RSG INC.
RESOURCE SYSTEMS GROUP, INC.

Environment, Energy & Acoustics

Kingdom Community Wind Sound Compliance Testing Report: Fall 2012

26 February 2013

Prepared by
Resource Systems Group, Inc.
for
Green Mountain Power Corporation

Resource Systems Group, Inc.
55 Railroad Row
White River Junction, VT 05001
TEL 802.295.4999 | FAX 802.295.1006
www.rsginc.com

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

This report provides monitoring results for sound compliance testing that was conducted at Kingdom Community Wind (KCW) from December 6, 2012 to January 15, 2013. The monitoring was conducted in accordance with the *Final Monitoring Protocol: Kingdom Community Wind* (the Monitoring Protocol) dated April 2012 as required by the project's Certificate of Public Good (CPG). This report includes:

- A primer on sound and terminology
- A description of the project including, information about the project area, turbines, and modeled sound levels
- Measurement methodology including when turbines were functioning under noise reduced operation (NRO)
- Measurement results
- A discussion of potential exceedances of the limits set in the CPG
- Conclusions

The report includes detailed appendices with operational data, background monitoring, time histories, and 10-minute data for each turbine including wind speed, electrical output, and NRO mode.

2.0 SOUND TERMINOLOGY PRIMER

1.1 How is Sound Described?

Sound is caused by variations in air pressure at a range of frequencies. Sound levels that are detectable by human hearing are defined in the decibel (dB) scale, with 0 dB being the approximate threshold of human hearing, and 135 dB causing pain and permanent damage to the ear. Figure 1 shows the sound levels of typical activities that generate noise.

The decibel scale can be weighted to mimic the human perception of certain frequencies. The most common of these weighting scales is the "A" weighting. It is used most frequently in environmental noise analyses. Sound levels that are weighted by the "A" scale have units of dBA or dB(A).

1.2 Description of Terms

Sound can be measured in many different ways. Perhaps the simplest way is to take an instantaneous measurement, which gives the sound pressure level at an exact moment in time. The level reading could be 62 dB, but a second later it could 57 dB. Sound pressure levels are constantly changing. It is for this reason that it makes sense to describe noise and sound in terms of time.

The most common ways of describing noise over time is in terms of various levels. Take as an example, the sound levels measured over time shown in Figure 2. Instantaneous measurements are

shown as a ragged grey line. The sound levels that occur over this time can be described verbally, but it is much easier to describe the recorded levels statistically. This is done using a variety of "levels" which are described below.

1.2.1 Equivalent Average Sound Level - Leq

One of the most common ways of describing noise levels is in terms of the continuous equivalent sound level (Leq). The Leq is the average of the sound pressure over an entire monitoring period and expressed as a decibel. The monitoring period could be for any amount of time. It could be one second (Leq 1-sec), one hour (Leq(1)), or 24 hours (Leq(24)). Because Leq describes the average pressure, loud and infrequent noises have a greater effect on the resulting level than quieter and more frequent noises. For example, in Figure 2, the median sound level is about 47 dBA, but the equivalent average sound level (Leq) is 53 dBA. Because it tends to weight the higher sound levels and is representative of sound that takes place over time, the Leq is the most commonly used descriptor in noise standards and regulations. The KCW monitoring protocol requires the reporting of hourly Leq for comparison to permit noise limits.

1.2.2 Percentile Sound Level - Ln

Ln is the sound level exceeded n percent of the time. This type of statistical sound level, also shown in Figure 2, gives us information about the distribution of sound levels over time. For example, the L10 is the sound level that is exceeded 10 percent of the time, while the L90 is the sound level exceeded 90% of the time. The L50 is exceeded half the time. The L90 is a residual base level which most of the sound exceeds, while the L10 is representative of the peaks and higher, but less frequent levels. When one is trying to measure a continuous sound, like a wind turbine, the L90 is often used to filter out other short-term environmental sounds that increase the level, such as dogs barking, vehicle passbys, wind gusts, and talking. That residual sound, or L90, is then the sound that is occurring in the absence of these noises. The KCW monitoring protocol specifies that L90s will be reported for each hour.

1.2.3 Lmin and Lmax

Lmin and Lmax are simply the minimum and maximum sound level, respectively, monitored over a period of time.

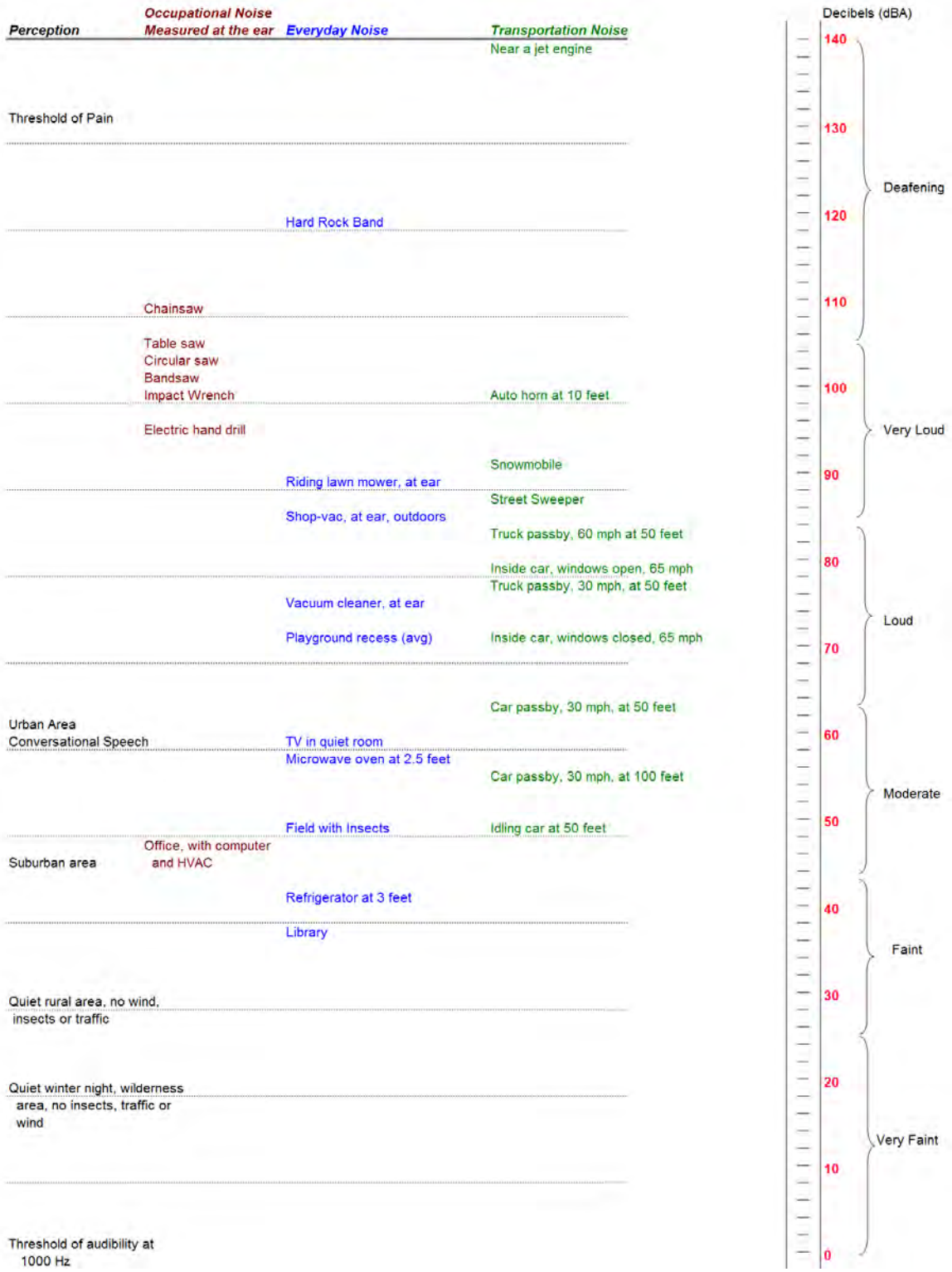


Figure 1: Common Sounds in A-weighted Decibels

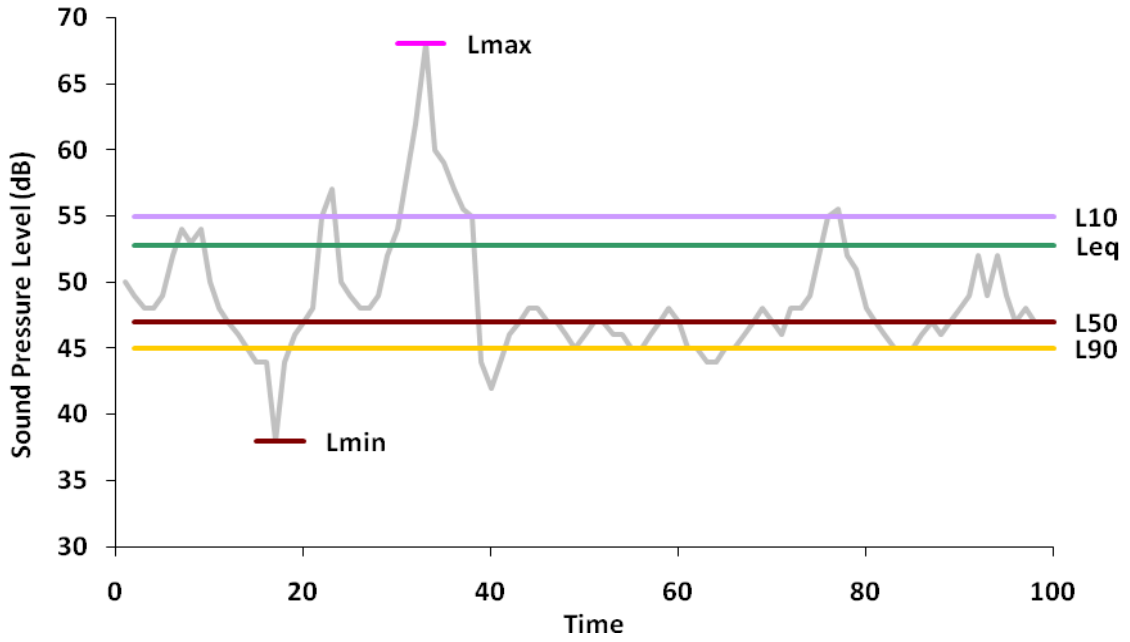


Figure 2: Example of Descriptive Terms of Sound Measurement over Time

3.0 PROJECT DESCRIPTION

3.1 General Area

Kingdom Community Wind is a wind power project located in the southeast corner of Lowell, Vermont along an approximately 3.2 mile ridge which runs parallel to VT 14 (east of the project) and VT 100 (west of the project). The area around the mountain is primarily forested with a few open fields at the base. The village of Albany is located approximately 2.5 miles east of the turbines, and VT 100 is between 1.1 and 2.4 miles west of the turbines.

The closest residences are to the northwest on Farm Road generally between 3,400 and 5,500 feet to the nearest turbine and east of the project on Eden Road and Baily Hazen Road generally between 3,600 and 4,750 feet to the closest turbine.

A map of the area is provided in Figure 3. Figure 3 also shows the four monitoring locations that were chosen according to the Monitoring Protocol and defined in the *Kingdom Community Wind: Preliminary Sound Monitoring Report* dated November 2012 (Preliminary Monitoring Report). Additional details on the monitoring locations are provided in Section 4.6 of this report.

Figure 3: Area Map with Monitoring Locations

3.2 Project Turbines

The project is composed of 21 Vestas V112 3.0 MW wind turbines. The V112 is a pitch regulated wind turbine with a hub height of 84 meters. The turbine operates at variable rotor speeds with electronic controls to help minimize sound emissions at certain times (Noise Reduced Operations or NRO). The guaranteed maximum sound power level from the V112 is 106.5 ± 2.0 dBA. Sound power levels by wind speed and by octave band are provided in Figure 4 and Figure 5, respectively.

