INFORMATION REGARDING ENVIRONMENTAL AUDIT REPORTS

August 2007

VICTORIA'S AUDIT SYSTEM

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

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

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A certificate indicates that the auditor is of the opinion that the site is suitable for any beneficial use defined in the Act, whilst a statement indicates that there is some restriction on the use of the site.

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WIND ENERGY FACILITY NOISE AUDIT PROTOCOL

Facility Alberton Wind Energy Facility
Standard NZS6808:2010 & Noise Management Plan endorsed under Planning Permit
Evidence Alberton Wind Farm Pre Construction Noise Assessment, Marshall Day Acoustics, 19 April 2018

NZS specifications:

Section	Requirements relevant to the Audit	Comply	Observations/ Comments
Definitions	Measurement time: 10min accuracy 1% ie 6 secs		
	Noise Limit: not to be exceeded		
	Notional Boundary: A line 20m from any side of a noise sensitive location		
	Post-installation sound level: A weighted L90 centile level i..e dB L90(10min)		
	Cut in speed typical: 4 m per sec. Shut down 25 m per sec		Cut in wind speed is provided in Figures as down to 3m/s. Shut down is not specified. Maximum sound power is reached by 11 m/s for all candidate turbines (ref Figure 1 MDA, 2018).
3.1	Metric for wind farm sound: A weighted L90 centile level i..e dB L90(10min)		
3.2	Process: Figure 1-prediction, measurement and assessment process		
	Determine location of 35 dB Contour	Yes	Predicted contour maps prepared and illustrated in the Figures within the noise assessment report for the various candidate turbine types.
	Determine wind farm noise limits	Yes	The report has adopted a base 40dB LA90 limit and therefore has not progressed to background measurements. Advice was sought from EPA as to aherence to the Cherry Tree VCAT decision relating to a Farming Zone. Advice received supports there are no special circumstances nor special locations that would suggest a higher noise amenity than standard within a Farming Zone. The noise assessment report adoption of a base standard for predictive modelling is therefore appropriate.
	Refine Predictions at each noise sensitive location	Yes	Included in the noise assessment report along with GPS locations for each NSL. A sample confirmed these as accurate. Further advice provided by the WEF planner supports a review of houses that hold Council building approval. Further confirmation was sought and received from Beveridge Williams planners that support all relevant NSL have been considered and included in the noise assessment report.
	Report		
	Post installation sound level measurements	NA	
4.1.1	Audibility is not an appropriate basis for setting noise limits. Limits based on Section 5.		
4.2	Reverse Sensitivity		
	Nomination of a 40dB wind farm sound level contour and the 35dB contour.	Yes	Predicted contour maps have been prepared and are included in noise assessment report.
5	**NOISE LIMITS** - designed to protect sleep disturnbance whilst inside house		
5.1.2	Upper limit at residential location of 40 dB L90(10min)	Yes	This limit has been used for predictions. In the absence of background data the base limit was used to predict compliance at the 95% power rating level, even though these occur at wind speeds where background influence may be expected.
	(assumes typical 15 dB reduction indoors to <30 dB Leq)		
	Sleep protection also protects health and amenity.		
	C5.1.4. *The use of a background +5dB limit means that the wind farm sound may be the dominant sound heard at a noise sensitive location for a significant proportion of the time when the wind farm is operating* .		*Note: the site can have low background noise and the 40 dB LA90 limit may mean the wind energy facility is at time readily audible.*

EnviroRisk

Section	Requirements relevant to the Audit	Comply	Observations/ Comments
5.2	Noise limit		*Note: the NZS acknowledges and states that at a noise level of BG + 5dB that 'the wind farm may be the dominant sound heard at a noise sensitive location for a significant proportion of the time the wind farm is operating'.*
	Wind farm sounds (as LA90 10 min) should not exceed background by more than 5dB or a level of 40 dB LA90(10min), whichever is the greater at notional boundary of any noise sensitive location.	Yes	The noise assessment report has been assessed against a 40 dB LA90 limit for all candidate turbines.
5.3	Secondary noise limit: only considered…		
	Background are commonly less than 25dB when predicted to exceed by 10dB or more	NA	40dB LA90 10 min. has been used as the compliance limit in all instances for predictions. Given high amenity protection is not applicable under planning scheme zoning, background is not required where the base limit is adopted.
	Higher degree of protection of amenity required	Yes	All dwellings within 2km of a turbine appear to be located within a Farming Zone. There is no specific planning requirement that the Auditor could identify that directly specifies a high amenity area. A high amenity noise limit is discussed in the noise assessment report and is not considered applicable in the Farming Zone. Communications with EPA on planning scheme interpretation has resulted in 'EPA Advice to Auditors dated 25 October 2019'. According to the Cherry Tree VCAT decision and EPA Advice, a Farming Zone is not considered a High Amenity Area. Accordingly a standard noise amenity is appropriate and a higher degree of amenity protection is not required.
	Planning rules dictate	Yes	refer above
	Only applies to to locations within 35dB contour	NA	refer above
	Arithmetically average difference for all 10 minute intervals. If less than 8 dB secondary not justified	NA	refer above
5.3.2	Lowest stated level is 35dB or 5db above background if above 35db L90 10 min.	NA	The Farming Zoned land is not been considered high amenity. i.e. Cherry Tree VCAT decision and EPA Advice. Background monitoring is not required based on planning scheme interpretation that the zoning does not afford high amenity protection.
	Generally only applies during evening and night periods when wind speed at hub height is equal to or less than 6m per sec	NA	As above
5.4	**SPECIAL AUDIBLE CHARACTERISTICS**		
5.4.1	Wind farms shall be designed so that wind farm sound does not have special audible characteristics at noise sensitive locations. Considerations to be given to and special audible characteristics of the wind farm sound when comparing levels against noise limits.	Yes	None are predicted. However, some turbines do not have technical detail provided. Data provided for one turbine type supports absence of any tonal characteristics i.e. Senvion 3.4M140. Performance specifications reportedly will be placed in contracts for turbines specifying no tonal audibility to mitigate risk.
5.4.2	Tonal, impulsiveness, amplitude modulation shall be adjusted by arithmetically adding up to +6dB to the measured level,	Yes	As above

Section	Requirements relevant to the Audit	Comply	Observations/ Comments
	If there is doubt about the presence of tonality, the following two methods provide an objective measure for tonality. The simplified test method may be carried out using one third octave-band measurement equipment. The reference test method requires the use of narrow band analysis. If the simplified method does not indicate tonality, it may still be necessary to use the reference method to confirm the presence or absence of tonality. In addition, the reference method can properly assess modulated tones where the tone is varying or where there are complex tones with many closely-spaced tone components. However, the method does not address wind farm amplitude modulation	NA	
	No appropriate objective test for amplitude modulation has been standardised. If a local authority enforcement officer or an acoustics advisor to a local authority considers that a wind farm creates sound with a clearly audible amplitude modulation at a noise sensitive location, an adjustment of +5 dB shall be applied to the wind farm sound level at that location for the wind conditions under which the modulation	NA	
	In making an assessment under B3.1, modulation special audible characteristics are deemed to exist if the measured A-weighted peak to trough levels exceed 5 dB on a regularly varying basis, or if the measured third-octave band peak to trough levels exceed 6 dB on a regular basis in respect of the blade pass frequency.	NA	
	Where special audible characteristics are confirmed, the value of the adjustment (k2) shall be 5 dB for that sample, provided that where the reference test method for tonality is used, the value of the adjustment (k2) shall be between 1 and 6 dB where justified. The adjustment (k2) shall only be applied to samples in which special audible characteristics are present. Only one adjustment value (k2) shall be applied to each measurement, even if more than one type of special audible characteristic is present	NA	
5.4.3	Conducted in accordance with Appendix B of the NZS.	NA	
	Cumulative adjustments shall not be made. Max adjustment not to exceed 6dB	NA	
5.5	**Other Factors**	NA	
5.5.1&.2	Ultrasound and infrasound frequencies considered to be outside normal range of human hearing. Paucity of evidence to set a limit more stringent that recommended in Sect. 5.2.	NA	Commentary only
5.5.3	No ground borne vibration level considered necessary.	NA	Commentary only
5.6	**Cumulative Effects**	NA	No existing wind farm is present. Site inspection confirmed cumulative effects due to predictions are not relevant from other wind farms.
5.6.1	Limits apply to cummulative levels of all wind farms.	NA	
5.6.2	Staging of a wind farm is not to affect pre-wind farm background readings.	NA	Reportedly background noise will be monitored post approval and pre construction.
5.6.3	Where a new wind farm will impact on the same noise sensitive locations as an existing wind farm, the assessment of background sound should exclude wind farm sound generated by all existing wind farms.	NA	
5.6.4	If predicted wind farm sound levels for a new wind farm are at least 10dB below and existing wind farm… then the cumulative effect shall not be taken into account.	NA	
5.7	**Uncertainty** (refer Appendix C below)	Yes	A 1 dB margin was applied to account for uncertainties with provided sound power levels
6	**Predictions**		

Section	Requirements relevant to the Audit	Comply	Observations/ Comments
6.1	**Methods.** Predictions to identify levels greater than 35dB LA90(10min) at 95% rated power. In octave bands from at least 63Hz-4KHz, and against wind speed (hub speed) and 35 and 40 predicted contours shown.	Yes	Predictions have been made for various turbine options. Sound power levels (guaranteed by manufacturer) and octave band spectra have been specified as being provided from the manufacturer(with some qualifications eg Senvion 3.4M140 candidate turbine). Documents where data has been taken are referenced with the earliest data from 2015.
6.2	**Sound Power Levels.** Obtain from manufacturer obtained in accord with IEC 61400-11	Yes	Manufacturer sound power levels were reportedly obtained as guaranteed sound power levels. Whether the assessments were conducted in accord with IEC standard is not documented. However, a margin of 1 dB has reportedly been applied to the highest SPL which appears a reasonable safeguard.
	Requires SPL to be measured against a wind speed of 10m AGL converted to Hub Height	Not determined	as above
7	**MEASUREMENTS**		
7.1	**Locations**		
7.1.2	(a) Has the operator chose to adopt a noise limit of 40 dB for all wind speeds?	Yes	See comments in Sect 3.2 above
	(b)Has the operator agreed to conduct on/off testing if required.	NA	
7.1.3	Have noise sensitive locations been clearly identified	Yes	The identification process was undertaken during the assessment phase. Enquiries by the Auditor on properties that may have building permission were reponded to with advice from council as to planning and building approval status. Further advice provided by the WEF planning consultant Beveridge Williams supports a review of houses that hold Council building approval. Further confirmation was sought and received from Beveridge Williams planners that support all relevant NSL have been considered and included in the noise assessment report.
	b. Does the auditor consider all noise sensitive locations are appropriately captured	Yes	As best reasonably within or near the predicted 35dB contour. Written advice received from the planning consultant supports the NSL as illustrated in the noise assessment report are complete. This advice is Appended to the Audit Report.
7.1.4	Have background sound level measurements been appropriately established and representative of the group: proximity and character	NA	Background data has not been attained as yet. For compliance prediction a base 40 dB LA90 limit has been assumed for wind speeds up to 14m/sec. Maximum power is reached generally at or before 11m/sec. Under this approach background data is not required for predictive modelling purposes.
	When and where were they taken.	NA	
	Were predictions at 95% rated power made in deriving 35 dB LA90 (10 min.) contour background locations	Yes	Guaranteed maximum sound power levels with a 1 dB margin were reported to be used in predictive modelling.
	If there are no noise sensitive locations within the 35dB LA90(10min) predicted wind farm sound level contour then background sound level measurements are not required.	Yes	There are NSL withn the 35 dB LA90 predicted contour. Background noise levels were triggered yet no background monitoirng undertaken. Instead the base limit of 40 dB LA90 was adopted.
7.1.5	If there are a group of noise sensitive locations… locations selected are representative of the group in terms of proximity and character	Yes	Individual NSL are identified in the noise assessment report.
7.1.6	Selected on wind farm side of buildings. >3.5m from significant reflecting surfaces. Not near streams nor watercourses where possible (or substantiated if not)	NA	
7.2	**SOUND DATA**		
7.2.1	Made during a representative range of wind speeds and durations from cut-in to rated power.	NA	
	For dual speed turbines, include cut-in wind speed for the higher generating capacity.	NA	
	The number of measurements made are to be sufficient to obtain dependable correlations between sound levels and wind speeds	NA	

Section	Requirements relevant to the Audit	Comply	Observations/ Comments
C7.2.1	Minimum of 10 days continuous monitoring >1440 data points to be plotted against wind data.	NA	
	Further measurements if: data points is not uniform between min. and max. for each 1m/s interval; a lack of sparseness exists for one or more wind conditions; seasonal variations.	NA	
7.2.2	Sound measured in accordance with NZS6801 *Section 7.1.5 of NZS 6801 states 'the provisions of this section do not apply for the purposes of NZS 6808'.*	NA	
	Measurements time intervals of 10 minutes to be used.	NA	
7.2.3	Instrument used shall meet requirements of Section 5 of NZS6801.	NA	
	Microphone protected from extraneous wind sound by wind shield in accordance with NZS 6801.	NA	
	Cables etc. secured to avoid extraneous wind noise.	NA	
	Class 1 meter may be necessary so that sound levels at low wind speeds can be accurately measured.	NA	
7.2.4	Extraneous sounds caused by events, including precipitation, insects, fauna and so on, should, as far as is practical for an unattended monitoring exercise, be identified and removed from the data set.	NA	
	Streams and tree induced background sound may be considered part of the overall background at the locations. Traffic lulls to a minimum level need to be included.	NA	
	Octave band spectrum analysis and resident logs may be used.	NA	
7.3	**WIND DATA**		
7.3.1	Concurrent measurements of wind speed and direction taken from a known height preferably the wind turbine hub.	NA	
	Monitored over 10 minute intervals syncronised with SLM time intervals and average values found for every interval	NA	
7.3.2	If wind speeds are not taken from hub height… predictions may be used from wind shear relationships: at least two heights	NA	
	Wind flow modelling may be required if wind measurements are not representative.	NA	
7.3.3	Same location and height used for before and after installation when not impacted by turbines.	NA	
7.4	**BACKGROUND MEASUREMENTS**		Background has not as yet been confirmed, yet it does not influence compliance predictions given the base limit has been adopted. Background information can only raise this limit, so the approach may be considered conservative.
7.4.1	Background SLM to be plotted against the hub-height wind speeds to obtain a scatter plot	NA	None are provided in the predictive assessment as it has been modelled against the 40dB LA90 criterion. Background will be required in order to calculate wind farm noise and, given the marginal level of compliance predicted at some non-stakeholder properties, is recommended to occur well prior to construction commencing.
	Plot to be examined to establish whether a singular regression relationship is evident.	NA	
	If there are markedly different groups, separate scatter plots may be required for different conditions, including wind directions and times of day.	NA	

Section	Requirements relevant to the Audit	Comply	Observations/ Comments
7.4.2	Find the regression curve that gives the best correlation coefficient between the sound level and wind speed for each scatter plot and use it to describe the average background sound level at different wind speeds.	NA	
	Sparseness of data or obvious outliers should not be allowed to unreasonably influence the regression curve.	NA	
	Removal of outliers may be required.	NA	
	Has a bin analysis procedure IEC 61400-11 been used where there are limited data points? If so is it reasonable and appropriate.	NA	
7.4.3	If there is a poor correlation between wind speed and sound level, further investigation of wind conditions should be undertaken e.g. wind flow modelling,local knowledge, site observations or local wind monitoring	NA	
7.4.4	Where multiple regressions are indicated and several regression curves obtained, noise limits should be set on the basis of each regression curve derived.	NA	
	Where not practical, use the most stringent regression curve with lowest SL.		
	Where the lowest BG is when wind is blowing from the noise sensitive location to the wind farm, it is reasonable to consider additional attenuation that may occur.	NA	
7.5	**POST INSTALLATION MEASUREMENTS**		
7.5.1	Measure where practical at the same locations where background SL were determined.	NA	
7.5.2	Scatter curves shall be drawn of SL against wind speed and regression curved obtained (as per 7.4)	NA	
7.5.3	Capture both the wind farm sound and the background sound.	NA	
	The contribution of the background sound shall be removed from the regression curve drawn in S. 7.5.3 at each integer wind speed.	NA	
7.5.4	An assessment for any special audible characteristics shall be undertaken (S. 5.4) covering the range of operational wind speeds.	NA	
7.6	**COMPLIANCE ASSESSMENT**		This Section of the Standard applies to compliance testing. It is noted the 35dB LA90 controur has been predicted and include within the noise assessment report for the range of candidate turbines.
7.6.1	The 35dB wind farm SL contour shall be predicted and measurements made within this contour.	NA	
7.6.2	Compare the best fit regression lines of the background SLs and the regression curves of the wind farm sound levels adjusted for any special audible characteristics at each noise sensitive location.	NA	
	Adjustments apply to wind farm speeds at which it is assessed and applied before comparison with the noise limit.	NA	
7.6.3	If background SLs were not measured prior to installation, it may be necessary to obtain SLM for limited periods at critical wind speeds. These may be for a limited range of end speeds and directions while the wind turbines are not operating, i.e. on/off testing to get a representative number of measurements	NA	
	Turbines 10dB lower that the higher contribution need not be turned off for testing.	NA	
7.6.4	Compliance at one period does not negate the need for further testing.	NA	

