aercoustics
Aercoustics Engineering Ltd.
1004 Middlegate Road, Suite 1100
Mississauga, ON L4Y 1M4
Tel: 416-249-3361
Fax 416-249-3613
aercoustics.com

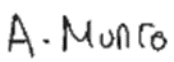
REPORT ID: **16227.00.T35.RP1**

Niagara Region Wind Farm – Turbine T35
IEC 61400-11 Edition 3.0 Measurement Report

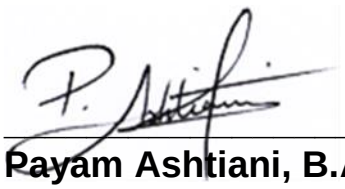
Prepared for:

1021702 B.C. Ltd
as general partner for and on behalf of FWRN LP

Prepared by:



Allan Munro, B.A.Sc.



Payam Ashtiani, B.A.Sc., P.Eng.

03 November 2017 – Revision #1

Revision History

Revision Number	Description	Date
1	Issued Edition 3.0 test report	03.11.2017

This report in its entirety, including appendices contains 74 pages.

Statement Qualifications and Limitations

This report was prepared by Aercoustics Engineering Limited in accordance with International Standard IEC 61400-11 (Edition 3.0, released 2012-11), "Wind turbine generator systems – Part 11: Acoustic noise measurement techniques". This report is specific only to the Wind Turbine identified in this report.

Aercoustics Engineering Limited shall not be responsible for any events or circumstances that may have occurred since the date on which the Wind Turbine was tested and/or this report was prepared, or for any inaccuracies contained in information that was provided to Aercoustics Engineering Limited. Further, Aercoustics Engineering Limited agrees that this report represents test data analysed as per the above described standard for the specific Wind Turbine described in this report, but Aercoustics Engineering Limited makes no other representations with respect to this report or any part thereof.

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This Statement of Qualifications and Limitations is attached to and forms part of this report.

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1 Introduction

Aercoustics Engineering Limited (Aercoustics) was retained by 1021702 B.C. Ltd as a general partner for and behalf of Niagara Region Wind Farm ("FWRN") to conduct an acoustic measurement of turbine T35 at the Niagara Region Wind Farm. The purpose of the measurement was to provide verification of the maximum noise emission of the turbine. The measurement was carried out in accordance with International Standard IEC 61400-11 (Edition 3.0, released 2012-11), "Wind turbine generator systems – Part 11: Acoustic noise measurement techniques". This report is specific only to Turbine T35.

2 Wind Turbine Information

2.1 Wind turbine equipment specific information

Wind turbine specific equipment information for turbine T35 was provided by FWRN and is summarized in Tables 1 – 5.

Table 1 - Wind Turbine Details

Wind Turbine Details	
Manufacturer	Enercon
Model Number	E-101
Turbine ID	1011189

Table 2 - Operating Details

Operating Details	
Vertical or Horizontal axis wind turbine	Horizontal Axis
Upwind or downwind rotor	Upwind
Hub height	124 M
Horizontal distance from rotor centre to tower axis	6 M
Diameter of rotor	101 M
Tower type (lattice or tube)	Tube
Passive stall, active stall, or pitch controlled turbine	Pitch controlled
Constant or variable speed	Variable speed
Power curve	See Figure B.01
Rotational speed at each integer standardised wind speed	See Figure B.02 from measurement data
Rated power output	3000 kW
Control software version	Main control board version 5.20. Pitch software version 5.87

Table 3 - Rotor Details

Rotor Details	
Rotor control devices	Electric pitch
Presence of vortex generators, stall strips, serrated trailing edges	Tip bows (90-degree curve blade tips)
Blade type	Composite (Epoxy resin, Balsa)
Serial number	N/A
Number of blades	3

Table 4 - Gearbox Details

Gearbox Details	
Manufacturer	N/A
Model number	N/A
Serial number	N/A

Table 5 - Generator Details

Generator Details	
Manufacturer	Enercon
Model number	G3 annular generator
Serial number	N/A

2.2 Wind Turbine Location

The Niagara Wind Farm is located in the Townships of West Lincoln and Wainfleet and the Town of Lincoln within the Niagara Region and within Haldimand County in Southern Ontario. The coordinates of Turbine T35 are 17T 627164 Easting and 4764483 Northing. The area surrounding T35 is flat and consists primarily of farmland.

A general layout of the area in which the turbine is located is provided in the site plan (Figure A.01).

3 Measurement Details

3.1 Measurement Equipment

3.1.1 Acoustic Measurement Equipment

A summary of acoustic equipment utilized by Aercoustics for the measurement of turbine T35 is summarized in Table 6.

Table 6 - Acoustic Measurement Equipment

Equipment	Manufacturer Name & Model	Serial Number
Acoustic Data acquisition system	LMS SCADA Mobile	22163146
Microphone	B&K 4189	2625417
Pre-amplifier	B&K 2671	2614900
Acoustic calibrator	B&K 4231	3012380

Calibration of the measurement setup was carried out before and after Aercoustics set of measurements.

3.1.2 Meteorological Equipment

Wind speed for Turbine ON was derived from the power curve (as per procedures outlined in IEC 61400-11). Wind direction for turbine ON measurements was utilized from the yaw angle output provided from the turbine system from turbine T35. Data for background measurements was obtained from a 10m high anemometer, which was placed as per guidelines outlined in IEC-61400-11.

The meteorological equipment is summarized in Table 7

Table 7 – Meteorological Measurement Equipment

Equipment	Manufacturer Name & Model	Serial Number
Anemometer	VAISALA WXT520	G4420002
Serial to Analog Converter	NOKEVAL 7470	A159784

3.2 Measurement Setup

3.2.1 Microphone Placement

The measurement microphone was setup 147m from the base of the turbine in ‘Position 1’, (i.e. downwind of the turbine, as per IEC 61400-11) at an elevation of 0m relative to the base of T35. The microphone was placed in the centre of a circular, acoustically reflective board.

During the measurement period only, data points for which the microphone was within 15 degrees of downwind from the turbine were used. The microphone position relative to downwind of the turbine was monitored via the yaw angle output provided from the turbine

system (discussed further in Section 3.5). During placement of the microphone the turbine was parked and the reference yaw angle for that measurement logged.

When measurements of T35 were taken, the surrounding land was cleared farmland. There were no nearby reflecting surfaces (houses, barns etc.); as such the influence from reflecting surfaces was considered to be negligible.

Photos of the measurement setup are provided in Figure A.02, Appendix A.

3.2.2 Double Windscreen Setup

A double windscreen setup was not utilized.

3.3 Measurement Schedule

Table 8 provides a summary of the test date and times. Data was logged in 10 second intervals for post-processing (as per the measurement standard).

Table 8 - Measurement Schedule Summary

Date	Test Type	Start Time	Finish time
October 19, 2017	Turbine ON	2:36pm	3:20pm
	Background	3:24pm	3:54pm
	Turbine ON	4:21pm	4:51pm
	Background	4:55pm	5:23pm
	Background	5:33pm	6:01pm

3.4 Meteorological Conditions

Detailed meteorological data relevant to the measurement is provided in Appendix E.

As previously mentioned, wind speed for Turbine ON was derived from T35's power curve (as per the standard), while wind direction was provided by T35's yaw position. Background data was obtained from an anemometer located 10m above ground level near T35.

Temperature and pressure readings during the measurement period were provided by the 10m anemometer, located near turbine T35 for the duration of Aercoustics measurements.

3.5 Turbine operational information

Output data from the turbine (Power, yaw, RPM, pitch angle, and nacelle wind speed) were obtained as analog output signals that were simultaneously acquired with the acoustic and anemometer measurement data using Aercoustics data acquisition system.

4 Measurement Results

4.1 Deviations from IEC-61400-11 Edition 3.0

Due to Electromagnetic Interference affecting microphone signal in the test cabling at 1/3 octave frequency bands at 8 kHz and above, the analysis excludes these affected frequency bands. As wind turbines do not generate sound of notable levels at high frequencies, this has a negligible impact on the conclusions of the analysis.

4.2 Special Notes & Considerations

There were no other turbines in the immediate vicinity of T35.

4.3 Analysis Details

The following section outlines analysis of the measurement data acquired for T35. The data presented is exclusive of transient events such as vehicle traffic, wildlife, air traffic etc. The site has been assessed to have a roughness length of 0.05m, representative of farmland with some vegetation.

4.3.1 Double Windscreen Adjustment

As previously mentioned, no double wind screen was used, as such the measurement data did not require adjustment.

4.3.2 Wind Speed Correction

The wind speed for each measurement data point for Turbine ON was derived through the power curve (as per Section 8.2.1.1 of IEC-61400-11). For data points during Turbine ON that were outside the allowed range of the power curve, the wind speed was derived from the nacelle anemometer wind speed (as specified in Section 8.2.1.2 of IEC-61400-11).

Background wind speed was derived utilizing data acquired with the 10m anemometer and normalizing the wind speed (as per Section 8.2.2 of IEC-61400-11).

4.4 Type B uncertainties

Type B uncertainties were obtained through interpretation of information provided in Annex C of IEC-61400-11, and instrument uncertainties obtained from the calibration certificate. A summary of Type B uncertainties is provided in Table 9, while detailed information (including data in 1/3 octave) is provided in Appendix C.

Table 9 - Summary of Type B uncertainties

Component	Typical (dB)	Used (dB)
Calibration	0.2	0.2
Board	0.3	0.3
Distance & direction	0.1	0.1
Air absorption	0	0
Weather conditions	0.5	0.5
Wind speed measured	0.7	0.7
Wind speed derived	0.2	0.2
Wind speed from power curve	0.2	0.2

4.5 Sound Pressure Level Measurements

Sound pressure level measurements are summarized in Table 10. Detailed 1/3 Octave band spectrum data, respective uncertainties, and analysis plots are provided in Appendix C. A copy of the measurement data used for analysis is provided in Appendix E and includes meteorological and turbine operational data.

Table 10 - Summary of Sound Pressure Level Measurements

Wind Speed (m/s)	Turbine ON		Background		Turbine ON, Background adjusted L_{eq}, (dBA)
	L_{eq}, (dBA)	# of data pts	L_{eq}, (dBA)	# of data pts	
8.5	51.1	10	40.9	41	50.7
9	51.2	10	41.7	50	50.7
9.5	52.1	10	42.2	31	51.6
10	52.7	20	43.3	41	52.2
10.5	53.0	10	43.9	28	52.5
11	53.8	16	45.3	36	53.2
11.5	54.0	10	46.8	31	53.2
12	55.0	35	46.4	27	54.4
12.5	54.7	21	46.9	24	53.9
13	54.7	25	47.9	12	53.7
13.5	55.1	28	47.8	10	54.2

4.6 Sound Power Level of Turbine

The calculated sound power level of the turbine T35 (as per IEC 61400-11) is summarized in Table 11 (hub height) and Table 12 (10m height). Detailed 1/3 Octave band spectrum data and respective uncertainties are provided in Appendix C.

Table 11 - $L_{WA,K}$ at each integer wind speed

Wind Speed (m/s)	Apparent L_{WA}, (dBA)	Uncertainty (dB)
8.5	101.6	1.2
9	101.5	1.0
9.5	102.5	1.0
10	103.1	0.9
10.5	103.3	0.9
11	104.1	0.8
11.5	104.0	1.0
12	105.3	0.9
12.5	104.8	0.9
13	104.6	0.9
13.5	105.1	1.0

Table 12 - $L_{WA\ 10m,K}$ at each integer wind speed

Wind Speed (m/s)	Apparent L_{WA}, (dBA)	Uncertainty (dB)
6	101.6	0.9
7	103.3	0.9
8	104.8	0.8
9	105.0	0.9

4.7 Tonality Analysis

The tonality analysis for Turbine T35 is summarized in Table 13, while plots of narrow band spectra at each wind speed are provided in Appendix D. The ΔL_{tn} and ΔL_a values reported represent the energy average of all data points with an identified tone that falls within the same frequency origin (as specified in Section 9.5.8 in IEC-61400-11).

The narrow band spectra provided in the plots represents an energy average of all data points in the given wind speed bin for both Turbine ON and Background.

Table 13 - Tonality Assessment Summary

Wind Speed (m/s)	Frequency (Hz)	Tonality, ΔL_{tn} (dB)	Tonal audibility, ΔL_a (dB)	FFT's with tones	Total # of FFT's	Presence (%)
10.5	116	-4.9	-2.9	10	10	100%
11	116	-4.4	-2.4	16	16	100%
11.5	116	-5.0	-3.0	10	10	100%

5 Closure

Measurements and analysis were carried on Turbine T35 of the Niagara Region Wind Farm as per International IEC 61400-11 (Edition 3.0, released 2012-11), "Wind turbine generator systems – Part 11: Acoustic noise measurement techniques".

Should you have any questions or comments please do not hesitate to contact the authors of this report.

6 References

1. International Standard IEC 61400-11 (Edition 3.0, released 2012-11), "Wind turbine generator systems – Part 11: Acoustic noise measurement techniques".

Aercoustics Engineering Ltd.
1004 Middlegate Road, Suite 1100
Mississauga, ON L4Y 1M4

Tel: 416-249-3361
Fax 416-249-3613
aercoustics.com

Appendix A
Site Details

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16227.00.T35.RP1	**Project Name**
Scale: NTS Drawn by: AM Reviewed by: PA Date: Oct 30, 2017 Revision: 1	Niagara Region Wind Farm - Turbine T35 - IEC61400-11 Edition 3.0
	Figure Title Site Plan

Figure A.01

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16227.00.T35.RP1

Scale: NTS
Drawn by: AM
Reviewed by: PA
Date: Oct 30, 2017
Revision: 1

Project Name

Niagara Region Wind Farm - Turbine T35 - IEC61400-11 Edition 3.0

Figure Title

Site Photos

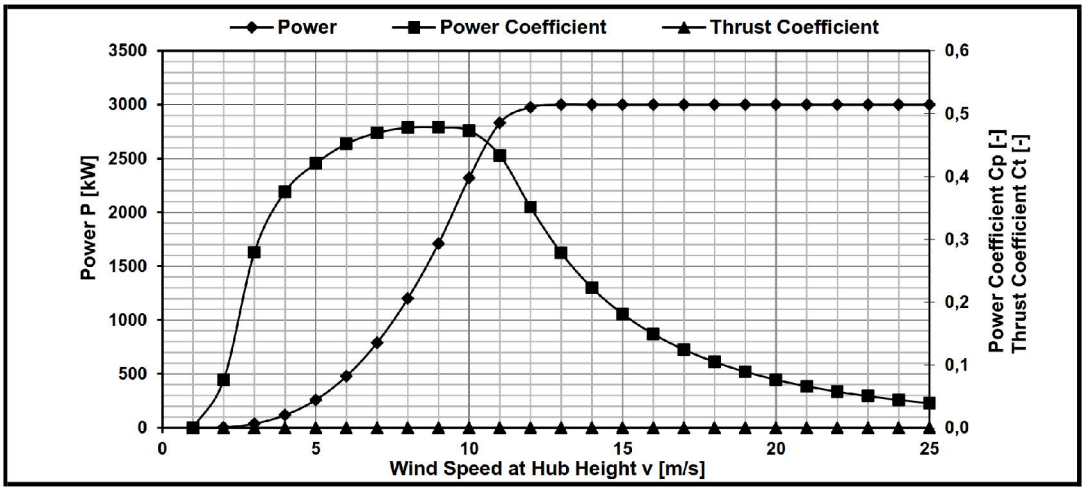
Figure A.02

aercoustics
Aercoustics Engineering Ltd.
1004 Middlegate Road, Suite 1100
Mississauga, ON L4Y 1M4
Tel: 416-249-3361
Fax 416-249-3613
aercoustics.com

Appendix B
Turbine Information

ENERCON ENERGY FOR THE WORLD	Power Curve E-101 3050 kW OM 3000 kW
Rated Power Output:	3050 kW
Operation Mode:	OM 3000 kW
Designation:	PC_E-101_3050_kW_OM_3000_kW_calculated_V1.0
Standard Air Density:	1.225 kg/m³

Wind Speed v [m/s]	Power P [kW]	Power Coefficient Cp [-]	Thrust Coefficient Ct [-]
1	0	0.00	-
2	3	0.08	-
3	37	0.28	-
4	118	0.38	-
5	258	0.42	-
6	479	0.45	-
7	790	0.47	-
8	1200	0.48	-
9	1710	0.48	-
10	2320	0.47	-
11	2830	0.43	-
12	2975	0.35	-
13	3000	0.28	-
14	3000	0.22	-
15	3000	0.18	-
16	3000	0.15	-
17	3000	0.12	-
18	3000	0.10	-
19	3000	0.09	-
20	3000	0.08	-
21	3000	0.07	-
22	3000	0.06	-
23	3000	0.05	-
24	3000	0.04	-
25	3000	0.04	-



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Author:	Benjamin Ahrens
Department:	WRD Power Performance
Date:	15.09.2015

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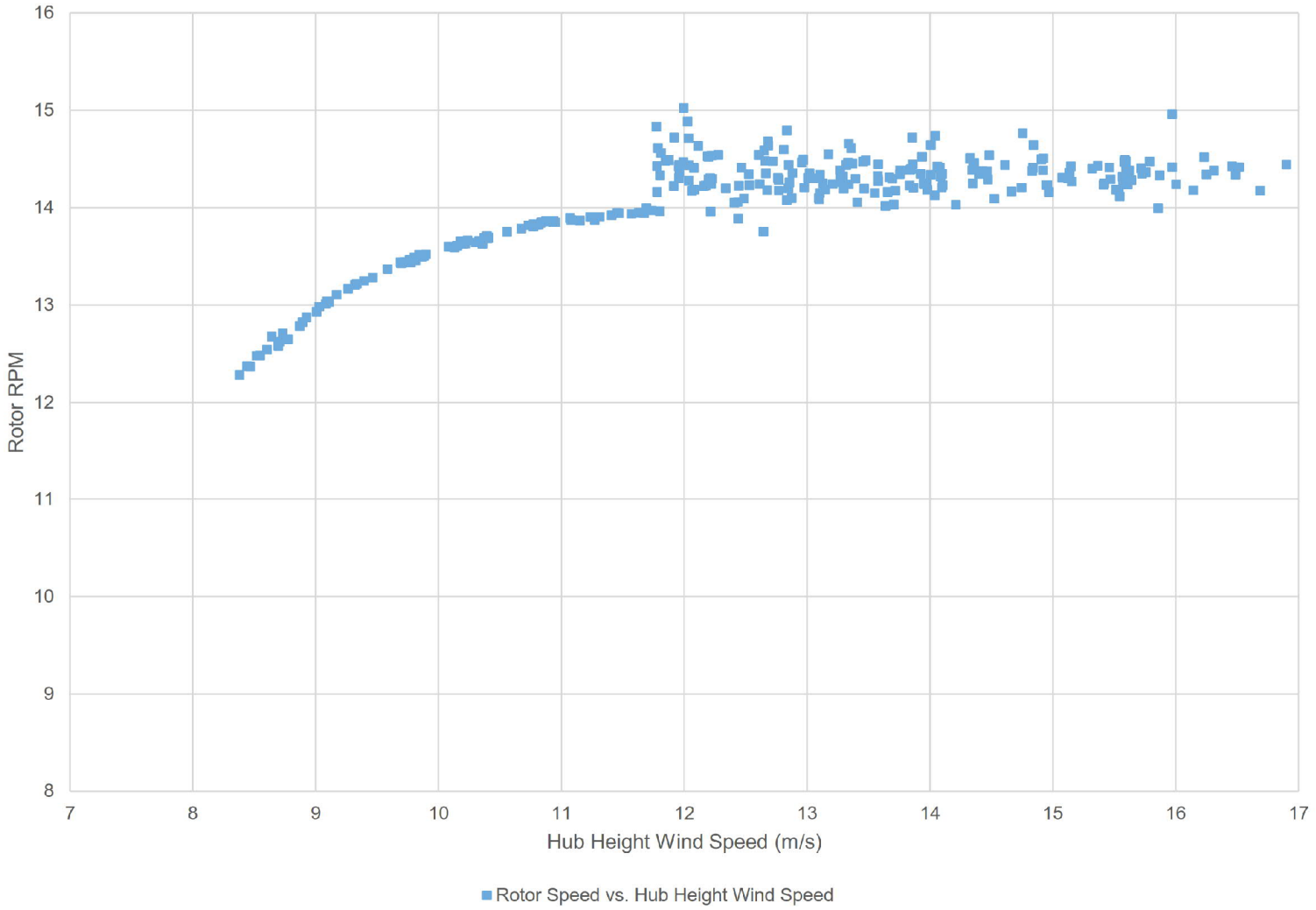

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Figure B.02

aercoustics
Aercoustics Engineering Ltd.
1004 Middlegate Road, Suite 1100
Mississauga, ON L4Y 1M4
Tel: 416-249-3361
Fax 416-249-3613
aercoustics.com

