REPORT

JERICHO WIND ENERGY CENTRE

LAMBTON COUNTY, ONTARIO

CONSOLIDATED I-AUDIT #2 REPORT – REVISION #2
RWDI # 1501440
November 18, 2020

SUBMITTED TO

Jericho Wind, LP
c/o Cordelio Power, Inc.
65 Queen St. W.,
Suite No. 605
Toronto, ON M5H 2M5
c/o Derek Dudek
derek.dudek@nexteraenergy.com

SUBMITTED BY

Greg Conley, M.Eng., P.Eng.
Senior Project Manager / Principal
greg.conley@rwdi.com

Ben Coulson, P.Eng., B.A.Sc., M.A.Sc.
Senior Consultant / Principal
ben.coulson@rwdi.com

RWDI AIR Inc.
600 Southgate Drive
Guelph Ontario Canada N1G 4P6
T: 519.823.1311
F: 519.823.1316

SIGNATURES

Ben Coulson, P.Eng., B.A.Sc., M.A.Sc.
Senior Consultant / Principal

EXECUTIVE SUMMARY

Jericho Wind, LP retained RWDI AIR Inc. to conduct an immission acoustic audit of the Jericho Wind Energy Centre located in Lambton County, Ontario. The purpose of this audit is to capture measurements of the sound level produced by the wind turbines for comparison with the applicable Ministry of the Environment, Conservation and Parks (MECP) limits. The wind farm is permitted to operate 92 General Electric 1.6-100 wind turbine generators. The wind farm also has one (1) 150 MVA transformer substation. The project then connects to one of two step-up transformers at the Parkhill Interconnect. The total nameplate capacity of the wind farm is approximately 150 MW.

The first I-Audit was completed in the spring of 2015. Analysis and reporting followed the 2011 MECP Compliance Protocol for Wind Turbine Noise (2011 Protocol). The required data amount was obtained for Monitors A through D and compliance was shown for these points of reception. For Monitor E, the required data amount was not obtained. To present the results of the first I-Audit monitoring campaign, a report was submitted, titled "Acoustic Audit Report – Immission: Spring 2015" and dated April 1, 2016.

A second I-Audit was completed in the fall of 2015 in accordance with the 2011 Protocol. This audit obtained sufficient data for Monitors B and C, and compliance was shown for these locations. An insufficient data amount was collected for Monitors A, D, and E. The results of the second I-Audit are presented in the report entitled "Acoustic Audit Report – Immission: Fall 2015" and dated May 20, 2016.

Due to the incomplete I-Audit for Monitor E in spring of 2015, a further measurement campaign was completed for Monitor E in the spring and summer of 2018. This audit followed the requirements of part E5.5 of the MECP 2017 Compliance Protocol for Wind Turbine Noise (2017 Protocol or Protocol), specifically the procedures of the revised assessment methodology for I-Audits (RAM I-Audit). As a result of low winds, equipment issues, and interference from sounds of nature, the required amount of data was not collected, and this RAM I-Audit at Monitor E was finished incomplete. The results are presented in the RAM I-Audit report entitled "Supplemental I-Audit #1 Report" and dated October 4, 2018.

A second supplemental RAM I-Audit was conducted during the fall of 2018 for Monitors A, D and E to fulfill a second immission audit at Monitors A, D, and E. This RAM I-Audit was undertaken under the requirements of the 2017 Protocol. The required amount of data was obtained for Monitor D first, with the results showing that this monitor is in compliance with the REA sound level limits as presented in the report titled "Supplemental I-Audit #2 Report" and dated February 28, 2019.

The second supplemental RAM I-Audit was continued at Monitors A and E until the minimum required amount of points was acquired. The results showed that Monitor A and Monitor E are in compliance with REA sound level limits. These complete and compliant audits were presented in the report titled "Supplemental I-Audit #2 Report Update" and dated December 18, 2019.

The current report represents a consolidation of the second supplemental I-Audit reports, namely "Supplemental I-Audit #2 Report" dated February 28, 2019 and "Supplemental I-Audit #2 Report Update" dated December 18, 2019, and also addresses MECP comments received on March 28, 2019; March 23, 2020; and October 14, 2020. This report presents results showing completeness and compliance at Monitors A, D, and E.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1 INTRODUCTION

Jericho Wind, LP, retained RWDI AIR Inc. (RWDI) to conduct an I-Audit of the Jericho Wind Energy Centre (Jericho) located in Lambton County, Ontario. The purpose of this audit is to capture measurements of the sound level produced by the wind turbines for comparison with the applicable Ministry of the Environment, Conservation and Parks (MECP) limits at nearby points of reception. This I-Audit is intended to meet the requirements of part E5 of the 2017 MECP Compliance Protocol for Wind Turbine Noise (2017 Protocol or Protocol), specifically the procedures of the revised assessment methodology for I-Audits (RAM I-Audit).

The wind turbines and ancillary equipment are located on privately-owned farmland through a legal agreement between the landowner and Jericho Wind, LP. The zoning within the project and surrounding areas is mainly agricultural. The acoustic environment surrounding the project area is rural and is influenced primarily by road traffic, farming activities, and sounds of nature. The site plan as found in the "Jericho Wind Energy Centre – Revised Noise Assessment Report" (i.e., the "NIA"), dated February 2014, and prepared by AECOM is included in Appendix A.

The facility's Renewable Energy Approval (REA), number 5855-9HHGQR dated April 14, 2014, along with amendments dated September 2, 2014 and November 12, 2014, are provided in Appendix B. Condition E of the REA requires Jericho to complete two acoustic audit (immission) tests at five (5) locations. The general practice, though not explicitly stated in the REA, is to complete one test in the fall (i.e., suggested October/November) and one in the spring (i.e., suggested March/April). A first I-Audit was completed in the spring of 2015, while the second was completed in the fall of 2015. Both were performed under the original 2011 MECP Compliance Protocol for Wind Turbine Noise (2011 Protocol).

Two audit reports (i.e., spring and fall audit programs) have previously been submitted to meet the reporting requirements of the facility's REA under the original 2011 Protocol. The first I-Audit report was entitled "Acoustic Audit Report – Immission: Spring 2015" and is dated April 1, 2016 (Spring 2015 Report). The required data amount was obtained for Monitors A through D and compliance was shown for these points of reception. For Monitor E, the required data amount was not obtained. The second I-Audit report was entitled "Acoustic Audit Report – Immission: Fall 2015" and is dated May 20, 2016 (Fall 2015 Report). That audit obtained sufficient data for Monitors B and C, and compliance was shown for these locations. An insufficient data amount was collected for Monitors A, D, and E.

Due to the incomplete I-Audit for Monitor E in spring of 2015, a further measurement campaign was completed for Monitor E in the spring and summer of 2018. This audit followed the requirements of part E5 of the MECP 2017 Compliance Protocol for Wind Turbine Noise (2017 Protocol or Protocol), specifically the procedures of the revised assessment methodology for I-Audits (RAM I-Audit). As a result of insufficient winds, equipment issues, and interference from sounds of nature, the required amount of data was not collected, and this RAM I-Audit at Monitor E finished as incomplete. The results were presented in the RAM I-Audit report entitled "Supplemental I-Audit #1 Report" and dated October 4, 2018.

A second supplemental RAM I-Audit was conducted during the fall of 2018 for Monitors A, D and E to fulfill a second immission audit for Monitors A, D, and E. This RAM I-Audit was undertaken under the requirements of the 2017 Protocol. The required amount of data was obtained for Monitor D first, with the results showing that this monitor is in compliance with the REA sound level limits as presented in the report titled "Supplemental I-Audit #2 Report" and dated February 28, 2019.

The second supplemental RAM I-Audit was continued at Monitors A and E until the minimum required amount of points was acquired. The results showed that Monitor A and Monitor E are in compliance with REA sound level limits. These complete and compliant audits were presented in the report titled "Supplemental I-Audit #2 Report Update" and dated December 18, 2019.

The current report represents a consolidation of the second supplemental I-Audit reports, namely "Supplemental I-Audit #2 Report" dated February 28, 2019 and "Supplemental I-Audit #2 Report Update" dated December 18, 2019, and also addresses MECP comments received on March 28, 2019; March 23, 2020; and October 14, 2020. This report presents results showing completeness and compliance at Monitors A, D, and E.

2 FACILITY DESCRIPTION

The facility is owned by Jericho Wind, LP a wholly owned subsidiary of Cordelio Power, Inc., and operated by NextEra Energy Canada Operating Services Inc. The Jericho wind farm became commercially operational in November 2014.

The project site is generally bounded by Lakeshore Road/Bog Line to the north, Egremont Road to the south, the Lambton Shores/North Middlesex municipal boundary to the east, and Rawlings Road/Elarton Road to the west, in Lambton County. The project site extends eastward into Middlesex County, generally along and adjacent to Elginfield Road, and Nairn Road between the Lambton Shores/North Middlesex municipal boundary and Cassidy Road.

The Jericho wind farm consists of 92 General Electric 1.6-100 wind turbine generators and one 150 MVA transformer substation. The total nameplate capacity of the wind farm is 150 MW. The project connects to one of two 225 MVA step-up transformers at the Parkhill Interconnect. All turbines have a hub height of 80 m above local grade.

3 INSTRUMENTATION

All instrumentation used for the immission testing followed the requirements set out in the Protocol.

3.1 Acoustic Instrumentation

The measurements were conducted using a proprietary data collection system developed by RWDI that is based on National Instruments signal processing hardware and software. A list of the acoustic equipment including serial numbers is provided in Appendix C. The data collection system is capable of recording both sound level and audio. The monitor meets the following requirements:

- Type 1 measurement system per the IEC standard 61672-1 Sound Level Meter, Part 1: Specifications;
- Class 1 microphone systems;
- The instrumentation having constant frequency response over at the 20 Hz to 20000Hz frequency range;
- The filters meeting the requirements of IEC 61620 for Class 1 filters; and
- The instrumentation being capable of measuring audio recordings continuously during the measurement campaign, at sampling rate of at least 8000 Hz.

All sound monitoring locations were calibrated before the measurement campaign using a Larson-Davis CAL200 precision acoustic calibrator. The calibrator's accuracy is equal to or better than +/- 0.3 dB and is Class 1 according to IEC 60942 within the temperature range of this measurement program. Manufacturer recommendations suggest a re-calibration period of 1-2 years. RWDI policy is to calibrate all components at least every two years, with field calibrators being re-certified annually. In this way, the acoustic measurement chain is ensured to be within calibration requirements. All components calibrated appropriately in the field, so there are no concerns with measurement drift or calibration.

In addition to the 90mm diameter primary wind screen that is commonly used for long term monitoring campaigns, a secondary 500mm diameter wind screen was deployed at the monitoring location. The secondary wind screen was constructed according to MECP recommendations included in section D 2.1.4 of the 2017 Protocol. The secondary wind screen meets the specifications indicated in IEC 61400-11. Transmission loss was assumed to be negligible at the frequencies important for wind turbine sound (i.e., less than about 0.2 dB below 1000 Hz) based on manufacturer acoustic wind screen data (see attached excerpt from Larson Davis 824 manual in Appendix C). Our prior experience in testing a similar windscreen in a reverberation chamber equipped with registered sound source and flow noise yielded similar results.

3.2 Non-Acoustic Instrumentation

The sound level monitoring location was co-located with a meteorological station. The weather monitoring equipment meets the requirements in the Protocol. The weather station consisted of a Campbell Scientific weather console using a CR300 data logging system and a R.M. Young 05103 wind anemometer. Auxiliary measurement instrumentation to also record temperature, relative humidity, and precipitation was installed at Monitor E. Precipitation data was supplemented with data from a monitor at the Goshen Wind Energy Centre (i.e., approximately 15 km northeast and a similar setback from Lake Huron) due to a malfunction with the sensor at the Jericho site.

Calibration records for all acoustic equipment indicate traceability to an accredited acoustic laboratory and show that all equipment was within the valid calibration recertification time throughout the duration of the measurement campaign. Calibration certificates are provided in Appendix C.

4 MEASUREMENT PROCEDURE

4.1 Noise Measurement Location

The microphone was located at a height of approximately 4.5 m above local ground representing a 2-storey residence. This height is consistent with the dwelling located at the nearest point of reception in this study and the modelled receptor height identified in the Noise Assessment Report.