Section	Requirements relevant to the Audit	Comply	Observations/ Comments
	Note: Section 7.1.2 of NZ6801-2008 states: *'To demonstrate compliance, measurements should be appropriately adjusted to slightly positive propogation conditions which are the upper limits of the meteorological window* '. However, section 7.1.5 states '*the provisions of this section do not apply for the purposes of NZS 6808'.*		
7.7	**ON/OFF TESTING**		
	Often an appropriate method for measuring small wind turbine sound levels.	NA	
8	**DOCUMENTATION**		
8.1	**Predictions**		
	Any report of wind farm sound level predictions in accordance with this Standard shall refer to this Standard and provide the following: (a) A map showing the topography (contour lines) in the vicinity of the wind farm, the position of the wind turbines, and noise sensitive locations;	Yes	A suitable map has been provided in the Appendix of the noise assessment report.
	(b) Noise sensitive locations for which wind farm sound levels are calculated;	Yes	The process followed to identify all relevant sensitive locations was communicated and reproduced below. A site visit indicated the possibility of other cabins and possible 'habitable spaces or education spaces in a building'. The building's identified did not appear to on a stakeholder property. This was followed up with th planning consultant and further detail provided based on a Council response to approvals provided. Subsequently confirmation was requested and received from the planning consultant that all appropriate NSL had been identified and marked on the map within the noise assessment report. This confirmation is provided in Appendix 2 of the Audit Report. Communications as to the process that led to mapped dwellings appears rigorous and reportedly included the following: 'Dwellings were identified using aerial imagery and verified by site inspection by our landscape assessment sub-contractors and by Synergy Wind. Contact was also been made with South Gippsland and Wellington Shire in relation to the status of structures and any valid planning permits adjoining the application area. Consultation with the community occurred in late August 2017. As a result of consultation additional inspections and enquiries were carried out'. It is however not clear in the guidelines, nor the NZS, whether the definition of a dwelling in Victoria is the same as a 'habitable space (and noise sensitive location) as specified in the NZS. For the purposes of this review they have been taken as one and the same. However this may ultimately require a ruling from the Responsible Authority.
	(c) Wind turbine sound power levels;	Yes	SPL have been specified for a range of turbines and all were modelled. The most restrictive being the Vesta V136-3.45 due to a noisy low frequency spectrum.
	(d) The make and model of the wind turbines;	Yes	The turbine reportedly has not been specified as yet. Therefore all turbines with the potential to be used have been modelled. All were found to comply at all identified Noise Sensitive Locations. The Vesta V136-3.45 complies by a small margin and with micro-siting changes may actually predict a slight non compliance. Any proposed micro-siting will tehrfeore warrant additional review.
	(e) The hub-height of the wind turbines;	Yes	Hub height and turbine details are specified in Table 1.
	(f) Distance of noise sensitive locations from the wind turbines;	Yes	Distance is specified in the report.
	(g) Calculation procedure used;	Yes	SoundPlan V7.4 used and in accordance with NZS LAeq is deemed to be equival

Section	Requirements relevant to the Audit	Comply	Observations/ Comments
	(h) Meteorological conditions assumed;		10 degrees C and 70 percent humidity reported to be modelled, representative of reasonably expected worst case noise propagation conditions. Interview reveals all predictions are taken with a down wind scenario. Detailed wind row data is therefore not required for predictions. (Note: It will be needed for background readings and prior to actual compliance testing).
	(i) Air absorption parameters used;	Yes	Octave band data is reportedly inserted into the model along with associated distance attenuation.
	(j) Ground attenuation parameters used;	Yes	G=0.5 used and deemed appropriate and possibly conservative given the setting's ground cover.
	(k) Topography/screening assumed	Yes	The site inspection reveals the ground to be reasonably flat. The topographical map reveals terrain generally lower than 75m above sea level.
	(l) Predicted far-field wind farm sound levels.	Yes	Prediction go out to 30 dB contour.
	Detail (note: not specified in standard but applicable for modelling):		
	Turbine Sound Power Levels	n/a	Guaranteed SPL provided from various suppliers - max 107.3dB (Gamesa-3.465). Rated power varies from 3.15 to 3.6MW turbines. Most significant low freq noise spectrum is Vestas V136-3.45 (94.1 @ 63Hz & 98.3 dB @ 125Hz). These were noted to be appropriately included in noise modelling. A reality check of results reveals Vestas turbine to be noisiest in field - which is as expected given the elevated low frequency noise spectrum.
	Micro Siting Allowance (noting 'model planning permit conditions allow up to 100m change if nominated).	Yes	The report nominates the location of the turbines and distance measurements are made from the centre point (as is reasonable). However given the margin of compliance against the noisiest turbine, micro-siting may become a factor in compliance predictions. Turbines should not be relocated any closer to some dwellings (e.g. D60, D62) if a compliant noise outcome is to remain predicted. Micro siting alterations may result in non compliance situation and therefore any location changes where a turbine is closer to a NSL will likely require re-modelling to verify compliance prior to construction.
	Identification of relevant noise sensitive locations - process and outcomes		Interviews were held with the acoustic specialist and the town planning specialist as to the process employed to identify all relevant noise sensitive locations that warranted inclusion within the predictive modelling; particularly within 2km of a turbine which is considered to equate to the highest compliance risk locations. Detail was provided to support the rigor of the identification process. Dwellings at noise sensitive locations were marked on a map and including the subject report. A site visit and a tour of the roads leading to the nearest dwellings has been conducted.
	SACs- Tonality allowance at various wind speeds		The modelling has assumed the turbine procurement contract will specify no tones and therefore tonal adjustment has not been included as a penalty to modelling outputs. The rationale to not include a tonal adjustment in predictive modelling is reasonable based on current best practice technology. There should be no tones, and if there is one the turbine should be controlled in accordance with a noise management plan. Operations can be fine tuned by engineering to avert any detected tone. Only one manufacturer's test data (Senviron) was available and this reportedly specified no tones (No third octave change >2dB for >5.9m/s operation.)
	Noise level (SPL) with respect to varying wind speed		Rated power and hub heights specified for a range of turbines. Wind influence above the 15m/s data provided is likely to mask wind farm noise and not needed for predictive modelling.

Section	Requirements relevant to the Audit	Comply	Observations/ Comments
	Best practice blade design		Serrated trailing edge specified for most turbines where information was available.
	Cumulative influences		No other wind farm is relevant and requires consideration. Cumulative effects of a number of turbines has been included in the modelling.
	Ground absorption ratio 'G'		G=0.5 considered appropriate given rationale provided.
	Predictive model used		SoundPlan V7.4. Appropriate model for environmental predictions.
	Results discussion - non stakeholder sensitive locations		Compliance is marginal at a number of non-stakeholder locations particularly D30, D51, D60 and D62. Micro-siting changes may result in a exceedance of the 40 dB limit being predicted. As it is the margin predicted is less than 0.1dB at one receptor against the noisiest Vestas 3.45 turbine type (extending to a 2.5dB compliance safety margin against the quiter Senvion 3.4M140 turbine if this is ultimately selected). Exceedances are predicted at Stakeholder premises for many of the turbines with up to a 1.9dB excess predicted. The Senvion 3.4 M140 turbine is predicted as being compliant at all Stakeholder locations. (Note: Stakeholder locations are not within the scope of the Audit)
	Results discussion - Stakeholder Properties		The NZS6808:2010 defines a noise sensitive location as any habitable or education space within a building 'not on the wind farm site' (refer Sect 2.4 Definitions) i.e. stakeholder properties are not considered noise sensitive locations in the Standard. A conformance level of 45dB has been specified in the subject report as a reasonable noise level to be achieved. Although such an approach may be considered reasonable, this audit is against the NZS and therefore excludes stakeholder properties from the methodology evaluation.
	Any report of background sound level measurements and assessment in accordance with this Standard shall refer to this Standard and provide the following:	NA	No background measurements have been taken as yet, nor are they required for a predictive assessment wher ethe base limit is adopted.
	(a) Description of the sound monitoring equipment including ancillary equipment;		
	(b) The location of sound monitoring positions;		
	(c) Description of the anemometry equipment including the height AGL of the anemomometer		
	(d) Position of wind speed measurements;		
	(e) Time and duration of the monitoring period;		
	(f) Averaging period for both sound and wind speed measurements;		
	(g) Atmospheric conditions: the wind speed and direction at the wind farm position & rainfall		
	(h) Number of data pairs measured (wind speed in m/s, background sound in L90);		
	(i) Description of the regression analysis; and		
	(j) Graphical plots showing the data scatter and the regression curves		
8.3	**COMPLIANCE ASSESSMENT**	NA	Relevant for Post Construction Assessments
	Any report of wind farm post-installation sound level measurements and compliance assessment, other than on/off tests, made in accordance with this Standard shall refer to this Standard and provide the following:	na	
	(a) Description of the sound monitoring equipment including any ancillary equipment	na	
	(b) A statement confirming the use of A-frequency-weighting;	na	
	(c) The location of sound monitoring positions;	na	
	(d) Description of the anemometry equipment including the height AGL of the anemometer	na	
	(e) Position of wind speed measurements;	na	

Section	Requirements relevant to the Audit	Comply	Observations/ Comments
	(f) Make and model of the wind turbines;	na	
	(g) Number of operational wind turbines;	na	
	(h) Time and duration of monitoring period;	na	
	(i) Averaging period for both sound and wind speed measurements	na	
	(j) Atmospheric conditions: the wind speed and direction at the wind farm position & rainfall	na	
	(k) Number of data pairs measured (wind speed in m/s, sound in L90);	na	
	(l) Description of the regression analysis;	na	
	(m) Graphical plots showing the data scatter and the regression lines;	na	
	(n) Graphical plots showing the data scatter and the regression lines for both the background and the wind farm in operation.	na	
	(o) Assessment of special audible characteristics; and	na	
	(p) A statement that the wind farm complies with relevant limits – or not – as determined from the results of the measurements	na	
Other	No noise complaints have been recorded.	na	
Appendix C	**Uncertainty**		
	It is good practice to state the uncertainty and confidence level for all sound levels determined in accordance with this Standard. Uncertainty should be determined in accordance with the procedures in Craven and Kerry (2001). These procedures involve determining the standard uncertainty for every source of uncertainty in the measurement/ assessment process, and summing these standard uncertainties in quadrature (root sum of squares) to obtain the combined uncertainty. If a source of uncertainty is assumed to have a normal distribution, standard uncertainty is related to standard deviation, but this is not always the case and rectangular distributions are also common. *When comparing a sound level with an applicable noise limit, the sound level should be deemed to comply if the sound level is equal to or less than the noise limit. It should be deemed not to comply if the sound level is greater than the noise limit, regardless of the uncertainty. Where compliance or non-compliance is marginal and contested, steps should be taken to reduce the uncertainty, where practical*	Yes	An allowance of 1dB has been added to the sound power levels used in the calculations. A statement of uncertainty otherwise has not been specified. It is noted several sites are within 1 dB of compliance with the limit including non-stakeholder locations D30, D51, D60 and D62. A comment on the impact of micro-siting should be included in the report.
	Definitions (from NZS6808:2010)		

Section	Requirements relevant to the Audit	Comply	Observations/ Comments
	Noise Sensitive Location: The location of a noise sensitive activity, associated with a habitable space or education space in a building not on the wind farm site. Noise sensitive locations include: (a) Any part of land zoned predominantly for residential use in a district plan; (b) Any point within the notional boundary of buildings containing spaces defined in (c) to (f (c) Any habitable space in a residential building including rest homes or groups of buildings for the elderly or people with disabilities, papakainga and marae, excluding habitable spaces in buildings where the predominant activity is commercial or industrial. (Residential buildings designed for permanent habitation on land zoned for predominantly rural or rural-residential use are not classified as commercial or industrial for the purposes of this Standard); (d) Teaching areas and sleeping rooms in educational institutions, including public and private primary, intermediate, and secondary schools, universities, polytechnics, and other tertiary institutions; (e) Teaching areas and sleeping rooms in buildings used for licensed kindergartens, childcare, and day-care centres; and (f) Temporary accommodation including in hotels, motels, hostels, halls of residence, boarding houses, and guest houses. **In some instances holiday cabins and camping grounds might be considered as noise sensitive locations. Matters to be considered include whether it is an established activity with existing rights**.		
	Commentary of note in NZS: *Wind farm sound may be audible at times at noise sensitive locations, and this Standard does not set limits that provide absolute protection for residents from audible wind farm sound. Guidance is provided on noise limits that are considered reasonable for protecting sleep and amenity from wind farm sound received at noise sensitive locations*		
Note	*Background noise is a combination of sounds including tree leaf and grass rustle, crickets, frogs, birds, dogs, cattle, sheep, distance traffic (car and air) and even wave motion. When a source, such as turbine noise, is introduced the background noise level may increase.* *The addition of a new source with a noise level 10dB below the background would increase noise to a the new background 0.4dB higher.* *If the two sources have the same noise level then an increase of 3.0dB results. Therefore if the background is 35dB and the turbine is also 35dB, the resultant noise is 38dB.* *To increase the background by 5dB, the new turbine based source would need to be 3.3dB above the previously confirmed background.*		

WIND ENERGY FACILITY NOISE PROTOCOL

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

DELWP Guideline - *Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria, March 2019*

Evidence Alberton Wind Farm. Pre- Construction Noise Assessment, Marshall Day Acoustics

Section	Requirement	Comply	Observations/ Comments
Auditor note.	*Micro siting plan permits relocation of turbines by up to 100m. Has this been taken into consideration?*	Yes	Micro-siting in certain places has potential to compromise compliance predictions. This needs factoring in to final design.
5.1.2			
a) Noise	A wind energy facility should comply with the noise limits recommended for dwellings and other noise sensitive locations in the New Zealand Standard NZS 6808:2010 Acoustics – Wind Farm Noise (the Standard).	Yes	
	The Standard specifies a general 40 decibel limit for wind energy facility sound levels outdoors at noise sensitive locations, or the sound should not exceed the background sound level by more than five decibels, whichever is the greater.	Yes	
	A limit of 45 decibels is recommended for stakeholder dwellings (*taken to mean LA90*).	Part	Conformance achieved under 1x turbine option. Others turbine options present slight non conformance. (Note: Not a NZS 6808: 2010 requirement and therefore not within Audit scope.)
	Under section 5.3 of the Standard, a 'high amenity noise limit' of 35 decibels applies in special circumstances. All wind farm applications must be assessed using section 5.3 of the Standard to determine whether a high amenity noise limit is justified for specific locations, following procedures outlined in clause C5.3.1 of the Standard. Guidance can be found on this issue in the VCAT determination for the Cherry Tree Wind Farm.	Yes	A high amenity noise limit is discussed in the noise assessment report and is not considered applicable in the Farming Zone. Communications with EPA on planning scheme interpretation has resulted in Advice to Auditors (25 October 2019). According to the Cherry Tree VCAT decision and EPA Advice, a Farming Zone is not considered a High Amenity Area. Accordingly the process followed in the noise assessment report against a standard noise amenity is appropriate.
	Planning permit conditions should require post installation noise compliance to be monitored and demonstrated to the satisfaction of the responsible authority.	NA	
	Certification of whether a wind energy facility complies with the Standard and other applicable noise requirements must be undertaken by an acoustic engineer.	Yes	Provided by this Audit

	The wind energy facility operator must provide the responsible authority with an assessment by an independent, appropriately qualified and experienced acoustician that demonstrates whether the facility is compliant with the noise standard.	Yes	An appropriate technical report has been prepared. Submission will reportedly be made by the operator.
	Measurement and compliance assessment methods are set out in the Standard	Yes	Whilst the auditor has not undertaken any detailed predictive modelling themselves, the compliance assessment and source data has been reality checked as being based on sound methodology and by competent personnel. Experience of WEF post construction performance has also been integrated into whether the predictions are reasonably achievable.
	All noise reports must be accompanied by an environmental audit report. The report must verify that the assessment has been conducted in accordance with the Standard	Yes	
Wind Energy Facility Noise Compliance			
	Wind farm noise compliance must be established by testing and assessment by acoustic consultants against the requirements of the Standard.	Yes	See detailed evaluation in separate spreadsheet.
	The party must engage an environmental auditor to conduct a Risk of Harm audit under thE EP Act 1970 to verfiy that wind energy facility noise assessments have been conducted in accordance with the Standard.	Yes	
	Proposed or existing wind farm operators should consider obtaining an assessment of compliance, as part of any submission, to demonstrate ongoing compliance to satisfy permit requirements.	Yes	
	An assessment of compliance issued by an EPA appointed auditor?	Yes	
	The report issued by the EPA appointed auditor is a declaration that the noise assessments:		
	1. have been conducted in accordance with the Standard;	Yes	The auditor confirms that the appropriate standard, NZS6808:2010, has been referenced and assessed against.

	2. meet the requirements of the permit or other regulatory instrument (*specified and relating to noise compliance*).	Yes	Compliance with the standard is predicted for a standard noise amenity area - albeit marginally under certain turbine scenarios.
	The declaration must be accompanied by a report, signed by the auditor, addressing the matters 1. and 2. above and detailing the considerations they have relied upon in forming their view.	Yes	This protocol forms an Appendix to the audit report.
	This report should be thorough but concise.	Yes	Agreed and considered achieved.
	The report must have adequate detail including an annexure listing all documents examined or relied up on to permit any reader to follow the deliberations that the auditor undertook in forming their view.	Yes	Documents included in the report have been referenced.