Appendix C
Apparent Sound Power Level

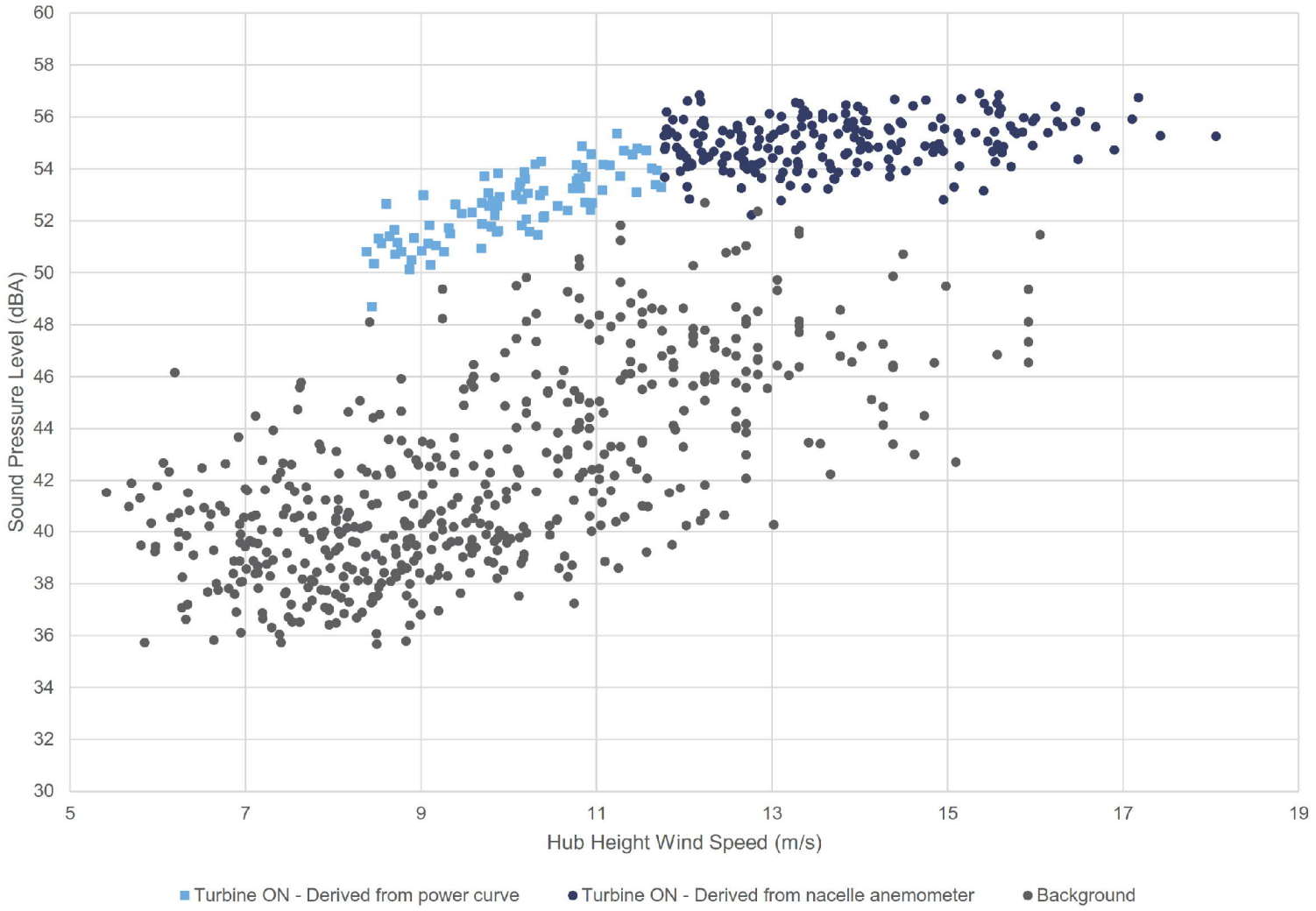

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Figure C.01

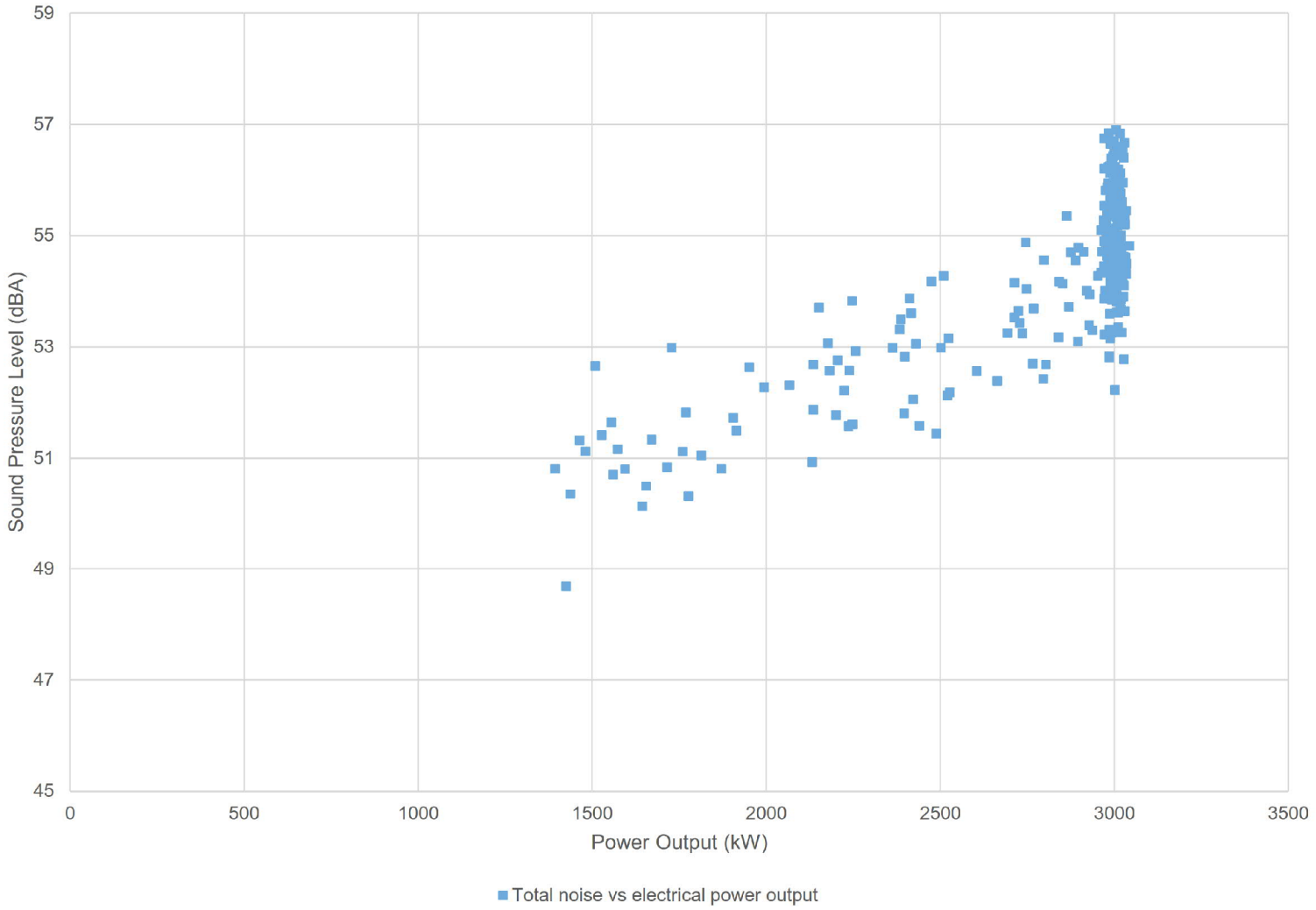

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Figure C.02

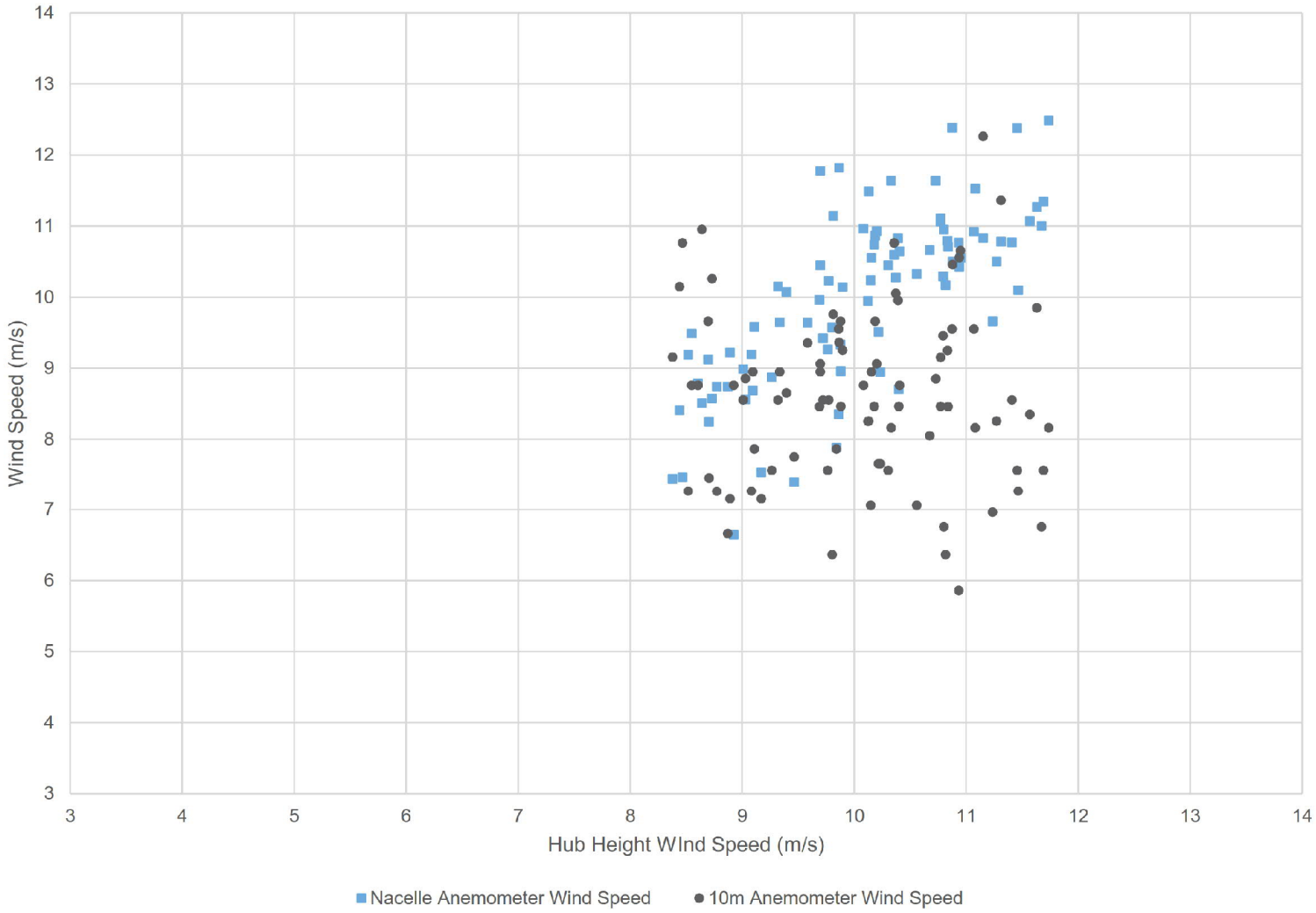

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Figure C.03

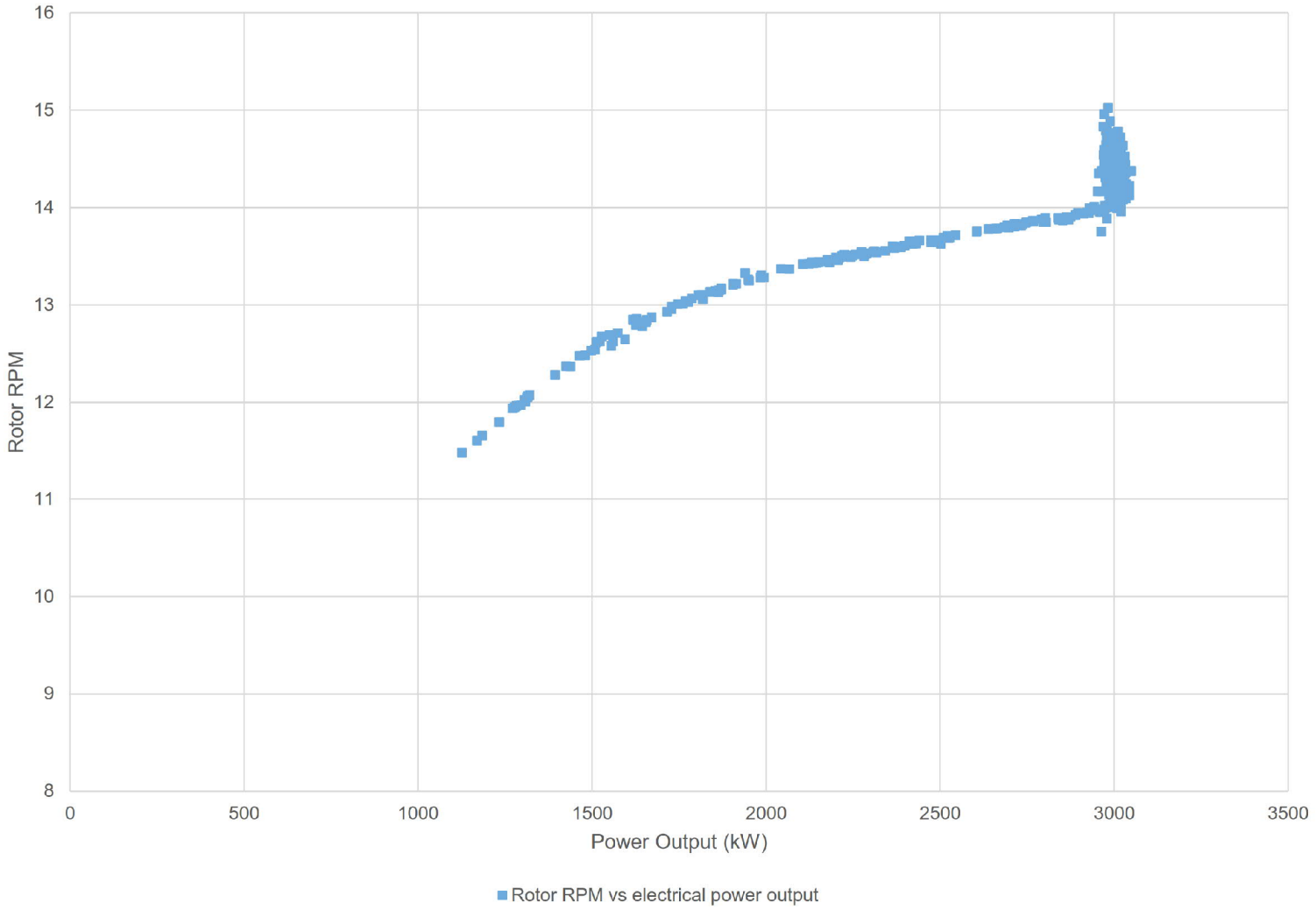

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Figure C.04

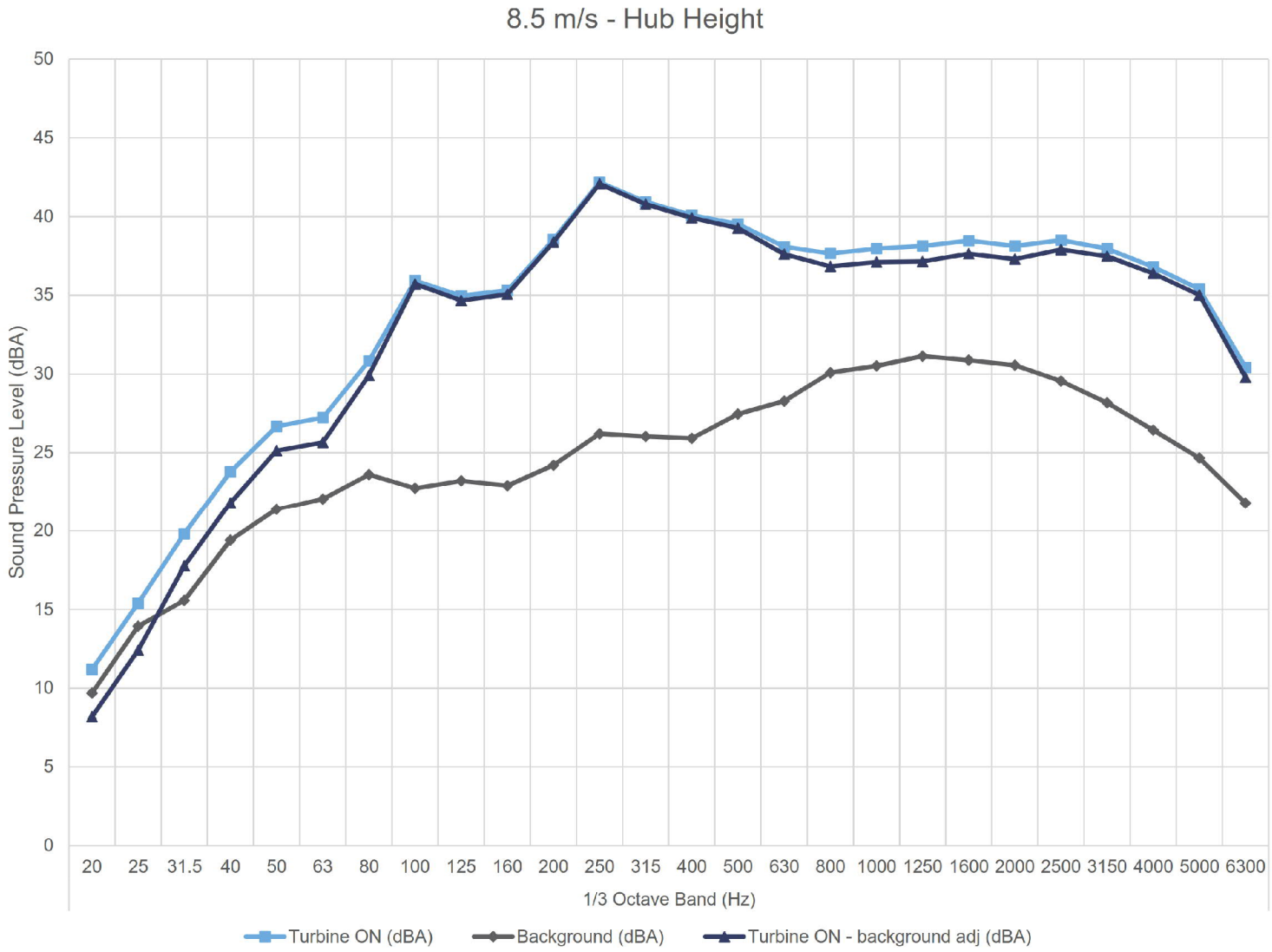

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Figure C.05

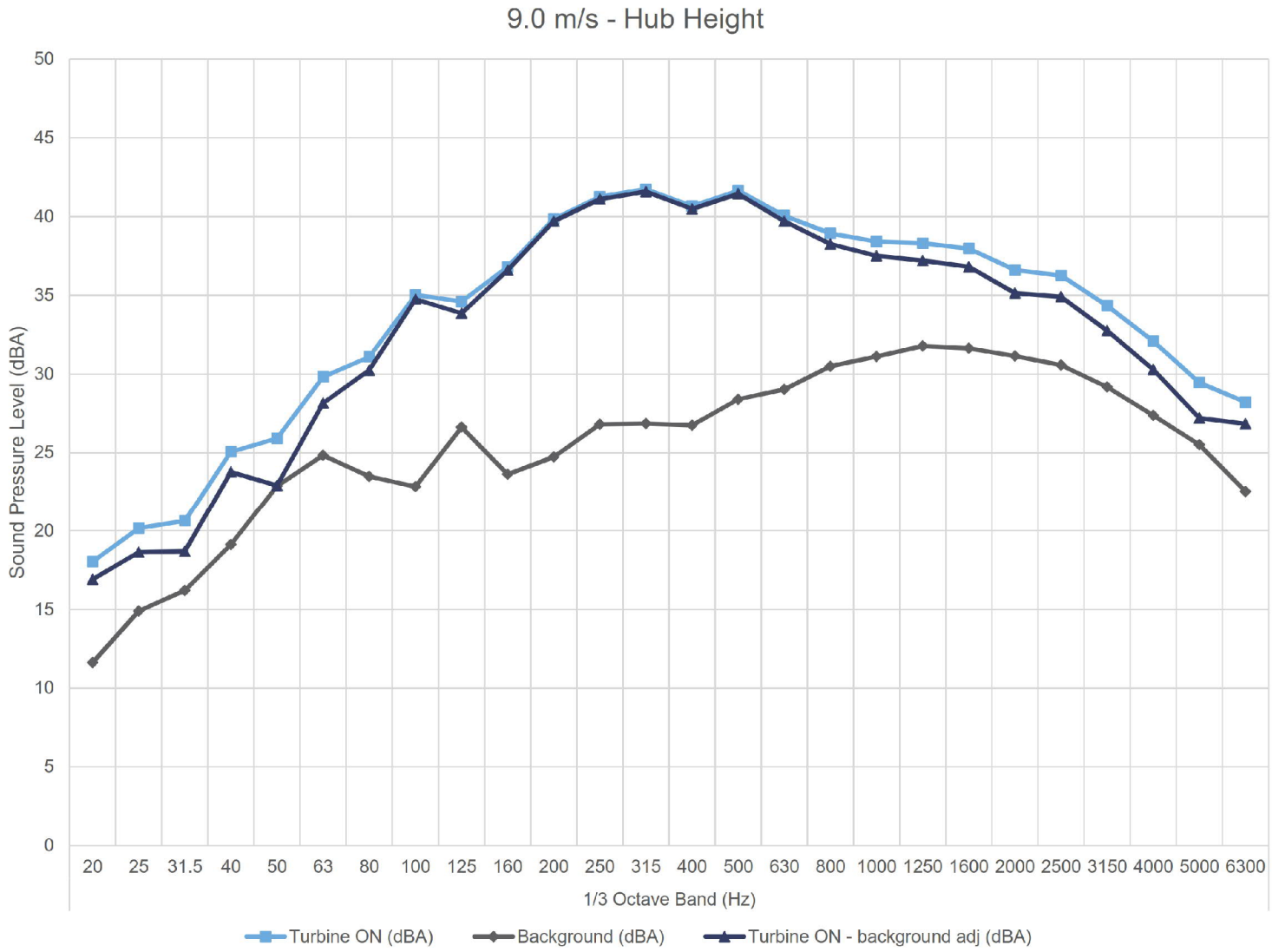

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Figure C.06

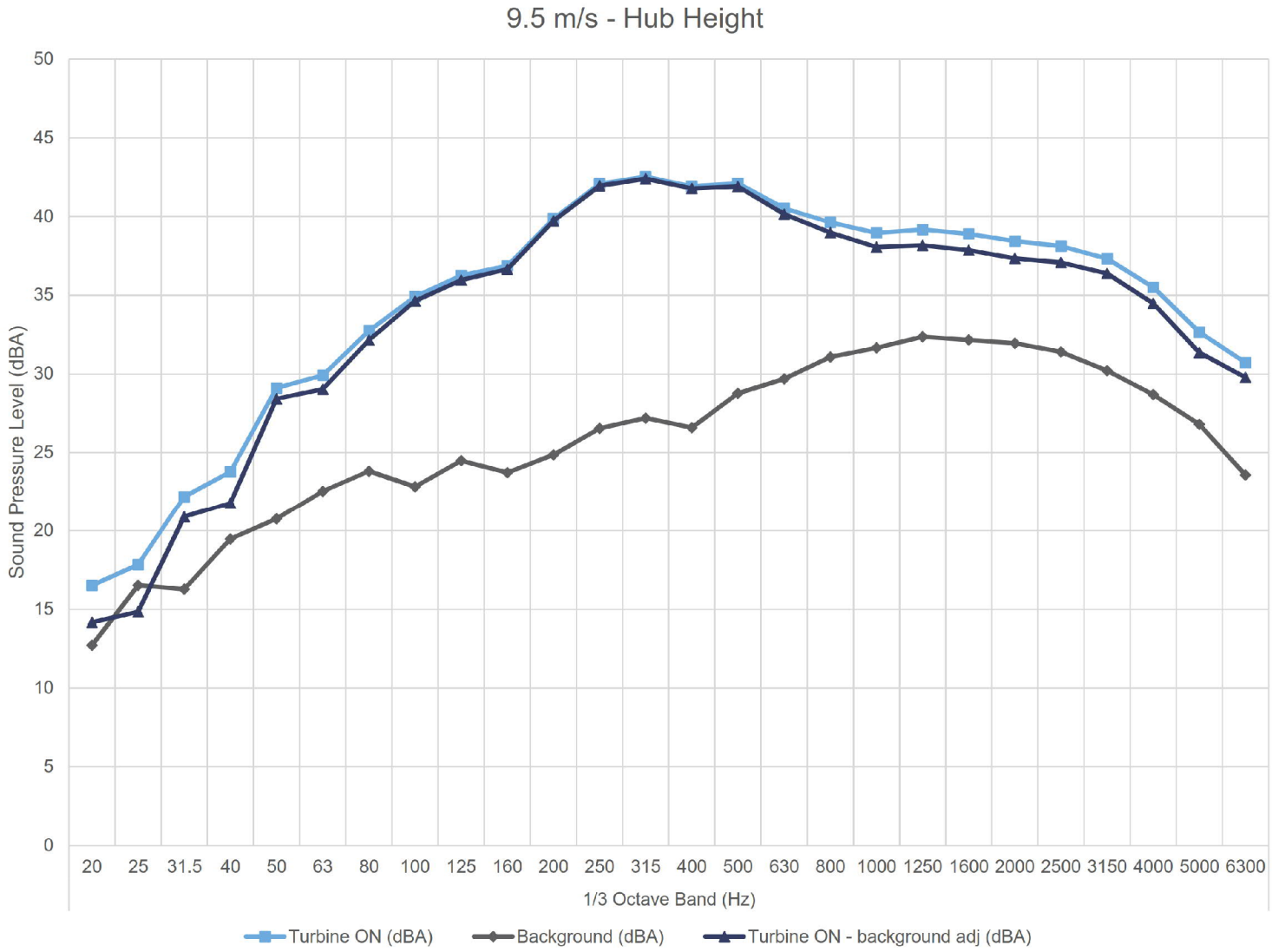

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Figure C.07

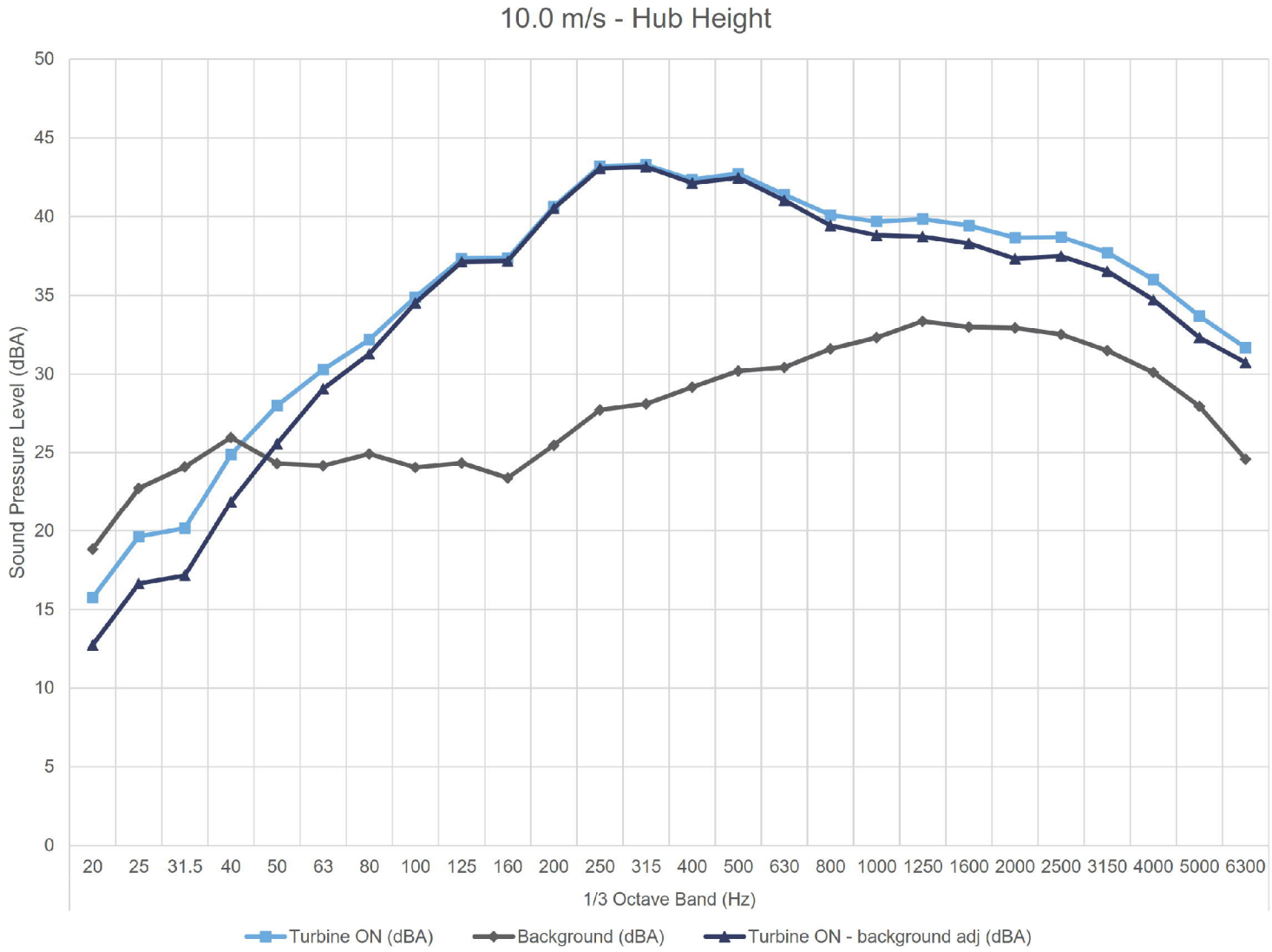

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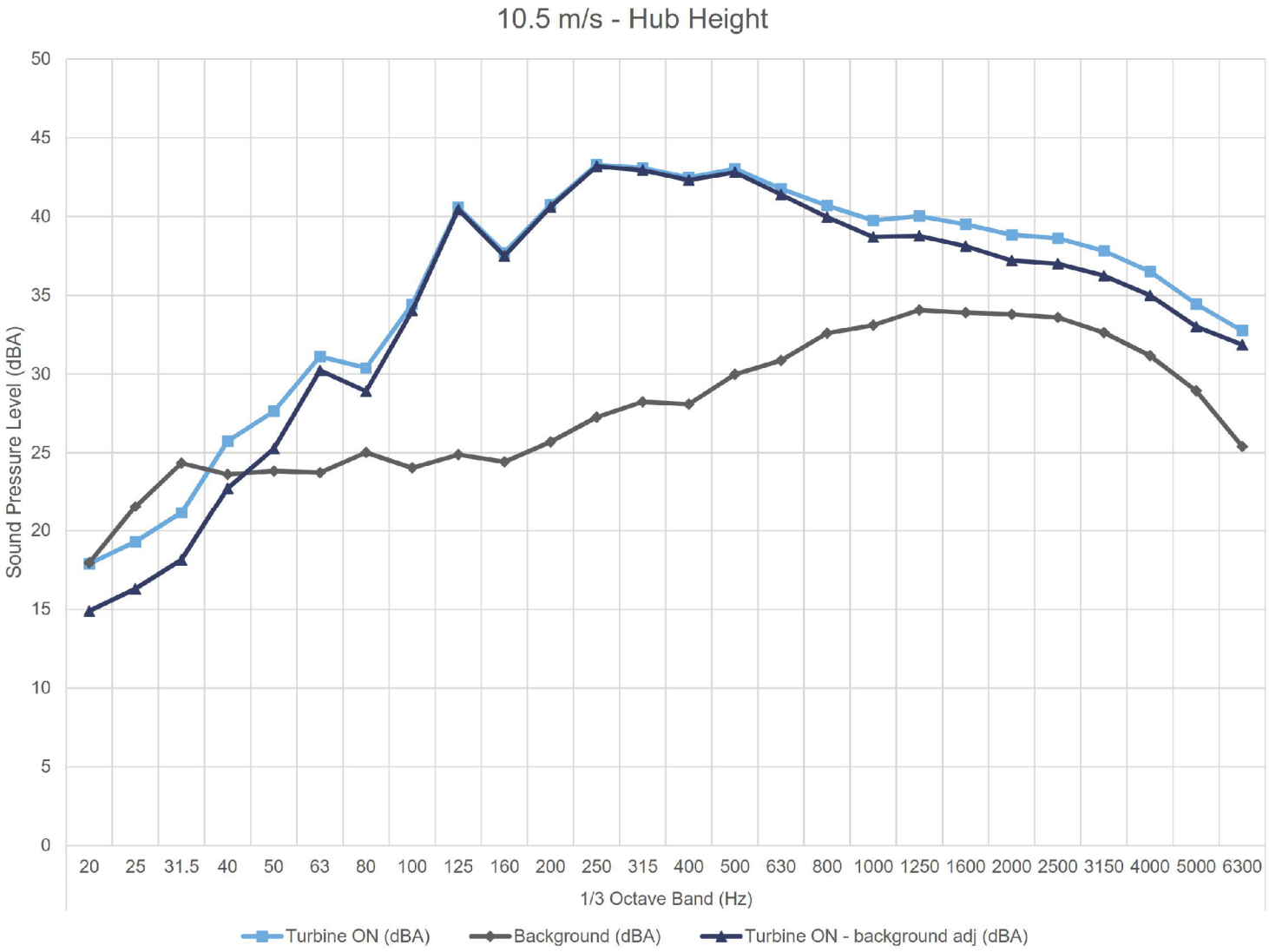
Figure C.08



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Scale: NTS Drawn by: AM Reviewed by: PA Date: Nov 3, 2017 Revision: 1	Niagara Region Wind Farm - Turbine T35 - IEC61400-11 Edition 3.0
	Figure Title Plot of sound pressure spectrum in 1/3 Octave at 10.5 m/s

