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ASSESSMENT REPORT - **Project: 15039.00**

Cedar Point Wind Power Project
1st Acoustic Immission Audit
Lambton County, Ontario

Prepared for:

Cedar Point II Limited Partnership
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Executive Summary

Aercoustics Engineering Limited ("Aercoustics") has been retained by Cedar Point II Limited Partnership to complete the acoustic audit outlined in the Renewable Energy Approval ("REA") for the Cedar Point Wind Power Project ("CPWPP"). CPWPP operates under REA #6914-9L5JBB, issued on August 22, 2014 and amended on August 20, 2015. This report details the first measurement campaign of the CPWPP immission audit.

Noise measurements were conducted from March 18, 2016 to June 12, 2016 near receptors R1587, R1395, R1414, R96 and R130.

Acoustic and weather data was logged simultaneously for the duration of the measurement campaign. The audit was completed as per the methodology outlined in Part D of the "MOE Compliance Protocol for Wind Turbine Noise – Guideline for Acoustic Assessment and Measurement."

The turbine-only noise contribution was compared to the Ministry of Environment and Climate Change sound level limits and the facility was found to be in compliance.

1 Introduction

Aercoustics Engineering Limited ("Aercoustics") has been retained by Cedar Point II Limited Partnership to complete the acoustic audit outlined in the Renewable Energy Approval ("REA") for the Cedar Point Wind Power Project ("CPWPP") [1]. CPWPP operates under REA #6914-9L5JBB , issued on August 22, 2014 and amended on August 20, 2015. This report details the results of the first measurement campaign (Spring 2016).

The audit was completed as per the methodology outlined in Part D of the "MOE Compliance Protocol for Wind Turbine Noise – Guideline for Acoustic Assessment and Measurement," [2] as per requirements of Section E, "Acoustic Audit – Immission" of the REA. This report outlines the methodology of the measurements, the results, and a comparison of the sound contribution of the turbines to the Ontario Ministry of Environment Conservation and Parks ("MECP") sound level limits.

2 Facility Description

The CPWPP is comprised of 46 Siemens SWT-2.3-113 wind turbines. Twenty-five (25) turbines have a nameplate capacity of 2.221 MW, nineteen (19) turbines have a nameplate capacity of 2.126 MW and two (2) turbines have a nameplate capacity of 2.030 MW. The 46 Siemens SWT-2.3-113 have a hub height of 99.5 meters, and a rotor diameter of 113 meters. The facility operates 24 hours per day, 7 days per week.

3 Audit Details

The acoustic audit was conducted at five (5) receptors: R1587, R1395, R1414, R96 and R130. The acoustic audit spanned from March 18, 2016 to June 12, 2016. The following sections detail the test equipment, measurement methodology, measurement locations, and environmental conditions during the audit.

3.1 Test Equipment

The following list details the equipment, acoustic and non-acoustic, that was used at each audit location for the measurement campaign.

- One (1) Type 1 sound level meter, with microphone and pre-amplifier that meet the MECP protocol specifications outlined in Part D, Section D2.1 - Acoustic Instrumentation.

- 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 data analysis.

- One (1) anemometer programmed to sample weather data every 0.5 seconds. The anemometer was located 10m above grade, as defined by Section D3.4.

Performance specifications comply with Part D, Section D.2.2 of the MECP protocol.

The following table lists the specific model and serial numbers for the equipment used during the measurement campaign.

Table 1 Equipment Details

Location	Equipment	Serial Number
M1587	NI cRIO-9067 controller with NI9234 Data Acquisition card	1A6C107(controller) 30900A7(DAQ card)
	PCB 377B02 Microphone	156314
	PCB 378B02 Pre-amplifier	121695
	Vaisala WXT 520	K0630017
M1395	NI cRIO-9067 controller with NI9234 Data Acquisition card	1ADD957 (controller) 30BE72D (DAQ card)
	PCB 377B02 Microphone	158828
	PCB 378B02 Pre-amplifier	041165
	Vaisala WXT 520	M0410467
M1414	NI cRIO-9067 controller with NI9234 Data Acquisition card	1AE4581 (controller) 30BE72E (DAQ card)
	PCB 377B02 Microphone	158980
	PCB 378B02 Pre-amplifier	041181
	Vaisala WXT 520	M0410645
M96	NI cRIO-9067 controller with NI9234 Data Acquisition card	1ADD957 (controller) 30BD113 (DAQ card)
	PCB 377B02 Microphone	158838
	PCB 378B02 Pre-amplifier	041180
	Vaisala WXT 520	M0410643
M130	NI cRIO-9067 controller with NI9234 Data Acquisition card	1ADE458C (controller) 30BD111 (DAQ card)
	PCB 377B02 Microphone	148047
	PCB 378B02 Pre-amplifier	041166
	Vaisala WXT 520	M0410646

The sound level meter, microphone, and pre-amplifier were calibrated before and after the measurement campaign using a type 4231 Brüel & Kjær acoustic calibrator.

3.2 Measurement Methodology

For the duration of the measurement campaign, acoustic and anemometer data was logged simultaneously in one-minute intervals. The measurement equipment was setup to log one-minute equivalent sound levels (L_{eq}) in broadband and 1/3 octave bands between 20-10,000 Hz. The microphone was placed at a measurement height of 4.5m above grade, at least 5 meters away from any large reflecting surfaces, in direct line of sight to the nearest turbines, and as far away as practically possible from trees or other foliage. Measurement data was filtered into integer wind bins. Each bin ranged from

0.5m/s below to 0.5m/s above each respective wind bin (i.e. 5 m/s data represents data between 4.5m/s and 5.5m/s).

A one-minute measurement interval was considered valid if:

- The interval occurred between 10pm – 5am
- No precipitation was detected within an hour before or after the interval
- The maximum measured wind speed at 10m was no more than 2m/s higher than the recorded average for that interval
- The temperature was above -20˚C
- Either all nearby required turbines were on (for turbine ON measurements), or all nearby required turbines were off (for ambient measurements). Section 3.6 details the operational conditions during turbine on and turbine off measurements. Appendix F details the turbine status during TON and TOFF measurements.
- The measured L_{eq} was no more than 10 dB greater than the L90 value

These filters were designed to obtain measurement data of the wind project when it is fully operational, as well as reduce the amount of contamination from transient ambient noise sources such as vehicle passbys. These filters also are based on equipment operating limitations, and the filters prescribed in Part D of the Protocol to eliminate noise from precipitation, as well as noise on the microphone from gusty periods where the reliability of the data is reduced.

It should be noted that although the MECP Protocol calls for data points to be excluded if the minimum wind speed at 10m is more than 2m/s less than the recorded average. The effect of this filter significantly reduces the number of samples. Aercoustics has removed this filter in order to increase the amount of data collected so that the audit may be completed in a practical time frame.

In order to justify the removal of this filter Aercoustics reviewed 11 different data sets representing measurements from 3 different wind farms and 10 different receptor locations. Each data set was filtered using both the prescribed and modified methods for wind speed gusting. The results of the analysis shows increases in the number of data points in all wind bins, with a more pronounced effect at high wind speeds, while there is a negligible effect in the measured sound levels; this study is provided in Appendix D.

3.3 Sample size requirements

In order to account for the dependence on wind speed of wind turbine noise and ambient noise, the measurement data is sorted into integer wind speed bins according to the measured wind speed. As per Section D3.8 of the MECP protocol, at least 120 data points in each wind bin are required for Turbine ON measurements, and 60 data points for the

ambient measurements. For wind speeds where the sufficient number of samples was not achieved, the results are presented and indicated as such.

3.4 Measurement Location

Receptors R1587, R1395, R1414, R96 and R130 were chosen to audit the facility. The receptors chosen represent locations with a predicted level of more than 37 dBA and are as close to downwind as possible of the nearest turbine from the prevailing wind direction. The predicted level at R1587, R1395, R1414, R96 and R130 is 38.7 dBA, 37.2dBA, 38.0, 37.8 and 38.2 dBA respectively [3]. The following describes the measurement locations in relation to the above listed receptors:

- M1587: Measurement equipment was placed on the vacant lot R1587, facing the nearest turbine (CP215/WTG15). The ground cover between the monitor and CP215 was an open field. The predicted level based on the acoustic model at M1587 is 38.6 dBA.
- M1395: Measurement equipment was placed on the vacant lot R1395, facing the nearest turbine (CP241/WTG72). The ground cover between the monitor and CP241 was an open field. The predicted level based on the acoustic model at M1395 is 37.2 dBA.
- M1414: Measurement equipment was placed on an adjacent strip of demising land to R1414, facing the nearest turbine (CP228/WTG31). The ground cover between the monitor and CP228 was an open field and a tree lot. The predicted level based on the acoustic model at M1414 is 38.4 dBA.
- M96: Measurement equipment was placed on the adjacent farm land of R96, facing the nearest turbine (CP244/WTG 44). The ground cover between the monitor and CP 244 was an open field. The predicted level based on the acoustic model at M96 is 37.7 dBA.
- M130: Measurement equipment was placed on the adjacent farm land of R130, facing the nearest turbine (CP241/WTG72). The ground cover between the monitor and CP241 was an open field. The predicted level based on the acoustic model at M130 is 38.3 dBA.

Table 2 provides a summary of the receptor locations. Detailed site plans showing the receptor and audit locations are attached in Appendix A.

Table 2 Receptor Measurement Locations

	Audit Receptor ID Nearest Turbine ID	M1587 CP215	M1395 CP241	M1414 CP228	M96 CP244	M130 CP241
Receptor	UTM Coordinates (X,Y)	17T 420769mE 4775052mN	17T 414607mE 4766788mN	17T 415148mE 4773715mN	17T 409776mE 4770010mN	17T 414012mE 4767233mN
	Distance to Nearest Turbine	553m	646m	676m	611m	811m
	Predicted Level dBA*	38.7	37.2	38.0	37.8	38.2
Monitor	UTM Coordinates (X,Y)	17T 420769mE 4775052mN	17T 414607mE 4766788mN	17T 415091mE 4773724mN	17T 409699mE 4770000mE	17T 414018mE 4767158mN
	Distance to Nearest Turbine	553m	646m	625m	611m	736m
	Predicted Level dBA**	38.6	37.2	38.4	37.7	38.3

* Predicted level from Sound Level Prediction Results, November 25, 2015 As built 46 WTGs – HGC [3]
** Predicted level from Aercoustics' acoustic model

3.5 Weather Conditions

Ambient conditions encountered over the measurement campaign were as follows:

- Ambient Humidity: 20% to 95%
- Ambient Temperature: -7˚C to 25.6˚C
- 10m Wind Speed: 0 m/s to 19 m/s

During the audit period, the predominant wind direction was measured to be from the South for M1414 and M96; South east for M1395 and M130; and East for M1587. A wind rose detailing the measured wind direction at the five (5) monitor locations has been provided in Appendix B. Wind directions shown on the wind roses indicate the direction the wind is coming from.

3.6 Operational Conditions

Wind turbine SCADA information were logged for the duration of the measurement campaign by CPWPP. Logged parameters included wind speed, wind direction, and power output. The turbines included in this study were chosen such that when they are turned off, the partial impact of the remaining turbines was predicted to be less than 30dBA; 10dB below the lowest sound level limit. Turbine ON measurement data at each receptor was filtered to include only intervals when all turbines in the immediate vicinity were operational.

The turbines were verified by the operator to be running properly during all measurement periods of the campaign using SCADA data and IESO dispatch instructions. Any times where some of the turbines were down for maintenance or otherwise not operating normally were excluded from the measured dataset; see Appendix C for a statement from the operator.

4 Sound Level Limits

The purpose of the sound measurements was to confirm whether the sound emitted by the wind facility is in compliance with the MECP allowable sound level limits. The REA identifies the sound level limits in Condition C1 (1), the MECP sound level limits for wind turbines vary with wind speed defined at a 10m height. The details of the sound level limits are presented in Table 3 below.

Table 3 MECP Sound Level Limits for Wind turbines for Class 3 Areas (Rural)

Wind speed at 10m height [m/s]	MECP Sound level limit [dBA]
4	40.0
5	40.0
6	40.0
7	43.0
8	45.0
9	49.0
10	51.0

5 Audit Results

The following tables detail the sound levels measured at the M1587, M1395, M1414, M96 and M130 receptors when all the nearby turbines were on (Turbine ON) and when all the nearby turbines were off (Turbine OFF). Turbine ON measurements are the total sound measured when the turbines were operating and includes all other sound sources that were producing noise during that measurement in addition to the wind turbine.

One hundred and seventeen (117) data points were collected at 7m/s for Turbine ON at M1414. This deviation from the protocol's requirement are considered minor and does not affect the conclusion of the report.

Table 4 M1587 Sound levels measured for Turbine ON and OFF

	Wind speed at 10m height [m/s]	4	5	6	7
Turbine ON	Number of Samples	804	703	399	130
	LAeq [dBA]	38	39	41	44
	Standard Deviation [dBA]	2.6	2.5	2.3	2.2
Turbine OFF	Number of Samples	188	109	74	75
	LAeq [dBA]	32	35	38	41
	Standard Deviation [dBA]	3.0	2.8	2.3	1.8
Turbine ONLY		36	38	38	41

Table 5 M1395 Sound levels measured for Turbine ON and OFF

	Wind speed at 10m height [m/s]	4	5	6	7
Turbine ON	Number of Samples	1159	408	245	120
	LA_{eq} [dBA]	39	41	45	49
	Standard Deviation [dBA]	2.9	2.4	2.3	2.0
Turbine OFF	Number of Samples	372	95	62	74
	LA_{eq} [dBA]	33	38	44	48
	Standard Deviation [dBA]	3.0	2.3	1.9	1.8
Turbine ONLY		38	37	39†	43†

† Higher uncertainty on calculated Turbine ONLY levels in cases where the measured ambient sound level (Turbine OFF) is within 1 dB of the measured Turbine ON level

Table 6 M1414 Sound levels measured for Turbine ON and OFF

	Wind speed at 10m height [m/s]	4	5	6	7
Turbine ON	Number of Samples	834	513	336	117*
	LA_{eq} [dBA]	38	39	43	47
	Standard Deviation [dBA]	2.2	2.0	2.2	2.0
Turbine OFF	Number of Samples	141	165	85	67
	LA_{eq} [dBA]	32	36	41	46
	Standard Deviation [dBA]	1.6	2.5	2.2	2.5
Turbine ONLY		37	37	38	40†

† Higher uncertainty on calculated Turbine ONLY levels in cases where the measured ambient sound level (Turbine OFF) is within 1 dB of the measured Turbine ON level
*No. of samples deficient by 3 samples

Table 7 M96 Sound levels measured for Turbine ON and OFF

	Wind speed at 10m height [m/s]	4	5	6	7
Turbine ON	Number of Samples	1889	1077	413	174
	LA_{eq} [dBA]	40	41	44	48
	Standard Deviation [dBA]	2.6	2.2	1.9	1.7
Turbine OFF	Number of Samples	130	372	214	62
	LA_{eq} [dBA]	35	38	42	47
	Standard Deviation [dBA]	3.2	3.1	2.4	2.3
Turbine ONLY		39	39	39	40†

† Higher uncertainty on calculated Turbine ONLY levels in cases where the measured ambient sound level (Turbine OFF) is within 1 dB of the measured Turbine ON level

Table 8 M130 Sound levels measured for Turbine ON and OFF

	Wind speed at 10m height [m/s]	4	5	6	7
Turbine ON	Number of Samples	1281	969	412	135
	LA_{eq} [dBA]	41	42	43	46
	Standard Deviation [dBA]	3.4	2.6	2.0	1.6
Turbine OFF	Number of Samples	185	164	114	91
	LA_{eq} [dBA]	35	37	41	44
	Standard Deviation [dBA]	1.2	1.3	1.6	1.5
Turbine ONLY		39	40	40	40

The following figures are the plots of the measured sound levels at the receptors when all the nearby turbines were on (Turbine ON) and when all the nearby turbines were off (Turbine OFF). Note that all plots include the 95% confidence interval as a dashed line above and below the average value.

Figure 1 M1587 – Measured Turbine ON + Background (Average)

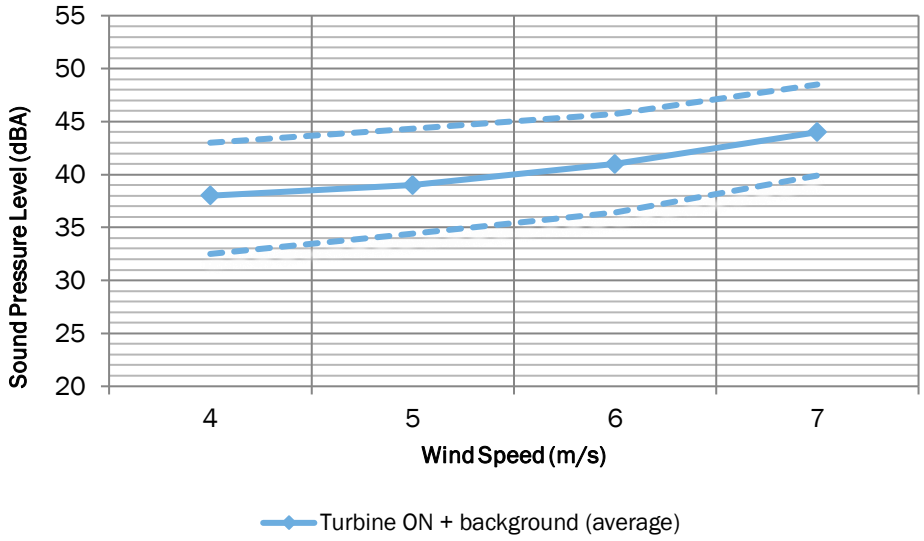


Figure 2 – M1587 - Measured Background (average)

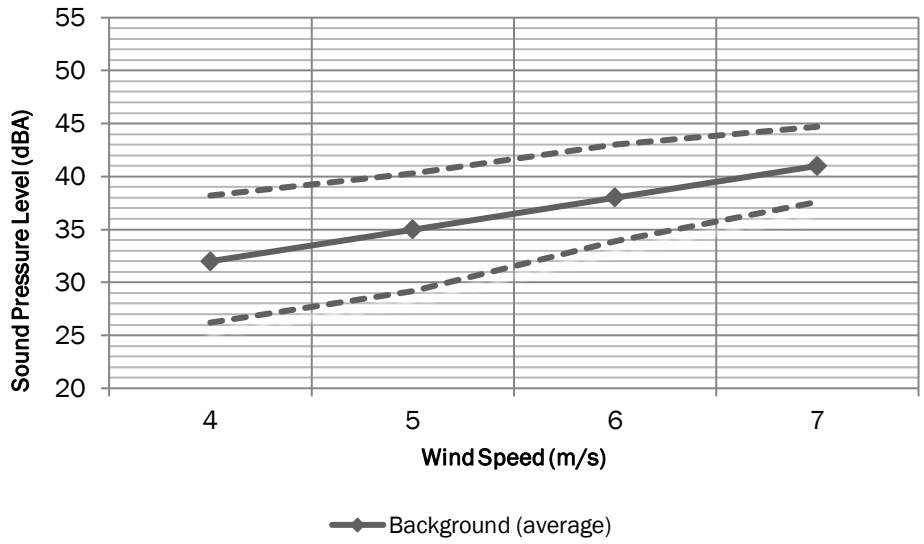


Figure 3 M1395 - Measured Turbine ON + Background (Average)

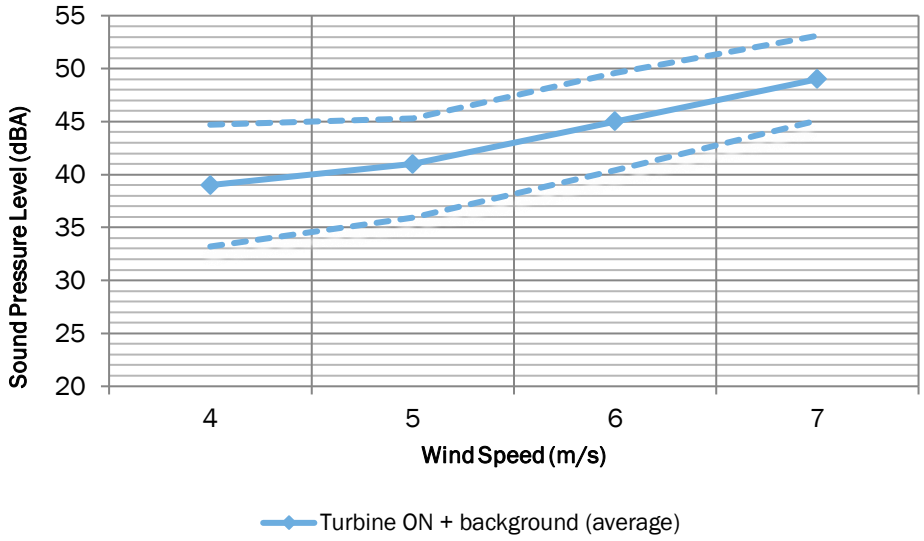


Figure 4 M1395 - Measured Background (Average)

