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ASSESSMENT REPORT - **Project: 14215.04**

Suncor Adelaide Wind Power Project
Additional Acoustic Immission Audit- Phase 2

Township of Adelaide-Metcalfe, Country of Middlesex

Prepared for:

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1 Introduction

Aercoustics Engineering Limited has been retained by Suncor Energy Services Incorporated ("Suncor") to conduct an additional acoustic immission audit to support the completion of the requirements outlined in Section E of the Renewable Energy Approval ("REA") for the Suncor Adelaide Wind Power Project ("SAWPP"). SAWPP operates under REA #8279-9AUP2B [1], issued on December 11, 2013 and amended on August 5, 2014 [2].

As per Section E1(2) of the SAWPP REA, I-audits are to be conducted at three (3) Points of Reception for two (2) separate occasions. Acoustic immission audits have been previously conducted at receptors R331, R347 and R393 for SAWPP. The results of these measurements have been submitted to the Ontario Ministry of Environment, Conservation and Parks (MECP) in the following reports; completing the measurement requirements per Section E of the REA:

- Suncor Adelaide Wind Power Project – 1st Acoustic Immission Audit (Revision 3) dated October 10, 2017, and

- Suncor Adelaide Wind Power Project – 2nd Acoustic Immission Audit dated May 27, 2016.

In a letter dated October 16, 2018, the MECP confirmed that the measurements at two of the required three receptors (M331 and M393) have adequately fulfilled the requirements of condition "E" in the approval. However, the letter directed that one audit location (R347) required additional measurements to support the determination of compliance due to high ambient sound levels.

Per further discussion with the MECP, it was mutually agreed that an alternate Point of Reception would be chosen in place of R347. The Points of Reception chosen for the additional audits is R754.

The first acoustic immission audit has been previously conducted at receptor R754 for SAWPP. The results of this measurement has been submitted to the Ontario Ministry of Environment, Conservation and Parks (MECP) in the following report; completing the measurement requirements per Section E of the REA:

- Suncor Adelaide Wind Power Project – Additional Acoustic Immission Audit- Phase 1 dated July 29, 2019

For the second acoustic immission audit, monitoring equipment was erected near the receptor R754 and measurements were conducted nightly from September 2019 to December 2019.

The audit has been conducted as per the methodology outlined in Part D and E5.5 RAM-I (Revised Assessment Methodology) of the "MECP Compliance Protocol for Wind Turbine Noise" (Updated: April 21, 2017). This report outlines the measurement methodology, results, and a comparison of the turbine-only sound contribution to the MECP sound level limits of the I-audit measurements conducted in the Fall of 2019.

2 Facility Description

SAWPP is a class 4 wind facility consisting of eighteen (18) Siemens 2.3-113 wind turbines, each turbine with a nameplate capacity of 2.221 MW. The turbines have a hub height of 99.5 m with a rotor diameter of 113 m. The facility operates 24 hours per day, 7 days per week.

There are four adjacent wind facilities within 10 km of SAWPP: Bornish Wind Energy Centre approximately 6 km to the north, NextEra Adelaide Wind Energy Centre approximately 1 km to the South, Jericho Wind Energy Centre approximately 2.5 km to the West, and Napier Wind Farm approximately 6 km to the Southwest. These facilities are located at a distance greater than 5 km from the audit location and do not have a significant impact for the current measurement campaign.

For Total Noise measurement periods, the current audit considers the operations of any wind turbines within 3.0 km of the monitor location. For Background measurement periods, all relevant turbines in the vicinity of the monitor location were parked such that the cumulative predicted level was 30 dBA or less.

A Site Plan of the facility and the surrounding area are provided in Appendix A.

2.1 Measurement Locations

The following section describes the measurement location at receptor R754. Table 1 provides specific details of the receptor and monitoring equipment locations. Photos of the measurement setup and surrounding area are included in Appendix A.

2.1.1 Receptor R754

Monitoring equipment for receptor R754 was located roughly 30 m west of Hansford Road, approximately 600 m to the northeast of turbine WTG06. Highway 402 is located approximately 3 km away and was noted to be audible during periods of the audit. The ground cover between the measurement location and turbine WTG06 was predominantly open farmland with mix woodlots in the surrounding area.

Table 1: Receptor and Sound Monitor Locations

Receptor	Measurement Duration	Location	UTM Coordinates [m] (Zone 17T)	Distance to Nearest Turbine [m]	Predicted Level (dBA)
R754	*September 24, 2019 to December 16, 2019*	*Receptor*	452,347 E 4,763,086 N	602	37.5*
		Monitor	452,264 E 4,763,140 N	602	37.7*

* Based on CadnaA prediction model created by Aercoustics

3 Measurement Methodology

Measurements and data analyses were conducted per the Ministry of the Environment, Conservation and Parks ("MECP") Compliance Protocol for Wind Turbine Noise ("Protocol") of 2017. Specific details regarding the measurement methodology are presented in this section.

3.1 Test Equipment

Measurement equipment used for the I-audit campaign, both acoustic and non-acoustic, is detailed below. Equipment specifications and measurement positions comply with MECP Protocol Sections *D2 – Instrumentation* and *D3 – Measurement Procedure*, respectively. The remote monitoring unit is comprised of the following:

- One (1) Type 1 sound level meter, with microphone and pre-amplifier installed at a height of 4.5 meters, at least 5 meters from any large reflecting surfaces.
- One (1) primary and one (1) secondary windscreen for the microphone. The 1/3 octave band insertion loss of the secondary windscreen has been tested and was accounted for in the measurement analysis.
- One (1) anemometer, installed 10 metres above ground level ("10-m AGL").

Table 2 provides the specific make, model, and serial number of each piece of measurement equipment used during the I-audit campaign.

Table 2: Equipment Details

Location	Equipment	Make/Model	Serial Number
R754	Sound Level Meter	NI 9234	1ADD957
	Microphone/Pre-amp pair (Microphone)	PCB 378B02 (PCB 377B02)	132223 (175300)
	Pre-amplifier	PCB 426E01	051460
	Signal Conditioner	PCB 480E09	34591
	Weather Anemometer	Vaisala WXT520	K2420011

The measurement chain was calibrated during the measurement campaign using a Type 4231 Brüel & Kjær acoustic calibrator.

Calibration certificates have been included in Appendix B.

3.2 Measurement Parameters

During the measurement campaign, acoustic and weather data were logged simultaneously in one-minute intervals.

Measured acoustic data includes A-weighted overall equivalent sound levels ("LA_{eq}"), 90th percentile statistical levels ("L_{90}")[1], and 1/3rd octave band levels between 20 Hz and 10,000 Hz (inclusive). Raw signal recordings were also stored for listening and post-processing. Measured weather data includes average wind direction, wind speed, temperature, relative humidity, and atmospheric pressure. The maximum and minimum wind speed for each one-minute interval was also stored.

To account for the effect of wind speed on the measured sound level, intervals are sorted into integer wind bins based on their measured 10-m AGL wind speeds. Each wind bin ranges from 0.5 m/s below to 0.5 m/s above each integer wind speed (i.e. the 5 m/s wind bin comprises all intervals having average wind speeds between 4.5 m/s and 5.5 m/s).

3.3 Data Reduction and Filtering

Data reduction procedures have been employed according to the Protocol to remove invalid and extraneous data points from the assessment datasets. Specific filters are summarized below.

3.3.1 General Filters

General filters are applied to all measurement intervals and are designed to maximize data quality by minimizing ambient contamination and removing periods when the environmental conditions are outside of the specification of the acoustic equipment.

A measurement interval is excluded if any of the following criteria are <u>not</u> satisfied:

- The interval occurred between 10pm – 5am
- No precipitation was detected within 60 minutes before or after the interval
- The ambient temperature was above -20˚C

The following filters are also applied to all intervals:

[1] L_{90} refers to the sound level that is exceeded for 90% of samples in the measurement interval.

Flora and Fauna

Ambient contamination from flora and fauna was present to varying degrees at the measurement location. Transient contamination (dogs barking etc.) are removed by listening tests. Intervals dominated by insect noise have been removed from the analysis by listening tests.

Wind Facility Operation

Intervals that pass the filtering criteria listed above are sorted into Total Noise or Background periods according to the conditions listed below. If neither Total Noise or Background conditions are met, the data point is excluded from further analysis.

- Total Noise: All facility turbines within 3 km must be rotating and generating power
- Background: All facility turbines with predicted impact of greater than 30 dBA must be parked and not generating power

Note that the study area only includes wind turbines from SAWPP. No wind turbines from another wind facility are located within 3.0 km of the monitoring location.

Table 3 identifies the wind turbines that are considered during Total Noise and Background measurements periods.

Table 3: Turbines considered for Total Noise and Background Periods

Measurement Period	SAWPP Turbines Considered
Total Noise	WTG05, WTG06, WTG07, WTG08, WTG09
Background	WTG06, WTG08

Wind facility SCADA information was provided for the duration of the measurement campaign by SAWPP. This data was used to verify that the SAWPP wind turbines were operational for Total Noise periods and parked for Background periods. The turbine operating conditions were verified by SAWPP for the duration of the campaign, see Appendix C.

Once an interval is sorted based on facility operation, additional filters are applied as described in Sections 3.3.2 for Total Noise Intervals.