APPENDIX 2

Beveridge Williams

Our Ref: 1600439
Office: Melbourne

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Melbourne
1 Glenferrie Road
PO Box 61
Malvern Vic 3144
ph: 03 9524 8888

with the former
wbcmgroup

26 July 2019

EnviroRisk Management Pty Ltd
Att: Mr Stephen Jenkins
PO Box 183
LARA VIC 3212

Dear Mr Jenkins,

RE: PLANNING PERMIT APPLICATION FOR A WIND ENERGY FACILITY
APPLICATION PA1700284
ALBERTON WIND FARM
RESPONSE TO MATTERS RELATED TO THE STATE RESOURCE OVERLAY

We act on behalf of Synergy Wind Pty Ltd in relation to the above matter.

Clause 52.32-4 requires:

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

You have requested confirmation that all noise sensitive locations applicable to the planning application have been identified and are appropriately listed in the Figures within the Noise Assessment Report provided to the Auditor.

Noise sensitive location were determined by field assessment and a review of aerial photography. Where there was any uncertainty with regard to the status of a structure, confirmation was sought from the local Council to confirm the status of the structures. Two rounds of community notification were also undertaken (one prior to lodgement of the planning permit application to all properties within a minimum of 3km of the nearest turbines and one post to a minimum distance of 5km) which invited owners and occupiers the opportunity to comment on the proposed plans and supporting reports. Feedback from the community was taken into consideration in the nominated noise sensitive locations.

I can therefore confirm that all noise sensitive locations applicable to the planning application have been identified and are appropriately listed in the Figures within the Noise Assessment Report provided to the Auditor.

Should you have any queries, please do not hesitate to contact me via email stewartb@bevwill.com.au or by phone 0418 444 366.

Yours sincerely,

BEVERIDGE WILLIAMS & CO PTY LTD

BERNARD STEWART
Senior Town Planner

APPENDIX 3

MARSHALL DAY Acoustics

ALBERTON WIND FARM
NOISE ASSESSMENT

Rp 002 R02 2015590ML | 19 April 2018

MARSHALL DAY Acoustics

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T: +613 9416 1855
A.C.N. 006 675 403
www.marshallday.com

Project: **ALBERTON WIND FARM**
Noise Assessment

Prepared for: **Synergy Wind Pty Ltd**
PO Box 327
Balaclava VIC 3183

Attention: **Coralie Spitzner**

Report No.: **002 R02 2015590ML**

Document Control

Status:	Rev:	Comments	Date:	Author:	Reviewer:
Final	-		14 Sep. 2017	C. Delaire	A. Morabito
Final	R01	Response to EPA auditor's comments	27 Mar. 2018	A. Morabito	C. Delaire
Final	R02	Updated receiver text	19 Apr. 2018	A. Morabito	-

TABLE OF CONTENTS

1.0 INTRODUCTION

This report, commissioned by Synergy Wind Pty Ltd (Synergy Wind), details the results of a noise assessment for the proposed Alberton Wind Farm, located within the Wellington Shire, Victoria.

The assessment has been undertaken in accordance with the New Zealand Standard 6808:2010 *Acoustics – Wind farm noise* as required by the Victorian Government's *Policy and planning guidelines for development of wind energy facilities in Victoria* dated January 2016.

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

2.0 PROJECT DESCRIPTION

2.1 Wind farm layout

The Alberton Wind Farm is proposed to be located approximately 5 km west of Yarram in Victoria and comprises thirty-four (34) wind turbines.

A plan of the proposed layout is presented in Appendix B together with coordinates for the wind turbines and nearby residential receivers.

2.2 Wind turbines

2.2.1 Turbine type

A number of candidate turbine models have been selected for this project, detailed in Table 1 below.

Table 1: WTG manufacturer specifications

Detail	Senvion 3.4M140	Siemens SWT 3.3-130	Vestas V136-3.45	Siemens SWT-3.15-142	Siemens SWT-3.6-130	Gamesa G132-3.465	Vestas V136-3.6
Make	Senvion	Siemens	Vestas	Siemens	Siemens	Gamesa	Vestas
Model	3.4M140	SWT 3.3-130	V136	SWT-3.15-142	SWT-3.6-130	G132	V136-3.6
Rated power (MW)	3.4	3.3	3.45	3.15	3.6	3.465	3.6
Rotor Diameter (m)	140	130	136	142	130	132	136
Hub Height (m)	110	115	112	109	115	114	112
Serrated trailing edge	No	Yes	Yes	Information not available	Yes	Information not available	Yes
Highest sound Power L_{WA} dB	105.0*	107.0*	106.5*	105.9*	107.0*	107.3*	106.5*
Tonal audibility ($\Delta L_{a,k}$>0 dB)	No**	Information not available	Information not available	Information not available	Information not available	Information not available	Information not available

* Guaranteed sound power level, including a 1 dB margin to account for uncertainties (See Section 2.2.2)

** See Section 2.2.3

As a general point of context, it is important to note that the application for the proposed wind farm does not seek consent for a specific make or specification of turbine. The selection of a final proposed turbine would occur after consent for the project, and would be subject to detailed layout design work (e.g. micro-siting) and a tender process to procure the supply of turbines. The final turbine would be selected on the basis of achieving compliance with the planning permit noise limits at surrounding noise sensitive receiver locations.

Accordingly, at this stage in the project, the candidate turbine models referred to in the noise assessment is primarily for the purpose of assessing the viability of the wind farm achieving compliance with the applicable limits at surrounding receiver locations. The key objective is to demonstrate that the noise limits can be practically achieved, accounting for typical noise emission levels that are representative of the types of turbine options that may be considered for the site.

2.2.2 Sound power levels

Sound power levels used in the assessment have been sourced from the documents detailed in Table 2, for each of the candidate turbine models.

Table 2: Reference documents

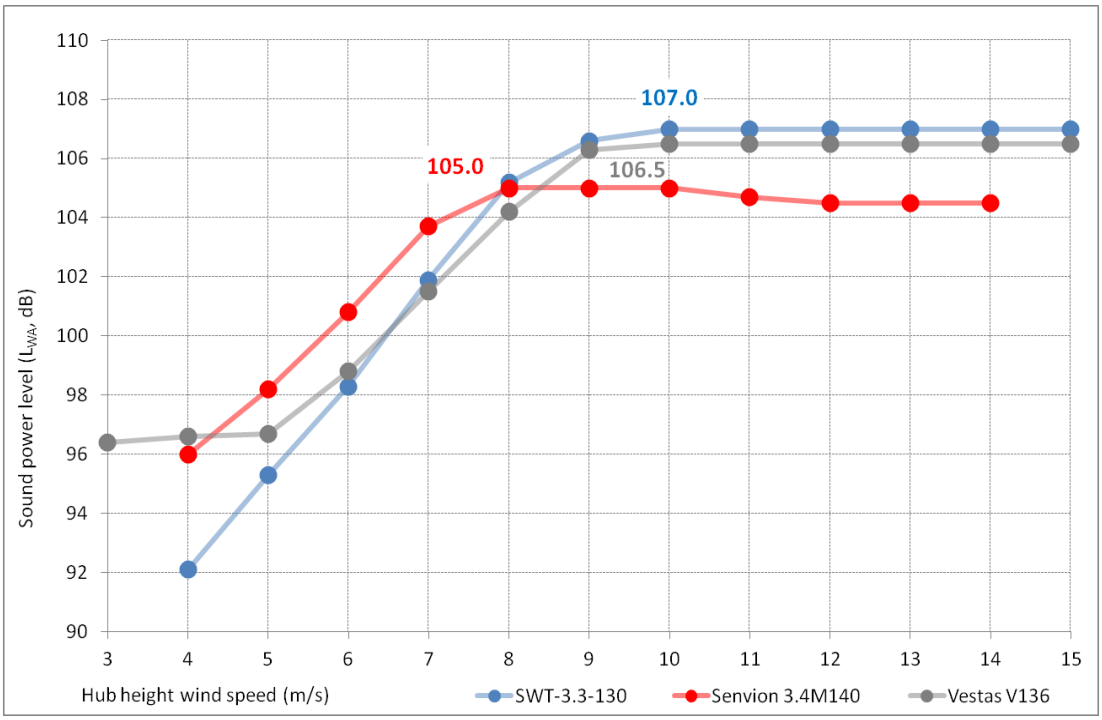
Model	Reference document
Senvion 3.4M140	Senvion document No. SD-3.20-WT.PC.01-A-B-EN *Power Curve & Sound Power Level [3.4M140/50Hz],* dated 2 June 2016 Senvion document No. GI-3.5-WT.PO.04-A-A-EN *Octave & Third Octave Band Data [3.0M122/50Hz] General Information,* dated 1 December 2015
Siemens SWT 3.3-130	Siemens document No. WP TE-40-0000-D104-01 *Standard Acoustic Emission SWT-3.3-130, Rev 0*, dated 8 May 2015
Vestas V136-3.45	Vestas document No. 0053-3713 V01 *Performance Specification V136-3.45 MW 50/60 Hz*, dated 24 November 2015 Vestas document No. 0055-9919 V00 *V136-mk3 -3.45 MW Third octave noise emission*, dated 23 November 2015
Siemens SWT-3.15-142	*Standard Acoustic Emission, SWT-3.15-142, Rev. 0* Document ID: WP ON PLM&EN EN GS-40-0000-G669-00, dated 12 May 2016
Siemens SWT-3.6-130	*Standard Acoustic Emission, SWT-3.6-130, Rev. 1* Document ID: WP ON PLM&EN EN GS-40-0000-G955-00, dated 12 May 2016
Gamesa G132-3.465	*G132-3.465MW POWER CURVE AND NOISE*. dated 26 February 2017; and MCG G132-3.465MW NOISE SPECTRUM, dated 26 February 2017
Vestas V136-3.6	*Performance Specification V136-3.60 MW 50/60 Hz* Document no.: 0056-6306 V02 2017-04-21; and *V136-3.6 MW Third octave noise emission* Document no. 0064-2970_01 2017-02-16

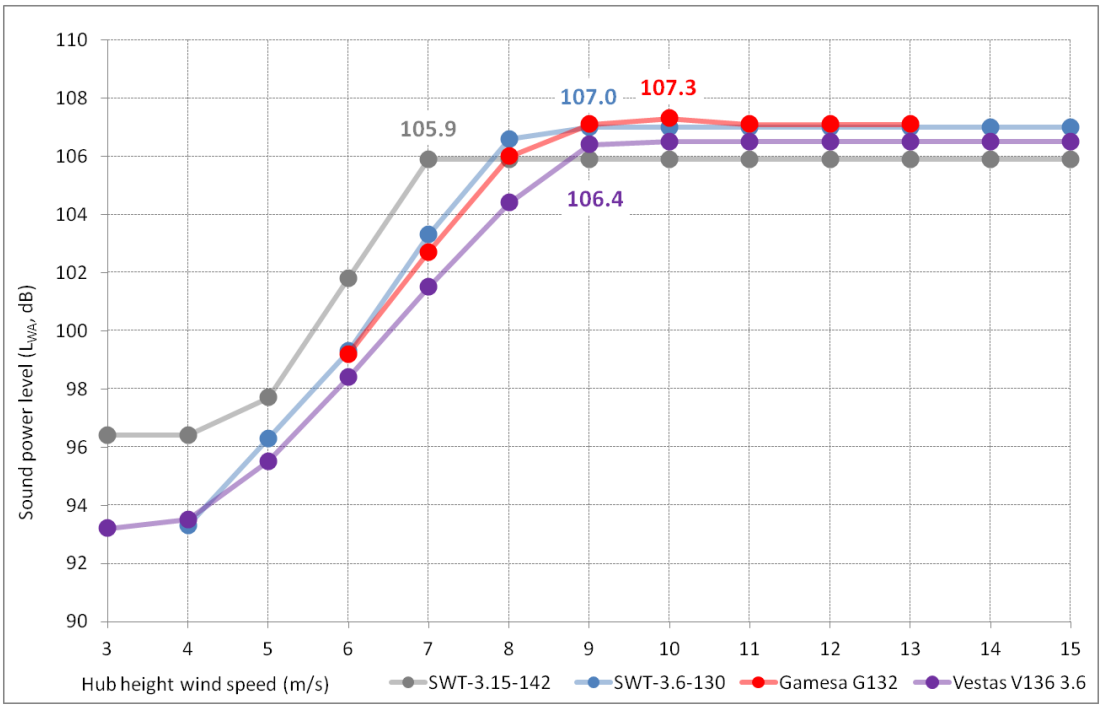
For each of the candidate turbines, the sound power level values used for this assessment have been derived from the above documents with the inclusion of a 1 dB margin to account for uncertainties.

The profile of A-weighted sound power levels as a function of hub height wind speed[1], detailed the documents listed in Table 1, are presented in Figure 1 for each of the candidate turbine models.

[1] For the Siemens SWT 3.3-130, sound power level data referenced to hub height wind speeds have been derived from sound power level data referenced to 10 m AGL

Figure 1: Guaranteed sound power level vs. hub height wind speed

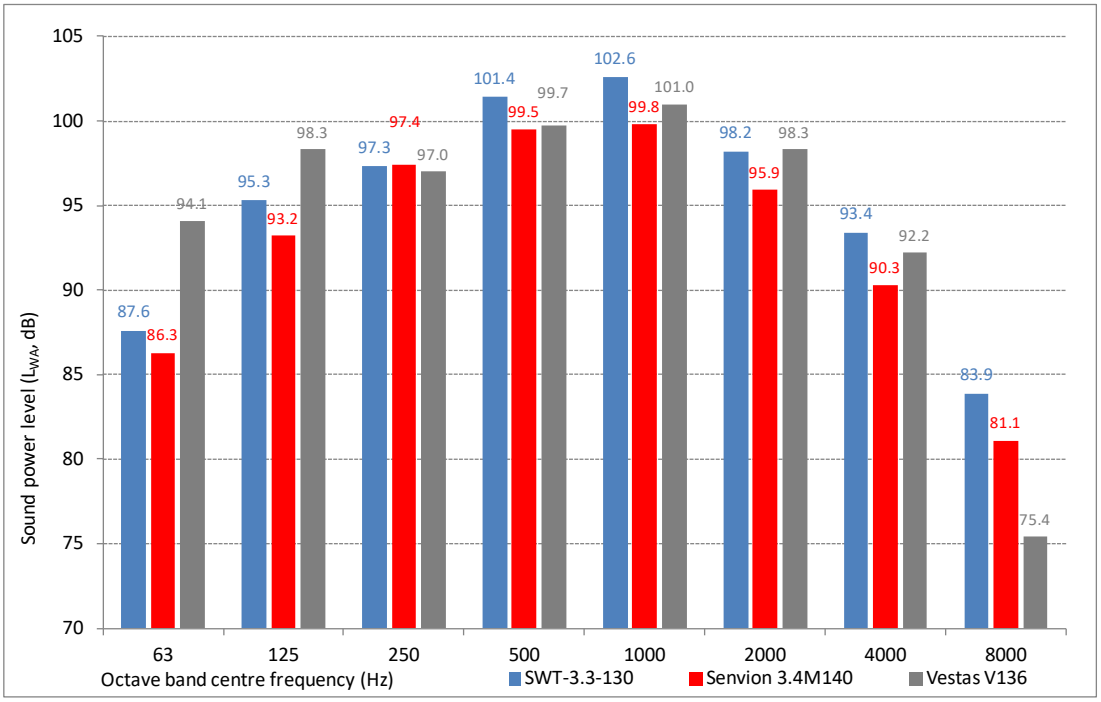


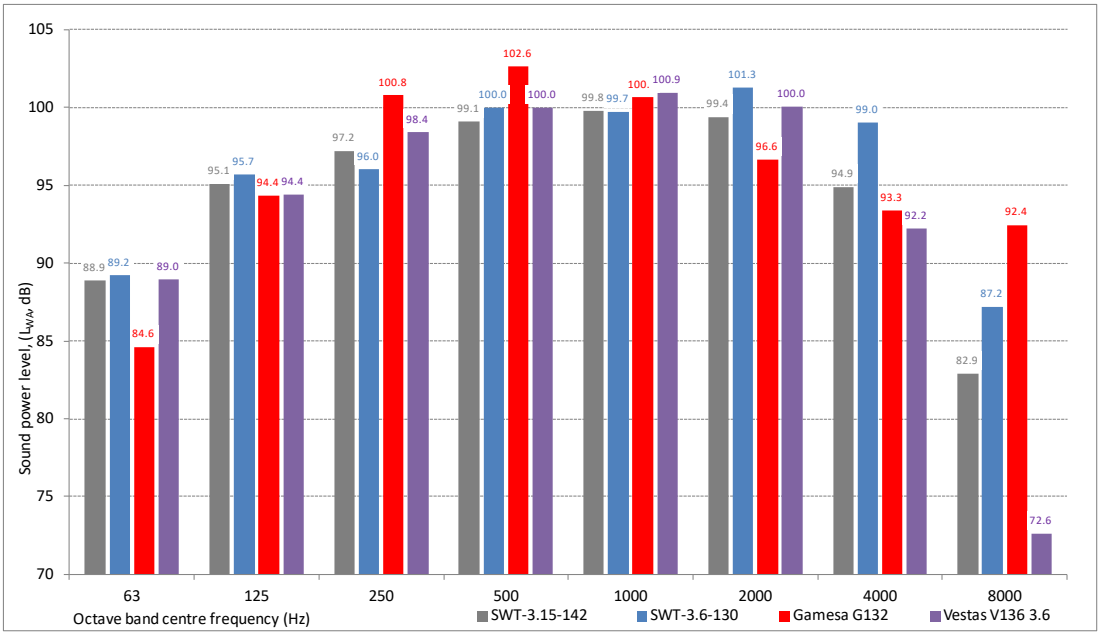


The octave band data provided in the reference documents have been adjusted to the highest sound power level detailed in Table 1 and are presented in Figure 2 for each of the candidate turbine models.

