MEMO

MARSHALL DAY Acoustics

Project:	St Patricks Plains Wind Farm	**Document No.:**	Mm 004
To:	Ark Energy	**Date:**	5 March 2024
Attention:	Donna Bolton	**Cross Reference:**	Rp 001 R06 20190433 Rp 002 R01 20190433 Mm 004 R01 20190433
Email/Delivery:	By email	**Project No.:**	20190433
From:	Christophe Delaire / Justin Adcock	**No. Pages:**	8
Subject:	EPA Request for additional information		

The following reports, prepared by Marshall Day Acoustics Pty Ltd (MDA), were appended to the Environmental Impact Statement for the St Patricks Plains Wind Farm (the Project)[1]:

- MDA report Rp 001 R06 *St Patricks Plains Wind Farm – Environmental noise assessment*, dated 10 July 2023 (referred to herein as the environmental noise assessment)
- MDA report Rp 002 R01 *St Patricks Plains Wind Farm – Background noise assessment*, dated 10 July 2023 (referred to herein as the background noise assessment)

In response to the additional information required by EPA Tasmania[2] relating to the above reports (referred to herein as the EPA RFI), we prepared an additional information memo[3] responding to query references 60, 62, 63, 64 and 65.

Further correspondence from EPA Tasmania[4] outlines outstanding information requirements for queries that are not considered to have been adequately addressed. This memo has been prepared to address the outstanding information requirements for query references 60 and 63.

1 ERA Planning and Environment report *St Patricks Plains Wind Farm Environmental Impact Statement*, dated 29 June 2023

2 *EPA - St Patricks Plains Wind Farm Pty Ltd – St Patricks Plains Wind Farm - Additional information requirements part 2 – Representations*, dated 20 November 2023

3 MDA memo Mm 003 R01 20190433 *EPA Request for additional information,* dated 17 January 2024

4 *EPA - St Patricks Plains Wind Farm Pty Ltd – St Patricks Plains Wind Farm – Outstanding information requirements for EIS Supplement*, dated February 2024

Certified System ISO 9001

QUERY REF. 60 & 63 OUTSTANDING INFORMATION REQUIRED

The outstanding information requirements specified by EPA Tasmania are as follows:

> *In relation to a contingency management plan (which could also be referred to as a 'draft noise management plan' or 'draft noise management strategy'), only a cursory list of potential adaptive management measures has been provided in the EIS supplement, and specific information on the effectiveness of most of these measures is lacking. Therefore the following is still required:*
>
> - *Clarity on the noise mitigation measures that the proponent is committing to implement, should noise levels at dwelling(s) exceed the specified limit of 35 dB(A), and/or should special audible characteristics be identified. The measures are expected to include those to be implemented over the short term, for example mitigating increased noise emissions from faulty equipment, and those that will be implemented in the medium-long term, for example should inherent turbine noise be higher than predicted in the model.*
> - *Detail on the effectiveness of proposed noise mitigation measures, including in mitigating noise levels at the dwellings to the north east, with particular focus on dwellings modelled to be the closest to the specified limit of 35 dB(A). The assessment is expected to be quantitative where information is available and include modelling of proposed sector management measures (e.g. select turbine shutdown and/or operating in reduced noise modes). It should be clear that should a worst-case scenario eventuate (e.g. maximum penalty applied for ongoing special audible characteristics and or significant difference between predicted model and constructed windfarm) the wind farm is still able to operate without exceeding the 35 dB(A) threshold at the nearest dwellings.*

Further information is therefore required in relation to mitigation options and their effectiveness. These items are addressed separately in the following sections.

MITIGATION OPTIONS

Practical experience of wind farm developments across Australia demonstrates that the vast majority of wind farm projects comply with their environmental noise requirements. Importantly, compliance is normally demonstrated following commencement of operation without the need to implement noise mitigation. Non-compliant outcomes, either at commencement of operations, or subsequently during ongoing operations, are atypical for wind farm projects and are therefore unlikely to occur. The following factors are among the reasons for consistent compliance outcomes:

- Wind turbine noise emissions are well understood and documented in manufacturer specifications and guarantees (i.e. in contrast to other types of development where equipment noise emission data can be limited);
- Environmental noise is one of the key constraints for a wind farm development and therefore attracts considerable attention during the design and procurement process to achieve a compliant outcome; and
- The noise prediction methods used to inform the design of contemporary wind farms are well established and provide a reliable indication of the upper wind turbine noise levels expected to occur in practice.

