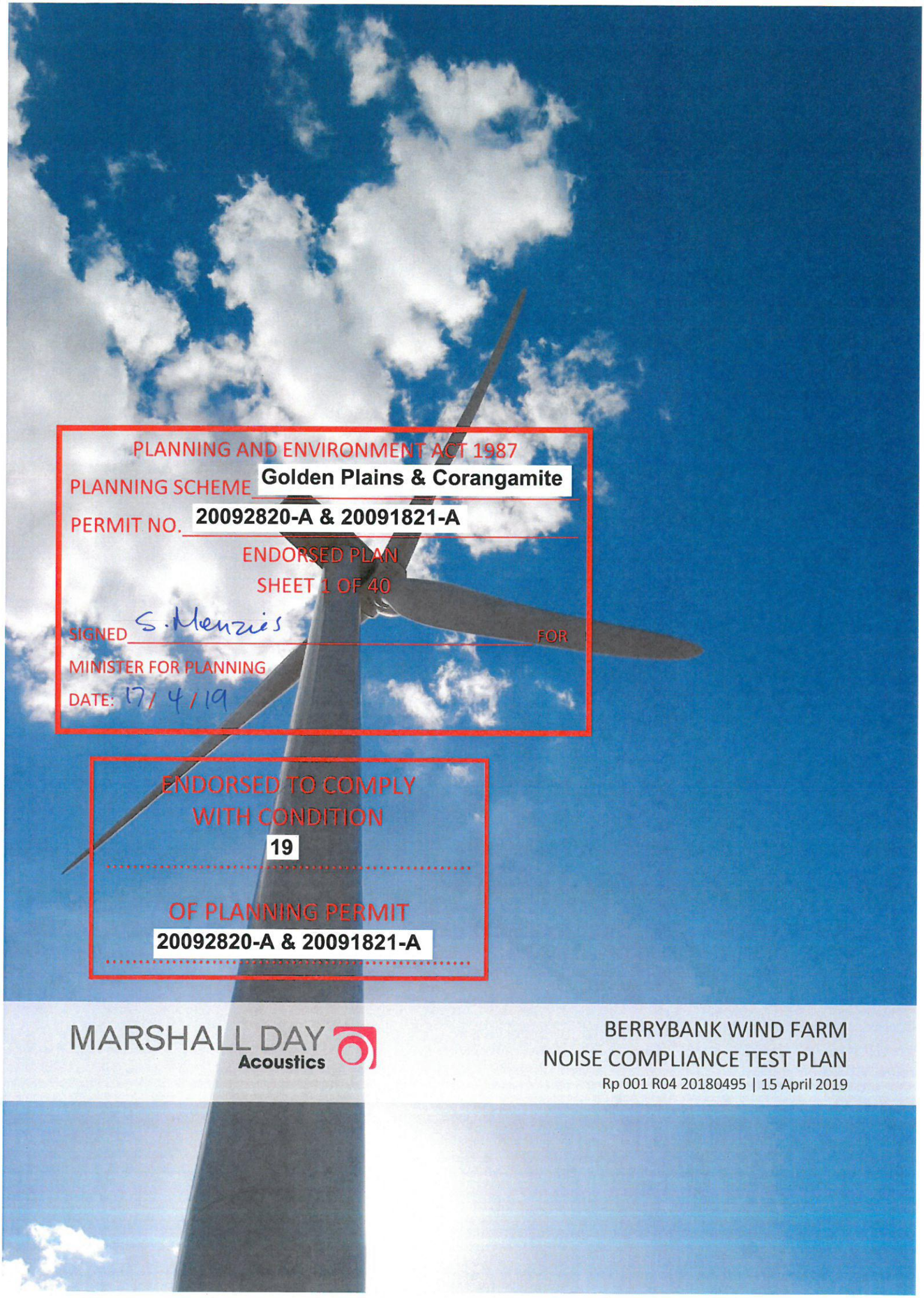

PLANNING AND ENVIRONMENT ACT 1987

PLANNING SCHEME Golden Plains & Corangamite

PERMIT NO. 20092820-A & 20091821-A

ENDORSED PLAN

SHEET 1 OF 40

SIGNED S. Menzies FOR

MINISTER FOR PLANNING

DATE: 17/4/19

ENDORSED TO COMPLY WITH CONDITION

19

OF PLANNING PERMIT

20092820-A & 20091821-A

MARSHALL DAY Acoustics

BERRYBANK WIND FARM
NOISE COMPLIANCE TEST PLAN

Rp 001 R04 20180495 | 15 April 2019

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Report No.: **Rp 001 R04 20180495**

Document Control

Status:	Rev.:	Comments	Date:	Author:	Reviewer:
Complete	-	For external issue	27 June 2018	J Adcock	C Delaire
Complete	01	Appendix G figure fixed	4 July 2018	J Adcock	C Delaire
Complete	02	Response to DEWLP comments	6 March 2019	C Delaire	-
Complete	03	Response to BDPL comments	13 March 2019	C Delaire	-
Complete	04	Response to DEWLP comments	15 April 2019	C Delaire	-

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1.0 INTRODUCTION

1.1 Overview

This report presents the noise compliance monitoring procedures for the Berrybank Wind Farm.

The Berrybank Wind Farm is a consented project located in the Golden Plains Shire and Corangamite Shire local government areas. The amended planning permits for the Berrybank Wind Farm (Planning Permit No. 20092820A and Planning Permit No. 20092821A) include conditions which specify requirements for the control of environment noise associated with the project.

This report was commissioned by Berrybank Development Pty Ltd (BDPL), subsidiary of Global Power Generation Australia Pty Ltd, to address Condition 19 of the amended planning permits 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 permits for the wind farm.

This report includes the NCTP content specified in Condition 19 of the amended planning permits and therefore specifies:

- Construction noise limits
- Construction noise monitoring procedures
- A program of construction noise compliance monitoring
- Wind turbine near field compliance testing procedures
- Operational wind farm noise limits
- Operational wind farm noise monitoring and assessment procedures
- Operational wind farm noise compliance reporting procedures.

This report has been prepared on the basis of relevant information documented in Marshall Day Acoustics (MDA) report *Berrybank Wind Farm – Pre-construction Noise Assessment* (report reference Rp 002 R02 20180495) dated 8 April 2019 (referred to as the *pre-construction noise report* herein).

The basic quantities used within this document to describe noise adopt the conventions outlined in ISO 1996-1:2016[1]. 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 dB L_A. 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.

The NCTP has been prepared on the basis of the wind turbine selection and wind farm layout described in Appendix B and Appendix C respectively. 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.

[1] ISO 1996-1:2016 *Acoustics - Description measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures*

1.2 Required content

Condition 19 defines the information that must be included in the NCTP.