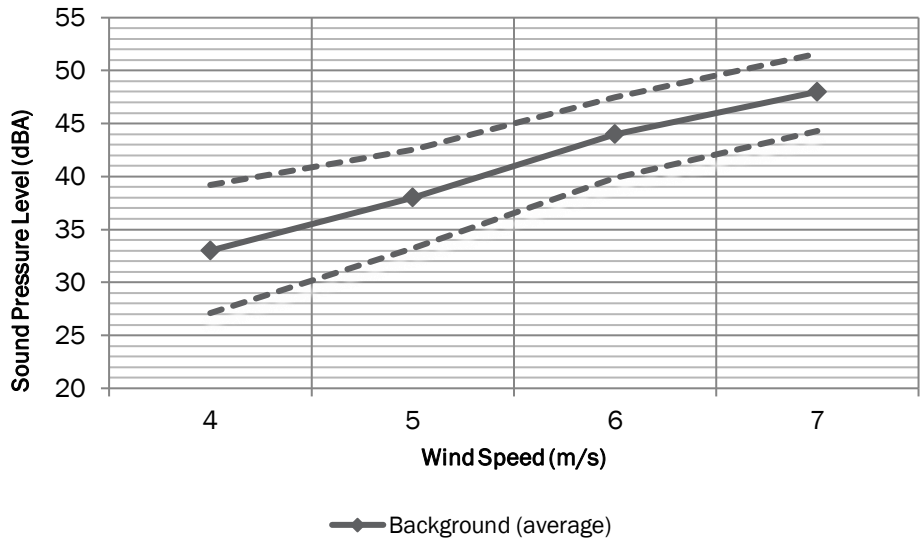


Figure 5 M1414 - Turbine ON + Background (Average)

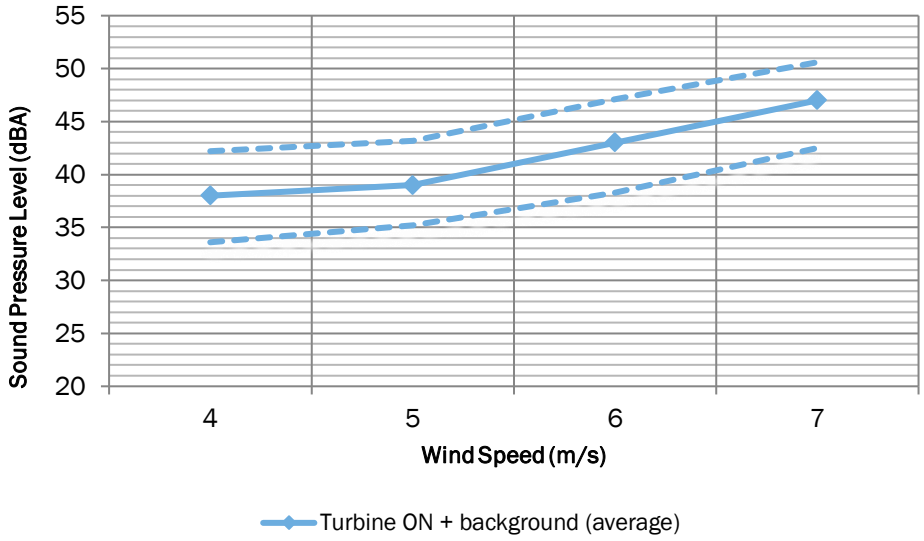


Figure 6 M1414 - Background (Average)

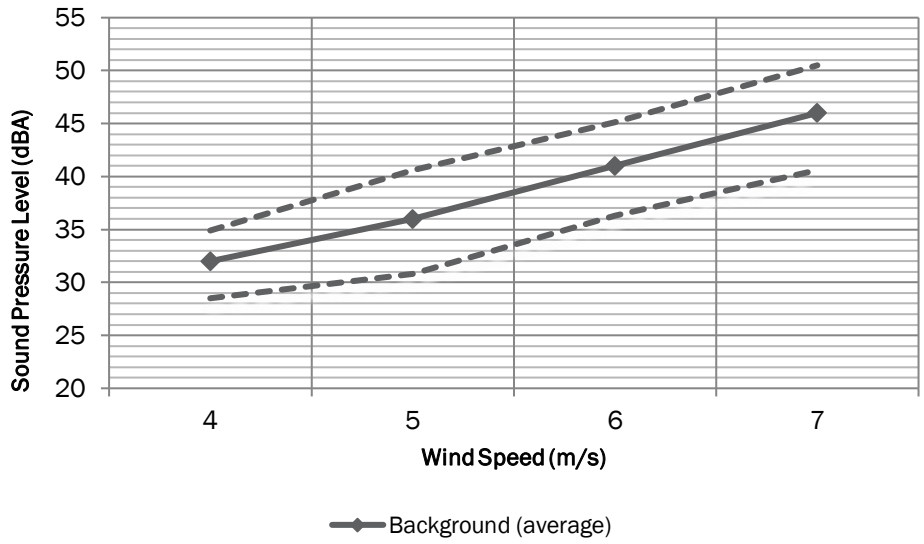


Figure 7 M96 - Turbine ON + Background (Average)

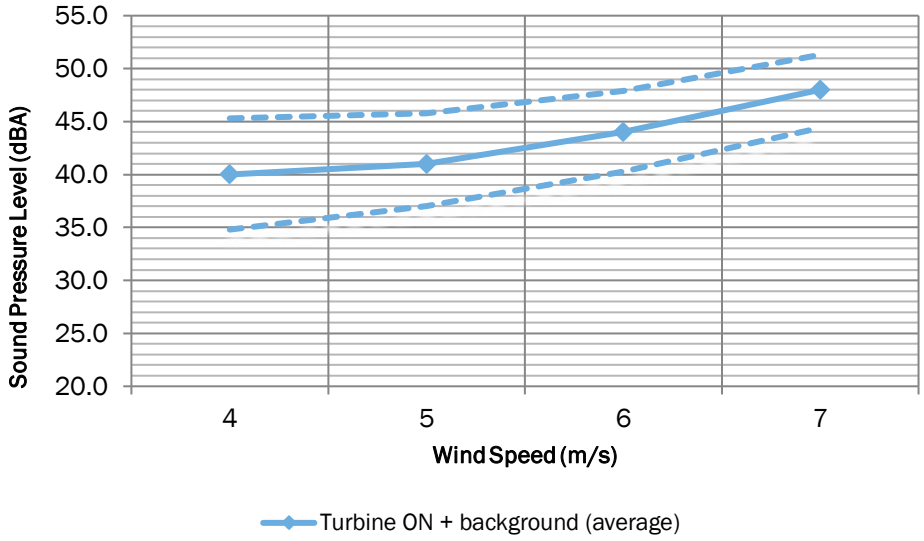


Figure 8 M96 - Measured Background (Average)

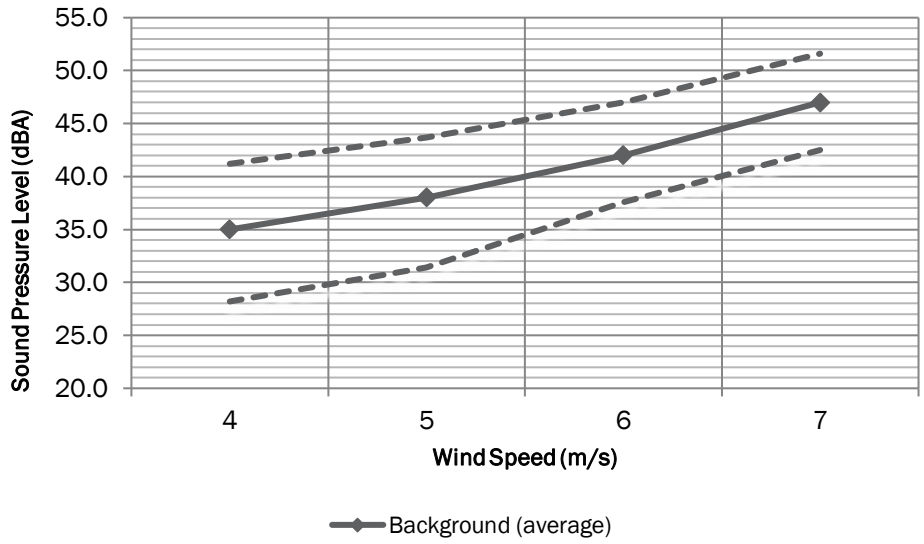


Figure 9 M130 - Measured Turbine ON + Background (Average)

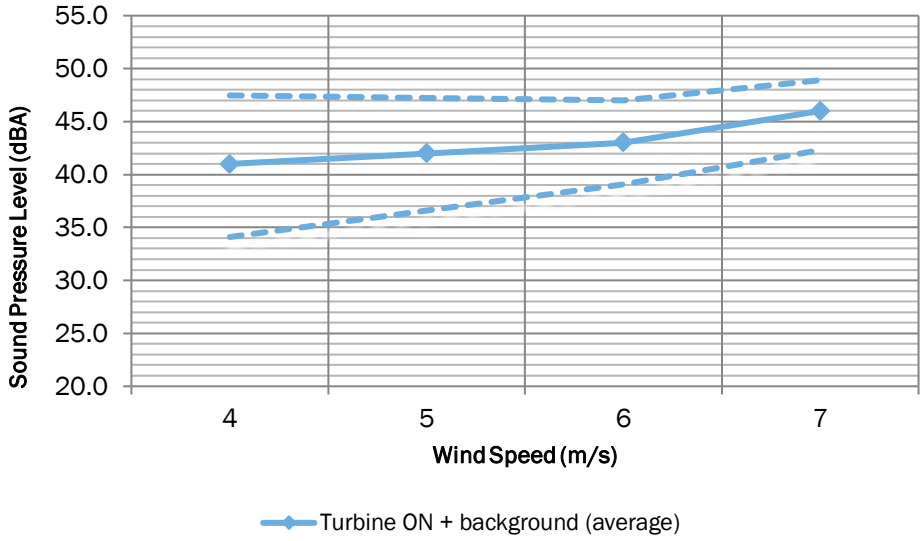
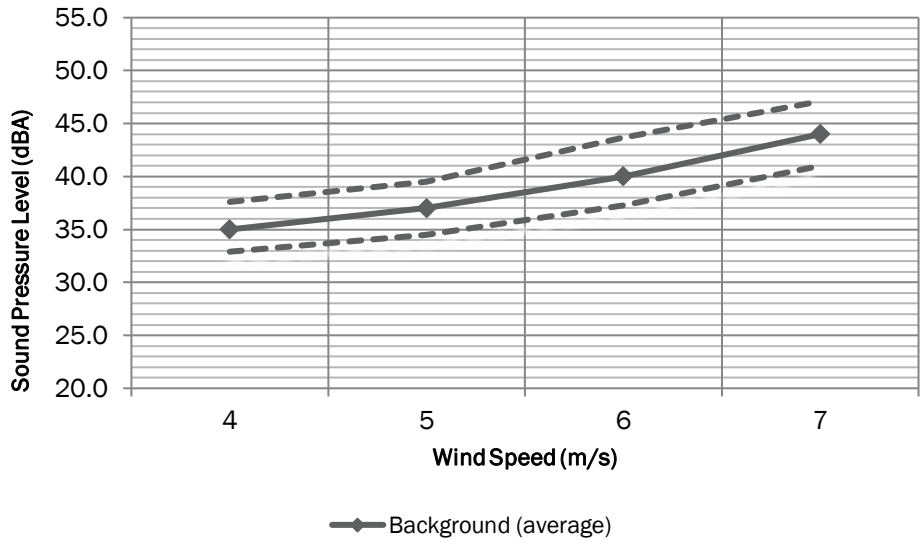


Figure 10 M130- Measured Background (Average)



6 Discussion

6.1 Overall Sound Level

The turbine component of the sound level was derived by logarithmically subtracting the ambient noise from the turbine on measurements. This calculation represents the noise level attributed to the partial impact of the wind turbine sound on the total measured receptor noise level. The turbine only component of the sound level can be calculated using the formula below, where T_{ONLY} is Turbine ONLY, T_{ON} is Turbine ON and T_{OFF} is Turbine OFF:

$$T_{ONLY} = 10\log_{10}(\log^{-1}(T_{ON}/10)-\log^{-1}(T_{OFF}/10))$$

As per section D6 of the MEOCC protocol, if the background sound levels are greater than the applicable exclusion limits then the applicable limits are now the background sound levels without extraneous noise sources.

The audit at M1587, M1395, M96, M130 and M1414 measurement locations are considered representative of the sound levels at Receptors R1587, R1395, R96, R130 and M1414 given the placement of the monitoring rigs.

Table 9 to Table 13 presents the Turbine ON, Turbine OFF and calculated Turbine ONLY sound pressure levels at each receptor between 4-7 m/s.

Table 9 Assessment Table - R1587

Measurement Location	Wind speed at 10m height [m/s]	4	5	6	7
R1587	Turbine ON LAeq [dBA]	38	39	41	44
	Turbine OFF LAeq [dBA]	32	35	38	41
	Calculated Turbine ONLY LAeq [dBA]	36	38	38	41
MECP Sound Level Limit		40	40	40	43

Table 10 Assessment Table - R1395

Measurement Location	Wind speed at 10m height [m/s]	4	5	6	7
R1395	Turbine ON LAeq [dBA]	39	41	45	49
	Turbine OFF LAeq [dBA]	33	38	44	48
	Calculated Turbine ONLY LAeq [dBA]	38	37	39†	43†
MECP Sound Level Limit		40	40	40	43

† Higher uncertainty on calculated Turbine ONLY levels in cases where the measured ambient sound level (Turbine OFF) is within 1 dB of the measured Turbine ON level

Table 11 Assessment Table - R1414

Measurement Location	Wind speed at 10m height [m/s]	4	5	6	7
R1414	Turbine ON LAeq [dBA]	38	39	43	47
	Turbine OFF LAeq [dBA]	32	36	41	46
	Calculated Turbine ONLY LAeq [dBA]	37	37	38	40†
MECP Sound Level Limit		40	40	40	43

† Higher uncertainty on calculated Turbine ONLY levels in cases where the measured ambient sound level (Turbine OFF) is within 1 dB of the measured Turbine ON level

Table 12 Assessment Table - R96

Measurement Location	Wind speed at 10m height [m/s]	4	5	6	7
R96	Turbine ON LAeq [dBA]	40	41	44	48
	Turbine OFF LAeq [dBA]	35	38	42	47
	Calculated Turbine ONLY LAeq [dBA]	39	39	39	40†
MECP Sound Level Limit		40	40	40	43

† Higher uncertainty on calculated Turbine ONLY levels in cases where the measured ambient sound level (Turbine OFF) is within 1 dB of the measured Turbine ON level

Table 13 Assessment Table - R130

Measurement Location	Wind speed at 10m height [m/s]	4	5	6	7
R130	Turbine ON LAeq [dBA]	41	42	43	46
	Turbine OFF LAeq [dBA]	35	37	41	44
	Calculated Turbine ONLY LAeq [dBA]	39	40	40	40
MECP Sound Level Limit		40	40	40	43

The data from Table 9 to Table 13 is plotted in Figure 11 to Figure 15.

Figure 11 M1587 - Turbine Levels compared to the MECP sound level limits

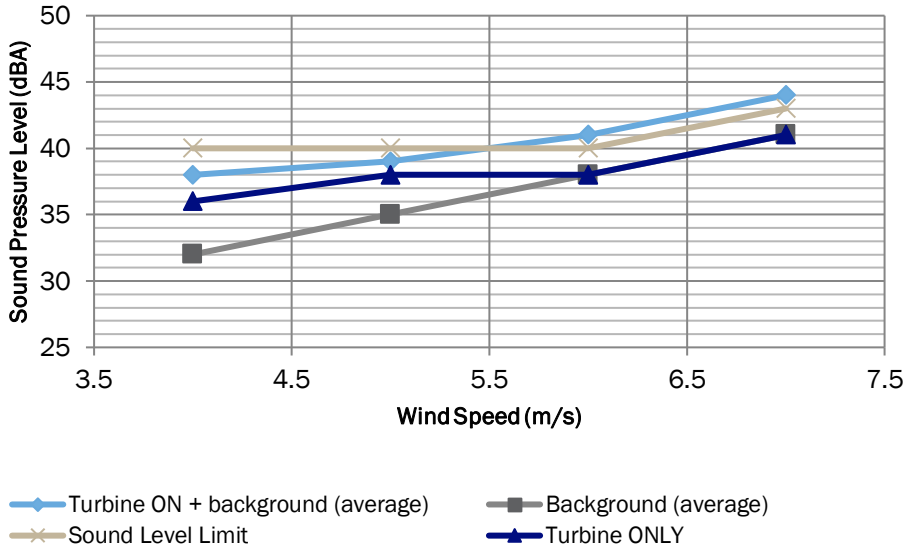
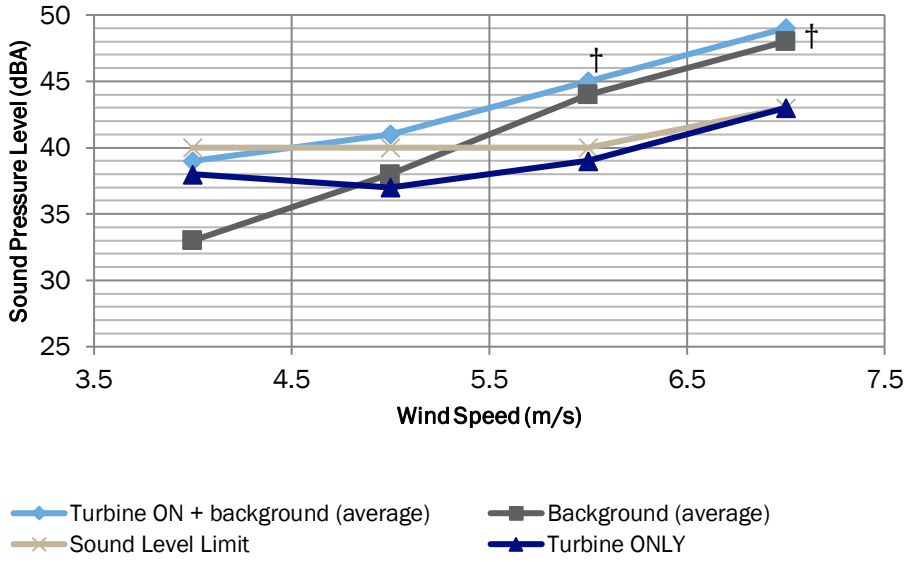
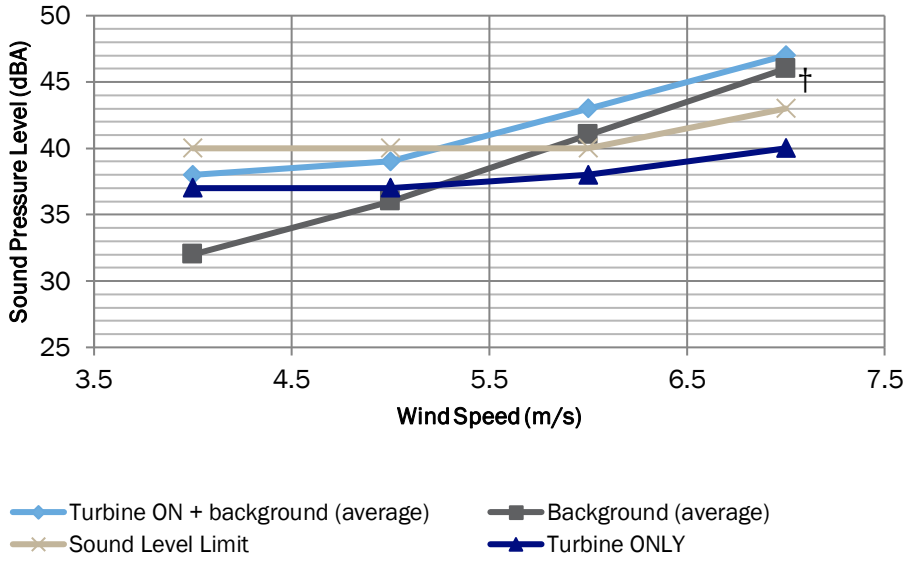


Figure 12 M1395 - Turbine Levels compared to the MECP sound level limits



† Higher uncertainty on calculated Turbine ONLY levels in cases where the measured ambient sound level (Turbine OFF) is within 1 dB of the measured Turbine ON level

Figure 13 M1414 - Turbine Levels compared to the MECP sound level limits



† Higher uncertainty on calculated Turbine ONLY levels in cases where the measured ambient sound level (Turbine OFF) is within 1 dB of the measured Turbine ON level