However, non-compliances can and do occur in a small number of situations. In these instances, the reasons for non-compliance are varied and highly specific to each wind farm installation. As a result, in the unlikely event of a non-compliance, the noise mitigation must be tailored to the specifics of the situation. For example, if a non-compliance was detected as a result of an adjustment for identified tonality, the priority would be to reduce or eliminate the source of the tone, before investigating ways to reduce overall noise levels. Conversely, if a non-compliance was detected as a result of the wind farm's noise emissions being higher than expected, the noise mitigation could involve rectification of defects, the use of noise-reduced modes of operation for selected turbines, or a combination of the two. It is therefore neither appropriate nor practicable at this stage of the Project to commit to a specific type of mitigation measure for an unforeseen compliance issue.

In the event that a non-compliance is identified, the proponent commits to the preparation of a noise remediation plan for submission to EPA Tasmania. The noise remediation plan would define how the non-compliance would be addressed. Specifically, the noise remediation plan would document:

- A concise summary of the testing that has been undertaken to determine that wind turbine noise is not compliant with the relevant standard;
- The receivers where non-compliance has been directly or indirectly established;
- The wind conditions in which non-compliance has been established;
- A performance specification for the noise reduction that must be achieved for the wind farm to be compliant at all relevant receivers. The performance specification would be expressed in terms of the magnitude of the noise level reduction that must be achieved, and the wind speeds and wind directions that the performance specifications apply to;
- Details of the noise mitigation to be implemented in order to achieve the performance specification;
- A time frame for implementing the proposed noise mitigation;
- A brief statement describing the selected method of additional noise testing that will be conducted to assess the effectiveness of the noise mitigation and reassess compliance with the requirements of the relevant standard; and
- A time frame for conducting additional noise testing and producing a report documenting the outcomes.

One of the key noise mitigation options for contemporary wind farms is to implement changes to the way the wind farm operates, sometimes referred to as *operational curtailment* (or simply *curtailment*). Curtailment involves reconfiguring certain turbines to use noise-reduced modes of operation or shutdowns for certain conditions (e.g. according to wind speed, wind direction and/or time of day). Curtailment is normally implemented via the Supervisory Control and Data Acquisition (SCADA) system for the wind farm which controls how each turbine operates. Importantly, curtailment can be implemented at any time after a wind farm has begun operating if noise levels are non-compliant.

Curtailment can be used as a short-term noise mitigation option to enable compliance while any required long-term mitigation options are developed and implemented (e.g. physical changes to the turbines to address higher than expected noise levels or tonality). Conversely, in some situations, curtailment can be used as a long-term noise mitigation option.

The process for developing and implementing curtailment broadly involves the following steps:

- Identifying all locations where a non-compliance has been confirmed
- Determining the wind speeds and wind directions when the non-compliance occurs
- Quantifying the magnitude of the non-compliance at each receiver and wind speed, accounting for any applicable adjustments for special audible characteristics (SACs), including amplitude modulation, tonality, and impulsiveness, as specified in NZS 6808

- Defining a performance specification for the noise reduction that must be achieved by curtailment in order for noise levels to comply, accounting for all locations and SAC adjusted levels as applicable
- Conducting iterative noise modelling of the wind farm to assess alternative forms of curtailment that would be capable of achieving the performance specification, comprising:
  - noise-reduced modes of operation for the nearest turbines for the relevant conditions (e.g. considering different curtailment scenarios, such as a small number of turbines using restrictive noise-reduced modes, or a larger number of turbine numbers using less restrictive noise-reduced modes); or
  - shutting down the nearest turbines for the relevant conditions; or
  - a combination of noise-reduced modes of operation and shutdowns.
- Consulting with the site's operations manager to agree the most appropriate and efficient method of achieving the performance specification;
- Implementing the curtailment via the wind farm's SCADA system, which would automatically engage noise-reduced modes and/or shutdowns for the relevant turbines and conditions, in accordance with the agreed curtailment;
- Conducting repeat noise monitoring at intermediate and receiver locations to assess the effectiveness of the curtailment; and
- Documenting the results of the repeat noise monitoring to either verify compliance or outline the requirement for further investigations and/or modifications if required.