The microphone was located as close to the nearby dwelling or vacant lot receptor location as practically and technically feasible, or in an acoustically-equivalent location in accordance with the Protocol, as appropriate. More specifically, the microphone was located more than 5 m away from any large reflecting surface and generally away from trees or foliage that could affect the measurements. The monitoring position was also generally located such that any intervening obstacles or terrain did not shield it from line-of-sight to the wind turbines.

4.2 Wind Measurement Location

The Protocol requires the wind measurement location be in close proximity to the sound measurement location. An anemometer was mounted to the same tower as the microphone at each of the sound measurement locations. The weather measurement location was not shielded by nearby buildings or obstructions. Wind speed and direction measurements were obtained at a height of 10 m. The monitoring station was configured to record data on a 10-second interval, the smallest interval permitted under the RAM I-Audit procedures (i.e., per section E5.5 (7)) in order to afford the maximum data collection efficiency.

4.3 Acoustic Measurements

Turbines Operational

The key statistical data used in the analysis is the A-weighted 10-second energy-equivalent sound level ($L_{EQ,\ 10\ sec}$ in dBA). Ten-second intervals were used consistent with the meteorological measurements and per the smallest interval permitted in the RAM I-Audit procedures. Audio was also recorded on a continual basis for sound identification purposes. Sound and weather measurement equipment was time-synchronized with each other.

Turbines Parked

System configurations were not changed between the turbine operational and turbine parked conditions. The turbines were parked on different occasions to establish ambient sound levels, and as close in time as feasible to operational periods of interest. During parked conditions, all nearby influential turbines (i.e., turbines that contribute more than 30 dBA cumulatively to the modelled receptor sound level) were stopped so that the measured sound levels at the point of reception were representative of ambient background levels.

Appendix D includes a statement signed by an authorized representative of the Jericho wind farm confirming that all nearby influential wind turbines were not operational and that there were no modifications to the turbine blades during the audit.

Parked conditions were coordinated at several periods during the acoustical measurements to obtain the required ambient data. The parked conditions were confirmed by verifying the rotational speed (RPM) of the influential turbines was negligible based on turbine data received from NextEra.

4.4 Non-Acoustic Measurements

All meteorological stations were configured to continuously log the appropriate statistical parameters. The station was configured to log the following data on 10-second intervals:

- average wind speed (m/s);
- maximum wind speed (m/s);
- minimum wind speed (m/s); and
- average wind direction (azimuth degrees).

Precipitation data was also collected at Monitor E with a data output time interval of 10 seconds.

For all relevant turbines, data was also provided by Jericho for wind angle, wind speed, rotor rpm, and electrical energy output. While RWDI cannot warrant the accuracy of wind angle data, and is aware that the nacelle yaw angle is subject to some error based on the operational limitations of the wind farm and turbines, RWDI is nonetheless comfortable, based on discussions with NextEra operators, that values relied on for analysis are reasonable and appropriate given operational limitations.

4.5 Number of Measurement Intervals

Turbines Operational

The Protocol requires 120 one-minute intervals (or 120 minutes total) to be measured for each integer wind speed for the data set to be considered large enough to conduct the analysis and to be able to assess compliance. However, in accordance with section E5.5 (7) of the Protocol, this audit was completed using 10-second rather than one-minute measurement intervals. As a result, 720 10-second intervals (120 minutes total) were required to be measured for each integer wind speed. In certain circumstances, the Protocol permits consideration of a reduced number of data points with appropriate justification for RAM I-Audits per section E5.5 (5). Wind speed measurements are rounded to the nearest integer prior to sorting to a representative integer wind speed "bin".

Turbines Parked

Ambient sound measurements were completed with all applicable turbines parked. The Protocol states that 60 one-minute intervals (or 60 minutes total) are required to be measured for each integer wind speed for the data set to be considered large enough to determine the ambient sound level. However, in accordance with section E5.5 (7) of

the Protocol, this audit was completed using 10-second rather than one-minute measurement intervals. As a result, 360 10-second intervals (60 minutes total) were required to be measured for each integer wind speed. Wind speed measurements are rounded to the nearest integer prior to "binning".

5 ACOUSTIC AUDIT PROCEDURE

5.1 Points of Reception

Condition E1 (2) of the REA requires measurements to be made at five (5) different points of reception that represent the locations of the greatest predicted sound levels and are downwind of the prevailing winds. This report presents the second I-audit results for three of the five identified points of reception.

Selected points of reception were identified based on those expected to be most affected by sounds from the operation of the wind farm. The most affected points of reception were determined from the noise contours provided in the NIA report. The receptor nomenclature used below in describing each monitor location is consistent with that used in the NIA report.

A rationale summary table is included in Appendix E that takes into consideration worst-case parameters such as high wind shear, highest predicted sound levels, and wind direction. Non-participating receptors from the NIA report were sorted from highest predicted sound level to lowest. Starting at the top of the list, locations were categorized based on surrounding influences, area of wind farm, and direction to prevailing winds for the current season (i.e., westerly winds). Locations that were not downwind of a nearby turbine for prevailing winds were ruled out. Permissions were then sought for the top-ranked receptors in discrete areas of the wind farm. This review resulted in points of reception being ideally positioned in the locations shown in Figure 1.

Ideally monitors should be located at the most impacted non-participating receptors. However, this is not always feasible due to location limitations (e.g., proximity to other sound sources like farming operations, roadways, or construction) or inability to secure landowner permission (e.g., declined or did not return messages). Hence, alternate locations were selected (where noted) that are acoustically-equivalent and conservative. Based on conversations with the MECP, we understand that this approach is acceptable. Further information is provided below. These locations are consistent with the historical monitoring locations for this wind farm conducted under previous audits and already reviewed by MECP without comment. Pictures of the monitors and UTM coordinates together with microphone height are included in Appendix E.

Monitor A (UTM location Zone 17, 427145 m E, 4778057 m N) - monitor is positioned within the fenced in area of Jericho wind farm substation/laydown area (JER2533) in the north east corner. This lot is located directly across the street from non-participating receptor (JER5563) and beside vacant lot receptor (JER2532). Though multiple attempts were made to contact both the non-participating and vacant lot owners in 2015, they were ultimately unsuccessful; consequently, discussion could not begin, nor could permission be obtained to locate a monitor on those lands. The location of the monitor is considered acoustically-equivalent and more conservative (i.e., sound levels closer to 40 dBA contour) than both the non-participating and vacant land receptors to the north and east, respectively. This monitor is near located approximately 300 m away from the facility transformer substation. At

this setback, neither it nor the switchgear were audible. The transformer substation audit, titled "Acoustic Audit Report – Transformer Substation" and dated December 7, 2015 and produced by RWDI, shows a transformer contribution of less than 25 dBA at this distance. Specifically, at the vacant lot receptor (JER2532), the turbine contribution was 23 dB. The transformer substation contribution is considered in further detail in Section 6.4.

Monitor D (UTM location Zone 17, 425981 m E, 4780199 m N) – monitor is ideally positioned on the lands of a non-participating receptor (JER3205). This receptor is one of the top vacant lot or non-participating receptors for Turbines 14-16 for westerly winds (i.e., dominant wind direction). It was also predicted to be one of the highest affected non-participating receptors in the area.

Monitor E (UTM location Zone 17, 428210 m E, 4779544 m N) – monitor is positioned on the lands of a vacant lot receptor (JER2499). This receptor is considered one of the worst-case receptors along Northville Road between Ravenswood Line and Thomson Line for Turbines 21-25 for westerly winds (i.e., dominant wind direction).

5.2 Time of Measurements

The REA requires immission acoustic audit measurements be completed on two separate occasions within a period of twelve months during the lowest annual ambient sound levels. Though not explicitly stated in the REA, the historically assumed time periods are:

1. October and November; and
2. March and April.

This consolidated report presents completed RAM I-Audits for outstanding audits at Monitors A, D, and E.

Sound level measurements for this measurement program started in October 2018, with deployment of Monitor A in November 2018. The measurement program ended with the final data at Monitor A on July 8, 2019, at Monitor D on February 25, 2019, and at Monitor E on November 20, 2019. The monitoring continued past the minimum six weeks as the required data was not obtained within this time period.

Operational and parked data are collected in as close time proximity as is feasible given the constraints of the operator, timing of required wind conditions, and the accuracy limits of weather forecasting tools. The operator requires advanced permission from the Ontario Independent Electricity System Operator (IESO) to park or idle turbines. Hence, forecasting tools are used to identify periods several days in advance when wind conditions will be of interest to generate any required missing parked data points. When appropriate periods are noted, a request is made to IESO several days in advance. In some instances, these requests are not approved, or wind conditions may change from the initial forecast, and hence the proposed shut-down is cancelled. Hence, periods of several weeks can elapse between valid operational and parked data collection. This outcome is a result of the electricity system operation and the random variance of wind conditions, and does not derive from the measurement program.

5.3 Applicable Limits

Section D6 of the Protocol outlines the applicable exclusion limits for the integer wind speed bins. Section E5.5 (1) of the Protocol indicates that the objective of the RAM I-Audit is to assess the acoustic immission at the measurement location at wind speeds between 1 and 7 m/s (inclusive). Per section D3.5 of the Protocol, if the background sound levels are greater than the applicable exclusion limits then the applicable limits are the background sound levels without extraneous noise sources. Table 1 summarizes the applicable exclusion limits for rural areas, without considering elevated background levels. Where a limit has been amended for an integer wind speed bin due to elevated background sound, this is noted in the summary tables (see tables 2 through 4). Section D3.5 is only applied to amend the exclusion limits when the data has been fully filtered and the reported background levels are acceptable per the Protocol. In each case, the amount of ambient data collected meets or exceeds the required data minimums outlined in the Protocol (i.e., at least 1-hour of ambient data).

6 DATA PROCESSING

6.1 Data Reduction and Filtering

The measurement data must be filtered in accordance with the Protocol. The following filters were applied to the measured data and only the data that satisfied these conditions were used in the subsequent analysis:

1. Measurements were recorded between 22:00 and 05:00.
2. No valid data was recorded within an hour of a period of rainfall.
3. Seasonality exclusions were applied as described in Section 6.1.1.
4. Operational data was valid, with reference to the turbine having the greatest predicted noise impact at the measurement location, only when downwind data spanned ±45 degrees from the line of sight between the turbine and measurement location, or/and with angles amended as per section E5.5 (10) of the Protocol:
    - The angle range used at Monitor A was amended to include two angle sectors, as both J_WTG15 and J_WTG26 were found to be impactful as defined in the Protocol. This procedure directly followed MECP guidance provided in a September 19, 2018 email:
        i. The angle range used at Monitor A for J_WTG25 was 282° - 12°
        ii. The angle range used at Monitor A for J_WTG26 was 164° - 254°
    - The angle range used at Monitor D was expanded per appendix F11 of the Protocol to include 198° - 333°.
    - The angle range used at Monitor E was 210° - 300° and was not expanded.

    Angles are stated with due North (i.e., 0° or 360°) as the reference. See Appendix E for illustrations of the valid angle sector(s) for each monitor.

5. Operational data was valid, with reference to the turbine having the greatest predicted noise impact at the measurement location, only when sound power was greater than 90% of the maximum sound power level and turbine electrical power output was at least 85% of the maximum electrical power output. The electrical power criterion was the limiting of the two, as this model of turbine cannot generally operate at 85% of its maximum electrical power output without first radiating at least 90% of its maximum sound power level.
6. Parked data was valid, with reference to all impactful turbines at the measurement location, i.e., those within 1500 m of the receptor location and those defined in section D3.5.2, only when:
    - Operations curtailment of the impactful turbines was a result of a requested shutdown and not of calm weather activity. These requested shutdown periods are summarized in Appendix J. This condition was enacted to guard against collection of data while wind conditions were in a subdued state compared to regular weather patterns; and
    - Turbine RPM was equal to or less than 0.5 – 1.0. This condition was enacted to ensure only data while the turbine blades were effectively not spinning were included as valid ambient measurements.
7. Data was valid only when removal of notable extraneous high-level events (e.g., wind over microphone, traffic pass-bys, human activities, etc.) was completed. Note that this filtering is performed by listening to the recorded audio files. The highest sound level points are considered first. For ambient data, listening and filtering are performed until no extraneous sounds are heard, and for operational data, listening and filtering are performed until either compliance can be demonstrated or no extraneous sounds are heard. This approach limits the labour involved in screening for extraneous noise events. Interference from local activities like car pass-bys tends to fall in a higher sound level range compared to other background. Therefore, allowing for some extraneous sources to possibly remain within the operational data – if compliance has already been demonstrated - is acceptable, as it results in more conservative turbine-only levels. Extraneous source filtering is performed individually for each integer wind speed bin so each wind bin may be filtered to varying degrees. This filtering process may result in a "stepped" appearance of the graphs in Figures 3 to 6, but is a conservative treatment of the valid data for compliance purposes and does not adversely affect the outcome.