Figure C.09

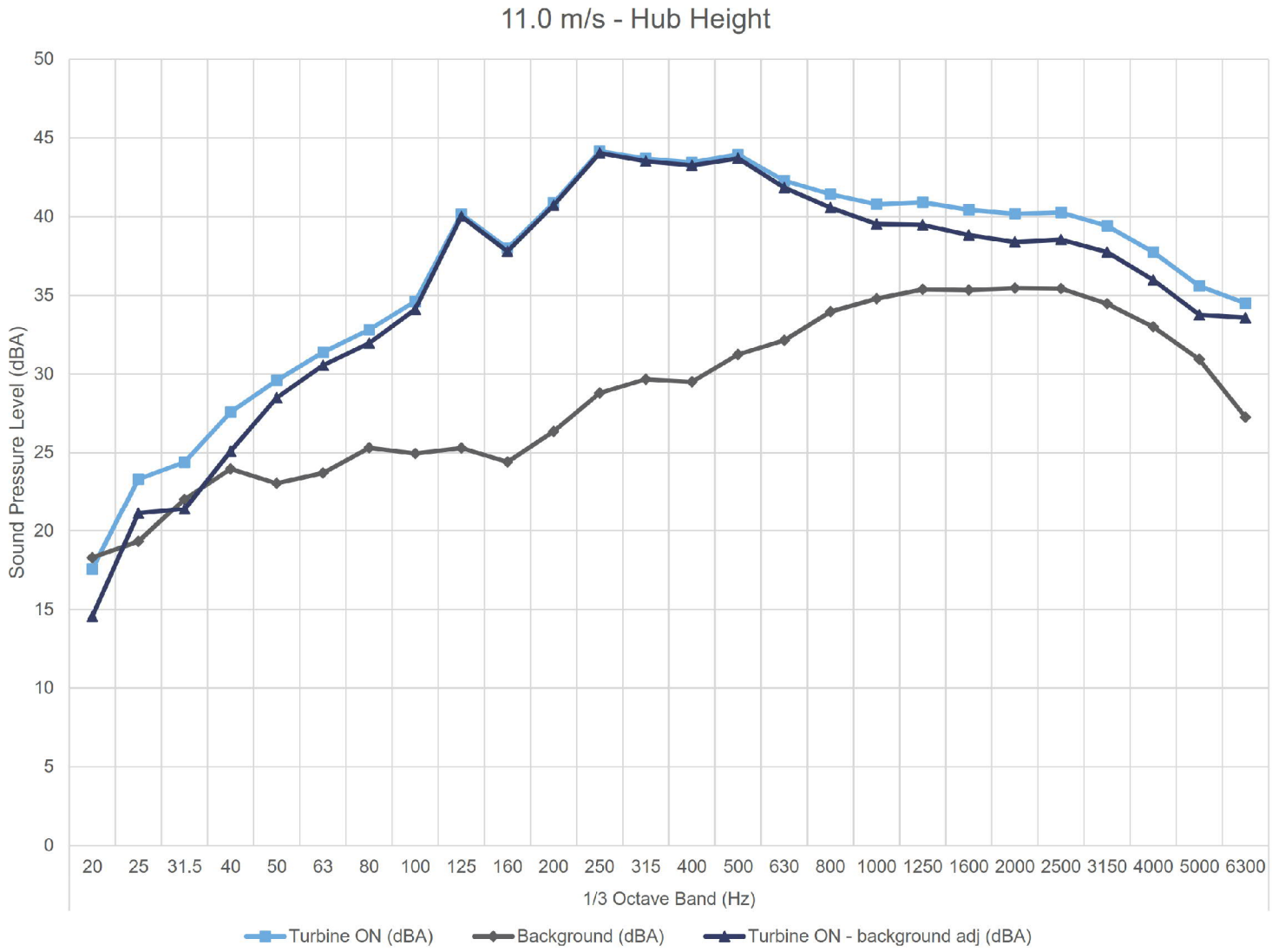

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Figure C.10

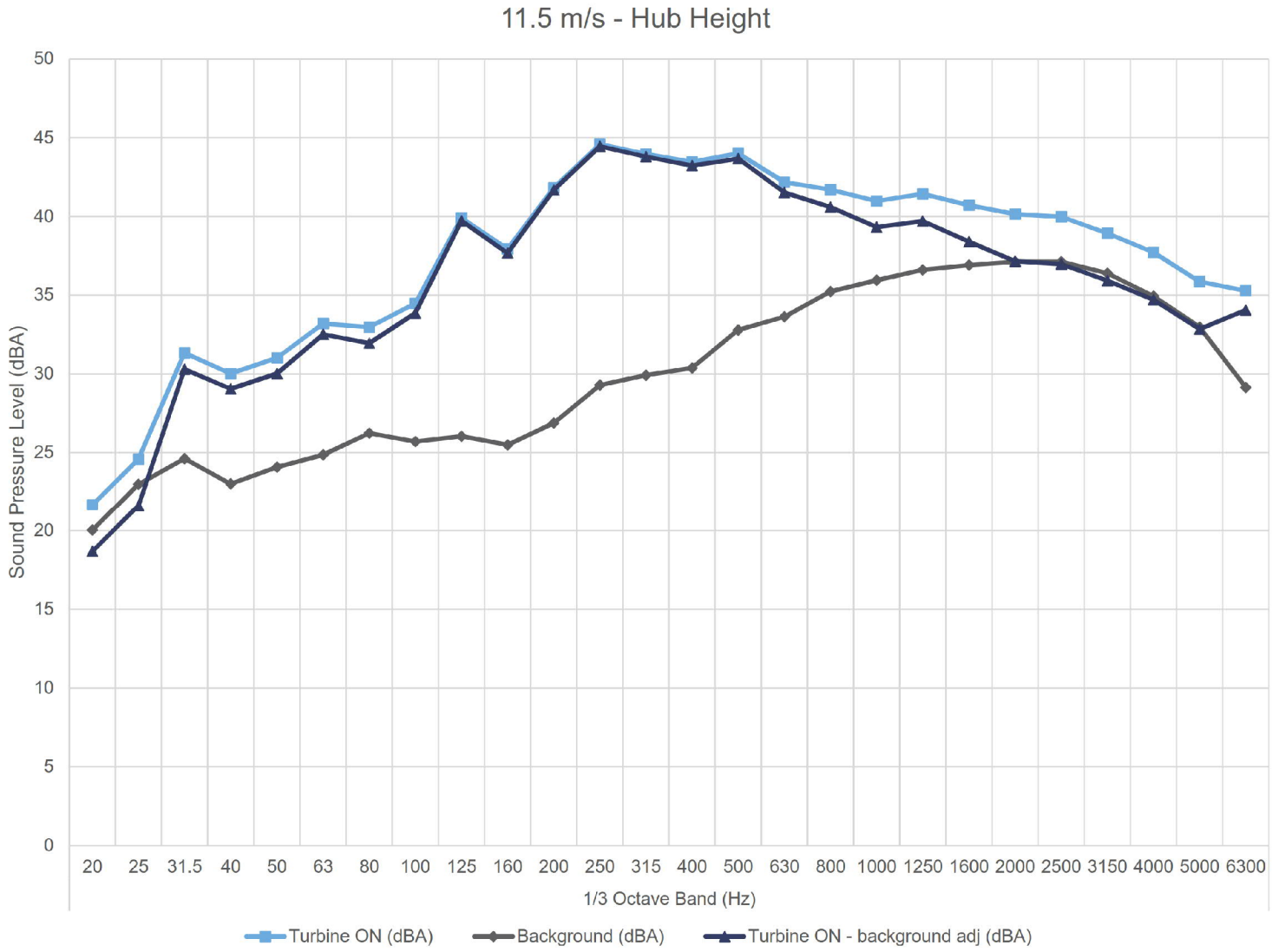

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Figure C.11

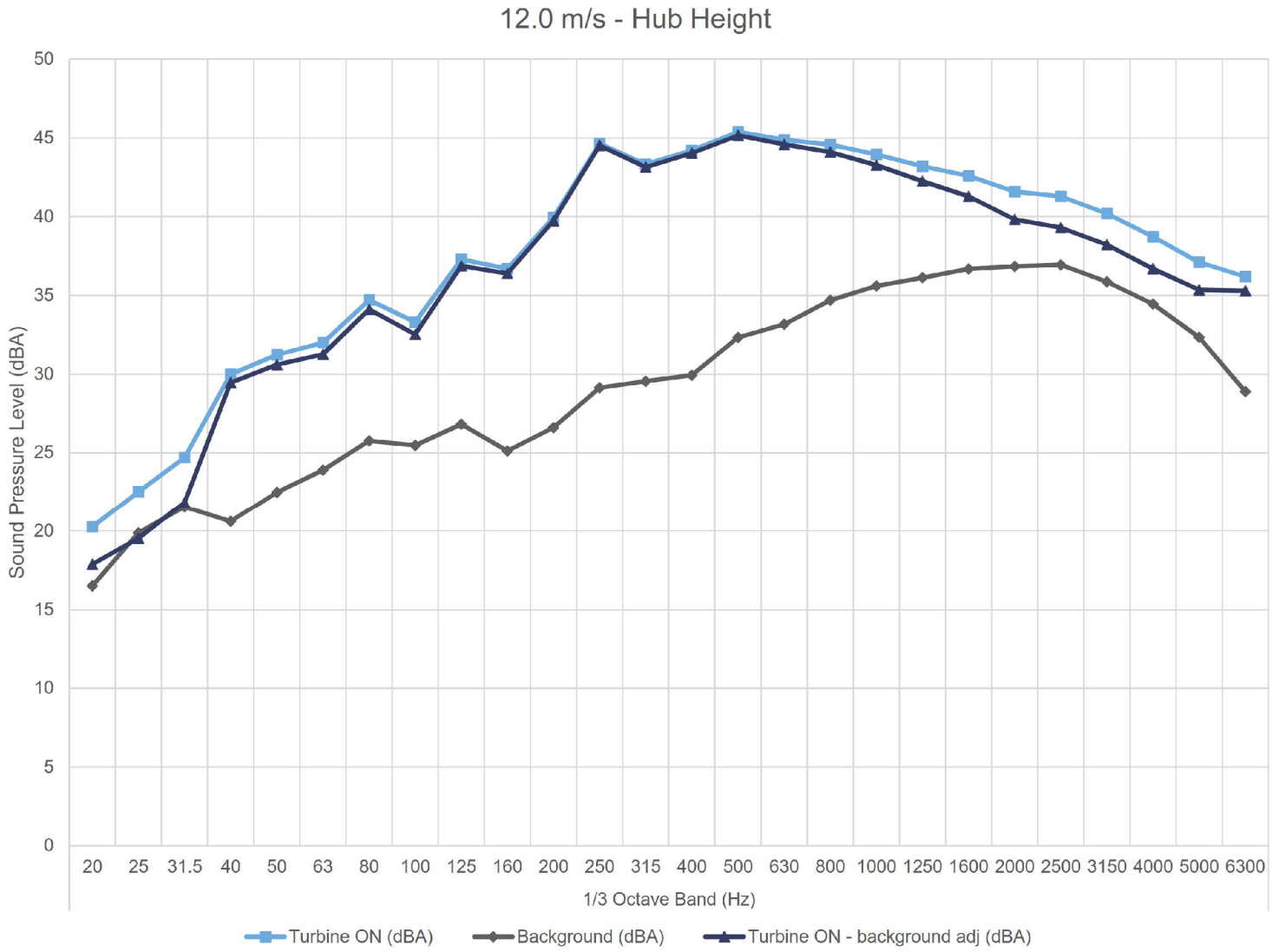

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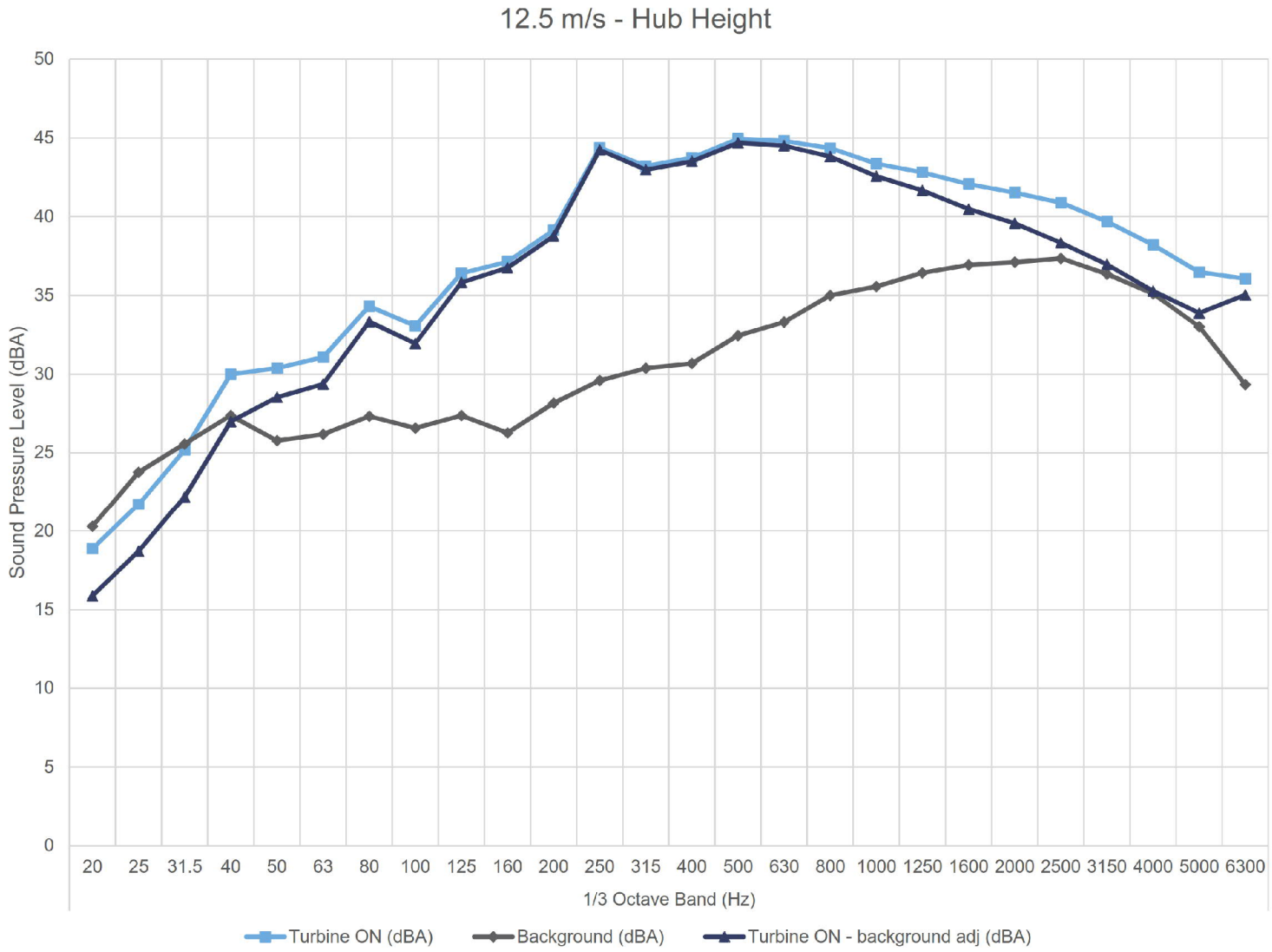
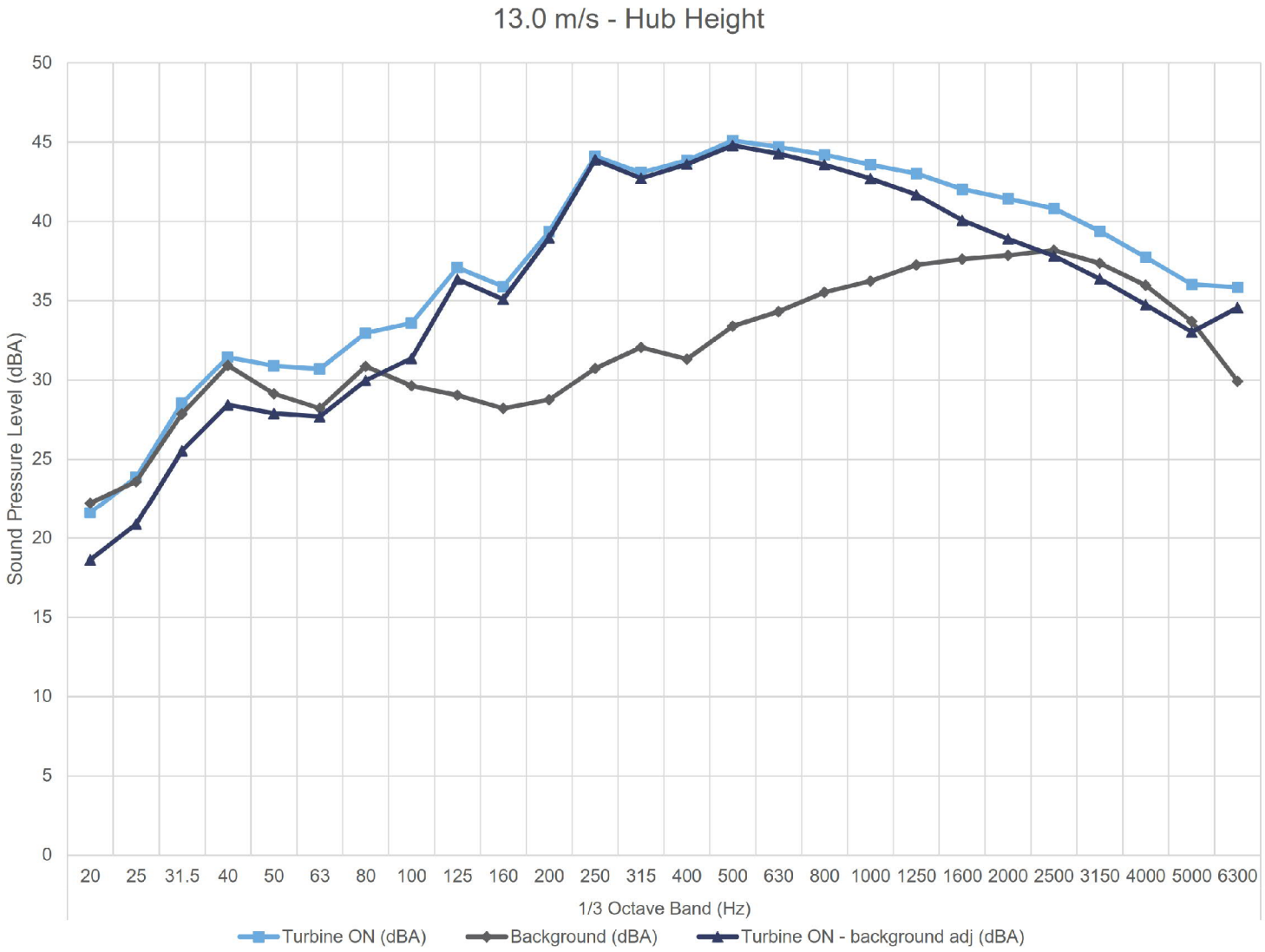
Figure C.12



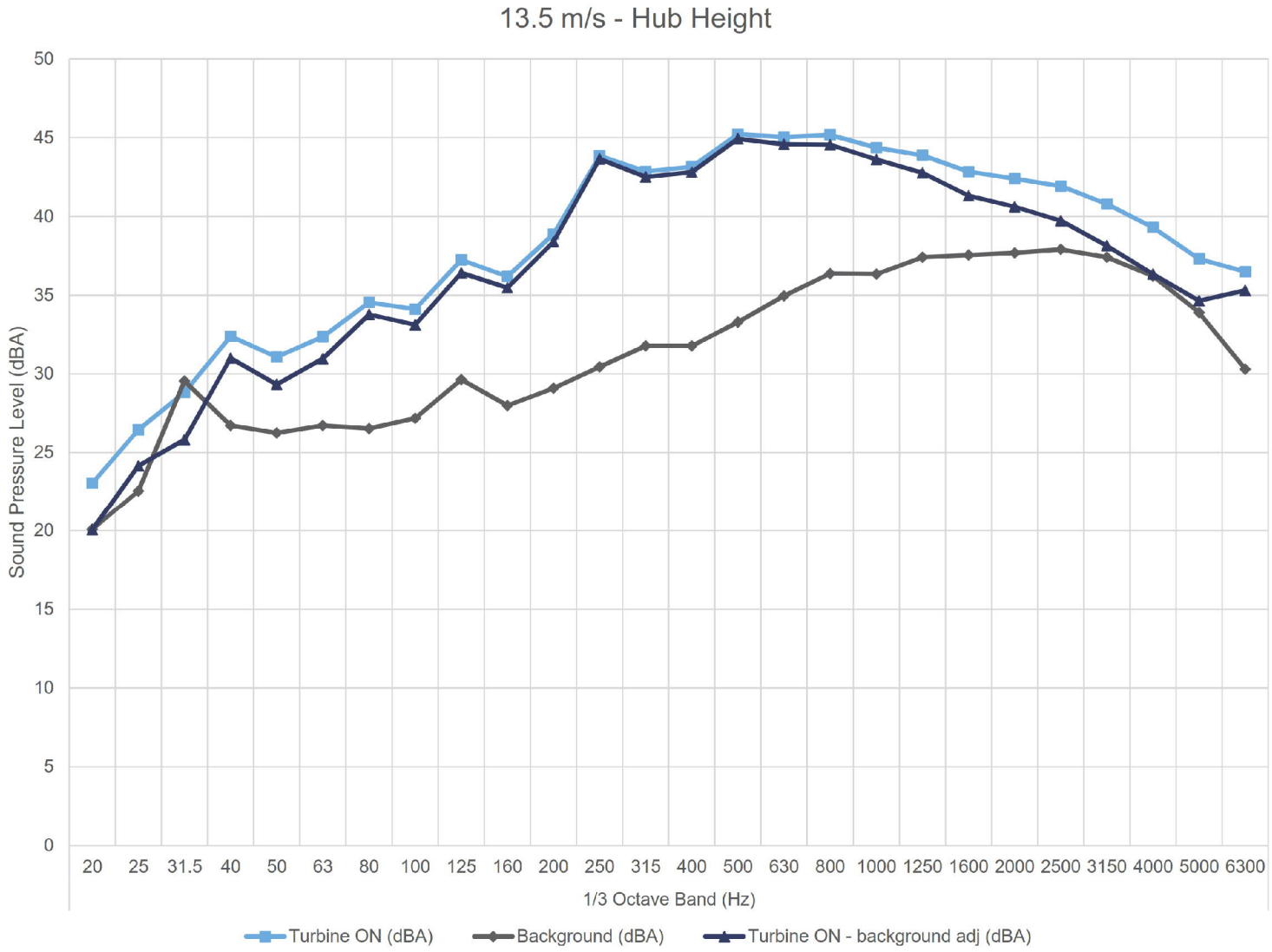
aercoustics	16227.00.T35.RP1 Scale: NTS Drawn by: AM Reviewed by: PA Date: Nov 3, 2017 Revision: 1	**Project Name** Niagara Region Wind Farm - Turbine T35 - IEC61400-11 Edition 3.0 **Figure Title** Plot of sound pressure spectrum in 1/3 Octave at 12.5 m/s

Figure C.13



aercoustics	16227.00.T35.RP1 Scale: NTS Drawn by: AM Reviewed by: PA Date: Nov 3, 2017 Revision: 1	**Project Name** Niagara Region Wind Farm - Turbine T35 - IEC61400-11 Edition 3.0 **Figure Title** Plot of sound pressure spectrum in 1/3 Octave at 13 m/s

Figure C.14



aercoustics	16227.00.T35.RP1 Scale: NTS Drawn by: AM Reviewed by: PA Date: Nov 3, 2017 Revision: 1	**Project Name** Niagara Region Wind Farm - Turbine T35 - IEC61400-11 Edition 3.0 **Figure Title** Plot of sound pressure spectrum in 1/3 Octave at 13.5 m/s

Figure C.15

Table C.01 Detailed apparent sound power level data at hub height

Project: Niagara Wind Farm - Turbine T35 - IEC 61400-11 Measurement

Report ID: 16227.00.T35.RP1

Created on: 11/3/2017

1/3 Octave values marked with brackets [ ] denote less than 3 dB difference between Turbine ON and Background

Overall levels marked with an asterisk * denote 3 to 6 dB difference between Turbine ON and Background, while Overall values with less than 3 dB difference between Turbine ON and Background are not reported

Wind Bin (m/s)	Parameter	1/3 Octave Band (Hz)																												Overall
		20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	
8.5	Turbine ON (dBA)	11.2	15.4	19.8	23.8	26.7	27.2	30.8	35.9	35.0	35.3	38.5	42.2	40.9	40.1	39.5	38.1	37.7	38.0	38.1	38.5	38.1	38.5	38.0	36.8	35.4	30.4	51.1
	Background (dBA)	9.7	13.9	15.6	19.4	21.4	22.1	23.6	22.7	23.2	22.9	24.2	26.2	26.0	25.9	27.5	28.3	30.1	30.5	31.1	30.9	30.6	29.6	28.2	26.4	24.7	21.8	40.9
	Turbine ON - background adj (dBA)	[8.2]	[12.4]	17.8	21.8	25.1	25.7	29.9	35.7	34.7	35.1	38.4	42.1	40.8	39.9	39.3	37.6	36.8	37.1	37.2	37.6	37.3	37.9	37.5	36.4	35.0	29.8	50.7
	Signal to noise (dB)	1.5	1.5	4.2	4.4	5.3	5.2	7.2	13.2	11.8	12.4	14.3	16.0	14.9	14.2	12.1	9.8	7.6	7.5	7.0	7.6	7.6	9.0	9.8	10.4	10.7	8.6	10.2
	Uncertainty (dB)	4.6	4.0	3.0	2.6	1.9	2.0	1.3	1.3	1.3	1.2	1.2	1.0	1.1	1.0	1.1	1.1	1.2	1.1	1.2	1.2	1.2	1.3	1.3	1.3	1.4	1.3	1.2
	PWL (dBA)	[59.1]	[63.3]	68.6	72.7	76.0	76.5	80.8	86.6	85.5	85.9	89.3	92.9	91.7	90.8	90.1	88.5	87.7	88.0	88.0	88.5	88.2	88.8	88.4	87.3	85.9	80.7	101.6
9.0	Turbine ON (dBA)	18.0	20.2	20.6	25.0	25.9	29.8	31.1	35.0	34.6	36.8	39.8	41.3	41.7	40.7	41.7	40.1	38.9	38.4	38.3	38.0	36.6	36.3	34.3	32.1	29.5	28.2	51.2
	Background (dBA)	11.6	14.9	16.2	19.1	22.9	24.8	23.5	22.8	26.6	23.6	24.7	26.8	26.9	26.8	28.4	29.0	30.5	31.1	31.8	31.6	31.1	30.6	29.2	27.4	25.5	22.5	41.7
	Turbine ON - background adj (dBA)	16.9	18.6	18.7	23.8	22.9	28.2	30.2	34.8	33.9	36.6	39.7	41.1	41.6	40.5	41.4	39.7	38.3	37.5	37.2	36.8	35.1	34.9	32.7	30.3	27.2	26.8	50.7
	Signal to noise (dB)	6.4	5.3	4.4	5.9	3.0	5.0	7.6	12.2	8.0	13.2	15.1	14.5	14.9	13.9	13.3	11.0	8.4	7.3	6.5	6.3	5.5	5.7	5.2	4.7	3.9	5.7	9.5
	Uncertainty (dB)	4.1	3.2	2.2	1.8	2.1	1.3	1.2	1.1	1.3	1.0	0.9	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.1	1.3	1.4	1.4	1.7	1.2	1.0
	PWL (dBA)	67.8	69.5	69.6	74.6	73.8	79.0	81.1	85.6	84.7	87.5	90.6	92.0	92.5	91.4	92.3	90.6	89.1	88.4	88.1	87.7	86.0	85.8	83.6	81.2	78.1	77.7	101.5
9.5	Turbine ON (dBA)	16.5	17.8	22.2	23.8	29.1	29.9	32.7	34.9	36.3	36.9	39.9	42.1	42.5	41.9	42.1	40.5	39.6	39.0	39.2	38.9	38.4	38.1	37.3	35.5	32.7	30.7	52.1
	Background (dBA)	12.7	16.5	16.3	19.5	20.8	22.5	23.8	22.8	24.5	23.7	24.9	26.5	27.2	26.6	28.8	29.7	31.1	31.7	32.4	32.2	32.0	31.4	30.2	28.7	26.8	23.6	42.2
	Turbine ON - background adj (dBA)	14.2	[14.8]	20.9	21.8	28.4	29.0	32.2	34.6	36.0	36.7	39.7	42.0	42.4	41.8	41.9	40.1	39.0	38.1	38.2	37.9	37.3	37.1	36.4	34.5	31.4	29.8	51.6
	Signal to noise (dB)	3.8	1.3	5.9	4.3	8.4	7.4	8.9	12.1	11.8	13.1	15.0	15.5	15.3	15.3	13.3	10.8	8.5	7.3	6.8	6.7	6.5	6.7	7.1	6.8	5.9	7.1	9.9
	Uncertainty (dB)	3.9	4.4	2.3	1.8	1.5	1.2	1.4	1.0	1.1	0.9	0.8	0.8	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.0	1.1	1.3	1.5	1.6	1.5	1.1	1.0
	PWL (dBA)	65.1	[65.7]	71.8	72.7	79.3	79.9	83.0	85.5	86.8	87.5	90.6	92.8	93.3	92.7	92.8	91.0	89.9	88.9	89.0	88.7	88.2	88.0	87.3	85.4	82.2	80.7	102.5
10.0	Turbine ON (dBA)	15.7	19.6	20.2	24.9	28.0	30.3	32.2	34.9	37.3	37.4	40.7	43.2	43.3	42.3	42.7	41.4	40.1	39.7	39.8	39.4	38.7	38.7	37.7	36.0	33.7	31.7	52.7
	Background (dBA)	18.8	22.8	24.1	26.0	24.3	24.2	24.9	24.1	24.3	23.4	25.5	27.7	28.1	29.2	30.2	30.4	31.6	32.3	33.3	33.0	32.9	32.5	31.5	30.1	28.0	24.6	43.3
	Turbine ON - background adj (dBA)	[12.7]	[16.6]	[17.2]	[21.9]	25.6	29.1	31.3	34.5	37.1	37.2	40.5	43.1	43.2	42.1	42.5	41.0	39.4	38.8	38.7	38.3	37.3	37.5	36.5	34.7	32.3	30.7	52.2
	Signal to noise (dB)	-3.1	-3.1	-3.9	-1.1	3.7	6.1	7.3	10.8	13.0	14.0	15.2	15.5	15.2	13.2	12.5	11.0	8.5	7.4	6.5	6.4	5.7	6.2	6.2	5.9	5.7	7.1	9.4
	Uncertainty (dB)	4.4	3.8	3.1	2.7	2.0	1.3	1.2	1.0	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.3	1.3	1.4	1.4	1.1	0.9
	PWL (dBA)	[63.6]	[67.5]	[68]	[72.8]	76.4	79.9	82.2	85.4	88.0	88.1	91.4	93.9	94.0	93.0	93.3	91.9	90.3	89.7	89.6	89.2	88.2	88.4	87.4	85.6	83.2	81.6	103.1
10.5	Turbine ON (dBA)	17.9	19.3	21.2	25.7	27.6	31.1	30.4	34.4	40.6	37.7	40.7	43.3	43.1	42.5	43.0	41.8	40.7	39.8	40.0	39.5	38.8	38.6	37.8	36.5	34.4	32.7	53.0
	Background (dBA)	17.9	21.5	24.3	23.6	23.8	23.7	25.0	24.0	24.9	24.4	25.7	27.3	28.2	28.1	30.0	30.9	32.6	33.1	34.1	33.9	33.8	33.6	32.6	31.2	28.9	25.4	43.9
	Turbine ON - background adj (dBA)	[14.9]	[16.3]	[18.2]	[22.7]	25.3	30.2	28.9	34.0	40.5	37.5	40.6	43.2	42.9	42.3	42.8	41.4	40.0	38.7	38.8	38.1	37.2	37.0	36.3	35.0	33.0	31.9	52.5
	Signal to noise (dB)	-0.1	-2.2	-3.2	2.1	3.8	7.4	5.4	10.4	15.7	13.3	15.1	16.0	14.9	14.4	13.1	10.9	8.1	6.7	6.0	5.6	5.1	5.0	5.2	5.3	5.5	7.3	9.1
	Uncertainty (dB)	5.1	3.9	3.3	2.5	2.0	1.8	1.4	0.9	1.0	1.0	0.7	0.7	0.8	0.8	0.9	0.9	0.9	0.9	1.0	1.0	1.1	1.3	1.4	1.5	1.5	1.1	0.9
	PWL (dBA)	[65.8]	[67.2]	[69]	[73.6]	76.1	81.1	79.8	84.9	91.3	88.4	91.5	94.1	93.8	93.2	93.7	92.3	90.9	89.6	89.6	89.0	88.1	87.9	87.1	85.9	83.9	82.7	103.3
11.0	Turbine ON (dBA)	17.6	23.3	24.4	27.6	29.6	31.4	32.8	34.6	40.2	38.0	40.9	44.2	43.7	43.4	43.9	42.3	41.4	40.8	40.9	40.4	40.2	40.3	39.4	37.7	35.6	34.5	53.8
	Background (dBA)	18.3	19.3	22.0	24.0	23.1	23.7	25.3	25.0	25.3	24.4	26.4	28.8	29.7	29.5	31.2	32.1	34.0	34.8	35.4	35.3	35.5	35.4	34.5	33.0	30.9	27.3	45.3
	Turbine ON - background adj (dBA)	[14.6]	21.1	[21.4]	25.1	28.5	30.6	32.0	34.1	40.0	37.8	40.7	44.0	43.5	43.3	43.7	41.8	40.6	39.5	39.5	38.8	38.4	38.5	37.7	36.0	33.8	33.6	53.2
	Signal to noise (dB)	-0.7	4.0	2.4	3.6	6.5	7.7	7.5	9.7	14.9	13.6	14.5	15.4	14.0	13.9	12.7	10.1	7.5	6.0	5.5	5.1	4.7	4.8	5.0	4.8	4.6	7.2	8.5
	Uncertainty (dB)	3.6	3.0	3.0	2.1	1.4	1.2	1.2	0.9	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.9	1.0	1.0	1.1	1.3	1.3	1.3	1.3	0.9	0.8
	PWL (dBA)	[65.4]	72.0	[72.3]	76.0	79.4	81.4	82.8	85.0	90.9	88.7	91.6	94.9	94.4	94.1	94.6	92.7	91.5	90.4	90.4	89.7	89.3	89.4	88.6	86.9	84.6	84.5	104.1
11.5	Turbine ON (dBA)	21.7	24.6	31.3	30.0	31.0	33.2	33.0	34.5	39.9	37.9	41.8	44.6	44.0	43.5	44.0	42.2	41.7	41.0	41.4	40.7	40.2	40.0	38.9	37.7	35.9	35.3	54.0
	Background (dBA)	20.0	23.0	24.6	23.0	24.1	24.9	26.2	25.7	26.0	25.5	26.9	29.3	29.9	30.4	32.8	33.6	35.2	36.0	36.6	36.9	37.1	37.1	36.4	34.9	33.0	29.1	46.8
	Turbine ON - background adj (dBA)	[18.7]	[21.6]	30.3	29.1	30.0	32.5	31.9	33.9	39.7	37.7	41.7	44.5	43.8	43.2	43.7	41.5	40.6	39.3	39.7	38.4	37.2	[37]	[35.9]	[34.7]	[32.9]	34.1	53.2
	Signal to noise (dB)	1.6	1.6	6.7	7.0	6.9	8.3	6.7	8.8	13.9	12.4	14.9	15.3	14.1	13.1	11.2	8.5	6.5	5.0	4.8	3.8	3.0	2.9	2.5	2.8	2.9	6.1	7.2
	Uncertainty (dB)	5.0	5.0	4.4	2.3	2.1	1.9	1.6	1.1	1.0	1.0	0.8	0.7	0.8	0.7	0.8	0.8	1.0	1.2	1.2	1.4	1.9	2.2	2.3	2.4	2.4	1.1	1.0
	PWL (dBA)	[69.6]	[72.5]	81.2	79.9	80.9	83.4	82.8	84.7	90.6	88.6	92.6	95.3	94.7	94.1	94.6	92.4	91.5	90.2	90.6	89.3	88.0	[87.9]	[86.8]	[85.6]	[83.7]	84.9	104.0

Table C.01 Detailed apparent sound power level data at hub height

Project: Niagara Wind Farm - Turbine T35 - IEC 61400-11 Measurement
Report ID: 16227.00.T35.RP1

Created on: 11/3/2017

1/3 Octave values marked with brackets [ ] denote less than 3 dB difference between Turbine ON and Background
Overall levels marked with an asterisk * denote 3 to 6 dB difference between Turbine ON and Background, while Overall values with less than 3 dB difference between Turbine ON and Background are not reported

Wind Bin (m/s)	Parameter	1/3 Octave Band (Hz)																												Overall
		20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	
12.0	Turbine ON (dBA)	20.3	22.5	24.7	30.0	31.2	32.0	34.7	33.3	37.3	36.7	40.0	44.6	43.3	44.2	45.4	44.9	44.6	44.0	43.2	42.6	41.6	41.3	40.2	38.7	37.1	36.2	55.0
	Background (dBA)	16.5	19.9	21.5	20.6	22.5	23.9	25.8	25.5	26.8	25.1	26.6	29.1	29.6	29.9	32.3	33.2	34.7	35.6	36.1	36.7	36.8	36.9	35.9	34.4	32.4	28.9	46.4
	Turbine ON - background adj (dBA)	17.9	[19.5]	21.8	29.5	30.6	31.3	34.1	32.5	36.9	36.4	39.8	44.5	43.1	44.0	45.2	44.6	44.1	43.3	42.2	41.3	39.8	39.3	38.2	36.7	35.3	35.3	54.4
	Signal to noise (dB)	3.7	2.6	3.2	9.4	8.7	8.1	8.9	7.8	10.5	11.6	13.4	15.5	13.8	14.3	13.0	11.7	9.9	8.4	7.1	5.9	4.7	4.3	4.3	4.3	4.8	7.3	8.7
	Uncertainty (dB)	2.8	3.3	2.7	1.1	1.2	1.1	1.2	1.1	1.0	0.9	0.8	0.8	0.7	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.2	1.5	1.5	1.6	1.4	1.0	0.9
	PWL (dBA)	68.7	[70.4]	72.7	80.3	81.5	82.1	85.0	83.4	87.8	87.3	90.6	95.4	94.0	94.9	96.0	95.5	95.0	94.2	93.1	92.2	90.7	90.2	89.1	87.6	86.2	86.2	105.3
12.5	Turbine ON (dBA)	18.9	21.7	25.2	30.0	30.4	31.1	34.3	33.1	36.4	37.1	39.1	44.4	43.2	43.7	44.9	44.8	44.4	43.4	42.8	42.1	41.5	40.9	39.7	38.2	36.5	36.1	54.7
	Background (dBA)	20.3	23.8	25.6	27.4	25.8	26.2	27.3	26.6	27.4	26.3	28.2	29.6	30.4	30.7	32.4	33.3	35.0	35.6	36.4	36.9	37.1	37.4	36.4	35.1	33.0	29.3	46.9
	Turbine ON - background adj (dBA)	[15.9]	[18.7]	[22.2]	[27]	28.5	29.4	33.3	31.9	35.8	36.8	38.8	44.2	43.0	43.5	44.7	44.5	43.8	42.6	41.7	40.5	39.6	38.3	37.0	35.3	33.9	35.0	53.9
	Signal to noise (dB)	-1.4	-2.1	-0.4	2.6	4.6	4.9	7.0	6.5	9.0	10.9	11.0	14.8	12.8	13.1	12.5	11.5	9.4	7.8	6.4	5.1	4.4	3.5	3.3	3.1	3.5	6.7	7.8
	Uncertainty (dB)	3.6	3.5	3.1	2.7	1.7	1.3	1.3	1.2	1.0	1.0	0.7	0.8	0.7	0.7	0.7	0.7	0.8	0.8	0.9	1.0	1.2	1.7	1.8	1.9	1.7	1.0	0.9
	PWL (dBA)	[66.7]	[69.6]	[73.1]	[77.9]	79.4	80.3	84.2	82.8	86.7	87.6	89.6	95.1	93.9	94.4	95.6	95.4	94.7	93.4	92.5	91.4	90.5	89.2	87.8	86.2	84.8	85.9	104.8
13.0	Turbine ON (dBA)	21.6	23.9	28.6	31.4	30.9	30.7	33.0	33.6	37.1	35.9	39.4	44.1	43.1	43.9	45.1	44.7	44.2	43.6	43.0	42.0	41.4	40.8	39.4	37.7	36.0	35.9	54.7
	Background (dBA)	22.2	23.6	27.9	30.9	29.1	28.2	30.9	29.6	29.1	28.2	28.8	30.7	32.1	31.3	33.4	34.3	35.5	36.3	37.3	37.6	37.9	38.2	37.4	36.0	33.7	29.9	47.9
	Turbine ON - background adj (dBA)	[18.6]	[20.9]	[25.6]	[28.4]	[27.9]	[27.7]	[30]	31.4	36.4	35.1	39.0	43.9	42.7	43.6	44.8	44.3	43.6	42.7	41.7	40.1	38.9	[37.8]	[36.4]	[34.7]	[33]	34.6	53.7
	Signal to noise (dB)	-0.6	0.3	0.7	0.5	1.8	2.5	2.1	4.0	8.0	7.7	10.6	13.4	11.0	12.5	11.7	10.4	8.7	7.3	5.8	4.4	3.6	2.6	2.0	1.8	2.3	5.9	6.8
	Uncertainty (dB)	4.0	3.8	4.0	3.7	3.2	2.4	2.4	1.9	1.0	1.0	0.8	0.8	0.8	0.7	0.7	0.8	0.8	0.9	1.0	1.2	1.5	2.0	2.0	2.0	2.0	1.1	1.0
	PWL (dBA)	[69.5]	[71.8]	[76.4]	[79.3]	[78.8]	[78.6]	[80.8]	82.2	87.2	86.0	89.9	94.8	93.6	94.5	95.7	95.2	94.5	93.6	92.6	91.0	89.8	[88.7]	[87.3]	[85.6]	[83.9]	85.4	104.6
13.5	Turbine ON (dBA)	23.1	26.4	28.8	32.4	31.1	32.4	34.5	34.1	37.2	36.2	38.9	43.9	42.9	43.1	45.2	45.0	45.2	44.4	43.9	42.8	42.4	41.9	40.8	39.3	37.3	36.5	55.1
	Background (dBA)	20.1	22.6	29.6	26.7	26.3	26.7	26.5	27.2	29.6	28.0	29.1	30.5	31.8	31.8	33.3	34.9	36.4	36.3	37.4	37.5	37.7	37.9	37.4	36.2	33.9	30.3	47.8
	Turbine ON - background adj (dBA)	[20.1]	24.2	[25.8]	31.0	29.3	31.0	33.8	33.1	36.4	35.5	38.4	43.6	42.5	42.8	44.9	44.6	44.6	43.6	42.8	41.3	40.6	39.7	38.1	36.3	34.6	35.3	54.2
	Signal to noise (dB)	3.0	3.9	-0.7	5.7	4.8	5.6	8.0	6.9	7.6	8.2	9.8	13.4	11.1	11.4	11.9	10.1	8.8	8.0	6.5	5.3	4.7	4.0	3.4	3.1	3.4	6.2	7.3
	Uncertainty (dB)	4.1	3.8	4.8	1.7	1.6	1.4	1.2	1.1	1.1	1.0	0.8	0.8	0.8	0.7	0.7	0.8	0.8	0.9	1.0	1.1	1.2	1.6	1.9	2.2	2.0	1.1	1.0
	PWL (dBA)	[70.9]	75.0	[76.7]	81.9	80.2	81.9	84.7	84.0	87.3	86.4	89.3	94.5	93.4	93.7	95.8	95.5	95.4	94.5	93.6	92.2	91.5	90.6	89.0	87.2	85.5	86.2	105.1