3.3.2 Total Noise Filters

Total Noise filters are applied per Protocol guidance and designed such that the noise output from the wind facility is maximized. Filtering is based on the power output and wind direction measured from the nearest turbine. Specifically,

> "*Only downwind data will be considered in the analysis. With reference to the Turbine location, downwind directions are ±45 degrees from the line of sight between the Turbine and receptor/measurement location.*" *{Section D5.2(4)}*

And

> *"Only data when the turbine's electrical output sound power level is approximately equal to or greater than 85% of its rated electrical power output should be included in the analysis. {Section D5.2(5)}*

3.3.3 Background Noise Filters

The conditions present during the Total Noise and Background periods must be from similar weather and wind shear conditions, per Protocol section D3.8.2:

> *D3.8.2 Overall equivalent sound level – wind turbines parked*
>
> *"Ambient noise measurements should be performed with the turbines parked and conducted within the same general measurement period and with the same weather and wind shear conditions. Measurements of ambient noise obtained during other periods are not recommended and should only be used with great caution to ensure that they represent the "current" ambient noise."*

Background measurements were collected periodically throughout the measurement campaign, which ensures the Background and Total Noise measurements are collected during the same season(s). Further, the Background periods were filtered to only include intervals having the downwind condition as those during the Total Noise periods, and therefore have similar ambient conditions.

3.4 Revised Assessment Methodology – "RAM-I"

RAM-I analysis, described in Section E5.5 of the Protocol, is employed in cases where insufficient data is collected after an extended monitoring campaign lasting 6-weeks or more. The SAWPP monitoring campaign lasted for almost 14-weeks and therefore RAM-I analysis is employed for all receptors. RAM-I methodologies used in this assessment, in addition to those already mentioned in Section 3.3, are detailed below.

3.4.1 Allowable Wind Speed Range

Per Protocol Section E5.5(1), the range of wind bins which may be used to assess compliance is expanded to include a minimum of one of the following conditions:

a. *"three (3) of the wind speed bins between 1 and 7 m/s (inclusive), or*
b. *two (2) of the wind speed bins between 1 and 4 m/s (inclusive)"*

3.4.2 Minimum Sample Size

Per Protocol Section E5.5(5), the sample size requirements are relaxed:

> "*The Ministry may accept a reduced number of data points for each wind speed bin with appropriate justification. […] The acceptable number of data points will be influenced by the quality of the data (standard deviation)"*

The threshold of 60 data points for Total Noise measurements and 30 data points for Background measurements is used in this assessment.

3.5 Sample Size Requirements

Section D3.8 of the Protocol requires at least 120 Total Noise intervals and 60 Background intervals in a wind bin for that bin to be deemed complete. However, as noted in Section 3.4.2, a reduced threshold for completeness has been applied to this dataset based on the allowances for RAM-I analysis given in Protocol Section E5.5.

The RAM-I sample size requirement of 60 data points for Turbine ON and 30 data points for the ambient measurements for 3 wind speed bins between 1 and 7 m/s has been satisfied for receptor R754.

3.6 Contribution from Adjacent Wind Facilities

The operations of any wind turbines within in a 3 km of the monitoring location are considered this assessment. All neighbouring wind facilities are located further than 3 km from the monitoring location.

There are four wind facilities within a 10 km distance from the SAWPP: NextEra Adelaide Wind Energy Centre to the southwest, Bornish Wind Energy Centre to the North, Napier Wind Farm to the west and Jericho Wind Energy Centre to the northwest. Distances to the nearest turbines of each adjacent wind facility from the monitoring location are shown in Table 4.

Table 4: Approximate Distances to Nearest Turbines from Adjacent Wind Facilities

Nearby Wind Facilities	Approximate Distance of Closest Turbine to the Monitoring Location
NextEra Adelaide	6 km (NextEra Adelaide T11)
Bornish	10 km (Bornish T45)
Napier	13 km (Napier WTG2)
Jericho	19 km (Jericho WTG103)

The closest turbine from an adjacent facility is greater than 5 km and no appreciable noise impact is expected at the monitoring location.

4 Sound Level Limits

Sound level limits are set by the MECP and vary based on the classification of the surrounding acoustic environment as well as the measured background sound level (if available). The area surrounding the facility has been deemed Class III, having exclusion limits based on 10-m AGL wind speed as noted in Table 5.

Table 5: MECP Exclusion Limits

Wind speed at 10 m AGL [m/s]	MECP Sound level limit [dBA]
≤ 6	40
7	43

Per Sections D3.5 and D6 of the Protocol, wind bins where the measured background sound levels are greater than the applicable exclusion limits have a sound level limit equal to the background sound level without extraneous noise sources. In effect, the exclusion limits outline the minimum sound level limit by wind bin, with increases in sound level limit permissible if it can be shown through measurements that the existing background sound level is higher than the exclusion limit.

5 Audit Results

Acoustic and weather data measured during the I-audit campaign are summarized in the following section.

5.1 Weather Conditions

General weather conditions measured over the course of the measurement are summarized in Table 6. These values represent the range of weather conditions present in the data used for assessment.

Table 6: General Weather Conditions – Range of Measured Values (Assessment Dataset)

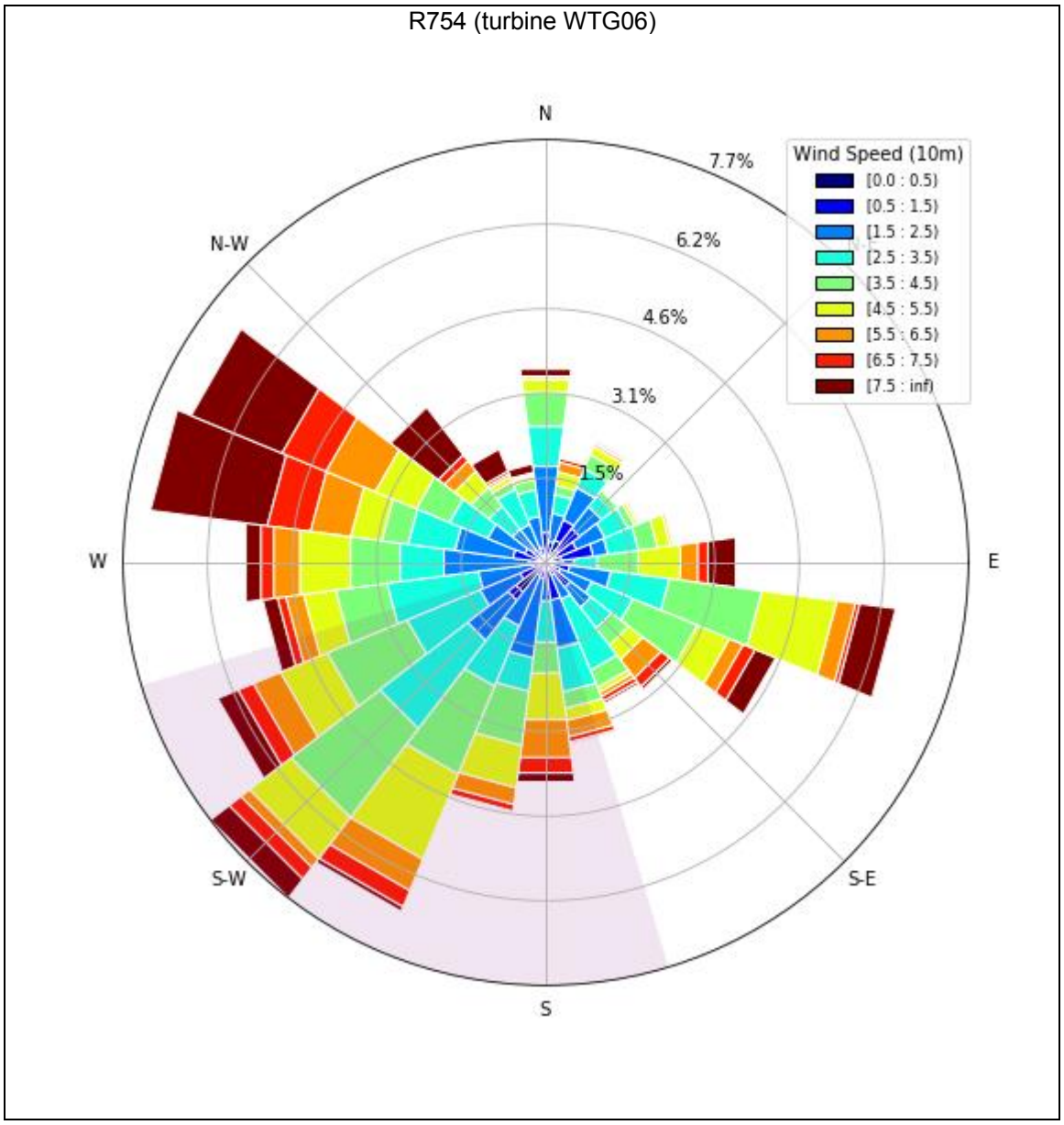
		10 m AGL				*Hub height*
		Atmospheric Pressure [hPa]	Wind Speed [m/s]	Relative Humidity [%]	Temperature [°C]	Wind speed [m/s]
R754	Minimum	965.9	0.1	38.7	-12.5	0.3
	Maximum	1003.5	17.8	89.3	20.7	18.8

5.2 Wind Direction

A Wind rose was created for monitor R754 using the yaw angle from the nearest wind turbine and the wind speeds from the 10m-AGL anemometer. As noted in Section 0 of this report, RAM-I methodology is being used, and thus all wind speeds from 1-7 m/s 10-m AGL can be used in the assessment.

Wind roses for receptor R754 are provided in Figure 1.

Figure 1: Measured wind rose of All (unfiltered) collected data for I-audit campaign. Turbine from which the yaw angle information was taken is indicated in brackets. Downwind angle to closest turbine is denoted by the shaded region



5.3 Sound Levels

Table 7 presents the average measured sound levels at the monitoring location. Results are separated by wind bin into Total Noise and Background periods.