All of the required information is contained within this report. For completeness, Table 1 below references the sections where each requirement of Condition 19 is addressed.

Table 1: Condition 19 – required content and the corresponding section of the NCTP

Condition 19	Requirement	Section where the requirement is addressed
a)	*a determination of the noise limits to be applied during construction using the methodology prescribed in the EPA Noise Control Guidelines – publication 1254 released October 2008;*	See Section 3.1 *Construction noise limits*
b)	*a program of compliance testing to be implemented during the construction of the wind energy facility that:* *(i) Is designed by a suitably qualified acoustic expert; and* *(ii) Utilises the methodology prescribed in State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) No N-1, to demonstrate compliance with the limits determined in (a) above.*	See Section 3.2 *Construction Measurement procedures* and Section 3.3 *Construction noise measurement program*
c)	*a procedure for a near field compliance test of the first turbine commissioned at the wind energy facility; and*	See Section 4.0 *Operational Turbine Noise – Near Field Compliance Testing*
d)	*a procedure for a final compliance test of the wind energy facility after the commissioning of the last turbine, such testing to:*	
	(i) consider compliance of the operational wind energy facility as a whole with the noise limits set under condition 17;	See Section 5.0 *Operational Wind Farm Noise Limits* for the limits which would apply to the noise of the wind farm as a whole, derived in accordance with the NZS 6808:2010 as required by Condition 17.
	(ii) be carried out according to the method described in NZS6808: 2010 'Acoustics – Wind farm noise'; and	See Section 6.0 *Operational Wind Farm Noise Testing Procedures* and Section 7.0 *Operational Wind Farm Noise Analysis* for compliance testing and analysis procedures in accordance with NZS 6808:2010.
	(iii) be submitted to the responsible authority within 6 months of the first turbine operating. Further post-construction acoustic compliance reports prepared in accordance with this condition must be submitted to the responsible authority annually from the date of the first report being submitted until the final turbine is operating.	See Section 6.3 for details of documentation requirements and timeframes for submission.

2.0 PLANNING PERMIT

2.1 Overview

Amended Planning Permit No. 20092820 – A and Amended Planning Permit No. 20092821 – A, for the Golden Plains Shire and Corangamite Shire sections of the Berrybank Wind Farm respectively, were issued on 4 February 2018.

Conditions 17 to 19 of the planning permits establish requirements for the control of noise during construction and operation of the Berrybank Wind Farm. The conditions are reproduced in full in Appendix F. The key requirements are summarised in Table 2.

Table 2: Amended planning permits – summary of operational noise related requirements

Condition	Summary of key requirements
17	Specifies the criteria that operational wind farm noise must comply with at noise sensitive locations, and specifies exemptions for dwellings where an agreement exists between a land owner and the project developer.
18	Establishes a requirement for a pre-construction noise assessment of operational wind turbine noise for the final turbine layout and turbine selection before development of the wind farm starts.
19	Specifies that a Noise Compliance Testing Plan (NCTP) must be prepared prior to commencement of development of the wind farm, addressing both construction and operational noise associated with the wind farm.

2.2 Construction noise

Condition 19 requires the following with respect to construction noise:

- Limits are to be determined in accordance with Victorian EPA publication 1254 titled *Noise Control Guidelines* dated October 2008 (EPA Publication 1254).
- Measurements are to be conducted in accordance with *State Environment Protection Policy (Control of Noise from Industry, Commerce and Trade) No. N-1* dated 15 June 1989 (SEPP N-1).

2.3 Operational noise

Condition 17 specifies that operational wind farm noise levels are to be measured and assessed in accordance with New Zealand Standard NZS 6808:2010 *Acoustics – Wind farm noise* (NZS 6808:2010).

Condition 19 specifies a requirement for the NCTP to include a procedure for conducting a near field compliance test of the first wind turbine commissioned at the wind farm.

3.0 CONSTRUCTION NOISE

3.1 Construction noise limits

3.1.1 Normal working hours

Normal working hours are defined in EPA publication 1254 as follows:

- 0700 to 1800 hours Monday to Friday (excluding public holidays)
- 0700 to 1300 hours on Saturdays (excluding public holidays)

EPA publication 1254 does not specify objective noise criteria for normal working hours. Instead, the publication defines requirements in terms of emission and managerial controls for the control of noise during normal working hours. Accordingly, this NCTP does not specify noise limits or noise monitoring requirements for construction work occurring during normal working hours.

3.1.2 Evening & night periods

The majority of the construction work for the Berrybank Wind Farm is to occur during normal working hours. Exceptions may include construction activity on Saturday afternoons until 1600 hrs or unavoidable works (e.g. delivery of oversized components).

In the event that construction work needed to occur during the evening or night period, the criteria specified in this section would apply.

In relation to general construction activities (all construction works other than unavoidable works and low-noise or managed-impact works discussed subsequently), the applicable EPA publication 1254 criteria are detailed in Table 3.

Table 3: EPA Publication 1254 – evening and night noise criteria

Period	Day of the week	Time Period	Construction activity up to 18 months	Construction activity after 18 months
Evening	Monday-Friday	1800-2200 hrs	Noise to be less than 10 dB above background (L_{A90}), outside residential dwelling	Noise to be less than 5 dB above background (L_{A90}), outside residential dwelling
	Saturday	1300-2200 hrs		
	Sunday, Public Holidays	0700-2200 hrs		
Night	Monday-Sunday	2200-0700 hrs	Noise from construction activities must be inaudible inside a habitable room with windows open	

The criteria summarised in Table 3 provide a basis for setting objective noise criteria if construction work was to occur during the evening.

However, in relation to the night period, EPA publication 1254 does not specify an objective criterion for inaudibility. The level that construction noise would need to be restricted to in order to achieve inaudibility would ultimately be dependent on a range of variables such as the level and character of construction noise, the level and character of the background sound and the hearing threshold of the individual observing the noise. To address these variables, a limit between 5 and 10 dB below the background sound level is usually specified for the purpose of achieving inaudibility. In quiet environments, this represents a very stringent criterion. Further, in quiet environments, it may not always be necessary to maintain the same margin below the background sound in order to achieve inaudibility. For example, if the resulting level inside a residential dwelling is comparable to the average hearing threshold, the construction noise may be inaudible, irrespective of the margin between the construction noise and the background sound. For context, it is also noted that additional EPA guidance that is specific to construction is detailed in EPA Publication 480 *Environmental Guidelines for Major Construction Sites* dated 1996. EPA Publication 480 specifies that night-time construction noise should not be above the background sound inside any adjacent residence.