Figure 14 M96 - Turbine Levels compared to the MECP sound level limits

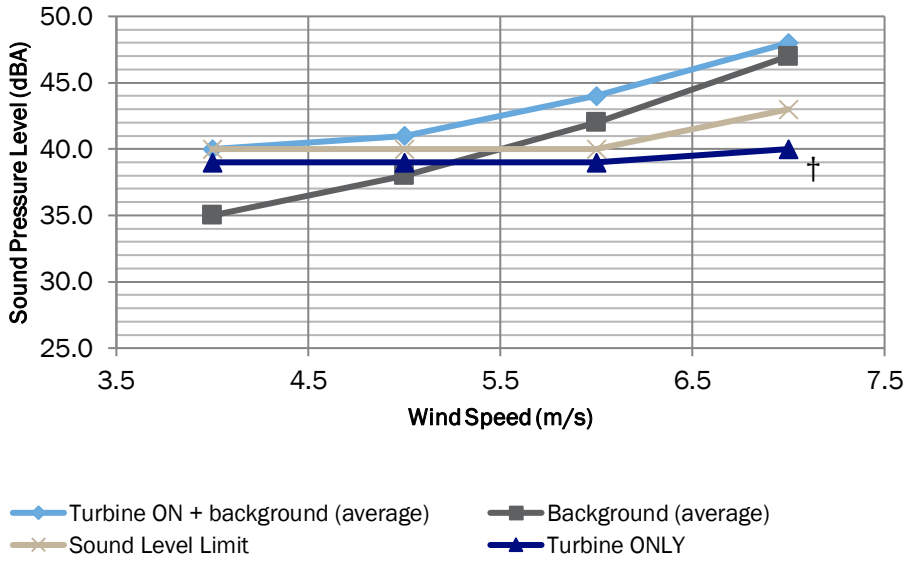
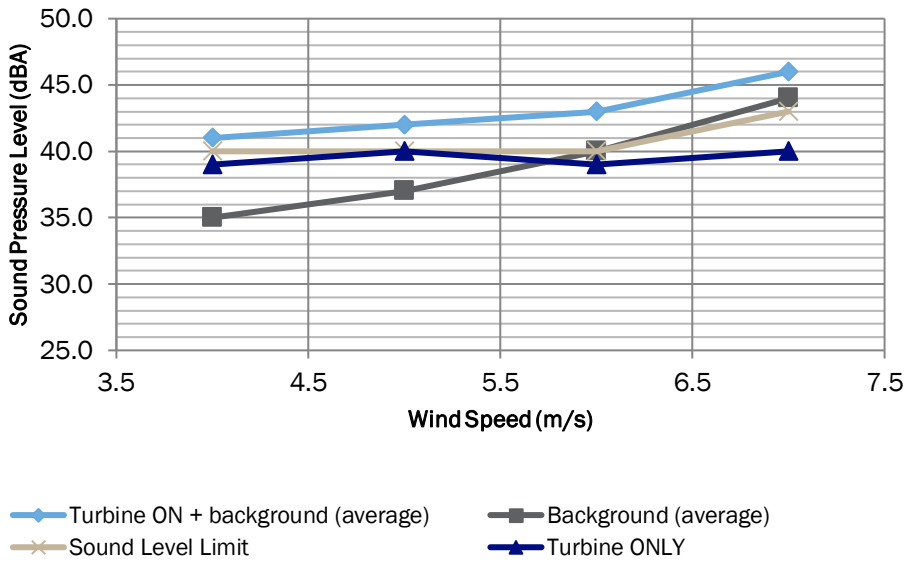


Figure 15 M130 - Turbine Levels compared to MECP sound level limits



6.2 **Tonality**

Our site observations qualitatively indicate no presence of distinctly audible tones at the measurement location. The noise from the wind turbines was subjectively assessed not to be tonal.

Additionally, measurements carried out in accordance with International Standard IEC 61400-11 (Edition 3.0), "Wind turbine generator systems – Part 11: Acoustic noise measurement techniques" did not show any tonal audibilities values of concern at 156m from the turbine. At further distances (>550m) the tonal audibility is expected to be lower.

7 Assessment of Compliance

Based on the calculated turbine only component indicated in Table 9 to Table 13 and Figures 11 to Figure 15, the Cedar Point Wind Power Project is compliant with MECP limits at Receptors R1587, R1395, R1414, R96 and R130.

8 Conclusion

Aercoustics Engineering Limited has completed the acoustic audit outlined in the Renewable Energy Approval for the Cedar Point Wind Power Project. The audit was completed as per the methodology outlined in Part D of the "MOE Compliance Protocol for Wind Turbine Noise." The levels measured were compared to the MECP limits, and the facility was determined in compliance at the receptors audited.

9 References

[1] V. Schroter, “Renewable Energy Approval #8279-9AUP2B”, Ontario Ministry of the Environment, Toronto, ON, June 20, 2013.

[2] Ministry of the Environment, “Compliance Protocol for Wind Turbine Noise – Guideline for Acoustic Assessment and Measurement”, Ontario Ministry of the Environment, Toronto, ON, January 2011.

[3] “Cedar Point All Acoustic Results 2015-11-25, As built 46 WTGs” Howe Gastmeir Chapnik limited, November 25, 2015.

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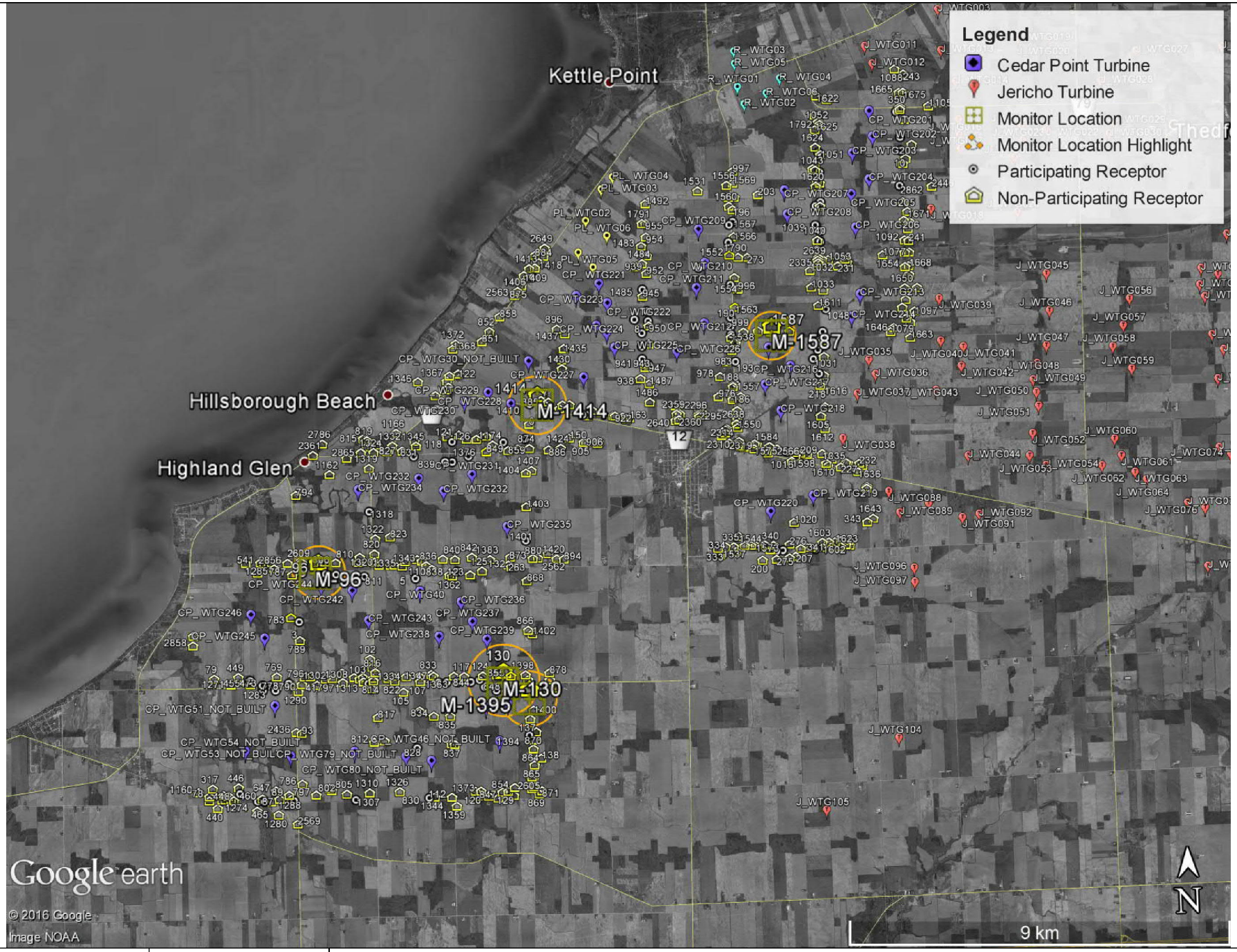
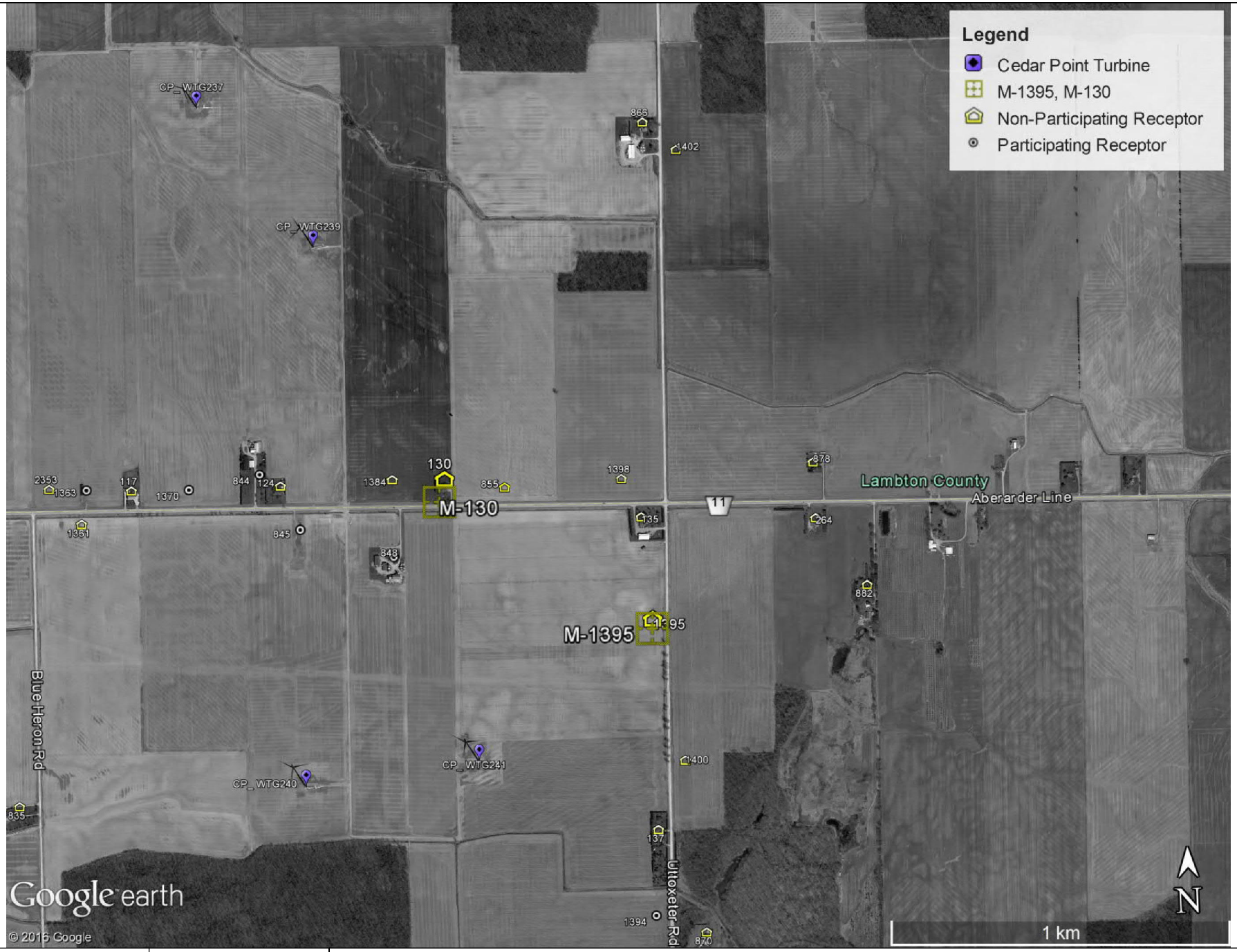
Appendix A
Location Details



aercoustics	15039.00	**Project Name**
	Scale: NTS Drawn by: AM Reviewed by: PA Date: Jul 25, 2016 Revision: 1	Cedar Point Wind Power Project - 1st Acoustic Immission Audit
		Figure Title Site Plan
		Figure A.01

aercoustics	15039.00	**Project Name**
	Scale: NTS Drawn by: AM Reviewed by: PA Date: Jul 25, 2016 Revision: 1	Cedar Point Wind Power Project - 1st Acoustic Immission Audit
		Figure Title M1587 - Monitor and Receptor Location Details
		Figure A.02

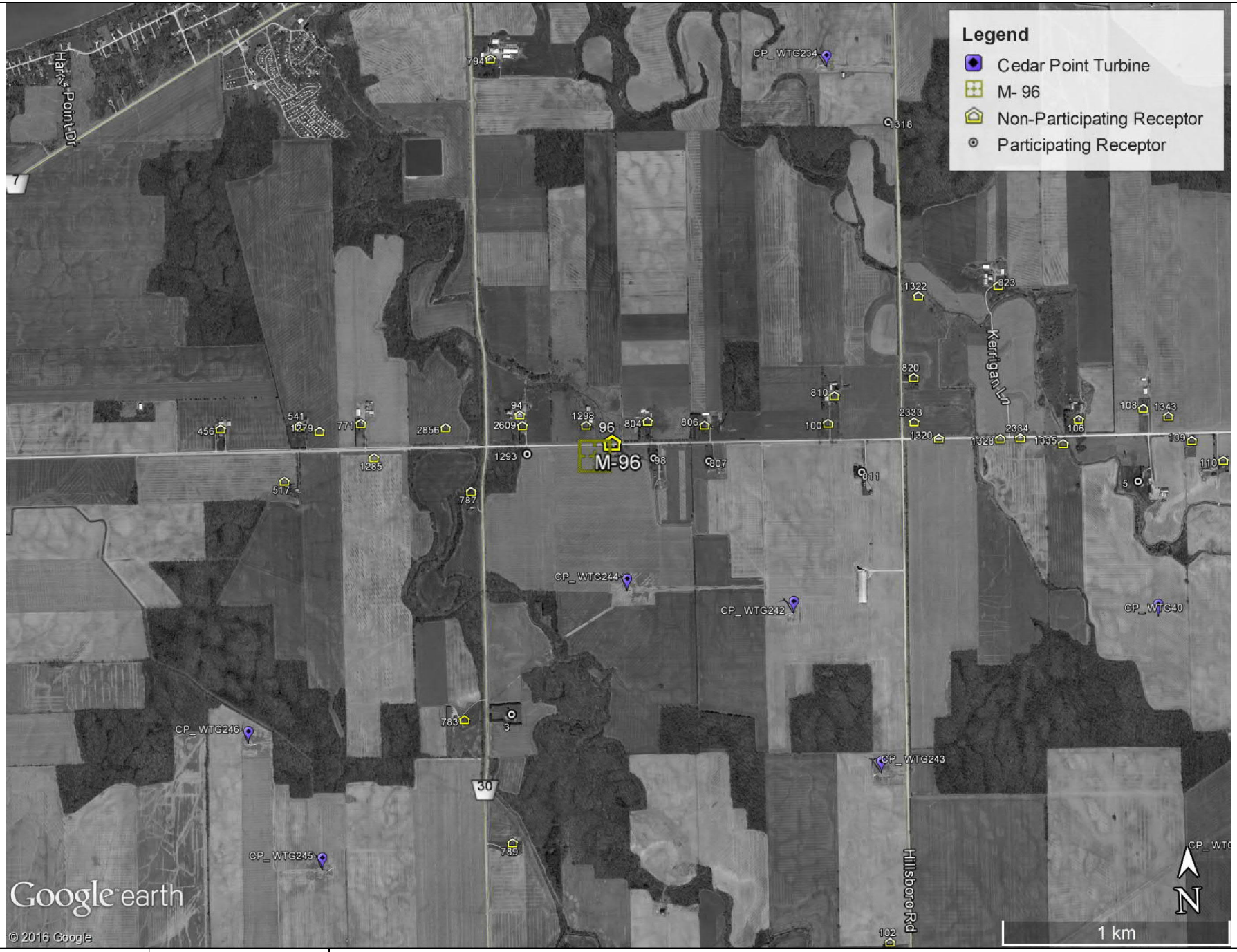


aercoustics	15039.00 Scale: NTS Drawn by: AM Reviewed by: PA Date: Jul 25, 2016 Revision: 1	**Project Name** Cedar Point Wind Power Project - 1st Acoustic Immission Audit **Figure Title** M1395 - Monitor and Receptor Location Details

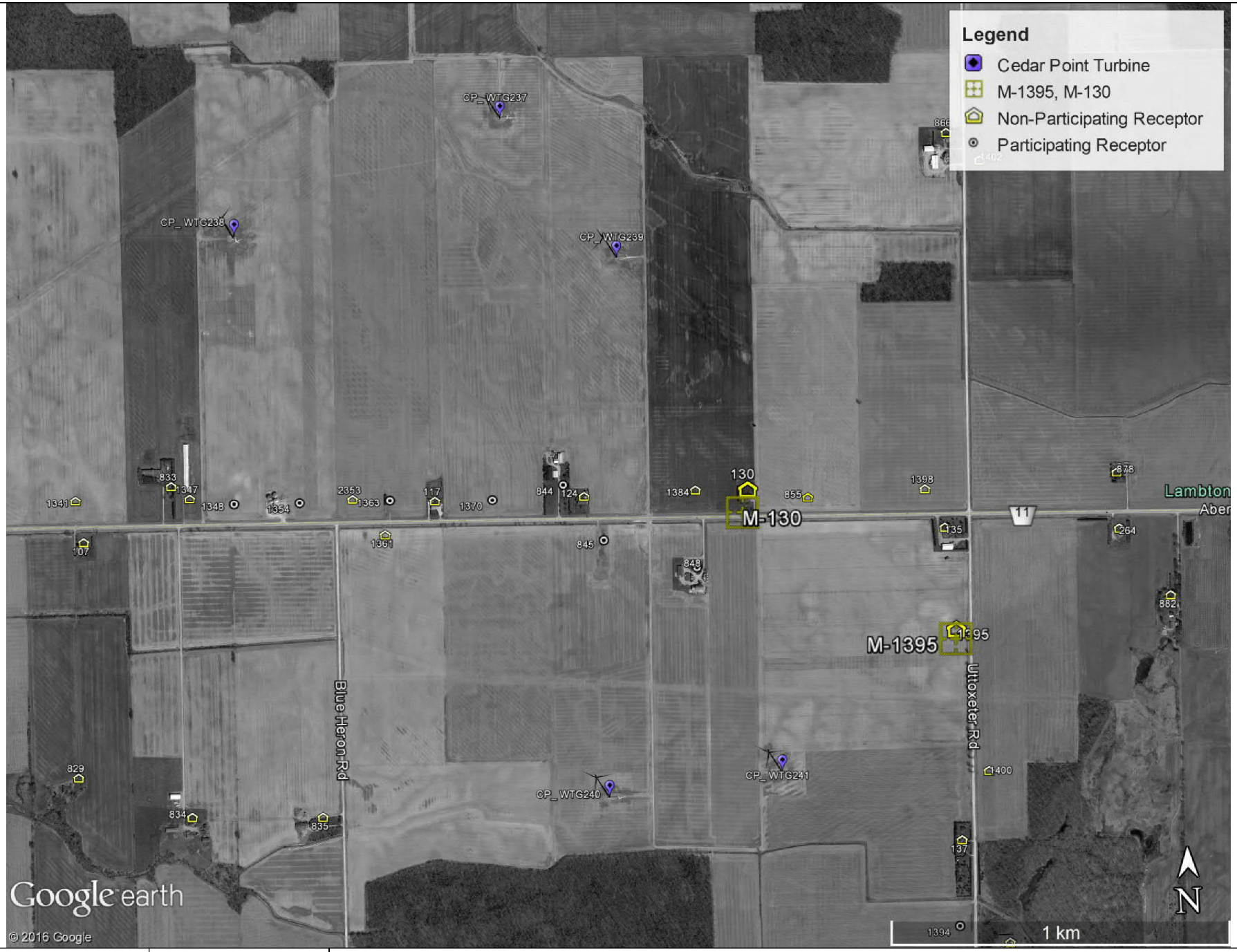
Figure A.03

aercoustics	15039.00 Scale: NTS Drawn by: AM Reviewed by: PA Date: Jul 25, 2016 Revision: 1	**Project Name** Cedar Point Wind Power Project - 1st Acoustic Immission Audit **Figure Title** M1414 - Monitor and Receptor Location Details