A-weighted octave band sound power spectra for the Senvion 3.4M140 candidate turbine is based on information provided by Senvion for the 3.0M122 turbine. It is understood that there is sufficient similarity between these two variants, that the 3.0M122 octave band data can be considered as representative of the spectral content for the 3.4M122.

Figure 2: A-weighted octave band sound power level spectra





2.2.3 Tonality

In accordance with New Zealand Standard 6808:2010 *Acoustics – Wind farm noise* (NZS 6808:2010), a risk assessment for the potential of tonality should be undertaken using tonality values determined in accordance with *International Standard IEC 61400-11 Wind turbine generator systems – Part 11: Acoustic noise measurement techniques* (IEC 61400-11).

The data for wind turbine tonality that is provided in an IEC 61400-11 emission test report relates to a complex parameter referred to as the tonal audibility, $\Delta L_{a,k}$. However, this data is not applicable for assessing tonality at receiver locations, nor does IEC 61400-11 provide a rating scheme for defining the subjective significance of reported $\Delta L_{a,k}$ values.

For the separate purpose of assessing the potential for tonality to attract a Special Audible Characteristic penalty at receiver locations, NZS 6808:2010 specifies the use of Annex C to ISO 1996-2:2007[2] 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 are 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[3]. 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.

While the tonal audibility concepts of IEC 61400-11 and ISO 1996-2:2017 are based on similar principles, the $\Delta L_{a,k}$ of IEC 61400-11 and the ΔL_{ta} of ISO 1996-2:2017 are defined in slightly different ways and, as a result, there is not a direct relationship between the two. However, to provide some context, it is noted that IEC 61400-11 states that any tones identified with a tonal audibility of $\Delta L_{a,k}$ greater than -3 dB shall be reported. This does not infer that a tone that is greater than -3 dB is problematic or audible, but it is a technical reporting requirement for documenting the characteristics of the turbine.

When available, tonal audibility values ($\Delta L_{a,k}$) are specified in the reference documents for each of the candidate turbines, as follows:

- Senvion 3.4M140: Senvion SE typically warrants tonal audibility $\Delta L_{a,k} < 2$ dB (for wind speed at 10 m AGL above 6 m/s)
- Siemens SWT 3.3-130: Tonal audibility information was not available for this turbine model at the time of preparing this document
- Vestas V136-3.45: Tonal audibility information was not available for this turbine model at the time of preparing this document.
- Siemens SWT 3.15-142: Tonal audibility information was not available for this turbine model at the time of preparing this document
- Siemens SWT 3.6-130: Tonal audibility information was not available for this turbine model at the time of preparing this document
- Gamesa G132-3.465: Tonal audibility information was not available for this turbine model at the time of preparing this document
- Vestas V136-3.6: Tonal audibility information was not available for this turbine model at the time of preparing this document.

---

[2] ISO 1996-2:2007 *Acoustics — Description, measurement and assessment of environmental noise - Determination of environmental noise levels* (ISO 1996-2:2007)

[3] ISO/PAS 20065:2016 *Acoustics - Objective method for assessing the audibility of tones in noise – Engineering Method* (ISO/PAS 20065:2016)

We have been advised by Senvion that there is currently no installed prototype of the 3.4M140 turbine model and therefore measured data regarding tonality is not yet available.

In the absence of test data, Senvion states, in document No. SD-3.20-WT.PC.01-A-B-EN, the following performance specification for the 3.4M140 turbine for contractual purposes:

There is no tonal audibility $\Delta L_{a.k} > 2$ dB (for $V_{10} \geq 6$ m/s).

Considering that the application of a penalty in accordance with ISO 1996 -2 (as required during post-construction assessment in accordance NZS 6808:2010) apply from a tonal audibility value ΔL_{ta} equal to or greater than +4 dB, it is unlikely that a tonal audibility $\Delta L_{a.k}$ less than +2 dB measured in close proximity of a turbine would attract a penalty for Special Audible Characteristics at a receiver location.

Therefore, for the current works, no penalty for special audible characteristics for tonality has been applied to wind farm noise levels predicted using the Senvion 3.4M140.

Notwithstanding the above, we envisage that the procurement contract for the site would stipulate that the final selected turbine model must not produce emissions which would attract a penalty when assessed in accordance with the relevant noise criteria and any associated conditions of consent.

2.3 Residential receivers

A total of one hundred and two (102) residential receivers have been included in the assessment, including seventeen (17) stakeholders and eighty-five (85) non-stakeholders.

These receiver locations were based on an updated dataset provided by Synergy Wind in June 2017.

The receiver locations considered in this assessment are detailed in Appendix B.

3.0 NOISE CRITERIA

New Zealand Standard 6808:2010 *Acoustics – Wind farm noise* (NZS 6808:2010) is used to assess wind farm noise as prescribed by the Victorian Government's *Policy and planning guidelines for development of wind energy facilities in Victoria* dated January 2016 (Victorian Guidelines).

3.1 Objective

Section C1.1 of NZS 6808:2010 discusses the intent of the standard, which is:

> [...] *to avoid adverse noise effects on people caused by the operation of wind farms while enabling sustainable management of natural wind resources.*

Furthermore, the *Outcome Statement* of NZS 6808:2010 reads as follows:

> *This Standard provides suitable methods for the prediction, measurement, and assessment of sound from wind turbines. In the context of the Resource Management Act, application of this Standard will provide reasonable protection of health and amenity at noise sensitive locations.*

To deliver on this objective the standard specifies noise criteria which are used to assess wind farm noise.

3.2 Noise limit

Section 5.2 *Noise limit* of NZS 6808:2010 defines acceptable noise limits as follows:

> *As a guide to the limits of acceptability at a noise sensitive location, at any wind speed wind farm sound levels ($L_{A90(10\ min)}$) should not exceed the background sound level by more than 5 dB, or a level of 40 dB $L_{A90(10\ min)}$, whichever is the greater.*

This arrangement of noise limits requires the noise associated with wind farms to be restricted to a permissible level above background noise, except in instances when both the background and source noise levels are low. In this respect, the criteria indicate that it is not necessary to continue to adhere to a margin above background when the background values are below the range of 30-35 dB.

Compliance with the criteria may result in wind turbine noise being audible at some locations for some of the time. The foreword of NZS 6808:2010 notes that:

> *Wind farm sound may be audible at times at noise sensitive locations, and this Standard does not set limits that provide absolute protection for residents from audible wind farm sound. Guidance is provided on noise limits that are considered reasonable for protecting sleep and amenity from wind farm sound received at noise sensitive locations.*

3.3 High amenity areas

Section 5.3.1 of NZS 6808:2010 states that the base noise limit of 40 dB L_{A90} (as detailed in Section 3.2) is *appropriate for protection of sleep, health, and amenity of residents at most noise sensitive locations*. It goes on to note that high amenity areas may require additional consideration:

> […] *In special circumstances at some noise sensitive locations a more stringent noise limit may be justified to afford a greater degree of protection of amenity during evening and night-time. A high amenity noise limit should be considered where a plan promotes a higher degree of protection of amenity related to the sound environment of a particular area, for example where evening and night-time noise limits in the plan for general sound sources are more stringent than 40 dB $L_{Aeq(15\ min)}$ or 40 dBA L_{10}. A high amenity noise limit should not be applied in any location where background sound levels, assessed in accordance with section 7, are already affected by other specific sources, such as road traffic sound.*

Section 5.3 of NZS 6808:2010 provides details of high amenity noise limits that apply to residential receivers that are deemed to be located within a high amenity area as defined in Sections 5.3.1 and 5.3.2 of the standard. The high amenity limit specifies that wind farm noise levels (L_{A90}) during evening and night-time periods should not exceed the background noise level (L_{A90}) by more than 5 dB or 35 dB L_{A90}, whichever is the greater, for wind speeds below 6 m/s at hub height. High amenity noise limits are not applicable during the daytime period.

In Section 5.1.2.a, the Victorian Guidelines states the following:

> *Under section 5.3 of the Standard, a 'high amenity noise limit' of 35 decibels applies in special circumstances. All wind farm applications must be assessed using section 5.3 of the Standard to determine whether a high amenity noise limit is justified for specific locations, following procedures outlined in clause C5.3.1 of the Standard. Guidance can be found on this issue in the VCAT determination for the Cherry Tree Wind Farm.*

The definition of a high amenity area provided in NZS 6808:2010 is specific to New Zealand planning legislation and guidelines. A degree of interpretation is therefore required when determining how to apply the concept of high amenity in Victoria. As recommended in the Victorian Guidelines, it is therefore appropriate to follow the guidance detailed in the Cherry Tree Wind Farm Pty Ltd v Mitchell Shire Council decisions[4].

Paragraph 53 of the Cherry Tree Wind Farm Decision states the following:

> *The Tribunal does not accept that the permit conditions need to refer to the High Amenity Area provisions of the New Zealand standard because it has not been established that any such area could reasonably be identified within the environs of this wind energy facility.* […]

[4] Mitchell Shire Council interim decision dated 4 April 2013 (the Cherry Tree Wind Farm Interim Decision) and Mitchell Shire Council decision dated 27 November 2013 (the Cherry Tree Wind Farm Decision)

Further justification for the above statement was provided in Paragraphs 107 to 109 of the Cherry Tree Wind Farm Interim Decision:

> *107. We were invited by the respondents to treat the subject land and the locality as a high amenity area. This invitation meets with the immediate conundrum that the language of the standard is not translatable to the Victorian planning framework. The "plan" referred to in section 5.3 is a plan as defined by the Resources Management Act of New Zealand. Section 43AA of that Act defines "plan" to mean "a regional plan or a district plan". No such animals exist under the Victorian legislation.*
>
> *108. Applying the standard mutatis mutandis to the Victorian experience we treat the plan referred to in the standard as a planning scheme approved under the Planning and Environment Act 1987. The Mitchell Planning Scheme does not anywhere expressly or by implication "promote a higher degree of protection of amenity related to the sound environment of a particular area". Approaching the matter by a process of elimination it can be seen with certainty that the controls contained within the Farming zone, which includes most of the locality, do not answer this description. The purpose of the Farming zone is to encourage agricultural use, which is not an inherently quiet land use. In fact reference to the zone purposes confirms that agricultural use is to be preferred to residential use if there is potential conflict between the two.*
>
> *109. Accordingly the Tribunal concludes that the subject land and its locality is not capable of designation as a high amenity area because it does not possess the necessary characteristics of such an area as specified in the NZ standard.*

As detailed in Paragraph 108, for the land surrounding the proposed wind farm to be considered a high amenity area, the zoning of the land must be identified in the relevant planning scheme as *promoting a higher degree of protection of amenity related to the sound environment*.

The application of the high amenity area for this site is discussed in Section 6.1.

3.4 Special audible characteristics

Section 5.4.2 of NZS 6808:2010 requires the following:

> *Wind turbine sound levels with special audible characteristics (such as tonality, impulsiveness and amplitude modulation) shall be adjusted by arithmetically adding up to +6dB to the measured level at the noise sensitive location.*

Notwithstanding this, the standard requires that wind farms be designed with no special audible characteristics at nearby residential receivers while concurrently noting in Section 5.4.1 that:

> […] *as special audible characteristics cannot always be predicted, consideration shall be given to whether there are any special audible characteristics of the wind farm sound when comparing measured levels with noise limits.*

While the standard emphasises assessment of special audible characteristics during the post-construction measurement phase of a project, an assessment of tonality is possible pre-construction, using tonality assessments carried out according to IEC 61400-11.

4.0 NOISE ASSESSMENT METHODOLOGY

There are several key stages involved in a noise assessment undertaken in accordance with NZS 6808:2010.

Firstly, preliminary wind farm noise predictions[5] are carried out for all identified residential receivers around the wind farm. The results of the preliminary analysis are used for the following:

- Identification of *noise sensitive locations,* where predicted wind farm noise levels exceed 35 dB L_{A90}
- Identification of selected *noise sensitive locations* where background noise monitoring should be undertaken, if required

Section 7.1.4 of NZS 6808:2010 notes the following:

> *If there are no noise sensitive locations within the 35 dB $L_{A90(10\,min)}$ predicted wind farm sound level contour then background sound level measurements are not required.*

Having identified noise sensitive locations and carrying out any background noise monitoring that may be required, applicable limits for the wind farm noise are determined.

Once noise limits have been established, further wind farm predictions are carried out.

Compliance is assessed by comparing the predicted wind farm noise levels with the noise limits over a range of wind speeds.

[5] See Section 5.1

5.0 NOISE SENSITIVE LOCATIONS

NZS 6808:2010 requires that the noise assessment be undertaken at all noise sensitive locations in the vicinity of the proposed wind farm which it defines as follows:

> *The location of a noise sensitive activity, associated with a habitable space or education space in a building not on the wind farm site.*

Noise sensitive locations therefore include residential dwellings, schools and hotels located outside the wind farm site.

As stakeholder receivers are located within the wind farm site, they are not considered as noise sensitive locations as part of an assessment in accordance with NZS 6808:2010. However, they have been considered as part of this assessment for informative purpose.

5.1 Preliminary noise predictions

Preliminary noise predictions have been undertaken at the one hundred and two (102) residential receivers identified by Synergy Wind in the vicinity of the Alberton Wind Farm (refer Section 2.3) using the noise prediction methodology detailed in Section 6.2.

Preliminary noise predictions corresponding to the highest sound power levels for each candidate turbine model (as detailed in Section 7.2) are presented in Table 3 and Table 4.

Only receivers where predicted levels are equal or greater than 35 dB L_{A90} for any of the candidate turbine models are presented.

Table 3: Preliminary noise predictions, dB L_{A90} – Non-stakeholder receivers

Receiver	Senvion 3.4M140	Siemens SWT 3.3-130	Vestas V136-3.45	Siemens SWT-3.15-142	Siemens SWT-3.6-130	Gamesa G132-3.465	Vestas V136-3.6
D10	32	34	35	33	33	34	33
D13	36	38	38	37	37	38	37
D21	32	33	35	32	33	34	33
D22	36	37	38	36	36	38	37
D24	34	35	37	34	35	36	35
D25	32	33	35	32	33	34	33
D29	35	37	38	35	36	37	36
D30	37	39	39	37	38	39	38
D31	36	38	38	36	37	38	37
D33	36	38	38	36	37	38	37
D34	34	35	36	34	34	36	35
D35	36	38	39	37	37	38	37
D45	33	34	35	33	33	35	34
D46	36	37	38	36	36	38	37
D47	36	37	38	36	36	38	37
D48	36	38	38	36	37	38	37

Receiver	Senvion 3.4M140	Siemens SWT 3.3-130	Vestas V136-3.45	Siemens SWT-3.15-142	Siemens SWT-3.6-130	Gamesa G132-3.465	Vestas V136-3.6
D49	36	37	38	36	36	38	37
D50	33	34	35	33	33	35	34
D51	37	39	40	38	38	39	38
D52	34	36	37	35	35	36	35
D53	34	36	36	34	35	36	35
D54	35	36	37	35	35	37	36
D55	34	36	37	35	35	36	35
D56	34	36	37	35	35	36	35
D57	36	38	39	37	37	39	38
D58	35	37	37	35	35	37	36
D59	34	36	37	35	35	37	36
D60	38	39	40	38	38	40	39
D61	33	35	36	34	34	35	34
D62	37	39	40	38	38	39	38
D63	32	34	35	33	33	34	33
D64	34	35	36	34	35	36	35
D65	34	36	37	35	35	37	36
D66	35	36	37	35	35	37	36
D67	34	35	36	34	34	36	35
D68	33	34	35	33	33	35	34
D71	32	33	35	32	33	34	33
D72	34	36	37	35	35	37	36
D73	35	36	37	35	35	37	36
D74	34	36	36	34	35	36	35
D75	33	35	36	33	34	35	34
D76	32	34	35	33	33	34	33
D81	36	38	39	37	37	38	37
D82	33	35	36	34	34	35	34
D83	33	35	36	34	34	35	34
D84	34	36	37	35	35	37	36
D85	35	36	37	35	35	37	36

Table 4: Preliminary noise predictions, dB L_{A90} – Stakeholder receivers

Receiver	Senvion 3.4M140	Siemens SWT 3.3-130	Vestas V136-3.45	Siemens SWT-3.15-142	Siemens SWT-3.6-130	Gamesa G132-3.465	Vestas V136-3.6
R01	37	39	39	37	38	39	38
R02	45	47	47	46	46	47	46
R03	39	41	42	40	40	41	41
R05	39	41	41	39	40	41	40
R08	40	42	42	40	40	42	41
R09	39	41	42	40	40	41	40
R10	35	37	38	36	36	37	36
R11	35	37	38	36	36	37	36
R12	41	43	44	42	42	43	43
R13	43	44	45	43	43	45	44
R14	44	46	46	45	45	46	46
R15	41	43	43	42	42	43	42
R16	40	42	42	41	41	42	41
R17	43	45	46	44	45	45	45
R18	37	39	40	38	38	39	38
R19	36	38	39	36	37	38	37

Based on the results for the candidate turbine model providing the highest noise levels, it can be seen from Table 3 and Table 4 that predicted noise levels at sixty-three (63) of the identified residential receivers in the vicinity of the proposed wind farm are above 35 dB L_{A90}, including the sixteen (16) stakeholders.