Table C.02 Detailed apparent sound power level data at 10m height

Project: Niagara Wind Farm - Turbine T35 - IEC 61400-11 Measurement

Report ID: 16227.00.T35.RP1

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1/3 Octave values marked with brackets [ ] denote less than 3 dB difference between Turbine ON and Background

Overall levels marked with an asterisk * denote 3 to 6 dB difference between Turbine ON and Background, while Overall values with less than 3 dB difference between Turbine ON and Background are not reported

Wind Bin (m/s)	Parameter	1/3 Octave Band (Hz)																												Overall
		20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	
6.0	Turbine ON (dBA)	15.4	17.7	19.7	24.1	26.4	28.8	31.3	35.4	34.9	36.1	39.4	41.7	41.5	40.8	41.1	39.5	38.5	38.2	38.3	38.3	37.5	37.4	36.1	34.4	32.4	29.4		51.2
	Background (dBA)	10.9	14.0	15.6	18.9	21.7	23.4	23.4	22.9	25.2	23.3	24.5	26.4	26.5	26.3	27.9	28.6	30.4	30.9	31.4	31.2	30.8	30.0	28.6	27.0	25.1	22.2		41.3
	Turbine ON - background adj (dBA)	13.6	15.2	17.6	22.6	24.5	27.3	30.5	35.2	34.4	35.9	39.2	41.6	41.4	40.6	40.9	39.1	37.8	37.3	37.3	37.3	36.5	36.6	35.3	33.5	31.5	28.5		50.8
	Signal to noise (dB)	4.5	3.7	4.1	5.3	4.7	5.4	7.9	12.6	9.7	12.8	14.9	15.3	15.0	14.5	13.2	10.9	8.1	7.3	6.9	7.1	6.7	7.4	7.5	7.4	7.3	7.2		10.0
	Uncertainty (dB)	2.9	2.9	2.0	1.6	1.5	1.4	1.1	1.0	1.1	1.0	0.9	0.8	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.1	1.2	1.2	1.3	1.1		0.9
	PWL (dBA)	64.4	66.1	68.5	73.5	75.4	78.2	81.4	86.1	85.3	86.8	90.1	92.4	92.2	91.5	91.7	90.0	88.7	88.2	88.2	88.2	87.4	87.4	86.2	84.4	82.4	79.3		101.6
7.0	Turbine ON (dBA)	17.0	21.2	22.2	25.8	28.7	30.9	32.2	34.6	39.1	37.6	40.6	43.3	43.1	42.6	43.0	41.7	40.7	40.0	40.1	39.7	39.1	39.1	38.3	36.7	34.4	32.7		53.0
	Background (dBA)	18.3	21.5	23.4	24.8	23.8	23.9	24.8	24.3	24.9	23.9	25.9	28.0	28.6	28.9	30.4	31.1	32.7	33.4	34.2	34.1	34.1	33.9	32.9	31.4	29.4	25.8		44.2
	Turbine ON - background adj (dBA)	[14]	[18.2]	[19.2]	[22.8]	27.0	30.0	31.4	34.2	39.0	37.4	40.4	43.2	43.0	42.4	42.8	41.3	39.9	38.9	38.8	38.3	37.5	37.6	36.8	35.1	32.7	31.7		52.4
	Signal to noise (dB)	-1.3	-0.2	-1.2	1.0	4.9	7.0	7.4	10.4	14.2	13.7	14.7	15.3	14.5	13.7	12.6	10.6	8.0	6.6	5.9	5.6	5.1	5.3	5.4	5.2	5.0	6.9		8.9
	Uncertainty (dB)	3.2	3.0	2.4	2.1	1.4	1.1	1.1	0.9	0.9	0.8	0.7	0.7	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.3	1.3	1.3	1.3	1.1		0.9
	PWL (dBA)	[64.8]	[69.1]	[70]	[73.6]	77.9	80.9	82.2	85.1	89.8	88.3	91.3	94.0	93.9	93.3	93.7	92.2	90.8	89.8	89.7	89.2	88.4	88.5	87.7	86.0	83.6	82.6		103.3
8.0	Turbine ON (dBA)	20.0	22.9	26.5	29.6	30.9	31.9	34.4	33.7	37.9	37.4	40.3	44.4	43.5	43.8	44.8	44.2	43.7	43.0	42.5	41.9	41.1	40.9	39.8	38.4	36.6	35.7		54.6
	Background (dBA)	18.8	22.2	23.3	22.2	23.2	24.2	26.3	25.1	26.1	25.3	26.6	29.1	29.7	30.0	32.3	33.1	34.8	35.5	36.2	36.6	36.7	36.8	35.9	34.5	32.4	28.8		46.4
	Turbine ON - background adj (dBA)	[17]	[19.9]	23.7	28.8	30.0	31.1	33.7	33.1	37.6	37.1	40.1	44.3	43.4	43.7	44.6	43.8	43.1	42.1	41.4	40.4	39.2	38.7	37.6	36.1	34.6	34.7		53.9
	Signal to noise (dB)	1.2	0.7	3.2	7.5	7.7	7.7	8.1	8.6	11.8	12.1	13.7	15.4	13.8	13.9	12.5	11.0	8.9	7.5	6.3	5.4	4.4	4.1	3.9	3.9	4.2	6.9		8.2
	Uncertainty (dB)	2.8	2.8	2.6	1.1	1.1	1.0	1.0	0.9	0.9	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.9	1.0	1.1	1.4	1.5	1.5	1.4	1.0		0.8
	PWL (dBA)	[67.9]	[70.8]	74.6	79.6	80.9	82.0	84.5	83.9	88.5	88.0	91.0	95.2	94.2	94.5	95.5	94.7	94.0	93.0	92.3	91.3	90.1	89.6	88.5	87.0	85.4	85.6		104.8
9.0	Turbine ON (dBA)	22.4	24.8	28.3	31.7	30.8	31.7	33.6	33.7	36.9	35.8	39.0	44.0	43.0	43.6	45.2	45.0	44.8	44.0	43.5	42.5	42.0	41.5	40.3	38.8	36.9	36.2		54.9
	Background (dBA)	21.3	23.3	28.6	29.6	27.8	27.3	28.9	28.3	28.9	27.5	28.9	30.2	31.4	31.3	33.0	34.1	35.6	36.1	37.0	37.3	37.5	37.7	37.0	35.7	33.5	29.7		47.5
	Turbine ON - background adj (dBA)	[19.4]	[21.8]	[25.3]	[28.7]	27.8	29.7	31.8	32.2	36.2	35.1	38.6	43.9	42.7	43.4	44.9	44.6	44.2	43.3	42.4	41.0	40.1	39.1	37.5	35.8	34.2	35.1		54.1
	Signal to noise (dB)	1.2	1.5	-0.3	2.1	3.0	4.4	4.7	5.4	8.0	8.3	10.1	13.8	11.6	12.4	12.2	10.8	9.2	8.0	6.5	5.2	4.5	3.7	3.3	3.1	3.4	6.5		7.4
	Uncertainty (dB)	3.0	3.0	2.8	2.3	1.9	1.6	1.4	1.2	1.0	1.0	0.8	0.8	0.8	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.2	1.5	1.7	1.8	1.6	1.1		0.9
	PWL (dBA)	[70.3]	[72.7]	[76.2]	[79.6]	78.7	80.5	82.7	83.0	87.0	86.0	89.5	94.7	93.6	94.3	95.8	95.5	95.1	94.1	93.2	91.8	91.0	90.0	88.4	86.7	85.1	86.0		105.0

Table C.03 Type B measurement uncertainty summary

Overall Equipment Uncertainties		
	Typical values	Used values
Calibration	0.2 dB	0.2 dB
Board	0.3 dB	0.3 dB
Distance	0.1 dB	0.1 dB
Air absorption	0 dB	0 dB
Weather	0.5 dB	0.5 dB

1/3 Octave Band Uncertainties		
Frequency (Hz)	Microphone Uncertainty	Overall (including overall equipment Uncertainties)
20	0.8 dB	1 dB
25	0.8 dB	1 dB
31.5	0.5 dB	0.8 dB
40	0.5 dB	0.8 dB
50	0.5 dB	0.8 dB
63	0.5 dB	0.8 dB
80	0.5 dB	0.8 dB
100	0.5 dB	0.8 dB
125	0.5 dB	0.8 dB
160	0.5 dB	0.8 dB
200	0.3 dB	0.7 dB
250	0.3 dB	0.7 dB
315	0.3 dB	0.7 dB
400	0.3 dB	0.7 dB
500	0.3 dB	0.7 dB
630	0.3 dB	0.7 dB
800	0.3 dB	0.7 dB
1000	0.3 dB	0.7 dB
1250	0.3 dB	0.7 dB
1600	0.3 dB	0.7 dB
2000	0.3 dB	0.7 dB
2500	0.5 dB	0.8 dB
3150	0.5 dB	0.8 dB
4000	0.5 dB	0.8 dB
5000	0.5 dB	0.8 dB
6300	0.5 dB	0.8 dB
8000	0.5 dB	0.8 dB
10000	1.3 dB	1.4 dB

Table C.04 Detailed measurement uncertainty at hub height

Project: Niagara Wind Farm - Turbine T35 - IEC 61400-11 Measurement

Report ID: 16227.00.T35.RP1

Created on: 11/3/2017

Wind Bin (m/s)	Parameter	Average Wind Speed	# of data points	Parameter	1/3 Octave Band (Hz) 20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	Overall
8.5	Turbine ON	8.57	10	Average (dBA)	12.2	16.1	19.9	24.0	26.5	27.6	30.9	35.8	34.9	35.5	38.7	42.0	41.1	40.2	39.9	38.4	37.9	38.0	38.2	38.4	37.9	38.2	37.4	36.1	34.5	30.1	51.1
				Uncertainty A (dB)	1.4	1.1	1.3	1.1	0.7	0.8	0.3	0.6	0.7	0.5	0.7	0.4	0.5	0.5	0.5	0.5	0.4	0.3	0.4	0.4	0.4	0.5	0.6	0.5	0.7	0.5	
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	
				Combined Uncertainty (dB)	1.7	1.5	1.5	1.3	1.1	1.2	0.9	1.0	1.1	1.0	1.0	0.8	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	1.0	1.0	1.1	0.9	
	Background	8.48	41	Average (dBA)	9.6	13.9	15.6	19.4	21.3	22.0	23.6	22.7	23.1	22.9	24.2	26.2	26.0	25.9	27.4	28.3	30.1	30.5	31.1	30.9	30.5	29.5	28.2	26.4	24.6	21.8	40.9
				Uncertainty A (dB)	1.5	1.5	1.1	0.9	0.6	0.5	0.5	0.4	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.8	0.8	0.8	0.6	0.5	
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	
				Combined Uncertainty (dB)	1.9	1.8	1.3	1.2	1.0	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9	1.0	1.1	1.2	1.1	1.0	1.0	
9.0	Turbine ON	9.00	10	Average (dBA)	18.0	20.2	20.6	25.1	25.9	29.8	31.1	35.0	34.6	36.8	39.8	41.3	41.7	40.7	41.6	40.1	38.9	38.4	38.3	38.0	36.6	36.2	34.3	32.1	29.4	28.2	51.2
				Uncertainty A (dB)	3.0	1.9	1.0	1.0	0.5	0.3	0.6	0.6	0.7	0.5	0.5	0.3	0.4	0.5	0.5	0.6	0.5	0.4	0.4	0.3	0.3	0.4	0.5	0.4	0.4	0.3	
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	
				Combined Uncertainty (dB)	3.1	2.2	1.3	1.3	0.9	0.9	1.0	1.0	1.1	1.0	0.8	0.8	0.8	0.8	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9	
	Background	8.99	50	Average (dBA)	11.6	14.9	16.2	19.1	22.9	24.9	23.5	22.8	26.7	23.6	24.7	26.8	26.9	26.8	28.4	29.0	30.5	31.1	31.8	31.6	31.1	30.5	29.2	27.4	25.5	22.5	41.7
				Uncertainty A (dB)	1.5	1.4	1.1	0.8	0.7	0.7	0.5	0.4	0.6	0.4	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.6	0.5	
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	
				Combined Uncertainty (dB)	1.8	1.8	1.3	1.1	1.0	1.0	1.0	0.9	1.0	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.9	1.0	1.1	1.1	1.0	
9.5	Turbine ON	9.52	10	Average (dBA)	16.5	17.8	22.3	23.7	29.2	29.9	32.8	34.9	36.3	36.9	39.9	42.1	42.6	42.0	42.1	40.5	39.7	39.0	39.2	38.9	38.5	38.2	37.4	35.6	32.8	30.8	52.1
				Uncertainty A (dB)	2.0	1.7	1.6	0.7	1.1	0.6	0.9	0.5	0.7	0.5	0.5	0.5	0.5	0.4	0.5	0.6	0.5	0.4	0.4	0.4	0.5	0.7	0.9	1.0	0.7	0.3	
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	
				Combined Uncertainty (dB)	2.2	2.0	1.8	1.1	1.4	1.0	1.2	0.9	1.0	0.9	0.8	0.8	0.9	0.8	0.9	0.9	0.9	0.8	0.8	0.8	0.8	1.0	1.2	1.3	1.1	0.9	
	Background	9.52	31	Average (dBA)	12.8	16.6	16.3	19.5	20.7	22.5	23.8	22.8	24.4	23.7	24.9	26.5	27.2	26.6	28.8	29.7	31.1	31.7	32.4	32.2	32.0	31.4	30.3	28.8	26.9	23.6	42.2
				Uncertainty A (dB)	1.5	1.8	1.3	0.9	0.5	0.5	0.6	0.5	0.5	0.6	0.4	0.5	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.7	0.8	0.8	0.7	0.6	
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	
				Combined Uncertainty (dB)	1.8	2.1	1.5	1.2	1.0	1.0	1.0	0.9	1.0	1.0	0.8	0.8	0.8	0.8	0.9	0.9	0.8	0.8	0.9	0.9	0.9	1.1	1.1	1.1	1.1	1.0	
10.0	Turbine ON	10.00	20	Average (dBA)	15.7	19.6	20.1	24.9	28.0	30.3	32.2	34.9	37.3	37.4	40.7	43.2	43.3	42.3	42.7	41.4	40.1	39.7	39.8	39.4	38.7	38.7	37.7	36.0	33.7	31.7	52.7
				Uncertainty A (dB)	1.6	1.1	0.8	0.7	0.6	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.3	0.3	0.4	0.2	0.3	0.3	0.3	0.5	0.5	0.6	0.5	0.3	
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	
				Combined Uncertainty (dB)	1.9	1.5	1.1	1.0	1.0	0.9	1.0	0.9	0.9	0.8	0.8	0.8	0.7	0.7	0.7	0.8	0.8	0.7	0.8	0.8	0.8	0.9	1.0	1.0	1.0	0.8	
	Background	10.00	41	Average (dBA)	18.8	22.8	24.1	26.0	24.3	24.2	24.9	24.1	24.3	23.4	25.5	27.7	28.1	29.2	30.2	30.4	31.6	32.3	33.4	33.0	32.9	32.5	31.5	30.1	28.0	24.6	43.3
				Uncertainty A (dB)	2.1	2.2	2.0	1.5	0.9	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.6	0.7	0.6	0.5	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.8	0.7	0.6	
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	
				Combined Uncertainty (dB)	2.3	2.4	2.2	1.7	1.2	1.0	1.0	1.0	0.9	0.9	0.9	0.8	0.9	1.0	0.9	0.8	0.8	0.8	0.9	0.9	1.0	1.1	1.1	1.1	1.1	1.0	
10.5	Turbine ON	10.45	10	Average (dBA)	18.0	18.9	20.9	25.6	27.4	31.1	30.1	34.4	40.6	37.7	40.7	43.2	43.0	42.4	42.9	41.7	40.6	39.6	39.9	39.4	38.7	38.4	37.6	36.4	34.3	32.6	52.9
				Uncertainty A (dB)	2.3	1.4	1.1	0.7	0.8	1.4	0.7	0.5	0.7	0.6	0.4	0.3	0.5	0.4	0.6	0.7	0.4	0.4	0.4	0.3	0.4	0.5	0.6	0.7	0.8	0.5	
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	
				Combined Uncertainty (dB)	2.5	1.7	1.3	1.1	1.1	1.6	1.1	0.9	1.1	1.0	0.8	0.8	0.9	0.8	0.9	1.0	0.8	0.8	0.8	0.7	0.8	0.9	1.0	1.1	1.1	0.9	
	Background	10.53	28	Average (dBA)	17.9	21.5	24.4	23.5	23.8	23.7	25.0	24.0	24.9	24.5	25.7	27.2	28.2	28.0	30.0	30.9	32.7	33.2	34.1	34.0	33.8	33.7	32.7	31.2	29.0	25.5	43.9
				Uncertainty A (dB)	2.2	2.3	2.2	1.4	0.9	0.6	0.6	0.7	0.6	0.5	0.5	0.4	0.5	0.5	0.5	0.6	0.5	0.6	0.7	0.7	0.8	1.0	1.0	1.1	1.0	0.8	
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	
				Combined Uncertainty (dB)	2.4	2.5	2.3	1.6	1.2	1.0	1.0	1.1	1.0	1.0	0.9	0.8	0.8	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.1	1.2	1.3	1.3	1.2	1.1	
11.0	Turbine ON	10.92	16	Average (dBA)	16.9	23.1	23.3	27.2	29.4	31.1	32.8	34.6	40.2	38.0	40.7	44.1	43.7	43.4	43.9	42.3	41.4	40.8	40.8	40.4	40.2	40.3	39.5	37.8	35.5	34.4	53.8
				Uncertainty A (dB)	1.4	1.6	1.1	0.7	0.9	0.8	0.8	0.5	0.4	0.4	0.3	0.3	0.4	0.3	0.3	0.3	0.2	0.2	0.3	0.2	0.4	0.5	0.5	0.4	0.4	0.2	
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	
				Combined Uncertainty (dB)	1.8	1.9	1.3	1.1	1.2	1.1	1.1	0.9	0.9	0.9	0.7	0.8	0.8	0.7	0.8	0.8	0.7	0.7	0.8	0.7	0.8	0.9	0.9	0.9	0.9	0.8	
	Background	10.96	36	Average (dBA)	18.1	19.0	21.8	24.1	23.0	23.6	25.2	24.9	25.2	24.3	26.3	28.8	29.6	29.4	31.1	32.0	33.8	34.7	35.3	35.2	35.3	35.3	34.3	32.8	30.8	27.1	45.2
				Uncertainty A (dB)	1.6	1.4	1.6	1.3	0.7	0.6	0.7	0.7	0.5	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.7	0.8	0.9	0.9	0.8	0.7	
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	
				Combined Uncertainty (dB)	1.9	1.8	1.8	1.5	1.1	1.0	1.0	1.0	0.9	0.9	0.8	0.8	0.9	0.9	0.8	0.9	0.9	0.9	0.9	0.9	1.0	1.1	1.2	1.2	1.2	1.1	

Table C.04 Detailed measurement uncertainty at hub height

Project: Niagara Wind Farm - Turbine T35 - IEC 61400-11 Measurement

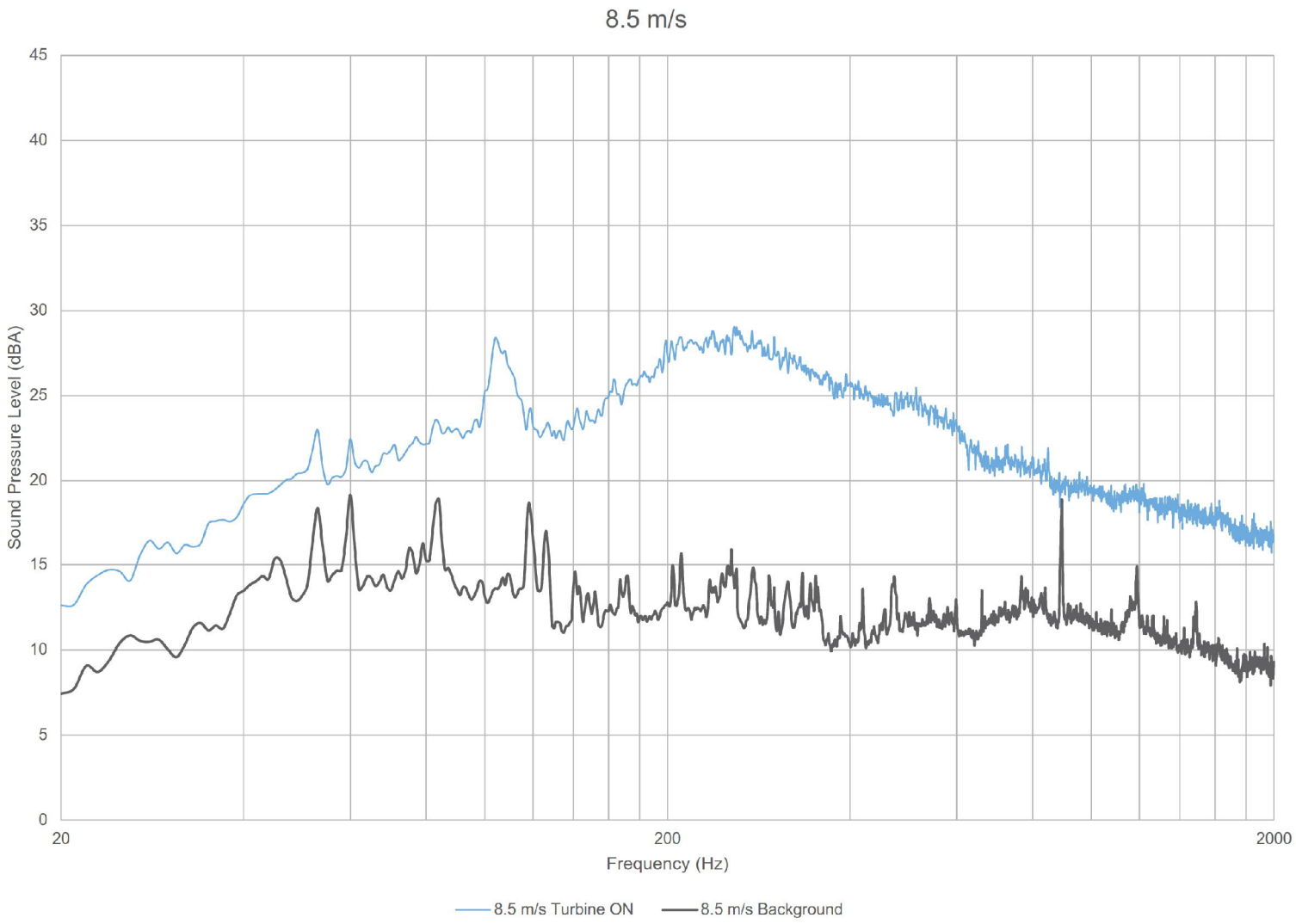
Report ID: 16227.00.T35.RP1

Created on: 11/3/2017

Wind Bin (m/s)	Parameter	Average Wind Speed	# of data points	Parameter	1/3 Octave Band (Hz) 20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	Overall
11.5	Turbine ON	11.52	10	Average (dBA)	21.9	24.7	31.7	30.1	31.1	33.3	33.0	34.5	39.9	37.9	41.9	44.6	44.0	43.5	44.0	42.2	41.7	41.0	41.5	40.7	40.2	40.0	38.9	37.7	35.9	35.3	54.1
				Uncertainty A (dB)	2.2	2.1	3.5	1.7	1.5	1.5	1.0	0.6	0.6	0.5	0.4	0.3	0.3	0.2	0.3	0.3	0.3	0.4	0.4	0.3	0.4	0.6	0.6	0.7	0.7	0.2	
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	
				Combined Uncertainty (dB)	2.4	2.3	3.6	1.9	1.7	1.7	1.3	1.0	1.0	0.9	0.8	0.7	0.8	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	1.0	1.0	1.0	1.0	0.8	
	Background	11.46	31	Average (dBA)	20.3	23.2	24.8	23.2	24.2	24.9	26.3	25.7	26.0	25.5	26.9	29.3	29.9	30.4	32.8	33.7	35.3	36.0	36.6	36.9	37.2	37.1	36.4	35.0	33.0	29.2	46.8
				Uncertainty A (dB)	1.9	2.1	1.6	0.9	0.7	0.6	0.7	0.8	0.5	0.5	0.4	0.6	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.9	1.0	1.1	1.1	1.1	0.9	
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	
				Combined Uncertainty (dB)	2.2	2.3	1.8	1.2	1.1	1.0	1.1	1.1	0.9	0.9	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.1	1.2	1.3	1.4	1.3	1.2	
12.0	Turbine ON	12.01	35	Average (dBA)	20.2	22.5	24.5	30.0	31.2	32.0	34.8	33.3	37.2	36.7	39.9	44.6	43.3	44.2	45.4	44.9	44.6	44.0	43.2	42.6	41.6	41.3	40.2	38.7	37.1	36.2	55.1
				Uncertainty A (dB)	1.1	0.9	0.8	0.5	0.7	0.5	0.7	0.5	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.3	0.3	0.3	0.2	0.2	0.3	0.3	0.4	0.4	0.4	0.2	
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	
				Combined Uncertainty (dB)	1.5	1.4	1.1	0.9	1.1	1.0	1.0	0.9	0.9	0.9	0.7	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.9	0.9	0.9	0.9	0.8	
	Background	12.05	27	Average (dBA)	16.1	19.6	21.2	20.4	22.3	23.8	25.7	25.4	26.9	25.1	26.6	29.1	29.5	29.9	32.3	33.1	34.6	35.5	36.1	36.7	36.8	36.9	35.8	34.4	32.3	28.9	46.3
				Uncertainty A (dB)	1.6	1.8	1.9	0.9	0.7	0.6	0.6	0.9	0.9	0.6	0.5	0.6	0.6	0.6	0.5	0.6	0.6	0.7	0.6	0.7	0.8	0.9	0.9	1.0	1.0	0.9	
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	
				Combined Uncertainty (dB)	1.9	2.1	2.0	1.2	1.1	1.0	1.0	1.2	1.2	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.0	0.9	1.0	1.0	1.2	1.2	1.3	1.3	1.2	
12.5	Turbine ON	12.55	21	Average (dBA)	18.7	21.6	25.3	30.0	30.3	31.0	34.3	33.0	36.3	37.2	39.0	44.4	43.2	43.7	44.9	44.8	44.3	43.3	42.8	42.0	41.5	40.8	39.6	38.1	36.4	36.0	54.7
				Uncertainty A (dB)	1.3	1.2	1.1	0.7	0.8	0.5	0.8	0.5	0.4	0.6	0.3	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.2	
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	
				Combined Uncertainty (dB)	1.6	1.6	1.3	1.1	1.1	0.9	1.1	1.0	0.9	1.0	0.8	0.8	0.7	0.8	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.8	
	Background	12.58	24	Average (dBA)	21.0	24.5	26.3	28.6	26.4	26.6	27.6	26.8	27.4	26.5	28.4	29.7	30.5	30.8	32.5	33.3	35.1	35.6	36.5	37.0	37.2	37.4	36.5	35.2	33.2	29.4	47.0
				Uncertainty A (dB)	2.1	2.1	2.0	1.9	1.1	0.9	0.9	0.9	0.7	0.6	0.6	0.4	0.5	0.5	0.4	0.5	0.5	0.5	0.5	0.6	0.7	0.8	0.8	0.9	0.9	0.9	
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	
				Combined Uncertainty (dB)	2.4	2.3	2.1	2.1	1.4	1.2	1.2	1.2	1.0	1.0	0.9	0.8	0.9	0.9	0.8	0.8	0.9	0.8	0.9	0.9	1.0	1.1	1.2	1.2	1.2	1.2	
13.0	Turbine ON	12.97	25	Average (dBA)	21.5	23.7	28.5	31.4	30.9	30.6	32.9	33.6	37.1	35.9	39.4	44.1	43.1	43.9	45.1	44.7	44.1	43.5	43.0	42.0	41.4	40.8	39.3	37.6	35.9	35.8	54.6
				Uncertainty A (dB)	1.4	1.2	1.5	0.8	0.8	0.5	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.2	0.3	0.3	0.4	0.3	0.3	0.3	0.4	0.4	0.4	0.3	0.2	
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	
				Combined Uncertainty (dB)	1.7	1.6	1.7	1.1	1.1	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.8	
	Background	12.95	12	Average (dBA)	22.3	23.7	27.4	31.3	29.4	28.4	31.3	29.9	28.9	28.2	28.7	30.7	32.1	31.2	33.4	34.2	35.4	36.2	37.2	37.6	37.9	38.2	37.4	35.9	33.7	29.9	47.9
				Uncertainty A (dB)	2.3	2.4	2.5	3.2	2.7	1.6	1.7	1.9	1.3	1.1	0.9	0.9	1.0	0.8	0.9	0.9	0.7	0.8	0.7	0.8	0.9	1.0	1.0	1.0	1.0	0.9	
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	
				Combined Uncertainty (dB)	2.6	2.6	2.6	3.3	2.8	1.8	1.9	2.1	1.5	1.3	1.1	1.1	1.2	1.1	1.1	1.1	1.0	1.0	1.0	1.1	1.1	1.3	1.3	1.3	1.3	1.2	
13.5	Turbine ON	13.46	28	Average (dBA)	23.0	26.5	28.9	32.4	31.1	32.3	34.6	34.1	37.3	36.2	38.9	43.9	42.8	43.1	45.2	45.0	45.2	44.4	43.9	42.8	42.4	41.9	40.8	39.3	37.3	36.5	55.1
				Uncertainty A (dB)	1.6	1.8	1.4	0.8	0.6	0.6	0.7	0.5	0.5	0.3	0.3	0.4	0.3	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.3	0.2	
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	
				Combined Uncertainty (dB)	1.9	2.1	1.7	1.1	1.0	1.0	1.0	0.9	0.9	0.9	0.7	0.8	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.8	
	Background	13.42	10	Average (dBA)	21.4	22.8	31.9	28.0	27.1	27.0	27.0	27.8	30.6	28.5	29.4	30.7	32.0	32.3	33.4	35.2	36.5	36.4	37.5	37.7	37.8	38.0	37.5	36.3	34.0	30.4	48.0
				Uncertainty A (dB)	2.4	3.1	4.4	2.6	1.8	1.4	0.8	1.2	1.9	1.3	1.2	0.8	1.0	0.9	0.7	1.2	0.9	0.7	0.9	1.0	1.1	1.3	1.5	1.6	1.6	1.6	
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	
				Combined Uncertainty (dB)	2.6	3.3	4.4	2.7	2.0	1.6	1.2	1.5	2.1	1.5	1.4	1.1	1.2	1.2	1.0	1.3	1.2	1.0	1.1	1.3	1.3	1.6	1.7	1.8	1.8	1.8	