Conditions during the measurement period are presented in Appendix F.

6.1.1 Seasonality Exclusions

Section D3.8.2 of the Protocol indicates that the ambient and operational measurement should be paired in time to ensure recording during similar weather and wind shear conditions. Therefore, attempting to collect additional data to complete wind bins by continuing to monitor across multiple seasons with different acoustical properties may result in data that is not representative of turbine-only sound levels. As a result, operational data was excluded when, for an extended period within a season, it was not paired with a corresponding ambient measured dataset. The following are date spans for which operational data was excluded due to lack of corresponding seasonal ambient data:

- Jericho A: December 2, 2018 to March 23, 2019
- Jericho E: November 27, 2018 to February 27, 2019

6.1.2 Standard Deviation

All measurement points reported were collected and filtered in accordance with the Protocol, the specifics of the applied filters are discussed above. Standard deviations that exceeded the Protocol objectives require an explanation per E5.5.(8). The standard deviations listed in Tables 2b, 3, and 4 exceed the Protocol objective for some wind speeds, with small differences for Monitor A and E (Tables 2b and 4 respectively) and larger values for Monitor D.

The standard deviation objectives provided in the Protocol are based on 1-minute sound measurements. The measurements conducted are 10-second data points (per section E5.5 (7) of the Protocol) and are expected to experience more variability around the mean as a result, producing a higher standard deviation. Comparisons of 1-minute and 10-second data points suggest this difference can be on the order of 1 dB for these measurements which is within the variability experienced for Monitors A and E.

Furthermore, the standard deviation of measured sound pressure will be influenced by the amount of atmospheric turbulence present. Atmospheric turbulence (i.e., wind gusts) manifests as a fluctuating sound pressure level in acoustic measurements, hence periods of high atmospheric turbulence can lead to higher fluctuations which would in turn lead to higher standard deviations. The data collected for Monitor D appears to have been subject to periods of high atmospheric turbulence, leading to higher than normal standard deviations. This result can be seen in both the operational and ambient results. The acoustic data was rigorously reviewed and determined to be valid data points in spite of the higher standard deviation, hence it is our opinion that the standard deviation will not affect the compliance outcome of the audits.

The Protocol does not outline any valid method for reduction of the standard deviation; therefore the data set was not further filtered to obtain a lower standard deviation.

6.2 Effects of Insects and Fauna

Audio recordings were reviewed for sounds from insects and fauna. Sounds of frogs and crickets were frequently audible during the sampling program at Monitor A and Monitor E. Third-octave spectral analysis of the sounds determined that the frequencies varied night-to-night but were generally between the 1250 Hz and 4000 Hz bands. The respective contribution in these bands was removed in the 1/3 octave spectra by linearly interpolating the values of the affected bands with the nearest non-contaminated bands. Figure 2 presents the noise removal methodology utilized in this audit. Sounds of insects and wildlife were generally inaudible during the sampling program at Monitor D.

6.3 Data Analysis

Following the guidance of the Protocol, the “binning method” is used to analyse one-minute sound level data. All sound level data that correlates to wind speeds between 1 to 7 m/s (per RAM I-Audit procedure) are grouped into integer wind speed bins. The data included within each bin is that which is +/- 0.5 m/s of the specified integer wind speed. After filtering of data per Section 6.1 and division of the data into bins as described here, further analysis is completed as detailed below.

6.4 Determination of Turbine Sound Level

After reduction, filtering, and binning (Sections 6.1-6.3), the binned data are then averaged. The resulting sound levels representing the turbine-only sound levels are the logarithmic subtraction of the average measured ambient sound from the average measured total sound at each wind speed bin.

Monitor A was similarly impacted by two turbines (J_WTG25 and J_WTGT26) situated at close to opposite bearings with respect to the monitor, resulting in analysis of two distinct angle sectors, as instructed in section E5.5 (10) of the Protocol. Per MECP direction through a September 19, 2018 email and attachment, these two sectors were analyzed separately. The two sectors together were used only to show completeness, i.e., that a sufficient amount of data had been collected during the measurement campaign. Turbine-only sound levels were separately calculated for each sector, and the higher of the two was used for further assessments of compliance, ensuring a conservative approach. This approach is consistent with the MECP guidance provided.

The MECP requested that the influence of the transformer located nearby Monitor A be subtracted from the background noise measurements for Monitor A. RWDI contends that the transformer contributes less than the predicted sound level at the monitor location based on worst-case transformer audit measurements that confirm its contribution is minimal. Nonetheless, RWDI understands the MECP's request is conservative and completed the analysis using a predicted transformer contribution (including the tonality penalty) of 33 dBA. The results of the analysis are shown in Table 5 and show that turbine-only contribution is in compliance despite the conservative adjustment to the ambient sound requested due to the transformer.

The complete valid datasets are plotted in Figures 3 and 4 for Monitor A, Figure 5 for Monitor D, and in Figure 6 for Monitor E. The graphs are plots of valid sound level data versus wind speed, both recorded at the co-located measurement location. Each plot presents the measured total sound and the measured ambient sound.

Valid data used to assess compliance is presented in Appendix G. Wind data is presented in wind rose plots in Figure 7, 8, and 9 for Monitor A, D, and E, respectively. Wind rose plots are presented separately for the operational and ambient data per request from the MECP. In addition to operational and ambient plots, a third figure for each monitor is provided that presents a wind rose with all data combined. All wind rose figures present only nighttime data, between 22:00 and 05:00. A summary of the final compliance analysis based on the valid data is provided in Table 2 through 4 for Monitor A, D, and E, respectively.

6.5 Tonal Assessment

Tonality was assessed per section D3.8.3 of the Protocol and no tones were detected from onsite observations and from a review of audio recordings. However, tonality above the criteria in the Protocol was identified at Turbine 80 based on an emission test (April 27, 2018 report by Aercoustics), thus triggering a requirement for further tonality analysis. No immission monitors were located in proximity to Turbine 80, and hence a conservative assessment of tonality at all monitors is presented. A detailed tonality assessment was conducted on the collected immission data at Monitor A, D, and E per the ISO/PAS 20065 (2016) method requested by MECP. The wind speed bins used in the tonality analysis were selected to match the complete wind speed bins used in the assessment of compliance.

- Section D3.8.3 of the Protocol requires that at least five 1-minute intervals are used. As the data is in 10-second format, 30 audio files (five minutes * six 10-second files each = 30) corresponding to the closest integer wind-bin values were used for the assessment of tonality.
- Section D3.8.3 limits the permissible line spacing to a range of 1.9 Hz to 4.0 Hz, so a frequency resolution of 2.0 Hz was chosen.
- The sampling rate used was 51200 Hz, resulting in a require audio file of length 0.5 seconds to output a frequency resolution of 2.0 Hz.
- Formula (1) of section 4.3 of the Standard was used to merge the 0.5-second-long spectra together such that an averaging time of 3.0 seconds was achieved, resulting in twenty 3-second merged spectra per 1-minute interval.
- These twenty spectra were then separately analyzed for tones per the Standard.
- Formula (20) in section 5.3.9 of the Standard was used to calculate the mean tonal audibility associated with each minute of data. This audibility was then reported for each minute.
- The results of the individual 1-minute intervals are reported, alongside an average for each wind speed bin. To complete the log-averaging a value must be substituted in for those minutes where a tone is not found at all and the results table shows an 'N/A'. For these cases, a value of -10 dB is used, per Section 5.3.9 of ISO/PAS 20065:2016.
- As per ISO 1996-2:2017, no tonal penalty was to be applied to the measured levels if tonal audibility values were below 0 dB.

A summary of the results is presented in Appendix H, along with a list of data points, by timestamp, which were used in the analysis. No tonal audibility values of concern were found for any of the wind bins; hence no tonality adjustments were applied to the results.

7 ASSESSMENT OF COMPLIANCE

The facility is required to meet the sound level limits identified in the REA. For a RAM I-Audit, the Protocol outlines the data requirements to show compliance. For the RAM I-Audit to be considered complete, section E5.5 (1) of the 2017 Protocol requires a minimum number of measurement points for either three of the wind speed bins between 1 and 7 m/s, or two of the wind speed bins between 1 and 4 m/s. The facility is deemed to be in compliance if the resulting turbine sound levels do not exceed the sound level limit or background sound level at each integer wind speed.

At MECP request, the checklist contained in Appendix F7 of the Protocol has been included in Appendix I along with report cross-references to each item noted.

After filtering, the minimum number of measurement data points at Monitor A for both operational and parked conditions was obtained for the 4, 5, 6, and 7 m/s wind speed bins. The results show that Monitor A is in compliance with the applicable sound level limits.

Section E5.5 (6) of the Protocol permits the supplement of ambient sound level data from a lower wind speed bin to represent a higher wind speed bin. For monitor D, the collected data from 1m/s ambient wind speed bin was added to 3 m/s wind bin to achieve the required number of data points. After filtering the minimum number of measurement data points at Monitor D for both operational and parked conditions was obtained for the 3 and 4 m/s wind speed bins. The results show that Monitor D is in compliance with the applicable sound level limits.

After filtering, the minimum number of measurement data points at Monitor E for both operational and parked conditions was obtained for the 3 and 4 m/s wind speed bins. The results show that Monitor E is in compliance with the applicable sound level limits.

TABLES

Table 1 - Applicable Sound Level Exclusion Limits for RAM I-Audits

Wind speed (m/s) at 10 m height (agl)	1	2	3	4	5	6	7
Wind turbine sound level limits Class 3[1] area, dBA	40	40	40	40	40	40	43

Notes:

[1] - Class 3 means a rural area with an acoustical environment that is dominated by natural sounds having little or no road traffic, such as the following: a small community, agricultural area, a rural recreational area such as a cottage or a resort area, or a wilderness area.

Table 2A – Summary of Number of Data Intervals Collected – Monitor A (2018/11/21 - 2019/07/08)

Jericho Wind Energy Centre – Fall 2018, 1501440

Receptor ID	Section	Turbine & Ambient Measurements Data Points (10-second intervals) Collected at Wind Speed Bins						
		1 m/s	2 m/s	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s
Monitor A	J_WTG25 Section	0	4	40	342	802	839	643
	J_WTG26 Section	0	0	80	511	827	1038	655
	Ambient	0	13	149	745	1149	985	389

Table 2B – Summary of Sound Levels – Monitor A - (2018/11/21 - 2019/07/08)

Jericho Wind Farm – Fall 2018, 1501440

Section / Receptor	Wind Speed Bin						
	1 m/s	2 m/s	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s
Energy Average Measured Levels - Turbines and Ambient							
Monitor A: Section J_WTG25 (dBA)	-	32.4	37.6	40.0	43.3	47.5	51.4
Monitor A: Section J_WTG25 Standard Deviation	-	0.2	2.3	1.9	2.5	2.8	2.9
Monitor A: Section J_WTG26 (dBA)	-	-	37.0	39.1	43.8	47.8	51.5
Monitor A: Section J_WTG26 Standard Deviation	-	-	1.1	1.8	2.5	3.0	2.9
Energy Averaged Measured - Ambient Only							
Ambient (dBA)	-	34.6	36.1	38.3	41.8	45.3	48.8
Ambient Standard Deviation	-	0.6	1.8	2.0	2.4	2.1	2.1
Energy Average Measured Levels - Turbines only (dBA)							
Monitor A: Section J_WTG25	-	22.4[3]	32.4	35.1	38.0	43.4	48.1
Monitor A: Section J_WTG26	-	-	29.5	31.6	39.3	44.1	48.2
Energy Averaged Combined Turbine Only (dBA)							
Monitor A	-	22.4[3]	31.2	33.7	38.7	43.7	48.1
Turbine Only Level for Assessment (dBA) {maximum in bin}							
Monitor A	-	22.4[3]	32.4	35.1	39.3	44.1	48.2
REA Sound Level Limit (dBA)							
Monitor A	40.0	40.0	40.0	40.0	41.8[1]	45.3[1]	48.8[1]
Over REA Limit?							
Monitor A	N/a[2]	N/a[2]	N/a[2]	No	No	N/a[2]	N/a[2]

Notes:

[1] Limit has been amended to account for elevated background levels under Section D 3.5 of the 2017 Compliance Protocol for Wind Turbine Noise.