5.2 Background noise monitoring

Section 7 of NZS 6808:2010 provides guidance on sound measurements for the development and operation of a wind farm. The standard states the following in section 7.1.1:

> *Sound level measurements are used to:*
>
> *(a) Define the noise limits (see 5.2 and 5.3);*
>
> *(b) Verify the predicted wind farm sound levels*
>
> *(c) Confirm compliance with noise limits*

Section 7 of the standard then goes on to provide guidance on a range of procedures for measuring background noise levels prior to commencement of operation of a wind farm, as well as wind farm noise levels after the development has commenced operation.

The standard notes that a wind farm operator may elect to not conduct the background and compliance measurements described in Section 7. However, planning permits for Victorian wind farm generally require compliance measurements in accordance with the standard and consideration must therefore be given to both the background and compliance measurements procedures in the standard.

In relation to the location of the measurements, Section 7.1.4 notes:

> *Background sound level measurements and subsequent analysis to define the relative noise limits should be carried out where wind farm sound levels of 35 dB $L_{A90(10\ min)}$ or higher are predicted for noise sensitive locations, when the wind turbines are at 95% rated power. If there are no noise sensitive locations within the 35 dB $L_{A90(10\ min)}$ predicted wind farm sound level contour then background sound level measurements are not required.*

The preceding section of this report identifies a total of forty-seven (47) non-stakeholder receiver locations where the predicted noise levels are higher than 35 dB L_{A90}. Accordingly, background noise measurements should be carried out prior to the wind farm being developed.

At this point in the project, the primary purpose of the noise assessment is to demonstrate the viability of the proposed wind farm by verifying that the project could be designed and operated to meet the applicable noise limits defined by NZS 6808:2010. For this purpose, the planning stage assessment has been carried out by assessing the wind farm using the lowest noise limit which could be applied to the project i.e. without consideration of any increase in noise limits which may be relevant at higher wind speeds when background noise levels are increased.

Subject to the wind farm being approved, it is proposed that background noise measurements be undertaken at a range of representative locations in order to enable post-construction compliance measurements to be carried out in accordance with Section 7 of the standard. The locations would be selected accounting for the final layout design and turbine selection for the wind farm design, as well as the final participation status of surrounding receiver locations (i.e. to prioritise the selection of non-participant receiver location). It is also proposed that the background surveys would be scheduled to occur just prior to commencement of construction of the wind farm in order to limit the time period between the background measurements and any subsequent compliance measurements. This provides the benefit of reducing the opportunity for significant environmental changes to occur in the period between the background and compliance measurements.

6.0 NOISE LIMITS

6.1 High amenity areas

The area surrounding the proposed wind farm is predominantly designated as Farming Zone in the planning map shown in Appendix C.

The *Victoria Planning Provisions Practice Note* prepared by the Department of Sustainability and Environment titled Applying the rural zones and dated March 2007 states the following:

> *The Farming Zone is designed to encourage diverse farming practices, some of which can have significant off-site impacts. For this reason, the level of amenity that can be expected in this zone will usually not be compatible with sensitive uses, particularly housing.*

Based on the above, the high amenity noise limit in NZS 6808:2010 is not considered applicable to residential receivers within a Farming Zone.

On this basis and following guidance from VCAT determination for the Cherry Tree Wind Farm, as required by the Victorian Guidelines, the high amenity noise limit detailed in NZS 6808:2010 is therefore not deemed to be applicable for residential receivers in the vicinity of the Alberton Wind Farm.

6.2 Stakeholder receivers

The definition given in NZS 6808:2010 of noise sensitive locations specifically excludes dwellings within the wind farm site boundary, identified as stakeholder receivers. For these, it is current practice to use the recommendations outlined in the final report by *The European Working Group on Noise from Wind Turbines* (ETSU-R-97) which allows for an increased base noise limit of 45 dB L_{A90} in lieu of the 40 dB L_{A90} minimum noise limit.

6.3 Applicable noise limits

For the purpose of this assessment, the NZS 6808:2010 base noise limit of 40 dB L_{A90} at all wind speeds has been used for all noise sensitive locations. This provides a conservative assessment.

The base noise limit of 45 dB L_{A90} has been used for stakeholder receivers.

7.0 NOISE PREDICTIONS

7.1 Methodology

Operational noise due to the Alberton Wind Farm has been predicted using ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors Part 2: General method of calculation* (ISO 9613-2:1996) as implemented in version 7.4 of SoundPLAN. Predictions have been carried out using the sound power level data presented in Section 2.2.

Section C6.2.1 of NZS 6808:2010 states that, *for the purposes of this Standard, the predicted wind farm* [L_{Aeq}] *at any receiver location is deemed to be equivalent to the* [L_{A90}] *value*.

Calculations have been performed using octave band data from 63 Hz to 8 kHz and each wind turbine has been modelled as a point source at hub height. All noise predictions use a receiver height of 1.5 m above ground level (AGL). Possible screening effects from the landscape are considered using 10 m elevation contour information provided by the proponent. A copy of the site topography map is included in Appendix D. Atmospheric attenuation has been modelled using a temperature of 10 °C and 70 % humidity as recommended by NZS 6808:2010.

The hardness of the ground between the sources and the receivers needs to be defined in accordance with ISO 9613-2:1996. 100 % hard ground (G=0) is considered to be fully reflective as would occur with concrete or asphalt, while 100 % soft ground (G=1) would be considered absorptive and be appropriate for fields and grass. Our experience is that, in rural areas, it is appropriate to assume that the ground is 50 % hard/50 % soft. A ground factor of 50 % (G=0.5) has been used in the predictions.

Further details regarding the use of ISO 9613-2:1996 for wind farm noise predictions and the use of G=0.5 is presented in Appendix E.

7.2 Predicted noise levels

The predicted wind farm noise levels at the sixty-three (63) noise sensitive locations detailed in Section 5.1, where predicted levels are greater than 35 dB L_{A90} are presented in Table 5 and Table 6.

Sound levels in environmental assessment work are typically reported to the nearest integer to reflect the practical use of measurement and prediction data. However, in the case of wind farm layout design, significant layout modifications may only give rise to fractional changes in the predicted noise level. This is a result of the relatively large number of sources influencing the total predicted noise level, as well as the typical separating distances between the turbine locations and surrounding assessment positions. It is therefore necessary to consider the predicted noise levels at a finer resolution than can be perceived or measured in practice. It is for this reason that the levels presented in this section are reported to one decimal place.

The predicted levels correspond to the highest sound power level presented in Section 2.2.2 for each of the candidate turbines.

From Table 5, it can be seen that predicted noise levels from the Alberton Wind Farm comply with the NZS 6808:2010 base noise limit at all noise sensitive locations in the vicinity of the proposed site for all candidate wind turbine models.

Table 5: Highest predicted noise levels at non-stakeholder receivers - dB L_{A90}

Receiver	Applicable base noise limit	Senvion 3.4M140	Siemens SWT 3.3-130	Vestas V136-3.45	Siemens SWT-3.15-142	Siemens SWT-3.6-130	Gamesa G132-3.465	Vestas V136-3.6
D10	40	32.1	33.9	34.8	32.7	32.9	34.3	33.3
D13	40	36.0	37.9	38.3	36.5	36.7	38.1	37.2
D21	40	31.7	33.3	34.7	32.3	32.5	33.8	32.9
D22	40	35.5	37.4	38.1	36.1	36.3	37.7	36.7
D24	40	33.7	35.4	36.5	34.3	34.5	35.9	34.9
D25	40	31.6	33.2	34.8	32.3	32.5	33.8	32.8
D29	40	34.9	36.6	37.6	35.4	35.6	37.0	36.0
D30	40	36.8	38.7	39.2	37.3	37.6	38.9	38.0
D31	40	35.7	37.5	38.3	36.2	36.5	37.9	36.9
D33	40	35.8	37.6	38.4	36.3	36.6	38.0	37.0
D34	40	33.5	35.3	36.3	34.1	34.3	35.7	34.7
D35	40	36.2	38.0	38.7	36.7	37.0	38.3	37.4
D45	40	32.5	34.2	35.5	33.1	33.3	34.6	33.7
D46	40	35.5	37.3	38.2	36.0	36.2	37.7	36.6
D47	40	35.6	37.4	38.3	36.1	36.3	37.8	36.7
D48	40	35.8	37.5	38.4	36.3	36.5	37.9	36.9
D49	40	35.7	37.4	38.3	36.2	36.4	37.8	36.8
D50	40	32.6	34.4	35.4	33.2	33.4	34.7	33.8
D51	40	37.2	39.0	39.6	37.6	37.9	39.3	38.3
D52	40	34.0	35.8	36.7	34.6	34.8	36.1	35.2
D53	40	33.8	35.5	36.5	34.3	34.6	35.9	34.9
D54	40	34.5	36.3	37.1	35.0	35.3	36.6	35.7
D55	40	34.2	36.0	36.9	34.7	35.0	36.3	35.4
D56	40	34.2	36.0	36.9	34.8	35.0	36.4	35.4
D57	40	36.4	38.2	38.9	36.9	37.1	38.5	37.6
D58	40	34.7	36.5	37.3	35.2	35.4	36.8	35.8
D59	40	34.4	36.2	37.0	34.9	35.2	36.5	35.5
D60	40	37.5	39.3	39.9	38.0	38.2	39.6	38.6
D61	40	32.9	34.6	35.7	33.5	33.7	35.0	34.1
D62	40	37.2	39.1	39.6	37.7	37.9	39.3	38.4
D63	40	32.1	33.8	35.0	32.7	32.9	34.2	33.3
D64	40	33.7	35.4	36.4	34.2	34.5	35.8	34.8
D65	40	34.4	36.2	36.9	34.9	35.1	36.5	35.5
D66	40	34.5	36.3	37.1	35.0	35.3	36.7	35.7
D67	40	33.6	35.4	36.1	34.1	34.4	35.7	34.8

Receiver	Applicable base noise limit	Senvion 3.4M140	Siemens SWT 3.3-130	Vestas V136-3.45	Siemens SWT-3.15-142	Siemens SWT-3.6-130	Gamesa G132-3.465	Vestas V136-3.6
D68	40	32.5	34.3	35.1	33.0	33.3	34.6	33.7
D71	40	31.6	33.3	34.7	32.3	32.5	33.8	32.8
D72	40	34.4	36.2	37.1	35.0	35.2	36.6	35.6
D73	40	34.6	36.4	37.2	35.1	35.4	36.7	35.7
D74	40	33.7	35.5	36.4	34.2	34.5	35.8	34.8
D75	40	32.8	34.5	35.6	33.4	33.6	34.9	33.9
D76	40	32.1	33.8	35.0	32.7	32.9	34.2	33.2
D81	40	36.2	38.1	38.6	36.7	37.0	38.3	37.4
D82	40	32.9	34.6	35.8	33.5	33.7	35.0	34.1
D83	40	33.0	34.7	35.9	33.6	33.8	35.1	34.2
D84	40	34.4	36.2	37.0	34.9	35.1	36.5	35.5
D85	40	34.5	36.2	37.3	35.1	35.3	36.7	35.7

Table 6: Highest predicted noise levels at stakeholder receivers - L_{A90}, dB

Receiver	Applicable base noise limit	Senvion 3.4M140	Siemens SWT 3.3-130	Vestas V136-3.45	Siemens SWT-3.15-142	Siemens SWT-3.6-130	Gamesa G132-3.465	Vestas V136-3.6
R01	45	36.9	38.8	39.1	37.4	37.7	38.9	38.1
R02	45	44.8	46.9	46.8	45.5	46.0	46.7	46.2
R03	45	39.2	41.2	41.4	39.8	40.1	41.2	40.5
R05	45	38.8	40.7	41.1	39.3	39.6	40.9	40.0
R08	45	39.6	41.5	41.9	40.1	40.4	41.7	40.8
R09	45	39.2	41.0	41.5	39.6	39.9	41.3	40.3
R10	45	35.0	36.8	37.5	35.5	35.8	37.1	36.2
R11	45	35.3	37.1	37.7	35.8	36.0	37.4	36.4
R12	45	41.3	43.3	43.5	41.9	42.2	43.3	42.6
R13	45	42.5	44.4	44.6	43.0	43.4	44.5	43.7
R14	45	44.2	46.3	46.3	44.9	45.3	46.2	45.6
R15	45	41.1	43.1	43.2	41.7	42.1	43.1	42.4
R16	45	40.1	42.1	42.3	40.7	41.0	42.1	41.4
R17	45	43.4	45.4	45.5	44.0	44.5	45.4	44.7
R18	45	37.3	39.1	39.6	37.8	38.1	39.3	38.4
R19	45	35.9	37.7	38.4	36.4	36.7	38.0	37.1

Note: Shaded cell(s) exceed the applicable base noise limit

The following can be seen from Table 6:

- Predicted noise levels from the Alberton Wind Farm comply with the applicable base noise limit at all stakeholder receivers using the Senvion 3.4 M140 turbine model
- Predicted noise levels from the Alberton Wind Farm exceed the applicable base noise limit at three (3) stakeholder receivers R02, R14 and R17 by 1.9 dB, 1.3 dB and 0.4 dB respectively using the Siemens SWT-3.3-130 turbine model
- Predicted noise levels from the Alberton Wind Farm exceed the base limit at three (3) stakeholder receivers R02, R14 and R17 by 1.8 dB, 1.3 dB and 0.5 dB respectively, using the Vestas V136-3.45 turbine model
- Predicted noise levels from the Alberton Wind Farm exceed the base limit at one (1) stakeholder receiver, R02 by 0.5 dB, using the Siemens SWT-3.15-142 turbine model
- Predicted noise levels from the Alberton Wind Farm exceed the base limit at two (2) stakeholder receivers, R02 and R14 by 1.0 dB and 0.3 dB respectively, using the Siemens SWT-3.6-130 turbine
- Predicted noise levels from the Alberton Wind Farm exceed the base limit at three (3) stakeholder receivers, R02, R14 and R17 by 1.7 dB, 1.2 dB and 0.4 dB respectively, using the Gamesa G132 turbine model
- Predicted noise levels from the Alberton Wind Farm exceed the base limit at two (2) stakeholder receivers, R02 and R14 by 1.2 dB and 0.6 dB respectively, using the Vestas V136-3.6 turbine model.

Wind farm noise at other stakeholder receivers further from the wind farm will be lower than 35 dB L_{A90} and therefore also comply with the lowest applicable NZS 6808:2010 noise limit of 40 dB L_{A90} at all wind speeds by at least 5 dB.

Noise contour maps are presented in Appendix F for the highest sound power levels corresponding to each of the candidate turbine models.

Given the margin of compliance at a number of receiver locations (for certain wind turbine models) and subject to the wind farm being approved, it is likely a permit requirement will require that once the final turbine selection and layout (allowing for micro-siting) are confirmed, that compliance with the relevant noise limit will also need to be reassessed.

7.3 Special audible characteristics

Based on the information provided in Section 2.2.3, it is considered that a penalty for tonality is not applicable for any of the assessed wind speeds.

This is based on the assumption that the turbine procurement contract for the site would stipulate that the turbines must not produce emissions which would attract a penalty for tonality when assessed in accordance with the relevant noise criteria and any associated conditions of consent.

8.0 CONCLUSION

The Alberton Wind Farm is proposed to consist of thirty-four (34) turbines, west Yarram in Victoria.

An assessment has been undertaken in accordance with NZS 6808:2010 as required by the current Victorian Guidelines at one hundred and two (102) residential receivers identified by Synergy Wind in the vicinity of the project.

The assessment has considered a number of candidate wind turbine models for the site, as follows:

- Senvion 3.4M140
- Siemens SWT 3.3-130
- Vestas V136-3.45
- Siemens SWT 3.15-142
- Siemens SWT 3.6-130
- Gamesa G132-3.465
- Vestas V136-3.6

Wind farm noise levels predicted using ISO 9613-2:1996, for each candidate turbine model, have been assessed against a base noise limit of 40 dB L_{A90} for non-stakeholder receivers identified as noise sensitive locations in accordance with NZS 6808:2010. A review of land zoning surrounding the proposed site indicates that high amenity noise limits are not applicable.

Compliance with the NZS 6808:2010 noise limit is achieved at all wind speeds at all identified non-stakeholder receivers identified in the vicinity of the proposed Alberton wind Farm for each of the assessed candidate wind turbine models.

For stakeholders, a base noise limit of 45 dB L_{A90} was used as recommended by supplementary guidance commonly referenced in Victoria (ETSU-R-97). Results of the NZS 6808:2010 noise assessment are as follows:

- Using the Senvion 3.4 M140 turbine model

  Compliance with the NZS 6808:2010 noise limit is achieved at all wind speeds at all identified receivers identified in the vicinity of the proposed Alberton wind Farm

- Using the Siemens SWT 3.3-130 turbine model

  Predicted noise levels exceed the applicable base noise limit at three (3) stakeholder receivers, R02, R14 and R17 by 1.9 dB, 1.3 dB and 0.4 dB respectively

- Using the Vestas V136-3.45 turbine model

  Predicted noise levels exceed the applicable base noise limit at three (3) stakeholder receivers, R02, R14 and R17 by 1.8 dB, 1.3 dB and 0.5 dB respectively

- Using the Siemens SWT-3.15-142 turbine model

  Predicted noise levels exceed the NZS 6808:2010 noise limit at one (1) stakeholder receiver, R02 by 0.5 dB

- Using the Siemens SWT-3.6-130 turbine model

  Predicted noise levels exceed the NZS 6808:2010 noise limit at two (2) stakeholder receivers, R02 and R14 by 1.0 dB and 0.3 dB respectively

- Using the Gamesa G132 turbine model

  Predicted noise levels exceed the NZS 6808:2010 noise limit at three (3) stakeholder receivers, R02, R14 and R17 by 1.7 dB, 1.2 dB and 0.4 dB respectively

- Using the Vestas V136-3.6 turbine model

  Predicted noise levels exceed the NZS 6808:2010 noise limit at two (2) stakeholder receivers, R02 and R14 by 1.2 dB and 0.6 dB respectively

- Compliance with the lowest possible NZS 6808:2010 noise limit is achieved at all wind speeds at all remaining receivers in the vicinity of the wind farm for all candidate turbine models

Given the margin of compliance at a number of receiver locations (for certain wind turbine models) and subject to the wind farm being approved, it is likely a permit requirement will require that once the final turbine selection and layout (allowing for micro-siting) are confirmed, that compliance with the relevant noise limit will also need to be reassessed.