Taking account of the above, if construction work was to occur during the night, an assessment of measured construction noise levels would need to be based on determining if:

- construction noise is equivalent to, or lower than, the background noise levels; or
- if construction noise is above the background noise level, whether the absolute level of the construction noise outside a noise sensitive location is sufficiently low that the corresponding noise inside the dwelling is likely to be inaudible. This will be dependent on a range of factors such as the location of the bedrooms at each dwelling, the construction of the dwelling facade and whether windows are open or closed. These factors would need to be accounted for by the acoustic engineer responsible for conducting the noise testing.

In accordance with EPA publication 1254, exceptions to the general evening and night requirements detailed above apply to the following types of work:

- Unavoidable works that cannot practicably be restricted to normal working hours because the activity involves continuous work or would otherwise pose an unacceptable risk to life or property, or risk a major traffic hazard. In relation to the construction of a wind farm, examples of these types of works may include the delivery of oversized turbine components outside of normal working hours to avoid traffic disruptions and hazards, or turbine component assembly operations that must occur during low wind conditions for safety reasons
- Low-noise or managed-impact works are activities that are approved by the local authority:
  - that are inherently quiet or unobtrusive (for example, manual painting, internal fit-outs, cabling); or
  - where the noise impacts are mitigated through actions specified in a noise management plan supported by expert acoustic assessment.

  Low-noise or managed-impact works must not feature intrusive characteristics such as impulsive noise or tonal movement alarms, and average noise levels over any half hour must not exceed the background sound pressure level.

3.2 Construction noise measurement procedures

The measurements shall be conducted in accordance with SEPP N-1. The following confirms several aspects of applying SEPP N-1 to construction noise:

- The measurement and analysis of background sound levels during the evening is to be based on the procedures defined by SEPP N-1. Measurements of background sound during the night shall adopt similar general procedures, but are to be based on the 30-minute background sound levels at the time of the assessment (in lieu of period-averaged hourly background sound levels defined by SEPP N-1) on account of the specific assessment requirements of EPA publication 1254 for the night-time period
- The objective of the construction noise measurements is to determine the effective noise level (dB L_{eff}) associated with the works
- The effective noise level shall be determined on the basis of the 30-minute equivalent noise level (dB $L_{Aeq,30\ minute}$), adjusted as required for duration, intermittency, tonality and impulsiveness
- The measurements shall be conducted in noise sensitive areas as defined by SEPP N-1
- Measurements conducting during the evening at noise sensitive receivers where construction noise will be significantly affected by atmospheric conditions shall account for the related provisions defined in SEPP N-1 i.e. the effective noise level to be determined on the basis of the arithmetic average of three (3) separate measurements. These provisions do not apply to measurements conducted during the night period on account of the EPA 1254 requirements being specified in terms of audibility when the construction work occurs. These provisions also do not apply to low-noise or managed impact works on account of the EPA 1254 requirements applying to any half hour period.

Attended noise measurements may be conducted for targeted periods. Alternatively, unattended noise measurements may be conducted over an extended period. The appropriate measurement strategy shall be determined by a qualified acoustic engineer based on the nature of the activity or the noise source in question. However, it is generally expected that attended measurements will be sufficient for evaluating construction noise.

3.3 Construction noise measurement program

Wind farm construction generally occurs during normal working hours at relatively large separating distances from noise sensitive receiver locations. In some instances, wind farm construction may involve work at reduced distances from noise sensitive receivers, or activities outside of normal working hours. For example, access track construction involves work at reduced separating distances for brief periods. Also, some construction activities may occur on Saturday afternoon (which is treated as an evening period under EPA 1254). However, activity during the most sensitive times (e.g. after 1800 hrs on weekdays, after 1600 hrs on Saturdays and all day Sunday) would be infrequent and would only occur for brief periods (e.g. delivery or of large turbine components typically needs to occur outside of peak traffic periods).

The construction noise monitoring program for the Berrybank Wind Farm, as required by Condition 19 of the permit, has therefore been determined on the basis of the relatively low risk of disturbance to noise sensitive receivers.

Given that EPA publication 1254 does not specify noise limits for construction activities occurring during normal working, measurements are not required for the purpose of assessing compliance. However, measurements may be considered appropriate in some instances as part of investigating and responding to any complaints relating to construction noise. Accordingly, for completeness, the construction noise monitoring program defines the situations when measurements may be warranted for activities occurring during normal working hours.

The construction noise monitoring program is defined in Table 4.

Table 4: Construction noise monitoring program

Period [1]	Monitoring
Day (normal working hours)	Construction noise monitoring shall be instigated when community complaints about construction noise cannot be addressed or resolved via the construction management plan for the project. The following specific triggers for construction monitoring are defined: • The complaint is determined to relate to an activity which occurs for an extended period (e.g. more than one week); and • The noise of the activity in question cannot be practically reduced to the satisfaction of neighbouring receivers.
Evening & Night	Construction noise monitoring shall be instigated for any work that is proposed to be carried out during the evening and night periods. The requirement for monitoring may be negated if the following can be demonstrated: • The activity in question will occur for a limited number of evenings and/or nights and will only occur for brief portions of the evenings and/or nights. A vehicle delivering an oversized item outside of normal working hours is an example of the type of activity which is appropriately exempted from the requirement for noise monitoring. • The activity or noise source in question is expected to result in noise levels significantly lower (e.g. at least 5 dB lower) than the applicable evening and night period limits, based on noise modelling conducted by a qualified acoustic engineer using conservative assessment parameters (i.e. assuming typical upper emission levels for the activity or source in question and atmospheric conditions which favour the propagation of sound).

Note 1: Period as defined in Section 3.1.2

4.0 OPERATIONAL TURBINE NOISE – NEAR FIELD COMPLIANCE TESTING

To address the requirements of Condition 19 for near field compliance testing of the first turbine that is commissioned at the site, the following provisions shall apply.

Within the first two (2) months of the first turbine being available to operate in a manner that is representative of normal operating conditions of the wind farm, a sound power level test shall be conducted for a single wind turbine at the site.

The sound power level test shall be conducted in accordance with IEC 61400-11 Edition 3.0 dated 2012 titled *Wind turbine – Part 11: Acoustic noise measurement techniques* (IEC 61400-11).

The sound power level test shall determine both the sound power levels and tonal audibility of the turbine for integer hub-height wind speeds from 6 m/s to 10 m/s inclusive.

The results of the test shall be presented in a technical Sound Power Level Test Report conforming to the documentation requirements specified in Section 10 of IEC 61400-11.

A Near-field Compliance Testing Report shall be separately prepared on the basis of the Sound Power Level Test Report. This report shall assess the results of the sound power level testing by:

- Verifying that the sound power levels and tonal audibility levels, accounting for test uncertainty, are equivalent to or less than the values adopted as the basis of the pre-construction noise report; or
- Verifying that predicted noise levels determined on the basis of the sound power level test results are below the planning permit noise limits which apply at neighbouring noise sensitive locations, using the same prediction methodology used for the pre-construction noise assessment.