Figure A.04



aercoustics	15039.00	**Project Name**
	Scale: NTS Drawn by: AM Reviewed by: PA Date: Jul 25, 2016 Revision: 1	Cedar Point Wind Power Project - 1st Acoustic Immission Audit
		Figure Title M96 - Monitor and Receptor Location Details
		Figure A.05



aercoustics	15039.00 Scale: NTS Drawn by: AM Reviewed by: PA Date: Jul 25, 2016 Revision: 1	**Project Name** Cedar Point Wind Power Project - 1st Acoustic Immission Audit **Figure Title** M130 - Monitor and Receptor Location Details

Figure A.06

aercoustics	15039.00	**Project Name**	
	Scale: NTS Drawn by: AM Reviewed by: PA Date: Jan 30, 2018 Revision: 1	Cedar Point Wind Power Project - 1st Acoustic Immission Audit	
		Figure Title Site Photos - M1587	**Figure A.07**

aercoustics	15039.00	**Project Name**
	Scale: NTS Drawn by: AM Reviewed by: PA Date: Jan 30, 2018 Revision: 1	Cedar Point Wind Power Project - 1st Acoustic Immission Audit
		Figure Title Site Photos - M1395
		Figure A.08

aercoustics	15039.00 Scale: NTS Drawn by: AM Reviewed by: PA Date: Jan 30, 2018 Revision: 1	**Project Name** Cedar Point Wind Power Project - 1st Acoustic Immission Audit	
		Figure Title Site Photos - M1414	**Figure A.09**

aercoustics	15039.00	**Project Name**
	Scale: NTS Drawn by: AM Reviewed by: PA Date: Jan 30, 2018 Revision: 1	Cedar Point Wind Power Project - 1st Acoustic Immission Audit
		Figure Title Site Photos - M96
		Figure A.10

aercoustics	15039.00 Scale: NTS Drawn by: AM Reviewed by: PA Date: Jan 30, 2018 Revision: 1	**Project Name** Cedar Point Wind Power Project - 1st Acoustic Immission Audit	
		Figure Title Site Photos - M130	**Figure A.11**

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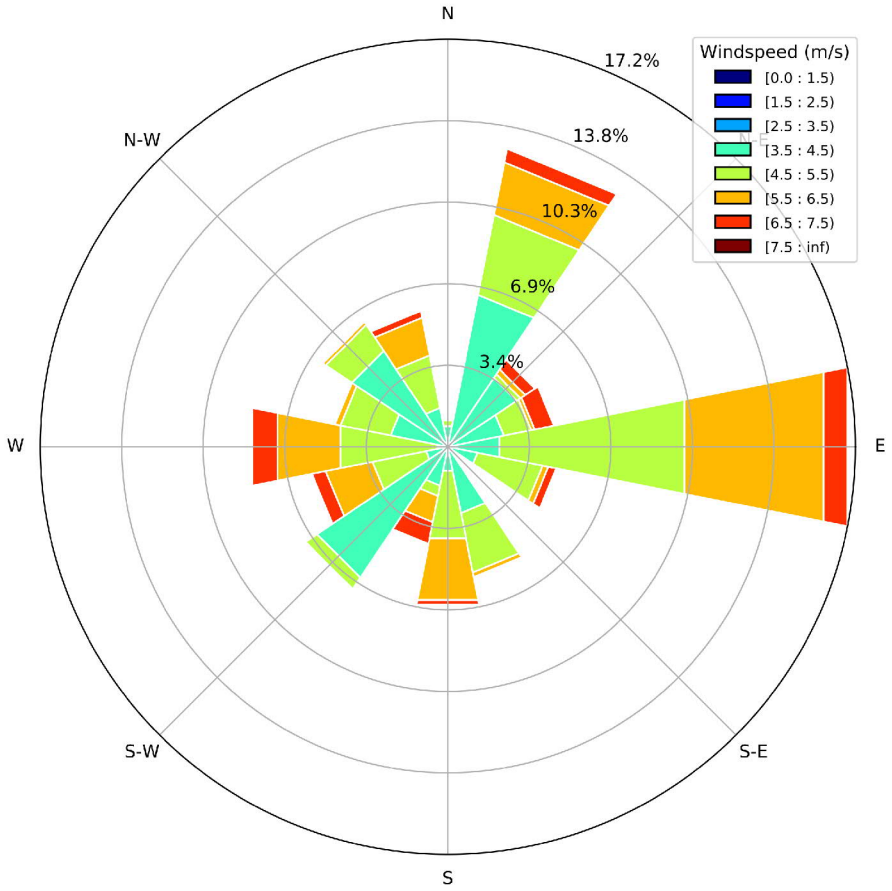
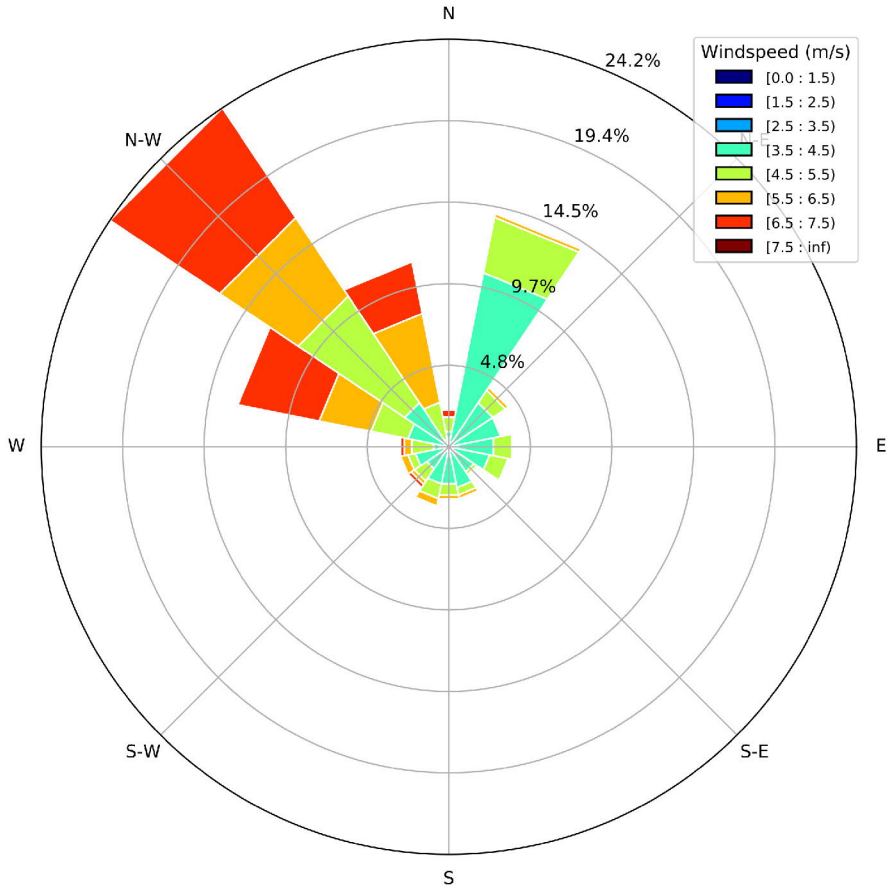
Appendix B
Wind Roses

M1587 TON



M1587 TOFF



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15039.00

Scale: NTS
Drawn by: AM
Reviewed by: PA
Date: Jan 28, 2015
Revision: 1

Project Name

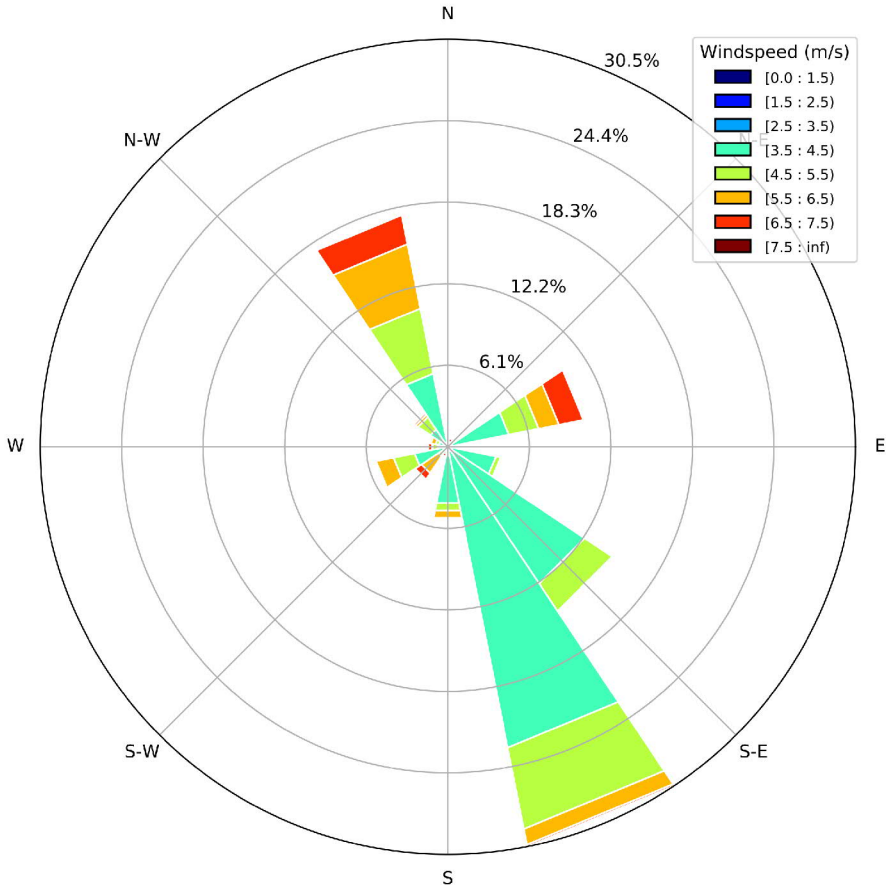
Cedar Point Wind Power Project - 1st Acoustic Immission Audit

Figure Title

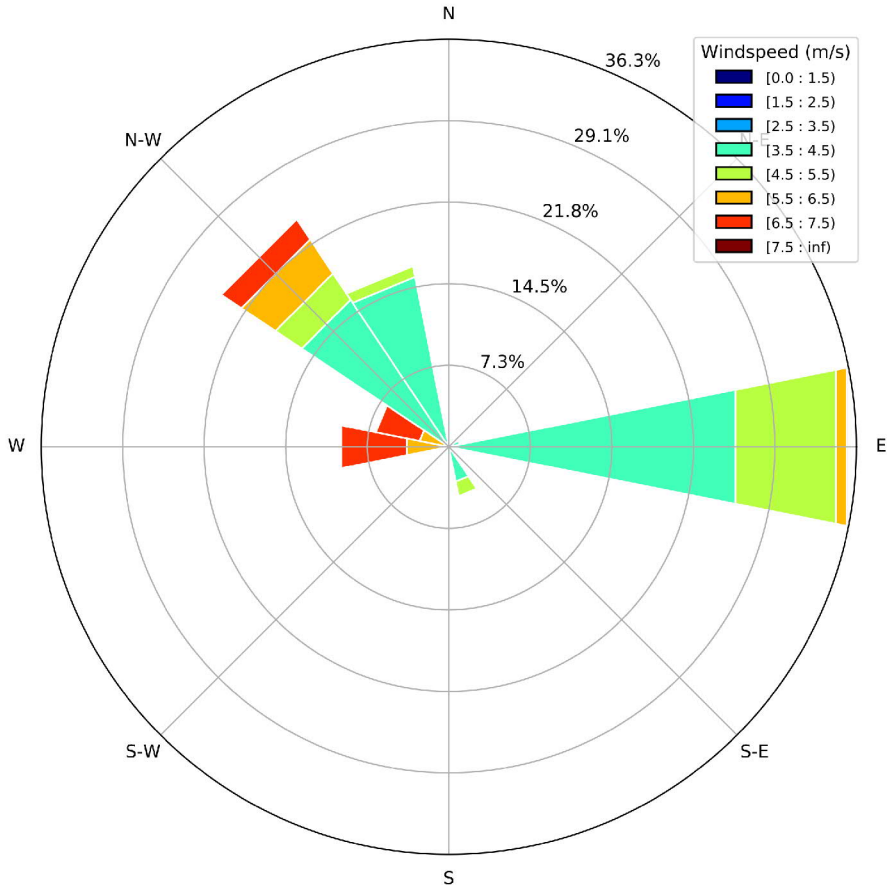
Wind Roses - M1587

Figure B.01

M1395 TON



M1395 TOFF



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15039.00

Scale: NTS
Drawn by: AM
Reviewed by: PA
Date: Sept 25, 2018
Revision: 1

Project Name

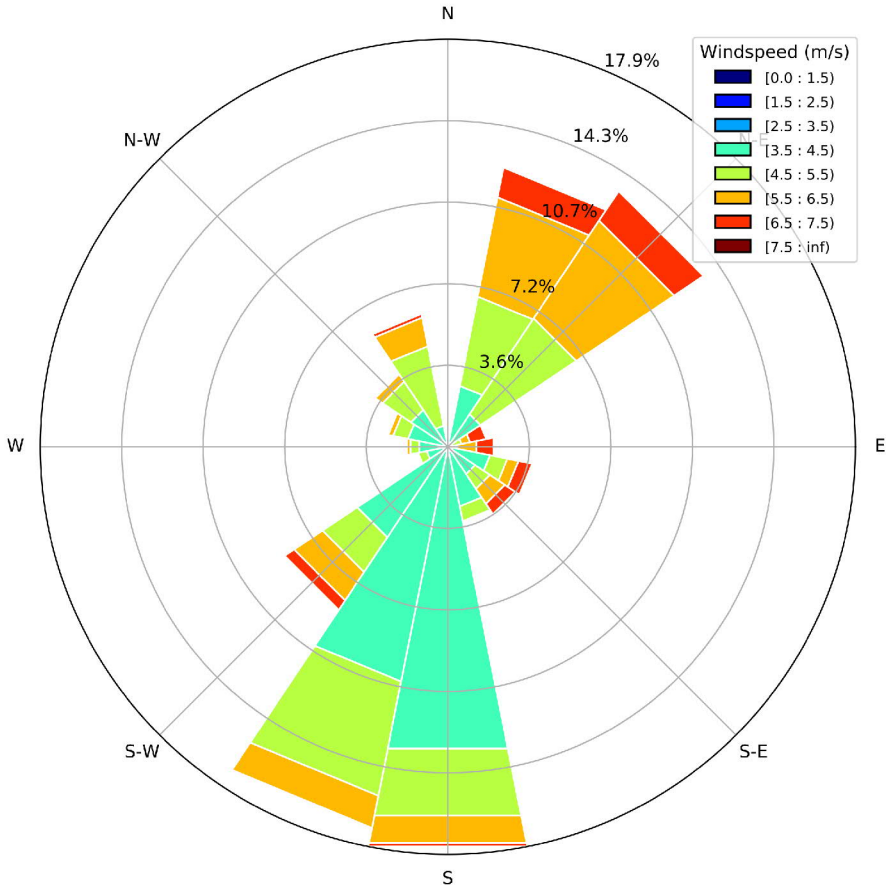
Cedar Point Wind Power Project - 1st Acoustic Immission Audit

Figure Title

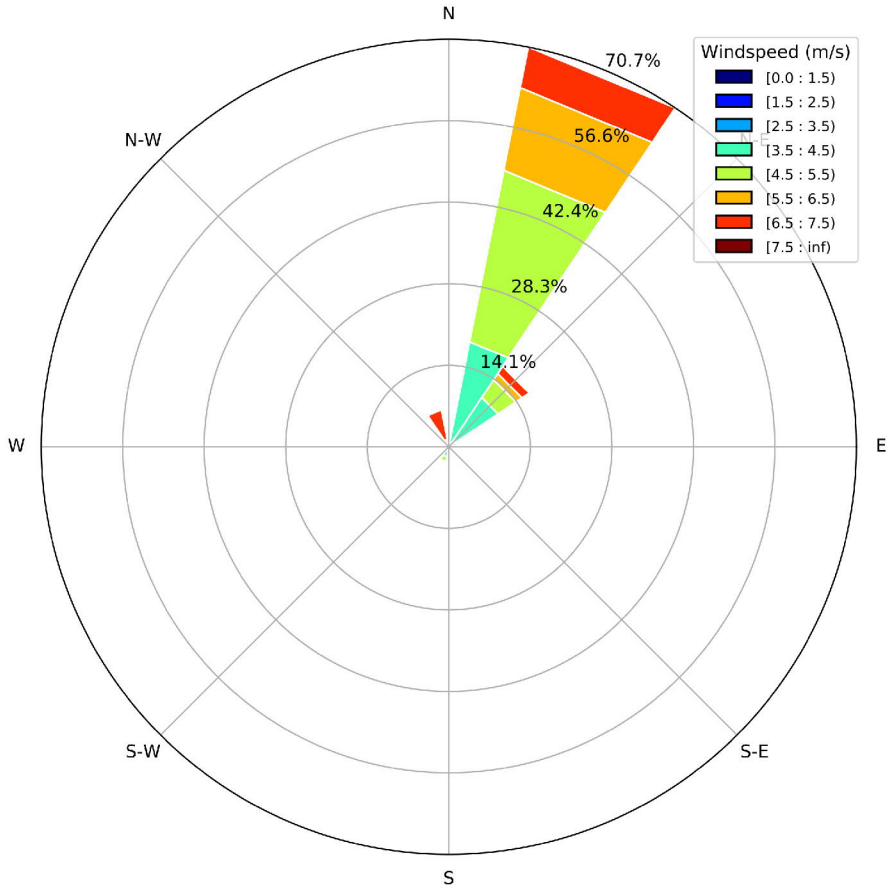
Wind Roses - M1395

Figure B.02

M1414 TON



M1414 TOFF



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15039.00

Scale: NTS
Drawn by: AM
Reviewed by: PA
Date: Jan 28, 2015
Revision: 1

Project Name

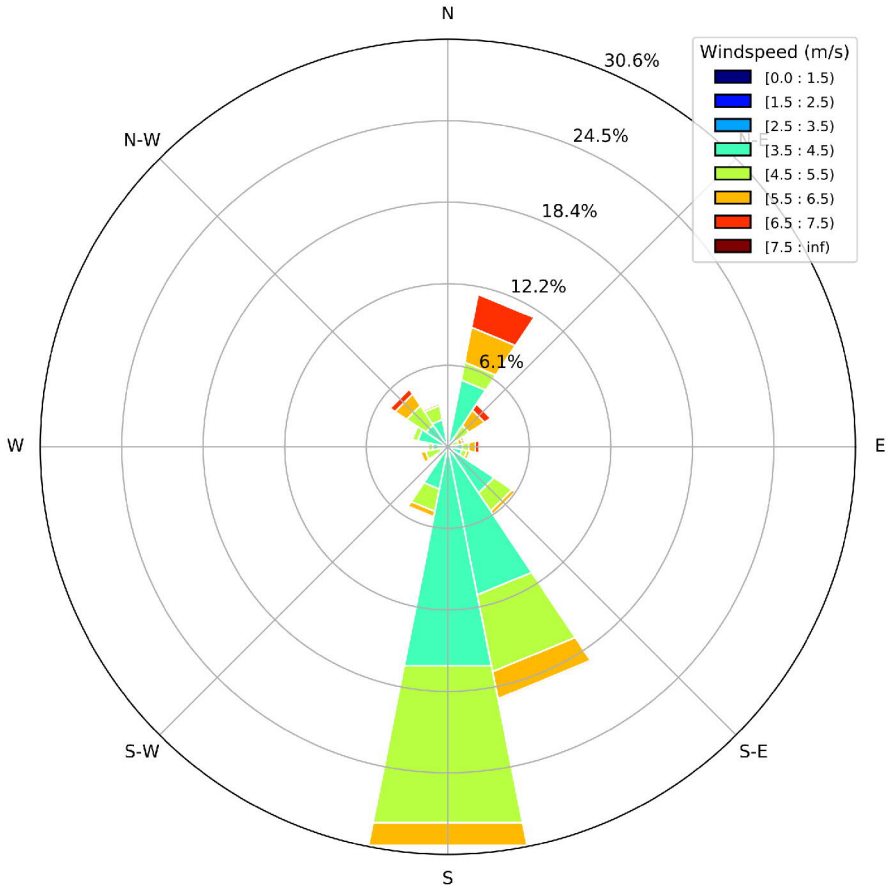
Cedar Point Wind Power Project - 1st Acoustic Immission Audit