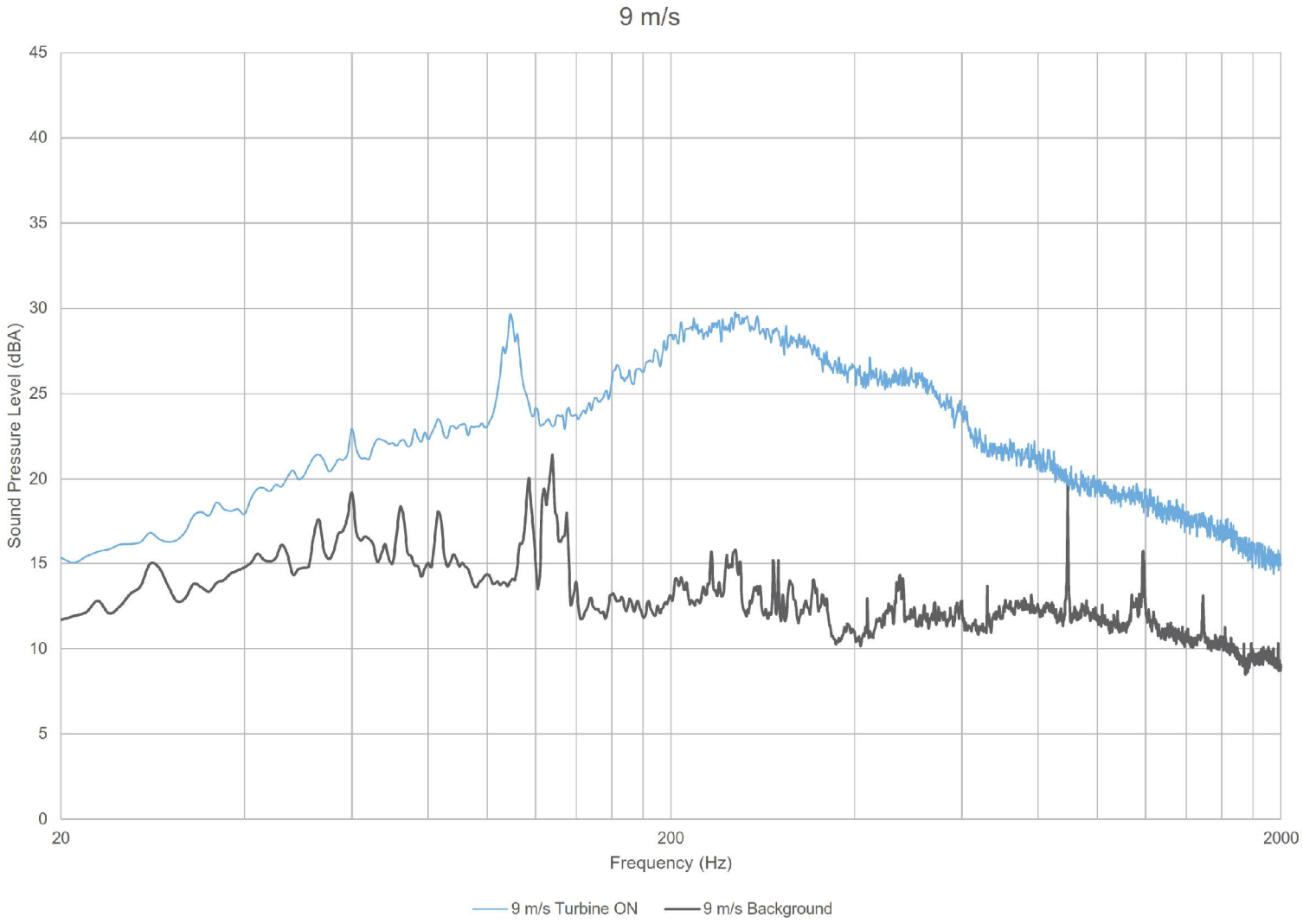
aercoustics
Aercoustics Engineering Ltd.
1004 Middlegate Road, Suite 1100
Mississauga, ON L4Y 1M4
Tel: 416-249-3361
Fax 416-249-3613
aercoustics.com

Appendix D
Tonality Assessment

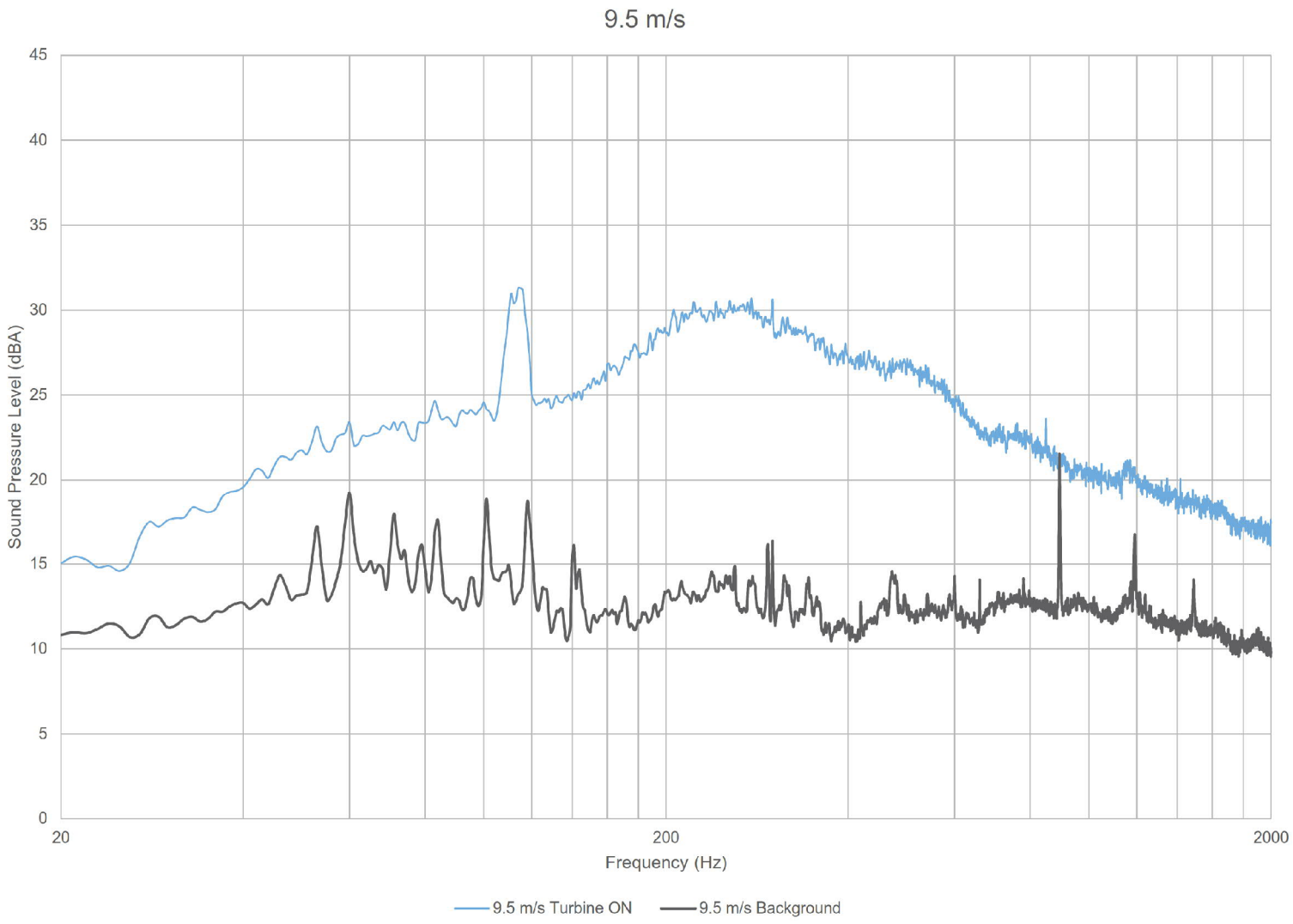


aercoustics	16227.00.T35.RP1 Scale: NTS Drawn by: AM Reviewed by: PA Date: Nov 3, 2017 Revision: 1	**Project Name** Niagara Region Wind Farm - Turbine T35 - IEC61400-11 Edition 3.0 **Figure Title** Plot of narrow band spectra – Turbine ON vs. Background at 8.5 m/s

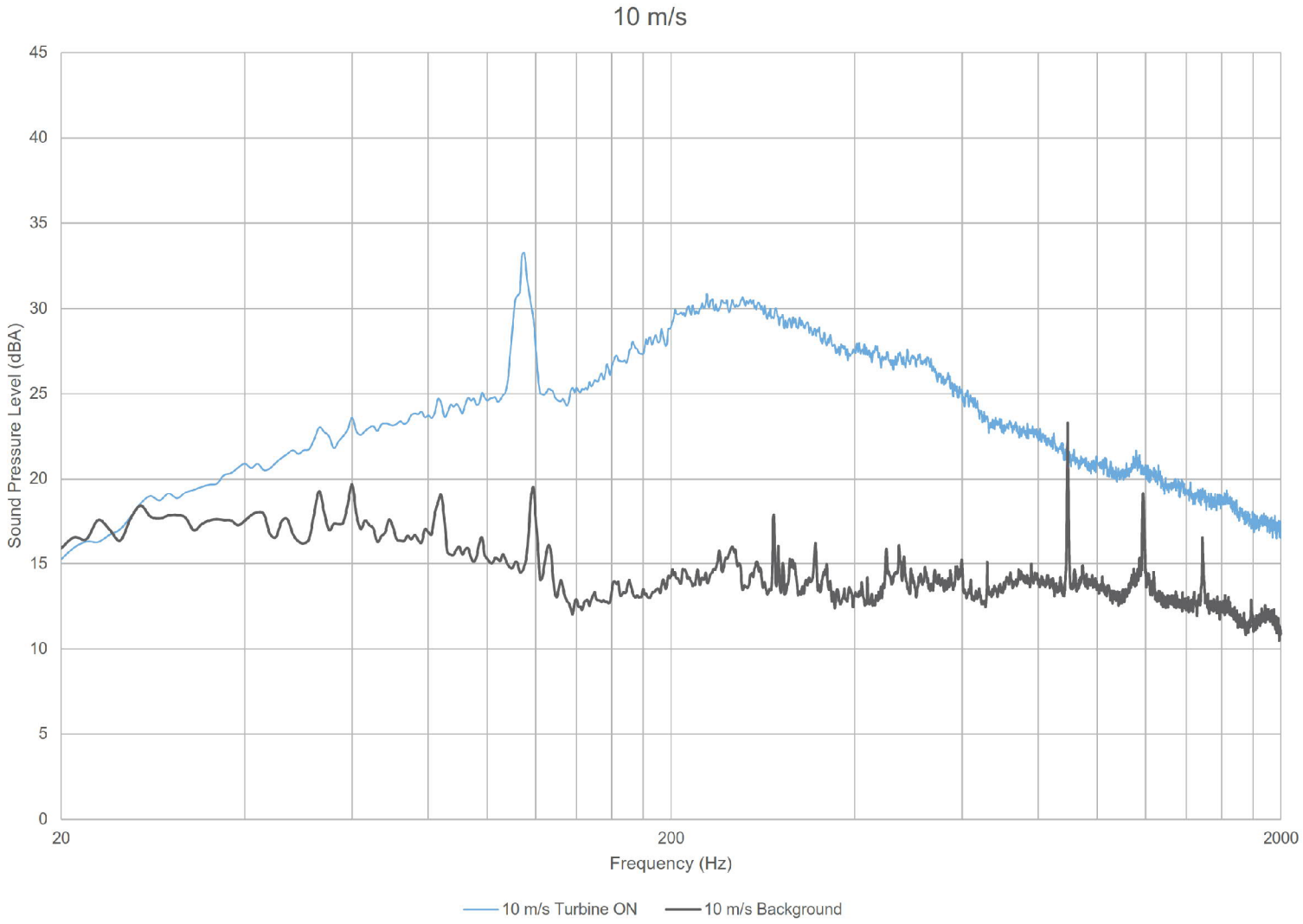
Figure D.01



aercoustics	16227.00.T35.RP1	**Project Name**
	Scale: NTS Drawn by: AM Reviewed by: PA Date: Nov 3, 2017 Revision: 1	Niagara Region Wind Farm - Turbine T35 - IEC61400-11 Edition 3.0
		Figure Title Plot of narrow band spectra – Turbine ON vs. Background at 9 m/s
		Figure D.02

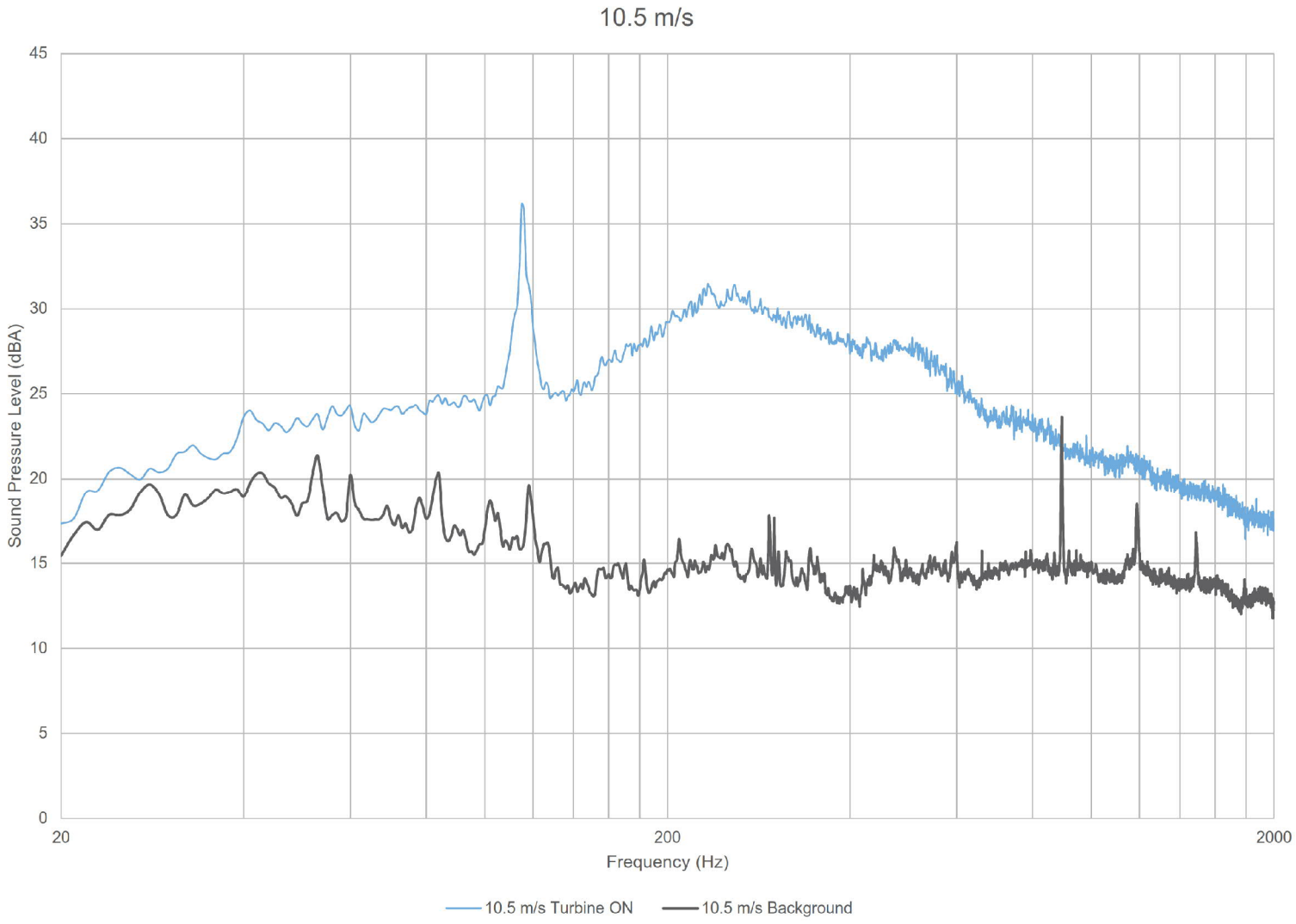


aercoustics	16227.00.T35.RP1	**Project Name**
	Scale: NTS Drawn by: AM Reviewed by: PA Date: Nov 3, 2017 Revision: 1	Niagara Region Wind Farm - Turbine T35 - IEC61400-11 Edition 3.0
		Figure Title Plot of narrow band spectra – Turbine ON vs. Background at 9.5 m/s
		Figure D.03



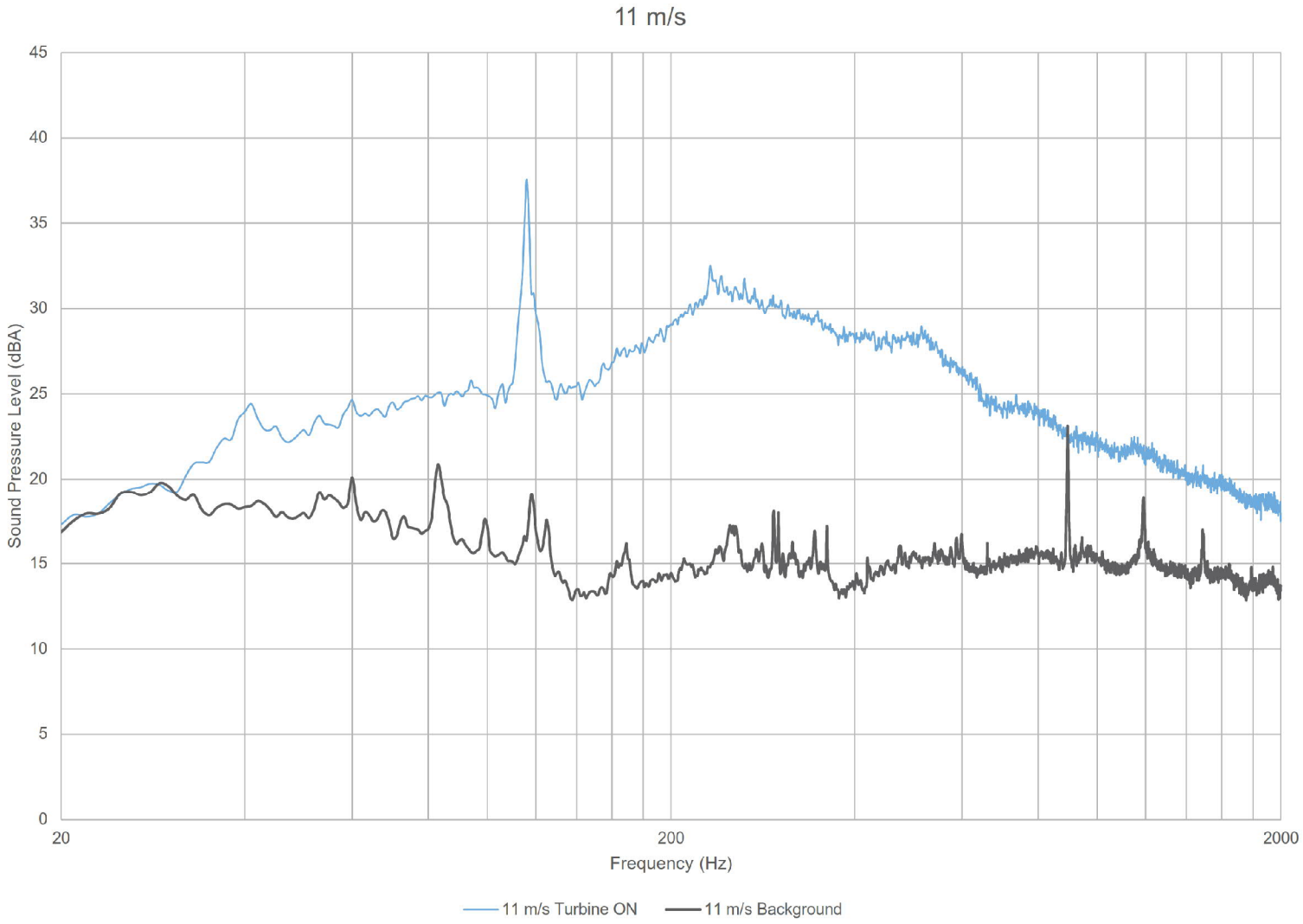
aercoustics	16227.00.T35.RP1 Scale: NTS Drawn by: AM Reviewed by: PA Date: Nov 3, 2017 Revision: 1	**Project Name** Niagara Region Wind Farm - Turbine T35 - IEC61400-11 Edition 3.0 **Figure Title** Plot of narrow band spectra – Turbine ON vs. Background at 10 m/s

Figure D.04



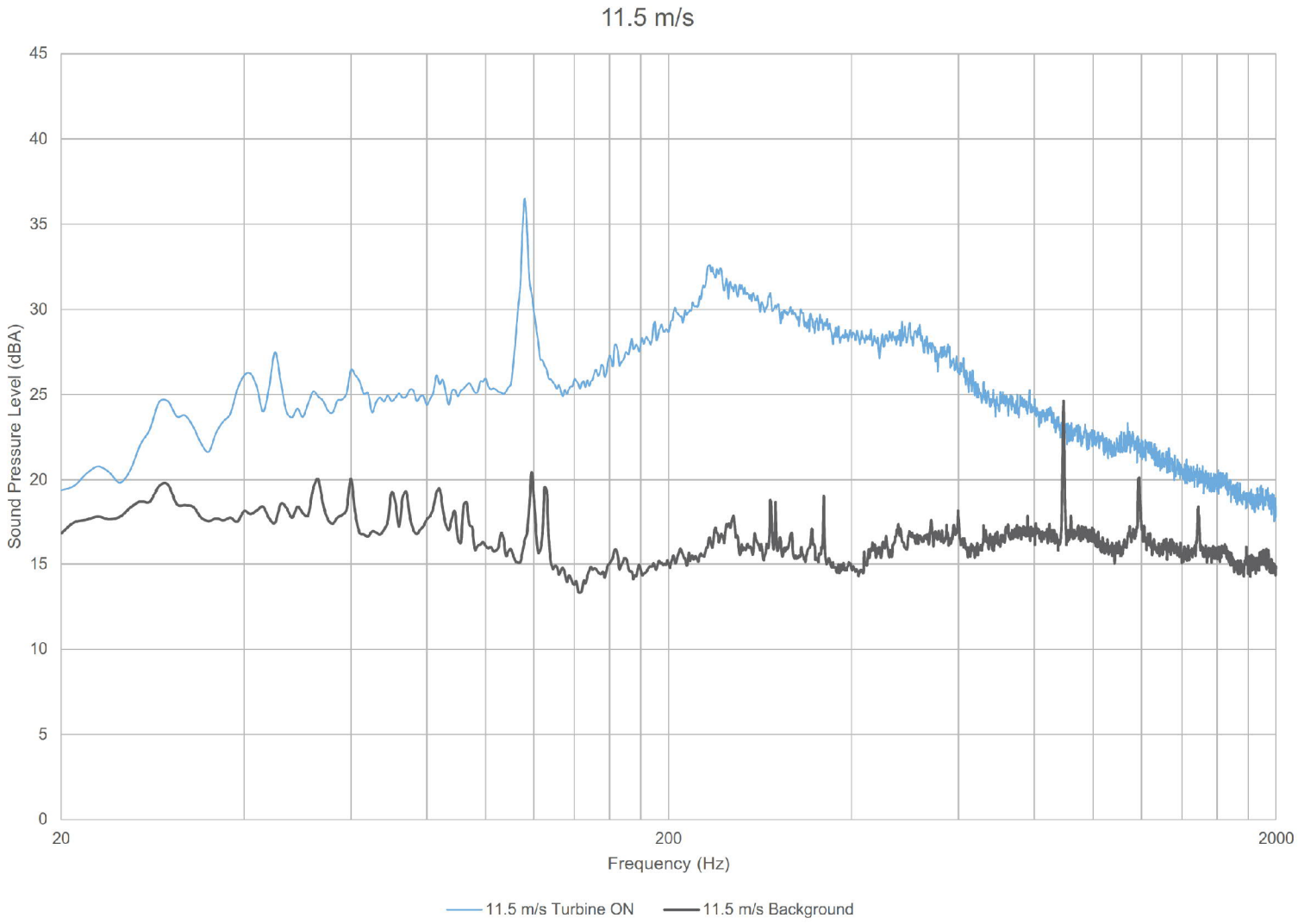
aercoustics	16227.00.T35.RP1 Scale: NTS Drawn by: AM Reviewed by: PA Date: Nov 3, 2017 Revision: 1	**Project Name** Niagara Region Wind Farm - Turbine T35 - IEC61400-11 Edition 3.0 **Figure Title** Plot of narrow band spectra – Turbine ON vs. Background at 10.5 m/s

Figure D.05

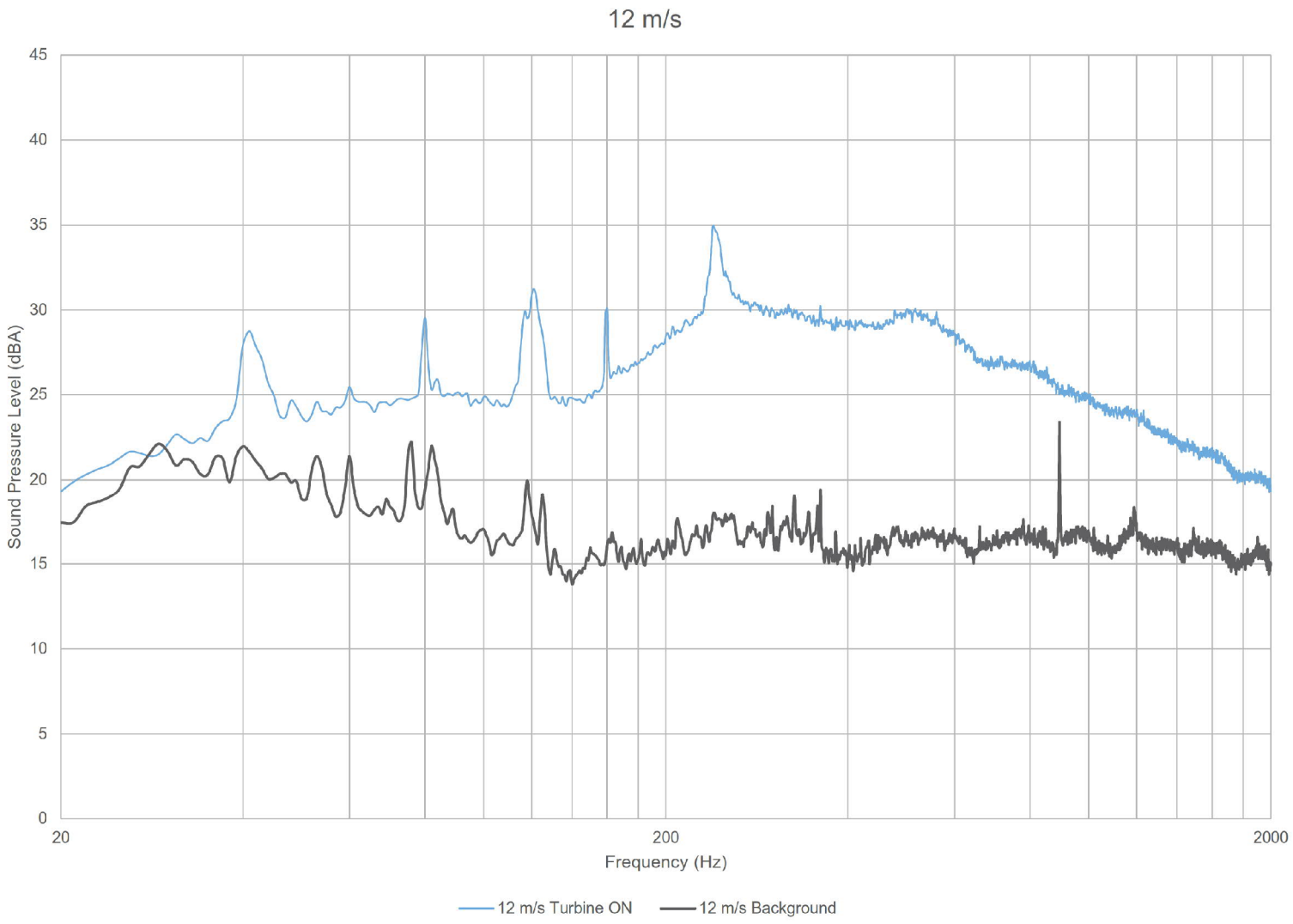


aercoustics	16227.00.T35.RP1 Scale: NTS Drawn by: AM Reviewed by: PA Date: Nov 3, 2017 Revision: 1	**Project Name** Niagara Region Wind Farm - Turbine T35 - IEC61400-11 Edition 3.0 **Figure Title** Plot of narrow band spectra – Turbine ON vs. Background at 11 m/s