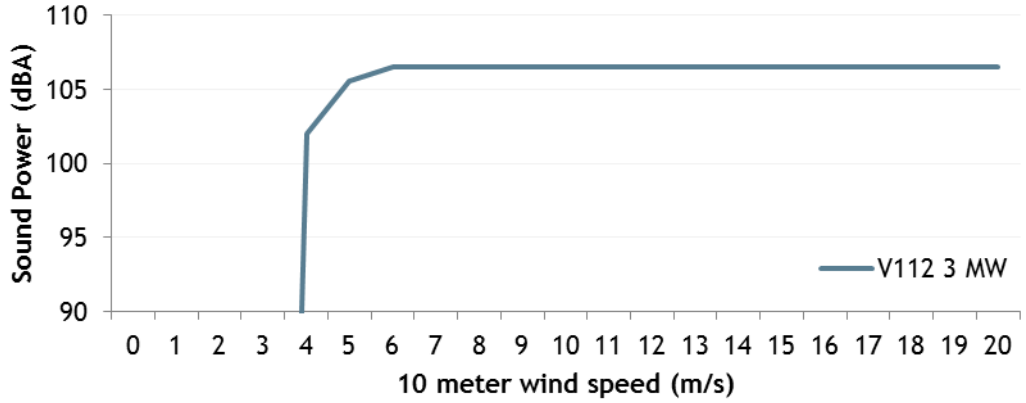


Figure 4: Sound Power Level (dBA) of the Vestas V112 by Wind Speed

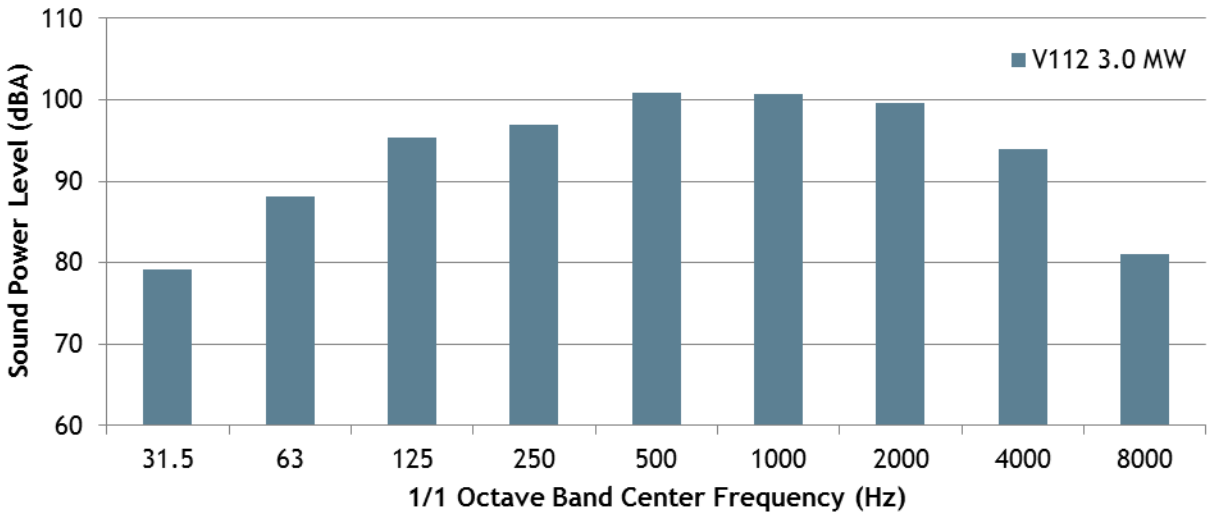


Figure 5: Sound Power Level (dBA) of the Vestas V112 by 1/1 Octave Band Frequency

3.3 Modeled Sound Levels

Modeled sound levels from Kingdom Community Wind are provided in Figure 6. The model run in Figure 6 includes standard meteorological conditions[1] modeled with ISO 9613-2, and no Noise Reduced Operation (NRO) modes on any of the wind turbines. As shown in the map, the monitor locations are in areas near residences that are projected to receive the highest sound levels from the project.

[1] Additional modeling was conducted using Concawe meteorological adjustments and are not included here.

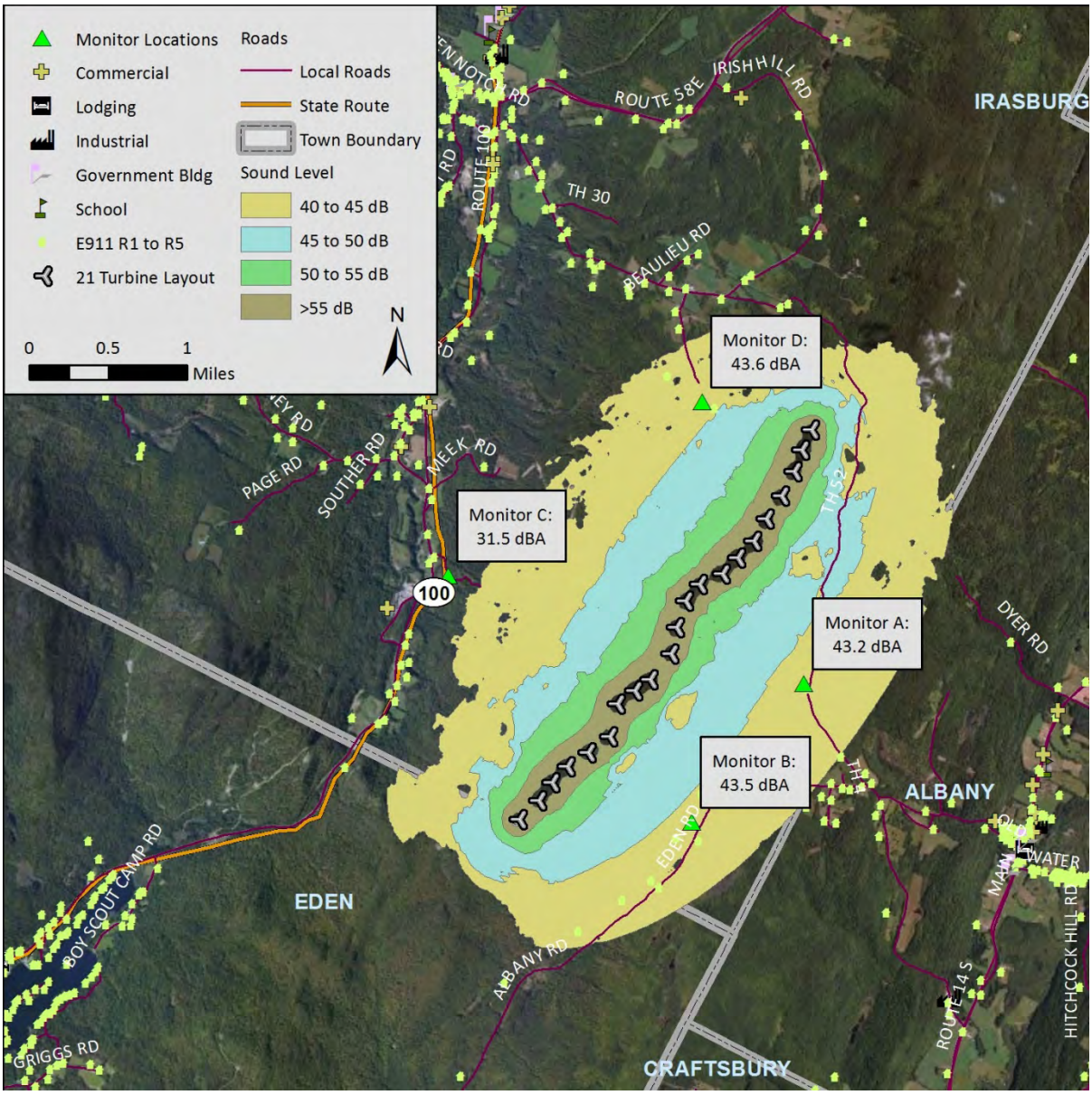


Figure 6: Modeled Sound Levels from Kingdom Community Wind (No NROs)

3.4 CPG Noise Limits

Kingdom Community Wind's Certificate of Public Good (CPG) sets noise limits for the project in Condition 39 which reads:

> 39. The Petitioners shall construct and operate the proposed project so that the turbines emit no prominent discrete tones pursuant to ANSI standards[2] at the receptor locations,

[2] A "prominent discrete tone" is defined in ANSI S12.9/Part 3 1993, "Quantities and Procedures for Description and Measurement of Environmental Sound." A tone is said to exist if the 1/3 octave band

and project-related sound levels at any existing surrounding residences do not exceed 45 dBA(exterior)(Leq)(1 hr) or 30 dBA (interior bedrooms)(Leq)(1 hr).

4.0 METHODOLOGY

4.1 Background Sound Monitoring

A soundscape is composed of the sum of the sound from different sources. In order to measure any one of those sources individually, it is necessary to separate the sound produced by the source of interest from all other sources (the background sound level). This is particularly important when compliance with an absolute sound level limit is being assessed.

There are five methods described in Section 2.7 of the Monitoring Protocol. Method 4, which was found to be unsuitable, was tested before Kingdom Community Wind commenced operation and was reported in the Preliminary Monitoring Report dated November 2012. For this round of monitoring, we utilized Method 3 and Method 2 of the Monitoring Protocol which are described below:

- **Method 3**
  - General Description: "If the microphone is 3 to 5 feet from the house, the home would act as a barrier to the wind turbine noise. The advantage of this method is that levels can be measured at the home in question. The disadvantage is that low frequencies may not be attenuated to the extent required for an accurate background measurement and other noise sources on the turbine side of the house, such as traffic, are attenuated as well.
  - Implementation Details: "At each site for which this technique is used, measurements will be made on the turbine side and opposite side of the building or nearby other outbuilding when the wind turbine is in operation. If attenuation of each octave band sufficient to eliminate Project sound can be achieved by the building, then this method will be used for background measurements. If not, then the following, Turbine Shutdown Method will be used."
- **Method 2**
  - General Description: "Turning off wind turbines allows a direct comparison between periods with and without turbines operating. The advantage is that background levels during the particular time and place are easily identified. The disadvantage is that many shutdowns may be required, affecting system reliability. Under ideal situations, the turbines would only be shut off when sound levels exceeded 45 dBA, but that would require continuous manned observations or wireless telemetry over the two-week period."

containing the suspected tone exceeds the arithmetic average of the two adjacent bands by 15 dB for frequencies below 125 Hz, 8 dB for frequencies between 160 and 400 Hz, and 5 dB for frequencies above 500 Hz.

- Implementation Details: "During the measurement program, the 12 turbines closest to the monitoring site will be shut down for 20 minutes at a time no less than every eighth hour that the hub height wind speeds are at 6 m/s or above. Alternatively, the turbines can be shut down for 20 minutes only when monitoring indicates 45 dBA is exceeded at the sound monitoring locations."

Method 2 was used at all sites, and Method 3 was used at Monitors A (Nelson), Monitor B (Eden Road), and Monitor D (Farm Road). Method 3 could not be used at Monitor C (VT 100) because there was no buildings near the primary monitor location at this site. For purposes of this report, "primary monitor" refers to the monitor at each site that was unshielded by a building while "background monitor" refers to the monitor at Monitors A, B, and D which were used for Method 3 background.

4.2 Sound Monitoring Logistics & Equipment

Sound monitoring was conducted in accordance with the Monitoring Protocol. As with the monitoring conducted in August and September of 2012 for the Preliminary Monitoring Report, RSG and a Third Party Observer, Cavanaugh Tocci Associates (CTA), visited each monitoring site shown in Figure 3, and RSG installed sound monitoring equipment.

At each of the primary monitoring sites, sound level data was collected using ANSI/IEC Type 1 sound level meters logging 1/3 octave band sound levels once each second, along with a sound recorder. For each of the background monitoring sites, sound level data was collected using ANSI/IEC Type 1 sound level meters logging 1/3 octave band sound levels once each second, although an ANSI/IEC Type 2 sound level meter which logged overall equivalent sound levels (dBA) was used at the Monitor D background site from December 24 to January 11 while the Type 1 meter was serviced.

Microphones were mounted on 1.5 meter tall wooden stakes and covered with 7 inch ACO-Pacific weather resistant windscreens. At each of the primary monitoring locations an anemometer, set at microphone height, was used to measure wind speed. A rain gauge and temperature sensor was also set at the Monitor D site.

4.3 Monitoring Timeframe

Sound monitoring was conducted from December 6, 2012 to January 12, 2013. This timeframe includes two weeks in the autumn and approximately three and a half weeks in the winter. The next compliance monitoring period is currently under way.

Monitoring equipment was installed on December 6, and regular check-ups approximately every 7 to 10 days were conducted to update power, download data, and calibrate equipment. The total run time for sound level meters, audio recorders, and weather sensors at each monitor is provided in Table 1.

Table 1: Number of Days of Sound Level, Audio, and Weather Data Collected at Each Monitor

Monitor	Monitor Type	Equipment	Equipment Brand/Model	Run Time (Days)
A - Nelson	Primary	Sound Level Meter	Cesva SC-310	37.3
		Sound Recorder	Roland Edirol R-05	32.3
	Background	Sound Level Meter	Larson Davis LD 831	29.3
		Anemometer	Onset HOBO	40.1
B – Eden Road	Primary	Sound Level Meter	Cesva SC-310	37.9
		Sound Recorder	Roland Edirol R-09 HR	37.9
	Background	Sound Level Meter	Larson Davis LD 831	36.7
		Anemometer	Onset HOBO	39.8
D – Farm Road	Primary	Sound Level Meter	Cesva SC-310	29.8
		Sound Recorder	Roland Edirol R-09 HR	32.4
	Background	Sound Level Meter	Cesva SC-310/Rion NL-22	26.4
		Anemometer	Onset HOBO	12.9
C - Vermont 100	Primary	Sound Level Meter	Cesva SC-310	17.8
		Sound Recorder	Roland Edirol R-09 HR	22.1
		Anemometer	Onset HOBO	40.0

4.4 Data Processing

Data was summarized into 10-minute periods. Data during some periods were removed from the results. These periods include when:

- Wind speeds at a monitoring site were above 5 m/s
- The temperature was below 14˚F
- Rain was present
- Anomalous sound sources and sounds that were due to animal interaction
- Spikes (such as wind-caused microphone clipping) that are not consistent with turbine operations and times when the wind farm is not operating

Extended periods that contained multiple wind-caused clipping were also eliminated.

4.4.1 Background Method 3 Data Processing

For Method 3 sound levels were summarized into 10-minute periods. Periods were eliminated in the same way described in Section 4.4. In addition all further wind-caused audio clipping was eliminated, as were discrete sound sources that were not present at both monitoring locations. After the data was processed the 10-minute background data periods were logarithmically subtracted from the primary data. Compliance was then tested by taking the energetic average of six consecutive periods resulting in a one-hour equivalent sound level.