If the results of the sound power level test indicate results (for the sound power level or tonal audibility levels) that are significantly different from the data referenced in the pre-construction noise assessment (in terms of sound power levels or tonality characteristics), the Near Field Compliance Testing Report must address these differences and outline whether additional sound power level testing is warranted to verify and assess the noise emissions of other wind turbines at the site.

The Near-field Compliance Testing Report shall be submitted to the Minister for Planning within six (6) weeks of completing the sound power level test.

5.0 OPERATIONAL WIND FARM NOISE LIMITS

Operational wind farm noise limits apply at noise sensitive locations in the vicinity of the Berrybank Wind Farm, except where a noise agreement is in place with the landowner (as per Condition 17 of the amended planning permits).

The coordinates of all identified noise sensitive locations around the Berrybank Wind Farm are tabulated in Appendix D.

Condition 17 of the amended planning permits specifies NZS 6808:2010 the applicable standard for the measurement and assessment of operational noise levels.

The noise criteria detailed in NZS 6808:2010 are defined using a combination of fixed values limits and background noise related limits.

The fixed value component of the limits is set at a value of 40 dB L_{A90} except in those instances where the high amenity provisions of NZS 6808:2010 are applicable.

The subject of high amenity limits was considered as part of the panel hearing associated with the amendment of the planning permits for the Berrybank Wind Farm. The panel report dated 19 December 2017 addressed the subject in Section 6.4.2 and notes that the Panel concluded:

> *From the evidence provided to it, the Panel is of the opinion that the Berrybank wind farm is not in an area where the 'high amenity noise limit' would apply.*
>
> *There is nothing substantive in the amended proposal that affects the Panel's further consideration of Berrybank as a "High Amenity Area."*

Accordingly, the high amenity noise limits are not applicable to the Berrybank Wind Farm. The applicable noise limits in accordance with NZS 6808:20120 are therefore defined as 40 dB L_{A90} or the background noise level L_{A90} + 5dB, whichever is higher.

Prior to commencement of operation of the wind farm, background noise levels are to be measured at the preferred compliance monitoring locations (see Section 6.1) in order to:

- Determine operational noise limits in accordance with the planning permit
- Assist the analysis of noise data obtained from compliance monitoring after the wind farm commences operating.

6.0 OPERATIONAL WIND FARM NOISE TESTING PROCEDURES

6.1 Noise measurement locations

Operational noise measurements shall be carried out at the seventeen (17) preferred noise sensitive receiver locations detailed in Table 2, subject to permission being granted by the landowners.

Table 5: Preferred noise compliance monitoring locations

Receiver	Direction from nearest turbine	Distance from nearest turbine (m)
9	NNE	1,150
10	NW	1,141
18	NNW	1,071
27	NW	1,099
56*	W	1,141
57	W	1,298
58	W	1,149
63	NE	1,416
69	SSW	1,114
70*	SW	1,171
72	E	1,247
73	ESE	1,220
79*	SSW	1,093
80	SW	1,091
83	E	1,128
102	SSE	1,196
103	NNE	1,159

* The inclusion of these noise sensitive receiver locations was requested by DEWLP

These locations have been selected to represent a range of noise sensitive receivers around the Berrybank Wind Farm where predicted noise levels are comparable to the 40 dB L_{A90} 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.

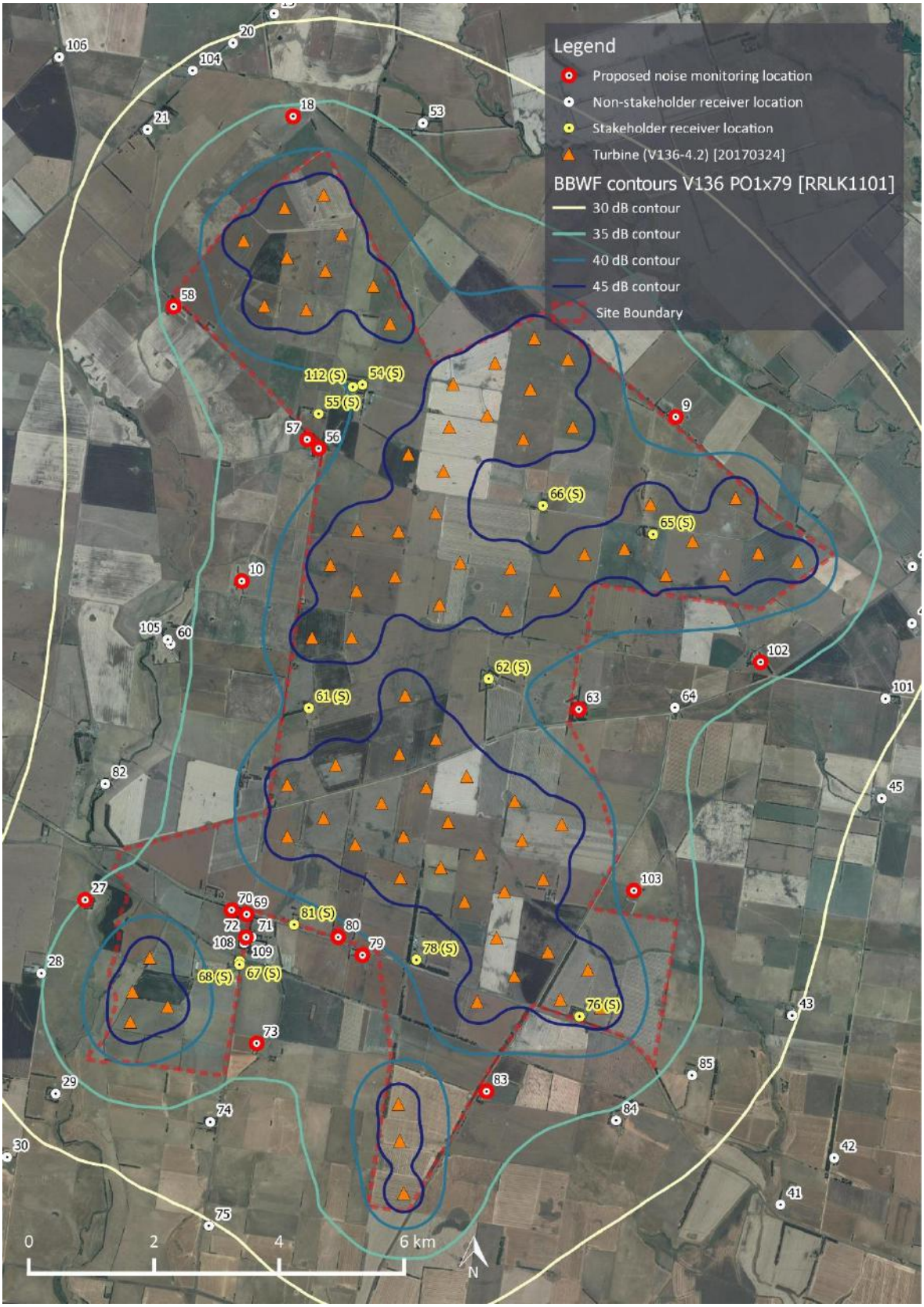
In the event that permission is not able to be obtained for conducting compliance measurements at the preferred noise sensitive receiver locations, alternative locations shall be considered.