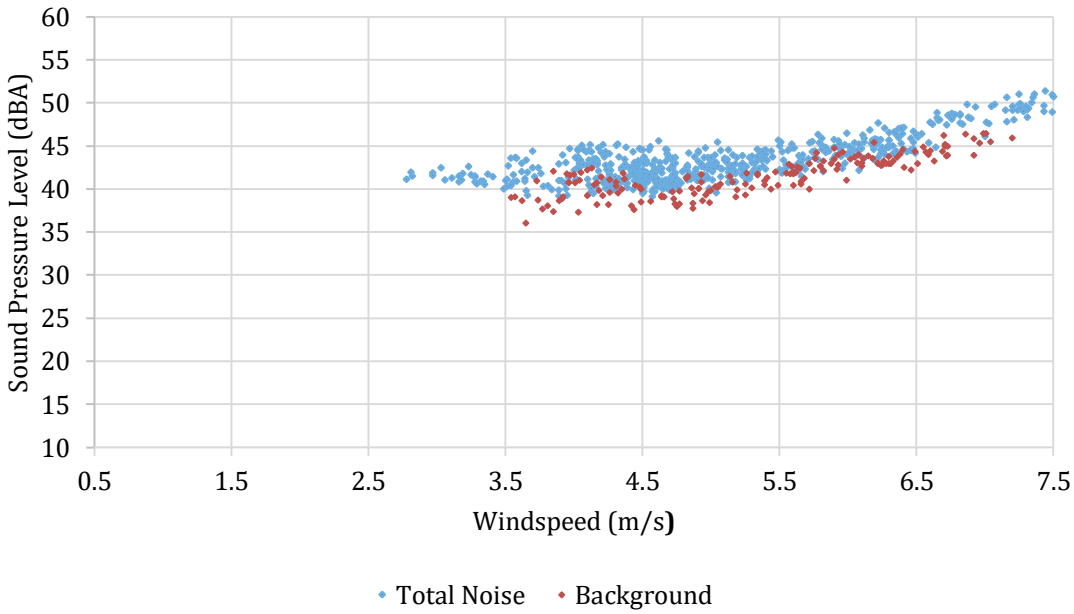
Table 7: Average Measured Sound Levels at Points of Reception, RAM-I Analysis

Receptor	Period	Measurement Parameter	I audit Wind Bins (m/s) 1	2	3	4	5	6	7
R754	*Total Noise*	Number of Samples	0	0	24	157	208	129	55
		Average LAeq [dBA]	-	-	-	42.4	42.4	44.7	-
		Standard Deviation	-	-	0.6	1.6	1.4	1.3	1.4
	Background	Number of Samples	0	0	0	46	44	57	21
		Average LAeq [dBA]	-	-	-	40.1	40.1	43.0	-
		Standard Deviation	-	-	-	1.5	1.2	1.1	1.1

- *indicates insufficient data counts were collected for the wind speed bin*

Visualizations of the assessment datasets for all receptors are presented in Figure 2.

Figure 2: Measurement Dataset – R754



6 Discussion

Additional discussion of the measured sound levels and analysis methodology are provided in this section.

6.1 Effect of Filtering

The measurement data was assessed according to Part D of the Protocol with the incorporation of the RAM-I data reduction methodology per Section E5.5 of the Protocol. The effect of each filter on the measurement datasets, as well as the total portion of measurement data excluded for each period, are summarized in Table 8.

Table 8: Effect of Data Filtering on Measurement Dataset

Data Filter	*% Data Excluded* R754
Turbine Power below threshold	89%
Wind Direction not downwind	66%
Rain	10%
Gusting	0%
Low Temperature	0%
Transient Contamination	0%
Excluded from Total Noise	98%

Table 8 illustrates the proportion of measurement time that during the campaign did not meet the criteria for worst-case noise impact at the receptor. Data not excluded by filters are used in the assessment of compliance.

It is important to note that the data that remains after filtering represents the conditions when the turbines were generating high power output in a downwind condition without transient contamination or inclement environmental conditions (such as precipitation or low temperature). In other words, this remaining data represents the portion of time during the monitor's I-audit campaign during which the immission impact from the facility was at its highest.

7 Assessment of Compliance

7.1 Tonality Assessment

The Compliance Protocol sates that tonality analysis may be triggered if there is observed continuous tonal characteristic sound from the turbine (or wind facility) or if the turbine manufacturer's noise test report shows tonal audibility to be a positive value greater than 3 dB.

The emission test results for SAWPP turbines WTG05 [3] and WTG26 [4] were used as a basis for tones at the audit location, which were likely to have been generated by the closest turbine rather than by an external source. No tones were reportable according to IEC 61400-11 Edition 3.0 noise emission measurements carried out on turbines WTG05 and WTG26.

Despite the results of the E-audit results, the MECP has requested that tonal analysis be conducted for the Phase 2 audit at receptor R754.

The tonal assessment has been completed using IEC 61400-11 Ed 3.0 with modifications to adapt to immission measurements and the tonal penalty structure taken from ISO 1996-2:2007 Annex C. This standard requires that the tonal penalty would be a positive number between 0 dB and 6 dB based on the degree of tonal audibility of the worst-case tone. A tonal penalty is calculated as Lta – 4 dB i.e. a tonal audibility of 6.5 dB would incur a penalty of 2.5 dBA on the overall Turbine ONLY level.

Tonality analysis was completed based on 1-minute narrow band spectra, ranging from 20 Hz to 3000 Hz with a frequency resolution of 2 Hz. Narrowband data was calculated for each 1-minute interval used in the immission analysis and binned by 10m AGL wind speed. The mean tonal audibility of spectra in each wind bin was then evaluated.

Similar to the methodology in IEC 61400-11, a tone would have to be present in at least 20% of the sample to be deemed as relevant. This reduces the possibility of intermittent tones related to either the unsteady operation of the turbines, or from other contaminating sources, being attributed to the steady state operation of the turbines. The tonal audibility for the most prominent tones in each wind bin were then evaluated to determine if a tonal penalty would be applicable.

Tonal assessment summary table is provided in Table 9 and Table 10.

Table 9: Tonality Summary – R754 – 58Hz

Wind Speed (m/s)	Turbine ON Data points	# of Data Points with Tone detected	Tonal Presence	Mean Audibility, ΔL (dB)	Tonal Adjustment, K_T (dB)*
1	0	0	-	-	-
2	0	0	-	-	-
3	24	0	0%	-	-
4	157	4	3%	-3.3	0
5	208	0	0%	-	-
6	129	0	0%	-	-
7	55	0	0%	-	-

*tonal adjustment K_T based on ISO 1996-2:2007 Annex C

Table 10: Tonality Summary – R754 – 530Hz

Wind Speed (m/s)	Turbine ON Data points	# of Data Points with Tone detected	Tonal Presence	Mean Audibility, ΔL (dB)	Tonal Adjustment, K_T (dB)*
1	0	0	-	-	-
2	0	0	-	-	-
3	24	1	4%	-6.7	0
4	157	8	5%	-2.1	0
5	208	23	11%	-6.4	0
6	129	3	2%	-5.0	0
7	55	0	0%	-	-

*tonal adjustment K_T based on ISO 1996-2:2007 Annex C

7.2 Assessment Tables

Cumulative turbine-only sound levels at receptor R754 is presented in the table below. The cumulative noise impact is calculated using the data presented in Table 7 and adding any relevant adjustments discussed in Section 6. Wind bins having insufficient data with which to determine the cumulative sound impact are marked with a "-". The signal-to-noise for each complete wind bin is also presented. This is the difference between the average Total Noise and Background sound levels from Table 7, unless otherwise noted.

Table 11: R754 Assessment Table – Cumulative Turbine-only Sound Impact

Audited Receptor	Wind speed at 10m height [m/s]	1	2	3	4	5	6	7
R754	Cumulative Sound Impact - Receptor Location	-	-	-	38	39	40	-
	Signal-to-noise	-	-	-	*2.3*	*2.3*	*1.7*	-
MECP Exclusion Limit		40	40	40	40	40	40	43
Measured Background		-	-	-	40.1	40.1	43.0	-
Predicted Sound Level (Monitor Location)		37.7						
Compliance? (Y/N)		-	-	-	Yes	Yes	Yes	-

Note: Cumulative Sound Impacts presented in Table 11 is calculated at the *monitor location*. Predicted sound impacts at the monitoring location are presented in the assessment tables and in Table 1.

7.3 Assessment of Compliance

Based on the results presented in Section 7.2, the cumulative sound impact complies with the MECP sound level limits at all wind bins having sufficient data for assessment.

8 Conclusion

Aercoustics Engineering Limited has conducted the second Immission audit outlined in Condition E the Renewable Energy Approval #8279-9AUO2B for the Suncor Adelaide Wind Power Project ("SAWPP"). Testing was conducted in accordance with the methodology outlined in Part D and Part E of the MECP Compliance Protocol for Wind Turbine Noise. The sound levels at the surrounding receptors to the Suncor Adelaide Wind Power Project facility are deemed to be in compliance with the applicable sound level limits.