4.4.2 Background Method 2 Data Processing

During the monitoring period KCW was shut down at the regular intervals shown, in Table 2, to allow measurement of the background sound levels. The investigated periods were those when the existence of a curtailment period could be determined by visually scanning spectrograms of the monitoring period. Periods were further eliminated if the conditions described in Section 4.4 were present. Then data with anomalous sound events (only present during either the curtailment period or the normal-operation period) and wind-caused audio clipping was eliminated. After this data filtering was completed, the curtailment period sound levels were subtracted from the 1-hour periods before and after the curtailment period to test compliance.

Table 2: Curtailment Schedule

12/6/12 -12/21/12			12/22/12 - 12/27/12		12/29/12 - 1/7/13		12/27/12, 12/28/12, 1/8/13 -		
Operation Type	Begin	End	Begin	End	Begin	End	Operation Type	Begin	End
Curtailment	3:00	3:20	12/22/12 9:00	12/22/12 9:20	None		Curtailment	4:00	4:20
Normal Operation	3:20	7:00	12/24/12 20:00	12/24/12 20:20			Normal Operation	4:20	12:00
Curtailment	7:00	7:20	12/25/12 12:00	12/25/12 12:20			Curtailment	12:00	12:20
Normal Operation	7:20	11:00	12/26/12 19:00	12/26/12 19:20			Normal Operation	12:20	20:00
Curtailment	11:00	11:20	12/26/12 23:00	12/26/12 23:20			Curtailment	20:00	20:20
Normal Operation	11:20	15:00	12/27/12 3:00	12/27/12 3:20			Normal Operation	20:20	4:00
Curtailment	15:00	15:20	12/27/12 7:00	12/27/12 7:20			Curtailment	-	-
Normal Operation	15:20	19:00	-	-			Normal Operation	-	-
Curtailment	19:00	19:20	-	-			Curtailment	-	-
Normal Operation	19:20	23:00	-	-			Normal Operation	-	-
Curtailment	23:00	23:20	-	-			Curtailment	-	-
Normal Operation	23:20	3:00	-	-			Normal Operation	-	-

4.4.3 Tonality Data Processing

Spectra from the curtailment analysis were analyzed in accordance with ANSI 12.9 part 3 tonality's definition, to determine the existence of any tones. First the background sound level spectra as measured during the curtailment periods were subtracted from the operational spectra from the 1-hour periods before and after the curtailment to see if any prominent discrete tones were potentially due to turbine operations (turbine only spectra). If a potential prominent discrete tone was identified from the turbine only spectra, ANSI 12.0 part 3 was then applied to the spectra from the primary monitor which includes both background sound and the sound from the wind turbines to see if the tone was still a prominent discrete tone or if it was masked by the background sound.

4.5 NRO Plan

KCW is currently operating under an initial Noise Reduced Operation (NRO) schedule as defined below in Table 3. RSG reviewed NRO data from KCW and found that this NRO schedule was being followed.

Since this is the first compliance monitoring session, there have been no changes to the initial NRO schedule. Following future compliance monitoring sessions, changes may be made to the NRO schedule and will be reported in future compliance monitoring reports if NRO changes occur.

Table 3: Initial NRO Schedule

Turbine ID	NRO Mode	Start Time	End Time
1	3 dB	4:00 PM	8:00 AM
2 through 5	2 dB	4:00 PM	8:00 AM
6 through 10	None		
11 through 18	2 dB	4:00 PM	8:00 AM
18 through 21	None		

4.6 Individual Monitoring Sites

4.6.1 Monitor A - Nelson Farm (East)

Monitor A was at the Nelson Farm on Baily Hazen Road. The primary monitor was set in the same location as in the August/September 2012 monitoring for Preliminary Monitoring Report which was approximately 165 feet north of the Nelson's house in an east/west sloping grassy field, with scattered trees. The ground elevation at this location is approximately 1,490 feet. The closest turbine is approximately 4,590 feet west-northwest.

The background monitor at this site was placed on the southeast side of the barn which is located across Bailey Hazen Road, northeast of the Nelson residence. Due to limitation immediately next to the building including potential snowfall from the roof, the microphone was placed approximately 10 feet east of the barn façade. There was limited line-of-sight to some further turbines to the south, but line-of-sight to the closest turbines was cut-off by the barn.

A map of the primary and background monitor locations at Monitor A is provided in Figure 7, and photographs of the two locations are provided in Figure 8 and Figure 9.

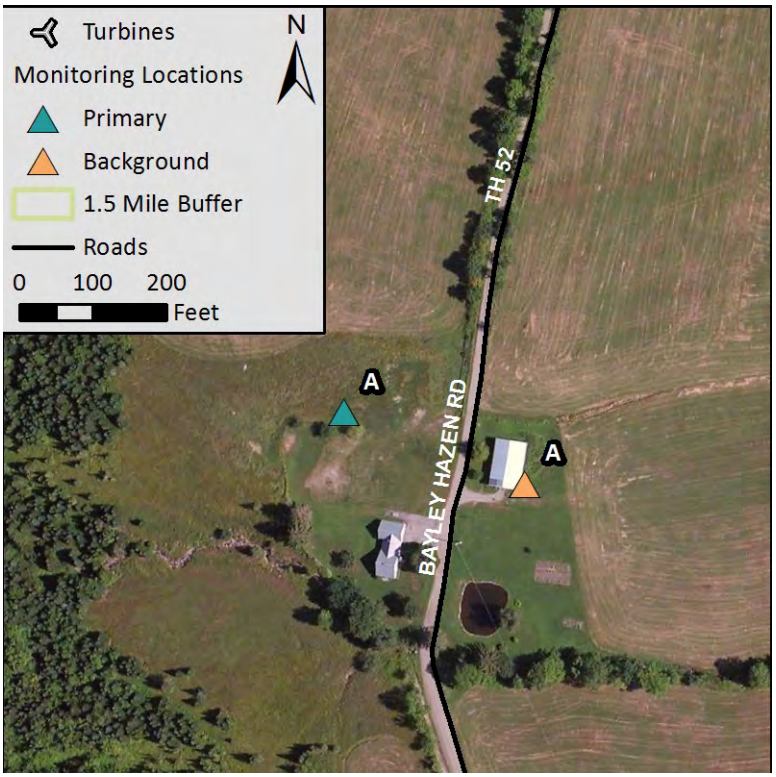


Figure 7: Monitor A (Nelson) Primary and Background Monitoring Location Map

Figure 8: Photograph of the Monitor A Primary Monitoring Location

Figure 9: Photograph of the Monitor A Background Monitoring Location

4.6.2 Monitor B - Eden Road (East)

Monitor B was at an abandoned camp on Eden Road. The primary monitor was set in the same location as in the August/September 2012 monitoring for Preliminary Monitoring Report which was approximately 180 feet west of Eden Road and 65 feet north of the camp structure on the property. This location was 5,900 feet west-southwest of the intersection of Eden Road and Bailey Hazen Road and 3,340 feet southeast of the nearest wind turbine. The site has similar vegetation density and distance to Eden Road as other residences along the road.

The background monitor at this site was placed on the northeast side of the camp structure. The microphone was installed approximately 5 feet east of the structure's façade and out of the line-of-sight to the wind turbines.

A map of the primary and background monitor locations at Monitor B is provided in Figure 10, and photographs of the two locations are provided in Figure 11 and Figure 12.

Figure 10: Monitor B (Eden Road) Primary and Background Monitoring Location Map

Figure 11: Photograph of the Monitor B Primary Monitoring Location

Figure 12: Photograph of the Monitor B Background Monitoring Location

4.6.3 Monitor C - VT 100 (West)

Monitor C was set in the same location as in the August/September 2012 monitoring for Preliminary Monitoring Report which was in a small clearing along an unimproved road that continues after the terminus of Steward Hill Road. This location is approximately 550 feet east of Vermont 100. The ground elevation at this location is approximately 1,280 feet. The closest turbine is approximately 6,890 feet southeast of the monitor. The site is representative of the closest residences to the project along Vermont 100, but also somewhat distant from the road to minimize traffic noise.

As discussed in Section 4.1, no background monitor was placed at this site due to the lack of a structure on the site.

A map of the monitor location at Monitor C is provided in Figure 13, and a photograph of the location is provided in Figure 14.

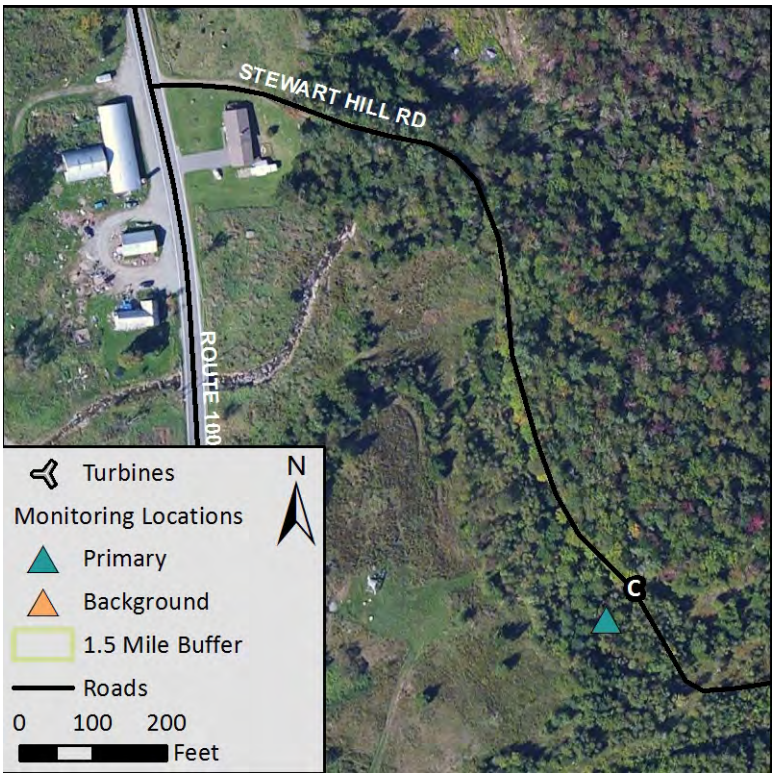


Figure 13: Monitor C (Vermont 100) Monitoring Location Map

Figure 14: Photograph of the Monitor C Monitoring Location

4.6.4 Monitor D - Farm Road (North)

Monitor D was at the terminus of Farm Road on the northwest flank of Lowell Mountain. The primary monitor was set in the same location as in the August/September 2012 monitoring for Preliminary Monitoring Report which was approximately 130 feet west of Farm Road, 3,610 feet south of the intersection of Farm Road and Irish Hill Road, and 3,610 feet west of the nearest turbine. The primary monitor was set on the edge of a small group of trees approximately 100 feet

south of the house on the property which is owned by the project. The elevation at this site is approximately 1,690 feet.

The background monitor at this site was placed on the northwest side of the house. The microphone was installed approximately 4 feet north of the house façade and out of the line-of-sight to the wind turbines.

A map of the primary and background monitor locations at Monitor D is provided in Figure 15, and photographs of the two locations are provided in Figure 16 and Figure 17.

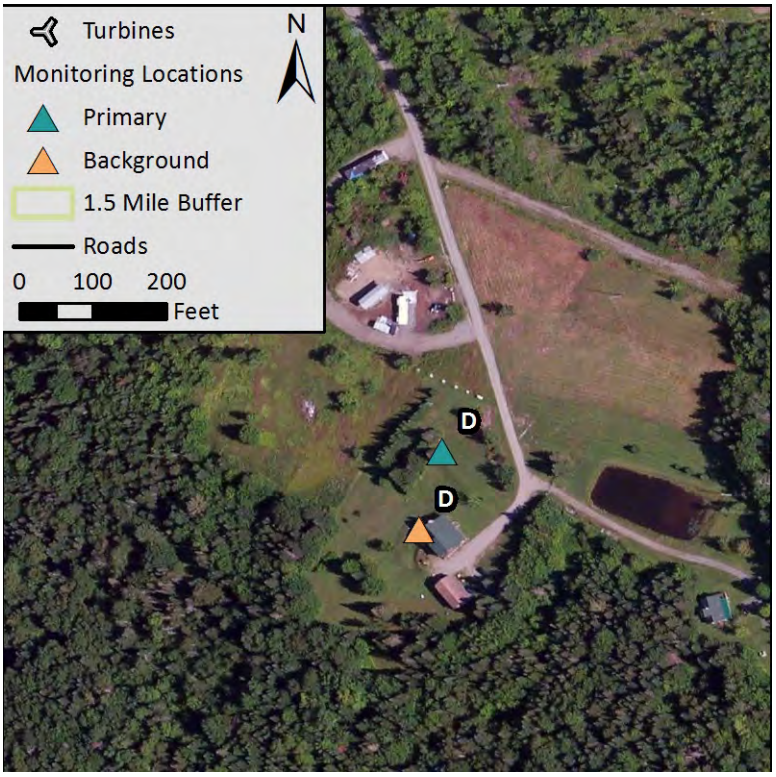


Figure 15: Monitor D (Farm Road) Primary and Background Monitoring Location Map

Figure 16: Photograph of the Monitor D Primary Monitor Location

Figure 17: Photograph of the Monitor D Background Monitor Location

5.0 RESULTS

5.1 Turbine Operations

A summary of the turbine operations during the monitoring period for the entire project is provided in Figure 18 through Figure 23. More detailed information for each turbine is provided in Appendix D.

The periodic curtailments scheduled for Method 2 background measurements is clearly seen in the figures below by the sudden periodic drop in Total Project Output. The figures also show:

- Several periods where 15 or more turbines were operating simultaneously
- Several periods, especially in January, when the Total Project Output exceeded 30 MW.