The measurement systems shall be positioned in the vicinity of the dwelling at each of the preferred noise sensitive locations 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 (wherever practicably possible)
- The measurements shall occur as close as practically possible to the location of any background noise monitoring conducted prior to commencement of operation of the wind farm.

In addition, the monitoring locations shall be located as far as practically possible from streams, watercourse and vegetation which may result in localised increases in background noise levels.

Figure 1: Preferred monitoring locations and predicted noise level contours (dB L_{A90})



6.2 Noise measurement procedures

The noise measurement procedures are to comprise unattended monitoring for a range of conditions, supplemented by attended measurements and observations.

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

- The measurements shall occur for the measurement durations defined in Section 6.3
- 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 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 (this requirement is only applicable to unattended measurements conducted at, or in the vicinity of, noise sensitive locations).

Further information and guidance about data to be obtained during attended observations is provided in Section 6.7.

6.3 Noise measurement timing and duration

Compliance measurements shall be conducted in stages in order to address the requirement of Condition 19 for:

- an acoustic compliance report to be submitted to the responsible authority within six (6) months of the first turbine operating; and
- further post-construction acoustic compliance reports to be prepared in accordance with the standard and submitted to the responsible authority annually from the date of the report being submitted until the final turbine is operating.

Each stage of unattended measurements 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.

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 G for reference)
  - representative of the normal operating range of the turbines (the target minimum wind speed range is 3 m/s to 14 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 7.0 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 Minister for Planning consulted.

The first stage of wind farm compliance monitoring shall be commenced within two (2) months following commencement of regular operation of the first turbine at the site (i.e. regular power supply to the grid). The subsequent stages of compliance monitoring shall occur annually (i.e. commencing within 12 months of completion of the proceeding stage of monitoring) until a final stage of monitoring has been completed with all wind turbines operating at the site.

The final compliance testing report provided to the Minister for Planning shall include a summary of the results in terms that are aimed at a lay person, and must be accompanied by a report by an environmental auditor appointed under the Environment Protection Act 1970, containing the auditor's opinion on the methodology of the compliance testing.

During the initial stages of noise compliance monitoring, significant sections of the wind farm may not be operational. As a result, operational noise levels at some noise sensitive locations may not yet be at a level which would enable a meaningful assessment of operational noise of the wind farm as a whole. In such instances, it may be appropriate to defer the monitoring at some noise sensitive locations until subsequent stages of the compliance monitoring. Deferral of the monitoring may only occur with the approval of the Minister for Planning, based on evidence provided to the Minister to demonstrate that construction of the wind farm is not sufficiently advanced to result in a meaningful assessment of noise from the wind farm as a whole at the relevant noise sensitive locations. This must include evidence that predicted noise levels at the monitoring locations to be deferred are at least 5 dB lower than the highest predicted noise level detailed in the pre-construction noise report.

Adhering to the planned schedule of monitoring 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 6.7.

6.4 Site wind speeds

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

This data shall be used to determine the wind speed at 112 m AGL (the reference wind speed height) corresponding to free-field conditions (i.e. free from turbine wake effects) at the reference mast used for any pre-construction background noise monitoring conducted prior to commencement of operation of the wind farm.

Wind speeds at 112 m AGL which are determined from wind speed measurements at heights other than 112 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 112 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 8.0).

6.5 Local weather data

The following local weather data shall be recorded during the noise survey:

- Local wind speeds: wind speeds at 1.5 m AGL shall be measured in ten (10) minute samples at a minimum of one (1) noise compliance monitoring location. The use of enhanced wind shield systems (detailed in Section 6.2) 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) noise compliance monitoring location during the survey.

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

6.6 Wind farm site data and records

The following data shall be obtained from the wind farm operators:

- 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. Each ten (10) minute interval of data shall be synchronised with the interval commencing on the hour and each 10-minute increment following the start of each hour.
- 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 (where appropriate), shall be provided to the acoustic consultant. As a minimum, each record shall include details of the time, duration and location of the observation.

6.7 Special Audible Characteristics

6.7.1 General assessment procedures

The potential presence of Special Audible Characteristics (SACs) in the noise associated with the wind farm shall be reviewed on the basis of the following:

- Attended observations
- The results of the near field compliance testing
- Site records during the monitoring period (comprising observations by site personnel and data from the site's complaint handling and management system – see description in Section 6.6).

In instances where SACs comprising amplitude modulation, impulsiveness or tonality are identified as potential feature(s) of the noise associated with the wind farm, an objective assessment of the sound's character shall be undertaken to determine if penalties should be applied to the measured noise levels.

6.7.2 Attended observations

To investigate whether SACs are a potential feature of the noise associated with the wind farm, attended observations shall be 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 equipment is dependent on practical considerations including timing of access to residential properties. However, the wind farm must be operating at the time of all 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:

- Wind speeds 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-time period (avoiding shoulder periods near sunrise or sunset when ambient noise levels may increase).

The attended observations should ideally include downwind conditions between the wind farm and the preferred noise sensitive location (wind directions in which there is a positive wind speed vector component of at least 2 to 3 m/s from the nearest turbines to the noise sensitive location). However, this will be dependent on the available wind conditions and will not always be practical. If wind conditions preclude observations under downwind conditions in the vicinity of noise sensitive locations, observations should be made at alternative orientations to the wind farm which are downwind of the wind farm at comparable separation distances (subject to practical access constraints).

Attended observations shall also be undertaken near 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. Given that the assessment of SACs strictly applies to the sound of the wind farm at the compliance monitoring locations, 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
- Instigate an objective assessment of 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. The reason is that 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.

If the available weather conditions and operating conditions at the time of attendance do not permit representative observations to be made, additional attended observations may need to be carried out. In addition, the acoustic engineer shall review the site records (see description in Section 6.6) to determine if additional attended observations may be warranted.

Each set of attended observations in the vicinity of the compliance monitoring locations shall comprise observations for at least ten (10) minutes. 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.

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.

6.7.3 Objective assessment methods

Appendix B1 of NZS 6808:2010 states that subjective assessment can be sufficient in some circumstances to assess SACs.