If curtailment is used as a short-term noise mitigation option, the proponent commits to maintaining the curtailment for as long as required to maintain compliance with the operational noise requirements. The curtailment would only be lifted if and when other longer-term measures have been put in place which enable compliance without the sector management strategy.

Examples of the types of longer-term noise mitigation options which can be investigated for a non-compliant wind farm include:

- Replacement or modification of components in the turbine nacelle, such as defective components of a turbine's drivetrain, which can lead to tonal noise emissions;
- Installation of tuned mass dampers to the drivetrain, nacelle enclosure structure or tower structure to mitigate identified tonality; and
- Replacement or modification of elements of the blade structure, or in extreme cases, the entire blade, if design or manufacturing defects cause higher A-weighted noise levels (i.e. higher than expected broad-band aerodynamic noise) or tonal characteristics (as can occur from localised blade defects or damage).

Again, these types of mitigation options are highly specific examples which are only applicable in very specific situations. Nonetheless, they are illustrative of the types of mitigation options that can require investigation to determine how noise levels would be reduced in the long-term. In situations where a non-compliance is identified as a result of SACs, the ideal objective of long-term noise mitigation is to reduce or eliminate the characteristic where practicable, rather than ongoing reliance on A-weighted noise level reductions (such as via a noise curtailment strategy) to achieve compliance.

EFFECTIVENESS OF MITIGATION MEASURES

As an indication of the level of noise reduction that can be achieved with noise mitigation option based on curtailment, Table 8 of Section 6.3.1 of the environment noise assessment presents a sample of reduced power and noise modes that are available for the candidate turbine. These types of noise-reduced modes are a common feature of pitch-regulated variable speed turbines that are now standard for all commercial scale wind farm development. The data from Table 8 was also reproduced in the additional information memo and is reproduced in Table 1 below for ease of reference.

The Project has been modelled based on all turbines operating at their maximum rated power outputs (referred to as operating mode PO6200, which designates a power optimised mode and a turbine rating of 6,200kW/6.2MW). The data in Table 1 below shows that the overall sound power level of the candidate turbine is able to be reduced by up to 4.8 dB, when using the noise-reduced operating mode S04, from the reference sound power level used in the noise modelling.

Table 1: Sound power levels versus hub height wind speed, dB L_{WA}

Operating mode	Power output, MW	Hub height wind speed, m/s								
		4	5	6	7	8	9	10	11	≥12
PO6200	6.2	95.1	95.3	97.2	100.2	103.0	105.3	105.8	105.8	105.8
Mode 0	5.6	94.7	95.3	98.3	101.2	103.9	105.0	105.0	105.0	105.0
SO2	5.0	94.7	95.3	98.3	101.2	103.0	103.0	103.0	103.0	103.0
SO3	4.8	94.7	95.3	98.3	101.2	102.0	102.0	102.0	102.0	102.0
SO4	4.6	94.7	95.3	98.3	100.7	101.0	101.0	101.0	101.0	101.0

The reduction in noise level that can be achieved at a receiver with these noise-reduced operating modes depends on several factors which include:

- the change in the frequency characteristics of the turbine's noise emissions at different wind speeds;
- the change in the frequency characteristics of a wind farm's noise levels with varying distance and orientation to the wind farm (e.g. using noise-reduced modes of operation for turbines along the broadside of a long wind farm will have a different effect to using these modes for turbines near the end of a line of turbines); and
- the number of turbines using noise-reduced operating modes, and the specific operating mode used by each turbine (e.g. curtailment can involve the use of a single identical noise-reduced mode for a selection of turbines, or different modes for different groups of turbines).