- Some extended periods where no turbines were operating such as portions of December 8, 8, 10, and 11, and periods of several days such as December 18 to December 21 or December 29 to January 4. RSG's understanding from GMP is that KCW was limited by ISO New England at the beginning of the monitoring period to a limited total power output, and turbines were curtailed for some periods at the end of December due to blade icing issues.

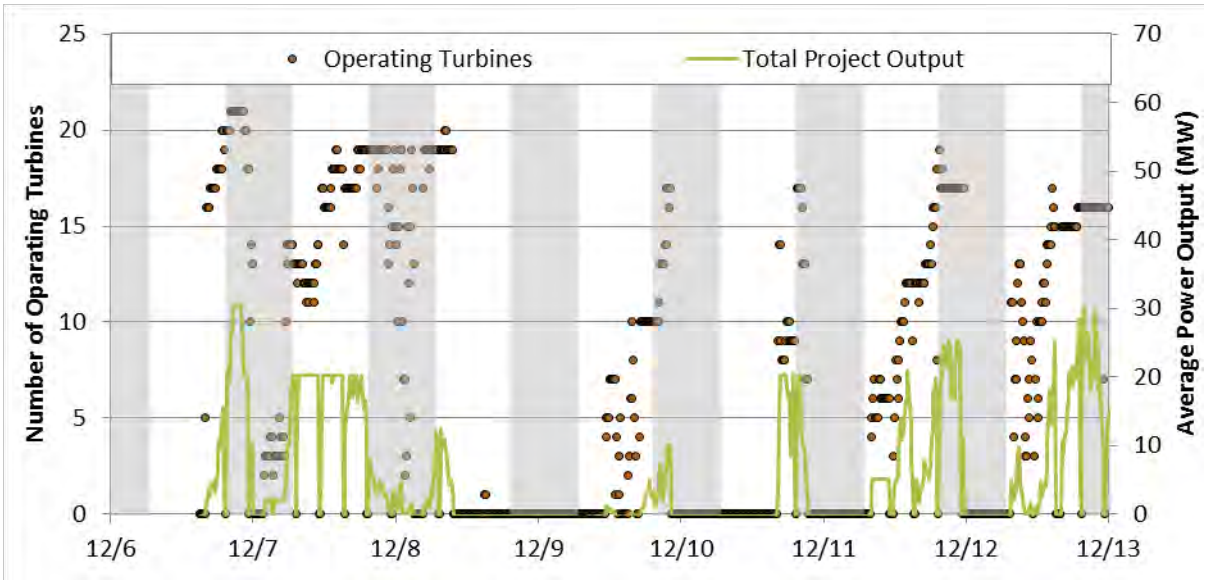


Figure 18: Project Activity - Part 1

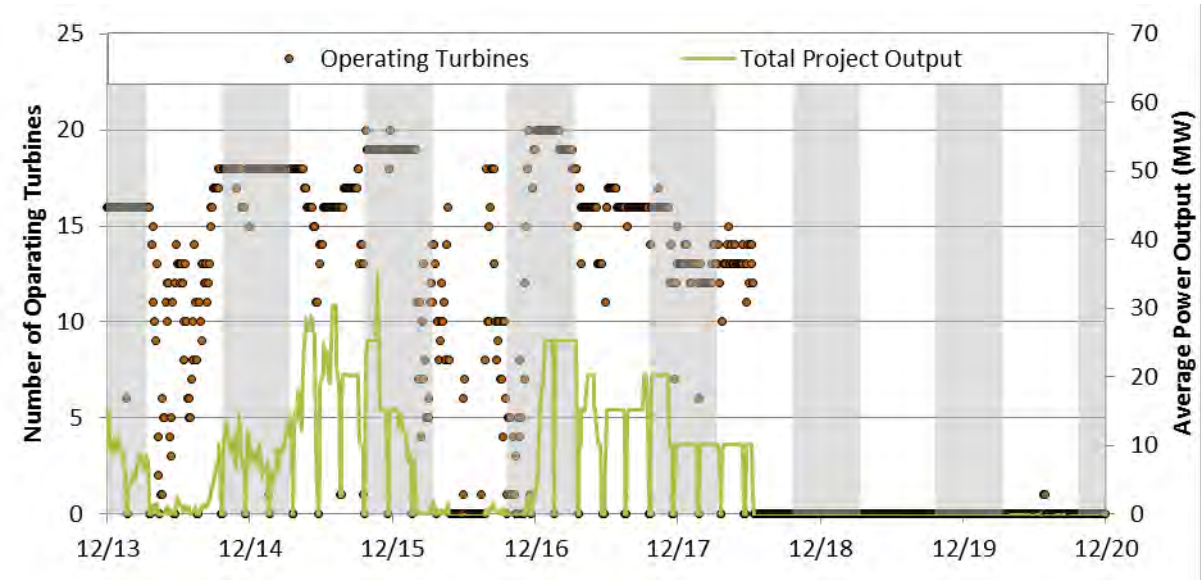


Figure 19: Project Activity - Part 2

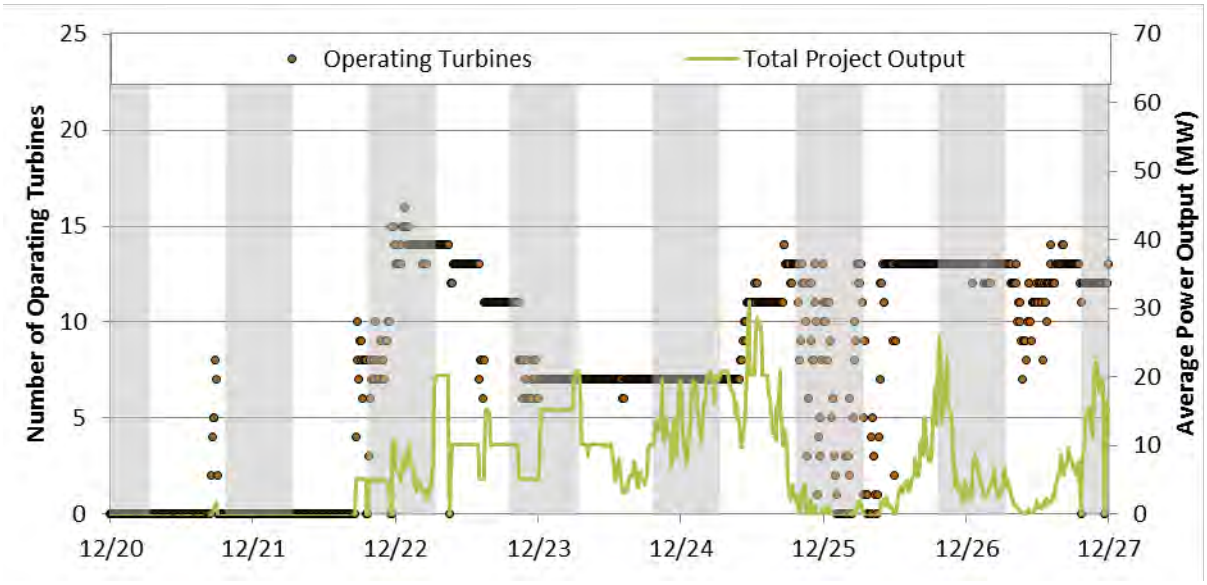


Figure 20: Project Activity - Part 3

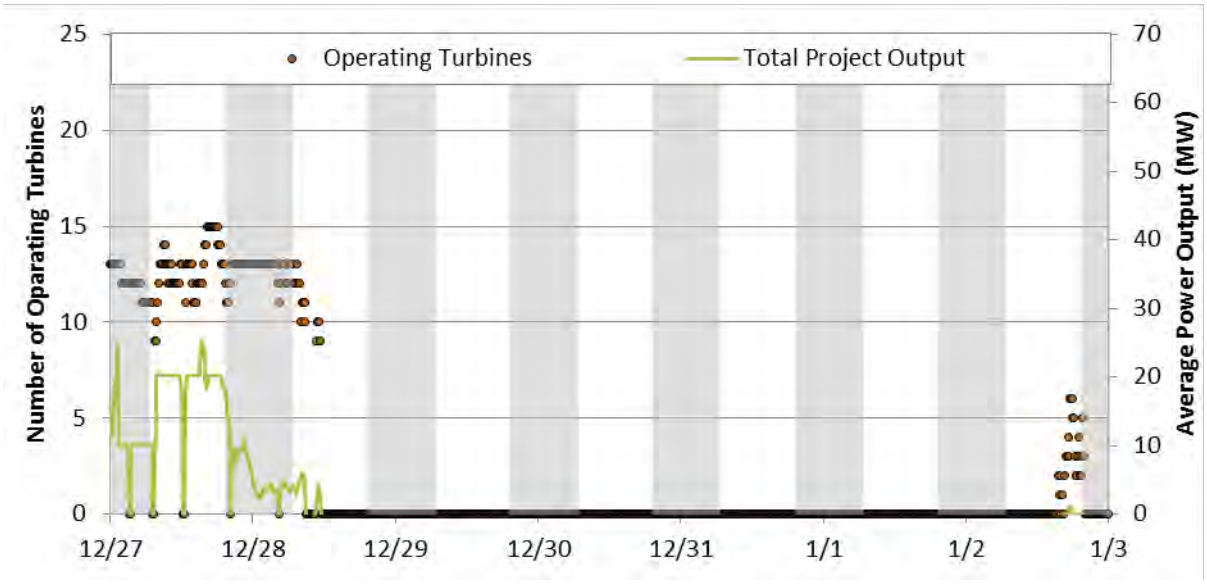


Figure 21: Project Activity - Part 4

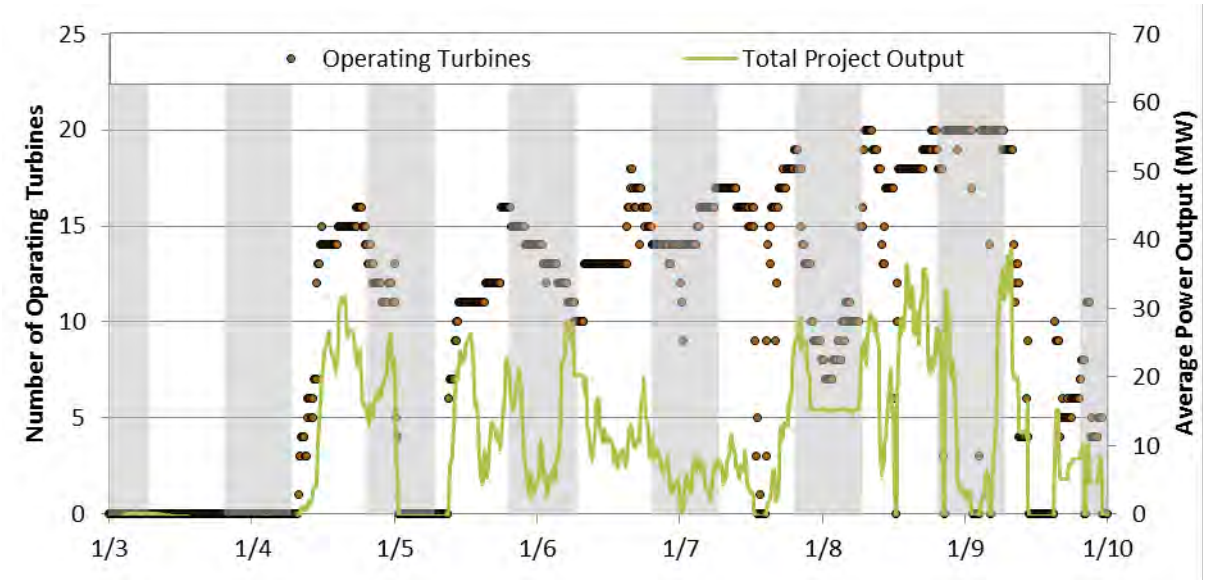


Figure 22: Project Activity - Part 5

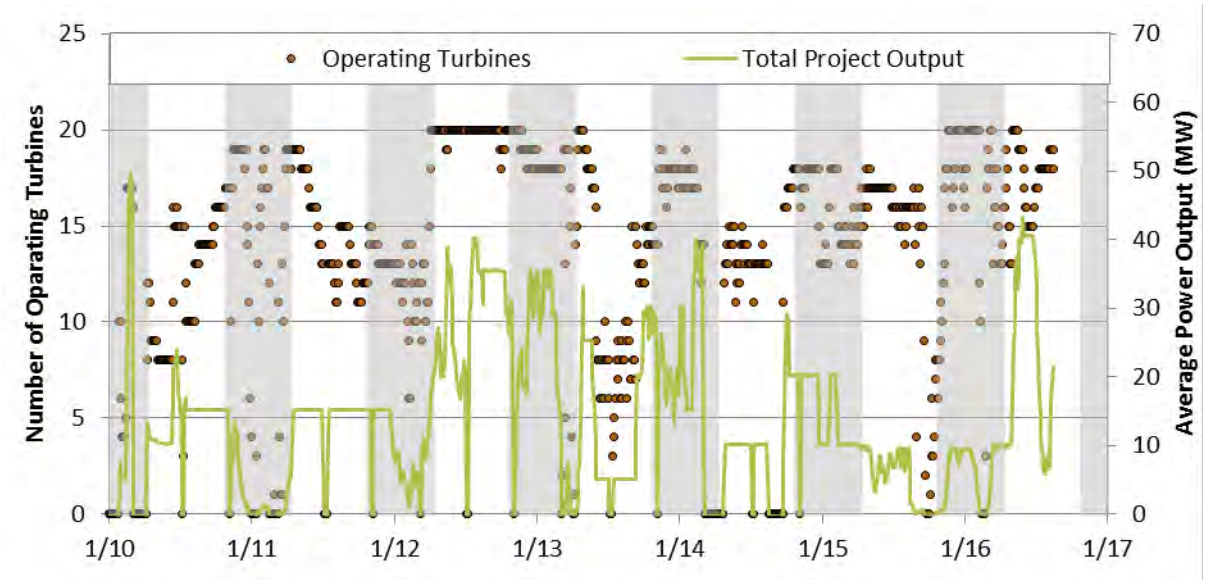


Figure 23: Project Activity - Part 6

5.2 Weather & Meteorology

Weather conditions during the monitoring period varied. Temperatures ranged from -16˚F to 51˚F. There were several periods of rain and cold temperatures (below 14˚F) during the monitoring period. These periods, as previously discussed, were excluded from the data analysis and are defined in Table 4 below. Rain and temperature readings were taken from the wunderground.com station in Westfield, Vermont (KVTWESTF3).