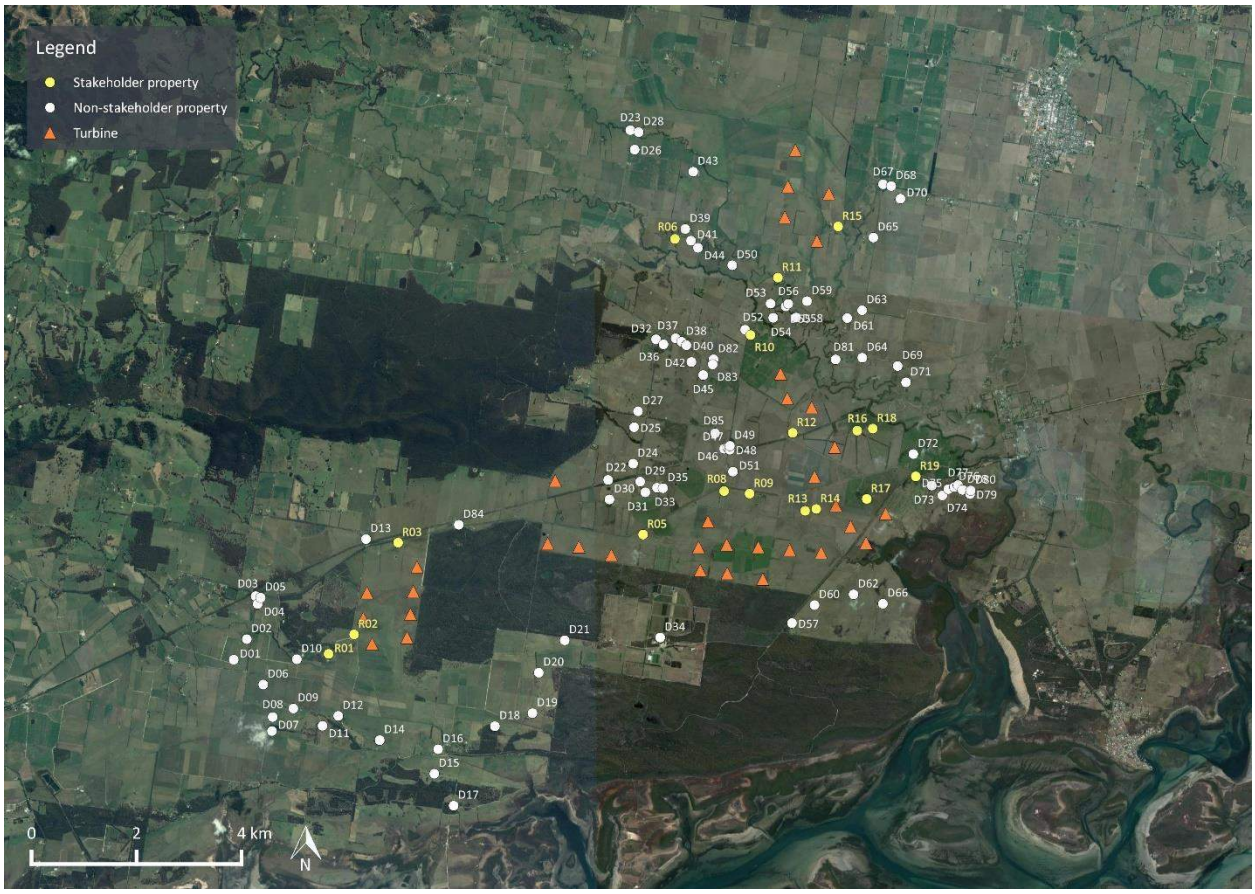
9.0 SUMMARY OF PARAMETERS

Documentation of relevant parameters as required by NZS 6808:2010 is contained in Appendix G.

APPENDIX A GLOSSARY OF TERMINOLOGY

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).
L_{A90}	The noise level exceeded for 90 % of the measurement period, measured in A-weighted decibels. This is commonly referred to as the background noise level.
L_W	The sound power level. The level of total sound power radiated by a sound source.
L_{WA}	The "A" weighted sound power level.
Octave Band	A range of frequencies where the highest frequency included is twice the lowest frequency. Octave bands are referred to by their logarithmic centre frequencies, these being 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, and 16 kHz for the audible range of sound.

APPENDIX B ALBERTON WIND FARM LAYOUT



B1 Turbine coordinates (WGS84 Zone 55)

Turbine	Easting	Northing	Turbine	Easting	Northing
T01	458853	5721594	T18	466207	5723430
T02	458685	5722082	T19	466293	5722824
T03	458756	5722567	T20	466711	5729705
T04	459518	5721714	T21	466771	5730287
T05	459584	5722157	T22	466804	5723380
T06	459637	5722587	T23	466912	5730979
T07	459708	5723054	T24	466630	5726724
T08	462198	5723499	T25	467223	5726089
T09	462340	5724695	T26	467278	5724773
T10	462791	5723439	T27	467403	5723331
T11	463408	5723282	T28	467323	5729252
T12	465069	5723430	T29	467662	5725331
T13	465102	5722990	T30	467551	5730153
T14	465248	5723919	T31	467683	5724225
T15	465606	5723479	T32	467964	5723825
T16	465616	5722934	T33	468258	5723514
T17	466758	5726258	T34	468632	5724068

B2 Dwelling coordinates (WGS84 Zone 55) – Stakeholder receivers

Receiver	Easting	Northing	Distance to nearest turbine (m)	Receiver	Easting	Northing	Distance to nearest turbine (m)
R01	458025	5721403	850	R11	466580	5728555	1,019
R02	458511	5721773	355	R12	466861	5725604	605
R03	459349	5723517	586	R13	467098	5724123	594
R05	464013	5723672	720	R14	467310	5724158	379
R06	464619	5729290	2,133	R15	467727	5729528	489
R08	465556	5724498	656	R16	468091	5725646	533
R09	466041	5724449	954	R17	468272	5724349	457
R10	466058	5727464	935	R18	468387	5725686	808
R01	458025	5721403	850	R19	469205	5724777	912

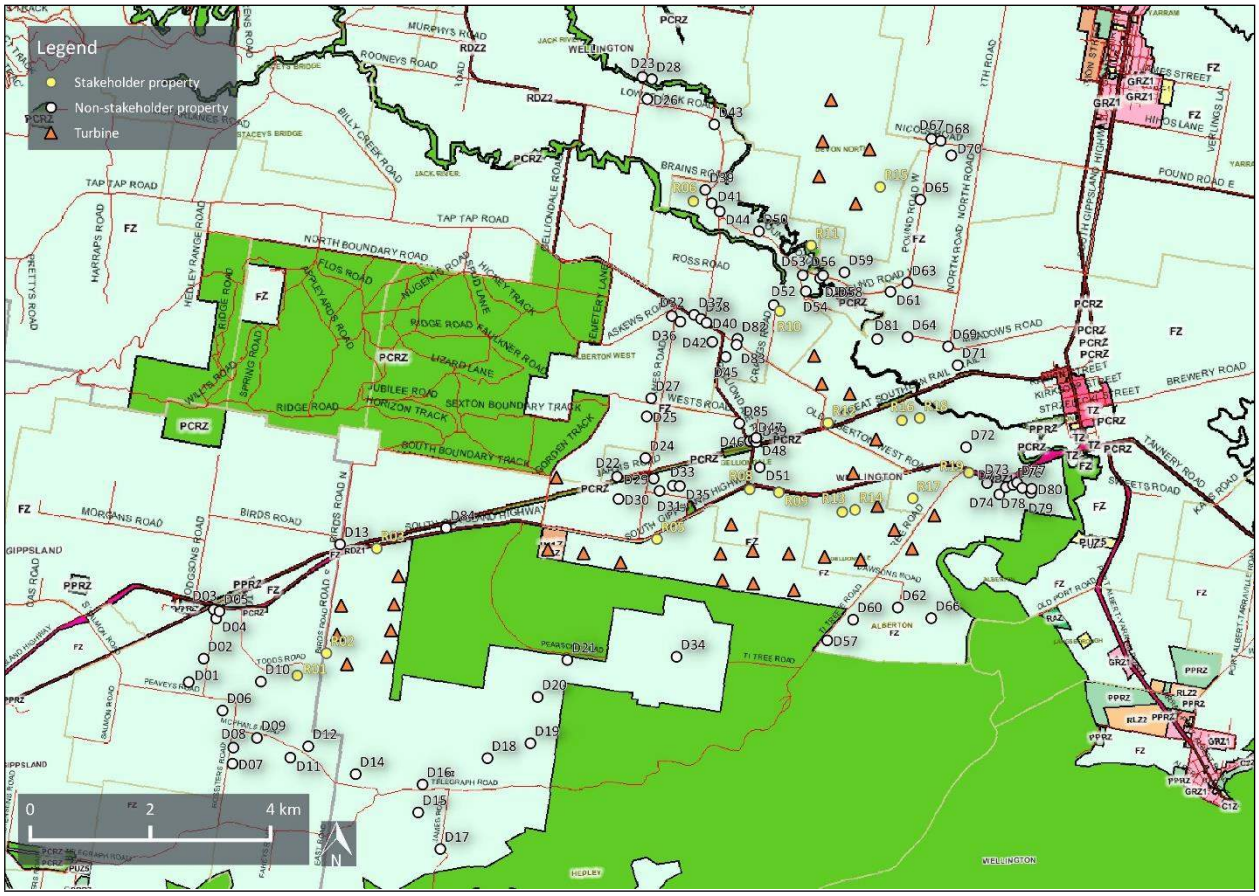
B3 Dwelling coordinates (WGS84 Zone 55) – Non-stakeholder receivers

Receiver	Easting	Northing	Distance to nearest turbine (m)	Receiver	Easting	Northing	Distance to nearest turbine (m)
D01	456219	5721293	2,589	D44	465058	5729122	1,753
D02	456468	5721683	2,253	D45	465158	5726702	1,472
D03	456636	5722500	2,091	D46	465557	5725302	1,417
D04	456675	5722351	2,028	D47	465624	5725326	1,456
D05	456731	5722471	1,992	D48	465662	5725284	1,426
D06	456782	5720820	2,211	D49	465666	5725357	1,416
D07	456947	5719936	2,526	D50	465711	5728791	1,355
D08	456961	5720204	2,348	D51	465724	5724867	1,061
D09	457354	5720365	1,938	D52	465957	5727564	1,076
D10	457420	5721301	1,463	D53	466440	5728061	1,350
D11	457910	5720036	1,821	D54	466491	5727792	1,077
D12	458209	5720224	1,514	D55	466729	5728009	1,289
D13	458737	5723585	1,018	D56	466778	5728057	1,313
D14	458998	5719763	1,837	D57	466848	5721988	1,003
D15	460039	5719125	2,641	D58	466928	5727796	1,113
D16	460111	5719590	2,205	D59	467134	5728108	1,160
D17	460407	5718517	3,318	D60	467278	5722331	1,008
D18	461192	5720028	2,376	D61	467900	5727786	1,575
D19	461907	5720276	2,788	D62	468021	5722533	1,009
D20	462027	5721045	2,460	D63	468183	5727934	1,574
D21	462521	5721661	1,798	D64	468186	5727032	1,348
D22	463348	5724709	1,008	D65	468397	5729317	1,076
D23	463770	5731358	3,165	D66	468579	5722356	1,202
D24	463822	5725019	1,517	D67	468582	5730329	1,046
D25	463843	5725711	1,814	D68	468737	5730295	1,194
D26	463853	5730988	3,001	D69	468860	5726875	1,816
D27	463917	5726014	2,056	D70	468913	5730054	1,366
D28	463929	5731320	3,002	D71	469019	5726564	1,834
D29	463958	5724677	1,496	D72	469159	5725201	1,250
D30	463373	5724339	1,058	D73	469510	5724603	1,028
D31	464056	5724474	1,315	D74	469711	5724415	1,133
D32	464260	5727382	2,460	D75	469822	5724534	1,278
D33	464278	5724560	1,163	D76	469938	5724573	1,400

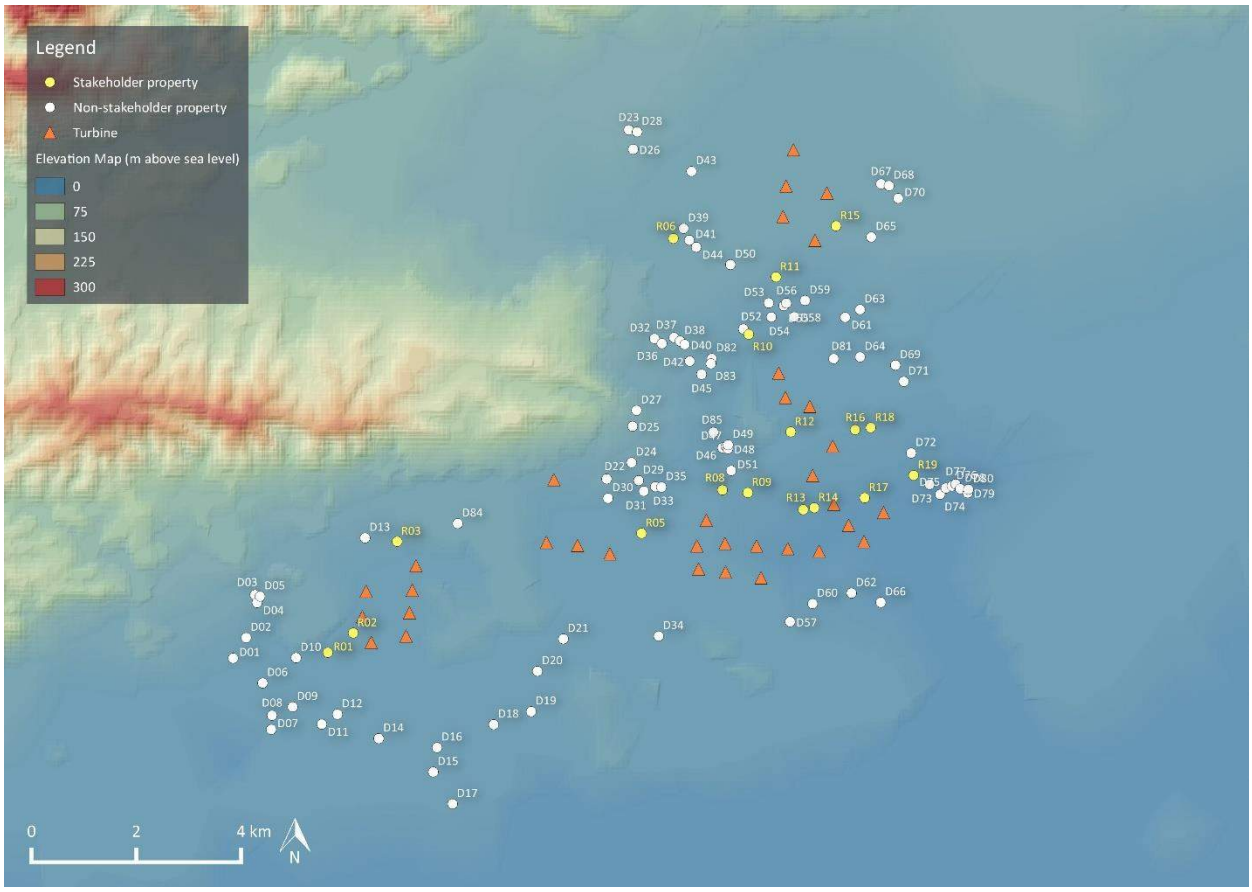
Receiver	Easting	Northing	Distance to nearest turbine (m)	Receiver	Easting	Northing	Distance to nearest turbine (m)
D34	464339	5721714	1,487	D77	470008	5724610	1,479
D35	464393	5724553	1,064	D78	470094	5724521	1,531
D36	464402	5727287	2,298	D79	470239	5724441	1,650
D37	464632	5727402	2,110	D80	470251	5724509	1,678
D38	464746	5727334	1,980	D81	467680	5726999	1,018
D39	464816	5729479	1,908	D82	465354	5727002	1,306
D40	464838	5727269	1,873	D83	465338	5726904	1,304
D41	464925	5729257	1,841	D84	460504	5723858	1,131
D42	464933	5726951	1,712	D85	465384	5725596	1,525
D43	464967	5730568	1,826				

APPENDIX C ZONING MAP

The zoning maps used in the following map were downloaded from the Department of Environment, Land, Water & Planning *Planning Maps Online* website on June 2017.