To provide an indication of the potential effectiveness of curtailment as a noise mitigation option, revised noise modelling has been conducted for a simple hypothetical scenario in which a non-compliance is identified at the nearest receivers to the northeast of the wind farm. For this exercise, the noise modelling has been conducted with hypothetical curtailment involving the five (5) turbines to the northeast of the Project being configured in the operating mode from Table 1 which equates to the lowest sound power levels (i.e. operating mode S04 with a reduced power output of 4.6 MW and a reduced sound power level of 101.0 dB L_{WA} at and above 8 m/s).

The results of the modelling with the hypothetical curtailment are illustrated in Figure 1. The figure identifies the turbines where the noise-reduced operating mode has been applied to the modelling, and shows the predicted noise level contours with and without the hypothetical curtailment. The results indicate predicted noise levels at the nearest receivers to the northeast of the wind farm are below 30 dB L_{A90} at all receivers, and lower than the un-curtailed predicted noise levels by 3.6 dB at the nearest receiver (receiver 7-1).

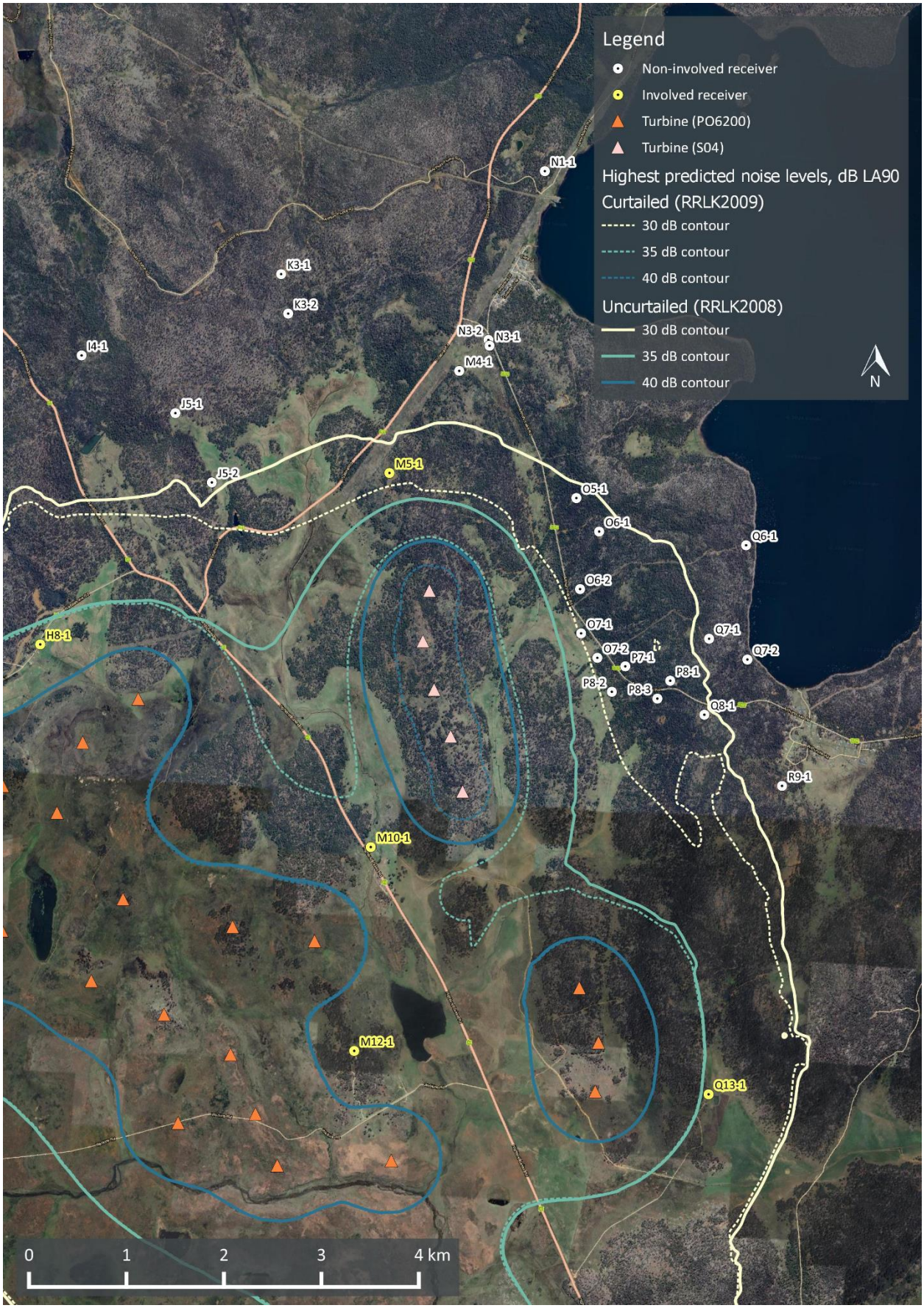
These results confirm that there is significant scope for wind farm noise levels to be reduced, without shutting down turbines, in the unlikely event that noise levels were found to be non-compliant.