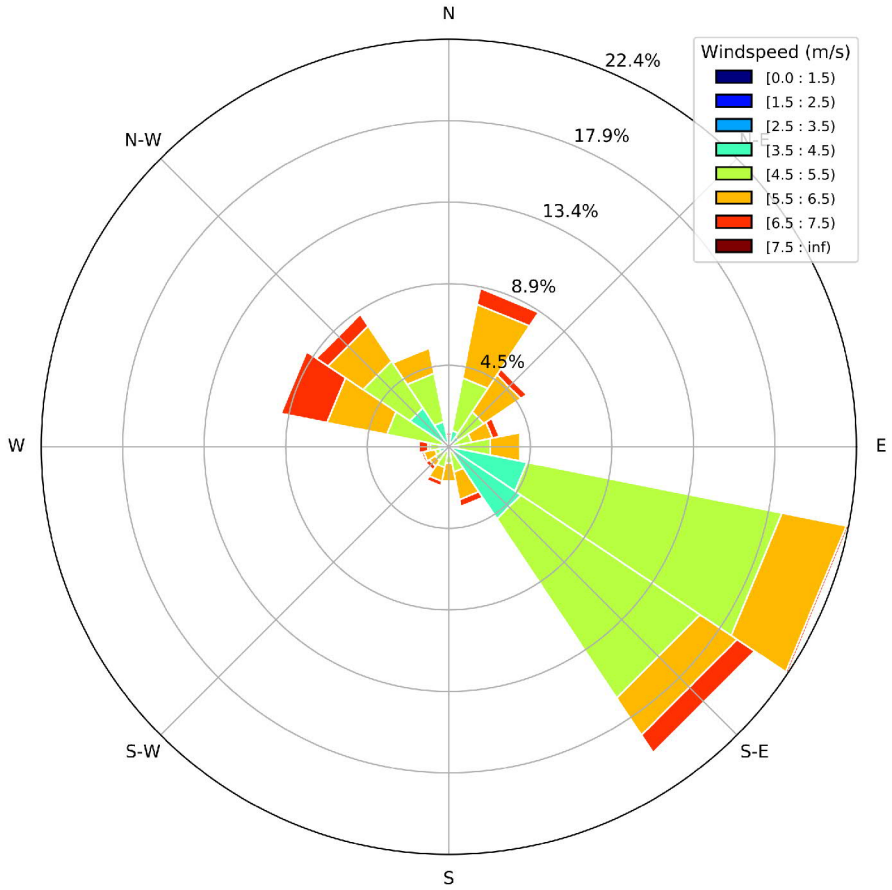
Figure Title

Wind Roses - M1414

Figure B.03

M96 TON	M96 TOFF





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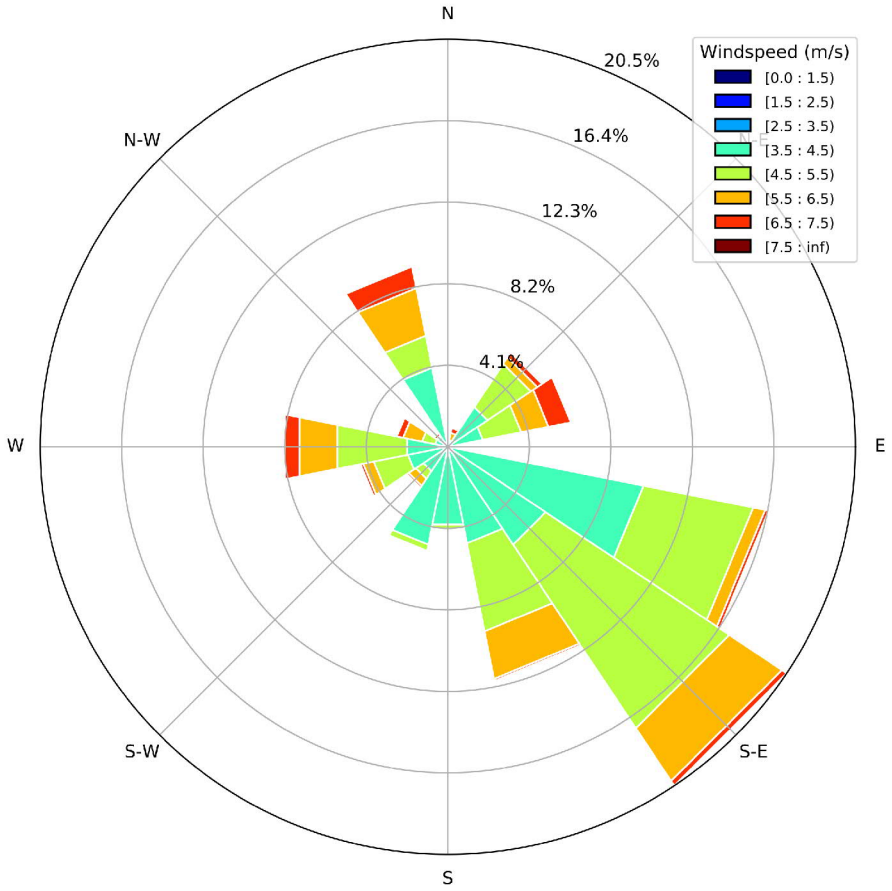
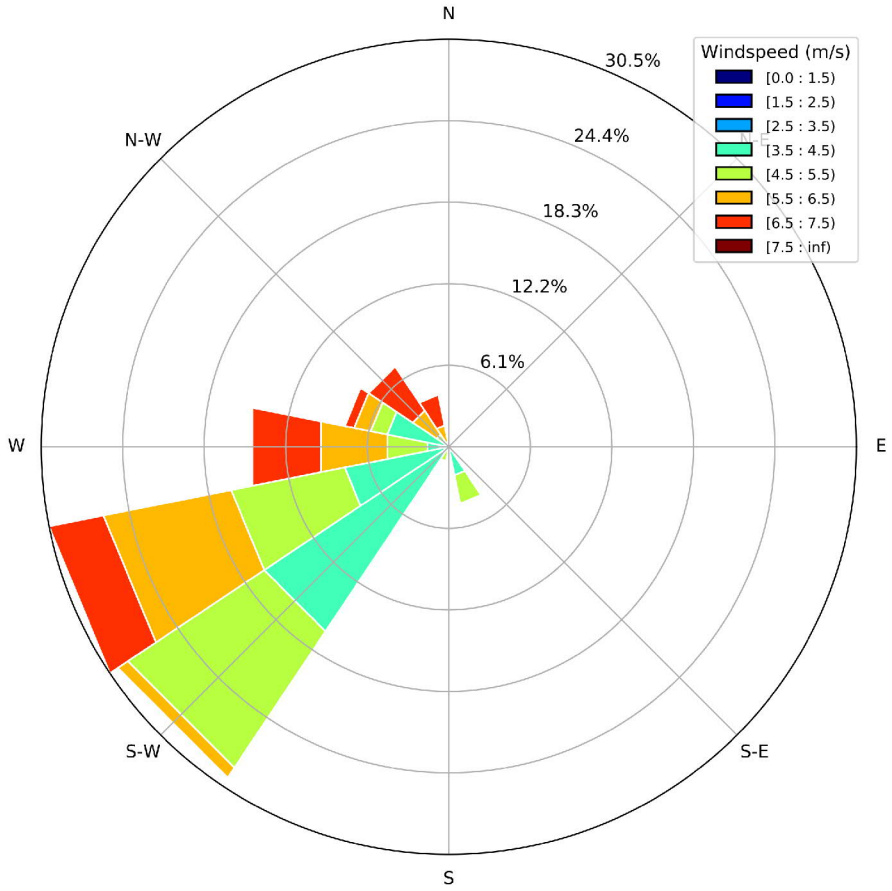
15039.00	**Project Name**
Scale: NTS Drawn by: AM Reviewed by: PA Date: Jan 28, 2015 Revision: 1	Cedar Point Wind Power Project - 1st Acoustic Immission Audit
	Figure Title Wind Roses - M96

Figure B.04

M130 TON	M130 TOFF





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15039.00	**Project Name**
Scale: NTS Drawn by: AM Reviewed by: PA Date: Sept 25, 2018 Revision: 1	Cedar Point Wind Power Project - 1st Acoustic Immission Audit
	Figure Title Wind Roses - M130

Figure B.05

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Appendix C
Turbine Operational Statement from Operator

To whom it may concern:

I can confirm on behalf of the Cedar Point II wind project that the wind turbines that were included in this Immission report were operating normally for the duration of the measurement campaign from March 18th 2016, through June 12th, 2016. More specifically, all wind turbines were in operation and operating normally during the valid data time periods indicated in this report.

Company Name:
NextEra Energy Canadian Operating Services

Name of Company Representative:
Douglas McIntosh

Title:
Regional General Manager
Northeast Wind Operations

Signature of Company Representative:

Date: 9/2/2016.

To whom it may concern:

I can confirm on behalf of the Cedar Point II Wind Power Project that the wind turbines were parked for Ambient Measurements during the measurement campaign from March 18, 2016, through June 12, 2016.

Company Name:

NextEra Energy Canadian Operating Services

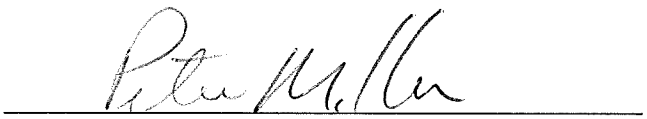
Name of Company Representative:

Peter Miller

Title:

Regional Windsite Manager-Region 6: Canada&East

Signature of Company Representative:



Date:

January 26, 2018

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Appendix D
Gust Filtering Case Study

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Wind Gusting Analysis Summary

The purpose of this document is to provide supporting information for wind turbine receptor audits in which the wind speed gusting filter deviates from that prescribed by the Ministry of the Environment and Climate Change (MOECC). The Compliance Protocol for Wind Turbine Noise requires that the maximum and minimum wind speeds be within 2 m/s of the average wind speed in a measurement interval (1-minute average). Any intervals that do not meet this requirement would be excluded from the analysis. Aercoustics examined the possibility of changing this filtering to only exclude intervals where the maximum wind speed is more than 2 m/s above the average without filtering based on minimum wind speed.

Aercoustics reviewed 11 different data sets representing measurements from 3 different wind farms and 10 different receptor locations. Each data set was filtered using both the prescribed and the modified methods for wind speed gusting. The resulting sound pressure levels for Turbine On and Background measurements were computed for each wind bin. The change in number of valid data points and the change in measured sound pressure level were calculated. The increase in number of data points and change in sound pressure from the prescribed filtering method to the proposed method were averaged across the 11 data sets. The mean values by wind speed are presented in Table 1 below.

Table 1: Results

Wind Bins	Turbine ON		Background	
	Difference (pts)	Difference (dB)	Difference (pts)	Difference (dB)
3	2%	0.0	3%	0.0
4	6%	0.1	7%	0.0
5	10%	0.1	9%	0.1
6	11%	0.1	13%	0.1
7	21%	0.1	25%	0.1

These results clearly show that the proposed modification of the wind speed gusting filter increases the number of data points in all wind bins, with a more pronounced effect at high wind speeds. The over 20% increase in data points in the 7 m/s wind bins is significant as these wind speeds are typically the most difficult to measure and can considerably increase the time required to complete an audit. There are negligible increases in the measured sound levels, which occur during both Turbine On and Background measurements.

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Appendix E - Turbine Status during TON and TOFF

Cedar Point - Turbine Status Matrix for TON and TOFF

AAR ID	CP ID	Monitor Locations				
		M-1587	M-1414	M-96	M-130	M-1395
CP_WTG1	CP 201					
CP_WTG2	CP 202					
CP_WTG4	CP 203					
CP_WTG5	CP 204					
CP_WTG6	CP 205					
CP_WTG8	CP 206					
CP_WTG7	CP 207					
CP_WTG82	CP 208					
CP_WTG10	CP 209					
CP_WTG13	CP 210	1				
CP_WTG14	CP 211	1				
CP_WTG17	CP 212	1				
CP_WTG9	CP 213	1				
CP_WTG11	CP 214	1				
CP_WTG15	CP 215	1				
CP_WTG16	CP 216	1				
CP_WTG18	CP 217	1				
CP_WTG20	CP 218	1				
CP_WTG26	CP 219					
CP_WTG29	CP 220					
CP_WTG21	CP 221					
CP_WTG22	CP 222					
CP_WTG23	CP 223					
CP_WTG24	CP 224					
CP_WTG25	CP 225					
CP_WTG19	CP 226	1				
CP_WTG27	CP 227		1			
CP_WTG31	CP 228		1			
CP_WTG32	CP 229		1			
CP_WTG34	CP 230		1			
CP_WTG35	CP 231					
CP_WTG36	CP 232					
CP_WTG37	CP 233					
CP_WTG39	CP 234					
CP_WTG71	CP 235					
CP_WTG81	CP 236					
CP_WTG76	CP 237					
CP_WTG69	CP 238					
CP_WTG70	CP 239				1	
CP_WTG42	CP 240				1	1
CP_WTG72	CP 241				1	1
CP_WTG41	CP 242			1		
CP_WTG43	CP 243			1		
CP_WTG44	CP 244			1		
CP_WTG48	CP 245					
CP_WTG47	CP 246					

1- Turbine ON/OFF

Turbines Turned off such that predicted impact at monitor/receptor location is 30 dBA or less

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Appendix F
Receptor Selection Rationale

Appendix F - Receptor Selection Summary

Project: Cedar Point Wind Power Project

Receptor ID	Description	Modelled Sound Level (dBA)	Receptor Height (m)	Distance to Closest Turbine (m)	Closest Turbine ID	Rationale
1437	Non-Participating Vacant Lot	39.5	4.5	746	Suncor WTG24	Not in Prevailing Wind Direction
1489	Non-Participating Vacant Lot	39.4	4.5	728	Suncor WTG19	Not in Prevailing Wind Direction
1630	Non-Participating Vacant Lot	39.4	4.5	749	Suncor WTG6	Not in Prevailing Wind Direction
1020	Non-Participating Receptor	39.3	4.5	567	Suncor WTG29	Not in Prevailing Wind Direction
945	Non-Participating Receptor	39.1	4.5	900	Suncor WTG22	In Proximity to ProofLine Wind Farm (impact above 30dBA), cannot reach below 30 dBA even if all Cedar Point Turbines Parked
950	Non-Participating Receptor	39.0	4.5	990	Suncor WTG19	Not in Prevailing Wind Direction
1620	Non-Participating Vacant Lot	38.9	4.5	780	Suncor WTG7	In Proximity to ProofLine Wind Farm (impact above 30dBA), cannot reach below 30 dBA even if all Cedar Point Turbines Parked
943	Non-Participating Receptor	38.9	4.5	762	Suncor WTG25	Not in Prevailing Wind Direction
6	Non-Participating Receptor	38.9	4.5	550	Suncor WTG31	Not in Prevailing Wind Direction
224	Non-Participating Receptor	38.9	4.5	844	Suncor WTG6	Not in Prevailing Wind Direction
952	Non-Participating Receptor	38.9	4.5	1192	Suncor WTG21	In Proximity to ProofLine Wind Farm (impact above 30dBA), cannot reach below 30 dBA even if all Cedar Point Turbines Parked
1430	Non-Participating Vacant Lot	38.8	4.5	613	Suncor WTG27	Not in Prevailing Wind Direction
1538	Non-Participating Vacant Lot	38.8	4.5	662	Suncor WTG17	Not in Prevailing Wind Direction
222	Non-Participating Receptor	38.7	4.5	853	Suncor WTG7	In Proximity to ProofLine Wind Farm (impact above 30dBA), cannot reach below 30 dBA even if all Cedar Point Turbines Parked
896	Non-Participating Receptor	38.7	4.5	781	Suncor WTG23	Not in Prevailing Wind Direction
124	Non-Participating Receptor	38.7	4.5	728	Suncor WTG70	Not in Prevailing Wind Direction
994	Non-Participating Receptor	38.7	4.5	599	Suncor WTG18	Not in Prevailing Wind Direction
1587	Non-Participating Vacant Lot	38.7	4.5	554	Suncor WTG15	Selected Monitoring Location
1100	Non-Participating Receptor	38.7	7.5	923	Suncor WTG2	Not in Prevailing Wind Direction
850	Non-Participating Receptor	38.6	4.5	842	Suncor WTG34	Not in Prevailing Wind Direction
846	Non-Participating Receptor	38.6	4.5	781	Suncor WTG34	Not in Prevailing Wind Direction
947	Non-Participating Receptor	38.6	4.5	696	Suncor WTG19	Not in Prevailing Wind Direction
1384	Non-Participating Vacant Lot	38.6	4.5	741	Suncor WTG70	Not in Prevailing Wind Direction
203	Non-Participating Receptor	38.5	4.5	624	Suncor WTG7	Not in Prevailing Wind Direction
1480	Non-Participating Vacant Lot	38.5	4.5	787	Suncor WTG19	Not in Prevailing Wind Direction
1002	Non-Participating Receptor	38.5	4.5	588	Suncor WTG15	Not in Prevailing Wind Direction
121	Non-Participating Receptor	38.5	4.5	651	Suncor WTG34	Not in Prevailing Wind Direction
1435	Non-Participating Vacant Lot	38.5	4.5	866	Suncor WTG24	Not in Prevailing Wind Direction
350	Non-Participating Receptor	38.5	4.5	751	Suncor WTG1	Not in Prevailing Wind Direction
1051	Non-Participating Receptor	38.4	4.5	757	Suncor WTG4	Not in Prevailing Wind Direction
218	Non-Participating Receptor	38.4	4.5	775	Suncor WTG16	Not in Prevailing Wind Direction
240	Non-Participating Receptor	38.4	4.5	762	Suncor WTG1	Not in Prevailing Wind Direction
1673	Non-Participating Vacant Lot	38.4	4.5	836	Suncor WTG1	Not in Prevailing Wind Direction
10	Non-Participating Receptor	38.4	4.5	867	Suncor WTG2	Not in Prevailing Wind Direction
1617	Non-Participating Vacant Lot	38.4	4.5	795	Suncor WTG16	Not in Prevailing Wind Direction
1634	Non-Participating Vacant Lot	38.3	4.5	1087	Suncor WTG1	Not in Prevailing Wind Direction
126	Non-Participating Receptor	38.3	4.5	790	Suncor WTG34	Not in Prevailing Wind Direction
843	Non-Participating Receptor	38.3	4.5	735	Suncor WTG34	Not in Prevailing Wind Direction
1043	Non-Participating Receptor	38.3	4.5	918	Suncor WTG4	Not in Prevailing Wind Direction
192	Non-Participating Receptor	38.3	4.5	805	Suncor WTG17	Not in Prevailing Wind Direction
270	Non-Participating Receptor	38.3	4.5	795	Suncor WTG17	Not in Prevailing Wind Direction
1431	Non-Participating Vacant Lot	38.3	4.5	751	Suncor WTG27	Not in Prevailing Wind Direction
1792	Non-Participating Vacant Lot	38.3	4.5	1185	Suncor WTG4	Not in Prevailing Wind Direction
1552	Non-Participating Vacant Lot	38.3	4.5	665	Suncor WTG13	In Proximity to ProofLine Wind Farm (impact above 30dBA), cannot reach below 30 dBA even if all Cedar Point Turbines Parked
1672	Non-Participating Vacant Lot	38.2	4.5	866	Suncor WTG2	Not in Prevailing Wind Direction
130	Non-Participating Receptor	38.2	4.5	811	Suncor WTG72	Selected Monitoring Location
1052	Non-Participating Receptor	38.2	4.5	1119	Suncor WTG4	Not in Prevailing Wind Direction
189	Non-Participating Receptor	38.2	4.5	820	Suncor WTG17	Not in Prevailing Wind Direction
985	Non-Participating Receptor	38.2	4.5	801	Suncor WTG17	Not in Prevailing Wind Direction
1044	Non-Participating Receptor	38.1	4.5	893	Suncor WTG4	Not in Prevailing Wind Direction
1625	Non-Participating Vacant Lot	38.1	4.5	1121	Suncor WTG4	Not in Prevailing Wind Direction
219	Non-Participating Receptor	38.1	4.5	931	Suncor WTG7	In Proximity to Ravenswood and Jericho Wind Farm (impact above 30dBA), cannot reach below 30 dBA even if all Cedar Point Turbines Parked
152	Non-Participating Receptor	38.1	4.5	603	Suncor WTG27	Not in Prevailing Wind Direction
1041	Non-Participating Receptor	38.0	4.5	875	Suncor WTG16	In Proximity to Jericho Wind Farm (impact above 30dBA), cannot reach below 30 dBA even if all Cedar Point Turbines Parked
1624	Non-Participating Vacant Lot	38.0	4.5	918	Suncor WTG4	Not in Prevailing Wind Direction
1414	Non-Participating Vacant Lot	38.0	4.5	676	Suncor WTG31	Selected Monitoring Location
114	Non-Participating Receptor	37.9	4.5	608	Suncor WTG34	Not in Prevailing Wind Direction
1646	Non-Participating Vacant Lot	37.9	4.5	1007	Suncor WTG11	Not in Prevailing Wind Direction
1057	Non-Participating Receptor	37.9	4.5	659	Suncor WTG8	Not in Prevailing Wind Direction
999	Non-Participating Receptor	37.9	4.5	778	Suncor WTG15	Not in Prevailing Wind Direction
137	Non-Participating Receptor	37.9	4.5	574	Suncor WTG72	Not in Prevailing Wind Direction
1365	Non-Participating Vacant Lot	37.8	4.5	621	Suncor WTG34	Not in Prevailing Wind Direction
1621	Non-Participating Vacant Lot	37.8	4.5	780	Suncor WTG11	Not in Prevailing Wind Direction
849	Non-Participating Receptor	37.8	4.5	765	Suncor WTG35	Permission not Granted
96	Non-Participating Receptor	37.8	4.5	611	Suncor WTG44	Selected Monitoring Location
1040	Non-Participating Receptor	37.8	4.5	851	Suncor WTG82	Not in Prevailing Wind Direction
1565	Non-Participating Vacant Lot	37.8	4.5	728	Suncor WTG13	Not in Prevailing Wind Direction
1058	Non-Participating Receptor	37.8	4.5	708	Suncor WTG8	Not in Prevailing Wind Direction
117	Non-Participating Receptor	37.7	4.5	911	Suncor WTG70	Not in Prevailing Wind Direction