[2] Insufficient data points to make a statement on compliance based on 2017 Compliance Protocol for Wind Turbine Noise.

[3] Where the ambient condition is greater than or equal to the total sound condition, the turbine only sound levels are estimated to be 10 dB lower than the total sound condition.

Table 3 - Summary of Sound Levels - Monitor D - Fall 2018

Jericho Wind Energy Centre - Fall 2018 Audit, 1501440

Wind Speed	Average L_{EQ} for Total Sound Condition	Total # of Valid 10-Second Intervals for Total Sound	Standard Deviation of Valid Intervals for Total Sound	Average L_{EQ} for Ambient Sound Condition	Total # of Valid 10-Second Intervals for Ambient Sound Condition	Standard Deviation of Valid Intervals for Ambient Sound Condition	Turbine Only Sound Levels	REA Sound Level Limits	Over REA Limits?
(m/s)	(dBA)		(dBA)	(dBA)		(dBA)	(dBA)	(dBA)	(Yes/No)
3	47	825	5	44	485	5	44	44 [1][2]	No
4	50	2116	5	47	360	4	47	47 [2]	No

Notes:

[1] - Initial monitoring in the 3 m/s wind bin was not successful in reaching the required number of data points. Ambient data from the 1 m/s bin was added to the 3 m/s bin to reach the required number of valid data points, in conjunction with E5.5(6)a. of NPC-350.

[2] - Limit has been amended to account for elevated background levels under Section D 3.5 of the 2017 Compliance Protocol for Wind Turbine Noise.

- Wind speed bins 3 and 4 m/s were used for the purposes of demonstrating compliance as per Section E5.5(1) of NPC-350

Table 4 - Summary of Sound Levels - Monitor E - Fall 2018
Jericho Wind Energy Centre - Fall 2018 Audit, 1501440

Wind Speed	Average L_{EQ} for Total Sound Condition	Total # of Valid 10-Second Intervals for Total Sound	Standard Deviation of Valid Intervals for Total Sound	Average L_{EQ} for Ambient Sound Condition	Total # of Valid 10-Second Intervals for Ambient Sound Condition	Standard Deviation of Valid Intervals for Ambient Sound Condition	Turbine Only Sound Levels	REA Sound Level Limits	Over REA Limits?
(m/s)	(dBA)		(dBA)	(dBA)		(dBA)	(dBA)	(dBA)	(Yes/No)
1	37	14 [2]	2	36	2765	3	27	40	N/A [2]
2	39	128 [2]	2	37	2395	3	33	40	N/A [2]
3	41	721	3	37	1868	2	38	40	No
4	42	1234	2	38	821	2	39	40	No
5	43	1496	1	41	177 [2]	2	40	41 [1]	N/A [2]
6	45	525 [2]	1	42	37 [2]	2	41	42 [1]	N/A [2]
7	46	97 [2]	1	45	19 [2]	1	38	45 [2]	N/A [2]

Notes:
[1] - Limit has been amended to account for elevated background levels under Section D 3.5 of the 2017 Compliance Protocol for Wind Turbine Noise.
[2] - Insufficient valid data points to make a statement on compliance based on the 2017 Compliance Protocol for Wind Turbine Noise.

Table 5: Monitor A Results (Fall 2018) Adjusted for Hypothetical Transformer Influence

Wind Speed (m/s)	1	2	3	4	5	6	7
Total Sound, Section J_WTG25 (dBA)	-	32.4	37.6	40.0	43.3	47.5	51.4
Total Sound, Section J_WTG26 (dBA)	-	-	37.0	39.1	43.8	47.8	51.5
Ambient Sound (dBA)	-	34.6	36.1	38.3	41.8	45.3	48.8
Adjusted Ambient (-33 dBA for transformer)	-	29.4	33.2	36.7	41.2	45.1	48.6
Turbine Only, Section J_WTG25 (dBA)	-	29.3	35.7	37.2	39.2	43.8	48.2
Turbine Only, Section J_WTG25 (dBA)	-	-	34.6	35.3	40.2	44.4	48.3
Maximum Turbine Only (dBA)	-	29.3	35.7	37.2	40.2	44.4	48.3
Applicable Limit (dBA)	40.0	40.0	40.0	40.0	41.2	45.1	48.6
Above Limit?	-	No	No	No	No	No	No

FIGURES

Jericho Wind Farm - Noise Monitoring Locations

Jericho Wind Energy Centre - Lambton County, Ontario

True North

Project #1501440

Drawn by:	DJK	Figure:	1
Approx. Scale:	1:75,000		
Date Revised:	Dec. 12, 2019		

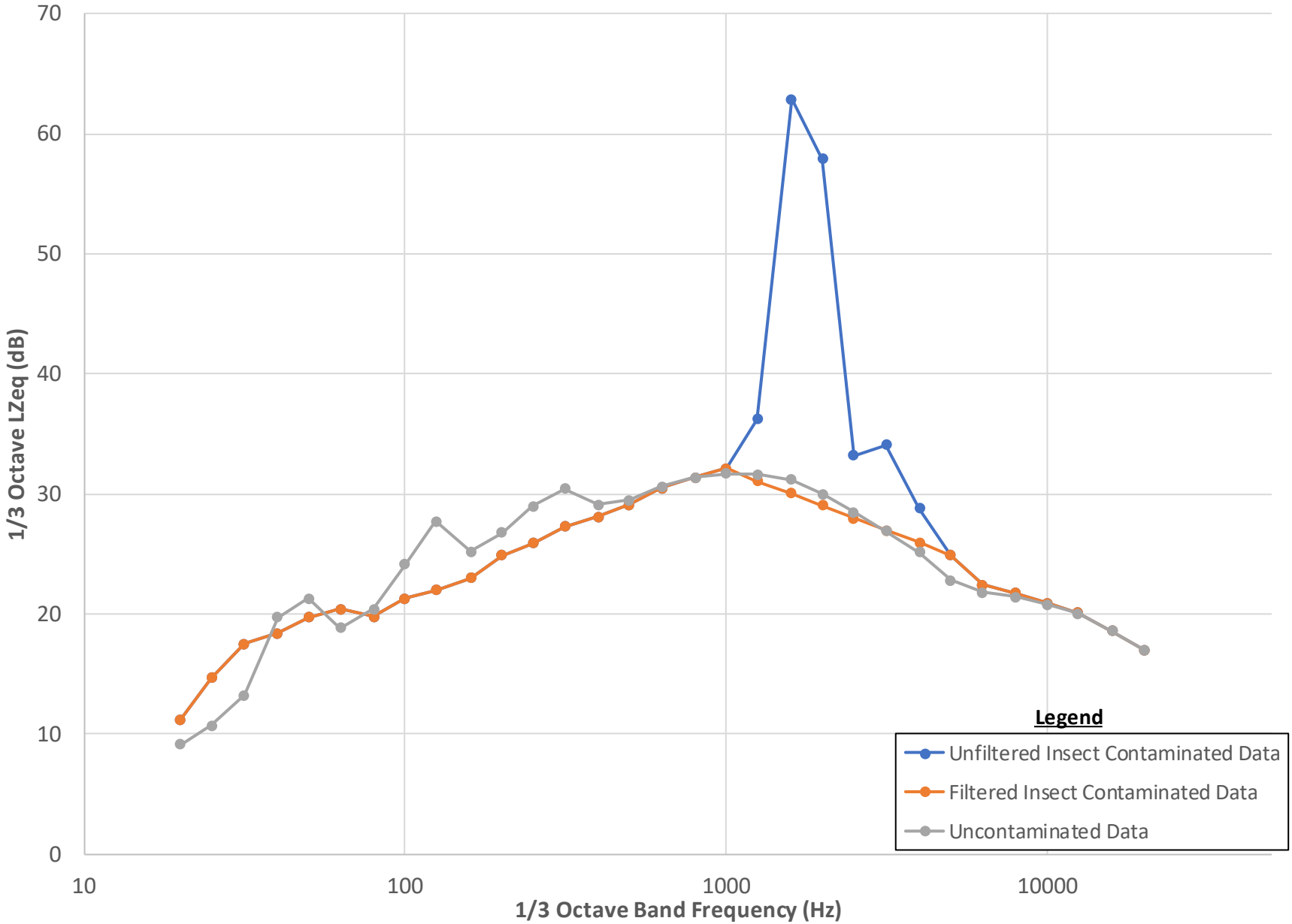
Map Notes:
Projection: NAD 1983 UTM Zone 17N.
Geopolitical Boundaries: Government of Canada, Statistics Canada Census, 2011, Esri, 2013; Transportation, Land Cover & Hydrology: © Department of Natural Resources Canada. All rights reserved., Esri, 2013.

SymbolID
- Jericho Built Turbine
- Transformer Substation
- Monitoring Station
- Highway
- Major Road
- Local Road
- Watercourses
- Waterbody