The findings of the attended observations shall therefore be used to determine whether an objective assessment of SACs is warranted. Specifically, if one or more potential SACs are identified during the attended observations, the SACs in question shall be analysed using the procedures defined in Table 6. The results shall be used to assist the decision to apply penalties, and if so, when to apply penalties. In the case of tonality, the results shall also be used to assist with determining the magnitude of the penalties to be applied when tones are identified.

Objective assessments shall also be instigated in the following situations:

- Site records (see description in Section 6.6): if site records 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.
- Near field compliance testing (see description in Section 4.0): if the results presented in the Near Field Compliance Test Report indicate tonal audibility levels (determined in accordance with IEC 61400-11) greater than 0 dB $\Delta L_{a,k}$, an objective assessment of tonality shall be conducted for all audio records obtained during the unattended monitoring at receiver locations.

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 attended observations. In instances where an objective assessment of tonality is instigated on the basis of the results detailed in the Near Field Compliance Test Report, the objective assessment shall be restricted to the frequency of the range of the tones identified by the near field testing.

Table 6: SAC objective assessment procedures

SAC	Objective assessment procedure
Amplitude modulation	UK Institute of Acoustics' Amplitude Modulation Working Group publication *Final Report - A Method for Rating Amplitude Modulation in Wind Turbine Noise Version 1* dated 9 Aug 2016 (UK IOA AM procedure)
Impulsiveness	British Standard *BS 4142:2014 Methods for rating and assessing industrial and commercial sound* (BS 4142:2014)
Tonality	International Standard ISO 1996-2:2017 *Acoustics — Description, measurement and assessment of environmental noise — Part 2: Determination of sound pressure levels* 2017 (ISO 1996-2:2017) The narrow band method defined in ISO 1996-2:2017 Annex J *Objective method for assessing the audibility of tones in noise — Engineering method* (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 procedure is primarily intended for frequencies greater than 50 Hz, as per the following extract from ISO/PAS 20065:2016:

> *This Publicly Available Specification is intended to augment the usual method for evaluation on the basis of aural impression, in particular, in cases in which there is no agreement on the degree of the audibility of tones. The method described can be used if the frequency of the tone being evaluated is equal to, or greater than, 50 Hz. In other cases, if the tone frequency is below 50 Hz, or if other types of noise (such as screeching) are to be captured, then this method cannot replace subjective evaluation.*

The objective assessment(s) shall be undertaken for each audio recording obtained during the attended observations in which one or more potential SACs were identified. The objective assessment shall be undertaken for each type of potential SAC which has been observed.

If the objective assessment(s) indicate the presence of SACs which may warrant the application of penalties, the objective assessment(s) shall be carried out for the audio records obtained from the unattended compliance monitoring.

If the objective assessment(s) do not indicate the presence of SACs at levels which warrant the application of penalties, the objective assessment(s) may still need to be carried out for the unattended audio records, 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(s) 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 8.0).Caution must be exercised when conducting objective assessment of unattended audio recordings. Applying the objective assessment methods to the total combined 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 7.8.

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 the corresponding 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 noise sensitive locations being assessed.

7.0 OPERATIONAL WIND FARM 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.

7.1 Rainfall

Any ten (10) minute period 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 the trend of the measurements indicates the noise levels are likely to have been elevated as a result of wet roads or flow noise associated with drainage systems and local watercourses.

7.2 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, but are not limited to, 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 conditions[2] 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 sound of a wind farm is unlikely to result in tones above 1 kHz at noise sensitive locations (due to high levels of atmospheric sound absorption at frequencies above 1 kHz) and, in the unlikely event of such a tone occurring, it is unlikely to dominate the sound pressure 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 indicated the potential for tones related to the operation of the wind farm. Further discussion of extraneous noise screening related to seasonal variations is provided in Section 7.4.

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

7.3 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 shall be reviewed for each ten (10) minute sample to identify any periods of atypical operation or shutdown. These periods shall be excluded from the analysis if the overall noise level of the wind farm is likely to have been reduced.

As a minimum, any ten (10) minute period in which relevant turbines 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.

Relevant turbines are all turbines other than those with the lowest predicted noise levels which collectively result in a predicted noise level 15 dB[3] lower than the total predicted noise level of the wind farm 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.

7.4 Review of seasonal considerations

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

7.4.1 Background sound

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

- Rainfall (see data filtering procedures in Section 7.1)
- Insect, bird and other fauna noise (see data filtering procedures in Section 7.2)
- Local domestic plant such as air-conditioning 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 (less than 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 likely to be attributable 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 7.7) or repeat measurements will be required.

[3] 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.

7.4.2 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 G. 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 (see Section 7.7 for procedures) 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 considerations relating to subsets of data as noted in Section 7.5), 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 using other information relating to the change in the wind farm's sound emission with increasing wind speed (e.g. sound power level test data obtained in accordance with IEC 61400-11:2012 or measurement data obtained at intermediate locations or other compliance monitoring locations around the wind farm – see supplementary procedures in Section 7.7).

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 because increased wind shear may result in lower background sound levels for a given wind speed (i.e. increasing the likelihood of the wind farm being audible) and may also 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 6.3 for at least one set of attended observations to occur during the night period for each stage of the surveys).

7.5 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 are found to warrant analysis shall be assessed separately when comparing the derived wind farm noise levels with the compliance limits.

7.6 Adjustment for background noise levels

The background noise monitoring data that is to be obtained prior to commencement of operation of the wind farm shall be used to adjust the 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.

7.7 Supplementary procedures

The data filtering and background noise adjustment procedures detailed in Section 7.1 to Section 7.6 shall be used to reduce the influence of background noise levels.

If the residual influence of background sound 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 (primarily for sites where background sound levels are not expected to vary significantly with wind direction).

Supplementary measurements may also be undertaken at intermediate locations that positioned nearer to the wind farm to:

- Assist the evaluation of noise levels solely attributable to the operation of the wind farm
- Provide data for reference locations where testing can be repeated, if required, for the purposes of re-assessing compliance in future.

If noise measurements are undertaken at an intermediate location between the wind farm and the noise sensitive receiver location(s), this data 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 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 noise sensitive location are attributable to the wind farm (i.e. the profiles at the intermediate and the compliance monitoring locations are equivalent) or the influence of wind related background sound 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 location is higher than the simultaneously measured level at the intermediate location shall be considered background sound 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 a +/-1 dB uncertainty margin to the predictions to account for variations in the tolerance of the calculations at intermediate and receptor distances. The procedure may also be used to assess noise levels at other noise sensitive locations where compliance monitoring has not been undertaken.

If the results of an assessment based on measurement data obtained at an intermediate location are inconclusive, or 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:

- Targeted assessment of specific conditions (i.e. wind speeds, wind directions and times of day);
- Additional measurements at a representative location where background sound levels are lower; or
- On/off testing in accordance with the procedures defined in Section 7.7 of NZS 6808:2010.