Table 4: Excluded Periods of Rain and Low Temperatures

Excluded Periods of Rain		Excluded Periods below 14˚F	
Start Time	End Time	Start Time	End Time
12/8/2012 9:34	12/8/2012 14:49	12/15/2012 9:16	12/16/2012 3:30
12/8/2012 23:30	12/9/2012 1:30	12/24/2012 19:40	12/25/2012 9:17
12/10/2012 7:52	12/11/2012 1:30	12/25/2012 18:12	12/26/2012 10:31
12/18/2012 9:30	12/19/2012 2:30	12/29/2012 1:30	12/29/2012 9:12
12/20/2012 18:32	12/20/2012 19:27	12/30/2012 10:18	12/31/2012 3:00
12/21/2012 9:47	12/21/2012 19:52	1/1/2013 7:26	1/3/2013 21:43
1/11/2013 11:57	1/11/2013 12:47	1/5/2013 15:51	1/5/2013 21:24
1/12/2013 23:00	1/12/2013 23:30	1/7/2013 3:14	1/7/2013 10:22
1/14/2013 7:13	1/14/2013 8:08	1/7/2013 11:21	1/7/2013 11:37
		1/7/2013 16:04	1/7/2013 19:12

Wind data was gathered at each monitoring site and is summarized with the time history sound level results in Appendix B. It should be noted that the anemometer at Monitor D (Farm Road) failed during the monitoring period. Wind speeds at Monitor D (Farm Road) from the August 2012 monitoring were correlated with wind speeds at Monitor C (VT 100), so we have applied wind speeds from Monitor C with a correction multiplication factor of 1.4 to our analysis of Monitor D.

Hub height wind speed for each turbine is provided in Appendix D.

5.3 Monitor A Results

Overall time history sound level results for primary Monitor A are provided in Appendix B along with wind speed at Monitor A and total project power output. Provided in the following sections are the results of the compliance analysis utilizing Method 3 and Method 2 and the results of the tonality analysis.

5.3.1 Background Method 3 Analysis

Compliance analysis results for Monitor A using background Method 3 are provided in Figure 24 through Figure 29.[3] In each of the figures, the 10-minute equivalent sound level at the primary

[3] As previously discussed both Method 3 and Method 2 were utilized for this study to account for background sound levels. By conducting both methods during the same monitoring period, we are able to evaluate Method 3 to determine if the buildings adequately attenuate wind turbine noise across all frequencies. Upon reviewing the data, we determine that Method 3 is not an adequate method for determining the background sound level for a number of reasons including:

- While the overall sound levels at the background monitors were consistently lower than the overall sound levels at the primary monitors, the sound levels measured at the background sound monitors were consistently higher than the background sound levels measured at the primary monitors during curtailment.

monitor is denoted by the dark blue line and the same acoustical parameter at the background monitor is shown in green. As discussed in Section 4.4.1, the 10-minute equivalent sound level at the background monitor was logarithmically subtracted out of the 10-minute equivalent sound level at the primary monitor resulting in a 10-minute equivalent sound level due to the project's wind turbines. For purposes of testing compliance with the project's permit conditions, the data was then summarized into a 1-hour equivalent sound level due to the project's wind turbines which is denoted in the figures by the light orange dots (1-hour Turbine Only). "Turbine Only" sound levels are the sound levels used for comparison with the CPG limit of 45 dBA ($Leq_{1\text{-hour}}$) and represent the sound level caused by the project not background sound.

Utilizing Method 3, the 1-hour equivalent sound level due to wind turbine noise at Monitor A generally ranged from 20 dBA to 40 dBA. There were two overlapping one-hour periods that exceeded the project's outdoor limit of 45 dBA ($Leq_{1\text{-hour}}$). This occurred on January 12, 2013 from 1:10 AM to 2:10 AM with an $Leq_{1\text{-hour}}$ of 45.3 and again from 1:20 AM to 2:20 AM with an $Leq_{1\text{-hour}}$ of 45.3 (Figure 29). Turbine only sound levels also approached 45 dBA on December 28, but did not exceed 45 dBA (Figure 27). More information about the potential exceedance of 45 dBA at Monitor A using Method 3 is provided in Section 6.

- Octave band data from the background monitors show that low to mid frequency sound levels from the wind turbines are not being sufficiently attenuated by the buildings. Graphs for the background monitors at Monitors A, B, and D in Appendix A show the sound levels at these frequencies and how the sound levels decrease at the start of a curtailment period and increase again at the end of the curtailment period indicating that wind turbine noise is not sufficiently attenuated by the buildings.
- Some noise at the background sound monitors is due to sounds associated with the monitors' proximity to the buildings. For example, at the background Monitor D the sound of the furnace in the house cycling on and off is clearly registered at the monitor. Another example is the wind blowing across the barn at Monitor A which causes the metal panels on the barn to generate noise that would be picked up readily by the background monitor, but not by the primary monitor.
- As discussed in the Monitoring Protocol, other noise sources on the turbine side of the structures, such as traffic or wind blowing through foliage, are attenuated as well.

Nonetheless, for this report we have provided an analysis of the results utilizing Method 3 in addition to Method 2 in following sections.