9 REFERENCES

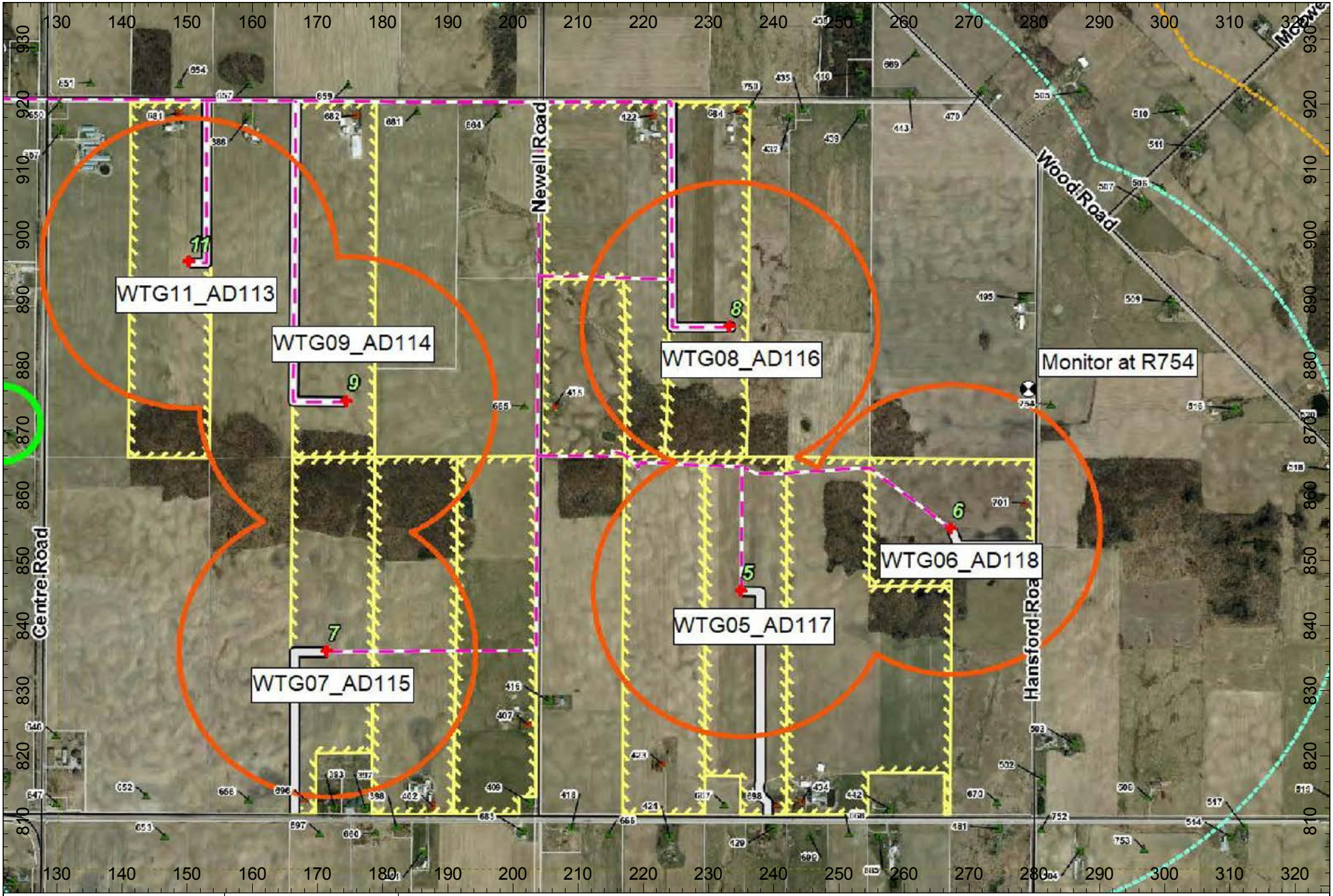
[1] Ministry of Environment Conservation and Parks, “Renewable Energy Approval #8279-9AUP2B,” Government of Ontario, Toronto, 2013.

[2] Ministry of the Environment Conservation and Pakrs, “Amendment to Renewable Energy Approval #8279-9AUP2B,” Government of Ontario, Toronto, 2014.

[3] A. Munro and P. Ashtiani, “Adelaide Wind Power Project- Tubrine T05 (AD117) IEC 61400-11 Edition 3.0 Measurement Report, ID: 14215.01.T05.RP6,” Aercoustics Engineering Limited, Missisauga, 2018.

[4] A. Munro and P. Ashtiani, “Adelaide Wind Power Project - Turbine T026 (AD102) IEC 61400-11 Edition 3.0 Measurement Report, ID: 14215.01.T26.RP6,” Aercoustics Engineering Limited, Missisauga, 2018.

APPENDIX A – LOCATION DETAILS



aercoustics	Project ID: 14215.04 Scale: As Shown Drawn by: DEA Reviewed by: AM Date: Dec 2019 Revision: 1	**Project Name** Suncor Adelaide Wind Power Project Additional Acoustic Immission Audit - Phase 2 **Figure Title** Site Plan
		Figure A.01

aercoustics	Project ID: 14215.04 Scale: NA Drawn by: DEA Reviewed by: AM Date: Dec 2019 Revision: 1	**Project Name** Suncor Adelaide Wind Power Project Additional Acoustic Immission Audit - Phase 2
		Figure Title Monitoring Location- R754
		Figure A.02

APPENDIX B – CALIBRATION CERTIFICATES

Compliant Calibration Certificate

Template Revision: Feb2018

Certificate Number:	6084260.1	**OE Number:**	21713479
Date Printed:	09-JUL-2019	**Page:**	1 of 14
Customer:	Aercoustics Engineering LTD (CA) 1004 Middlegate Road Suite 1100 ONTARIO MISSISSAUGA, L4Y 0G1 CANADA		
Manufacturer:	National Instruments	**Model:**	NI 9234
Serial Number:	1ADD957		
Part Number:	195551B-01L	**Description:**	MODULE ASSY,NI 9234, 4 AI CONFIGURABLE
Calibration Date:	09-JUL-2019	**Recommended Calibration Due:**	09-JUL-2020
Procedure Name:	NI 9234	**Verification Results:**	As Found: Passed As Left: Passed
Procedure Version:	3.6.1.0	**Calibration Executive Version:**	4.6.2.0
Lab Technician:	Carlos Perez	**Driver Info:**	NI-DAQmx:17.6.0
Temperature:	23.0° C	**Humidity:**	44.8% RH

NATIONAL INSTRUMENTS
CALIBRATED
SN/ID 1ADD957
DATE 09-JUL-2019
DUE 09-JUL-2020
ni.com/calibration

The data found in this certificate must be interpreted as:

As Found The calibration data of the unit as received by National Instruments.

As Left The calibration data of the unit when returned from National Instruments.

The As Found and As Left readings are identical for units not adjusted or repaired.

This calibration conforms to ANSI/NCSL Z540.1-1994 (R2002) requirements.

The TUR (Test Uncertainty Ratio) of this calibration is maintained at a ratio of 4:1 or greater, unless otherwise indicated in the measurements. A TUR determination is not possible for singled sided specification limits and therefore the absence of a value should not be interpreted as a TUR of 4:1 or greater, but rather undetermined. When provided, the expanded measurement uncertainty is calculated according to the Guide to the Expression of Uncertainty in Measurement (GUM) for a confidence level of approximately 95%. The uncertainty is calculated at time of calibration and does not include the object long-term stability and different environmental and operational conditions.

Results are reviewed to establish where any measurement results exceeded the manufacturer's specifications. Measured values greater than the Manufacturer's specification limits are marked as 'Failed', measured values within the Manufacturer's specifications are marked as 'Passed'.

This certificate applies exclusively to the item identified above and shall not be reproduced except in full, without National Instruments written authorization. Calibration certificates without signatures are not valid.

The Calibration Certificate can be viewed or downloaded online at www.ni.com/calibration/. To request a hard copy, contact **NI Customer Service at Tel:(800) 531-5066 or E-mail customer.service@NI.com**

Ted Talley
Technical Manager

National Instruments Calibration Services Austin
Building A
11500 N MoPac Expwy
AUSTIN, TX 78759-3504
USA
Tel: (800) 531-5066

NATIONAL INSTRUMENTS

Calibration Notes

Type	Note
Asset	Verification and adjustment were performed.

Standards Used

Manufacturer	Model	Type	Tracking Number	Calibration Due	Notes
Fluke	5720A	Calibrator	8253	18-JUL-2019	
National Instruments	PXI-4461	Function generator	9520	20-AUG-2019	
National Instruments	PXI-4071	Digital multimeter	1901	12-SEP-2019	
National Instruments	PXI-4132	SMU	9845	21-JUN-2020	

The standards used in this calibration are traceable to NIST and/or other National Measurement Institutes (NMI's) that are signatories of the International Committee of Weights and Measures (CIPM) mutual recognition agreement (MRA).

Calibration Results

As Found

Verify Accuracy

Lower Range	Upper Range	Channel	Test Value	Low Limit	Reading	High Limit	Status	Notes
-5 V	5 V	0	4.00000 V	3.99520 V	3.99996 V	4.00480 V	Passed	
-5 V	5 V	0	0.00000 V	-0.00120 V	-0.00001 V	0.00120 V	Passed	
-5 V	5 V	0	-4.00000 V	-4.00480 V	-3.99995 V	-3.99520 V	Passed	
-5 V	5 V	1	4.00000 V	3.99520 V	4.00004 V	4.00480 V	Passed	
-5 V	5 V	1	0.00000 V	-0.00120 V	0.00004 V	0.00120 V	Passed	
-5 V	5 V	1	-4.00000 V	-4.00480 V	-3.99989 V	-3.99520 V	Passed	
-5 V	5 V	2	4.00000 V	3.99520 V	3.99993 V	4.00480 V	Passed	
-5 V	5 V	2	0.00000 V	-0.00120 V	0.00001 V	0.00120 V	Passed	
-5 V	5 V	2	-4.00000 V	-4.00480 V	-3.99989 V	-3.99520 V	Passed	
-5 V	5 V	3	4.00000 V	3.99520 V	3.99993 V	4.00480 V	Passed	
-5 V	5 V	3	0.00000 V	-0.00120 V	-0.00003 V	0.00120 V	Passed	
-5 V	5 V	3	-4.00000 V	-4.00480 V	-3.99997 V	-3.99520 V	Passed	

National Instruments Calibration Services Austin
Building A
11500 N MoPac Expwy
AUSTIN, TX 78759-3504
USA
Tel: (800) 531-5066