0 1.5 3 4.5 km

Key Map

Figure 2 - Sample of Insect Data Filtering



Sample of Insect Data Filtering
Fall 2018

Jericho Wind Energy Centre, Lambton County, Ontario

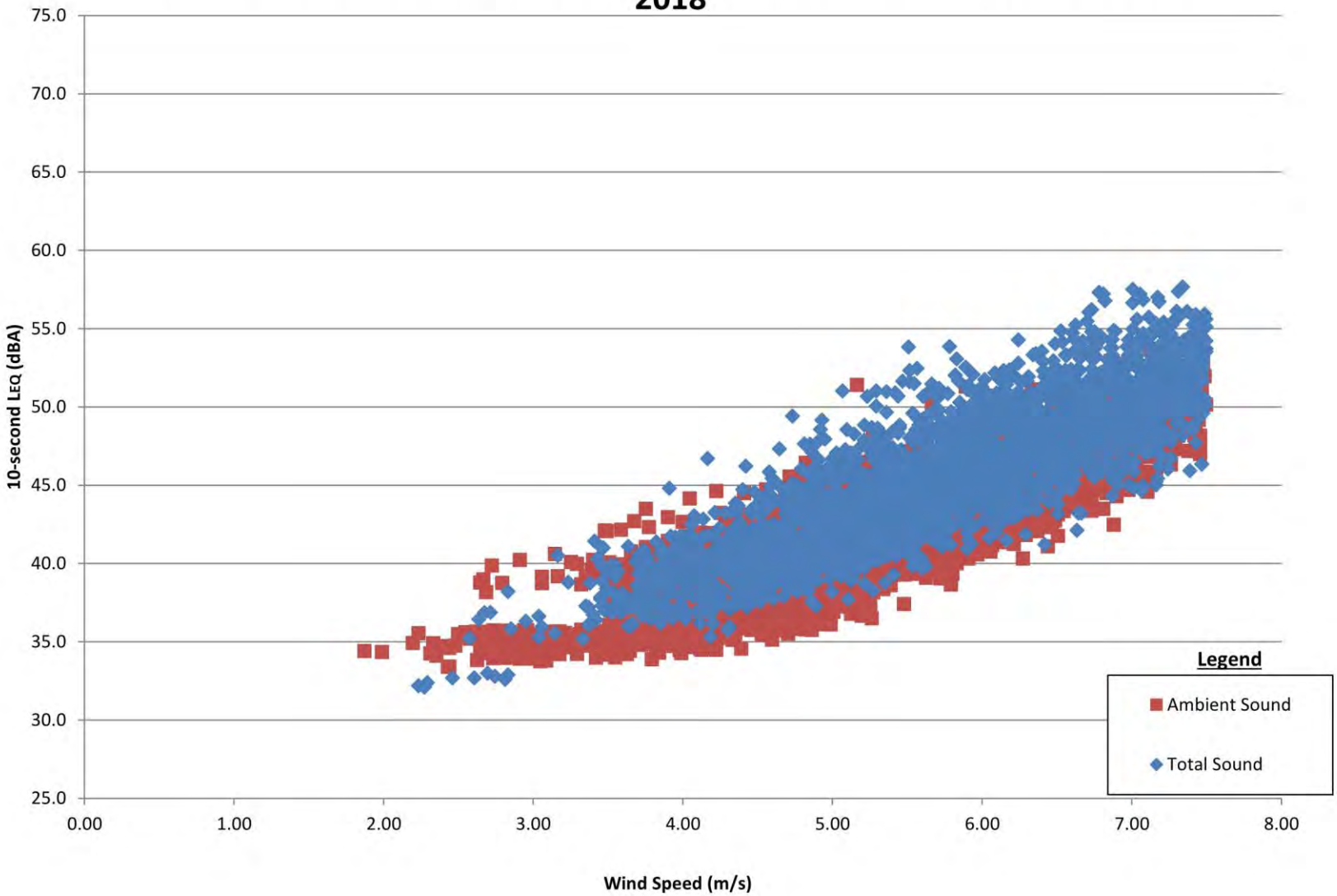
Project #1501440

Drawn by: LRC

Figure: 2

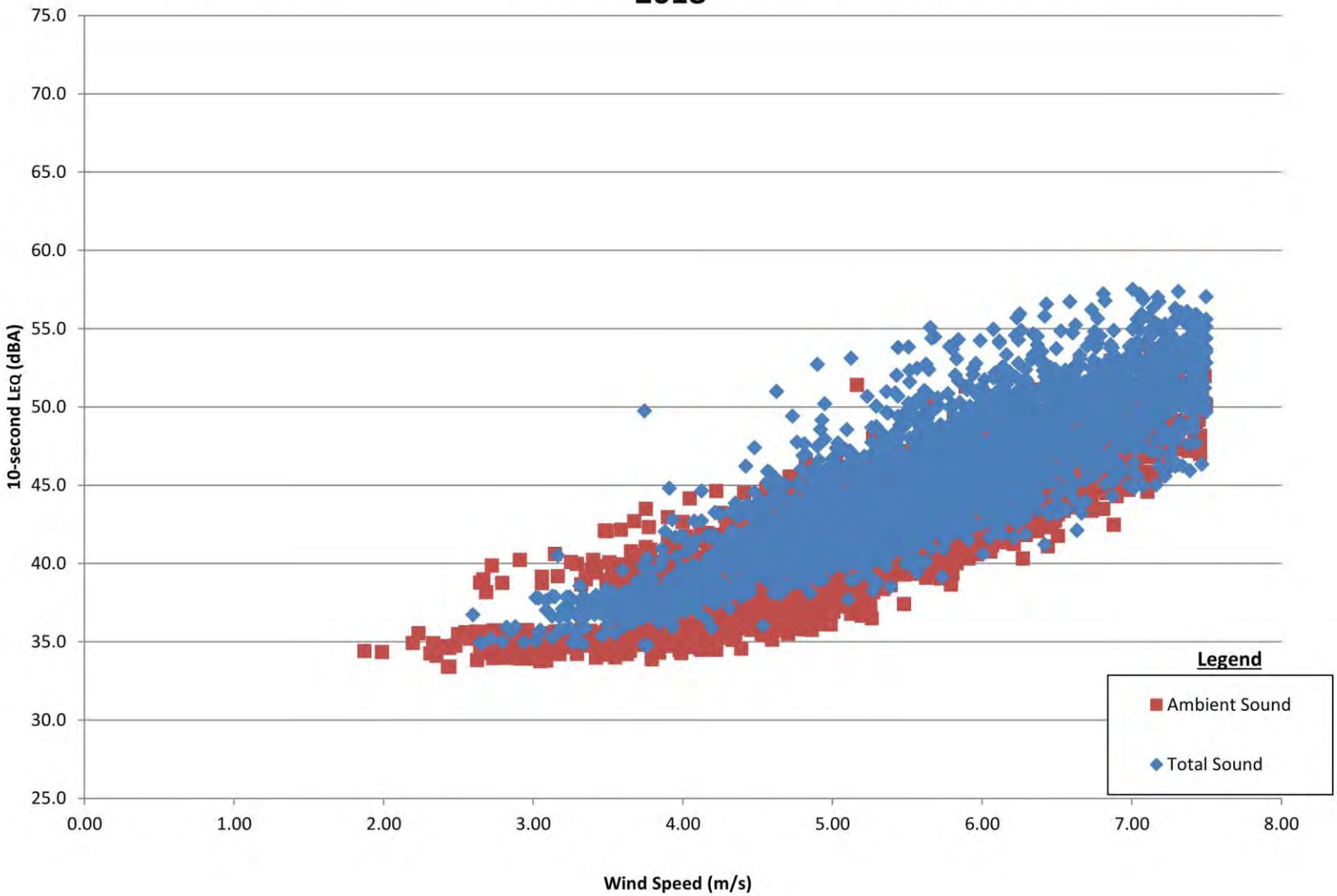
Date: December 09, 2019

Figure 3 - Valid Total 10-Second Sound Data - Monitor A J_WTG25 - Fall 2018



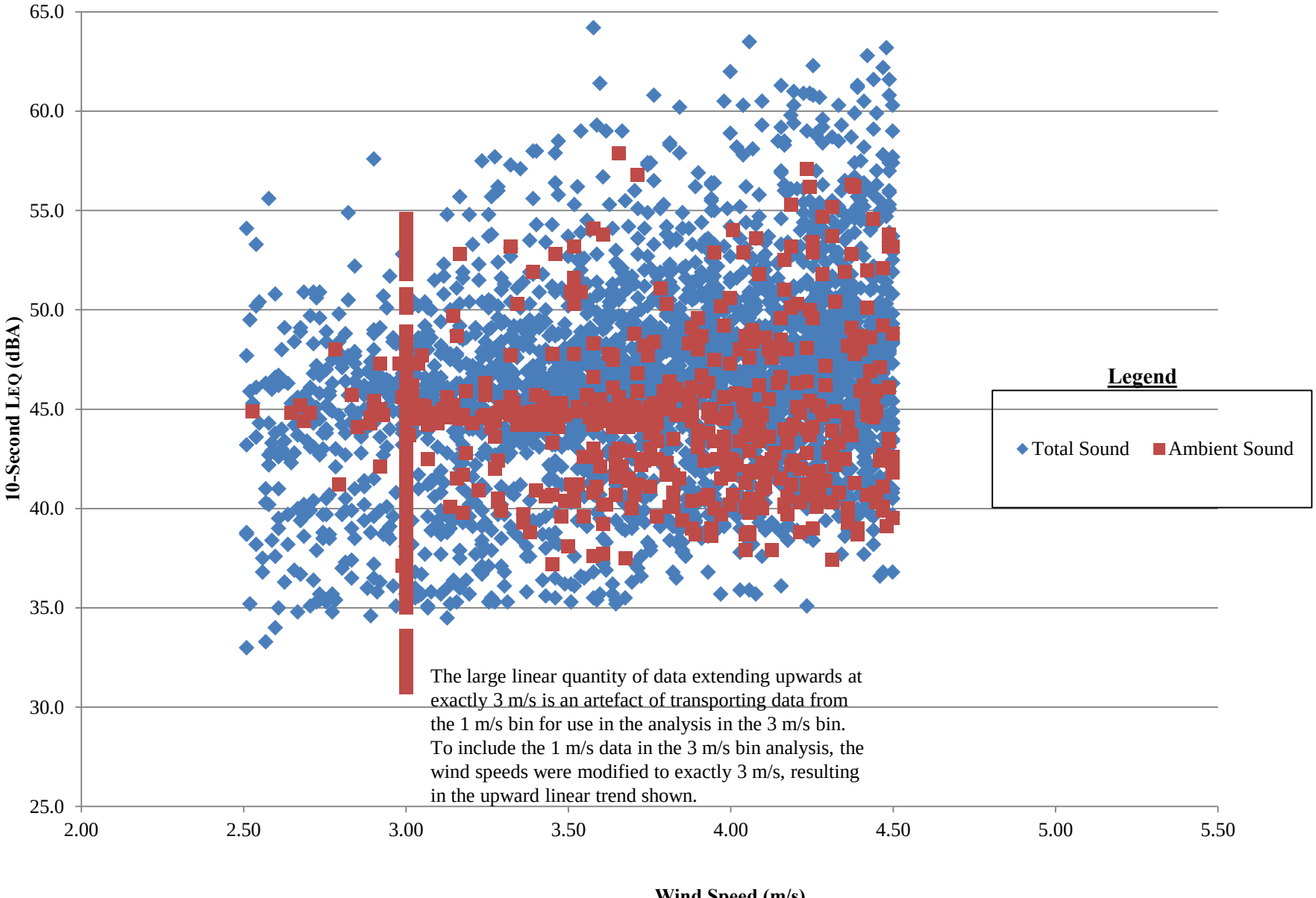
Valid Total 10s Sound Data - Monitor A J_TWG25 **Fall 2018** Jericho Wind Energy Centre, Lambton County, Ontario Project #1501440	Drawn by: LRC	Figure: 3
	Date: November 17, 2020	

Figure 4 - Valid Total 10-Second Sound Data - Monitor A J_WTG26 - Fall 2018



Valid Total 10s Sound Data - Monitor A J_TWG26 **Fall 2018** Jericho Wind Energy Centre, Lambton County, Ontario Project #1501440	Drawn by: LRC	Figure: 4
	Date: November 17, 2020	

Figure 5 - Valid Total 10-second Sound Data - Monitor D – Fall 2018



Valid Total 10s Sound Data – Monitor D
Fall 2018

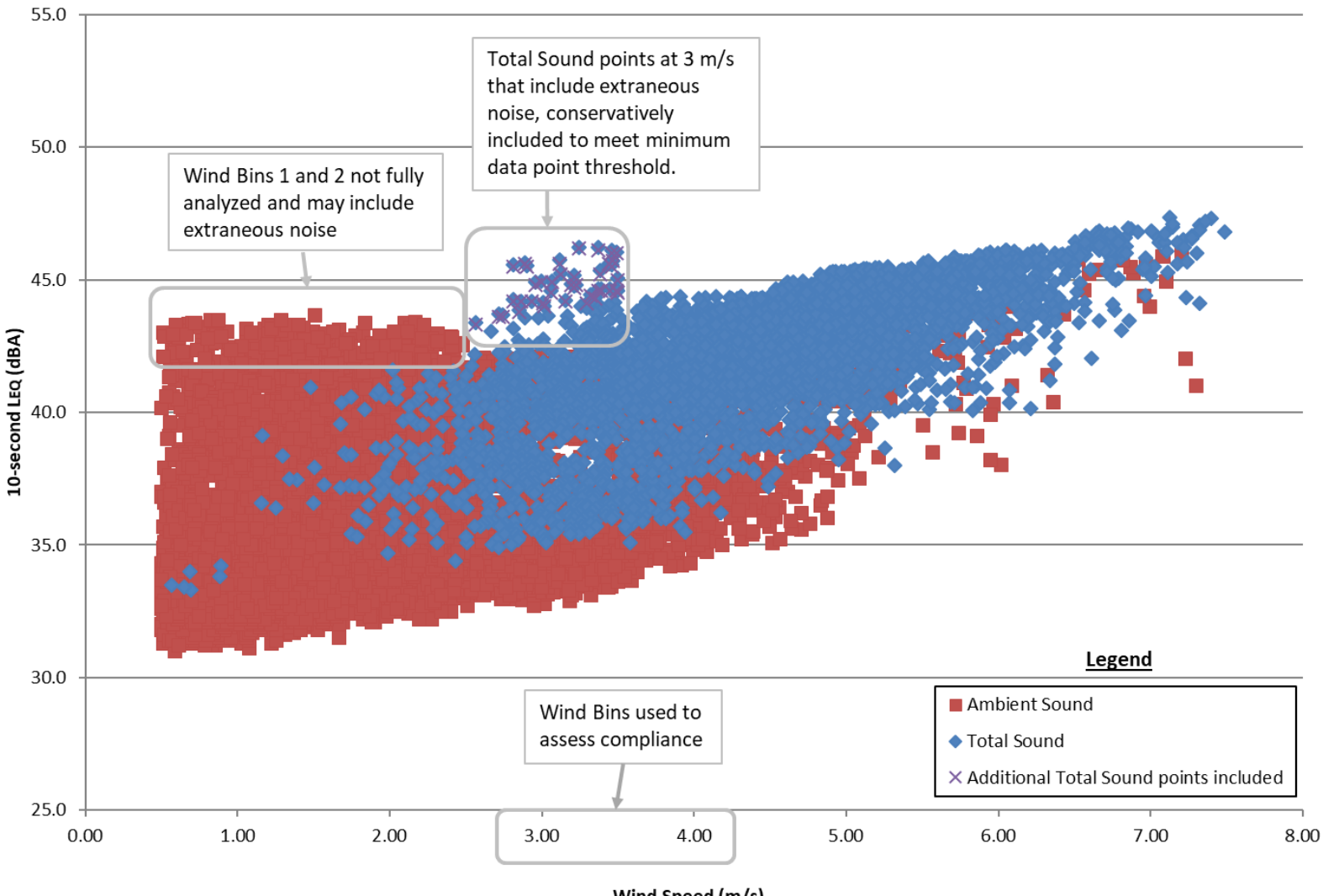
Jericho Wind Energy Centre, Lambton County, Ontario