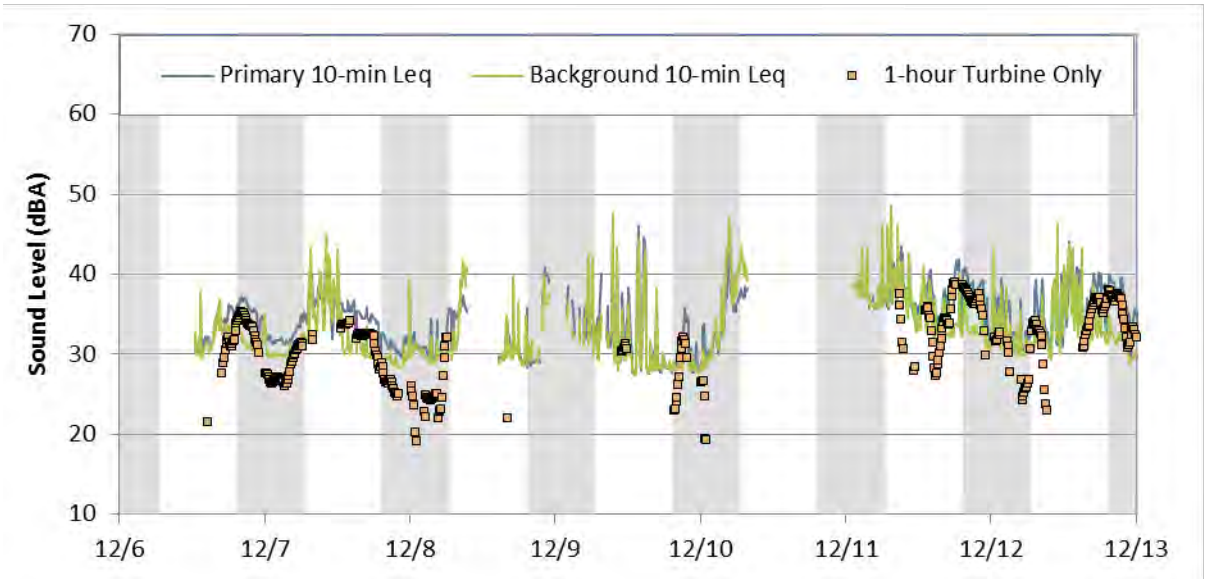


Figure 24: Nelson Method 3 Analysis Results - Part 1

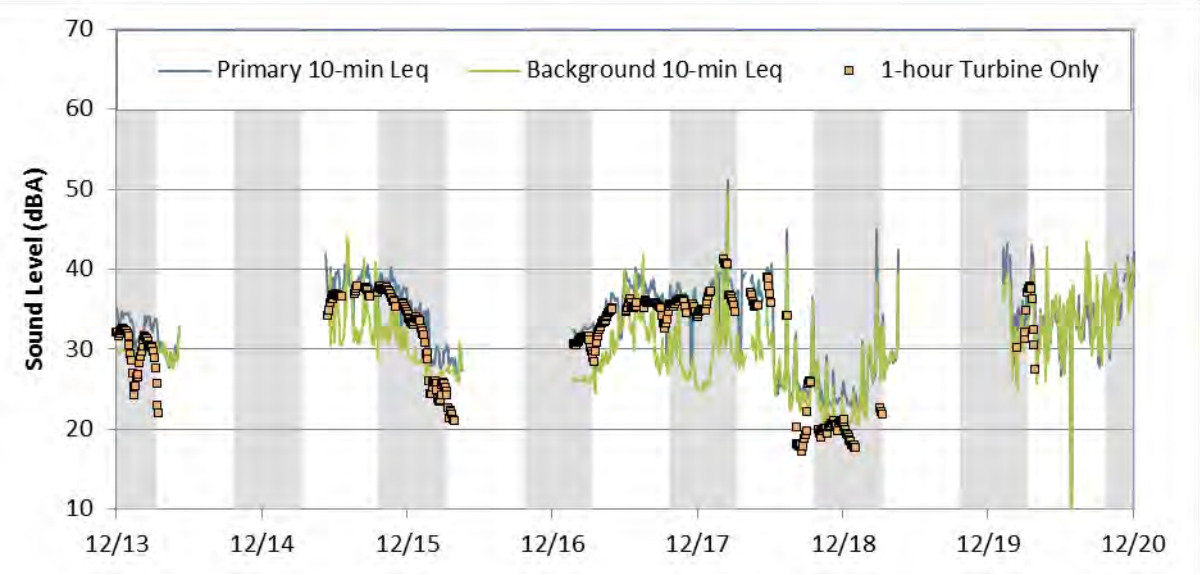


Figure 25: Nelson Method 3 Analysis Results - Part 2

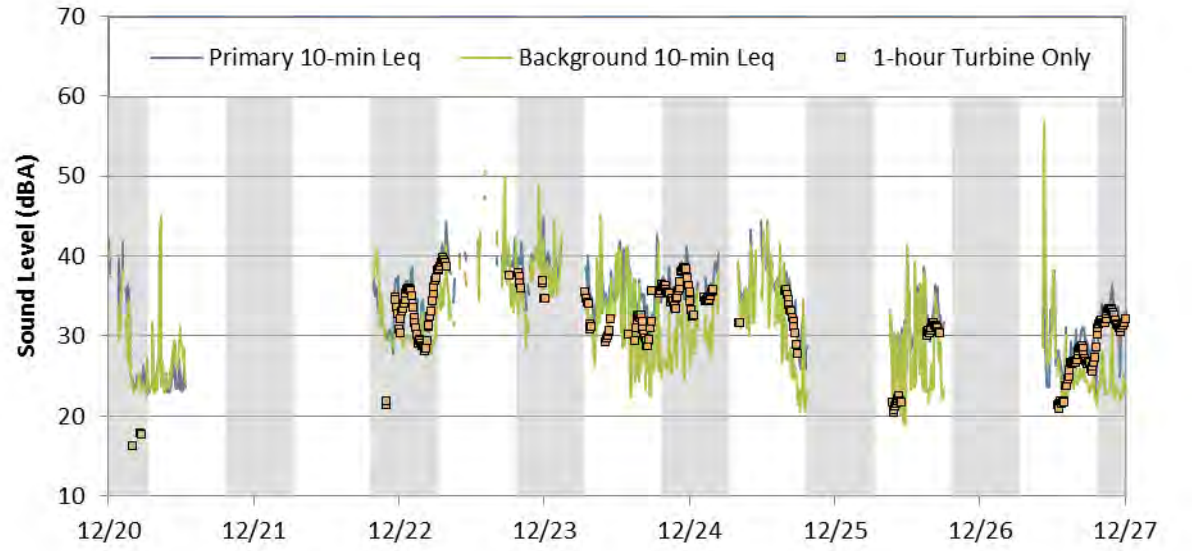


Figure 26: Nelson Method 3 Analysis Results - Part 3

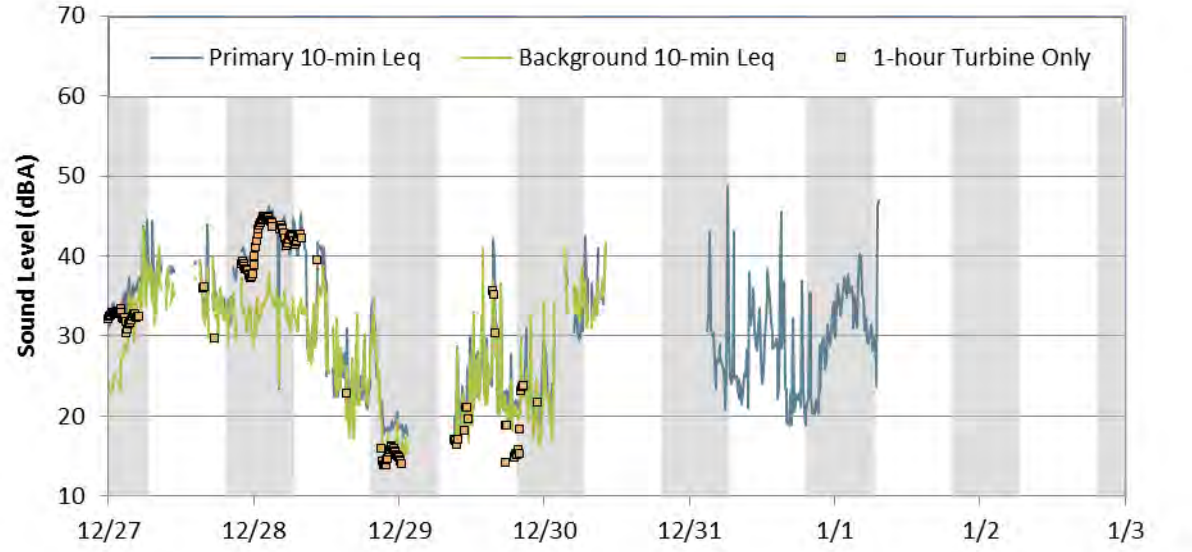


Figure 27: Nelson Method 3 Analysis Results – Part 4

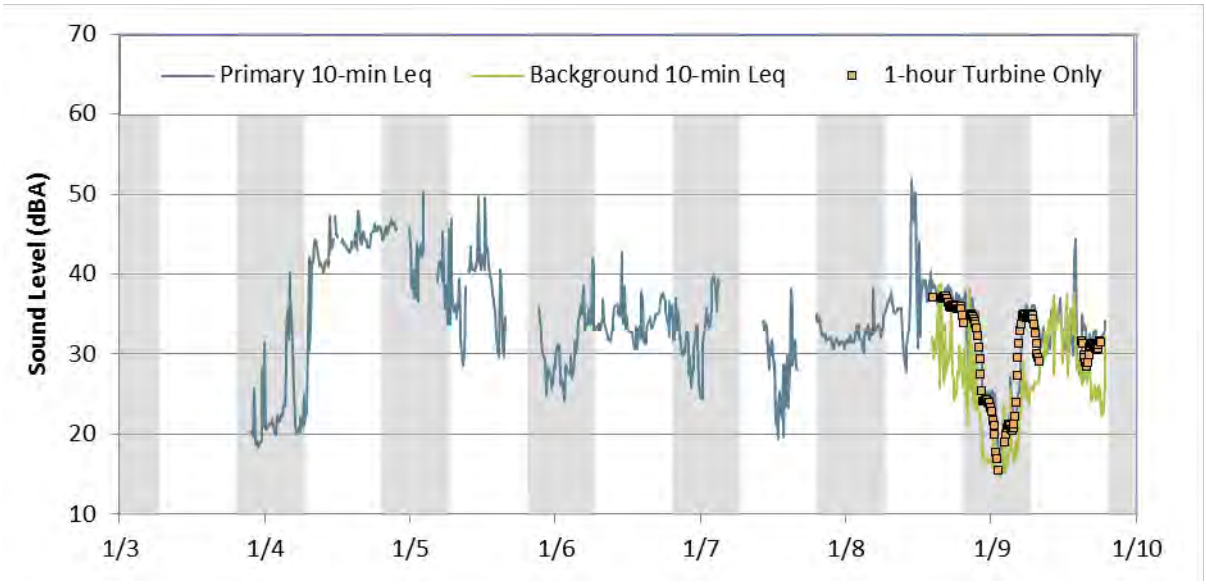


Figure 28: Nelson Method 3 Analysis Results - Part 5

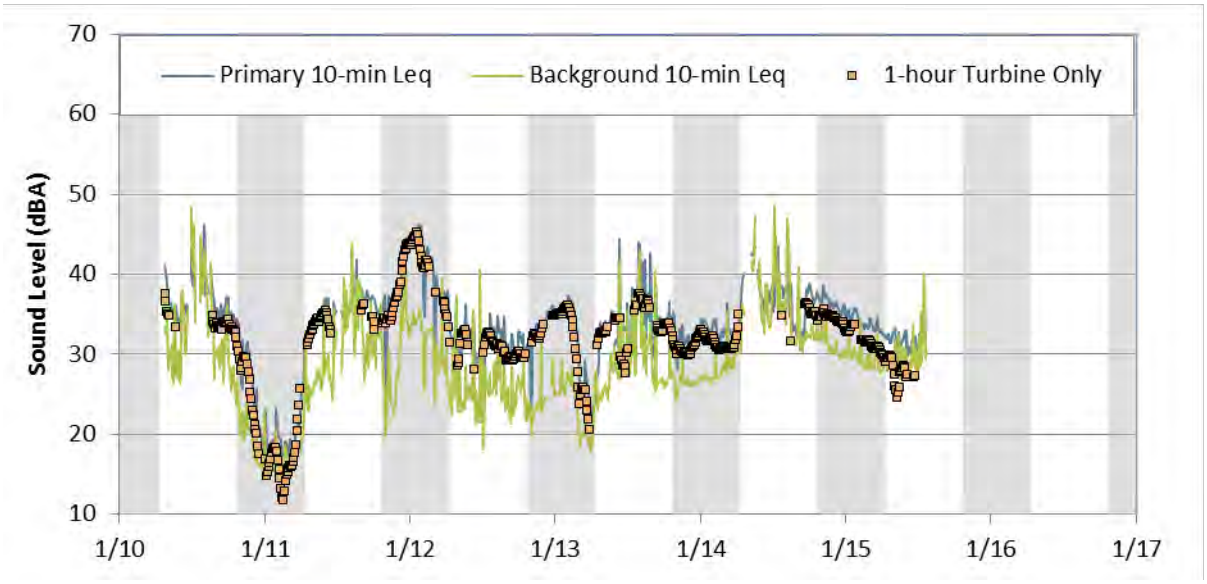


Figure 29: Nelson Method 3 Analysis Results - Part 6

5.3.2 Background Method 2 Analysis

Compliance analysis results for Monitor A using background Method 2 are provided in Table 5. This table is limited to occurrences when turbine only levels are 40 dBA or greater. Additional compliance analysis results for Monitor A utilizing Method 2 with turbine only levels less than 40 dBA are provided in Appendix C.

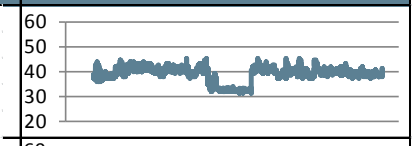
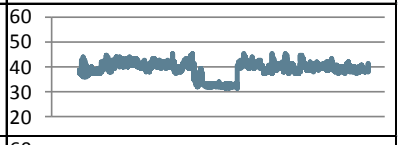
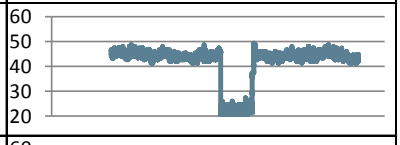
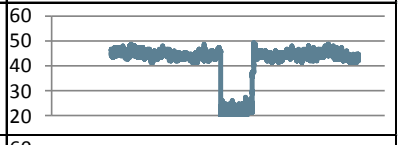
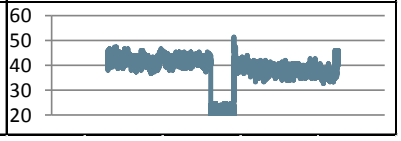
Results in Table 5 and following Method 2 analysis tables provide:

- A time stamp of the curtailment period

- The equivalent background sound level during the curtailment period
- The time stamp of the turbine measurement period which occurred either immediately before or after the curtailment period
- The 1-hour equivalent sound level during the turbine measurement period which includes background sound levels and turbine sound levels
- Turbine only sound levels which were calculated by subtracting out the background sound levels during the curtailment period from the turbine measurement period
- An indication of turbine activity from the five nearest turbines with red denoting no generation, yellow denoting some generation, green denoting generation that produces near maximum sound power level.
- A time history of the 1-second equivalent sound levels during the curtailment and the hour before and after the curtailment.

As shown in Table 5, the highest 1-hour equivalent turbine only sound level using Method 2 was 44.5 dBA which occurred on December 28 around 3 AM. There were no exceedances of the 45 dBA outdoor limit at Monitor A using Method 2.

Table 5: Nelson Method 2 Analysis Results - Periods at or Above 40 dBA[4]

Curtailment Period			Turbine Measurement Period			Turbine Only Level (dBA)	Turbine Activity	Time History (1-sec Leq, dBA)
Start	End	Sound Level (dBA)	Start	End	Sound Level (dBA)			
12/11 19:01	12/11 19:21	33	12/11 18:01	12/11 19:01	40	39.6	T07 T08 T10 T11 T12	
12/11 19:01	12/11 19:21	33	12/11 19:21	12/11 20:21	40	39.1	T07 T08 T10 T11 T12	
12/28 4:06	12/28 4:25	22	12/28 3:06	12/28 4:06	45	44.5	T07 T08 T10 T11 T12	
12/28 4:06	12/28 4:25	22	12/28 4:25	12/28 5:25	44	44.4	T07 T08 T10 T11 T12	
1/12 4:07	1/12 4:22	21	1/12 3:07	1/12 4:07	42	41.7	T07 T08 T10 T11 T12	

5.3.3 Tonality Analysis

Spectra from the curtailment analysis were analyzed in accordance with ANSI 12.9 part 3 tonality's definition, to determine the existence of any tones. The worst-case results of this analysis are provided in Figure 30. Out of 62 periods analyzed at Monitor A, there were none that showed a prominent discrete tone.

[4] For turbine activity - Red: No Generation, Yellow: Less than Full Sound Power, Green: Full Sound Power

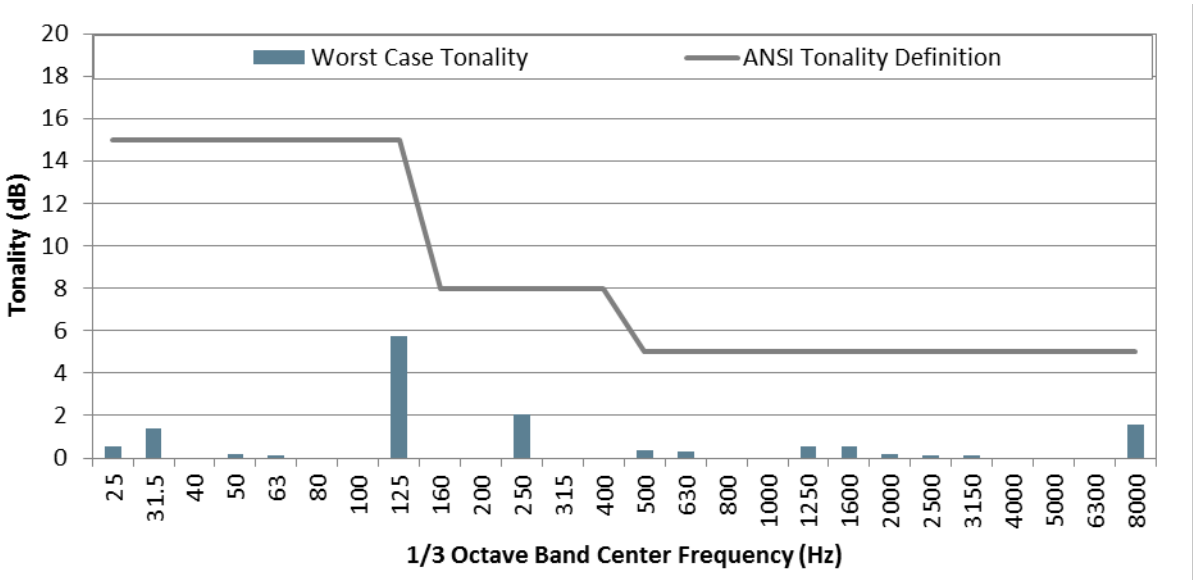


Figure 30: Nelson Worst Case Tonality

5.4 Monitor B Results

Overall time history sound level results for primary Monitor B are provided in Appendix B along with wind speed at Monitor B and total project power output. Provided in the following sections are the results of the compliance analysis utilizing Method 3 and Method 2 and the results of the tonality analysis.

5.4.1 Background Method 3 Analysis

Compliance analysis results for Monitor B using background Method 3 are provided in Figure 31 through Figure 36. Utilizing Method 3, the 1-hour equivalent sound level due to wind turbine noise at Monitor B generally ranged from 20 dBA to 40 dBA. The highest 1-hour equivalent sound levels were between 41 and 42 dBA which occurred on January 4 around 11 AM (Figure 35).

There were no exceedances of the 45 dBA outdoor limit at Monitor B using Method 3.