APPENDIX D SITE TOPOGRAPHY MAP



APPENDIX E NOISE PREDICTION MODEL

Operational wind farm noise levels are predicted at all residential dwellings considered within this assessment using a three-dimensional noise model generated in SoundPLAN® version 7.4 software. Specifically, predictions have been carried out using the SoundPLAN implementation of ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors Part 2: General method of calculation* (ISO 9613-2:1996) to calculate noise propagation from the wind farm to each receiver location.

The use of this method is supported by international research publications, measurement studies conducted by Marshall Day Acoustics and direct reference to the standard in NZS 6808:2010 *Acoustics – Wind farm noise* (NZS 6808:2010).

The standard specifies an engineering method for calculating noise at a known distance from a variety of sources under meteorological conditions favourable to sound propagation. The standard defines favourable conditions as downwind propagation where the source blows from the source to the receiver within an angle of +/-45 degrees from a line connecting the source to the receiver, at wind speeds between approximately 1 m/s and 5 m/s, measured at a height of 3 m to 11 m above the ground. Equivalently, the method accounts for average propagation under a well-developed moderate ground based thermal inversion. In this respect, it is noted that at the wind speeds relevant to noise levels from wind turbines, atmospheric conditions do not favour the development of thermal inversions throughout the propagation path from the source to the receiver.

To calculate far-field noise levels according to the ISO 9613-2:1996, the noise levels of each wind turbine are firstly characterised in the form of octave band frequency levels. A series of octave band attenuation factors are then calculated for a range of effects including:

- Geometric divergence
- Air absorption
- Reflecting obstacles
- Screening
- Vegetation
- Ground reflections

The octave band attenuation factors are then applied to the sound power level data to determine the corresponding octave band and total calculated noise level at relevant receiver locations.

Calculating the attenuation factors for each effect requires a relevant description of the environment into which the sound propagation such as the physical dimensions of the environment, atmospheric conditions and the characteristics of the ground between the source and the receiver.

Wind farm noise propagation has been the subject of considerable research in recent years. These studies have provided support for the reliability of engineering methods such as ISO 9613-2:1996 when a certain set of input parameters are chosen in combination.

A number of Australian and international studies support the assignment of a ground absorption factor of G=0.5 for the source, middle and receiver ground regions between a wind farm and a calculation point. This ground absorption factor of G=0.5 is adopted in combination with several cautious assumptions; specifically all wind turbines operating at identical wind speeds, emitting sound levels equal to the test measured levels plus a margin for uncertainty (or guaranteed values), at a temperature of 10 degrees and relative humidity of 70 % (conditions which give rise to low atmospheric absorption). The studies demonstrate that applying the ISO 9613-2:1996 prediction methodology in this way provides a reliable representation of the upper noise levels expected in practice.

The following specific adjustments have been made:

- In instances where the ground terrain provides marginal or partial acoustic screening, the barrier effect should be limited to not more than 2 dB
- Screening attenuation calculated based on the screening expected for the source located at the tip height of the wind turbine (in contrast to hub height in non-adjusted ISO 9613 predictions)
- In instances where the ground falls away significantly between the source and receiver, such as valleys, an adjustment of 3 dB should be added to the calculated sound pressure level. A terrain profile in which the ground falls away significantly is defined as one where the mean sound propagation height is at least 50 % greater than would occur over flat ground.

In support of the use of ISO 9613-2:1996 and the choice of G=0.5 as an appropriate ground characterisation, the following references are noted:

- A factor of G=0.5 is frequently applied in Australia for general environmental noise modelling purposes as a way of accounting for the potential mix of ground porosity which may occur in regions of dry/compacted soils or in regions where persistent damp conditions may be relevant
- NZS 6808:2010 refers to ISO 9613-2:1996 as an appropriate prediction methodology for wind farm noise, and notes that soft ground conditions should be characterised by a ground factor of G=0.5
- In 1998, a comprehensive study, part funded by the European Commission, Development of a Wind Farm Noise Propagation Prediction Model[6] found that the ISO 9613-2:1996 model provided a robust representation of upper noise levels which may occur in practice, and provided a closer agreement between predicted and measured noise levels than alternative standards such as CONCAWE and ENM. Specifically, the report indicated the ISO 9613-2:1996 method generally tends to marginally over predict noise levels expected in practice
- The UK Institute of Acoustics journal dated March/April 2009 published a joint agreement between practitioners in the field of wind farm noise assessment, including consultants routinely employed on behalf of both developers and community opposition groups, and indicated the ISO 9613-2:1996 method as the appropriate standard and specifically designated G=0.5 as the appropriate ground characterisation. It is noted that this publication specifically refers to predictions made to receiver heights of 4m in the interest of representing 2-storey dwellings which are more common in the UK. Predictions in Australia are generally based on a lower prediction height of 1.5 m which tends to result in higher ground attenuation factors, however conversely, predictions in Australia do not generally incorporate a -2 dB factor (as applied in the UK) to represent the relationship between L_{Aeq} and L_{A90} noise levels. The result is that these differences tend to balance out to a comparable approach and thus supports the use of G=0.5 in the context of Australian prediction methodologies
- A range of comparative measurement and prediction studies[7, 8, 9] for wind farms in which Marshall Day Acoustics' staff have been involved in have provided further support for the use of ISO 9613-2:1996 and G=0.5 as an appropriate representation of typical upper noise levels expected to occur in practice.

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6 Bass, Bullmore and Sloth - *Development of a wind farm noise propagation prediction model*; Contract JOR3-CT95-0051, Final Report, January 1996 to May 1998.

7 Bullmore, Adcock, Jiggins & Cand – *Wind Farm Noise Predictions: The Risks of Conservatism*; Presented at the Second International Meeting on Wind Turbine Noise in Lyon, France September 2007.

8 Bullmore, Adcock, Jiggins & Cand – *Wind Farm Noise Predictions and Comparisons with Measurements*; Presented at the Third International Meeting on Wind Turbine Noise in Aalborg, Denmark June 2009.

9 Delaire, Griffin, & Walsh – *Comparison of predicted wind farm noise emission and measured post-construction noise levels at the Portland Wind Energy Project in Victoria, Australia*; Presented at the Fourth International Meeting on Wind Turbine Noise in Rome, April 2011.

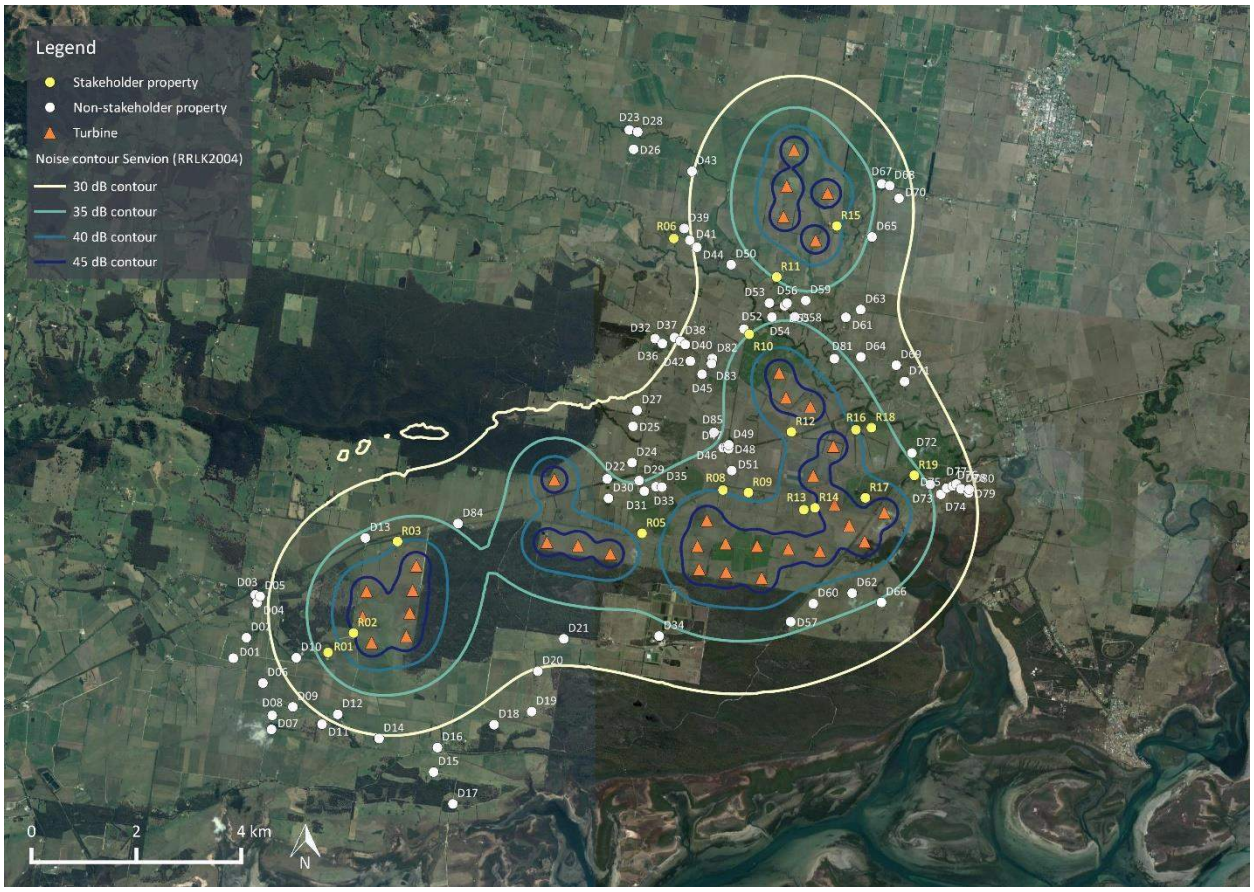
The key findings of these studies demonstrated the suitability of the ISO 9613-2:1996 method to predict the propagation of wind turbine noise for:

- the types of noise source heights associated with a modern wind farm, extending the scope of application of the method beyond the 30 m maximum source heights considered in the original ISO 9613
- the types of environments in which wind farms are typically developed, and the range of atmospheric conditions and wind speeds typically observed around wind farm sites. Importantly, this supports the extended scope of application to wind speeds in excess of 5 m/s.

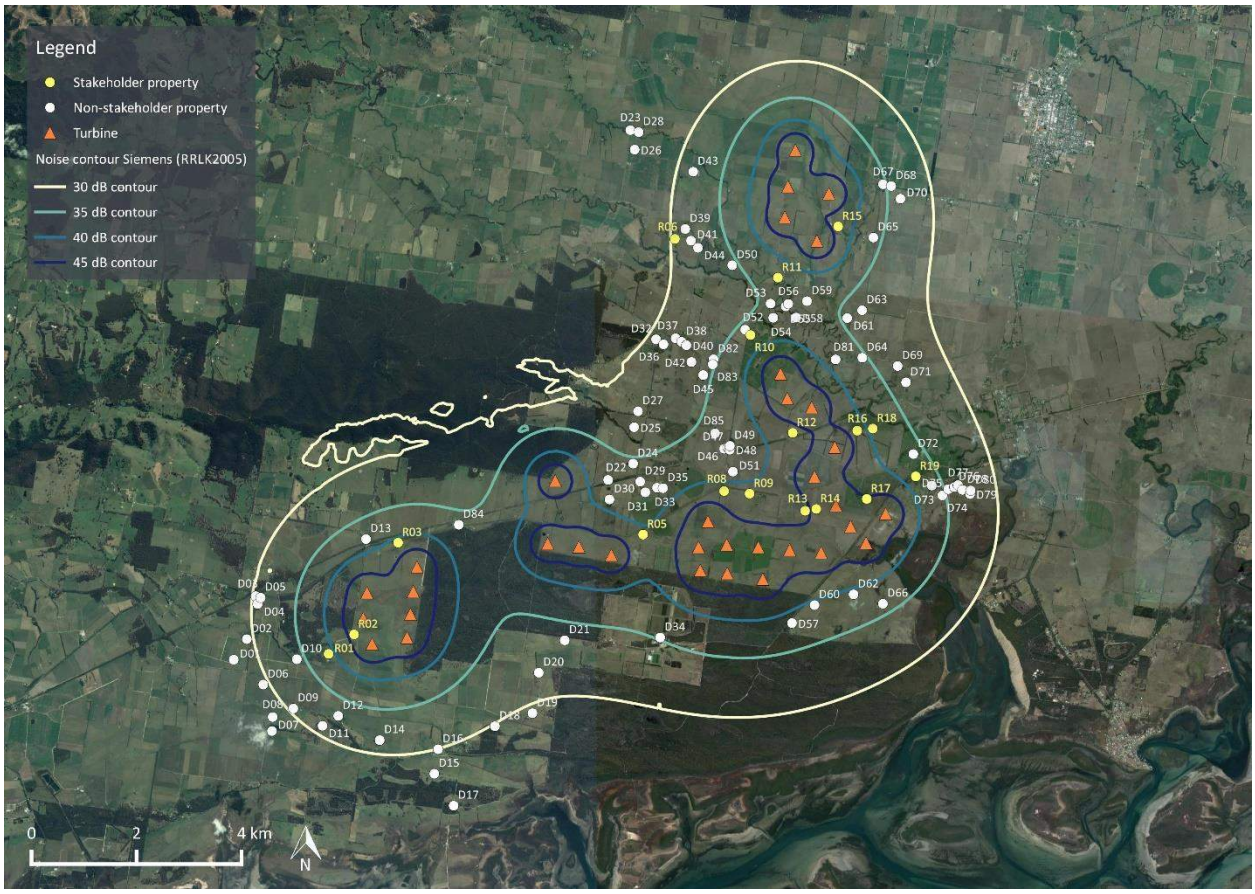
ISO 9613-2:1996 is primarily intended for the prediction of total A-weighted noise levels.