Project #1501440

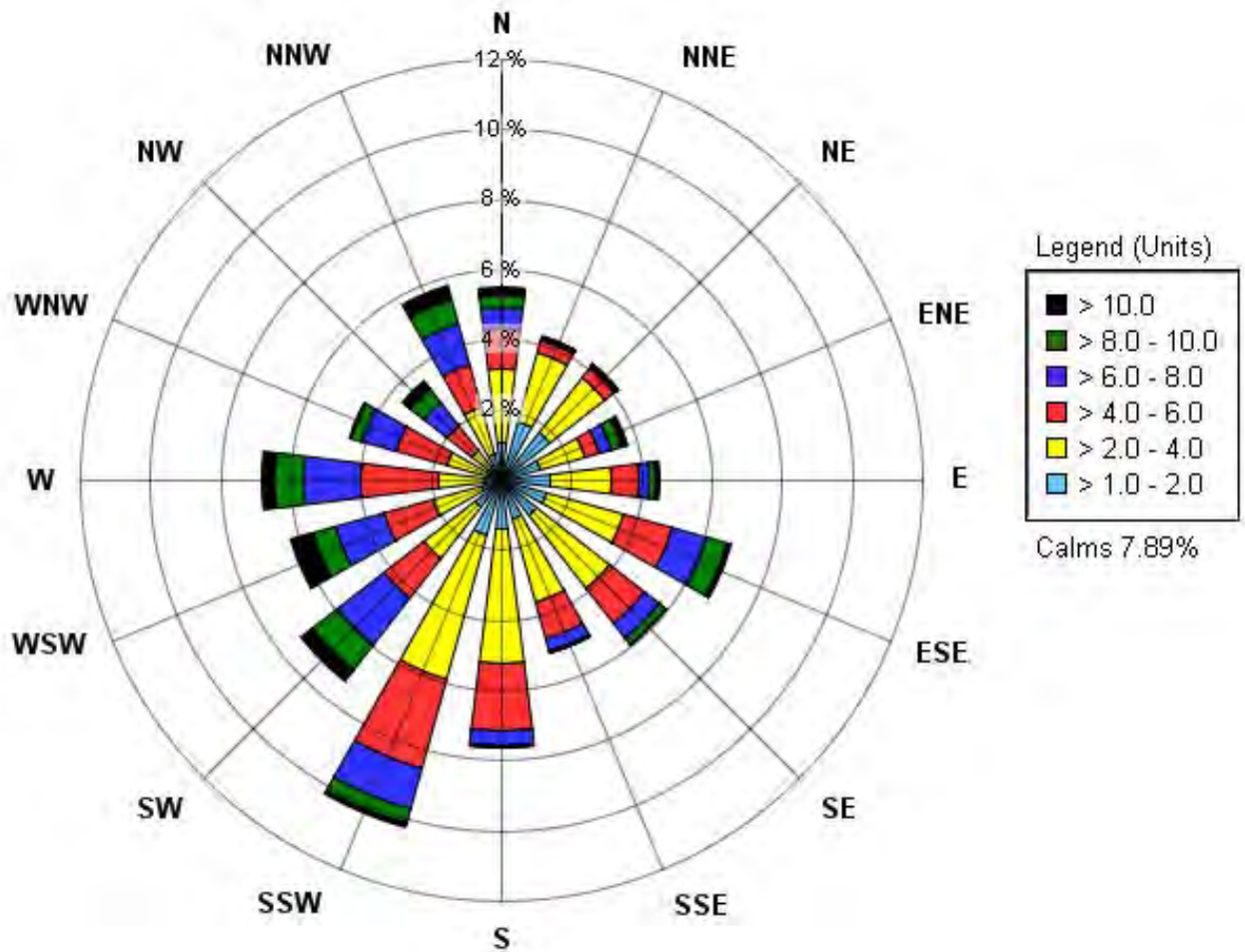
Drawn by: MFA | Figure: 5

Date: February 28, 2019

Figure 6 - Valid Total 10-Second Sound Data - Monitor E - Fall 2018



Valid Total 10s Sound Data - Monitor E **Fall 2018** Jericho Wind Energy Centre, Lambton County, Ontario Project #1501440	Drawn by: LRC	Figure: 6
	Date: November 18, 2020	



Wind Rose Plot – Monitor A – Operational Data

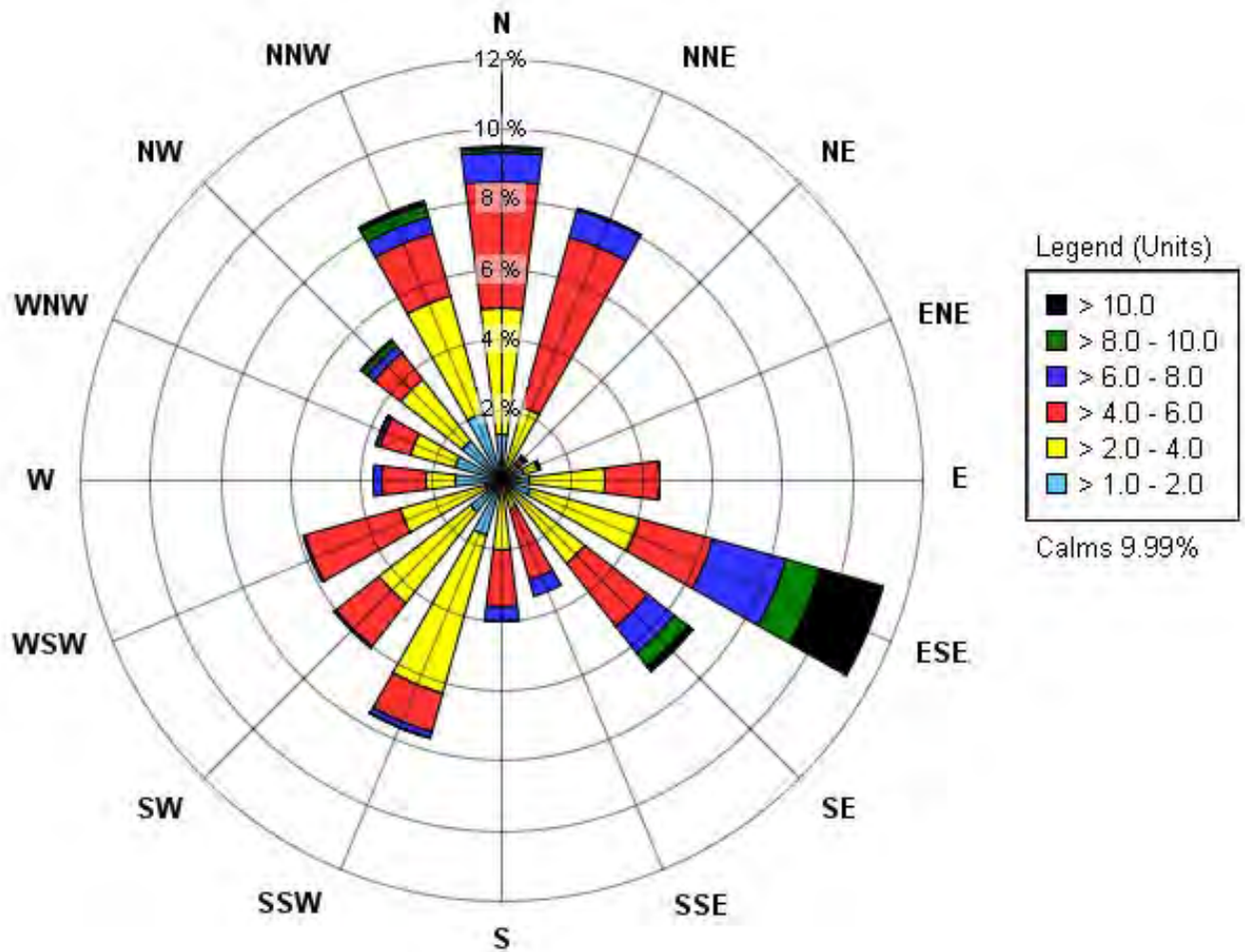
November 21, 2018 to June 7, 2019, Night Only

Excludes data after June 7, 2019 due to equipment error causing wind direction error

Jericho Wind Energy Centre, Lambton County, Ontario Project #1501440

Drawn by: ACCL | Figure: 7a

Date: June 4, 2020



Wind Rose Plot – Monitor A – Ambient Data

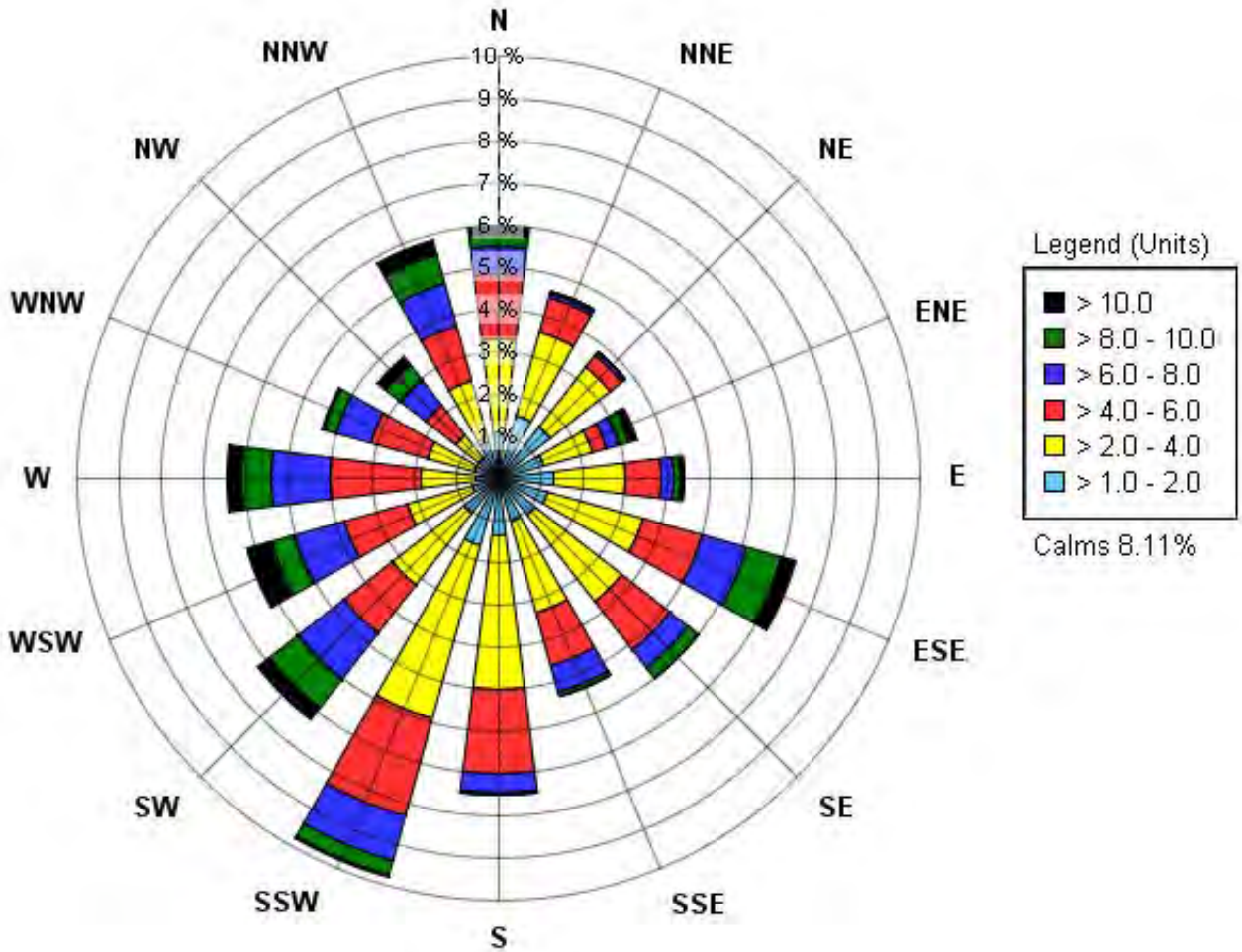
November 21, 2018 to June 7, 2019, Night Only