7.8 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 NZS 6808:2010 are clarified as follows:

- The penalties shall be applied to the individual ten (10) minute samples in which SACs are identified, prior to conducting a regression analysis of the complete measurement data set
- 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
- 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).

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 required when applying SAC related penalties to the results of unattended noise measurement data.

8.0 OPERATIONAL WIND FARM 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 additional information:

- 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.

APPENDIX A GLOSSARY OF TERMINOLOGY

Amplitude Modulation	Sound that is characterised by a rhythmic and higher than normal rise and fall in sound level at regular intervals.
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
dB	Decibel. The unit of sound level.
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).
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)
$L_{A90\,(t)}$	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.
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.
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)

APPENDIX B BERRYBANK WIND FARM TURBINE MODEL

Table 7: Proposed wind turbine model

Detail	Turbine model
Make	Vestas
Model	V136
Rotor diameter	136 m
Hub height	112 m
Blade orientation	Upwind
Turbine regulation method	Variable blade pitch
Maximum rated power generating capacity	4.2 MW
Cut-in wind speed (hub height)	3.0 m/s
Rated power wind speed (hub height)	13.0 m/s
Cut-out wind speed (hub height)	25.0 m/s

APPENDIX C TURBINE COORDINATES

The following table sets out the coordinates of the seventy-nine (79) turbine layout of the Berrybank Wind Farm.

Table 8: Berrybank Wind Farm turbine coordinates – MGA 94 zone 54

Turbine ID	Easting	Northing	Turbine ID	Easting	Northing
1	718723	5802176	51	725119	5798064
2	719252	5802580	52	722922	5798109
3	719751	5802721	54	722535	5797663
4	720031	5797730	55	720424	5790132
6	719967	5802221	57	720523	5797897
7	719492	5801285	58	720518	5795662
9	719747	5801765	59	720985	5795834
12	718962	5801349	60	721985	5797957
13	720348	5801559	61	721349	5798047
14	720545	5801081	62	717031	5792379
15	721921	5797435	63	720391	5790792
17	721258	5799760	64	723429	5798169
18	720733	5799429	65	719954	5797147
19	721859	5800552	66	720611	5796396
20	722364	5800847	67	719453	5797154
21	721322	5800299	69	721076	5797527
22	722296	5800211	72	719092	5795312
23	722817	5799718	73	719710	5795545
24	722780	5800575	74	717068	5792757
25	719710	5798063	75	719076	5794661
26	721169	5799204	76	719538	5794878
27	721740	5799891	77	720541	5794620
28	722189	5799582	78	720275	5795050
31	720387	5791255	79	720845	5795231
32	721000	5794218	80	722289	5794039
33	717508	5792561	82	719929	5794535
34	719266	5801952	84	721290	5793778
36	720062	5798490	85	721955	5795028
37	720583	5798464	86	722325	5793119
38	721057	5798686	88	720489	5794103

Turbine ID	Easting	Northing	Turbine ID	Easting	Northing
39	723772	5798717	89	721109	5794788
40	722821	5792881	90	721503	5794377
42	721414	5792516	93	722543	5794720
43	722465	5792519	94	722034	5794531
44	725612	5797947	96	721796	5793893
45	724851	5798766	97	721893	5792827
46	724683	5797804	98	721681	5793316
47	724291	5798236	99	722975	5792402
48	717298	5793181	100	721359	5795356
49	723942	5797816	-	-	-

APPENDIX D RECEIVER COORDINATES

The following table sets out the coordinates of the noise sensitive receiver locations considered in the preparation of the Berrybank Wind Farm NCTP. Receivers located within the wind farm site boundary are collectively referred to as stakeholder receivers and annotated with (S).

Table 9: Berrybank Wind Farm – noise sensitive receiver locations – MGA 94 zone 54

House number	Easting	Northing	Comments from BDPL
9	724123	5799807	
10	718587	5797888	House uninhabitable.
18	719391	5803724	
19	719185	5805026	
20	718656	5804668	
21	717547	5803608	
22	715098	5801127	
23	714589	5801057	
24	713788	5795489	
25	714049	5795420	
26	714511	5795536	
27	716501	5793929	
28	715923	5793021	
29	716065	5791501	
30	715431	5790719	
38	720714	5788267	
39	722143	5787638	
41	725172	5789858	
42	725866	5790427	
43	725385	5792233	
45	726590	5794934	
47	727033	5797127	
48	727061	5797842	
53	721028	5803596	
54 (S)	720176	5800321	Uninhabitable
55 (S)	719613	5799970	
56	719602	5799532	House uninhabitable
57	719459	5799651	