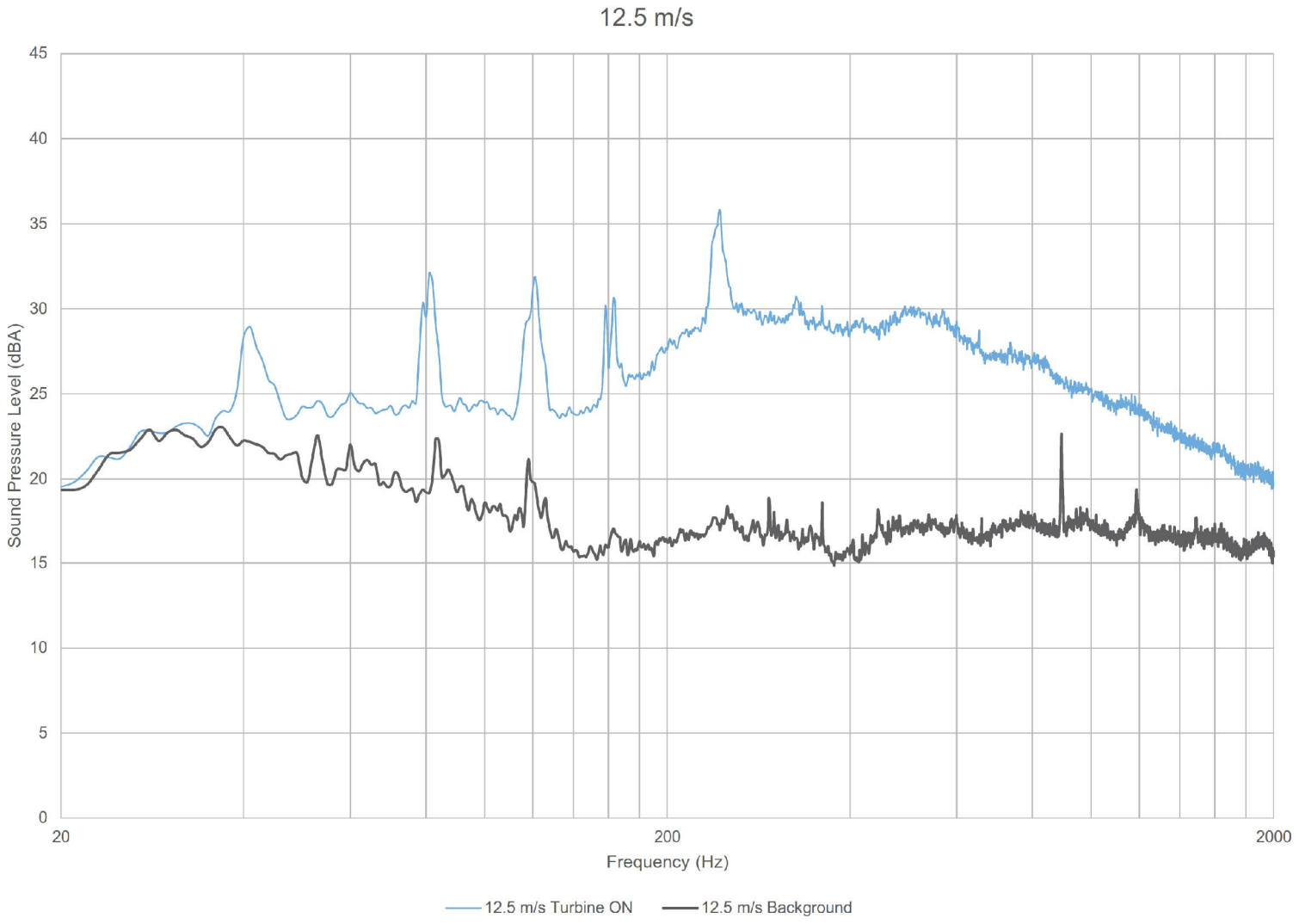
Figure D.06



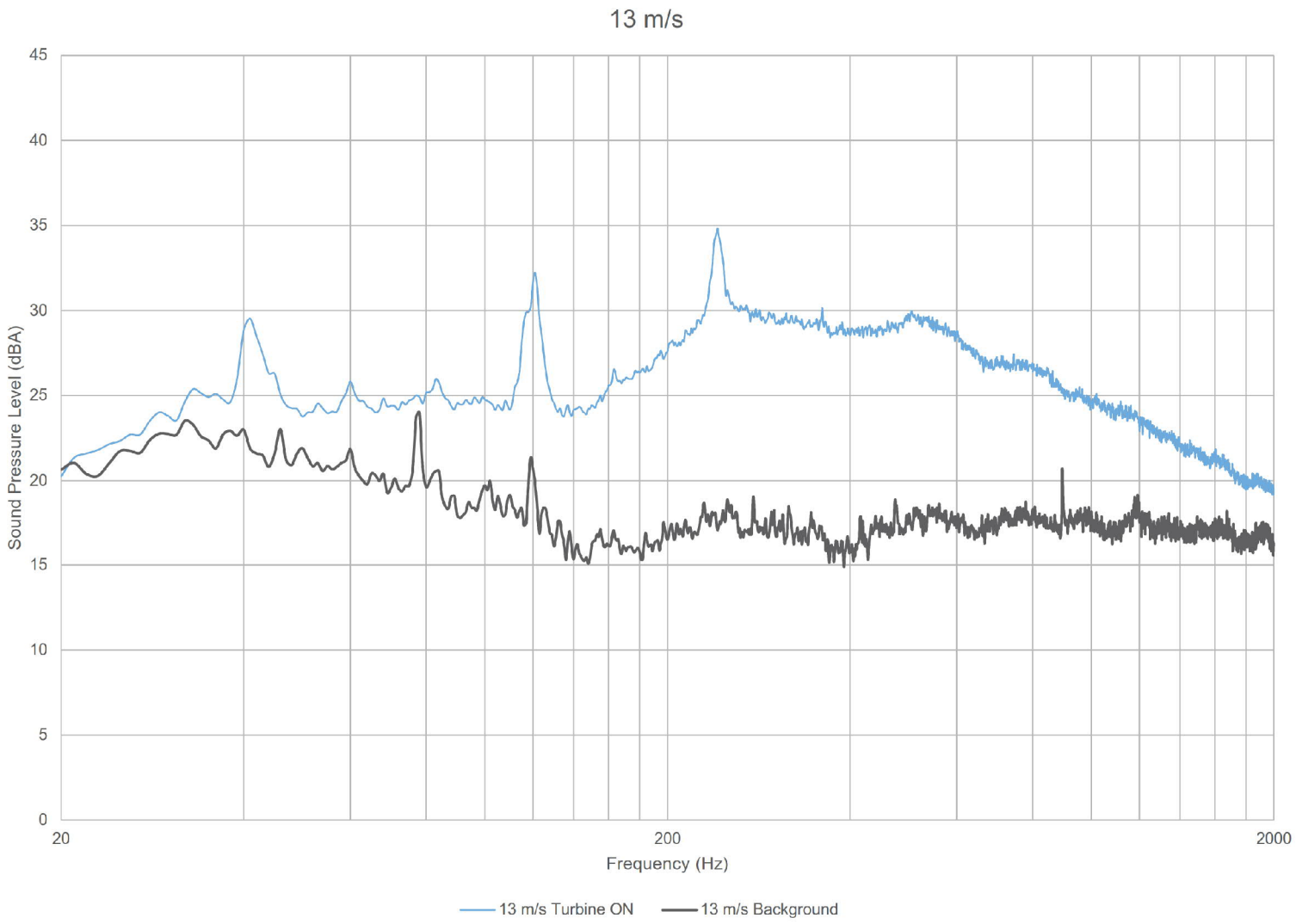
aercoustics	16227.00.T35.RP1	**Project Name**
	Scale: NTS Drawn by: AM Reviewed by: PA Date: Nov 3, 2017 Revision: 1	Niagara Region Wind Farm - Turbine T35 - IEC61400-11 Edition 3.0
		Figure Title Plot of narrow band spectra – Turbine ON vs. Background at 11.5 m/s
		Figure D.07



aercoustics	16227.00.T35.RP1	**Project Name**
	Scale: NTS Drawn by: AM Reviewed by: PA Date: Nov 3, 2017 Revision: 1	Niagara Region Wind Farm - Turbine T35 - IEC61400-11 Edition 3.0
		Figure Title Plot of narrow band spectra – Turbine ON vs. Background at 12 m/s
		Figure D.08

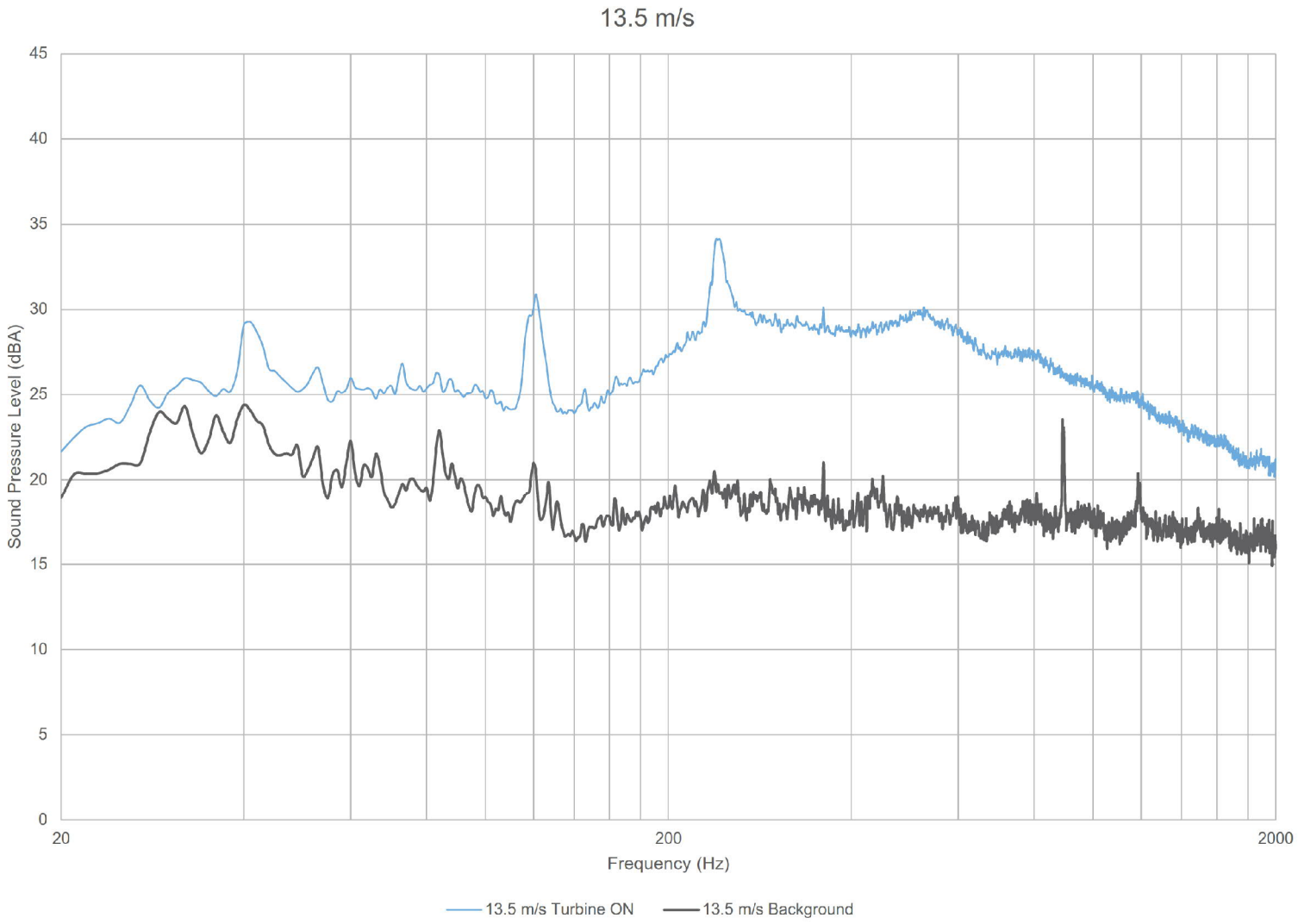


aercoustics	16227.00.T35.RP1	**Project Name**
	Scale: NTS Drawn by: AM Reviewed by: PA Date: Nov 3, 2017 Revision: 1	Niagara Region Wind Farm - Turbine T35 - IEC61400-11 Edition 3.0
		Figure Title Plot of narrow band spectra – Turbine ON vs. Background at 12.5 m/s
		Figure D.09



aercoustics	16227.00.T35.RP1 Scale: NTS Drawn by: AM Reviewed by: PA Date: Nov 3, 2017 Revision: 1	**Project Name** Niagara Region Wind Farm - Turbine T35 - IEC61400-11 Edition 3.0 **Figure Title** Plot of narrow band spectra – Turbine ON vs. Background at 13 m/s

Figure D.10



aercoustics	16227.00.T35.RP1 Scale: NTS Drawn by: AM Reviewed by: PA Date: Nov 3, 2017 Revision: 1	**Project Name** Niagara Region Wind Farm - Turbine T35 - IEC61400-11 Edition 3.0 **Figure Title** Plot of narrow band spectra – Turbine ON vs. Background at 13.5 m/s

Figure D.11

Table D.01 Tonality Assessment Table - 8.5 m/s

Project: Niagara Region Wind Farm- Turbine T35 - IEC 61400-11 Measurement

Report ID: 16227.00.T35.RP1

Created on: 10/30/2017

Measurement #	Centre frequency (Hz)	Energy average of all masking lines (dB)	Background (dB)	Background adjusted criterion level (dB)	Masking level (dB)	Tone level (dB)	Determination of tonality (dB)	Frequency dependent audibility criterion (dB)	Tonal Audibility (dB)
No Reportable Tones									

Table D.02 Tonality Assessment Table - 9 m/s

Project: Niagara Region Wind Farm- Turbine T35 - IEC 61400-11 Measurement

Report ID: 16227.00.T35.RP1

Created on: 10/30/2017

Measurement #	Centre frequency (Hz)	Energy average of all masking lines (dB)	Background (dB)	Background adjusted criterion level (dB)	Masking level (dB)	Tone level (dB)	Determination of tonality (dB)	Frequency dependent audibility criterion (dB)	Tonal Audibility (dB)
No Reportable Tones									

Table D.03 Tonality Assessment Table - 9.5 m/s

Project: Niagara Region Wind Farm- Turbine T35 - IEC 61400-11 Measurement

Report ID: 16227.00.T35.RP1

Created on: 10/30/2017

Measurement #	Centre frequency (Hz)	Energy average of all masking lines (dB)	Background (dB)	Background adjusted criterion level (dB)	Masking level (dB)	Tone level (dB)	Determination of tonality (dB)	Frequency dependent audibility criterion (dB)	Tonal Audibility (dB)
No Reportable Tones									

Table D.04 Tonality Assessment Table - 10 m/s

Project: Niagara Region Wind Farm- Turbine T35 - IEC 61400-11 Measurement

Report ID: 16227.00.T35.RP1

Created on: 10/30/2017

Measurement #	Centre frequency (Hz)	Energy average of all masking lines (dB)	Background (dB)	Background adjusted criterion level (dB)	Masking level (dB)	Tone level (dB)	Determination of tonality (dB)	Frequency dependent audibility criterion (dB)	Tonal Audibility (dB)
No Reportable Tones									

Table D.05 Tonality Assessment Table - 10.5 m/s

Project: Niagara Region Wind Farm- Turbine T35 - IEC 61400-11 Measurement

Report ID: 16227.00.T35.RP1

Created on: 11/3/2017

Measurement #	Centre frequency (Hz)	Energy average of all masking lines (dB)	Background (dB)	Background adjusted criterion level (dB)	Masking level (dB)	Tone level (dB)	Determination of tonality (dB)	Frequency dependent audibility criterion (dB)	Tonal Audibility (dB)
311	115			24.7	43.0	40.3	-2.7	-2.0	-0.7
379	115			25.7	43.9	42.2	-1.7	-2.0	0.3
57	115			25.5	43.8	40.0	-3.9	-2.0	-1.8
302	115			24.7	43.0	37.7	-5.3	-2.0	-3.3
268	115			25.4	43.7	39.0	-4.7	-2.0	-2.7
344	116			25.3	43.6	33.0	-10.6	-2.0	-8.6
391	116			25.2	43.5	36.6	-6.9	-2.0	-4.9
381	116			25.9	44.2	33.8	-10.3	-2.0	-8.3
351	116			25.7	44.0	39.1	-5.0	-2.0	-2.9
64	116			27.3	45.6	39.7	-5.8	-2.0	-3.8
Average	115.5						-4.9	-2.0	-2.9

Table D.06 Tonality Assessment Table - 11 m/s

Project: Niagara Region Wind Farm- Turbine T35 - IEC 61400-11 Measurement

Report ID: 16227.00.T35.RP1

Created on: 11/3/2017

Measurement #	Centre frequency (Hz)	Energy average of all masking lines (dB)	Background (dB)	Background adjusted criterion level (dB)	Masking level (dB)	Tone level (dB)	Determination of tonality (dB)	Frequency dependent audibility criterion (dB)	Tonal Audibility (dB)
65	115			26.3	44.6	41.2	-3.3	-2.0	-1.3
312	116			25.6	43.9	40.8	-3.0	-2.0	-1.0
61	116			27.0	45.3	39.9	-5.4	-2.0	-3.4
372	116			25.5	43.8	41.9	-1.9	-2.0	0.1
276	116			25.1	43.4	39.6	-3.7	-2.0	-1.7
271	116			25.6	43.9	40.8	-3.1	-2.0	-1.1
62	116			27.2	45.5	39.0	-6.5	-2.0	-4.5
342	116			25.8	44.1	39.5	-4.6	-2.0	-2.6
24	116			25.8	44.1	40.6	-3.5	-2.0	-1.5
270	116			24.9	43.1	33.6	-9.6	-2.0	-7.6
370	116			25.7	44.0	39.7	-4.3	-2.0	-2.3
349	116			24.7	43.0	37.2	-5.8	-2.0	-3.8
303	116			25.2	43.5	40.2	-3.3	-2.0	-1.3
51	116			26.0	44.3	38.2	-6.1	-2.0	-4.1
237	116			25.6	43.9	33.7	-10.2	-2.0	-8.1
277	117			25.8	44.1	39.8	-4.3	-2.0	-2.3
Average	116						-4.4	-2.0	-2.4

Table D.07 Tonality Assessment Table - 11.5 m/s

Project: Niagara Region Wind Farm- Turbine T35 - IEC 61400-11 Measurement

Report ID: 16227.00.T35.RP1

Created on: 11/3/2017

Measurement #	Centre frequency (Hz)	Energy average of all masking lines (dB)	Background (dB)	Background adjusted criterion level (dB)	Masking level (dB)	Tone level (dB)	Determination of tonality (dB)	Frequency dependent audibility criterion (dB)	Tonal Audibility (dB)
63	115			28.4	46.7	38.1	-8.6	-2.0	-6.6
265	115			26.2	44.4	38.9	-5.6	-2.0	-3.6
88	116			26.2	44.5	34.3	-10.2	-2.0	-8.2
193	116			26.4	44.7	34.0	-10.6	-2.0	-8.6
275	116			25.1	43.3	39.9	-3.5	-2.0	-1.5
285	116			25.2	43.5	40.0	-3.5	-2.0	-1.5
371	116			25.5	43.8	36.7	-7.0	-2.0	-5.0
272	116			25.5	43.8	41.2	-2.6	-2.0	-0.6
284	116			25.6	43.9	42.3	-1.6	-2.0	0.4
300	118			25.0	43.3	37.2	-6.1	-2.0	-4.1
Avearge	116						-5.0	-2.0	-3.0

Table D.08 Tonality Assessment Table - 12 m/s

Project: Niagara Region Wind Farm- Turbine T35 - IEC 61400-11 Measurement

Report ID: 16227.00.T35.RP1

Created on: 10/30/2017

Measurement #	Centre frequency (Hz)	Energy average of all masking lines (dB)	Background (dB)	Background adjusted criterion level (dB)	Masking level (dB)	Tone level (dB)	Determination of tonality (dB)	Frequency dependent audibility criterion (dB)	Tonal Audibility (dB)
No Reportable Tones									

Table D.09 Tonality Assessment Table - 12.5 m/s

Project: Niagara Region Wind Farm- Turbine T35 - IEC 61400-11 Measurement

Report ID: 16227.00.T35.RP1

Created on: 10/30/2017

Measurement #	Centre frequency (Hz)	Energy average of all masking lines (dB)	Background (dB)	Background adjusted criterion level (dB)	Masking level (dB)	Tone level (dB)	Determination of tonality (dB)	Frequency dependent audibility criterion (dB)	Tonal Audibility (dB)
No Reportable Tones									

Table D.10 Tonality Assessment Table - 13 m/s

Project: Niagara Region Wind Farm- Turbine T35 - IEC 61400-11 Measurement

Report ID: 16227.00.T35.RP1

Created on: 10/30/2017

Measurement #	Centre frequency (Hz)	Energy average of all masking lines (dB)	Background (dB)	Background adjusted criterion level (dB)	Masking level (dB)	Tone level (dB)	Determination of tonality (dB)	Frequency dependent audibility criterion (dB)	Tonal Audibility (dB)
No Reportable Tones									

Table D.11 Tonality Assessment Table - 13.5 m/s

Project: Niagara Region Wind Farm- Turbine T35 - IEC 61400-11 Measurement

Report ID: 16227.00.T35.RP1

Created on: 10/30/2017

Measurement #	Centre frequency (Hz)	Energy average of all masking lines (dB)	Background (dB)	Background adjusted criterion level (dB)	Masking level (dB)	Tone level (dB)	Determination of tonality (dB)	Frequency dependent audibility criterion (dB)	Tonal Audibility (dB)
No Reportable Tones									

aercoustics
Aercoustics Engineering Ltd.
1004 Middlegate Road, Suite 1100
Mississauga, ON L4Y 1M4
Tel: 416-249-3361
Fax 416-249-3613
aercoustics.com

Appendix E
Measurement Data

Table E.01 Measurement data - Turbine ON

Project: Niagara Wind Farm - Turbine T35 - IEC 61400-11 Measurement

Report ID: 16227.00.T35.RP1

Created on: 11/3/2017

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Turbine Power Output (kW)	Reference Yaw Angle (°)	Yaw Angle (°)	Pitch Angle (°)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (Pa)	Relative Humidity (%)
1	12.6	55.7	2989	209.0	209.8	0.0	14.5	12.4	12.4	18	99	65
2	16.0	54.9	2972	209.0	209.8	0.0	15.0	15.7	11.8	18	99	65
3	16.2	56.4	2991	209.0	209.8	0.0	14.5	16.0	11.1	18	99	65
4	15.7	54.1	3001	209.0	209.8	0.0	14.3	15.5	11.5	18	99	65
5	15.8	55.4	2992	209.0	209.8	0.0	14.5	15.6	9.2	18	99	65
6	14.4	54.0	2992	209.0	209.8	0.0	14.4	14.1	10.8	18	99	65
7	15.0	55.5	2990	209.0	209.8	0.0	14.2	14.8	10.1	18	99	65
8	14.3	54.4	2972	209.0	209.8	0.0	14.5	14.1	12.6	18	99	65
9	16.3	55.8	3008	209.0	209.8	0.0	14.3	16.0	11.8	18	99	65
10	14.1	55.9	3001	209.0	209.8	0.0	14.4	13.9	8.0	18	99	65
11	12.0	56.6	3006	209.0	209.8	0.0	14.4	11.9	11.8	18	99	65
12	12.7	54.7	3000	209.0	209.8	0.0	14.7	12.5	12.0	18	99	65
13	13.5	55.7	2988	209.0	209.8	0.0	14.5	13.3	12.3	18	99	64
14	13.0	55.2	3029	209.0	209.8	0.0	14.2	12.8	11.8	18	99	64
15	14.0	54.2	3023	209.0	209.8	0.0	14.2	13.8	12.3	18	99	64
16	12.8	55.9	3003	209.0	209.8	0.0	14.3	12.6	10.3	18	99	64
17	12.8	54.2	2989	209.0	209.8	0.0	14.1	12.6	10.8	18	99	64
18			2993	209.0	209.8	0.0	14.3	11.4	10.1	18	99	64
19	12.1	54.1	3008	209.0	209.8	0.0	14.2	11.9	12.4	18	99	64
20			2685	209.0	209.8	0.0	13.8	11.9	11.8	18	99	64
21			2259	209.0	209.8	0.0	13.5	12.5	12.1	18	99	64
22			2210	209.0	209.8	0.0	13.5	10.8	11.8	18	99	64
23			2475	209.0	209.8	0.0	13.7	10.5	11.2	18	99	64
24	10.9	53.7	2769	209.0	209.8	0.0	13.9	10.5	10.5	18	99	64
25	12.9	55.5	2999	209.0	209.8	0.0	14.4	12.7	12.4	18	99	64
26	13.6	54.4	2999	209.0	209.8	0.0	14.3	13.4	14.5	18	99	64
27	15.2	56.7	3000	209.0	209.8	0.0	14.3	14.9	13.0	18	99	64
28	15.6	56.5	3001	209.0	209.8	0.0	14.3	15.3	11.8	18	99	64
29	16.5	56.2	2972	209.0	209.8	0.0	14.4	16.3	11.6	18	99	64
30	13.9	55.8	2976	209.0	209.8	0.0	14.3	13.7	13.0	18	99	64
31	12.4	55.5	2979	209.0	209.8	0.0	13.9	12.3	11.7	18	99	63
32	13.6	55.9	2983	209.0	209.8	0.0	14.3	13.4	11.5	18	99	63
33			2998	209.0	209.8	0.0	14.2	11.4	13.0	18	99	63
34			2957	209.0	209.8	0.0	14.3	10.9	12.7	18	99	63
35			3011	209.0	209.8	0.0	14.8	11.4	12.0	18	99	63
36	11.8	55.5	2972	209.0	209.8	0.0	14.0	11.6	12.1	18	99	63
37			3012	209.0	209.8	0.0	14.4	11.4	11.8	18	99	64
38	13.3	54.1	3025	209.0	209.8	0.0	14.2	13.1	10.5	18	99	64
39	13.8	54.5	2992	209.0	209.8	0.0	14.2	13.6	8.2	18	99	64
40	14.5	55.8	3015	209.0	209.8	0.0	14.4	14.3	12.1	18	99	64
41			3049	209.0	209.8	0.0	14.4	14.5	11.1	18	99	64
42			3043	209.0	206.1	0.0	14.1	13.9	12.3	18	99	64
43	14.8	54.9	2994	209.0	205.8	0.0	14.6	14.6	12.1	18	99	64
44	13.7	54.0	2975	209.0	205.8	0.0	14.3	13.5	10.9	18	99	64
45	13.3	54.3	2994	209.0	205.8	0.0	14.3	13.1	10.6	18	99	64
46	12.7	54.6	3001	209.0	205.8	0.0	14.4	12.5	8.6	18	99	64
47			2996	209.0	205.8	0.0	14.5	11.3	9.5	18	99	64
48	13.1	54.7	3000	209.0	205.8	0.0	14.3	12.9	8.0	18	99	64
49			3004	209.0	205.8	0.0	14.1	11.2	8.0	18	99	65
50			2943	209.0	205.8	0.0	14.0	10.6	8.3	18	99	65
51	11.1	54.2	2842	209.0	205.8	0.0	13.9	11.5	8.2	18	99	65
52			2976	209.0	205.8	0.0	14.4	11.1	10.6	18	99	65
53			2733	209.0	205.8	0.0	13.8	12.0	12.7	18	99	65
54			2283	209.0	205.8	0.0	13.5	10.3	11.8	18	99	65
55			2308	209.0	205.8	0.0	13.5	10.9	12.1	18	99	64
56			2145	209.0	205.8	0.0	13.4	9.4	10.6	18	99	64
57	10.4	52.1	2521	209.0	205.8	0.0	13.7	10.8	10.0	18	99	64
58	9.6	52.3	2067	209.0	205.8	0.0	13.4	9.6	9.4	18	99	64
59	10.1	53.3	2384	209.0	205.8	0.0	13.6	9.9	8.3	18	99	64
60			2284	209.0	205.8	0.0	13.5	10.2	10.9	18	99	64
61	10.8	54.2	2715	209.0	205.8	0.0	13.8	11.1	9.2	18	99	65
62	10.8	54.0	2748	209.0	205.8	0.0	13.9	10.7	8.5	18	99	65
63	11.4	54.5	2890	209.0	205.8	0.0	13.9	10.8	8.6	18	99	65
64	10.7	53.2	2693	209.0	205.8	0.0	13.8	11.6	8.9	18	99	65
65	10.8	54.9	2746	209.0	205.8	0.0	13.8	10.8	9.2	18	99	65
66	13.0	55.3	3031	209.0	205.8	0.0	14.3	12.8	11.8	18	99	65
67			2959	209.0	205.8	0.0	14.0	10.6	10.1	18	99	65
68	14.0	56.2	2983	209.0	205.8	0.0	14.7	13.8	11.8	18	99	65
69	12.8	53.9	2973	209.0	205.8	0.0	14.6	12.6	11.3	18	99	65
70	12.2	56.6	3001	209.0	205.8	0.0	14.5	12.0	9.1	18	99	65
71	15.5	54.3	3020	209.0	205.8	0.0	14.1	15.3	10.3	18	99	65
72	15.4	56.5	3002	209.0	205.8	0.0	14.3	15.2	10.1	18	99	65
73	13.9	55.2	3031	209.0	205.8	0.0	14.5	13.7	10.7	18	99	65
74	15.1	55.4	3030	209.0	205.8	0.0	14.3	14.9	10.1	18	99	65
75	15.3	55.4	2998	209.0	205.8	0.0	14.4	15.1	9.8	18	99	65
76			3001	209.0	205.8	0.0	14.4	11.2	8.2	18	99	65
77	12.8	54.9	2976	209.0	205.8	0.0	14.8	12.6	9.2	18	99	65
78	13.1	55.6	3004	209.0	205.8	0.0	14.2	13.0	10.0	18	99	65
79			3020	209.0	205.8	0.0	14.0	11.4	8.9	18	99	66
80	14.0	54.7	3008	209.0	205.8	0.0	14.3	13.8	7.3	18	99	66
81	15.1	53.3	3006	209.0	205.8	0.0	14.3	14.9	8.9	18	99	66
82			3019	209.0	205.8	0.0	14.4	11.5	8.0	18	99	66
83	14.8	54.6	3007	209.0	205.8	0.0	14.4	14.6	10.9	18	99	66
84			3020	209.0	205.8	0.0	14.3	11.5	9.7	18	99	66
85	13.0	54.8	3004	209.0	205.8	0.0	14.5	12.8	10.1	18	99	65
86	14.3	55.6	3002	209.0	205.8	0.0	14.5	14.1	8.9	18	99	65
87			3020	209.0	205.8	0.0	14.0	10.8	8.8	18	99	65
88	11.3	53.7	2869	209.0	205.8	0.0	13.9	10.5	8.3	18	99	65