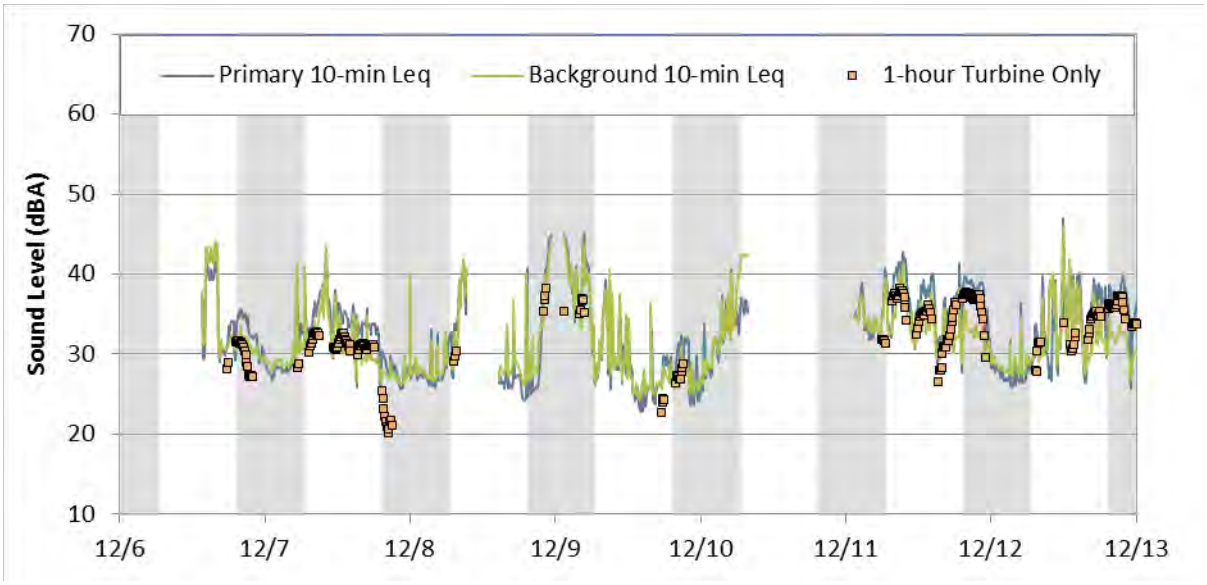


Figure 31: Eden Road Method 3 Analysis Results - Part 1

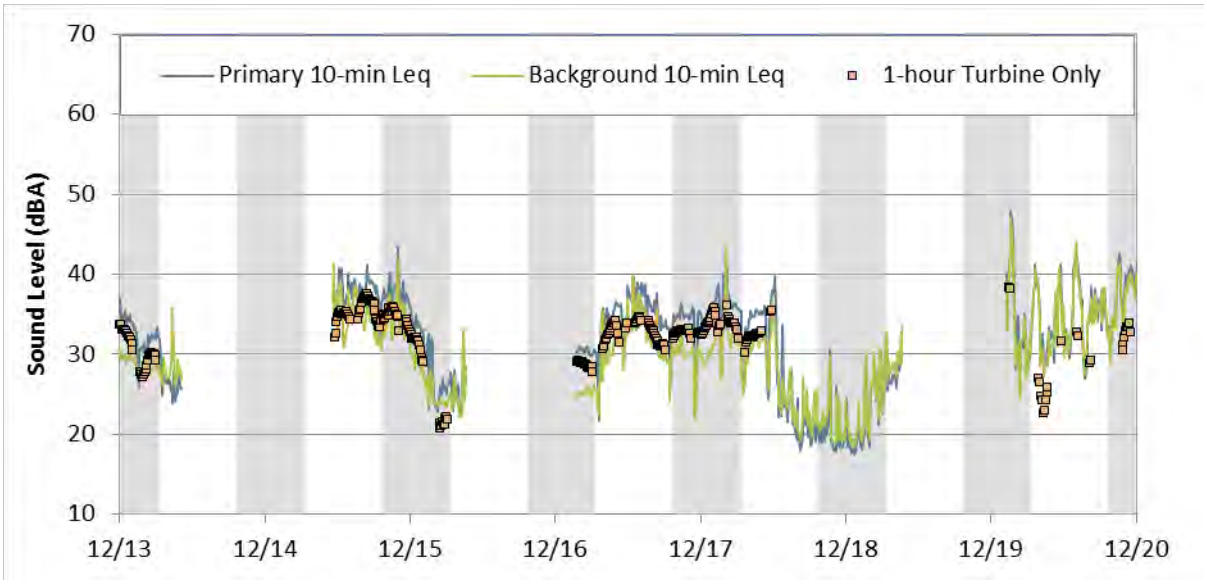


Figure 32: Eden Road Method 3 Analysis Results - Part 2

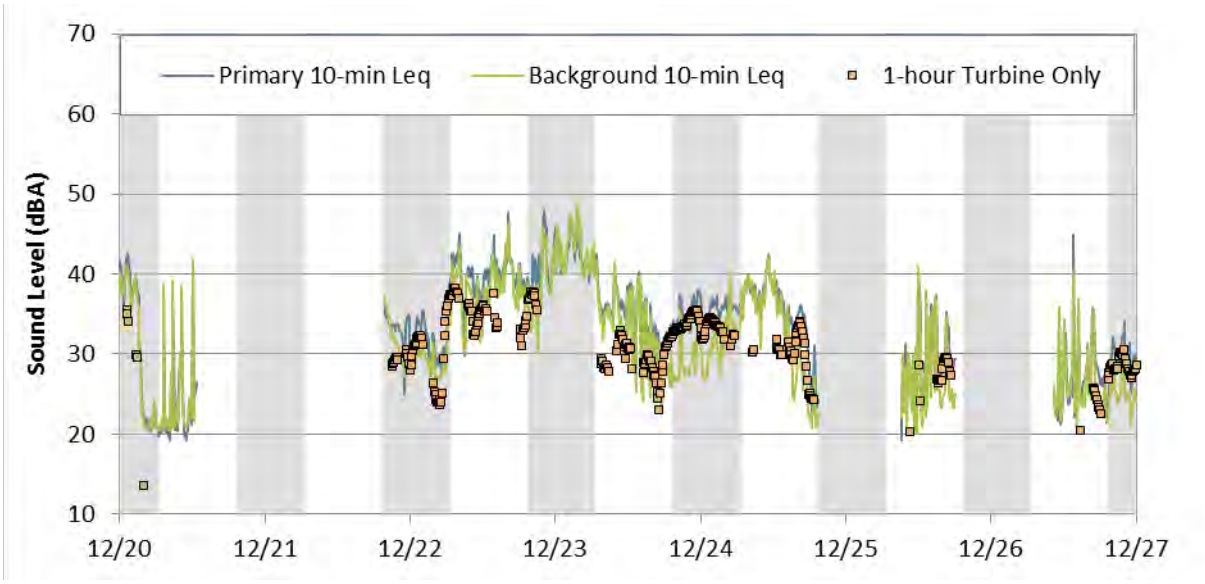


Figure 33: Eden Road Method 3 Analysis Results - Part 3

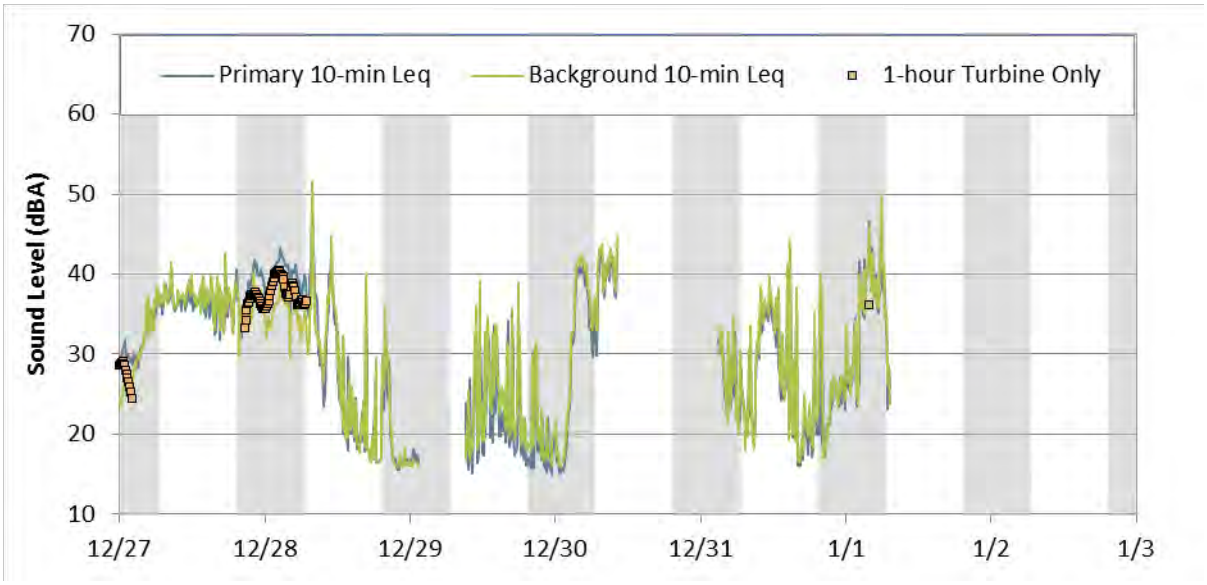


Figure 34: Eden Road Method 3 Analysis Results - Part 4

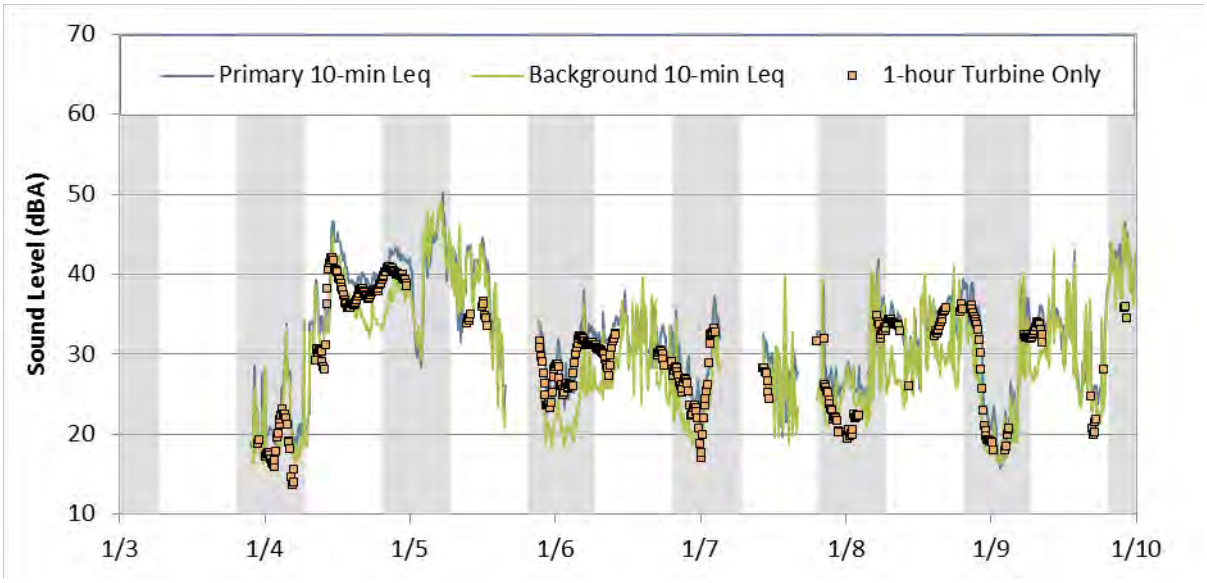


Figure 35: Eden Road Method 3 Analysis Results - Part 5

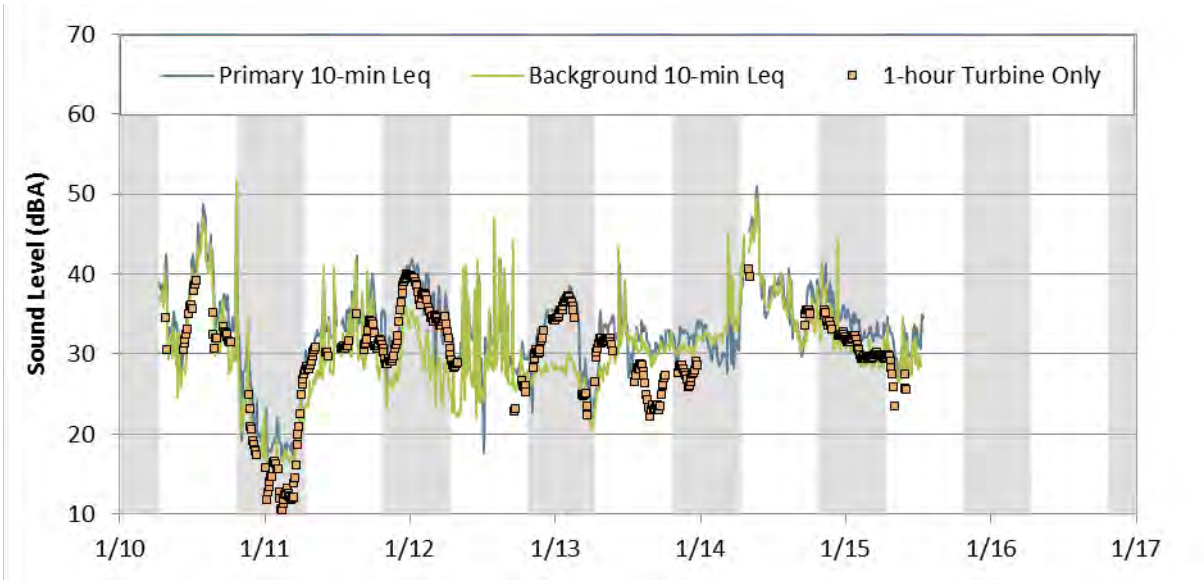


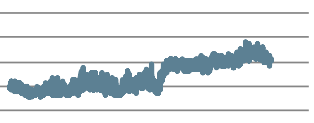
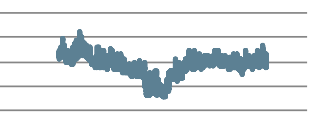
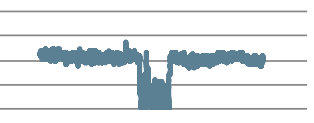
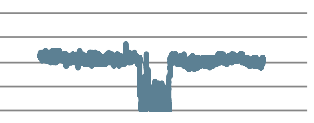
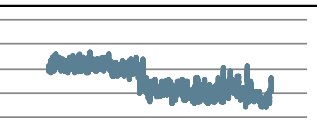
Figure 36: Eden Road Method 3 Analysis Results - Part 6

5.4.2 Background Method 2 Analysis

Compliance analysis results for Monitor B using background Method 2 are provided in Table 6 which show turbine only levels of 40 dBA or greater. Additional compliance analysis results for Monitor B utilizing Method 2 with turbine only levels less than 40 dBA are provided in Appendix C.