For example, if SACs were identified, and adjustments were applicable, the results demonstrate that noise levels could be reduced to enable compliance with the base (minimum) criterion of 35 dB while long-term mitigation options to resolve SACs are investigated. Specifically, while adjustments of up to 6 dB can apply under NZS 6808 to individual 10-minute periods when SACs are identified, at the limited number of sites where SACs have been identified, the characteristics are typically only present for part of the time. As a result, analysis for sites where SACs have been found to occur has demonstrated that the net adjustments to the wind farm noise levels, accounting for all 10-minute periods in accordance with NZS 6808, are significantly lower than 6 dB, and typically less than 2-3 dB at the critical wind speeds. Accordingly, reducing noise levels to less than 30 dB L_{A90} at the nearest receivers would enable compliance with the base criterion of 35 dB, even if adjustments for SACs were found to be applicable.

Similarly, if A-weighted wind farm noise levels were found to differ from the modelling in practice (e.g. as a result of the installed turbine's noise emissions being higher than stipulated in the turbine's supply guarantee), the results demonstrate sufficient scope to readily offset any plausible variations. Specifically, while it is possible for the noise emissions of a turbine to be higher in practice, experience has shown that this is unlikely and, where such differences have been observed, the magnitude of variation is typically less than 1-2 dB. These are relatively small variations compared to the reduction in noise level that can be readily achieved with noise-reduced modes of operations.

The hypothetical curtailment is only intended for illustrative purposes to provide an example of the scale of reductions which could be achieved in the unlikely event of a non-compliance. This example should not be interpreted as an indication of whether curtailment is likely to be required, nor is it an indication of the curtailment to be implemented in the unlikely event of a non-compliance. As detailed previously, if a non-compliance was identified, the appropriate noise mitigation option would be specific to the nature of the identified problem and, in some cases, curtailment may not be the most effective option. For example, if a non-compliance was found to occur as a result of SACs attributable to a single defective turbine, consideration would need to be given to the merit of shutting down the turbine in question until repairs are completed, rather than implementing curtailment to enable compliance with the characteristic present. The appropriate noise mitigation option must therefore be developed in response to the specifics of the situation. The key requirement is for a response framework to be in place to enable any identified non-compliances to be quickly and effectively addressed. This is the objective of the proposed noise remediation plan.

Figure 1: Highest predicted noise level contours with and without example curtailment, dB L_{A90}



SUMMARY

Practical experience of wind farm developments across Australia demonstrates that the vast majority of wind farm projects comply with their environmental noise requirements. Importantly, compliance is normally demonstrated following commencement of operation without the need to implement mitigation strategies.

The modelling for the St Patricks Plain Wind Farm demonstrates that predicted noise levels are below the base (minimum) noise criterion of 35 dB by a clear margin. The Project can therefore be readily designed and operated to comply with operational noise requirements.

However, if the noise of the Project was found to be non-compliant, the proponent commits to the preparation of a noise remediation plan for submission to EPA Tasmania. The noise remediation plan would define how the non-compliance would be addressed.

Based on experience, and as demonstrated by the modelling presented in this memo for a hypothetical example of curtailment, there are effective noise mitigation options available to enable compliance to be achieved in the unlikely event of higher than expected noise levels or unexpected special audible characteristics.