NATIONAL INSTRUMENTS

As Found

Verify Gain Matching

Max Gain Difference for Channel	Rate	Samples per Channel	Test Value	Low Limit	Reading	High Limit	Status	Notes
0	10240	10240	4 V	-0.040 dB	0.000 dB	0.040 dB	Passed	
1	10240	10240	4 V	-0.040 dB	0.000 dB	0.040 dB	Passed	
2	10240	10240	4 V	-0.040 dB	-0.000 dB	0.040 dB	Passed	
3	10240	10240	4 V	-0.040 dB	0.000 dB	0.040 dB	Passed	

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As Found

Verify Phase Matching

Max Phase Difference for Channel	Rate	Samples per Channel	Test Value	Low Limit	Reading	High Limit	Status	Notes
0	51200	16384	1000 Hz	-0.085 Degrees	-0.006 Degrees	0.085 Degrees	Passed	
1	51200	16384	1000 Hz	-0.085 Degrees	0.007 Degrees	0.085 Degrees	Passed	
2	51200	16384	1000 Hz	-0.085 Degrees	-0.007 Degrees	0.085 Degrees	Passed	
3	51200	16384	1000 Hz	-0.085 Degrees	0.006 Degrees	0.085 Degrees	Passed	
0	51200	16384	10000 Hz	-0.490 Degrees	-0.065 Degrees	0.490 Degrees	Passed	
1	51200	16384	10000 Hz	-0.490 Degrees	0.065 Degrees	0.490 Degrees	Passed	
2	51200	16384	10000 Hz	-0.490 Degrees	-0.065 Degrees	0.490 Degrees	Passed	
3	51200	16384	10000 Hz	-0.490 Degrees	0.048 Degrees	0.490 Degrees	Passed	

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Verify Common Mode Rejection Ratio

Channel	Rate	Samples per Channel	Test Value	Low Limit	Reading	High Limit	Status	Notes
0	51200	16384	1000 Hz	40.000 dB	51.243 dB	100.000 dB	Passed	
1	51200	16384	1000 Hz	40.000 dB	50.226 dB	100.000 dB	Passed	
2	51200	16384	1000 Hz	40.000 dB	51.495 dB	100.000 dB	Passed	
3	51200	16384	1000 Hz	40.000 dB	50.604 dB	100.000 dB	Passed	

As Found

Verify IEPE Current

Channel	Rate	DMM Range	Test Value	Low Limit	Reading	High Limit	Status	Notes
0	51200	0.01 A	2.000 mA	2.000 mA	2.093 mA	2.200 mA	Passed	
1	51200	0.01 A	2.000 mA	2.000 mA	2.069 mA	2.200 mA	Passed	
2	51200	0.01 A	2.000 mA	2.000 mA	2.072 mA	2.200 mA	Passed	
3	51200	0.01 A	2.000 mA	2.000 mA	2.068 mA	2.200 mA	Passed	

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As Found

Verify IEPE Compliance Voltage

Channel	Rate	SMU Voltage Limit	Test Value	Low Limit	Reading	High Limit	Status	Notes
0	51200	24 V	2 mA	19.000 V	20.838 V	24.000 V	Passed	
1	51200	24 V	2 mA	19.000 V	20.841 V	24.000 V	Passed	
2	51200	24 V	2 mA	19.000 V	20.840 V	24.000 V	Passed	
3	51200	24 V	2 mA	19.000 V	20.842 V	24.000 V	Passed	

As Left

Verify Accuracy

Lower Range	Upper Range	Channel	Test Value	Low Limit	Reading	High Limit	Status	Notes
-5 V	5 V	0	4.00000 V	3.99520 V	4.00002 V	4.00480 V	Passed	
-5 V	5 V	0	0.00000 V	-0.00120 V	0.00001 V	0.00120 V	Passed	
-5 V	5 V	0	-4.00000 V	-4.00480 V	-3.99997 V	-3.99520 V	Passed	
-5 V	5 V	1	4.00000 V	3.99520 V	4.00006 V	4.00480 V	Passed	
-5 V	5 V	1	0.00000 V	-0.00120 V	0.00000 V	0.00120 V	Passed	
-5 V	5 V	1	-4.00000 V	-4.00480 V	-3.99998 V	-3.99520 V	Passed	
-5 V	5 V	2	4.00000 V	3.99520 V	4.00004 V	4.00480 V	Passed	
-5 V	5 V	2	0.00000 V	-0.00120 V	0.00000 V	0.00120 V	Passed	
-5 V	5 V	2	-4.00000 V	-4.00480 V	-4.00001 V	-3.99520 V	Passed	
-5 V	5 V	3	4.00000 V	3.99520 V	4.00001 V	4.00480 V	Passed	
-5 V	5 V	3	0.00000 V	-0.00120 V	-0.00000 V	0.00120 V	Passed	
-5 V	5 V	3	-4.00000 V	-4.00480 V	-3.99999 V	-3.99520 V	Passed	

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As Left

Verify Gain Matching

Max Gain Difference for Channel	Rate	Samples per Channel	Test Value	Low Limit	Reading	High Limit	Status	Notes
0	10240	10240	4 V	-0.040 dB	-0.000 dB	0.040 dB	Passed	
1	10240	10240	4 V	-0.040 dB	0.000 dB	0.040 dB	Passed	
2	10240	10240	4 V	-0.040 dB	0.000 dB	0.040 dB	Passed	
3	10240	10240	4 V	-0.040 dB	-0.000 dB	0.040 dB	Passed	

As Left

Verify Phase Matching

Max Phase Difference for Channel	Rate	Samples per Channel	Test Value	Low Limit	Reading	High Limit	Status	Notes
0	51200	16384	1000 Hz	-0.085 Degrees	-0.005 Degrees	0.085 Degrees	Passed	
1	51200	16384	1000 Hz	-0.085 Degrees	0.007 Degrees	0.085 Degrees	Passed	
2	51200	16384	1000 Hz	-0.085 Degrees	-0.007 Degrees	0.085 Degrees	Passed	
3	51200	16384	1000 Hz	-0.085 Degrees	0.006 Degrees	0.085 Degrees	Passed	
0	51200	16384	10000 Hz	-0.490 Degrees	-0.065 Degrees	0.490 Degrees	Passed	
1	51200	16384	10000 Hz	-0.490 Degrees	0.065 Degrees	0.490 Degrees	Passed	
2	51200	16384	10000 Hz	-0.490 Degrees	-0.065 Degrees	0.490 Degrees	Passed	
3	51200	16384	10000 Hz	-0.490 Degrees	0.048 Degrees	0.490 Degrees	Passed	

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Verify Common Mode Rejection Ratio

Channel	Rate	Samples per Channel	Test Value	Low Limit	Reading	High Limit	Status	Notes
0	51200	16384	1000 Hz	40.000 dB	51.094 dB	100.000 dB	Passed	
1	51200	16384	1000 Hz	40.000 dB	50.058 dB	100.000 dB	Passed	
2	51200	16384	1000 Hz	40.000 dB	51.265 dB	100.000 dB	Passed	
3	51200	16384	1000 Hz	40.000 dB	50.532 dB	100.000 dB	Passed	

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As Left

Verify IEPE Current

Channel	Rate	DMM Range	Test Value	Low Limit	Reading	High Limit	Status	Notes
0	51200	0.01 A	2.000 mA	2.000 mA	2.073 mA	2.200 mA	Passed	
1	51200	0.01 A	2.000 mA	2.000 mA	2.069 mA	2.200 mA	Passed	
2	51200	0.01 A	2.000 mA	2.000 mA	2.072 mA	2.200 mA	Passed	
3	51200	0.01 A	2.000 mA	2.000 mA	2.068 mA	2.200 mA	Passed	

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Verify IEPE Compliance Voltage

Channel	Rate	SMU Voltage Limit	Test Value	Low Limit	Reading	High Limit	Status	Notes
0	51200	24 V	2 mA	19.000 V	20.837 V	24.000 V	Passed	
1	51200	24 V	2 mA	19.000 V	20.842 V	24.000 V	Passed	
2	51200	24 V	2 mA	19.000 V	20.840 V	24.000 V	Passed	
3	51200	24 V	2 mA	19.000 V	20.844 V	24.000 V	Passed	

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CERTIFICATE of CALIBRATION

Make :	PCB Piezotronics	Reference # :	157556
Model :	378B02	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	Microphone System 1/2" Free Field		
Serial # :	132223	P. Order :	2019.06.14C
Asset # :	01168		

Cal. status : Received in spec's, no adjustment made.
Preamp System with Mic 377B02 s/n 175300

Navair Technologies certifies that the above listed instrument was calibrated on date noted and was released from this laboratory performing in accordance with the specifications set forth by the manufacturer.

Unless otherwise noted in the calibration report a 4:1 accuracy ratio was maintained for this calibration.

Our Quality System system complies with the requirements of ISO-9001-2015 and is registered under certificate CA96/269, working standards used for calibration are certified by or traceable to the National Research Council of Canada or the National Institute of Standards and Technology.