APPENDIX F NOISE CONTOUR MAPS

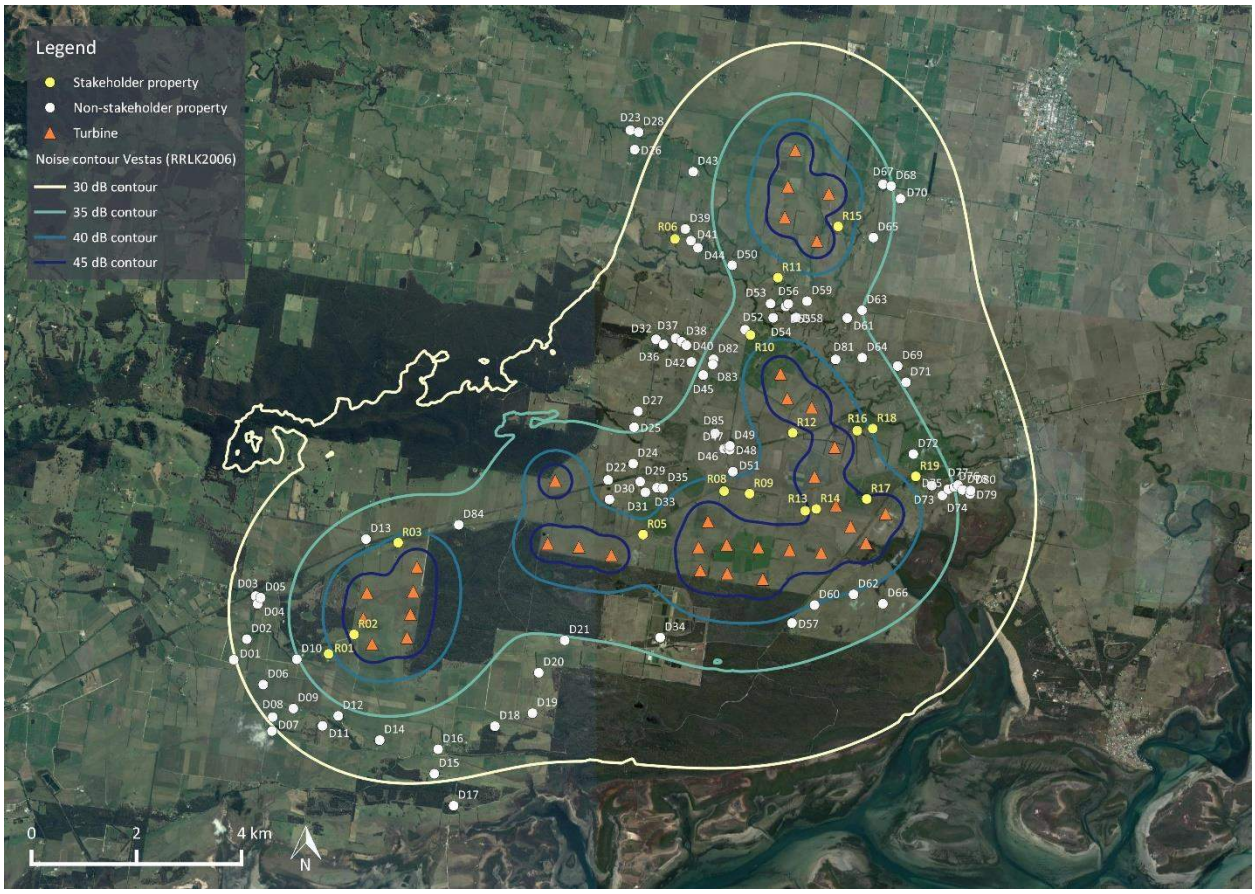
F1 Senvion 3.4M140



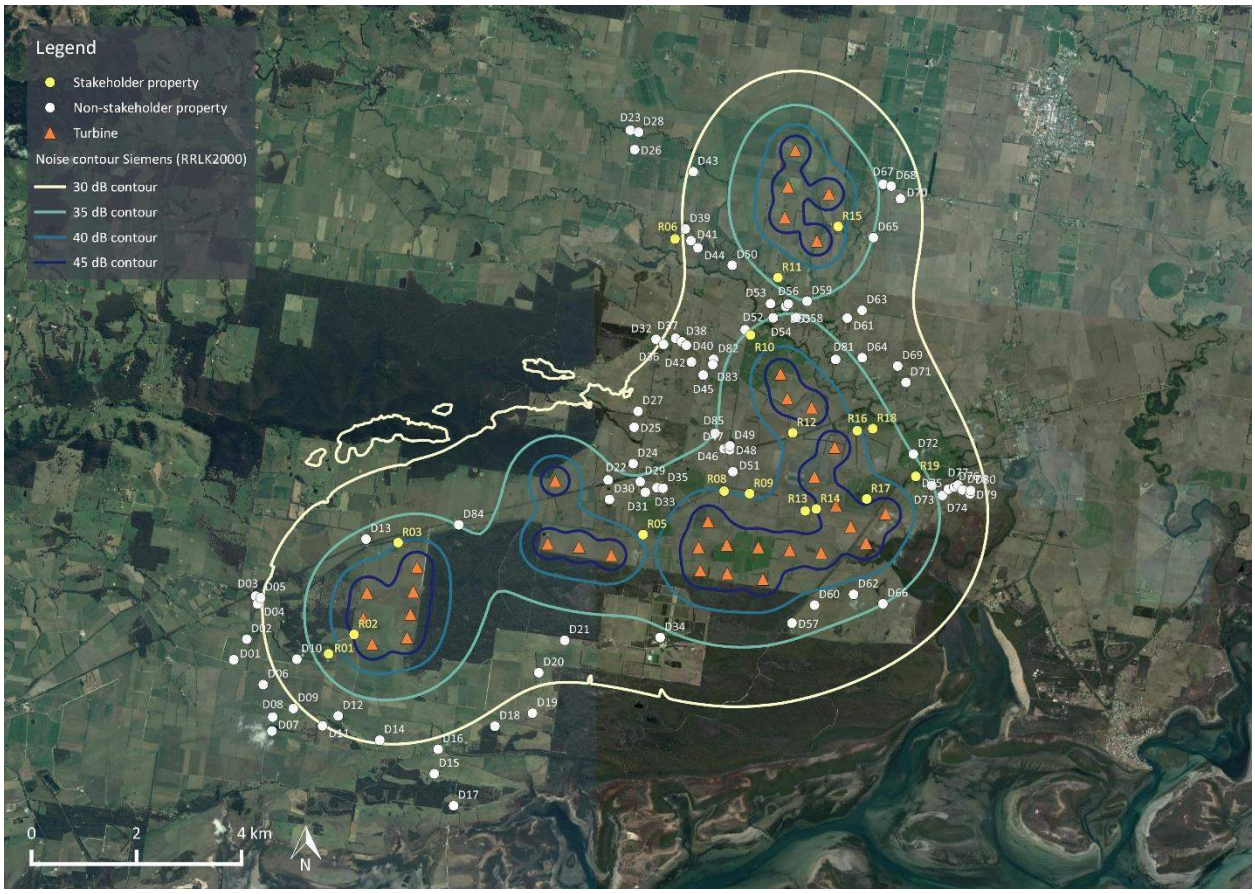
F2 Siemens SWT 3.3-130



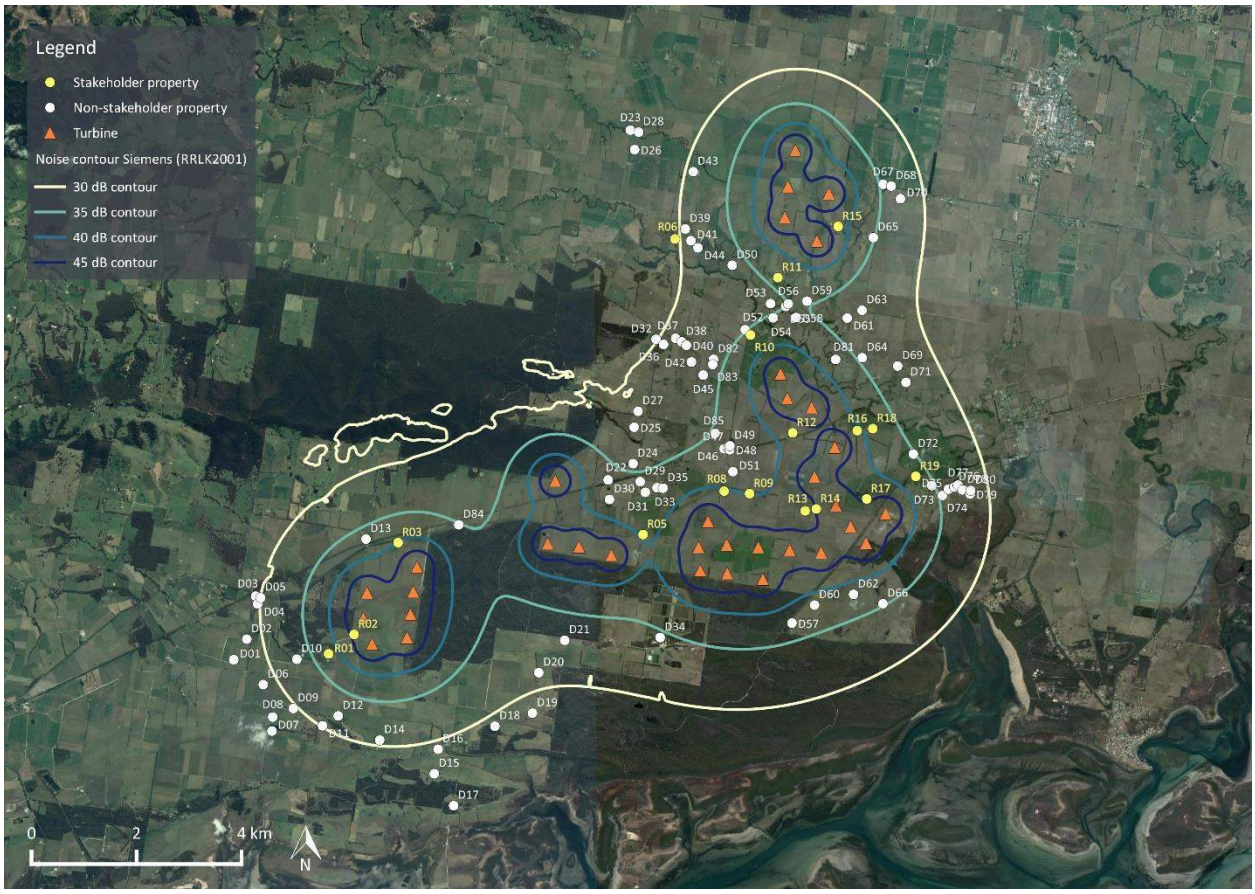
F3 Vestas V136-3.45



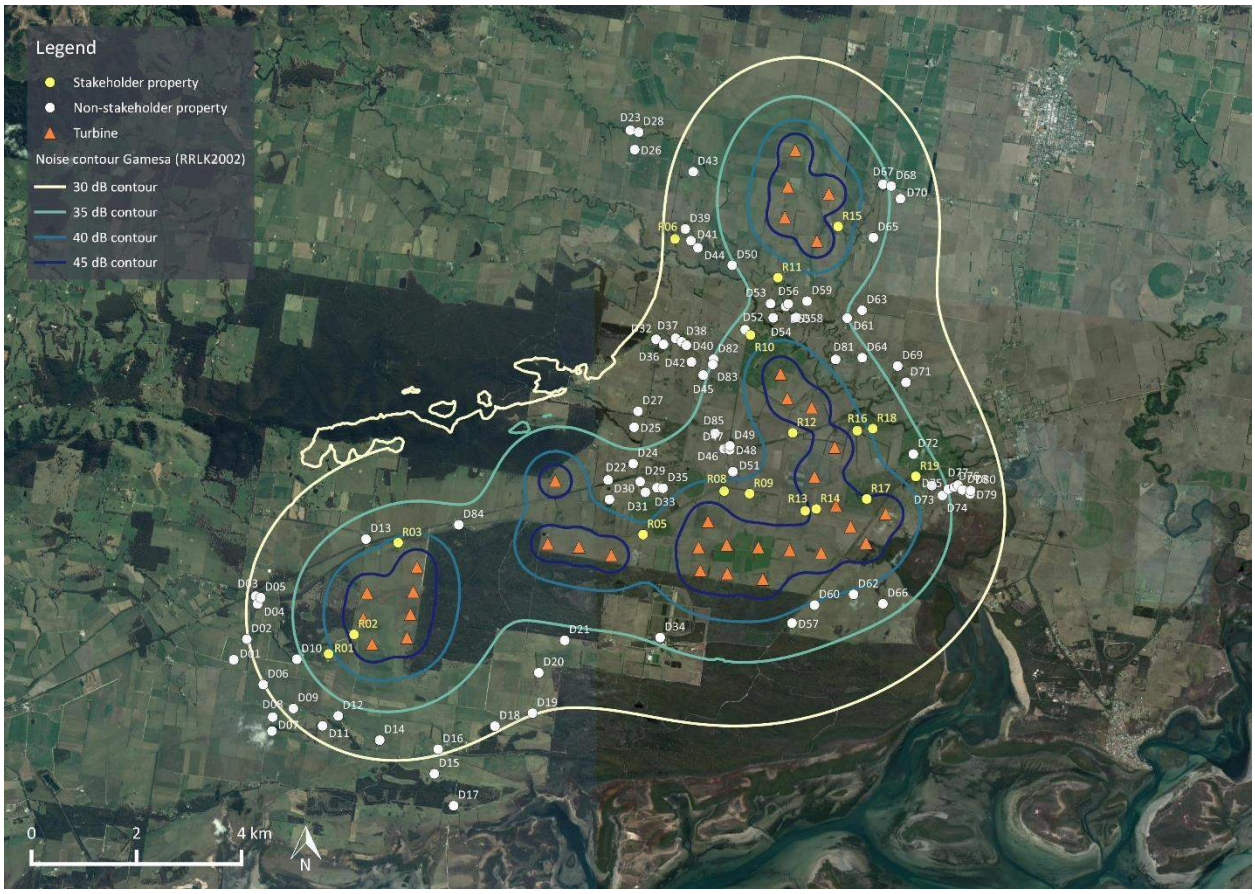
F4 Siemens SWT 3.15-142



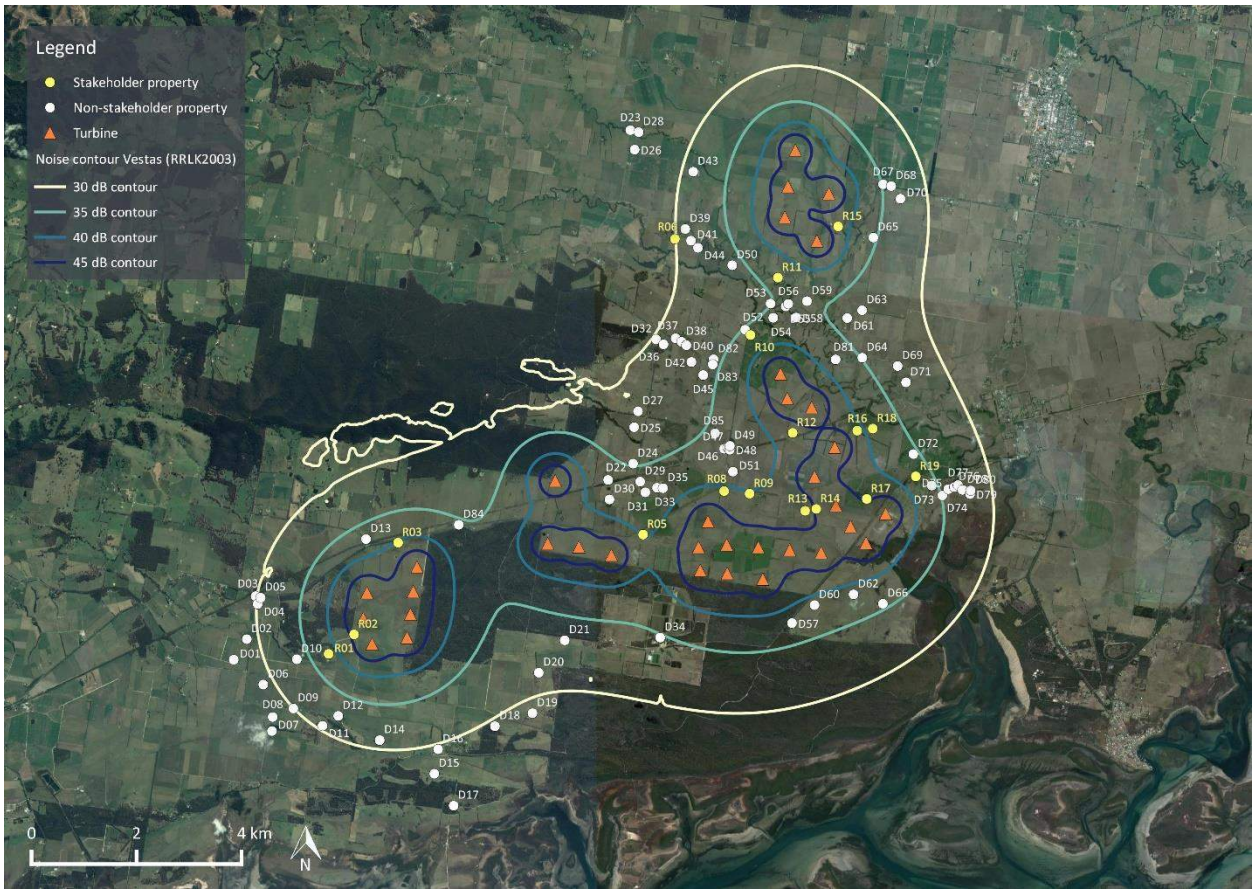
F5 Siemens SWT 3.6-130



F6 Gamesa G132-3.465



F7 Vestas V136-3.6



APPENDIX G DOCUMENTATION

(a) Map of the site showing topography, turbines and residential properties: See Appendix B and Appendix D

(b) Noise sensitive locations: See Section 5.0 and Appendix B

(c) Wind turbine sound power levels, L_{WA} dB (also refer to Section 2.2.2)

Sound power levels (Guaranteed levels + 1dB margin for uncertainty)

Turbine model	Hub height wind speed (m/s)											
	4	5	6	7	8	9	10	11	12	13	14	15
Senvion 3.4M140	96.0	98.2	100.8	103.7	105.0	105.0	104.9	104.7	104.5	104.3	104.2	-
Siemens SWT 3.3-130	92.1	95.3	98.3	101.9	105.2	106.6	107.0	107.0	107.0	107.0	107.0	107.0
Vestas V136-3.45	96.6	96.7	98.8	101.5	104.2	106.3	106.5	106.5	106.5	106.5	106.5	106.5
Siemens SWT-3.15-142	96.4	97.7	101.8	105.9	105.9	105.9	105.9	105.9	105.9	105.9	105.9	105.9
Siemens SWT-3.6-130	93.3	96.3	99.3	103.3	106.6	107.0	107.0	107.0	107.0	107.0	107.0	107.0
Gamesa G132-3.465	-	-	99.2	102.7	106	107.1	107.3	107.1	107.1	107.1	-	-
Vestas V136-3.6	93.5	95.5	98.4	101.5	104.4	106.4	106.5	106.5	106.5	106.5	106.5	106.5

Octave band spectrum adjusted, L_{WA}

Turbine model	Octave Band Centre Frequency (Hz)								
	63	125	250	500	1000	2000	4000	8000	Overall
Senvion 3.4M140*	86.3	93.2	97.4	99.5	99.8	95.9	90.3	81.1	105.0
Siemens SWT 3.3-130	87.6	95.3	97.3	101.4	102.6	98.2	93.4	83.9	107.0
Vestas V136-3.45	94.1	98.3	97.0	99.7	101.0	98.3	92.2	75.4	106.5
Siemens SWT-3.15-142	88.9	95.1	97.2	99.1	99.8	99.4	94.9	82.9	105.9
Siemens SWT-3.6-130	89.2	95.7	96.0	100.0	99.7	101.3	99.0	87.2	107.0
Gamesa G132-3.465	84.6	94.4	100.8	102.6	100.7	96.6	93.3	92.4	107.3
Vestas V136-3.6	89.0	94.4	98.4	100.0	100.9	100.0	92.2	72.6	106.5

* Based on octave band spectral information for the Senvion 3.0M122 turbine

(d) Wind turbine model: See Table 1 of Section 2.2.1

(e) Turbine hub height: See Table 1 of Section 2.2.1

(f) Distance of noise sensitive locations from the wind turbines: See Appendix Tables B2 and B3 of Appendix B

(g) Calculation procedure used: ISO 9613-2:1996 prediction algorithm as implemented in SoundPLAN v7.4 (See Section 7.0 and Appendix E)

(h) Meteorological conditions assumed:

Temperature: 10 °C

Relative humidity: 70 %

Atmospheric pressure: 101.325 kPa

(i) Air absorption parameters:

	Octave band mid frequency (Hz)							
Description	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Atmospheric attenuation (dB/km)	0.12	0.41	1.04	1.93	3.66	9.66	32.8	116.9

(j) Topography/screening: 10 m elevation contours provided by the Proponent

(k) Predicted far-field wind farm sound levels: See Table 5 and Table 6 of Section 7.0 and Appendix F.