Appendix F - Receptor Selection Summary

Project: Cedar Point Wind Power Project

Receptor ID	Description	Modelled Sound Level (dBA)	Receptor Height (m)	Distance to Closest Turbine (m)	Closest Turbine ID	Rationale
857	Non-Participating Receptor	37.7	4.5	582	Suncor WTG71	Not in Prevailing Wind Direction
1174	Non-Participating Vacant Lot	37.6	4.5	934	Suncor WTG31	Not in Prevailing Wind Direction
1025	Non-Participating Receptor	37.6	4.5	725	Suncor WTG15	Receptor location 400m away from selected monitoring location M1587
983	Non-Participating Receptor	37.6	4.5	926	Suncor WTG17	Not in Prevailing Wind Direction
188	Non-Participating Receptor	37.5	4.5	765	Suncor WTG18	Not in Prevailing Wind Direction
984	Non-Participating Receptor	37.5	4.5	772	Suncor WTG18	Not in Prevailing Wind Direction
938	Non-Participating Receptor	37.5	4.5	856	Suncor WTG25	Not in Prevailing Wind Direction
1563	Non-Participating Vacant Lot	37.5	4.5	895	Suncor WTG17	Permission not Granted
855	Non-Participating Receptor	37.5	4.5	797	Suncor WTG72	Receptor location 175m away from selected monitoring location M130
881	Non-Participating Receptor	37.5	4.5	747	Suncor WTG31	Not in Prevailing Wind Direction
1449	Non-Participating Vacant Lot	37.4	4.5	666	Suncor WTG27	Not in Prevailing Wind Direction
1364	Non-Participating Vacant Lot	37.3	4.5	792	Suncor WTG34	Not in Prevailing Wind Direction
1400	Non-Participating Vacant Lot	37.3	4.5	612	Suncor WTG72	Not in Prevailing Wind Direction
2353	Non-Participating Vacant Lot	37.3	4.5	861	Suncor WTG69	Not in Prevailing Wind Direction
783	Non-Participating Receptor	37.2	4.5	889	Suncor WTG48	Poor monitoring location; low point surrounded by trees
1395	Non-Participating Vacant Lot	37.2	4.5	646	Suncor WTG72	Selected Monitoring Location

aercoustics

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Appendix G
Calibration Certificates

~ Certificate of Calibration and Compliance ~

Model: 378B02	Serial Number: 123030	
Microphone Model: 377B02	Serial Number: 148047	Manufacturer: PCB
Preamplifier Model: 426E01	Serial Number: 041166	Manufacturer: PCB

Calibration Environmental Conditions

Environmental test conditions as printed on microphone calibration chart.

Reference Equipment

Manufacturer	Model #	Serial #	PCB Control #	Cal Date	Due Date
Larson Davis	PRM915	122	CA865	10/26/15	10/26/16
Larson Davis	PRM916	104	LD015	3/10/15	3/10/16
Larson Davis	CAL250	5025	CA1277	5/14/15	5/13/16
Larson Davis	2201	102	LD022	3/2/15	3/2/16
Larson Davis	PRA951-4	241	CA1449	9/29/15	9/29/16
Larson Davis	PRM902	5352	CA1247	3/10/15	3/10/16
Larson Davis	GPRM902	4923	CA2237	8/6/15	8/5/16
Bruel & Kjaer	4192	2764626	CA1636	6/15/15	6/15/16
Larson Davis	ADP005	0	0	not required	not required
Newport	BTH-W/N	8410668	CA1187	not required	not required
National Instruments	PCI-6251	1162ED1	CA1740	7/29/15	7/29/16
0	0	0	0	not required	not required
0	0	0	0	not required	not required
0	0	0	0	not required	not required
0	0	0	0	not required	not required

Frequency sweep performed with B&K UA0033 electrostatic actuator.

Condition of Unit

As Found: n/a

As Left: New Unit, In Tolerance

Notes

1. Calibration of reference equipment is traceable to one or more of the following National Labs; NIST, PTB or DFM.
2. This certificate shall not be reproduced, except in full, without written approval from PCB Piezotronics, Inc.
3. Calibration is performed in compliance with ISO 9001, ISO 10012-1, ANSI/NCSL Z540.3 and ISO 17025.
4. See Manufacturer's Specification Sheet for a detailed listing of performance specifications.
5. System Sensitivity is measured following procedure AT603-5.
6. Measurement uncertainty (95% confidence level with coverage factor of 2) for sensitivity is +/-0.20 dB.
7. Unit calibrated per ACS-63.

Technician: Nicholas Herdlein NH Date: January 7, 2016

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CALIBRATION CERT #1662.01

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3425 Walden Avenue, Depew, New York, 14043

TEL: 888-684-0013 FAX: 716-685-3886 www.pcb.com

ID CAL61-3535018123 439

~ Calibration Report ~

Model: 378B02 Serial Number: 123030
Microphone Model: 377B02 Serial Number: 148047 Description: 1/2" Free-Field Microphone
Preamplifier Model: 426E01 Serial Number: 041166 and Preamplifier

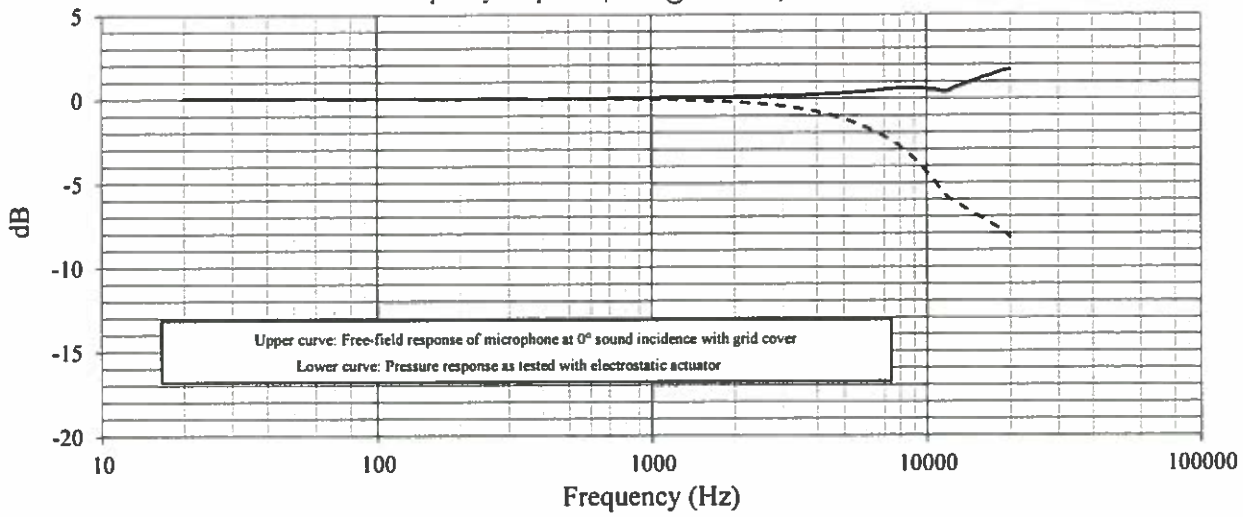
Calibration Data

System Sensitivity @ 251.2 Hz: 49.32 mV/Pa
-26.14 dB re 1V/Pa

Polarization Voltage, External: 0 V

Temperature: 72 °F (22°C) Ambient Pressure: 999 mbar Relative Humidity: 24 %

Frequency Response (0 dB @ 251.2 Hz)



Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)
20.0	0.05	0.05	1679	-0.15	0.08	7499	-2.51	0.56	-	-	-
25.1	0.04	0.04	1778	-0.16	0.09	7943	-2.79	0.60	-	-	-
31.6	0.04	0.04	1884	-0.18	0.10	8414	-3.14	0.59	-	-	-
39.8	0.05	0.05	1995	-0.20	0.11	8913	-3.51	0.60	-	-	-
50.1	0.04	0.04	2114	-0.23	0.11	9441	-3.92	0.60	-	-	-
63.1	0.04	0.04	2239	-0.25	0.12	10000	-4.39	0.56	-	-	-
79.4	0.03	0.03	2371	-0.28	0.13	10593	-4.86	0.54	-	-	-
100.0	0.03	0.03	2512	-0.31	0.15	11220	-5.41	0.45	-	-	-
125.9	0.02	0.02	2661	-0.35	0.16	11885	-5.88	0.44	-	-	-
158.5	0.01	0.01	2818	-0.40	0.16	12589	-6.12	0.65	-	-	-
199.5	0.01	0.01	2985	-0.44	0.18	13335	-6.39	0.80	-	-	-
251.2	0.00	0.00	3162	-0.49	0.19	14125	-6.63	0.96	-	-	-
316.2	-0.01	0.00	3350	-0.56	0.18	14962	-6.89	1.08	-	-	-
398.1	-0.01	-0.01	3548	-0.62	0.20	15849	-7.10	1.25	-	-	-
501.2	-0.02	0.02	3758	-0.69	0.21	16788	-7.37	1.35	-	-	-
631.0	-0.03	0.02	3981	-0.77	0.23	17783	-7.61	1.50	-	-	-
794.3	-0.03	0.06	4217	-0.86	0.25	18837	-7.87	1.64	-	-	-
1000.0	-0.05	0.07	4467	-0.96	0.28	19953	-8.23	1.70	-	-	-
1059.3	-0.06	0.07	4732	-1.09	0.28	-	-	-	-	-	-
1122.0	-0.07	0.07	5012	-1.21	0.32	-	-	-	-	-	-
1188.5	-0.07	0.08	5309	-1.35	0.35	-	-	-	-	-	-
1258.9	-0.08	0.08	5623	-1.51	0.38	-	-	-	-	-	-
1333.5	-0.09	0.09	5957	-1.67	0.40	-	-	-	-	-	-
1412.5	-0.10	0.09	6310	-1.85	0.44	-	-	-	-	-	-
1496.2	-0.12	0.08	6683	-2.05	0.47	-	-	-	-	-	-
1584.9	-0.13	0.08	7080	-2.26	0.52	-	-	-	-	-	-

Technician: Nicholas Herdlein NH Date: January 7, 2016

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VAISALA

Test report no. H31-16040160

TEST REPORT

Instrument	WXT520 AAB1BE30B0
Serial number	M0410646
Manufacturer	Vaisala Oyj, Finland
Test date	28th January 2016

This test report certifies that the instrument was thoroughly tested and inspected, and found to meet its published test limits when it was shipped from Vaisala.

Test results

Test	Result	Limit	Passed
Rain response	426.0 mV	(345...575) mV	OK
Zero wind speed	0.00 m/s	(0...0.4) m/s	OK
Pressure	978.5 hPa	PASS/FAIL	OK
Temperature	22.3 °C	PASS/FAIL	OK
Humidity	29.3 %RH	PASS/FAIL	OK
Heating	PASS	PASS/FAIL	OK
Current (service port)	0.57	(0.2...0.7) mA	OK
Communication (service port)	PASS	PASS/FAIL	OK
Current (main port)	0.32	(0.1...0.4) mA	OK
Communication (main port)	PASS	PASS/FAIL	OK

Signature

Technician

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VAISALA

Calibration sheet no. H31-16040159

CALIBRATION SHEET

Instrument	WXTPTU
Serial number	L5040044
Manufacturer	Vaisala Oyj, Finland
Test date	28th January 2016

This test report certifies that the instrument was thoroughly tested and inspected, and found to meet its published test limits when it was shipped from Vaisala.

Calibration results

Test phase of calibration process	Reference value	Observed value	Error*	Uncertainty**
Pressure	1078.7 hPa	1078.7 hPa	0.0 hPa	± 0.4 hPa
Pressure	896.5 hPa	896.6 hPa	0.1 hPa	± 0.4 hPa
Pressure	798.1 hPa	798.1 hPa	0.0 hPa	± 0.4 hPa
Pressure	596.5 hPa	596.5 hPa	0.0 hPa	± 0.4 hPa
Temperature	59.7 °C	59.7 °C	0.0 °C	± 0.2 °C
Temperature	24.8 °C	24.9 °C	0.1 °C	± 0.2 °C
Temperature	-5.7 °C	-5.7 °C	0.0 °C	± 0.2 °C
Temperature	-32.8 °C	-32.7 °C	0.1 °C	± 0.2 °C
Temperature	-52.0 °C	-52.0 °C	0.0 °C	± 0.2 °C
Relative humidity	29.9 %RH	29.9 %RH	0.0 %RH	± 2 %RH
Relative humidity	58.4 %RH	58.4 %RH	0.0 %RH	± 2 %RH
Relative humidity	91.5 %RH	91.5 %RH	0.0 %RH	± 3 %RH

*The test points for error values are polynomial fitting curve fitting points.
**The calibration uncertainty given at 95 % confidence level, k = 2

Traceability
The working standards for pressure and temperature are calibrated at Vaisala Measurement Standards Laboratory (MSL) by using MSL working standards traceable to National Institute of Standards and Technology (NIST, USA). The relative humidity values are calculated from measured temperature and dew-point temperature values. The dew-point working standards are traceable to the Finnish National Humidity Laboratory (MIKES).

Signature

Technician

Doc218938-A

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~ Certificate of Calibration and Compliance ~

Model: 378B02	Serial Number: 123031	
Microphone Model: 377B02	Serial Number: 158828	Manufacturer: PCB
Preamplifier Model: 426E01	Serial Number: 041165	Manufacturer: PCB

Calibration Environmental Conditions

Environmental test conditions as printed on microphone calibration chart.

Reference Equipment

Manufacturer	Model #	Serial #	PCB Control #	Cal Date	Due Date
Larson Davis	PRM915	122	CA865	10/26/15	10/26/16
Larson Davis	PRM916	104	LD015	3/10/15	3/10/16
Larson Davis	CAL250	5025	CA1277	5/14/15	5/13/16
Larson Davis	2201	102	LD022	3/2/15	3/2/16
Larson Davis	PRA951-4	241	CA1449	9/29/15	9/29/16
Larson Davis	PRM902	5352	CA1247	3/10/15	3/10/16
Larson Davis	GPRM902	4923	CA2237	8/6/15	8/5/16
Bruel & Kjaer	4192	2764626	CA1636	6/15/15	6/15/16
Larson Davis	ADP005	0	0	not required	not required
Newport	BTH-W/N	8410668	CA1187	not required	not required
National Instruments	PCI-6251	1162ED1	CA1740	7/29/15	7/29/16
0	0	0	0	not required	not required
0	0	0	0	not required	not required
0	0	0	0	not required	not required
0	0	0	0	not required	not required

Frequency sweep performed with B&K UA0033 electrostatic actuator.

Condition of Unit

As Found: n/a

As Left: New Unit, In Tolerance

Notes

1. Calibration of reference equipment is traceable to one or more of the following National Labs; NIST, PTB or DFM.
2. This certificate shall not be reproduced, except in full, without written approval from PCB Piezotronics, Inc.
3. Calibration is performed in compliance with ISO 9001, ISO 10012-1, ANSI/NCSL Z540.3 and ISO 17025.
4. See Manufacturer's Specification Sheet for a detailed listing of performance specifications.
5. System Sensitivity is measured following procedure AT603-5.
6. Measurement uncertainty (95% confidence level with coverage factor of 2) for sensitivity is +/-0.20 dB.
7. Unit calibrated per ACS-63.

Technician: Nicholas Herdlein NH Date: January 7, 2016

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ID:CAL61-353501977B.168

~ Calibration Report ~

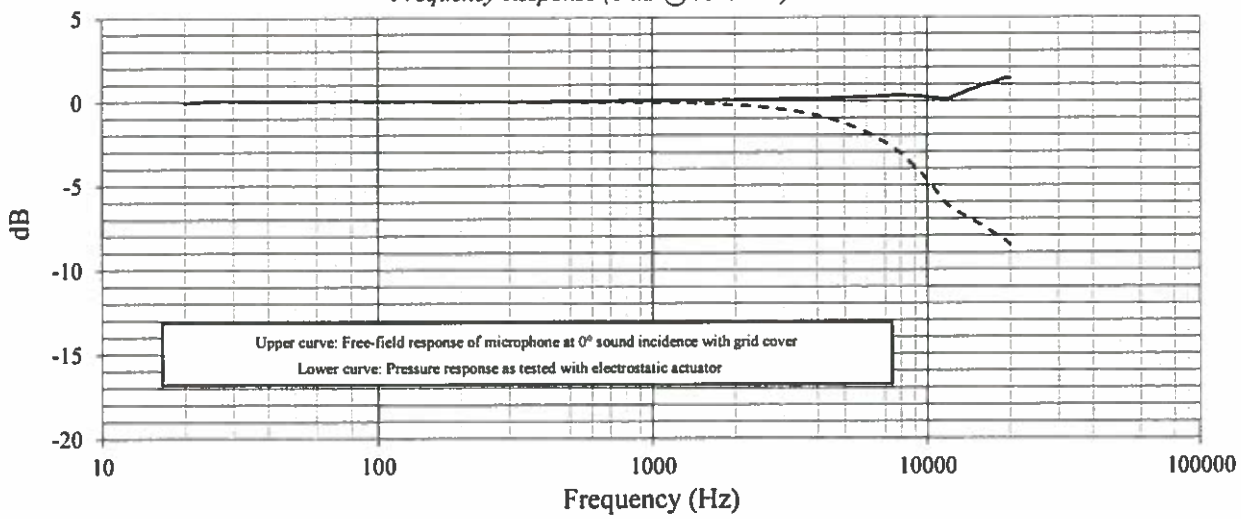
Model: 378B02 Serial Number: 123031
Microphone Model: 377B02 Serial Number: 158828 Description: 1/2" Free-Field Microphone
Preamplifier Model: 426E01 Serial Number: 041165 and Preamplifier

Calibration Data

System Sensitivity @ 251.2 Hz: 49.16 mV/Pa Polarization Voltage, External: 0 V
-26.17 dB re 1V/Pa

Temperature: 72 °F (22°C) Ambient Pressure: 999 mbar Relative Humidity: 24 %

Frequency Response (0 dB @ 251.2 Hz)



Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)
20.0	-0.05	-0.05	1679	-0.16	0.07	7499	-2.73	0.34	-	-	-
25.1	0.05	0.05	1778	-0.18	0.07	7943	-3.04	0.35	-	-	-
31.6	0.05	0.05	1884	-0.20	0.08	8414	-3.41	0.32	-	-	-
39.8	0.05	0.05	1995	-0.22	0.09	8913	-3.80	0.31	-	-	-
50.1	0.05	0.05	2114	-0.25	0.09	9441	-4.23	0.29	-	-	-
63.1	0.04	0.04	2239	-0.28	0.09	10000	-4.74	0.21	-	-	-
79.4	0.04	0.04	2371	-0.30	0.11	10593	-5.21	0.19	-	-	-
100.0	0.03	0.03	2512	-0.35	0.12	11220	-5.74	0.12	-	-	-
125.9	0.02	0.02	2661	-0.39	0.12	11885	-6.21	0.12	-	-	-
158.5	0.01	0.01	2818	-0.44	0.12	12589	-6.48	0.29	-	-	-
199.5	0.00	0.00	2985	-0.49	0.13	13335	-6.74	0.45	-	-	-
251.2	0.00	0.00	3162	-0.55	0.13	14125	-6.96	0.63	-	-	-
316.2	-0.01	0.00	3350	-0.61	0.13	14962	-7.20	0.77	-	-	-
398.1	-0.01	-0.01	3548	-0.68	0.14	15849	-7.42	0.93	-	-	-
501.2	-0.02	0.02	3758	-0.76	0.15	16788	-7.70	1.02	-	-	-
631.0	-0.03	0.01	3981	-0.85	0.15	17783	-7.96	1.15	-	-	-
794.3	-0.03	0.06	4217	-0.96	0.15	18837	-8.19	1.32	-	-	-
1000.0	-0.06	0.06	4467	-1.07	0.16	19953	-8.57	1.37	-	-	-
1059.3	-0.07	0.07	4732	-1.19	0.18	-	-	-	-	-	-
1122.0	-0.07	0.07	5012	-1.33	0.20	-	-	-	-	-	-
1188.5	-0.08	0.07	5309	-1.48	0.22	-	-	-	-	-	-
1258.9	-0.09	0.07	5623	-1.65	0.23	-	-	-	-	-	-
1333.5	-0.10	0.08	5957	-1.83	0.25	-	-	-	-	-	-
1412.5	-0.11	0.08	6310	-2.03	0.26	-	-	-	-	-	-
1496.2	-0.13	0.07	6683	-2.24	0.28	-	-	-	-	-	-
1584.9	-0.14	0.07	7080	-2.48	0.30	-	-	-	-	-	-

Technician: Nicholas Herdlein NH Date: January 7, 2016

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ID CAL81-3535019776.168

VAISALA

Test report no. H31-16040162

TEST REPORT

Instrument	WXT520 AAB1BE30B0
Serial number	M0410647
Manufacturer	Vaisala Oyj, Finland
Test date	28th January 2016

This test report certifies that the instrument was thoroughly tested and inspected, and found to meet its published test limits when it was shipped from Vaisala.