Calibrated : Jun 19, 2019 By : Petro Onasko

Cal. Due : Jun 19, 2021

Temperature : 23 °C ± 2 °C Relative Humidity : 30% to 70%

Standards used : J-216 J-324 J-333 J-420 J-512

Navair Technologies

REPAIR AND CALIBRATION TRACEABLE TO NRC AND NIST
6375 Dixie Rd. Mississauga, ON, L5T 2E7
Phone : 800-668-7440 Fax: 905 565 8325
http: // www.navair.com
e-Mail: service @ navair.com

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6375 Dixie Rd Unit # 7
Mississauga ON L5T 2E7
Tel: (905) 565-1583
Fax: (905) 565-8325

Form: 378B02	Approved by: JR	Feb-16	Ver 1.0

Calibration Report for Certificate : 157556

Make			Model	Serial	Asset		
PCB Piezotronics			378B02	132223	01168		
PCB Piezotronics			426E01	051460	01168		
PCB Piezotronics			377B02	175300	01168		

Sensitivity at 250 Hz

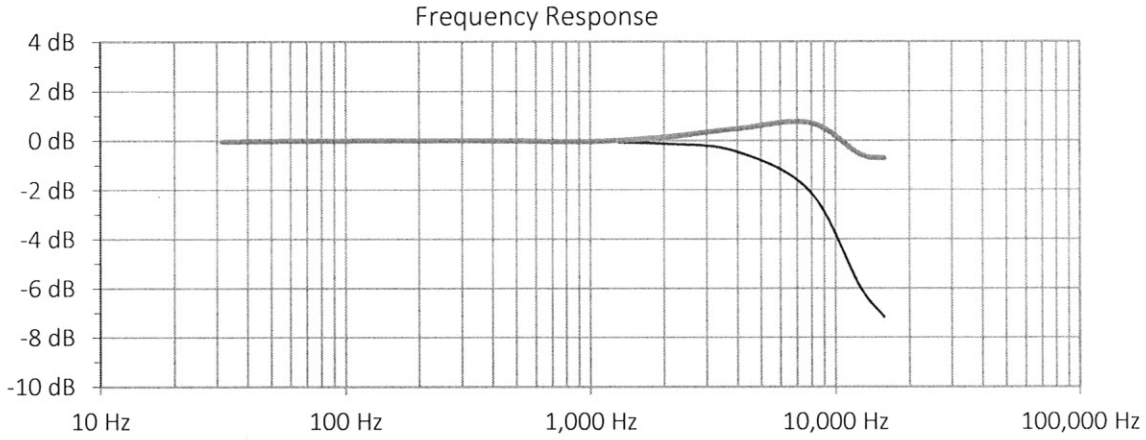
Specs Nom	Unit		Min	Reading	Max		In/Out
50	mV/Pa		39.72	46.23	62.94		In
-26.02	dB re 1V/Pa		-28.02	-26.70	-24.02		In
0	dB re 50mV/Pa		-2	-0.68	2		In

Ambient Conditions:

Static Pressure	98.8 kPa
Temperature	24.9°C
Rel.Humidity	46.0%

Frequency response

	Lower	Upper	
Freq	Pressure	Free Field	
Hz	dB	dB	
31.5	-0.03	-0.03	
63.1	-0.02	-0.01	
125.9	0.00	0.00	
251.3	**0.00**	**0.00**	ref
502.5	-0.01	-0.01	
1005.1	-0.06	-0.03	
1978.7	-0.13	0.14	
3957.5	-0.44	0.48	
7914.9	-2.09	0.71	
12663	-5.97	-0.57	
15830	-7.18	-0.72	



CERTIFICATE of CALIBRATION

Make :	PCB Piezotronics	Reference # :	157716
Model :	480E09	Customer :	Aercoustics Engineering Ltd Mississauga, ON
Descr. :	Conditioning Amplifier		
Serial # :	00034591	P. Order :	2019.06.26C
Asset # :	01032		

Cal. status : Received in spec's, no adjustment made.

Navair Technologies certifies that the above listed instrument was calibrated on date noted and was released from this laboratory performing in accordance with the specifications set forth by the manufacturer.

Unless otherwise noted in the calibration report a 4:1 accuracy ratio was maintained for this calibration.

Our Quality System system complies with the requirements of ISO-9001-2015 and is registered under certificate CA96/269, working standards used for calibration are certified by or traceable to the National Research Council of Canada or the National Institute of Standards and Technology.

Calibrated : Jun 28, 2019 By : Petro Onasko

Cal. Due : Jun 28, 2021

Temperature : 23 °C ± 2 °C Relative Humidity : 30% to 70%

Standards used : J-255 J-301 J-512

Navair Technologies

REPAIR AND CALIBRATION TRACEABLE TO NRC AND NIST

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6375 Dixie Rd Unit # 7
Mississauga ON L5T 2E7
Tel: (905) 565-1583
Fax: (905) 565-8325

Form: 480E09	Approved by: J. Raposo	Jun-19	Ver 2.0

Calibration Report for Certificate : 157716

Make	Model	Serial №	Asset	Cal by
PCB Piezotronics	480E09	00034591	01032	PO

Test	Setting	Input	Min	Reading	Max		In/Out

Excitation Voltage

• 1			25 Vdc	25.8 Vdc	29 Vdc		In

Constant Current Excitation

• 1			2.0 mA	2.99 mA	3.2 mA		In

Voltage Gain Accuracy at 1 kHz

• 1	1.000 V		0.98	1.00	1.02		In
• 10	0.100 V		9.80	10.00	10.20		In
• 100	0.010 V		98.0	100.0	102.0		In

SOH Wind Engineering LLC
141 Leroy Road · Williston, VT 05495 · USA
Tel 802.316.4368 · Fax 802.735.9106 · www.sohwind.com

CERTIFICATE FOR CALIBRATION OF SONIC ANEMOMETER

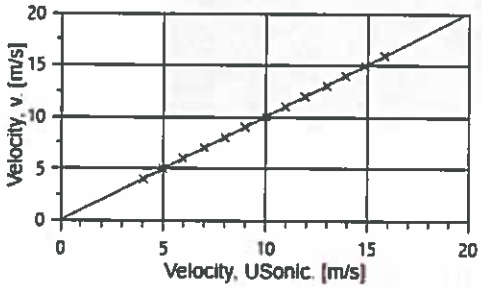
Certificate number: 18.US1.02882 **Date of issue:** July 02, 2018
Type: Vaisala Weather Transmitter, WXT520 **Serial number:** K2420011
Manufacturer: Vaisala, Oyj, Pl 26, FIN-00421 Helsinki, Finland
Client: Aercoustics Engineering Ltd., 1004 Middlegate RD, Suite 1100, S.Tower, Mississauga, ON L4Y 1M4, Canada

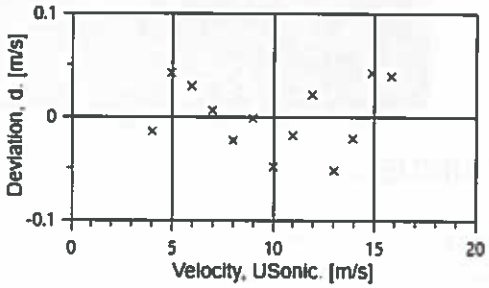
Anemometer received: June 29, 2018 **Anemometer calibrated:** June 29, 2018
Calibrated by: MEJ **Procedure:** MEASNET, IEC 61400-12-1:2017 Annex F
Certificate prepared by: EJF **Approved by:** Calibration engineer, EJF

Calibration equation obtained: v [m/s] = 1.00630 · f [m/s] + -0.03633

Standard uncertainty, slope: 0.00256 **Standard uncertainty, offset:** -0.75225
Covariance: -0.0000659 (m/s)²/m/s **Coefficient of correlation:** ρ = 0.999964
Absolute maximum deviation: -0.052 m/s at 12.990 m/s
Barometric pressure: 999.8 hPa **Relative humidity:** 51.4%

Succession	Velocity pressure, q. [Pa]	Temperature in wind tunnel [°C]	Temperature in d.p. box [°C]	Wind velocity, v. [m/s]	Anemometer Output, f. [m/s]	Deviation, d. [m/s]	Uncertainty u_c (k=2) [m/s]
2	9.08	27.6	27.5	3.974	4.0000	-0.015	0.021
4	14.29	27.6	27.5	4.985	4.9483	0.042	0.023
6	20.56	27.6	27.5	5.980	5.9500	0.029	0.026
8	28.15	27.6	27.5	6.997	6.9833	0.006	0.029
10	36.71	27.6	27.5	7.991	8.0000	-0.023	0.033
12	46.59	27.6	27.5	9.002	8.9833	-0.002	0.037
13-last	57.24	27.6	27.5	9.978	10.0000	-0.049	0.041
11	69.32	27.6	27.5	10.981	10.9667	-0.018	0.045
9	82.45	27.6	27.5	11.976	11.9167	0.021	0.049
7	96.99	27.6	27.5	12.990	12.9967	-0.052	0.053
5	112.02	27.6	27.5	13.960	13.9300	-0.021	0.057
3	128.74	27.6	27.5	14.966	14.8667	0.042	0.061
1-first	146.05	27.5	27.5	15.939	15.8367	0.039	0.065





AC-1746

EQUIPMENT USED

Serial Number	Description
Njord1	Wind tunnel, blockage factor = 1.0035
2254	Control cup anemometer
-	Mounting tube, D = 19 mm
TT002	Summit Electronics, 1XPT100, 0-10V Output, wind tunnel temp.
TP001	PR Electronics 5102, 0-10V Output, differential pressure box temp.
DP005	Setra Model 239, 0-1inWC, differential pressure transducer
HY003	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP003	Setra M278, 0-5VDC Output, barometer
PL8	Pitot tube
XB002	Computer Board. 16 bit A/D data acquisition board
9PRZRW1	PC dedicated to data acquisition

Traceable calibrations of the equipment are carried out by external accredited institutions: Atlantic Scale, Essco Calibration Labs & Furness Controls. A real-time analysis module within the data acquisition software detects pulse frequency.

Photo of the wind tunnel setup. The cross-sectional area is 2.5m x 2.5m.

UNCERTAINTIES

The documented uncertainty is the total combined uncertainty at 95% confidence level (k=2) in accordance with EA-4/02. The uncertainty at 10 m/s comply with the requirements in the IEC 61400-12-1:2005 procedure. See Document US.12.01.004 for further details.

COMMENTS

This sensor was calibrated at 0°.

Certificate number: 18.US1.02882

All calibrations are done in the "As Left" condition unless otherwise noted.
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West Caldwell Calibration Laboratories Inc.