Excludes data after June 7, 2019 due to equipment error causing wind direction error

Jericho Wind Energy Centre, Lambton County, Ontario Project #1501440

Drawn by: ACCL | Figure: 7b

Date: June 4, 2020



Wind Rose Plot – Monitor A – All Data

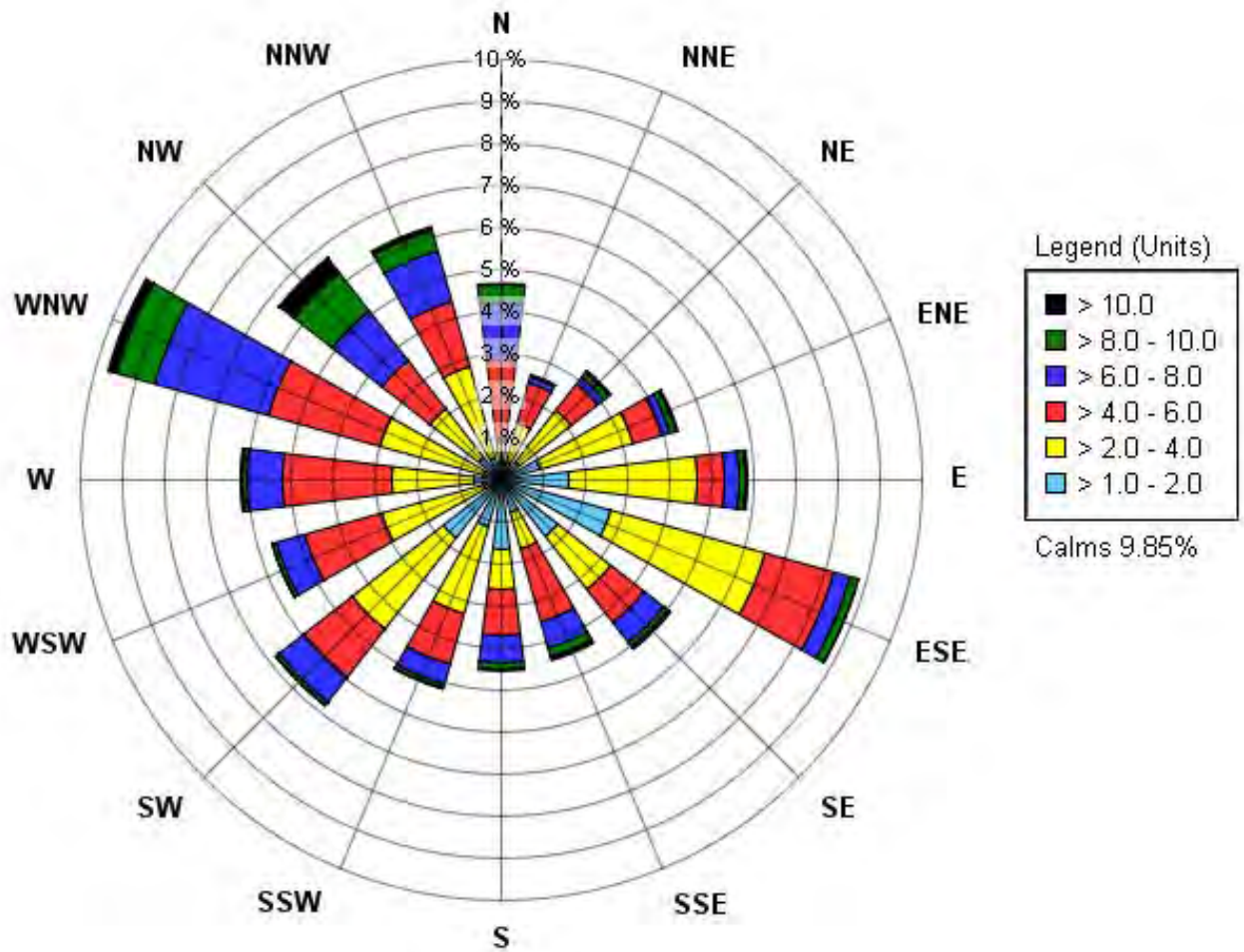
November 21, 2018 to June 7, 2019, Night Only

Excludes data after June 7, 2019 due to equipment error causing wind direction error

Jericho Wind Energy Centre, Lambton County, Ontario Project #1501440

Drawn by: ACCL | Figure: 7c

Date: June 4, 2020



Wind Rose Plot – Monitor D – Operational Data
October 26, 2018 to February 18, 2019, Night Only

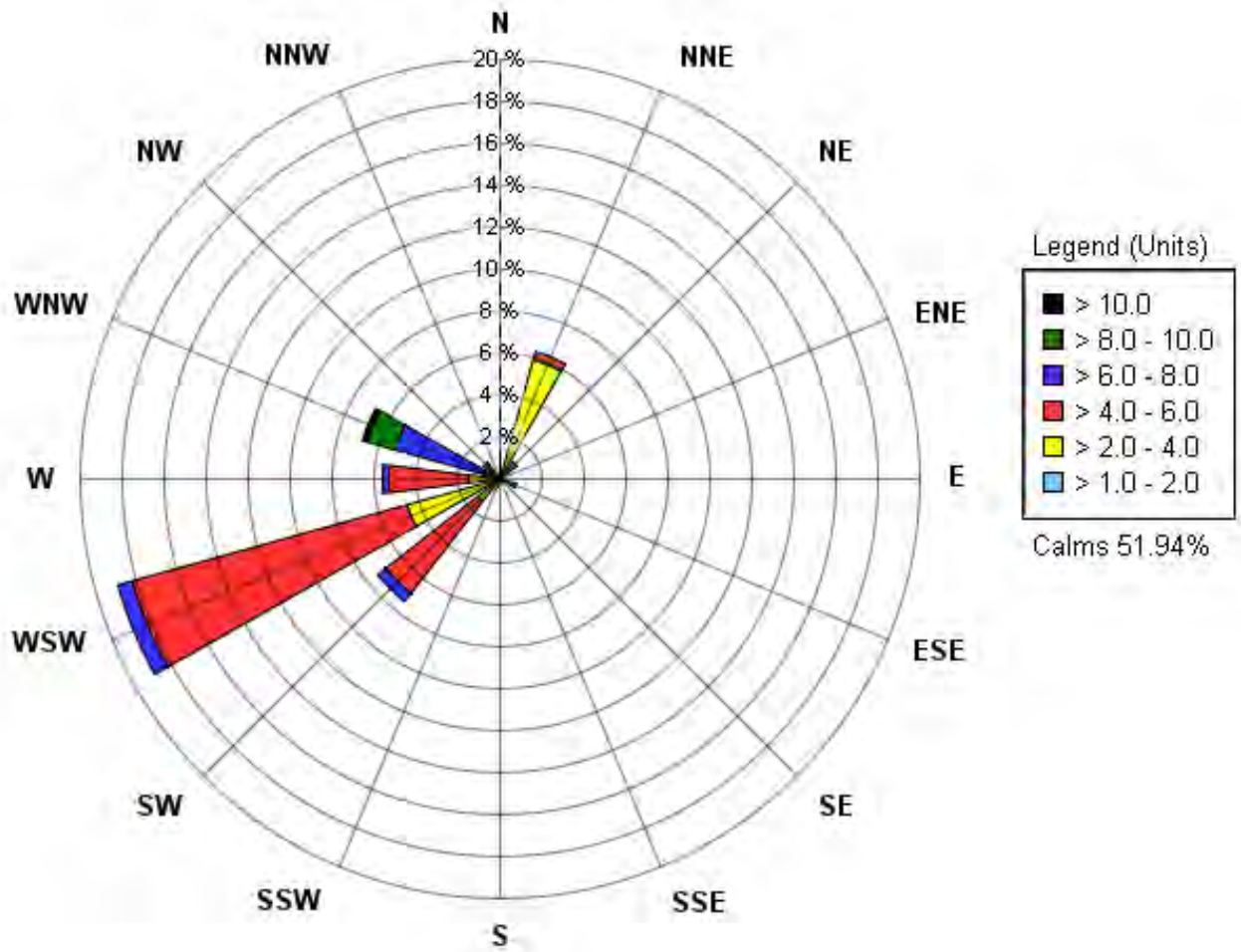
Jericho Wind Energy Centre, Lambton County, Ontario

Project #1501440

Drawn by: ACCL

Figure: 8a

Date: June 4, 2020

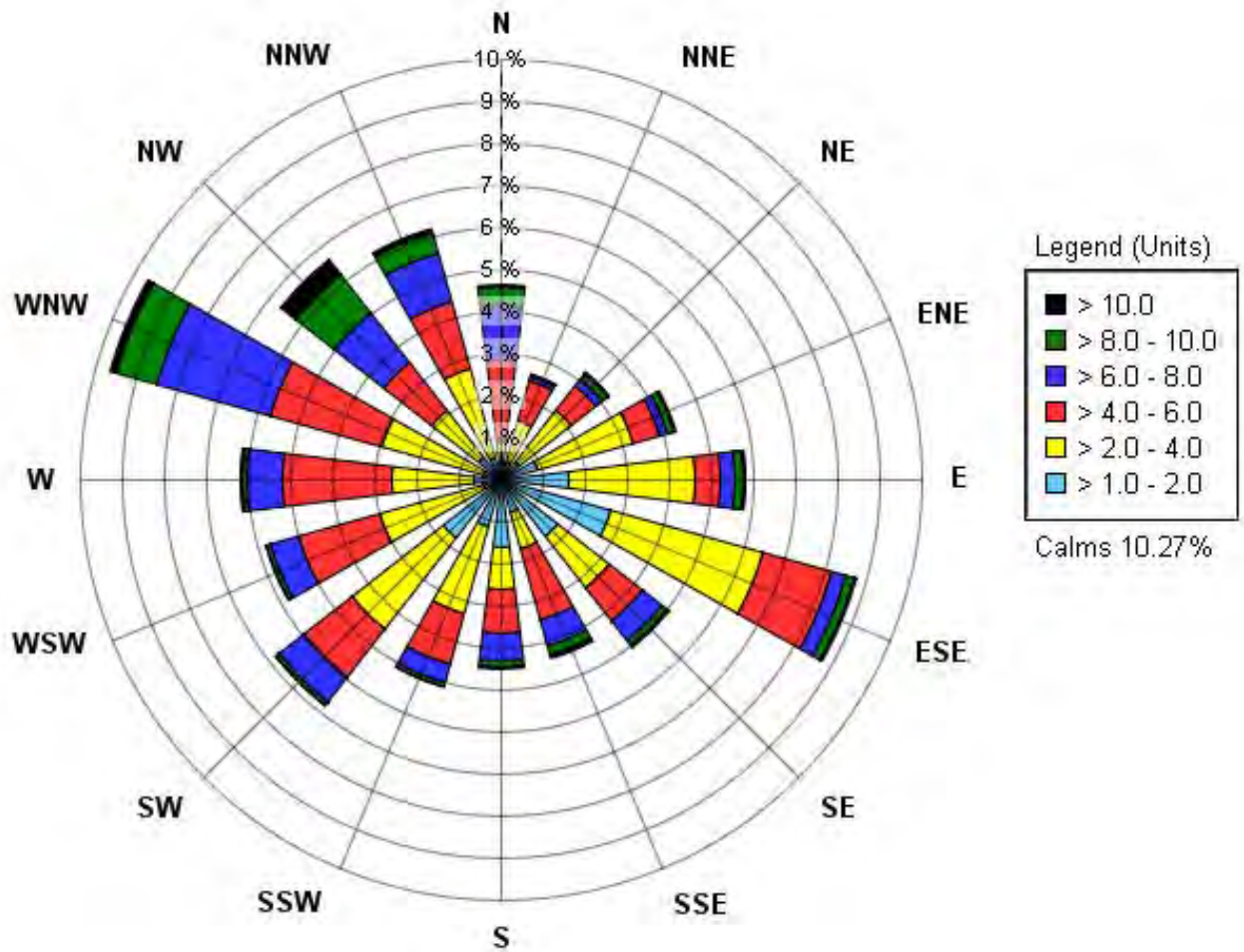


Wind Rose Plot – Monitor D – Ambient Data
October 26, 2018 to February 18, 2019, Night Only