Test results

Test	Result	Limit	Passed
Rain response	435.0 mV	(345...575) mV	OK
Zero wind speed	0.00 m/s	(0...0.4) m/s	OK
Pressure	978.2 hPa	PASS/FAIL	OK
Temperature	22.3 °C	PASS/FAIL	OK
Humidity	28.3 %RH	PASS/FAIL	OK
Heating	PASS	PASS/FAIL	OK
Current (service port)	0.56	(0.2...0.7) mA	OK
Communication (service port)	PASS	PASS/FAIL	OK
Current (main port)	0.31	(0.1...0.4) mA	OK
Communication (main port)	PASS	PASS/FAIL	OK

Signature COPY

Technician

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~ Certificate of Calibration and Compliance ~

Model: 378B02	Serial Number: 123028	
Microphone Model: 377B02	Serial Number: 158980	Manufacturer: PCB
Preamplifier Model: 426E01	Serial Number: 041181	Manufacturer: PCB

Calibration Environmental Conditions

Environmental test conditions as printed on microphone calibration chart.

Reference Equipment

Manufacturer	Model #	Serial #	PCB Control #	Cal Date	Due Date
Larson Davis	PRM915	122	CA865	10/26/15	10/26/16
Larson Davis	PRM916	104	LD015	3/10/15	3/10/16
Larson Davis	CAL250	5025	CA1277	5/14/15	5/13/16
Larson Davis	2201	102	LD022	3/2/15	3/2/16
Larson Davis	PRA951-4	241	CA1449	9/29/15	9/29/16
Larson Davis	PRM902	5352	CA1247	3/10/15	3/10/16
Larson Davis	GPRM902	4923	CA2237	8/6/15	8/5/16
Bruel & Kjaer	4192	2764626	CA1636	6/15/15	6/15/16
Larson Davis	ADP005	0	0	not required	not required
Newport	BTH-W/N	8410668	CA1187	not required	not required
National Instruments	PCI-6251	1162ED1	CA1740	7/29/15	7/29/16
0	0	0	0	not required	not required
0	0	0	0	not required	not required
0	0	0	0	not required	not required
0	0	0	0	not required	not required

Frequency sweep performed with B&K UA0033 electrostatic actuator.

Condition of Unit

As Found: n/a

As Left: New Unit, In Tolerance

Notes

1. Calibration of reference equipment is traceable to one or more of the following National Labs; NIST, PTB or DFM.
2. This certificate shall not be reproduced, except in full, without written approval from PCB Piezotronics, Inc.
3. Calibration is performed in compliance with ISO 9001, ISO 10012-1, ANSI/NCSL Z540.3 and ISO 17025.
4. See Manufacturer's Specification Sheet for a detailed listing of performance specifications.
5. System Sensitivity is measured following procedure AT603-5.
6. Measurement uncertainty (95% confidence level with coverage factor of 2) for sensitivity is +/-0.20 dB.
7. Unit calibrated per ACS-63.

Technician: Nicholas Herdlein NH Date: January 7, 2016

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ID CAL61-353501924S.704

~ Calibration Report ~

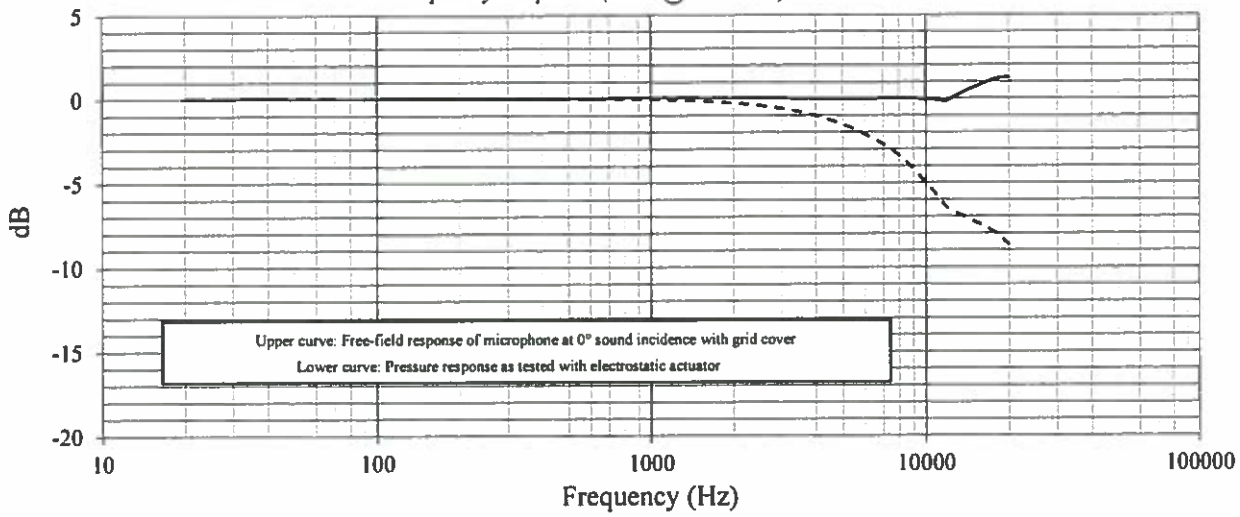
Model: 378B02 Serial Number: 123028
Microphone Model: 377B02 Serial Number: 158980 Description: 1/2" Free-Field Microphone
Preamplifier Model: 426E01 Serial Number: 041181 and Preamplifier

Calibration Data

System Sensitivity @ 251.2 Hz: 47.67 mV/Pa Polarization Voltage, External: 0 V
-26.43 dB re 1V/Pa

Temperature: 72 °F (22°C) Ambient Pressure: 999 mbar Relative Humidity: 24 %

Frequency Response (0 dB @ 251.2 Hz)



Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)
20.0	0.02	0.02	1679	-0.19	0.04	7499	-3.04	0.04	-	-	-
25.1	0.02	0.02	1778	-0.21	0.04	7943	-3.35	0.04	-	-	-
31.6	0.05	0.05	1884	-0.24	0.04	8414	-3.71	0.02	-	-	-
39.8	0.07	0.07	1995	-0.27	0.04	8913	-4.10	0.02	-	-	-
50.1	0.05	0.05	2114	-0.30	0.04	9441	-4.54	-0.02	-	-	-
63.1	0.04	0.04	2239	-0.33	0.04	10000	-5.03	-0.08	-	-	-
79.4	0.03	0.03	2371	-0.37	0.04	10593	-5.47	-0.07	-	-	-
100.0	0.03	0.03	2512	-0.41	0.05	11220	-5.99	-0.13	-	-	-
125.9	0.02	0.02	2661	-0.47	0.04	11885	-6.47	-0.15	-	-	-
158.5	0.02	0.02	2818	-0.52	0.04	12589	-6.70	0.07	-	-	-
199.5	0.01	0.01	2985	-0.58	0.04	13335	-6.92	0.27	-	-	-
251.2	0.00	0.00	3162	-0.66	0.02	14125	-7.09	0.50	-	-	-
316.2	0.00	0.01	3350	-0.73	0.01	14962	-7.32	0.65	-	-	-
398.1	-0.01	-0.01	3548	-0.81	0.01	15849	-7.50	0.85	-	-	-
501.2	-0.02	0.02	3758	-0.90	0.00	16788	-7.73	1.00	-	-	-
631.0	-0.03	0.01	3981	-1.00	0.00	17783	-7.97	1.14	-	-	-
794.3	-0.04	0.06	4217	-1.13	-0.02	18837	-8.29	1.22	-	-	-
1000.0	-0.06	0.06	4467	-1.26	-0.03	19953	-8.69	1.24	-	-	-
1059.3	-0.07	0.06	4732	-1.40	-0.03	-	-	-	-	-	-
1122.0	-0.08	0.06	5012	-1.55	-0.02	-	-	-	-	-	-
1188.5	-0.09	0.06	5309	-1.71	-0.01	-	-	-	-	-	-
1258.9	-0.10	0.06	5623	-1.90	-0.02	-	-	-	-	-	-
1333.5	-0.12	0.06	5957	-2.09	-0.02	-	-	-	-	-	-
1412.5	-0.13	0.06	6310	-2.30	-0.01	-	-	-	-	-	-
1496.2	-0.15	0.05	6683	-2.52	0.00	-	-	-	-	-	-
1584.9	-0.17	0.04	7080	-2.77	0.01	-	-	-	-	-	-

Technician: Nicholas Herdlein NH Date: January 7, 2016

ACCREDITED
CALIBRATION CERT #1662.01

PCB PIEZOTRONICS
VIBRATION DIVISION

3425 Walden Avenue, Depew, New York, 14043
TEL: 888-684-0013 FAX: 716-685-3886 www.pcb.com

ID:CAL01-3535019245.704

VAISALA

Test report no. H31-16040158

TEST REPORT

Instrument	WXT520 AAB1BE30B0
Serial number	M0410645
Manufacturer	Vaisala Oyj, Finland
Test date	28th January 2016

This test report certifies that the instrument was thoroughly tested and inspected, and found to meet its published test limits when it was shipped from Vaisala.

Test results

Test	Result	Limit	Passed
Rain response	441.0 mV	(345...575) mV	OK
Zero wind speed	0.00 m/s	(0...0.4) m/s	OK
Pressure	978.6 hPa	PASS/FAIL	OK
Temperature	22.4 °C	PASS/FAIL	OK
Humidity	29.3 %RH	PASS/FAIL	OK
Heating	PASS	PASS/FAIL	OK
Current (service port)	0.57	(0.2...0.7) mA	OK
Communication (service port)	PASS	PASS/FAIL	OK
Current (main port)	0.32	(0.1...0.4) mA	OK
Communication (main port)	PASS	PASS/FAIL	OK

Signature

Technician

 DOC216638.doc

Vaisala Oyj | PO Box 26, FI-00421 Helsinki, Finland
Phone +358 9 894 91 | Fax +358 9 8949 2227
Email firstname.lastname@vaisala.com | www.vaisala.com
Domicile Vantaa, Finland | VAT FI01244162 | Business ID 0124416-2

VAISALA

Calibration sheet no. H31-16040157

CALIBRATION SHEET

Instrument	WXTPTU
Serial number	L5040043
Manufacturer	Vaisala Oyj, Finland
Test date	28th January 2016

This test report certifies that the instrument was thoroughly tested and inspected, and found to meet its published test limits when it was shipped from Vaisala.

Calibration results

Test phase of calibration process	Reference value	Observed value	Error*	Uncertainty**
Pressure	1078.7 hPa	1078.7 hPa	0.0 hPa	± 0.4 hPa
Pressure	896.5 hPa	896.6 hPa	0.1 hPa	± 0.4 hPa
Pressure	798.1 hPa	798.1 hPa	0.0 hPa	± 0.4 hPa
Pressure	596.5 hPa	596.5 hPa	0.0 hPa	± 0.4 hPa
Temperature	59.7 °C	59.7 °C	0.0 °C	± 0.2 °C
Temperature	24.8 °C	24.9 °C	0.1 °C	± 0.2 °C
Temperature	-5.7 °C	-5.7 °C	0.0 °C	± 0.2 °C
Temperature	-32.8 °C	-32.8 °C	0.0 °C	± 0.2 °C
Temperature	-52.0 °C	-52.0 °C	0.0 °C	± 0.2 °C
Relative humidity	30.0 %RH	30.0 %RH	0.0 %RH	± 2 %RH
Relative humidity	58.4 %RH	58.4 %RH	0.0 %RH	± 2 %RH
Relative humidity	91.5 %RH	91.5 %RH	0.0 %RH	± 3 %RH

*The test points for error values are polynomial fitting curve fitting points.
**The calibration uncertainty given at 95 % confidence level, k = 2

Traceability
The working standards for pressure and temperature are calibrated at Vaisala Measurement Standards Laboratory (MSL) by using MSL working standards traceable to National Institute of Standards and Technology (NIST, USA). The relative humidity values are calculated from measured temperature and dew-point temperature values. The dew-point working standards are traceable to the Finnish National Humidity Laboratory (MIKES).

Signature

Technician

Vaisala Oyj | PO Box 26, FI-00421 Helsinki, Finland
Phone +358 9 894 91 | Fax +358 9 8949 2227
Email firstname.lastname@vaisala.com | www.vaisala.com
Domicile Vantaa, Finland | VAT FI01244162 | Business ID 0124416-2

~ Certificate of Calibration and Compliance ~

Model: 378B02	Serial Number: 121695	
Microphone Model: 377B02	Serial Number: 156314	Manufacturer: PCB
Preamplifier Model: 426E01	Serial Number: 039843	Manufacturer: PCB

Calibration Environmental Conditions

Environmental test conditions as printed on microphone calibration chart.

Reference Equipment

Manufacturer	Model #	Serial #	PCB Control #	Cal Date	Due Date
National Instruments	PCIe-6351	1896F08	CA1918	11/3/14	11/3/15
Larson Davis	PRM915	122	CA865	10/21/14	10/21/15
Larson Davis	PRM902	4943	CA1162	10/27/14	10/27/15
Larson Davis	PRM916	125	TA469	6/9/15	6/9/16
Larson Davis	CAL250	5374	CA2068	5/27/15	5/27/16
Larson Davis	2201	144	CA1409	3/12/15	3/11/16
Bruel & Kjaer	4192	2764626	CA1636	6/15/15	6/15/16
Larson Davis	GPRM902	5337	CA2063	1/5/15	1/5/16
Newport	iTHX-SD/N	1080002	CA1511	not required	not required
Larson Davis	PRA951-4	242	CA1456	11/10/14	11/10/15
Larson Davis	ADP005	0	0	not required	not required
0	0	0	0	not required	not required
0	0	0	0	not required	not required
0	0	0	0	not required	not required
0	0	0	0	not required	not required

Frequency sweep performed with B&K UA0033 electrostatic actuator.

Condition of Unit

As Found: n/a

As Left: New Unit, In Tolerance

Notes

1. Calibration of reference equipment is traceable to one or more of the following National Labs; NIST, PTB or DFM.
2. This certificate shall not be reproduced, except in full, without written approval from PCB Piezotronics, Inc.
3. Calibration is performed in compliance with ISO 9001, ISO 10012-1, ANSI/NCSL Z540.3 and ILAC-MRA.
4. See Manufacturer's Specification Sheet for a detailed listing of performance specifications.
5. System Sensitivity is measured following procedure AT603-5.
6. Measurement uncertainty (95% confidence level with coverage factor of 2) for sensitivity is +/-0.20 dB.
7. Unit calibrated per ACS-63.

Technician: Leonard Lukasik

Date: September 16, 2015

ilac-MRA A2LA ACCREDITED

CALIBRATION CERT #1882.01

PCB PIEZOTRONICS VIBRATION DIVISION

3425 Walden Avenue, Depew, New York, 14043

TEL: 888-684-0013 FAX: 716-685-3886 www.pcb.com

ID CAL:112-352526750 503

~ Calibration Report ~

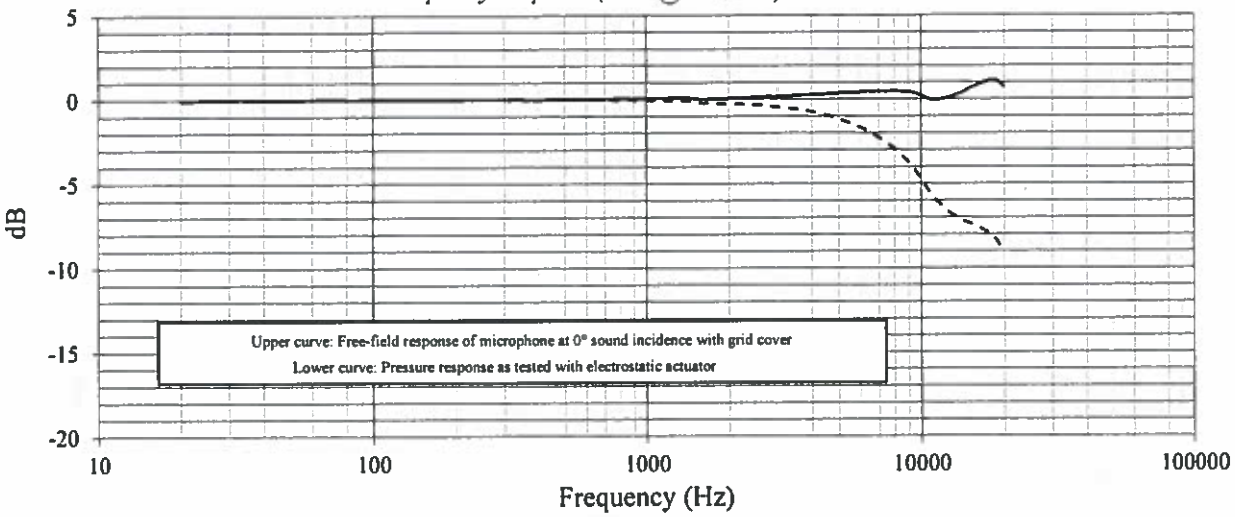
Model: 378B02 Serial Number: 121695
Microphone Model: 377B02 Serial Number: 156314 Description: 1/2" Free-Field Microphone
Preamplifier Model: 426E01 Serial Number: 039843 and Preamplifier

Calibration Data

System Sensitivity @ 251.2 Hz: 51.27 mV/Pa Polarization Voltage, External: 0 V
-25.8 dB re 1V/Pa

Temperature: 70 °F (21°C) Ambient Pressure: 1002 mbar Relative Humidity: 48 %

Frequency Response (0 dB @ 251.2 Hz)



Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)
20.0	-0.08	-0.08	1679	-0.23	0.00	7499	-2.62	0.45	-	-	-
25.1	-0.01	-0.01	1778	-0.23	0.02	7943	-2.91	0.48	-	-	-
31.6	0.00	0.00	1884	-0.28	0.01	8414	-3.28	0.45	-	-	-
39.8	-0.01	-0.01	1995	-0.26	0.05	8913	-3.68	0.43	-	-	-
50.1	-0.03	-0.03	2114	-0.27	0.07	9441	-4.15	0.37	-	-	-
63.1	0.01	0.01	2239	-0.29	0.08	10000	-4.76	0.20	-	-	-
79.4	0.00	0.00	2371	-0.31	0.10	10593	-5.39	0.01	-	-	-
100.0	0.00	0.00	2512	-0.33	0.14	11220	-5.92	-0.06	-	-	-
125.9	0.00	0.00	2661	-0.36	0.15	11885	-6.31	0.01	-	-	-
158.5	0.00	0.00	2818	-0.40	0.16	12589	-6.69	0.08	-	-	-
199.5	0.00	0.00	2985	-0.45	0.17	13335	-6.96	0.23	-	-	-
251.2	0.00	0.00	3162	-0.49	0.19	14125	-7.20	0.40	-	-	-
316.2	-0.01	0.00	3350	-0.54	0.20	14962	-7.35	0.62	-	-	-
398.1	-0.01	-0.01	3548	-0.59	0.23	15849	-7.54	0.81	-	-	-
501.2	-0.02	0.02	3758	-0.67	0.23	16788	-7.76	0.96	-	-	-
631.0	-0.03	0.01	3981	-0.73	0.27	17783	-8.01	1.10	-	-	-
794.3	-0.05	0.04	4217	-0.84	0.27	18837	-8.44	1.07	-	-	-
1000.0	-0.07	0.05	4467	-0.94	0.30	19953	-9.20	0.73	-	-	-
1059.3	-0.07	0.06	4732	-1.03	0.34	-	-	-	-	-	-
1122.0	-0.08	0.06	5012	-1.17	0.36	-	-	-	-	-	-
1188.5	-0.08	0.07	5309	-1.33	0.37	-	-	-	-	-	-
1258.9	-0.09	0.07	5623	-1.49	0.39	-	-	-	-	-	-
1333.5	-0.10	0.08	5957	-1.66	0.41	-	-	-	-	-	-
1412.5	-0.11	0.08	6310	-1.83	0.46	-	-	-	-	-	-
1496.2	-0.17	0.04	6683	-2.07	0.45	-	-	-	-	-	-
1584.9	-0.23	-0.02	7080	-2.32	0.46	-	-	-	-	-	-

Technician: Leonard Lukasik Date: September 16, 2015

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PCB PIEZOTRONICS
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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: 16.US1.01908 **Date of issue:** February 18, 2016