Certificate of Calibration

for

SOUND CALIBRATOR

Manufactured by:	**BRUEL & KJAER**
Model No:	**4231 (ID#00355)**
Serial No:	**2513183**
Calibration Recall No:	**30268**

Submitted By:

Customer:	**Iwona Stasiewicz**
Company:	**Aercoustics Engineering Ltd**
Address:	**1004 Middlegate Road**
	Mississauga, ON.Cana L4Y0G1

The subject instrument was calibrated to the indicated specification using standards traceable to the National Institute of Standards and Technology or to accepted values of natural physical constants. This document certifies that the instrument met the following specification upon its return to the submitter.

West Caldwell Calibration Laboratories Procedure No. 4231 (ID#0 BRUE

Upon receipt for Calibration, the instrument was found to be:

Within (X)

tolerance of the indicated specification. See attached Report of Calibration.
The information supplied relates to the calibrated item listed above.
West Caldwell Calibration Laboratories' calibration control system meets the following requirements, ISO 10012-1 MIL STD 45662A, ANSI/NCSL Z540-1, IEC Guide 25, ISO 9001:2015 and ISO 17025

Note: With this Certificate, Report of Calibration is included.

Approved by:

Calibration Date: 26-Aug-19

James Zhu

Quality Manager
ISO/IEC 17025:2005

Certificate No: 30268 -1

QA Doc. #1051 Rev. 2.0 10/1/01

uncompromised calibration **West Caldwell Calibration Laboratories, Inc.**
1575 State Route 96, Victor, NY 14564, U.S.A.

ACCREDITED

Calibration Lab. Cert. # 1533.01

West Caldwell Calibration Laboratories, Inc.
uncompromised calibration
1575 State Route 96, Victor NY 14564

ISO/IEC 17025: 2005
ACCREDITED
Calibration Lab. Cert. # 1533.01

REPORT OF CALIBRATION

for

Brüel & Kjær Sound Calibrator **Model No.: 4231** **Serial No.: 2513183**
Company: Aercoustics Engineering Ltd. **ID No.: 00355**

Calibration results:

Before data: ..... **After data:** .....
Before & after data same: ...X...
Sound Pressure Level at 1000.0 Hz and pressure of 1013 hPa (mbar)
was 114.07 dB re 20 µPa
(Calibrator tested with ½" adaptor UC 0210)
IEC 1094-4 Type WS 2 P Microphone was used for measurement.

	114 dB	94 dB
Sound Pressure Level:	Pass	Pass
Frequency:	Pass	Pass
Distortion:	Pass	Pass
Stability:	Pass	Pass
All tested parameters:		Pass

Laboratory Environment:		
Ambient Temperature:	20.2	°C
Ambient Humidity:	54.6	% RH
Ambient Pressure:	100.083	kPa
Calibration Date:	26-Aug-2019	
Calibration Due:	26-Aug-2020	
Report Number:	30268 -1	
Control Number:	30268	

The above listed instrument meets or exceeds the tested manufacturer's specifications

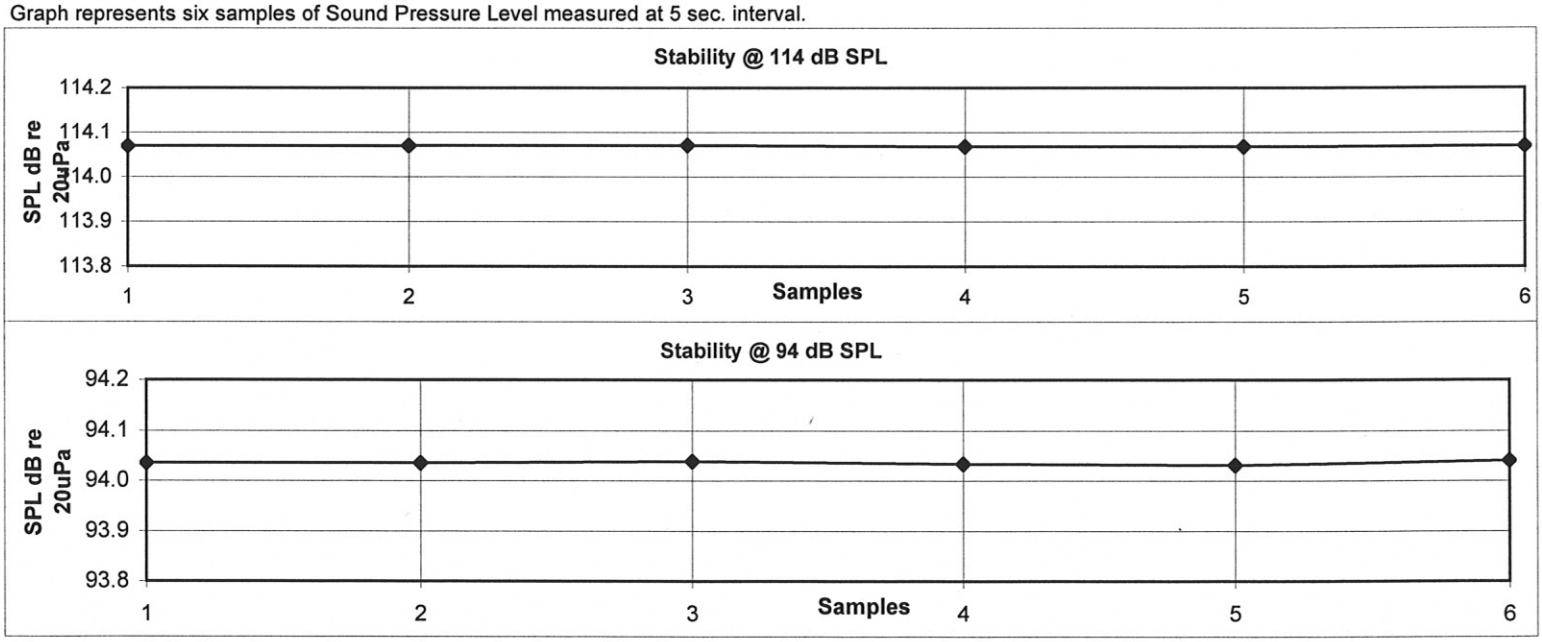
The IEC 60942:2003 Class 1 specifications, passed.

The ANSI S1.40-1984 specifications, passed.

This Calibration is traceable through NIST test numbers: 683/290345-18

The expanded uncertainty of calibration: 0.11 dB at 95% confidence level with a coverage factor of k=2.

Graph represents six samples of Sound Pressure Level measured at 5 sec. interval.



The above listed instrument was checked using calibration procedure documented in West Caldwell Calibration Laboratories Inc. procedure : **Rev. 7.0 Jan. 24, 2014 Doc. # 1038 4231B&K**

Calibration was performed by West Caldwell Calibration Laboratories Inc. under Operating Procedures intended to implement the requirements of ISO10012-1, IEC Guide 25, ANSI/NCSL Z540-1, (MIL-STD-45662A), ISO 9001:2015 and ISO 17025

Cal. Date: 26-Aug-2019

Measurements performed by: .....
James Zhu

Calibrated on WCCL system type 9700

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West Caldwell Calibration Laboratories Inc.
1575 State Route 96, Victor NY 14564
Tel. (585) 586-3900 FAX (585) 586-4327

Calibration Data Record

for

Brüel & Kjær Sound Calibrator **Model No.: 4231** **Serial No.: 2513183**
Company: Aercoustics Engineering Ltd.

All tested parameters: Pass

Measured Sound Pressure Level (Six samples measured at 5 sec. interval)

Sample	1	114.07 dB re 20 µPa	94.04 dB re 20 µPa	
	2	114.07	94.04	
	3	114.07	94.04	
	4	114.07	94.03	
	5	114.07	94.03	
	6	114.07	94.04	
	Average	**114.07** Spec. 114dB ± 0.2dB	**94.04**	Spec. 94 dB ± 0.2 dB

Frequency measured (Three samples at 30 sec. Interval)

Sample	1	999.98 Hz	1000.01 Hz	
	2	999.98	999.96	
	3	999.97	999.96	
	Average	**999.98**	**999.98**	Spec. 1000 Hz ±0.1%

The Frequency expanded uncertainty of calibration:45 µHz/Hz at 95% confidence level with a coverage factor of k=2.

Distortion measured	-48.2 dB	-45.3 dB	Spec. ≤-40 dB

Instruments used for calibration:			Date of Cal.	Traceability No.	Re-cal. Due Date
Brüel & Kjær	4231	S/N 2308998	1-Jul-2019	683/290345-18	1-Jul-2020
Brüel & Kjær	4134	S/N 1534449	9-Jul-2019	683/290345-18	9-Jul-2020
Brüel & Kjær	2669	S/N 2148476	2-Jul-2019	683/290345-18	2-Jul-2020
HP	34401A	S/N US360980	3-Jul-2019	,1010733	3-Jul-2020
Brüel & Kjær	2636	S/N 1323964	5-Jul-2019	683/290345-18	5-Jul-2020
HP	33120A	S/N US360458	3-Jul-2019	,1010733	3-Jul-2020

Cal. Date: 26-Aug-2019 **Tested by: James Zhu**

Calibrated on WCCL system type 9700

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APPENDIX C – STATEMENT FROM THE OPERATOR