Jericho Wind Energy Centre, Lambton County, Ontario Project #1501440

Drawn by: ACCL | Figure: 8b

Date: June 4, 2020



Wind Rose Plot – Monitor D – All Data
October 26, 2018 to February 18, 2019, Night Only

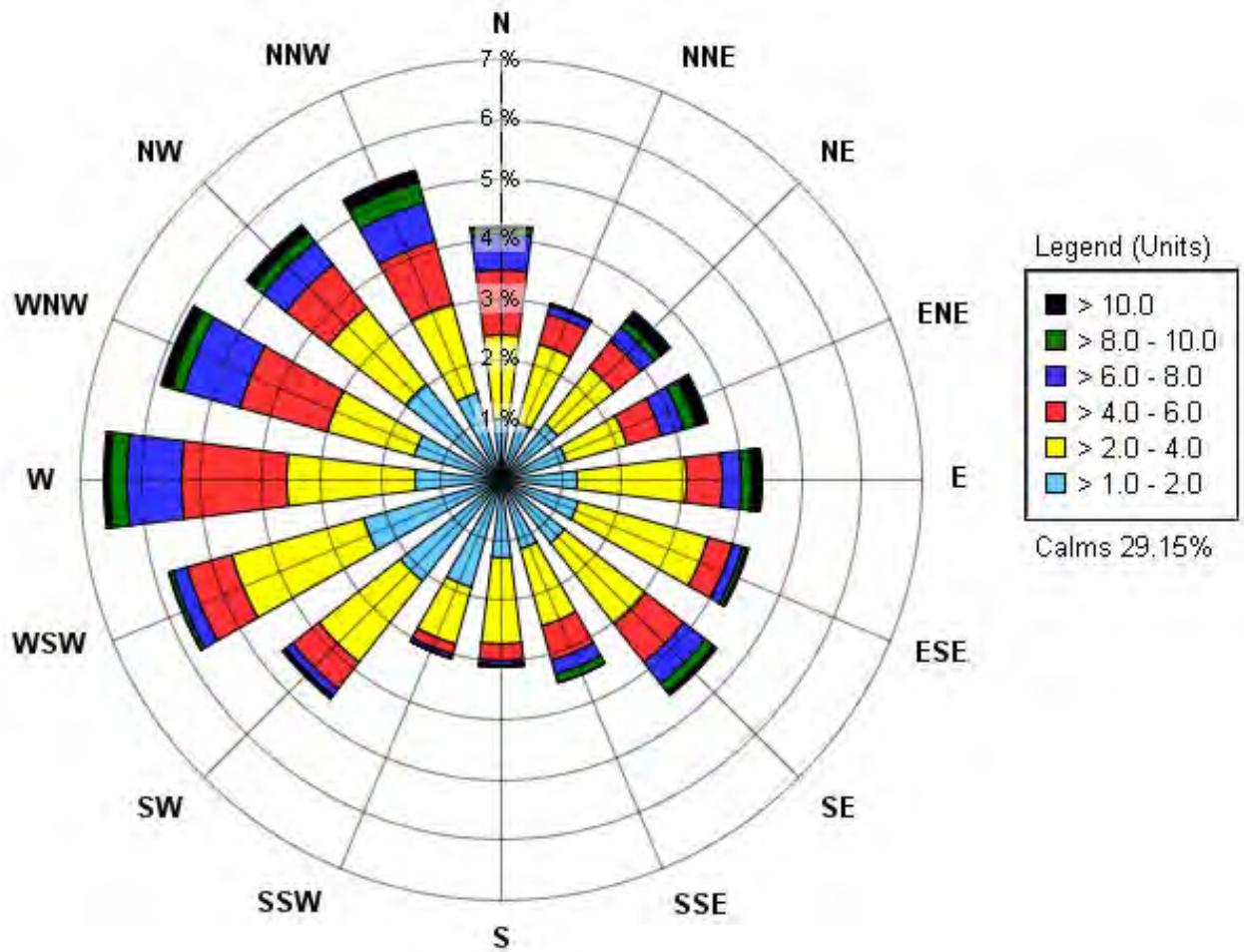
Jericho Wind Energy Centre, Lambton County, Ontario

Project #1501440

Drawn by: ACCL

Figure: 8c

Date: June 4, 2020

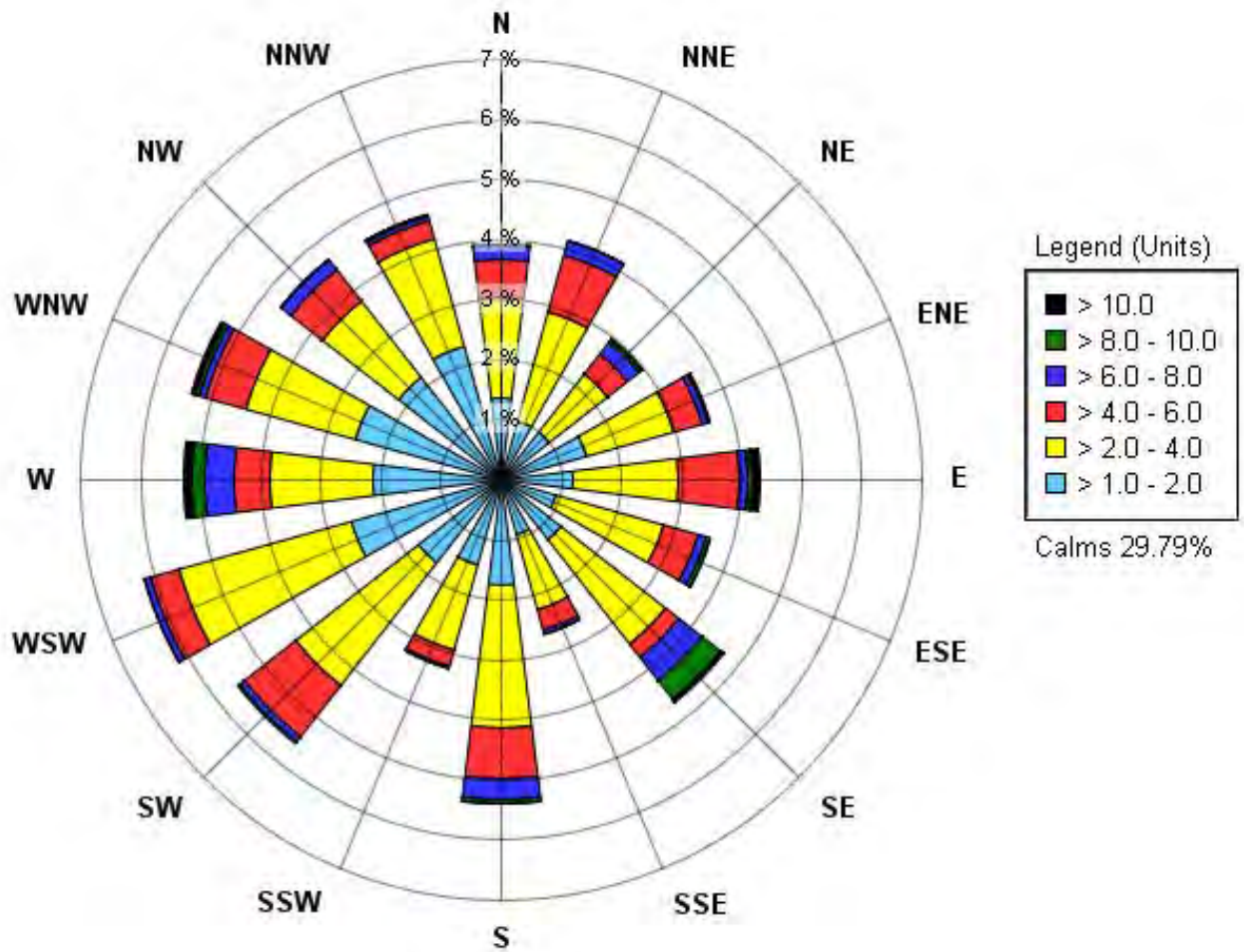


Wind Rose Plot – Monitor E – Operational Data
October 28, 2018 to November 20, 2019, Night Only

Jericho Wind Energy Centre, Lambton County, Ontario Project #1501440

Drawn by: ACCL | Figure: 9a

Date: June 4, 2020



Wind Rose Plot – Monitor E – Ambient Data
October 28, 2018 to November 20, 2019, Night Only

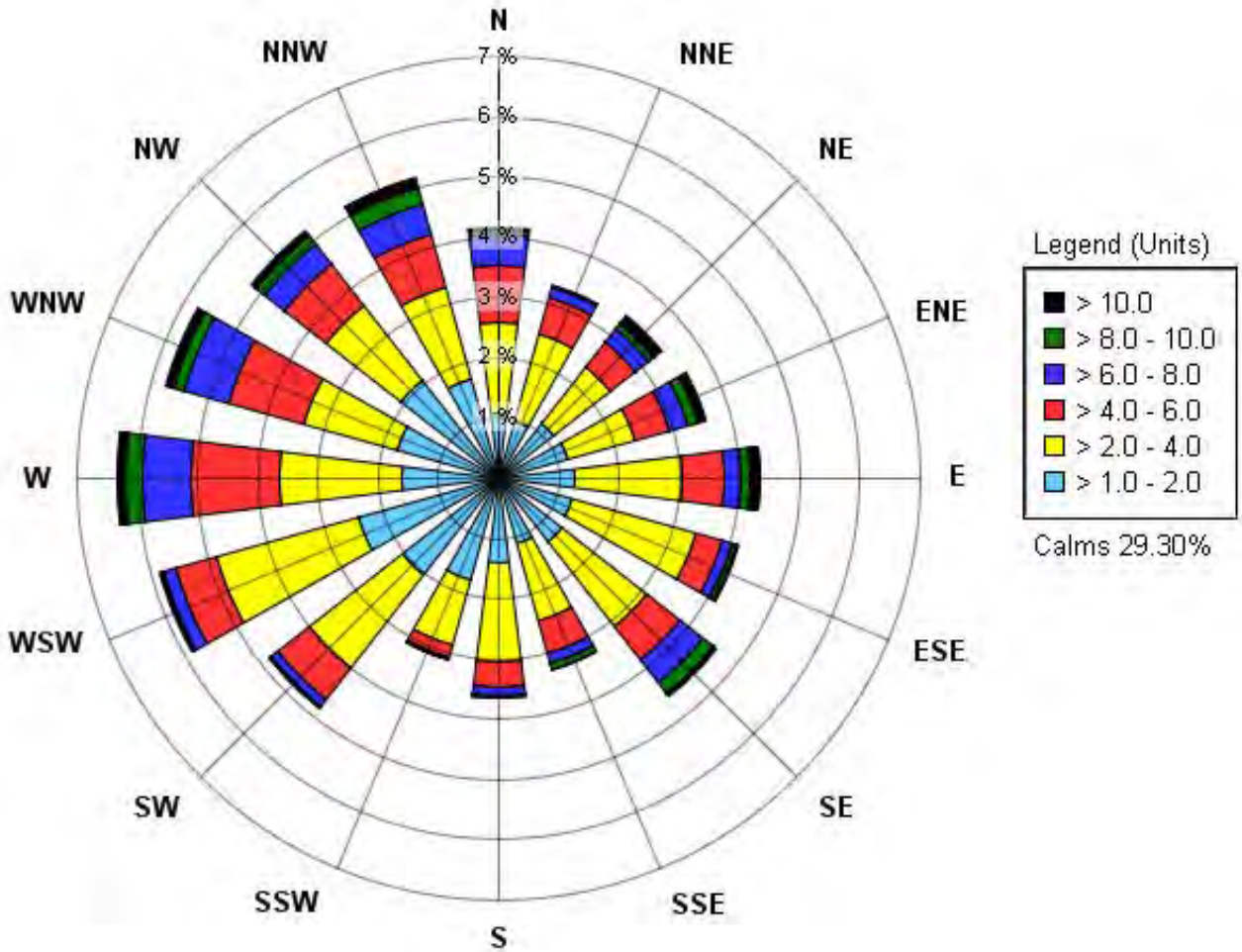
Jericho Wind Energy Centre, Lambton County, Ontario

Project #1501440

Drawn by: ACCL

Figure: 9b

Date: June 4, 2020



Wind Rose Plot – Monitor E – All Data
October 28, 2018 to November 20, 2019, Night Only

Jericho Wind Energy Centre, Lambton County, Ontario

Project #1501440

Drawn by: ACCL

Figure: 9c

Date: June 4, 2020