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Turbine Power Output (kW)	Reference Yaw Angle (°)	Yaw Angle (°)	Pitch Angle (°)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (Pa)	Relative Humidity (%)
89			3024	209.0	205.8	0.0	14.3	10.6	7.7	18	99	65
90	12.9	54.2	2996	209.0	205.8	0.0	14.1	12.7	7.0	18	99	65
91			3023	209.0	205.8	0.0	14.4	11.4	10.5	18	99	66
92	11.8	54.7	3021	209.0	205.8	0.0	14.2	11.6	8.3	18	99	66
93	13.1	53.9	3020	209.0	205.8	0.0	14.2	12.9	9.2	18	99	66
94	12.4	53.9	3005	209.0	205.8	0.0	14.2	12.3	7.4	18	99	66
95			2985	209.0	205.8	0.0	14.3	11.2	8.9	18	99	66
96			2991	209.0	205.8	0.0	14.0	11.1	8.3	18	99	66
97	12.0	54.5	2983	209.0	205.8	0.0	15.0	11.8	10.1	18	99	66
98	13.3	54.9	2997	209.0	205.8	0.0	14.5	13.1	12.1	18	99	66
99	12.3	54.7	3008	209.0	205.8	0.0	14.2	12.2	12.4	18	99	66
100	12.0	54.6	3033	209.0	205.8	0.0	14.4	11.8	12.0	18	99	66
101	12.0	54.1	2995	209.0	205.8	0.0	14.7	11.9	9.5	18	99	66
102	12.6	55.5	3002	209.0	205.8	0.0	14.5	12.4	9.1	18	99	66
103	13.3	56.0	3013	209.0	205.8	0.0	14.2	13.1	8.3	18	99	65
104	12.2	55.8	3018	209.0	205.8	0.0	14.5	12.0	12.0	18	99	65
105			2976	209.0	205.8	0.0	14.4	11.4	13.9	18	99	65
106	15.0	52.8	2986	209.0	205.8	0.0	14.2	14.7	10.8	18	99	65
107	13.7	54.2	2991	209.0	207.9	0.0	14.2	13.5	14.4	18	99	65
108	14.0	53.9	2988	209.0	211.8	0.0	14.2	13.8	12.7	18	99	65
109	14.0	56.4	3028	209.0	211.8	0.0	14.2	13.8	12.0	18	99	65
110	15.6	56.8	2985	209.0	211.8	0.0	14.5	15.4	10.9	18	99	65
111	13.9	55.8	3004	209.0	211.8	0.0	14.2	13.7	11.5	18	99	65
112	14.2	54.8	2986	209.0	211.8	0.0	14.0	14.0	13.2	18	99	65
113	13.5	53.8	3007	209.0	211.8	0.0	14.2	13.3	12.4	18	99	65
114	14.7	54.9	3010	209.0	211.8	0.0	14.2	14.5	12.3	18	99	65
115	12.2	54.6	2979	209.0	211.8	0.0	14.3	12.0	12.4	18	99	64
116	12.8	54.1	3019	209.0	211.8	0.0	14.2	12.6	10.7	18	99	64
117	14.3	55.5	2997	209.0	211.8	0.0	14.2	14.1	11.4	18	99	64
118	15.6	54.9	3001	209.0	211.8	0.0	14.3	15.3	11.6	18	99	64
119	15.4	53.1	2988	209.0	211.8	0.0	14.2	15.2	8.8	18	99	64
120	14.5	53.9	3007	209.0	211.8	0.0	14.1	14.3	9.5	18	99	64
121	13.4	53.3	3022	209.0	211.8	0.0	14.3	13.2	12.9	18	99	65
122	14.5	55.7	3002	209.0	211.8	0.0	14.5	14.3	13.2	18	99	65
123	15.6	54.6	2991	209.0	211.8	0.0	14.4	15.4	11.8	18	99	65
124	14.1	55.9	2981	209.0	211.8	0.0	14.4	13.9	13.2	18	99	65
125	14.9	55.9	2992	209.0	211.8	0.0	14.5	14.7	12.2	18	99	65
126	15.6	54.9	3013	209.0	211.8	0.0	14.3	15.4	11.4	18	99	65
127	16.1	55.4	2993	209.0	211.8	0.0	14.2	15.9	9.8	18	99	65
128	15.6	56.1	3017	209.0	211.8	0.0	14.5	15.4	12.3	18	99	65
129	17.4	55.3	3015	209.0	211.8	0.0	14.3	17.2	9.2	18	99	65
130	15.6	56.3	2996	209.0	211.8	0.0	14.2	15.4	11.7	18	99	65
131	15.7	55.7	3010	209.0	211.8	0.0	14.4	15.5	7.7	18	99	65
132			3012	209.0	211.8	0.0	14.3	15.9	10.9	18	99	65
133			3000	209.0	211.8	0.0	14.2	15.4	13.3	18	99	66
134			3009	209.0	211.8	0.0	14.2	13.3	12.1	18	99	66
135	14.8	56.6	2990	209.0	211.8	0.0	14.8	14.5	12.1	18	99	66
136	16.5	55.8	3009	209.0	211.8	0.0	14.4	16.2	11.4	18	99	66
137	16.0	55.9	3025	209.0	211.8	0.0	14.2	15.8	10.9	18	99	66
138	15.9	56.0	3005	209.0	211.8	0.0	14.3	15.6	12.7	18	99	66
139	13.8	56.1	3004	209.0	211.8	0.0	14.4	13.6	12.2	18	99	66
140	15.4	56.9	3006	209.0	211.8	0.0	14.4	15.1	12.1	18	99	66
141	15.5	56.2	3003	209.0	211.8	0.0	14.3	15.2	10.3	18	99	66
142	17.2	56.7	2972	209.0	211.8	0.0	14.4	16.9	10.3	18	99	66
143	16.3	55.6	3012	209.0	211.8	0.0	14.4	16.1	11.7	18	99	66
144	16.5	54.4	3027	209.0	211.8	0.0	14.3	16.2	9.8	18	99	66
145	16.7	55.6	3023	209.0	211.8	0.0	14.2	16.4	11.8	18	99	66
146	18.1	55.3	3026	209.0	211.8	0.0	14.1	17.8	11.7	18	99	66
147	15.0	54.7	3016	209.0	211.8	0.0	14.2	14.7	12.4	18	99	66
148	17.1	55.9	3001	209.0	211.8	0.0	14.2	16.9	8.9	18	99	66
149	16.9	54.7	3006	209.0	211.8	0.0	14.4	16.7	10.8	18	99	66
150	13.6	56.1	2988	209.0	211.8	0.0	14.3	13.4	12.9	18	99	66
151	13.4	56.1	3009	209.0	211.8	0.0	14.1	13.2	13.6	18	99	65
152			3007	209.0	211.8	0.0	14.3	11.5	12.7	18	99	65
153	13.4	56.2	2986	209.0	211.8	0.0	14.5	13.2	10.9	18	99	65
154			3003	209.0	211.8	0.0	14.3	11.2	12.7	18	99	65
155	14.1	54.9	3019	209.0	211.8	0.0	14.3	13.9	12.7	18	99	65
156	13.3	53.9	3021	209.0	211.8	0.0	14.3	13.1	12.2	18	99	65
157			3027	209.0	211.8	0.0	14.2	11.4	10.8	18	99	65
158	13.7	53.6	3011	209.0	211.8	0.0	14.0	13.5	9.5	18	99	65
159	14.3	53.7	3017	209.0	211.8	0.0	14.4	14.1	11.1	18	99	65
160	14.0	55.4	3009	209.0	211.8	0.0	14.1	13.8	10.9	18	99	65
161	14.1	54.8	3008	209.0	211.8	0.0	14.2	13.9	12.6	18	99	65
162	15.1	54.1	3028	209.0	211.8	0.0	14.4	14.9	13.0	18	99	65
163	15.8	55.4	3034	209.0	211.8	0.0	14.4	15.5	12.9	18	99	65
164	13.8	55.3	3016	209.0	211.8	0.0	14.3	13.6	10.9	18	99	65
165	12.9	55.1	3002	209.0	211.8	0.0	14.3	12.7	10.5	18	99	65
166	12.2	55.0	2978	209.0	211.8	0.0	14.2	12.0	11.2	18	99	65
167			2545	209.0	211.8	0.0	13.7	10.2	12.7	18	99	65
168			2803	209.0	211.8	0.0	13.9	11.4	12.2	18	99	65
169			2640	209.0	211.8	0.0	13.8	10.0	11.5	18	99	66
170	11.8	55.3	2970	209.0	211.8	0.0	14.8	11.6	13.0	18	99	66
171	13.9	55.6	3018	209.0	211.8	0.0	14.7	13.7	9.5	18	99	66
172	12.0	54.5	3015	209.0	211.8	0.0	14.4	11.8	11.6	18	99	66
173			3010	209.0	211.8	0.0	14.3	13.4	11.2	18	99	66
174			2986	209.0	211.8	0.0	14.1	12.4	12.1	18	99	66
175			2977	209.0	211.8	0.0	14.4	11.6	11.5	18	99	66
176	12.2	55.9	3005	209.0	211.8	0.0	14.2	12.0	12.1	18	99	66

Table E.01 Measurement data - Turbine ON

Project: Niagara Wind Farm - Turbine T35 - IEC 61400-11 Measurement

Report ID: 16227.00.T35.RP1

Created on: 11/3/2017

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Turbine Power Output (kW)	Reference Yaw Angle (°)	Yaw Angle (°)	Pitch Angle (°)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (Pa)	Relative Humidity (%)
177	14.0	55.1	2977	209.0	211.8	0.0	14.6	13.8	11.3	18	99	66
178	13.5	55.4	2998	209.0	211.8	0.0	14.5	13.3	11.1	18	99	66
179	13.7	56.0	3007	209.0	211.8	0.0	14.3	13.5	10.3	18	99	66
180	14.4	54.7	2965	209.0	211.8	0.0	14.4	14.2	10.9	18	99	66
181	13.3	56.6	3009	209.0	211.8	0.0	14.3	13.1	11.5	18	99	66
182	12.8	54.2	3010	209.0	211.8	0.0	14.2	12.7	13.2	18	99	66
183	12.5	53.9	2993	209.0	211.8	0.0	14.2	12.3	10.3	18	99	66
184			3018	209.0	211.8	0.0	14.3	11.3	10.6	18	99	66
185	12.2	55.7	2994	209.0	211.8	0.0	14.3	12.1	10.3	18	99	66
186	13.1	56.0	3000	209.0	211.8	0.0	14.3	12.9	10.1	18	99	66
187	12.2	56.8	3017	209.0	211.8	0.0	14.2	12.0	10.7	18	99	66
188	13.3	56.5	3025	209.0	211.8	0.0	14.4	13.1	10.8	18	99	66
189	14.9	55.0	2992	209.0	211.8	0.0	14.5	14.7	12.6	18	99	66
190	14.7	54.3	2953	209.0	211.8	0.0	14.2	14.5	12.0	18	99	66
191	13.6	53.2	2973	209.0	211.8	0.0	14.0	13.4	12.7	18	99	66
192	13.9	54.6	3028	209.0	210.7	0.0	14.4	13.7	10.9	18	99	66
193	11.3	54.7	2875	209.0	207.9	0.0	13.9	10.8	11.4	18	99	66
194			2996	209.0	207.9	0.0	14.2	10.7	12.6	18	99	66
195	12.5	54.5	3034	209.0	207.9	0.0	14.1	12.3	10.4	18	99	66
196	13.1	52.8	3028	209.0	207.9	0.0	14.1	12.9	12.4	18	99	66
197	15.5	54.7	3012	209.0	207.9	0.0	14.2	15.3	11.6	18	99	66
198	14.1	55.3	3015	209.0	207.9	0.0	14.3	13.9	10.8	18	99	66
199	12.6	54.5	3035	209.0	207.9	0.0	14.2	12.4	10.9	18	99	67
200	12.3	54.5	2970	209.0	207.9	0.0	14.5	12.1	11.2	18	99	67
201	13.4	56.2	3013	209.0	207.9	0.0	14.6	13.2	11.5	18	99	67
202	13.3	54.7	3013	209.0	207.9	0.0	14.3	13.1	9.4	18	99	67
203	12.7	54.3	3034	209.0	207.9	0.0	14.2	12.5	8.3	18	99	67
204	13.3	55.3	3006	209.0	207.9	0.0	14.4	13.1	11.4	18	99	67
205	12.0	54.7	3013	209.0	207.9	0.0	14.4	11.8	9.8	18	99	66
206			3019	209.0	207.9	0.0	14.3	10.9	11.7	18	99	66
207			3017	209.0	207.9	0.0	14.3	11.5	12.2	18	99	66
208	12.0	55.9	3012	209.0	207.9	0.0	14.5	11.8	12.6	18	99	66
209	12.2	54.4	3005	209.0	207.9	0.0	14.5	12.0	10.8	18	99	66
210	14.1	54.1	3012	209.0	207.9	0.0	14.2	13.9	11.4	18	99	66
211	12.4	55.0	3020	209.0	207.9	0.0	14.1	12.2	11.4	18	99	67
212	12.5	55.3	3010	209.0	207.9	0.0	14.3	12.3	12.7	18	99	67
213	11.9	55.9	2990	209.0	207.9	0.0	14.5	11.7	10.7	18	99	67
214	12.5	54.5	3006	209.0	207.9	0.0	14.4	12.3	9.5	18	99	67
215	15.9	55.4	3009	209.0	207.9	0.0	14.0	15.6	10.5	18	99	67
216	14.9	54.8	2985	209.0	207.9	0.0	14.4	14.7	9.2	18	99	67
217	15.6	56.1	3009	209.0	207.9	0.0	14.5	15.4	12.0	18	99	67
218	16.0	55.8	2995	209.0	207.9	0.0	14.4	15.7	10.1	18	99	67
219	14.6	56.4	2997	209.0	207.9	0.0	14.4	14.4	13.3	18	99	67
220	14.8	55.6	3007	209.0	207.9	0.0	14.4	14.6	10.7	18	99	67
221	15.5	55.4	3000	209.0	207.9	0.0	14.2	15.3	10.1	18	99	67
222	13.6	55.2	3009	209.0	207.9	0.0	14.4	13.4	10.1	18	99	67
223			3015	209.0	207.9	0.0	14.2	11.5	10.8	18	99	66
224	13.8	56.4	3006	209.0	207.9	0.0	14.4	13.6	10.1	18	99	66
225			2980	209.0	207.9	0.0	14.8	13.5	11.5	18	99	66
226	15.6	54.8	3020	209.0	207.9	0.0	14.4	15.4	12.0	18	99	66
227	15.5	55.0	2984	209.0	207.9	0.0	14.4	15.2	10.4	18	99	66
228	13.9	55.5	2991	209.0	207.9	0.0	14.2	13.7	10.8	18	99	66
229			3019	209.0	207.9	0.0	14.4	11.4	9.4	18	99	66
230	14.5	55.0	3000	209.0	207.9	0.0	14.3	14.3	9.4	18	99	66
231	12.7	54.0	2988	209.0	210.9	0.0	14.5	12.5	11.3	18	99	66
232			3006	209.0	210.9	0.0	14.3	13.8	11.2	18	99	66
233	13.0	56.1	3008	209.0	210.9	0.0	14.5	12.8	14.5	18	99	66
234	12.7	55.3	3023	209.0	210.9	0.0	14.5	12.5	13.6	18	99	66
235	11.9	54.8	3044	209.0	210.9	0.0	14.2	11.7	12.0	18	99	65
236			3011	209.0	210.9	0.0	14.1	11.6	13.3	18	99	65
237	11.2	54.1	2852	209.0	210.9	0.0	13.9	10.8	12.3	18	99	65
238			2982	209.0	210.9	0.0	14.6	10.8	13.2	18	99	65
239	12.4	54.2	3009	209.0	210.9	0.0	14.1	12.3	11.5	18	99	65
240	14.4	56.7	3030	209.0	210.9	0.0	14.3	14.2	10.7	18	99	65
241	15.1	55.1	2991	209.0	210.9	0.0	14.4	14.9	11.2	18	99	65
242	12.6	55.1	2964	209.0	210.9	0.0	13.8	12.5	8.9	18	99	65
243	13.1	55.5	3008	209.0	210.9	0.0	14.1	12.9	9.2	18	99	65
244			2971	209.0	210.9	0.0	14.4	10.4	8.5	18	99	65
245	11.8	56.2	2996	209.0	210.9	0.0	14.3	11.6	10.5	18	99	65
246	13.7	53.6	2987	209.0	210.9	0.0	14.2	13.5	12.1	18	99	65
247			2497	209.0	210.9	0.0	13.6	12.5	12.1	18	99	65
248			2369	209.0	210.9	0.0	13.6	12.3	10.1	18	99	65
249			2179	209.0	210.9	0.0	13.4	12.1	10.6	18	99	65
250			2311	209.0	210.9	0.0	13.6	11.1	11.8	18	99	65
251			2607	209.0	209.8	0.0	13.8	11.8	11.5	18	99	65
252			2290	209.0	205.0	0.0	13.5	8.5	10.1	18	99	65
253			2493	209.0	203.8	0.0	13.7	10.7	10.9	18	99	66
254			2318	209.0	203.8	0.0	13.5	12.1	11.5	18	99	66
255			2964	209.0	203.8	0.0	14.2	11.5	10.7	18	99	66
256	12.0	54.4	2989	209.0	203.8	0.0	14.9	11.9	10.0	18	99	66
257	13.3	55.6	2992	209.0	203.8	0.0	14.7	13.1	8.9	18	99	66
258	14.4	54.9	3010	209.0	203.8	0.0	14.5	14.2	7.8	18	99	66
259	13.8	53.9	2994	209.0	203.8	0.0	14.4	13.6	7.8	18	99	67
260			3020	209.0	203.8	0.0	14.6	11.1	7.8	18	99	67
261			3012	209.0	203.8	0.0	14.2	12.1	10.9	18	99	67
262			1819	209.0	210.9	0.0	13.1	10.3	11.0	18	99	65
263	9.7	51.9	2135	209.0	210.9	0.0	13.4	10.4	9.1	18	99	65
264	10.2	53.1	2431	209.0	210.9	0.0	13.6	9.5	7.7	18	99	66

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Turbine Power Output (kW)	Reference Yaw Angle (°)	Yaw Angle (°)	Pitch Angle (°)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (Pa)	Relative Humidity (%)
265	11.5	53.1	2896	209.0	210.9	0.0	13.9	12.4	7.6	18	99	66
266	13.6	54.9	3005	209.0	208.8	0.0	14.1	13.4	7.9	18	99	66
267	9.8	52.6	2183	209.0	206.8	0.0	13.4	10.2	8.6	18	99	66
268	10.6	52.6	2605	209.0	206.8	0.0	13.8	10.3	7.1	18	99	66
269	12.9	53.6	3030	209.0	206.8	0.0	14.4	12.7	6.0	18	99	66
270	10.9	52.4	2797	209.0	206.8	0.0	13.8	10.8	5.9	18	99	66
271	10.8	53.2	2736	209.0	206.8	0.0	13.8	10.2	6.4	18	99	66
272	11.7	53.4	2928	209.0	206.8	0.0	13.9	11.0	6.8	18	99	66
273	11.8	53.7	3020	209.0	206.8	0.0	14.4	11.6	8.3	18	99	66
274			2993	209.0	206.8	0.0	14.2	10.9	8.2	18	99	66
275	11.5	54.8	2898	209.0	206.8	0.0	13.9	10.1	7.3	18	99	66
276	10.8	53.4	2729	209.0	206.8	0.0	13.8	10.9	6.8	18	99	66
277	11.2	55.4	2864	209.0	206.8	0.0	13.9	9.7	7.0	18	99	66
278	12.2	54.3	2964	209.0	206.8	0.0	14.0	12.0	7.7	18	99	66
279	13.1	53.6	3007	209.0	206.8	0.0	14.1	12.9	9.1	18	99	66
280			2988	209.0	206.8	0.0	14.4	10.5	9.5	18	99	66
281			2988	209.0	206.8	0.0	14.6	11.0	10.0	18	99	66
282			3008	209.0	206.8	0.0	14.4	9.8	8.8	18	99	64
283	12.1	52.8	2986	209.0	206.8	0.0	14.2	11.9	8.0	18	99	64
284	11.7	53.9	2930	209.0	206.8	0.0	14.0	11.3	7.6	18	99	64
285	11.6	54.7	2913	209.0	206.8	0.0	13.9	11.1	8.3	18	99	64
286	11.9	55.2	2978	209.0	206.8	0.0	14.7	11.7	8.2	18	99	64
287	12.1	55.3	2980	209.0	206.8	0.0	14.6	11.9	8.8	18	99	64
288	12.0	53.3	2986	209.0	206.8	0.0	14.3	11.9	6.4	18	99	65
289	13.2	53.4	3012	209.0	206.8	0.0	14.2	13.0	8.6	18	99	65
290			3014	209.0	206.8	0.0	14.2	11.9	9.4	18	99	65
291	12.8	52.2	3002	209.0	206.8	0.0	14.3	12.6	8.8	18	99	65
292			2992	209.0	206.8	0.0	14.5	11.2	7.9	18	99	65
293	11.8	55.3	3015	209.0	206.8	0.0	14.6	11.6	7.1	18	99	65
294			3015	209.0	206.8	0.0	14.4	10.5	8.3	18	99	65
295			3026	209.0	206.8	0.0	14.2	10.9	7.8	18	99	65
296			3015	209.0	206.8	0.0	14.2	10.1	8.5	18	99	65
297			2997	209.0	206.8	0.0	14.4	10.9	8.8	18	99	65
298			3005	209.0	206.8	0.0	14.5	11.2	8.9	18	99	65
299			3013	209.0	206.8	0.0	14.2	11.3	9.4	18	99	65
300	11.7	53.3	2937	209.0	206.8	0.0	14.0	12.5	8.2	18	99	65
301	10.2	51.8	2397	209.0	206.8	0.0	13.6	10.2	7.1	18	99	65
302	10.4	52.2	2528	209.0	206.8	0.0	13.7	10.6	8.8	18	99	65
303	11.1	53.2	2840	209.0	206.8	0.0	13.9	10.9	9.5	18	99	65
304			3006	209.0	206.8	0.0	14.1	11.3	8.6	18	99	65
305	12.7	53.3	2994	209.0	206.8	0.0	14.6	12.5	9.3	18	99	65
306	13.2	54.2	2997	209.0	206.8	0.0	14.5	13.0	7.2	18	99	65
307	13.0	54.4	3022	209.0	206.8	0.0	14.3	12.8	7.7	18	99	65
308			3026	209.0	206.8	0.0	14.1	11.5	7.7	18	99	65
309			2976	209.0	206.8	0.0	14.0	10.9	10.5	18	99	65
310			2997	209.0	206.8	0.0	14.2	10.5	9.8	18	99	65
311	10.3	51.4	2489	209.0	206.8	0.0	13.7	11.6	8.2	18	99	65
312	10.8	53.5	2714	209.0	206.8	0.0	13.8	11.1	8.5	18	99	65
313	9.7	53.7	2151	209.0	206.8	0.0	13.4	9.4	8.6	18	99	65
314	9.3	50.8	1872	209.0	206.8	0.0	13.2	8.9	7.6	18	99	65
315	9.8	51.8	2201	209.0	206.8	0.0	13.5	9.6	6.4	18	99	66
316	10.2	52.8	2399	209.0	206.8	0.0	13.6	10.6	8.9	18	99	66
317	10.1	53.5	2388	209.0	206.8	0.0	13.6	11.5	8.3	18	99	66
318	9.8	53.1	2177	209.0	206.8	0.0	13.5	9.3	7.6	18	99	66
319			1863	209.0	206.8	0.0	13.1	9.9	9.7	18	99	66
320	9.3	51.7	1906	209.0	206.8	0.0	13.2	10.1	8.6	18	99	66
321	9.1	51.1	1761	209.0	206.8	0.0	13.0	9.2	7.3	18	99	66
322	8.9	50.5	1655	209.0	206.8	0.0	12.8	9.2	7.2	18	99	66
323	8.8	50.8	1595	209.0	206.8	0.0	12.6	8.7	7.3	18	99	66
324	9.2	51.0	1815	209.0	206.8	0.0	13.1	7.5	7.2	18	99	66
325	8.9	50.1	1645	209.0	206.8	0.0	12.8	8.7	6.7	18	99	66
326	9.0	50.8	1716	209.0	206.8	0.0	12.9	9.0	8.6	18	99	66
327	9.1	51.8	1769	209.0	206.8	0.0	13.0	8.7	8.9	18	99	65
328	9.1	50.3	1777	209.0	206.8	0.0	13.0	9.6	7.9	18	99	65
329	9.7	50.9	2132	209.0	206.8	0.0	13.4	10.0	8.5	18	99	65
330	9.8	52.2	2224	209.0	206.8	0.0	13.5	7.9	7.9	18	99	65
331	10.2	51.6	2441	209.0	206.8	0.0	13.7	8.9	7.7	18	99	65
332	9.9	52.9	2258	209.0	206.8	0.0	13.5	10.1	9.3	18	99	65
333	9.5	52.3	1994	209.0	206.8	0.0	13.3	7.4	7.8	18	99	64
334			2185	209.0	206.8	0.0	13.5	9.5	10.1	18	99	64
335	8.9	51.3	1672	209.0	207.9	0.0	12.9	6.6	8.8	18	99	64
336			1523	209.0	212.4	0.0	12.6	9.5	11.4	18	99	64
337			1272	209.0	216.9	0.0	11.9	8.7	11.1	18	99	64
338			1170	209.0	217.8	0.0	11.6	8.0	9.5	18	99	64
339			1283	209.0	217.8	0.0	12.0	8.6	10.9	18	99	64
340	10.1	53.0	2364	209.0	213.9	0.0	13.6	11.0	8.8	18	99	64
341	10.2	52.1	2423	209.0	213.9	0.0	13.6	10.9	9.1	18	99	64
342	10.9	52.7	2766	209.0	213.9	0.0	13.9	12.4	9.5	18	99	64
343	9.9	51.6	2237	209.0	213.9	0.0	13.5	8.4	9.5	18	99	65
344	10.3	54.2	2475	209.0	213.9	0.0	13.6	10.4	7.6	18	99	65
345	12.7	54.1	3025	209.0	213.9	0.0	14.6	12.5	8.3	18	99	65
346	12.0	53.9	3027	209.0	213.9	0.0	14.3	11.8	7.4	18	99	65
347			3021	209.0	213.9	0.0	14.2	11.0	6.3	18	99	65
348			2987	209.0	213.9	0.0	14.4	10.7	7.1	18	99	65
349	10.9	52.7	2804	209.0	213.9	0.0	13.8	10.6	10.7	18	99	64
350			2959	209.0	213.9	0.0	14.0	11.5	8.0	18	99	64
351	10.7	52.4	2665	209.0	213.9	0.0	13.8	10.7	8.0	18	99	64
352	10.2	53.6	2416	209.0	213.9	0.0	13.6	10.9	9.7	18	99	64

Table E.01 Measurement data - Turbine ON

Project: Niagara Wind Farm - Turbine T35 - IEC 61400-11 Measurement

Report ID: 16227.00.T35.RP1

Created on: 11/3/2017

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Turbine Power Output (kW)	Reference Yaw Angle (°)	Yaw Angle (°)	Pitch Angle (°)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (Pa)	Relative Humidity (%)
353	9.7	52.7	2136	209.0	213.9	0.0	13.4	11.8	8.9	18	99	64
354	10.2	53.9	2412	209.0	213.9	0.0	13.7	10.7	8.5	18	99	64
355	9.9	52.6	2239	209.0	213.9	0.0	13.5	11.8	9.4	18	99	65
356			1787	209.0	213.9	0.0	13.1	9.3	9.7	18	99	65
357			1854	209.0	213.9	0.0	13.1	9.1	9.4	18	99	65
358			1840	209.0	213.9	0.0	13.1	9.0	11.3	18	99	65
359			1747	209.0	213.9	0.0	13.0	8.4	11.0	18	99	65
360			1729	209.0	213.9	0.0	13.0	9.1	9.5	18	99	65
361	9.0	53.0	1729	209.0	213.9	0.0	13.0	8.6	8.9	18	99	65
362	8.7	50.7	1560	209.0	213.9	0.0	12.6	8.2	7.5	18	99	65
363			1512	209.0	213.9	0.0	12.6	9.1	10.4	18	99	65
364			1498	209.0	213.9	0.0	12.5	8.8	12.0	18	99	65
365			1516	209.0	213.9	0.0	12.6	9.7	10.3	18	99	65
366			1550	209.0	213.9	0.0	12.7	9.0	9.8	18	99	65
367			1840	209.0	213.9	0.0	13.1	9.1	10.8	18	99	65
368			2792	209.0	213.9	0.0	13.9	11.1	12.0	18	99	65
369			2988	209.0	213.9	0.0	14.0	11.0	11.7	18	99	65
370	10.9	54.6	2799	209.0	213.9	0.0	13.9	10.4	10.6	18	99	65
371	11.6	54.0	2922	209.0	213.9	0.0	13.9	11.3	9.8	18	99	65
372	10.8	53.6	2725	209.0	213.9	0.0	13.8	10.3	9.5	18	99	65
373	9.8	52.8	2207	209.0	213.9	0.0	13.5	11.1	9.8	18	99	65
374	9.4	52.6	1951	209.0	213.9	0.0	13.2	10.1	8.6	18	99	65
375			1657	209.0	213.9	0.0	12.8	9.3	9.3	18	99	65
376	8.5	51.3	1465	209.0	213.9	0.0	12.5	9.2	7.3	18	99	65
377			2107	209.0	213.9	0.0	13.4	11.7	9.8	18	99	65
378			2244	209.0	211.8	0.0	13.5	11.3	10.6	18	99	65
379	10.4	54.3	2510	209.0	205.9	0.0	13.7	10.3	10.1	18	99	65
380	9.9	51.6	2248	209.0	205.9	0.0	13.5	9.0	8.5	18	99	65
381	10.4	53.2	2524	209.0	205.9	0.0	13.7	8.7	8.5	18	99	65
382	11.8	55.4	3014	209.0	208.7	0.0	14.5	11.7	9.2	18	99	65
383	12.2	55.3	3024	209.0	208.8	0.0	14.3	12.0	9.5	18	99	66
384	12.1	54.2	3008	209.0	208.8	0.0	14.4	11.9	11.0	18	99	66
385	11.8	54.9	2987	209.0	208.8	0.0	14.6	11.6	9.8	18	99	66
386			2990	209.0	208.8	0.0	14.4	11.1	9.3	18	99	66
387			2659	209.0	208.8	0.0	13.8	11.4	12.0	18	99	66
388			2698	209.0	208.8	0.0	13.8	11.2	10.9	18	99	66
389			3027	209.0	208.8	0.0	14.4	11.5	11.5	18	99	66
390			2994	209.0	208.8	0.0	14.4	11.1	10.8	18	99	66
391	10.4	53.0	2503	209.0	208.8	0.0	13.6	10.6	10.8	18	99	66
392			2204	209.0	208.8	0.0	13.5	11.9	11.2	18	99	66
393			1985	209.0	208.8	0.0	13.3	10.7	12.0	18	99	66
394			1987	209.0	208.8	0.0	13.3	9.6	10.9	18	99	66
395			1626	209.0	208.8	0.0	12.8	8.7	10.1	18	99	66
396	8.6	52.7	1509	209.0	208.8	0.0	12.5	8.8	8.8	18	99	66
397	8.6	51.4	1528	209.0	208.8	0.0	12.7	8.5	11.0	18	99	66
398			1289	209.0	208.8	0.0	12.0	7.4	10.3	18	99	66
399			1309	209.0	208.8	0.0	12.0	8.0	9.1	18	99	66
400			1627	209.0	208.8	0.0	12.9	8.4	10.4	18	99	66
401			1618	209.0	208.8	0.0	12.8	7.6	11.9	18	99	66
402			1940	209.0	208.8	0.0	13.3	9.4	11.1	18	99	66
403			2043	209.0	208.8	0.0	13.4	9.3	10.3	18	99	66
404			1645	209.0	208.8	0.0	12.8	7.5	10.6	18	99	66
405	8.4	48.7	1426	209.0	208.8	0.0	12.4	8.4	10.1	18	99	66
406			1315	209.0	208.8	0.0	12.1	9.0	11.1	18	99	66
407			1277	209.0	208.8	0.0	12.0	7.6	11.8	18	99	66
408			1184	209.0	208.9	0.0	11.7	9.1	11.6	18	99	66
409			1316	209.0	208.8	0.0	12.1	8.8	11.8	18	99	66
410			1234	209.0	208.8	0.0	11.8	8.1	10.4	18	99	66
411			1307	209.0	208.8	0.0	12.0	7.5	10.7	18	99	66
412	8.6	51.1	1481	209.0	208.8	0.0	12.5	9.5	8.8	18	99	66
413	8.4	50.8	1394	209.0	208.8	0.0	12.3	7.4	9.2	18	99	66
414			1126	209.0	208.9	0.0	11.5	7.4	10.0	18	99	66
415			1321	209.0	208.8	0.0	12.1	10.7	10.3	18	99	66
416	8.7	51.2	1574	209.0	208.8	0.0	12.7	8.6	10.3	18	99	66
417			2274	209.0	208.8	0.0	13.5	9.5	10.1	18	99	66
418			2342	209.0	208.8	0.0	13.6	11.0	9.8	18	99	67
419			1906	209.0	208.8	0.0	13.2	8.9	10.8	18	99	67
420			1872	209.0	208.8	0.0	13.2	9.5	11.7	18	99	67
421	9.3	51.5	1915	209.0	208.8	0.0	13.2	9.6	8.9	18	99	67
422			2218	209.0	208.8	0.0	13.5	9.5	10.8	18	99	67
423			2123	209.0	208.8	0.0	13.4	10.1	10.9	18	99	67
424			1865	209.0	208.8	0.0	13.2	10.5	9.7	18	99	67
425			1949	209.0	208.8	0.0	13.3	9.4	9.5	18	99	67
426			1806	209.0	208.8	0.0	13.1	9.4	9.4	18	99	67
427	8.5	50.3	1439	209.0	208.8	0.0	12.4	7.5	10.8	18	99	67
428			1296	209.0	208.9	0.0	12.0	8.7	11.6	18	99	67
429	8.7	51.6	1556	209.0	208.8	0.0	12.6	9.1	9.7	18	99	66
430	9.9	53.8	2247	209.0	208.8	0.0	13.5	9.3	9.7	18	99	66
431			2722	209.0	208.8	0.0	13.8	10.7	8.0	18	99	66