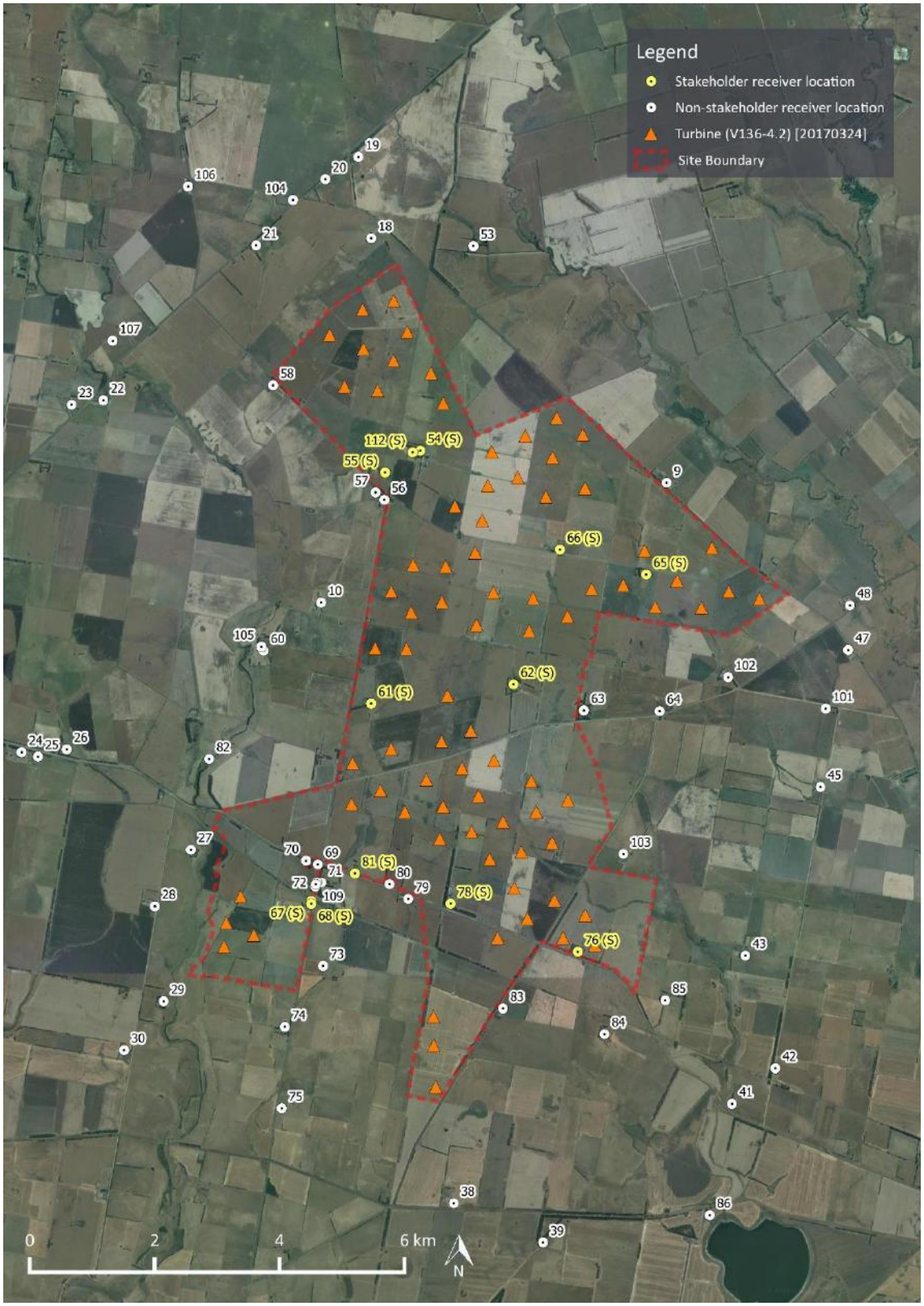
House number	Easting	Northing	Comments from BDPL
58	717818	5801367	
60	717667	5797118	
61 (S)	719390	5796269	
62 (S)	721670	5796577	
63	722798	5796160	
64	724012	5796148	
65 (S)	723797	5798337	House uninhabitable
66 (S)	722414	5798736	
67 (S)	718431	5793106	
68 (S)	718429	5793061	House uninhabitable
69	718535	5793693	
70	718346	5793752	
71	718590	5793405	
72	718520	5793406	
73	718619	5792068	
74	718006	5791092	
75	717955	5789787	
76 (S)	722702	5792294	House uninhabitable
78 (S)	720663	5793064	
79	719983	5793140	House burnt down several years ago
80	719684	5793375	
81 (S)	719130	5793548	House uninhabitable
82	716793	5795383	
83	721502	5791385	
84	723128	5790975	
85	724101	5791516	
86	724815	5788076	
101	726673	5796189	
102	725109	5796692	
103	723431	5793860	
104	718137	5804335	
105	717630	5797179	

House number	Easting	Northing	Comments from BDPL
106	716455	5804551	House uninhabitable.
107	715247	5802080	House uninhabitable.
108	718494	5793339	Berrybank CFA Fire truck Shed
109	718502	5793373	Unused Old Church building Land now owned by another person
112 (S)	720055	5800295	New house (replacing house 54)

(S) Stakeholder receiver

MARSHALL DAY Acoustics

APPENDIX E SITE LAYOUT PLAN



APPENDIX F AMENDED PLANNING PERMIT – NOISE REQUIREMENTS

The following noise related conditions are defined in Amended Planning Permit No. 20092820 – A and Amended Planning Permit No. 20092821 – A (both dated 4 February 2018) for the Golden Plains Shire and Corangamite Shire sections of the project respectively.

NOISE STANDARD

17. *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' at any noise sensitive location that existed at 3 April 2017, to the satisfaction of the Minister for Planning.*

    The limits specified under this condition do not apply if an agreement has been into with the relevant landowner waiving the limits. Evidence of the agreement must be provided to the satisfaction of the Minister for planning upon request, and be in a form that applies to the land for the life of the wind energy facility.

PRE-CONSTRUCTION NOISE ASSESSMENT

18. *Before development starts, a pre-construction noise assessment based on the final turbine layout and turbine model to be installed must be undertaken and the results submitted to the Minister for Planning.*

    The pre-construction noise assessment must be prepared in accordance with the Standard and must demonstrate to the satisfaction of the responsible authority that the facility will comply with the performance requirements specified in Condition 17 without operation in noise management mode unless the Minister for Planning consents to the use of noise management mode.

    The pre-construction noise assessment report provided to the Minister for Planning must include a summary of the results in terms that are aimed at a lay person, and must be accompanied by a report by an environmental auditor appointed under the Environment Protection Act 1970, containing the auditor's opinion on the methodology of the pre-construction assessment.

    If the proponent considers that a suitable cannot be engaged, the proponent may seek the written consent of the Minister for Planning to obtain an independent peer review of the results of the pre-construction noise assessment instead.

NOISE COMPLIANCE ASSESSMENT

19. *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.*

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

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

    The noise compliance testing plan must include:

    a) a determination of the noise limits to be applied during construction using the methodology prescribed in the EPA Noise Control Guidelines – publication 1254 released October 2008;

    b) a program of compliance testing to be implemented during the construction of the wind energy facility that:

        (i) Is designed by a suitably qualified acoustic expert; and

        (ii) Utilises the methodology prescribed in State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) No N-1, to demonstrate compliance with the limits determined in (a) above.

c) a procedure for a near field compliance test of the first turbine commissioned at the wind energy facility; and

d) a procedure for a final compliance test of the wind energy facility after the commissioning of the last turbine, such testing to:

(i) consider compliance of the operational wind energy facility as a whole with the noise limits set under condition 17;

(ii) be carried out according to the method described in NZS6808: 2010 'Acoustics – Wind farm noise'; and

(iii) be submitted to the responsible authority within 6 months of the first turbine operating. Further post-construction acoustic compliance reports prepared in accordance with this condition must be submitted to the responsible authority annually from the date of the first report being submitted until the final turbine is operating.

The final compliance testing report provided to the Minister for Planning must include a summary of the results in terms that are aimed at a lay person, and must be accompanied by a report by an environmental auditor appointed under the Environment Protection Act 1970, containing the auditor's opinion on the methodology of the compliance testing.

If the proponent considers that a suitable auditor cannot be engaged, the proponent may seek the written consent of the Minister for Planning to obtain an independent peer review of the results of the noise compliance testing instead.

Compliance test results must be publicly available.

APPENDIX G SITE WIND SPEED AND DIRECTION TRENDS

Representative wind rose for one of the most central and tallest met mast within the proposed site based on a period of approximately seven years, as provided by BDPL.

Wind data shown below has been extrapolated to the proposed hub height of 112 m from measured data at 80 m above ground level.