Type: Vaisala Weather Transmitter, WXT520 **Serial number:** K0630017.0deg

Manufacturer: VAISALA Oyj, Pl 26, FIN-00421 Helsinki, Finland

Client: Aercoustics Engineering Ltd., 50 Ronson Dr, Suite 165, Toronto, ON M9W 1B3, Canada

Anemometer received: February 18, 2016 **Anemometer calibrated:** 11:48 February 18, 2016

Calibrated by: mcj **Procedure:** MEASNET, IEC 61400-12-1:2005(E) Annex F

Certificate prepared by: ejf **Approved by:** Calibration engineer, rds

Calibration equation obtained: v [m/s] = 0.98953 · f [m/s] + 0.09392

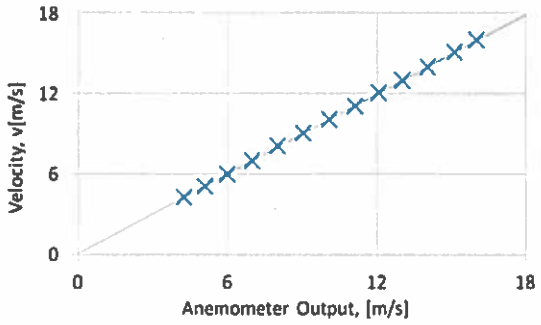
Standard uncertainty, slope: 0.00190 **Standard uncertainty, offset:** 0.21429

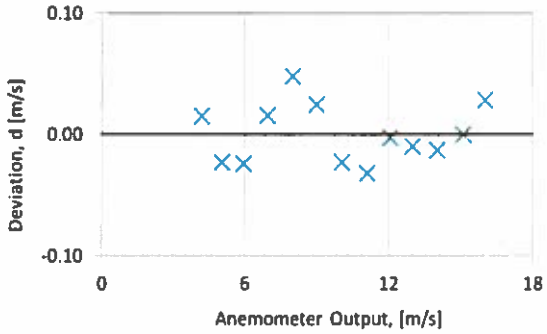
Covariance: -0.0000355 (m/s)²/m/s **Coefficient of correlation:** ρ = 0.999980

Absolute maximum deviation: 0.047 m/s at 8.060 m/s

Barometric pressure: 1020.9 hPa **Relative humidity:** 9.7%

Succession	Velocity pressure, q. [Pa]	Temperature in wind tunnel [°C]	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	11.01	24.4	27.5	4.293	4.229	0.015	0.048
4	15.52	24.4	27.5	5.098	5.081	-0.023	0.043
6	21.38	24.4	27.5	5.985	5.977	-0.024	0.041
8	29.18	24.4	27.5	6.991	6.955	0.015	0.039
10	38.79	24.4	27.5	8.060	8.003	0.047	0.040
12	48.71	24.4	27.5	9.034	9.010	0.024	0.041
13-last	59.98	24.4	27.5	10.024	10.058	-0.023	0.043
11	72.79	24.4	27.5	11.042	11.097	-0.032	0.045
9	86.28	24.4	27.5	12.023	12.058	-0.003	0.048
7	99.86	24.4	27.5	12.935	12.987	-0.010	0.051
5	116.09	24.4	27.5	13.947	14.013	-0.013	0.054
3	134.98	24.4	27.5	15.039	15.103	0.000	0.057
1-first	151.76	24.3	27.5	15.945	15.990	0.028	0.060





AC-1746

EQUIPMENT USED

Serial Number	Description
Njord 1	Wind tunnel, blockage factor = 1.004
2254	Control cup anemometer
-	Mounting tube, D = 30 mm
TT003	Summit RT-AUI, wind tunnel
TP001	Summit RT-AUI, differential pressure box
DP004	Setra Model 239 pressure transducer
HY003	Dwyer Instruments RHP-2D20 humidity transmitter
BP002	Setra Model 278 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, & 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 2.5 x 2.5 m.

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.

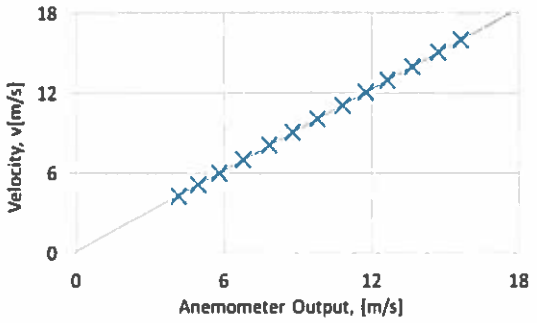
Certificate number: 16.US1.01908

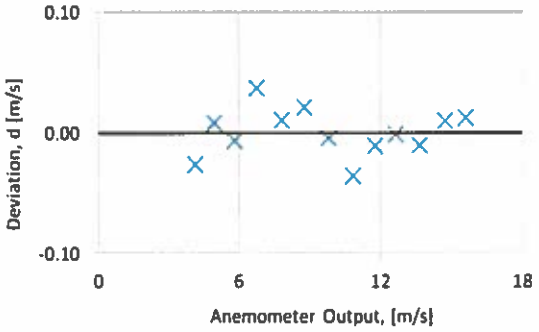
SOH Wind Engineering LLC
141 Leroy Road · Williston, VT 05495 · USA
Tel 802.316.4368 · Fax 802.735.9106 · www.sohwind.com

CERTIFICATE FOR CALIBRATION OF SONIC ANEMOMETER

Certificate number: 16.US1.01909 **Date of issue:** February 18, 2016
Type: Vaisala Weather Transmitter, WXT520 **Serial number:** K0630017.90deg
Manufacturer: VAISALA Oyj, Pl 26, FIN-00421 Helsinki, Finland
Client: Aercoustics Engineering Ltd., 50 Ronson Dr, Suite 165, Toronto, ON M9W 1B3, Canada
Anemometer received: February 18, 2016 **Anemometer calibrated:** 12:07 February 18, 2016
Calibrated by: mej **Procedure:** MEASNET, IEC 61400-12-1:2005(E) Annex F
Certificate prepared by: ejf **Approved by:** Calibration engineer, rds
Calibration equation obtained: v [m/s] = 1.01610 · f [m/s] + 0.08636
Standard uncertainty, slope: 0.00150 **Standard uncertainty, offset:** 0.18401
Covariance: -0.0000227 (m/s)²/m/s **Coefficient of correlation:** ρ = 0.999988
Absolute maximum deviation: 0.036 m/s at 6.993 m/s
Barometric pressure: 1020.8 hPa **Relative humidity:** 9.7%

Succession	Velocity pressure, q. [Pa]	Temperature in wind tunnel [°C]	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	10.93	24.5	27.5	4.279	4.152	-0.026	0.049
4	15.62	24.6	27.5	5.116	4.942	0.008	0.043
6	21.41	24.6	27.5	5.989	5.816	-0.007	0.041
8	29.18	24.5	27.5	6.993	6.761	0.036	0.039
10	38.75	24.5	27.5	8.058	7.835	0.010	0.040
12	48.65	24.5	27.5	9.029	8.781	0.021	0.041
13-last	59.99	24.5	27.5	10.026	9.787	-0.005	0.043
11	72.74	24.5	27.5	11.041	10.816	-0.035	0.045
9	86.24	24.5	27.5	12.022	11.758	-0.011	0.048
7	99.80	24.5	27.5	12.934	12.645	-0.001	0.051
5	116.10	24.5	27.5	13.951	13.655	-0.010	0.054
3	135.09	24.5	27.5	15.049	14.716	0.009	0.057
1-first	151.82	24.5	27.5	15.953	15.603	0.012	0.060





AC-1746

EQUIPMENT USED

Serial Number	Description
Njord 1	Wind tunnel, blockage factor = 1.004
2254	Control cup anemometer
-	Mounting tube, D = 30 mm
TT003	Summit RT-AUI, wind tunnel
TP001	Summit RT-AUI, differential pressure box
DP004	Setra Model 239 pressure transducer
HY003	Dwyer Instruments RHP-2D20 humidity transmitter
BP002	Setra Model 278 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, & Furness Controls. A real-time analysis module within the data acquisition software detects pulse frequency.

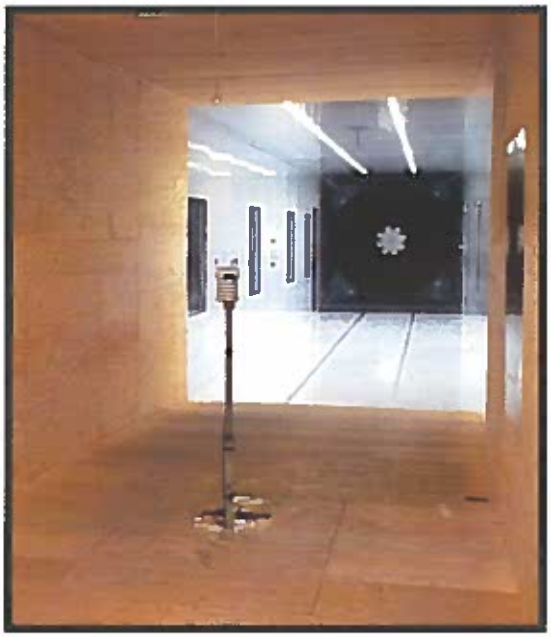


Photo of the wind tunnel setup. The cross-sectional area is 2.5 x 2.5 m.

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.

Certificate number: 16.US1.01909

~ Certificate of Calibration and Compliance ~

Model: 378B02	Serial Number: 123029	
Microphone Model: 377B02	Serial Number: 158838	Manufacturer: PCB
Preamplifier Model: 426E01	Serial Number: 041180	Manufacturer: PCB

Calibration Environmental Conditions

Environmental test conditions as printed on microphone calibration chart.

Reference Equipment

Manufacturer	Model #	Serial #	PCB Control #	Cal Date	Due Date
Larson Davis	PRM915	122	CA865	10/26/15	10/26/16
Larson Davis	PRM916	104	LD015	3/10/15	3/10/16
Larson Davis	CAL250	5025	CA1277	5/14/15	5/13/16
Larson Davis	2201	102	LD022	3/2/15	3/2/16
Larson Davis	PRA951-4	241	CA1449	9/29/15	9/29/16
Larson Davis	PRM902	5352	CA1247	3/10/15	3/10/16
Larson Davis	GPRM902	4923	CA2237	8/6/15	8/5/16
Bruel & Kjaer	4192	2764626	CA1636	6/15/15	6/15/16
Larson Davis	ADP005	0	0	not required	not required
Newport	BTH-W/N	8410668	CA1187	not required	not required
National Instruments	PCI-6251	1162ED1	CA1740	7/29/15	7/29/16
0	0	0	0	not required	not required
0	0	0	0	not required	not required
0	0	0	0	not required	not required
0	0	0	0	not required	not required

Frequency sweep performed with B&K UA0033 electrostatic actuator.

Condition of Unit

As Found: n/a

As Left: New Unit, In Tolerance

Notes

1. Calibration of reference equipment is traceable to one or more of the following National Labs; NIST, PTB or DFM.
2. This certificate shall not be reproduced, except in full, without written approval from PCB Piezotronics, Inc.
3. Calibration is performed in compliance with ISO 9001, ISO 10012-1, ANSI/NCSL Z540.3 and ISO 17025.
4. See Manufacturer's Specification Sheet for a detailed listing of performance specifications.
5. System Sensitivity is measured following procedure AT603-5.
6. Measurement uncertainty (95% confidence level with coverage factor of 2) for sensitivity is +/-0.20 dB.
7. Unit calibrated per ACS-63.

Technician: Nicholas Herdlein NH Date: January 7, 2016

ACCREDITED
CALIBRATION CERT #1862.01

PCB PIEZOTRONICS
VIBRATION DIVISION
3425 Walden Avenue, Depew, New York, 14043
TEL: 888-684-0013 FAX: 716-685-3886 www.pcb.com

ID CAL81-353501606I.228

~ Calibration Report ~

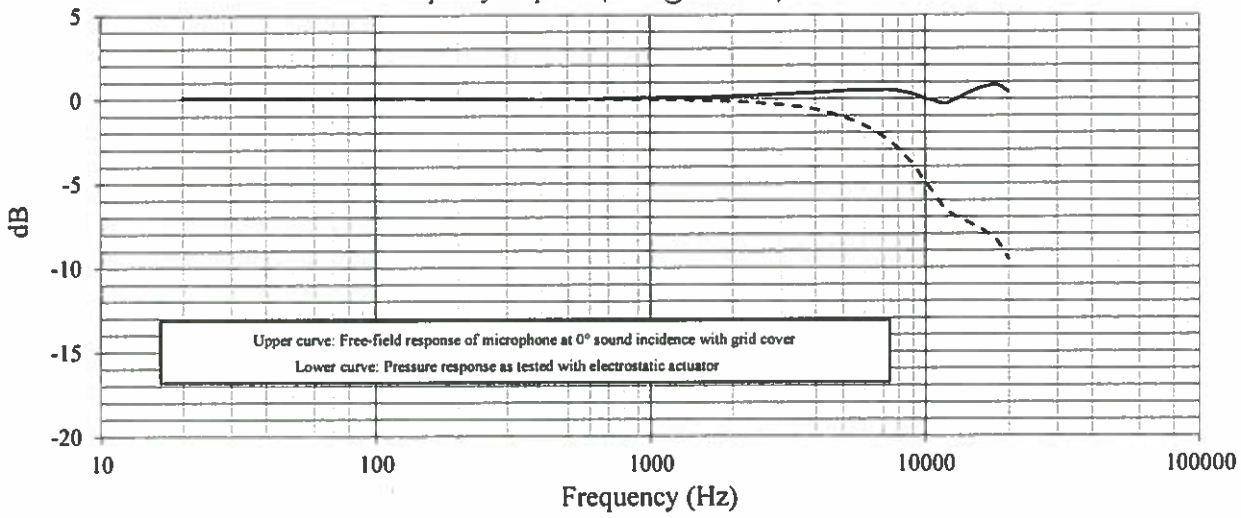
Model: 378B02 Serial Number: 123029
Microphone Model: 377B02 Serial Number: 158838 Description: 1/2" Free-Field Microphone
Preamplifier Model: 426E01 Serial Number: 041180 and Preamplifier

Calibration Data

System Sensitivity @ 251.2 Hz: 55.72 mV/Pa Polarization Voltage, External: 0 V
-25.08 dB re 1V/Pa

Temperature: 72 °F (22°C) Ambient Pressure: 999 mbar Relative Humidity: 24 %

Frequency Response (0 dB @ 251.2 Hz)



Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)
20.0	0.13	0.13	1679	-0.11	0.12	7499	-2.56	0.51	-	-	-
25.1	0.07	0.07	1778	-0.12	0.13	7943	-2.92	0.47	-	-	-
31.6	0.09	0.09	1884	-0.13	0.15	8414	-3.35	0.38	-	-	-
39.8	0.08	0.08	1995	-0.15	0.16	8913	-3.81	0.30	-	-	-
50.1	0.08	0.08	2114	-0.17	0.17	9441	-4.36	0.16	-	-	-
63.1	0.07	0.07	2239	-0.19	0.18	10000	-4.97	-0.02	-	-	-
79.4	0.07	0.07	2371	-0.21	0.20	10593	-5.50	-0.10	-	-	-
100.0	0.06	0.06	2512	-0.23	0.23	11220	-6.09	-0.23	-	-	-
125.9	0.06	0.06	2661	-0.27	0.24	11885	-6.61	-0.29	-	-	-
158.5	0.05	0.05	2818	-0.30	0.26	12589	-6.88	-0.11	-	-	-
199.5	0.04	0.04	2985	-0.33	0.29	13335	-7.11	0.08	-	-	-
251.2	0.00	0.00	3162	-0.38	0.30	14125	-7.29	0.30	-	-	-
316.2	-0.01	0.00	3350	-0.43	0.31	14962	-7.51	0.46	-	-	-
398.1	-0.02	-0.02	3548	-0.48	0.34	15849	-7.71	0.64	-	-	-
501.2	-0.02	0.02	3758	-0.55	0.35	16788	-7.98	0.74	-	-	-
631.0	-0.02	0.02	3981	-0.62	0.38	17783	-8.27	0.84	-	-	-
794.3	-0.03	0.07	4217	-0.73	0.39	18837	-8.80	0.72	-	-	-
1000.0	-0.04	0.08	4467	-0.82	0.41	19953	-9.52	0.41	-	-	-
1059.3	-0.05	0.08	4732	-0.93	0.44	-	-	-	-	-	-
1122.0	-0.05	0.09	5012	-1.07	0.46	-	-	-	-	-	-
1188.5	-0.06	0.09	5309	-1.21	0.49	-	-	-	-	-	-
1258.9	-0.06	0.10	5623	-1.37	0.51	-	-	-	-	-	-
1333.5	-0.07	0.11	5957	-1.56	0.51	-	-	-	-	-	-
1412.5	-0.08	0.11	6310	-1.77	0.52	-	-	-	-	-	-
1496.2	-0.09	0.11	6683	-2.00	0.52	-	-	-	-	-	-
1584.9	-0.10	0.11	7080	-2.26	0.52	-	-	-	-	-	-

Technician: Nicholas Herdlein NH Date: January 7, 2016

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ID CAL81-3535019081.228

VAISALA

Test report no. H31-16040154

TEST REPORT

Instrument	WXT520 AAB1BE30B0
Serial number	M0410643
Manufacturer	Vaisala Oyj, Finland
Test date	28th January 2016

This test report certifies that the instrument was thoroughly tested and inspected, and found to meet its published test limits when it was shipped from Vaisala.

Test results

Test	Result	Limit	Passed
Rain response	438.0 mV	(345...575) mV	OK
Zero wind speed	0.00 m/s	(0...0.4) m/s	OK
Pressure	979.8 hPa	PASS/FAIL	OK
Temperature	22.3 °C	PASS/FAIL	OK
Humidity	30 %RH	PASS/FAIL	OK
Heating	PASS	PASS/FAIL	OK
Current (service port)	0.57	(0.2...0.7) mA	OK
Communication (service port)	PASS	PASS/FAIL	OK
Current (main port)	0.33	(0.1...0.4) mA	OK
Communication (main port)	PASS	PASS/FAIL	OK

Signature

Technician

 DOC216638.doc

Vaisala Oyj | PO Box 26, FI-00421 Helsinki, Finland
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Domicile Vantaa, Finland | VAT FI01244162 | Business ID 0124416-2

VAISALA

Calibration sheet no. H31-16040153

CALIBRATION SHEET

Instrument	WXTPTU
Serial number	L5040041
Manufacturer	Vaisala Oyj, Finland
Test date	28th January 2016

This test report certifies that the instrument was thoroughly tested and inspected, and found to meet its published test limits when it was shipped from Vaisala.

Calibration results

Test phase of calibration process	Reference value	Observed value	Error*	Uncertainty**
Pressure	1078.7 hPa	1078.7 hPa	0.0 hPa	± 0.4 hPa
Pressure	896.5 hPa	896.5 hPa	0.0 hPa	± 0.4 hPa
Pressure	798.1 hPa	798.1 hPa	0.0 hPa	± 0.4 hPa
Pressure	596.5 hPa	596.5 hPa	0.0 hPa	± 0.4 hPa
Temperature	59.8 °C	59.8 °C	0.0 °C	± 0.2 °C
Temperature	24.8 °C	24.9 °C	0.1 °C	± 0.2 °C
Temperature	-5.7 °C	-5.7 °C	0.0 °C	± 0.2 °C
Temperature	-32.8 °C	-32.8 °C	0.0 °C	± 0.2 °C
Temperature	-52.0 °C	-52.1 °C	-0.1 °C	± 0.2 °C
Relative humidity	30.0 %RH	30.0 %RH	0.0 %RH	± 2 %RH
Relative humidity	58.4 %RH	58.4 %RH	0.0 %RH	± 2 %RH
Relative humidity	91.5 %RH	91.5 %RH	0.0 %RH	± 3 %RH

*The test points for error values are polynomial fitting curve fitting points.
**The calibration uncertainty given at 95 % confidence level, k = 2

Traceability
The working standards for pressure and temperature are calibrated at Vaisala Measurement Standards Laboratory (MSL) by using MSL working standards traceable to National Institute of Standards and Technology (NIST, USA). The relative humidity values are calculated from measured temperature and dew-point temperature values. The dew-point working standards are traceable to the Finnish National Humidity Laboratory (MIKES).

Signature

Technician

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Appendix H
I-Audit Checklist

Appendix H - (2017 Compliance Protocol AF7): 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	✓	Assessment performed to available Wind Turbine Noise Compliance Protocol at the time of measurements (2011 Wind Turbine Noise Compliance Protocol) as per Section A4.4.2 Transition rules for I-Audits of the 2017 WTNCP. All valid data with varying wind shear and wind directions included in the analysis.
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	✓	
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	✓	Provided separately in excel format. See Point 15.
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	✓	
16	If deviations from standard; was justification of the deviations provided	✓	Assessment performed to available Wind Turbine Noise Compliance Protocol at the time of measurements (2011 Wind Turbine Noise Compliance Protocol) as per Section A4.4.2 Transition rules for I-Audits of the 2017 WTNCP, No deviations from 2011 protocol