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Turbine Power Output (kW)	Reference Yaw Angle (°)	Yaw Angle (°)	Pitch Angle (°)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (Pa)	Relative Humidity (%)
441												
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Table E.02 Measurement data - Background

Project: Niagara Wind Farm - Turbine T35 - IEC 61400-11 Measurement

Report ID: 16227.00.T35.RP1

Created on: 11/3/2017

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Rotor RPM	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (Pa)	Relative Humidity (%)
1	12.3	46.1	0.0	10.4	18	99	65
2	12.0	48.6	0.0	10.1	18	99	65
3	10.8	50.2	0.0	9.1	18	99	65
4	11.3	51.8	0.0	9.5	18	99	66
5	11.3	51.2	0.0	9.5	18	99	66
6	11.3	49.6	0.0	9.5	18	99	66
7	9.2	48.2	0.0	7.8	18	99	66
8			0.1	8.3	18	99	66
9	13.3	51.6	0.2	11.2	18	99	66
10	12.2	52.7	0.1	10.3	18	99	66
11	12.6	50.8	0.0	10.6	18	99	66
12	13.1	49.3	0.0	10.9	18	99	66
13	11.4	47.3	0.0	9.5	18	99	66
14	12.1	50.3	0.0	10.1	18	99	66
15	14.3	47.3	0.0	12.0	18	99	66
16	15.6	46.8	0.2	13.1	18	99	65
17	15.0	49.5	0.1	12.6	18	99	65
18	12.5	50.8	0.3	10.5	18	99	65
19			0.4	9.5	18	99	65
20	10.3	48.4	0.0	8.6	18	99	65
21	10.3	46.1	0.0	8.6	18	99	65
22			0.0	8.9	18	99	66
23	11.4	46.1	0.0	9.5	18	99	66
24	8.8	45.9	0.0	7.4	18	99	66
25	12.1	47.5	0.3	10.1	18	99	66
26	12.2	45.1	0.4	10.3	18	99	66
27	10.2	49.8	0.4	8.6	18	99	66
28	10.1	47.5	0.1	8.5	18	99	66
29	10.1	49.5	0.0	8.5	18	99	66
30	10.3	47.3	0.1	8.6	18	99	66
31	10.1	44.0	0.0	8.5	18	99	66
32	13.2	46.1	0.0	11.1	18	99	66
33	11.9	45.8	0.0	10.0	18	99	66
34	11.9	44.1	0.0	10.0	18	99	65
35	10.3	44.1	0.0	8.6	18	99	65
36	10.2	44.6	0.0	8.6	18	99	65
37	11.5	49.2	0.0	9.7	18	99	65
38	10.8	50.5	0.0	9.1	18	99	65
39	13.1	46.4	0.0	10.9	18	99	65
40	11.2	47.9	0.0	9.4	18	99	65
41	12.8	46.6	0.0	10.8	18	99	65
42	12.8	46.1	0.0	10.8	18	99	65
43	12.1	47.3	0.0	10.1	18	99	65
44	14.0	47.2	0.0	11.8	18	99	65
45	15.9	46.5	0.0	13.3	18	99	65
46	15.9	49.4	0.0	13.3	18	99	65
47	14.9	46.5	0.0	12.5	18	99	65
48	12.2	45.8	0.0	10.3	18	99	65
49	15.9	47.3	0.0	13.3	18	99	65
50	16.1	51.5	0.0	13.5	18	99	65
51	14.5	50.7	0.0	12.2	18	99	65
52	12.7	51.0	0.0	10.7	18	99	65
53	13.3	51.5	0.0	11.2	18	99	65
54	12.1	47.6	0.0	10.1	18	99	65
55	15.9	48.1	0.0	13.3	18	99	65
56	14.3	44.1	0.0	12.0	18	99	65
57	14.4	46.4	0.0	12.1	18	99	65
58	14.4	43.4	0.0	12.1	18	99	64
59	14.7	44.5	0.1	12.4	18	99	64
60	12.7	46.2	0.1	10.7	18	99	64
61	11.3	45.9	0.1	9.5	18	99	64
62	10.2	48.1	0.1	8.6	18	99	64
63	13.3	48.0	0.0	11.2	18	99	64
64	12.2	47.8	0.0	10.3	18	99	65
65	12.8	48.5	0.0	10.8	18	99	65
66	13.7	47.6	0.0	11.5	18	99	65
67	10.6	43.8	0.0	8.9	18	99	65
68	12.7	43.8	0.0	10.7	18	99	65
69	13.3	46.4	0.0	11.2	18	99	65
70	11.5	46.3	0.0	9.7	18	99	65
71	10.2	45.0	0.0	8.6	18	99	65
72	12.9	45.5	0.0	10.9	18	99	65
73	10.8	45.2	0.0	9.1	18	99	65
74	12.6	46.8	0.2	10.6	18	99	65
75	11.4	46.6	0.1	9.5	18	99	65
76	11.6	45.7	0.1	9.8	18	99	66
77	12.7	48.2	0.1	10.7	18	99	66
78	12.6	48.7	0.1	10.6	18	99	66
79	13.3	47.7	0.1	11.2	18	99	66
80	10.7	49.3	0.4	8.9	18	99	66
81	12.6	45.8	0.5	10.6	18	99	66
82	10.4	45.4	0.5	8.8	18	99	65
83	12.6	44.6	0.1	10.6	18	99	65

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Rotor RPM	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (Pa)	Relative Humidity (%)
84	14.3	44.8	0.1	12.0	18	99	65
85	15.1	42.7	0.0	12.7	18	99	65
86	10.9	44.0	0.0	9.2	18	99	65
87	14.6	43.0	0.0	12.3	18	99	65
88	14.1	45.1	0.0	11.9	18	99	65
89	12.7	43.0	0.1	10.7	18	99	65
90	10.6	42.3	0.1	8.9	18	99	65
91	10.3	41.6	0.1	8.6	18	99	65
92	8.8	44.7	0.1	7.4	18	99	65
93	10.9	45.0	0.1	9.2	18	99	65
94	11.3	43.3	0.0	9.5	18	99	64
95	10.8	42.1	0.0	9.1	18	99	64
96	12.1	45.6	0.0	10.1	18	99	64
97	11.5	45.5	0.0	9.7	18	99	64
98	10.8	45.1	0.0	9.1	18	99	64
99	12.2	46.0	0.0	10.3	18	99	64
100	12.6	44.0	0.0	10.6	18	99	64
101	12.8	47.1	0.0	10.8	18	99	64
102	13.6	43.4	0.0	11.4	18	99	64
103	13.7	42.2	0.1	11.5	18	99	64
104	11.4	42.7	0.1	9.5	18	99	64
105	10.6	42.8	0.0	8.9	18	99	64
106	10.4	45.4	0.0	8.8	18	99	65
107	11.2	43.3	0.0	9.4	18	99	65
108	9.8	46.0	0.0	8.3	18	99	65
109	12.0	43.3	0.1	10.1	18	99	65
110	10.7	43.0	0.1	8.9	18	99	65
111	9.6	45.6	0.1	8.0	18	99	65
112	9.2	49.4	0.3	7.8	18	99	65
113	8.4	48.1	0.1	7.1	18	99	65
114	11.7	47.8	0.1	9.8	18	99	65
115	10.8	48.2	0.0	9.1	18	99	65
116	11.9	46.4	0.0	10.0	18	99	65
117	12.1	47.9	0.0	10.1	18	99	65
118	11.9	46.5	0.0	10.0	18	99	64
119			0.0	8.5	18	99	64
120	11.0	48.4	0.0	9.3	18	99	64
121	12.3	47.4	0.0	10.4	18	99	64
122	13.8	48.6	0.0	11.6	18	99	64
123	14.4	49.9	0.0	12.1	18	99	64
124	12.3	45.9	0.0	10.4	18	99	63
125	13.9	46.6	0.0	11.7	18	99	63
126	12.5	46.9	0.0	10.5	18	99	63
127	10.9	44.4	0.0	9.2	18	99	63
128	12.3	47.1	0.0	10.4	18	99	63
129	10.7	45.0	0.0	8.9	18	99	63
130	11.5	48.5	0.0	9.7	18	99	64
131	11.3	48.3	0.0	9.5	18	99	64
132	12.6	47.5	0.0	10.6	18	99	64
133	11.6	48.6	0.0	9.8	18	99	64
134	13.1	49.7	0.0	10.9	18	99	64
135	12.8	52.4	0.0	10.8	18	99	64
136	12.8	46.7	0.0	10.8	18	99	63
137	11.5	48.0	0.2	9.7	18	99	63
138	12.7	48.0	0.1	10.7	18	99	63
139	11.4	48.8	0.0	9.5	18	99	63
140	10.8	49.0	0.2	9.1	18	99	63
141	11.7	46.8	0.1	9.8	18	99	63
142	14.4	46.3	0.0	12.1	18	99	64
143	13.4	43.5	0.0	11.3	18	99	64
144	12.7	42.1	0.0	10.7	18	99	64
145	11.0	42.1	0.0	9.3	18	99	64
146	11.2	41.6	0.0	9.4	18	99	64
147	9.7	41.8	0.0	8.2	18	99	64
148	9.4	42.3	0.0	7.9	18	99	65
149	9.6	46.0	0.0	8.0	18	99	65
150	8.7	42.3	0.0	7.3	18	99	65
151	9.8	41.0	0.0	8.3	18	99	65
152	11.0	42.5	0.0	9.3	18	99	65
153	9.0	40.3	0.0	7.6	18	99	65
154	9.0	43.5	0.0	7.6	18	99	65
155	10.1	41.7	0.0	8.5	18	99	65
156	11.5	43.5	0.1	9.7	18	99	65
157	8.8	43.5	0.0	7.4	18	99	65
158	10.0	44.9	0.0	8.3	18	99	65
159	10.8	44.2	0.0	9.1	18	99	65
160	10.7	43.2	0.0	8.9	18	99	65
161	11.5	43.5	0.0	9.7	18	99	65
162	9.5	44.9	0.1	8.0	18	99	65
163	8.5	44.5	0.1	7.2	18	99	65
164	9.6	42.6	0.0	8.0	18	99	65
165	9.2	40.1	0.0	7.8	18	99	65
166	9.8	41.0	0.0	8.3	18	99	65

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Rotor RPM	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (Pa)	Relative Humidity (%)
167	11.5	41.0	0.0	9.7	18	99	65
168	12.2	41.8	0.0	10.3	18	99	65
169	12.7	44.2	0.0	10.7	18	99	65
170	10.0	46.9	0.0	8.3	18	99	65
171	9.6	46.5	0.0	8.0	18	99	65
172	10.8	44.0	0.0	9.1	18	99	66
173	11.0	45.0	0.0	9.3	18	99	66
174	10.2	45.0	0.1	8.6	18	99	66
175	9.5	45.5	0.0	8.0	18	99	66
176	11.0	47.4	0.0	9.3	18	99	66
177	12.7	45.6	0.0	10.7	18	99	66
178	13.8	46.8	0.1	11.6	18	99	64
179	13.3	48.1	0.1	11.2	18	99	64
180	12.6	44.1	0.0	10.6	18	99	64
181	11.7	48.6	0.0	9.8	18	99	64
182	11.3	46.1	0.0	9.5	17	99	68
183	10.9	48.0	0.0	9.2	17	99	68
184	11.9	47.0	0.0	9.9	17	99	68
185	11.1	44.6	0.0	9.3	17	99	68
186	9.8	42.3	0.0	8.2	17	99	68
187	9.1	42.5	0.0	7.6	17	99	68
188	10.8	44.0	0.0	9.0	17	99	68
189	9.6	45.8	0.0	8.0	17	99	68
190	10.6	45.7	0.0	8.9	17	99	68
191	10.6	46.2	0.0	8.9	17	99	68
192	12.0	44.7	0.0	10.1	17	99	68
193	10.4	43.1	0.0	8.7	17	99	68
194	8.5	44.4	0.0	7.1	17	99	68
195	10.9	43.4	0.0	9.1	17	99	68
196	11.1	43.0	0.0	9.3	17	99	68
197	11.8	41.5	0.0	9.9	17	99	68
198	13.0	40.3	0.0	10.9	17	99	68
199	12.2	40.7	0.0	10.3	17	99	68
200	11.5	42.4	0.0	9.6	17	99	67
201	9.1	40.7	0.0	7.6	17	99	67
202	12.5	40.6	0.0	10.4	17	99	67
203	11.6	39.2	0.0	9.7	17	99	67
204	11.9	39.5	0.0	9.9	17	99	67
205	12.2	40.4	0.0	10.2	17	99	67
206	10.2	39.1	0.0	8.5	17	99	67
207	11.1	38.8	0.0	9.3	17	99	67
208	10.1	38.8	0.0	8.5	17	99	67
209	10.1	42.4	0.0	8.5	17	99	67
210	10.3	41.6	0.0	8.6	17	99	67
211	10.0	39.6	0.0	8.4	17	99	67
212	8.7	38.4	0.0	7.3	17	99	67
213	11.1	41.1	0.0	9.3	17	99	67
214	10.2	39.0	0.0	8.5	17	99	67
215	8.8	41.4	0.0	7.4	17	99	67
216	10.5	39.9	0.0	8.8	17	99	67
217	11.3	38.6	0.0	9.4	17	99	67
218	9.8	40.2	0.0	8.2	17	99	68
219	9.3	39.6	0.0	7.8	17	99	68
220	10.6	39.0	0.0	8.9	17	99	68
221	11.0	41.5	0.0	9.2	17	99	68
222	10.0	39.7	0.0	8.4	17	99	68
223	10.9	40.0	0.1	9.2	17	99	68
224	10.8	42.3	0.0	9.1	17	99	68
225	12.0	41.7	0.0	10.0	17	99	68
226	11.2	42.2	0.0	9.4	17	99	68
227	11.9	43.9	0.0	10.0	17	99	68
228	10.1	42.3	0.0	8.5	17	99	68
229	9.7	39.9	0.0	8.2	17	99	68
230	9.8	38.8	0.0	8.2	17	99	68
231	8.7	39.3	0.0	7.3	17	99	68
232	9.4	43.6	0.0	7.9	17	99	68
233	9.8	43.0	0.0	8.2	17	99	68
234	9.8	39.6	0.0	8.2	17	99	68
235	10.7	38.7	0.0	9.0	17	99	68
236	9.9	38.2	0.0	8.3	17	99	68
237	8.8	37.5	0.0	7.4	17	99	68
238	9.3	38.3	0.0	7.8	17	99	68
239	8.6	38.4	0.0	7.2	17	99	68
240	7.1	38.4	0.0	6.0	17	99	68
241	8.0	36.5	0.0	6.7	17	99	68
242	7.5	37.7	0.0	6.3	17	99	68
243	7.3	36.3	0.0	6.1	17	99	68
244	7.0	38.6	0.0	5.9	17	99	68
245	6.0	39.4	0.0	5.0	17	99	68
246	7.2	40.1	0.0	6.0	17	99	68
247	6.6	40.2	0.0	5.5	17	99	68
248	7.2	42.8	0.0	6.0	17	99	69
249	8.4	40.2	0.0	7.0	17	99	69

Table E.02 Measurement data - Background

Project: Niagara Wind Farm - Turbine T35 - IEC 61400-11 Measurement

Report ID: 16227.00.T35.RP1

Created on: 11/3/2017

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Rotor RPM	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (Pa)	Relative Humidity (%)
250	8.8	41.4	0.0	7.4	17	99	69
251	7.4	40.7	0.0	6.2	17	99	69
252	6.7	41.0	0.0	5.6	17	99	69
253	8.7	39.1	0.0	7.3	17	99	69
254	7.6	40.5	0.0	6.3	17	99	69
255	9.5	39.0	0.0	7.9	17	99	69
256	9.0	39.1	0.0	7.5	17	99	69
257	8.9	40.2	0.0	7.4	17	99	69
258	8.9	38.9	0.0	7.5	17	99	69
259	9.2	40.3	0.0	7.7	17	99	69
260	9.4	41.0	0.0	7.8	17	99	68
261	8.8	40.4	0.0	7.4	17	99	68
262	9.1	43.4	0.0	7.6	17	99	68
263	9.1	41.9	0.0	7.7	17	99	68
264	8.2	38.5	0.0	6.9	17	99	68
265	9.1	39.3	0.0	7.6	17	99	68
266	7.9	39.3	0.0	6.6	17	99	68
267	7.8	38.1	0.0	6.5	17	99	68
268	7.9	37.8	0.0	6.6	17	99	68
269	9.6	39.7	0.0	8.0	17	99	68
270	11.0	42.4	0.0	9.2	17	99	68
271	10.0	41.3	0.0	8.4	17	99	68
272	9.6	39.2	0.0	8.0	17	99	68
273	9.3	39.5	0.0	7.8	17	99	68
274	10.1	37.5	0.0	8.5	17	99	68
275	10.7	37.2	0.0	9.0	17	99	68
276	9.1	38.1	0.0	7.6	17	99	68
277	11.0	40.2	0.0	9.3	17	99	68
278	9.7	41.2	0.0	8.1	17	99	68
279	10.0	43.2	0.0	8.4	17	99	68
280	8.9	42.8	0.0	7.5	17	99	68
281	7.8	40.6	0.0	6.5	17	99	68
282	10.8	45.5	0.0	9.0	17	99	68
283	10.1	39.8	0.1	8.5	17	99	68
284	9.6	39.4	0.0	8.1	17	99	68
285	10.5	40.4	0.0	8.8	17	99	68
286	11.2	40.4	0.0	9.4	17	99	68
287	10.6	40.5	0.0	8.8	17	99	68
288	10.0	39.8	0.0	8.3	17	99	68
289	10.7	41.2	0.0	9.0	17	99	68
290	11.6	42.1	0.0	9.7	17	99	68
291	10.9	40.6	0.0	9.2	17	99	68
292	11.6	41.0	0.0	9.7	17	99	68
293	11.3	40.6	0.0	9.5	17	99	68
294	9.6	40.5	0.1	8.0	17	99	68
295	8.4	38.1	0.0	7.0	17	99	68
296	9.5	37.6	0.0	7.9	17	99	68
297	8.5	37.5	0.0	7.1	17	99	68
298	9.2	36.9	0.0	7.7	17	99	68
299	9.6	38.4	0.0	8.0	17	99	68
300	8.6	42.4	0.0	7.2	17	99	68
301	8.4	42.3	0.0	7.0	17	99	68
302	9.6	40.9	0.0	8.1	17	99	68
303	8.2	40.2	0.0	6.9	17	99	68
304	8.2	40.6	0.0	6.8	17	99	68
305	9.2	42.9	0.0	7.7	17	99	68
306	8.4	40.2	0.0	7.0	17	99	68
307	6.9	39.9	0.0	5.8	17	99	68
308	7.0	40.5	0.0	5.9	17	99	69
309	8.4	41.0	0.0	7.1	17	99	69
310	8.6	43.6	0.0	7.2	17	99	69
311	8.2	44.6	0.0	6.9	17	99	69
312	7.1	44.5	0.0	6.0	17	99	69
313	6.9	43.7	0.0	5.8	17	99	69
314	8.5	42.2	0.0	7.1	17	99	69
315	9.0	42.6	0.0	7.5	17	99	69
316	10.0	41.6	0.0	8.4	17	99	69
317	9.8	41.4	0.0	8.2	17	99	69
318	8.9	41.1	0.0	7.5	17	99	69
319	7.7	41.2	0.0	6.5	17	99	69
320	8.0	39.1	0.0	6.7	17	99	69
321	8.1	38.3	0.1	6.8	17	99	69
322	8.8	39.7	0.0	7.4	17	99	69
323	9.9	39.3	0.0	8.3	17	99	69
324	12.0	40.2	0.0	10.1	17	99	69
325	10.7	38.3	0.0	9.0	17	99	69
326	10.6	38.6	0.0	8.9	17	99	68
327	9.8	38.9	0.0	8.2	17	99	68
328	8.8	38.6	0.0	7.4	17	99	68
329	9.4	41.3	0.0	7.9	17	99	68
330	8.9	39.5	0.0	7.5	17	99	68
331	9.7	40.3	0.1	8.1	17	99	68
332	8.8	39.4	0.0	7.4	17	99	69

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Rotor RPM	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (Pa)	Relative Humidity (%)
333	10.2	40.2	0.0	8.5	17	99	69
334	7.5	42.6	0.0	6.3	17	99	69
335	7.7	41.7	0.0	6.4	17	99	69
336	7.7	38.8	0.0	6.4	17	99	69
337	7.4	37.6	0.0	6.2	17	99	69
338	6.9	36.9	0.0	5.8	17	99	69
339	8.6	39.7	0.0	7.2	17	99	69
340	9.4	43.0	0.0	7.9	17	99	69
341	9.9	39.7	0.0	8.3	17	99	69
342	7.9	40.0	0.0	6.6	17	99	69
343	8.1	40.0	0.0	6.8	17	99	69
344	9.6	39.4	0.0	8.0	17	99	69
345	7.6	41.6	0.0	6.3	17	99	69
346	7.1	40.6	0.0	5.9	17	99	69
347	7.6	40.6	0.0	6.4	17	99	69
348	7.0	41.7	0.0	5.9	17	99	69
349	9.1	40.6	0.0	7.6	17	99	70
350	9.1	40.5	0.0	7.6	17	99	70
351	9.0	41.4	0.0	7.6	17	99	70
352	7.9	40.0	0.0	6.6	17	99	70
353	8.8	40.2	0.0	7.4	17	99	70
354	8.4	41.4	0.0	7.0	17	99	70
355	8.3	45.1	0.0	7.0	17	99	70
356	8.9	43.1	0.0	7.4	17	99	70
357	7.6	45.8	0.0	6.4	17	99	70
358	5.7	41.0	0.0	4.8	17	99	70
359	7.1	38.9	0.0	5.9	17	99	70
360	7.8	38.1	0.0	6.5	17	99	71
361	8.5	37.9	0.0	7.1	17	99	71
362	8.0	37.0	0.0	6.7	17	99	71
363	7.2	38.7	0.0	6.1	17	99	71
364	6.0	39.2	0.0	5.0	17	99	71
365	6.3	38.2	0.0	5.3	17	99	71
366	7.1	38.7	0.0	6.0	17	99	71
367	7.8	43.4	0.0	6.6	17	99	71
368	8.3	42.5	0.0	7.0	17	99	71
369	7.6	44.7	0.0	6.4	17	99	71
370	8.0	43.1	0.0	6.7	17	99	71
371	7.4	42.1	0.0	6.2	17	99	71
372	6.3	39.8	0.0	5.3	17	99	71
373	7.3	43.9	0.0	6.1	17	99	71
374	7.1	39.5	0.0	6.0	17	99	71
375	6.4	39.1	0.0	5.4	17	99	71
376	5.8	41.3	0.0	4.9	17	99	71
377	7.4	42.7	0.0	6.2	17	99	71
378	7.7	39.7	0.0	6.5	17	99	71
379	10.2	39.9	0.0	8.6	17	99	71
380	10.5	40.2	0.0	8.8	17	99	71
381	9.5	40.3	0.0	8.0	17	99	71
382	9.2	38.6	0.0	7.7	17	99	71
383	9.4	39.6	0.0	7.9	17	99	71
384	8.5	39.1	0.0	7.1	17	99	71
385	7.5	38.6	0.0	6.3	17	99	71
386	7.9	37.1	0.0	6.6	17	99	71
387	8.2	38.7	0.0	6.8	17	99	71
388	8.9	38.0	0.0	7.4	17	99	71
389	8.9	37.2	0.0	7.5	17	99	71
390	7.7	38.2	0.0	6.4	17	99	71
391	7.4	40.0	0.0	6.2	17	99	71
392	6.7	38.0	0.0	5.6	17	99	71
393	6.9	38.9	0.0	5.8	17	99	71
394	7.1	39.6	0.0	5.9	17	99	71
395	6.6	39.3	0.0	5.6	17	99	71
396	6.2	40.7	0.0	5.2	17	100	72
397	5.9	35.7	0.0	4.9	17	100	72
398	7.2	36.9	0.0	6.0	17	100	72
399	8.0	37.0	0.0	6.7	17	100	72
400	7.1	39.6	0.0	5.9	17	100	72
401	9.0	38.4	0.0	7.5	17	100	72
402	6.9	38.9	0.0	5.8	17	100	72
403	7.2	41.6	0.0	6.1	17	100	72
404	8.2	40.7	0.0	6.9	17	100	72
405	9.4	40.2	0.0	7.9	17	100	72
406	9.2	42.6	0.0	7.7	17	100	72
407	8.7	38.3	0.0	7.3	17	100	72
408	8.2	37.3	0.0	6.9	17	100	72
409	7.7	37.1	0.0	6.5	17	100	72
410	7.1	37.8	0.1	6.0	17	100	72
411	8.1	42.3	0.0	6.8	17	100	72
412	6.8	42.6	0.0	5.7	17	100	72
413	7.9	43.2	0.0	6.6	17	100	72
414	7.6	45.6	0.0	6.4	17	100	72
415	6.2	46.2	0.0	5.2	17	100	72

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Rotor RPM	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (Pa)	Relative Humidity (%)
416	6.5	42.5	0.0	5.5	17	100	72
417	6.1	42.7	0.0	5.1	17	100	72
418	5.4	41.5	0.1	4.5	17	100	72
419	6.3	41.5	0.0	5.3	17	100	72
420	9.2	40.8	0.0	7.7	17	100	72
421	9.9	38.5	0.0	8.3	17	100	72
422	8.7	38.1	0.0	7.3	17	100	72
423	7.9	39.8	0.0	6.6	17	100	72
424	7.3	38.9	0.0	6.1	17	100	72
425	7.1	38.4	0.0	6.0	17	100	72
426	9.2	38.3	0.0	7.7	17	100	72
427	8.8	38.5	0.0	7.4	17	100	72
428	7.6	36.5	0.0	6.4	17	100	72
429	8.1	36.8	0.0	6.8	17	100	72
430	8.5	37.5	0.0	7.1	17	100	72
431	8.8	38.7	0.0	7.4	17	100	72
432	8.1	41.2	0.0	6.8	17	100	72
433	8.1	40.0	0.0	6.8	17	100	72
434	7.5	41.8	0.0	6.3	17	100	72
435	6.9	38.4	0.0	5.8	17	100	72
436	8.0	40.4	0.0	6.7	17	100	72
437	8.0	40.5	0.0	6.7	17	100	72
438	7.5	37.2	0.0	6.3	17	100	72
439	7.8	38.4	0.0	6.6	17	100	72
440	7.0	39.4	0.0	5.9	17	100	72
441	8.3	39.6	0.0	6.9	17	100	72
442	8.0	38.6	0.0	6.7	17	100	72
443	7.5	39.2	0.0	6.3	17	100	72
444	7.9	37.7	0.0	6.6	17	100	72
445	7.5	36.5	0.0	6.3	17	100	72
446	6.9	38.1	0.0	5.8	17	100	72
447	8.2	39.6	0.0	6.9	17	100	72
448	8.3	38.1	0.0	6.9	17	100	72
449	8.6	38.0	0.0	7.2	17	100	72
450	8.5	36.1	0.0	7.1	17	100	72
451	8.9	36.4	0.0	7.4	17	100	72
452	9.0	36.8	0.0	7.5	17	100	72
453	7.3	38.3	0.0	6.1	17	100	72
454	8.0	37.6	0.0	6.7	17	100	72
455	8.5	37.3	0.0	7.1	17	100	72
456	8.1	37.5	0.0	6.8	17	100	72
457	8.8	35.8	0.0	7.4	17	100	72
458	7.5	36.7	0.0	6.3	17	100	72
459	7.8	37.3	0.0	6.5	17	100	72
460	8.1	40.8	0.0	6.8	17	100	72
461	6.8	37.8	0.0	5.7	17	100	72
462	8.2	40.1	0.0	6.8	17	100	73
463	7.1	40.6	0.0	6.0	17	100	73
464	8.6	38.9	0.0	7.2	17	100	73
465	8.4	37.2	0.0	7.1	17	100	73
466	8.4	39.0	0.0	7.0	17	100	73
467	7.0	41.6	0.0	5.9	17	100	73
468	8.3	40.1	0.0	7.0	17	100	73
469	9.9	40.0	0.0	8.3	17	100	73
470	8.9	39.7	0.0	7.5	17	100	73
471	8.5	41.1	0.0	7.1	17	100	73
472	6.0	41.8	0.0	5.0	17	100	73
473	7.2	39.2	0.0	6.1	17	100	73
474	8.4	38.4	0.0	7.0	17	100	73
475	8.1	39.4	0.0	6.8	17	100	73
476	7.5	40.9	0.0	6.3	17	100	73
477	7.9	41.2	0.0	6.6	17	100	73
478	6.1	42.3	0.0	5.1	17	100	73
479	7.4	42.3	0.0	6.2	17	100	73
480	6.8	40.8	0.0	5.7	17	100	73
481	6.4	40.8	0.0	5.3	17	100	73
482	5.7	41.9	0.0	4.8	17	100	73
483	6.6	40.7	0.1	5.5	17	100	73
484	7.7	37.9	0.1	6.5	17	100	73
485	6.6	37.7	0.1	5.5	17	100	73
486	6.9	37.6	0.1	5.8	17	100	73
487	5.8	39.5	0.0	4.9	17	100	73
488	8.0	39.3	0.1	6.7	17	100	73
489	9.2	39.8	0.1	7.7	17	100	73
490	8.7	39.9	0.0	7.3	17	100	73
491	8.1	39.9	0.0	6.8	17	100	73
492	8.2	40.7	0.0	6.9	17	100	73
493	6.9	39.6	0.0	5.8	17	100	73
494	6.5	40.9	0.0	5.5	17	100	73
495	6.2	40.5	0.0	5.2	17	100	73
496	6.2	39.4	0.0	5.2	17	100	73
497	5.9	40.3	0.0	5.0	17	100	73
498	7.7	40.0	0.0	6.4	17	100	73

Table E.02 Measurement data - Background

Project: Niagara Wind Farm - Turbine T35 - IEC 61400-11 Measurement

Report ID: 16227.00.T35.RP1

Created on: 11/3/2017

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Rotor RPM	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (Pa)	Relative Humidity (%)
499	6.9	40.3	0.0	5.8	17	100	73
500	6.3	37.1	0.0	5.3	17	100	73
501	6.2	40.0	0.0	5.2	17	100	73
502	6.3	37.2	0.0	5.3	17	100	73
503	6.3	36.6	0.0	5.3	17	100	73
504	7.0	38.1	0.0	5.8	17	100	73
505	7.4	36.0	0.0	6.2	17	100	73
506	7.4	35.7	0.0	6.2	17	100	73
507	7.2	36.6	0.0	6.0	17	100	73
508	6.6	35.8	0.0	5.6	17	100	73
509	8.5	35.7	0.0	7.1	17	100	73
510	6.9	36.1	0.0	5.8	17	100	73
511	8.1	37.9	0.0	6.8	17	100	73
512	8.0	36.4	0.0	6.7	17	100	73
513	8.3	36.9	0.0	7.0	17	100	73
514	8.3	36.7	0.0	6.9	17	100	73
515	6.7	37.8	0.0	5.6	17	100	73
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***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Rotor RPM	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (Pa)	Relative Humidity (%)
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***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Rotor RPM	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (Pa)	Relative Humidity (%)
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Aercoustics Engineering Ltd.
1004 Middlegate Road, Suite 1100
Mississauga, ON L4Y 1M4

Tel: 416-249-3361
Fax 416-249-3613
aercoustics.com

End of Report