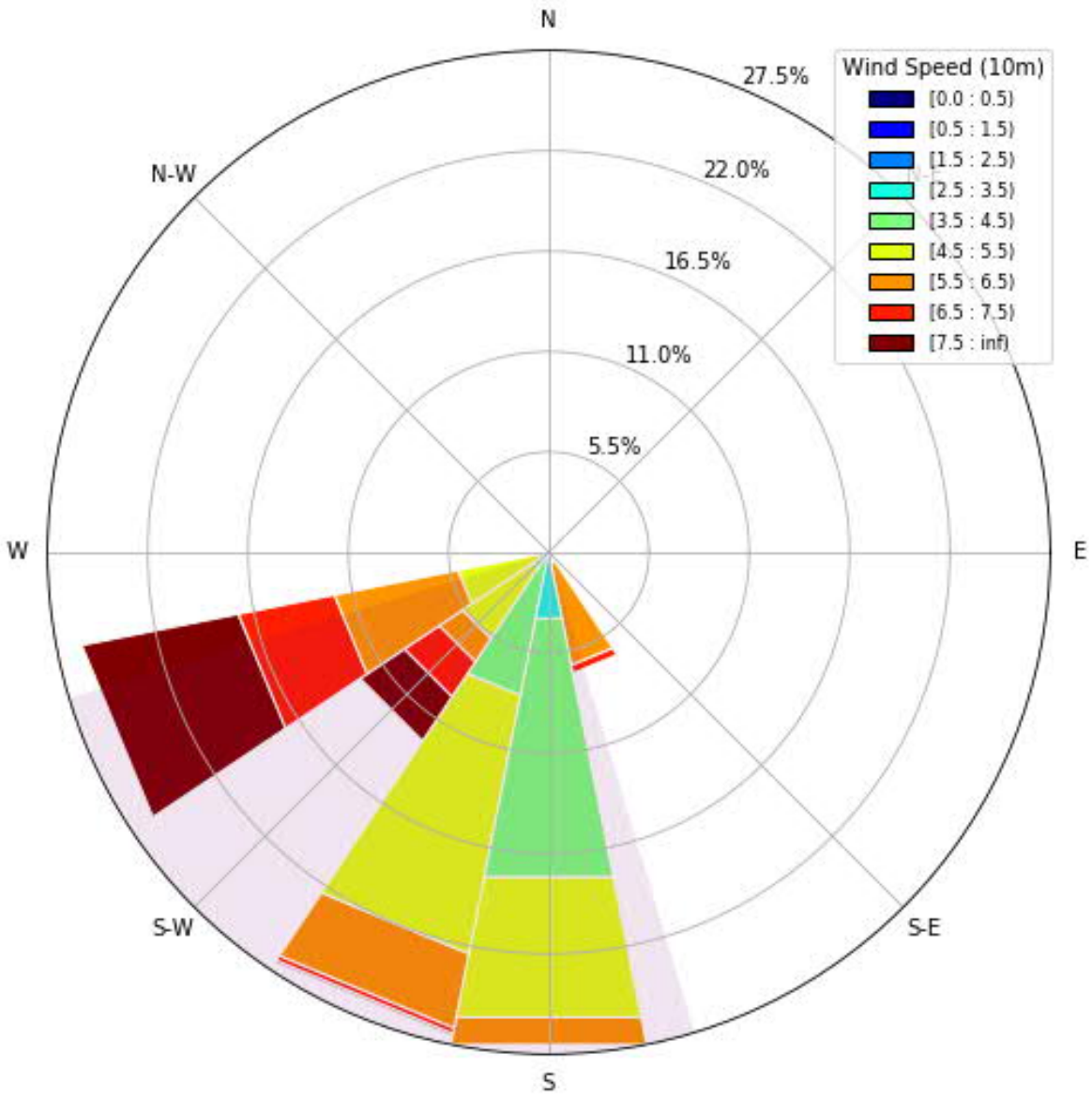
APPENDIX D – I-AUDIT CHECKLIST

Appendix D: I-Audit checklist

Wind Energy Project – Screening Document – Acoustic Audit Report – Immission

Information Required in the Acoustic Audit Report – Immission

Item #	Description	Complete?	Comment
1	Did the Sound level Meter meet the Type 1 Sound level meter requirements according to the IEC standard 61672-1 Sound level Meters, Part 1: Specifications? Section D2.1.1	✓	
2	Was the complete sound measurement system, including any recording, data logging or computing systems calibrated immediately before and after the measurement session at one or more frequencies using an acoustic calibrator on the microphone (must not exceed ±0.5dB)? Section D2.1.3	✓	
3	Are valid calibration certificate(s) of the noise monitoring equipment and calibration traceable to a qualified laboratory? Is the validity duration of the calibration stated for each item of equipment? Section D2.3	✓	
4	Was the predictable worst case parameters such as high wind shear and wind direction toward the Receptor considered? Section D3.2	✓	
5	Is there a Wind Rose showing the wind directions at the site? Section D7 (1e)	✓	
6	Did the results cover a wind speed range of at least 4-7 m/s as outlined in section D 3.8.?	✓	
7	Was the weather report during the measurement campaign included in the report? Section D7 (1c)	✓	
8	Did the audit state there was compliance with the limits at each wind speed category? Section D6	✓	
9	Are pictures of the noise measurement setup near Point of reception provided? Section D3.3.2 & D3.4	✓	
10	Was there justification of the Receptor location choice(s) prior to commencement of the I-Audit? Section D4.1	✓	
11	Was there sufficient valid data for different wind speeds? Section D5.2 # 3	✓	RAM-I sample size as per E5.5 #5
12	Was the turbine (operational) specific information during the measurement campaign in tabular form (i.e. wind speed at hub height, anemometer wind speed at 10 m height, air temperature and pressure and relative humidity) Section D3.7	✓	
13	Were all the calculated standard deviations at all relevant integer wind speeds provided? Section D7 (2d)	✓	
14	Compliance statement	✓	
15	All data included in an Excel spreadsheet	✓	Provided Separately
16	If deviations from standard; was justification of the deviations provided	⊘	No Deviations



Project ID: 15247.03
Drawn by: AM
Reveiwed by: PA
Date: February 21, 2020
Revision: 1

Scale: As Indicated

Suncor Adelaide Wind Power Project

Appendix E.1

Supplementary Wind Rose based on Assessment Data Total Noise

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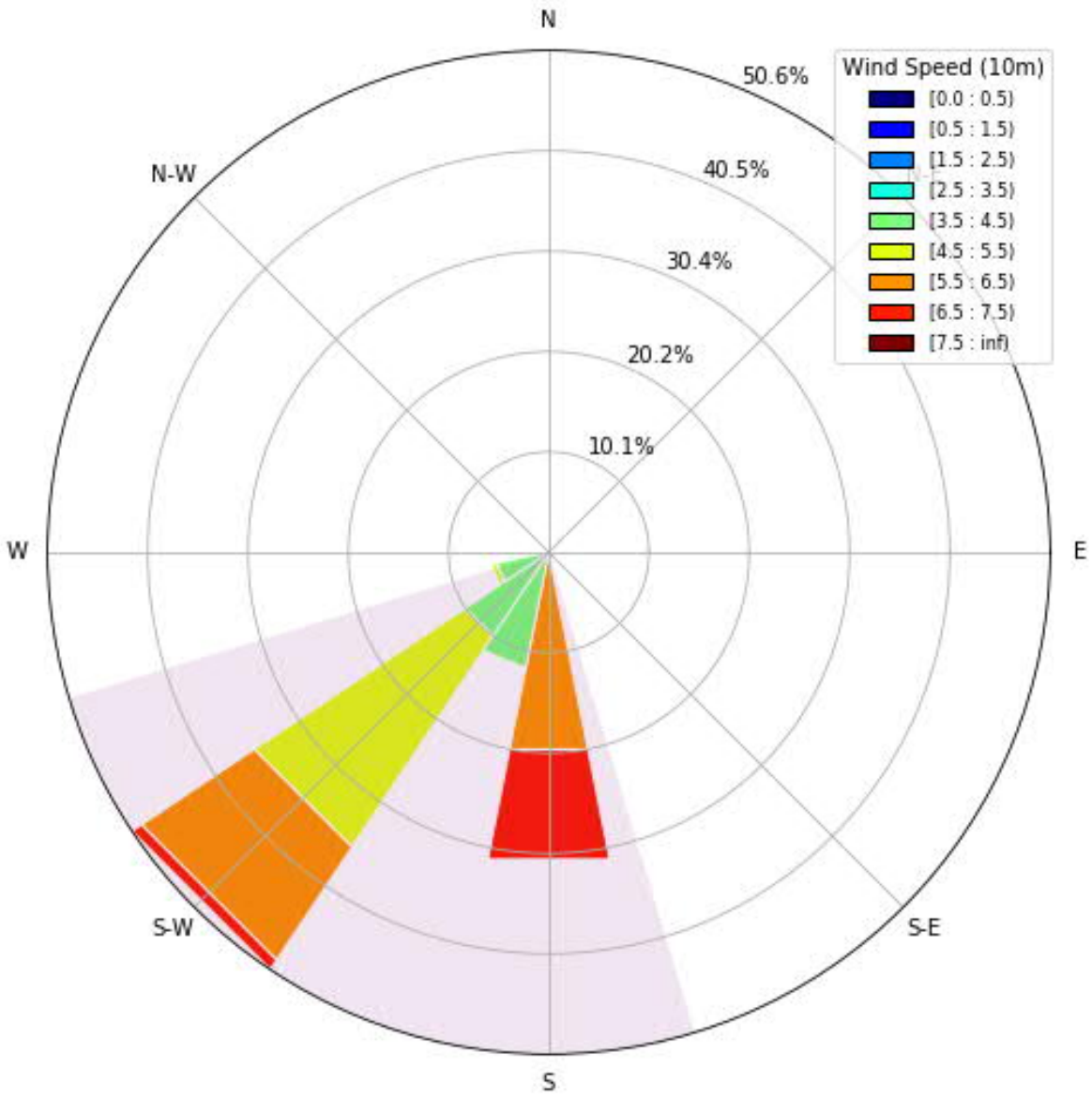

Project ID: 15247.03
Drawn by: AM
Reveiwed by: PA
Date: February 21, 2020
Revision: 1

Scale: As Indicated

Suncor Adelaide Wind Power Project

Appendix E.2

Supplementary Wind Rose based on Assessment Data Background Noise

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END OF REPORT