As shown in Table 6, the highest 1-hour equivalent turbine only sound level using Method 2 was 41.3 dBA which occurred on December 22 around 8 AM. There were no exceedances of the 45 dBA outdoor limit at Monitor B using Method 2.

Table 6: Eden Road Method 2 Analysis Results

Curtailment Period			Turbine Measurement Period			Turbine Only Level (dBA)	Turbine Activity	Time History (1-sec Leq, dBA)
Start	End	Sound Level (dBA)	Start	End	Sound Level (dBA)			
12/22 6:00	12/22 6:20	31	12/22 6:20	12/22 7:20	41	40.0	T14 T15 T16 T17 T18	
12/22 8:58	12/22 9:14	29	12/22 7:58	12/22 8:58	42	41.3	T14 T15 T16 T17 T18	
12/28 4:07	12/28 4:26	30	12/28 3:07	12/28 4:07	41	40.9	T14 T15 T16 T17 T18	
12/28 4:07	12/28 4:26	30	12/28 4:26	12/28 5:26	41	40.2	T14 T15 T16 T17 T18	
1/5 0:31	1/5 1:01	33	1/4 23:31	1/5 0:31	41	40.6	T14 T15 T16 T17 T18	

5.4.3 Tonality Analysis

Spectra from the curtailment analysis were analyzed in accordance with ANSI 12.9 part 3 tonality's definition, to determine the existence of any tones. The worst-case results of this analysis are provided in Figure 37 which shows that there was a prominent discrete tone at Monitor B in the 160 Hz 1/3-octave band. Out of 82 periods analyzed at Monitor B, a prominent discrete tone was present twice: once on the first day of monitoring, December 6 (7:22 to 8:22 PM) and once on the second day of monitoring, December 7 (6:00 to 7:00 PM). This is discussed further in Section 6.2.

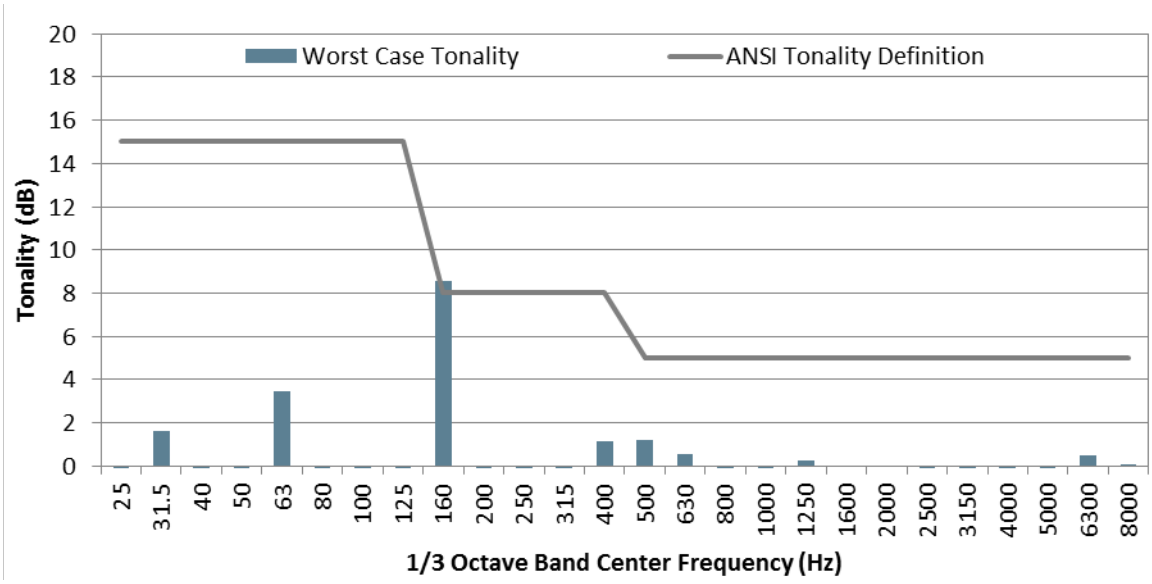


Figure 37: Eden Road Worst Case Tonality

5.5 Monitor C Results

Overall time history sound level results for primary Monitor C are provided in Appendix B along with wind speed at Monitor C and total project power output. Provided in the following sections are the results of the compliance analysis utilizing Method 2 and the results of the tonality analysis.

5.5.1 Background Method 2 Analysis

Utilizing Method 2, there were not periods where turbine only levels were 40 dBA or greater at Monitor C. The highest turbine only level at Monitor C was 34 dBA. As such, compliance analysis results for Monitor C using background Method 2 are provided in Appendix C. There were no exceedances of the 45 dBA outdoor limit at Monitor C using Method 2.

5.5.2 Tonality Analysis

Spectra from the curtailment analysis were analyzed in accordance with ANSI 12.9 part 3 tonality's definition, to determine the existence of any tones. The worst-case results of this analysis are provided in Figure 38. Out of 16 periods analyzed at Monitor C, there were none that showed a prominent discrete tone.

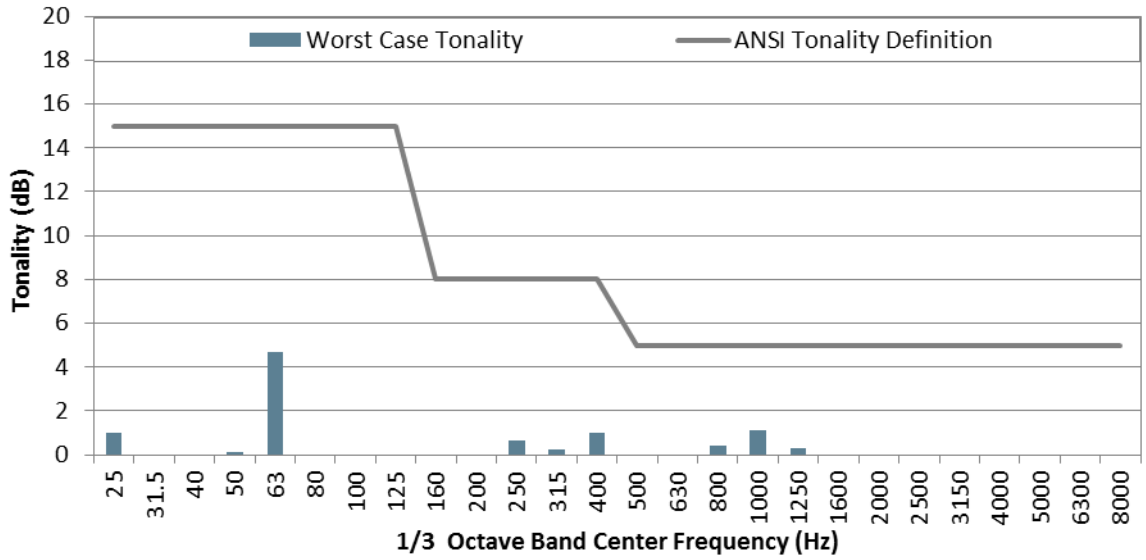


Figure 38: VT 100 Worst Case Tonality

5.6 Monitor D Results

Overall time history sound level results for primary Monitor D are provided in Appendix B along with wind speed at Monitor D and total project power output. Provided in the following sections are the results of the compliance analysis utilizing Method 3 and Method 2 and the results of the tonality analysis.

5.6.1 Background Method 3 Analysis

Compliance analysis results for Monitor D using background Method 3 are provided in Figure 39 through Figure 44. Utilizing Method 3, the 1-hour equivalent sound level due to wind turbine noise at Monitor B generally ranged from 20 dBA to 40 dBA. The highest 1-hour equivalent sound levels were between 40 and 41 dBA which occurred on December 7 (Figure 39), January 4 (Figure 43), and January 11 (Figure 44).

There were no exceedances of the 45 dBA outdoor limit at Monitor D using Method 3.

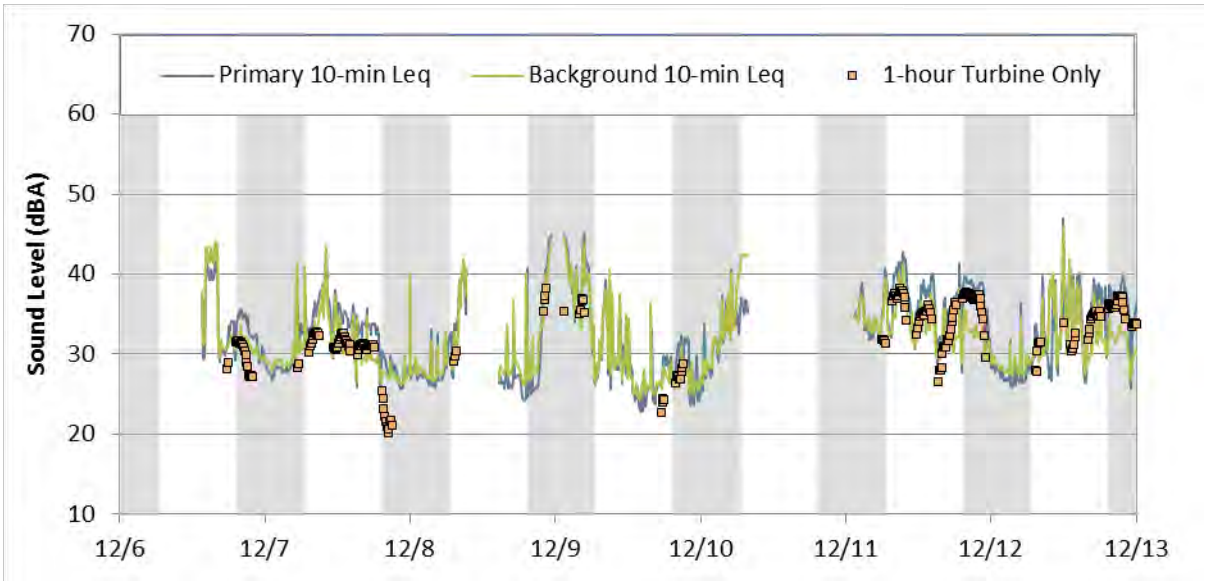


Figure 39: Farm Road Method 3 Analysis Results - Part 1

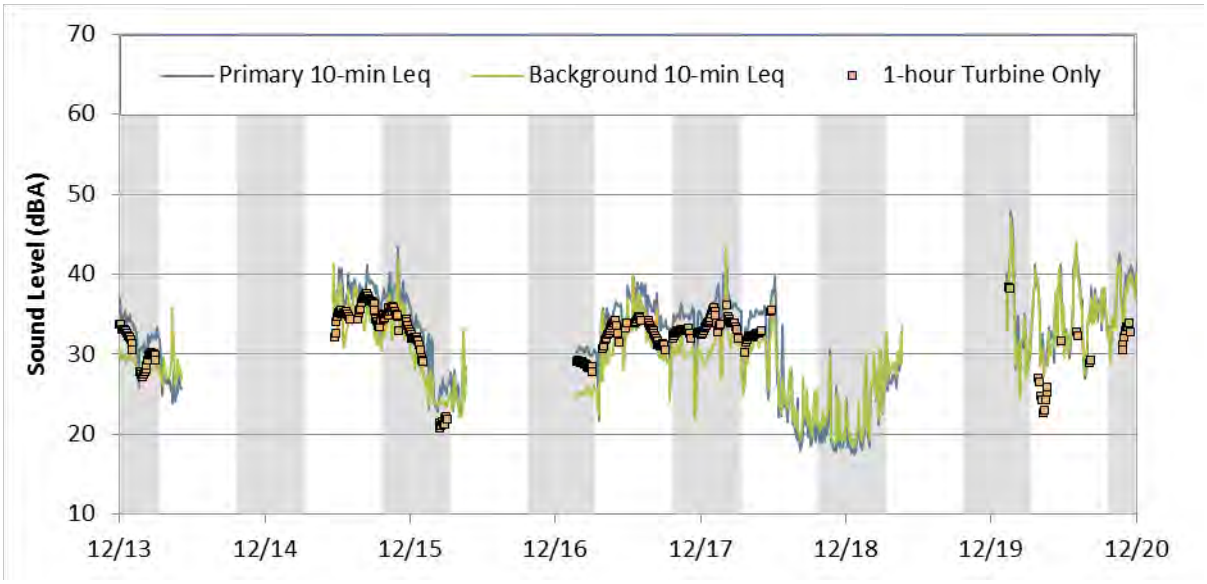


Figure 40: Farm Road Method 3 Analysis Results - Part 2

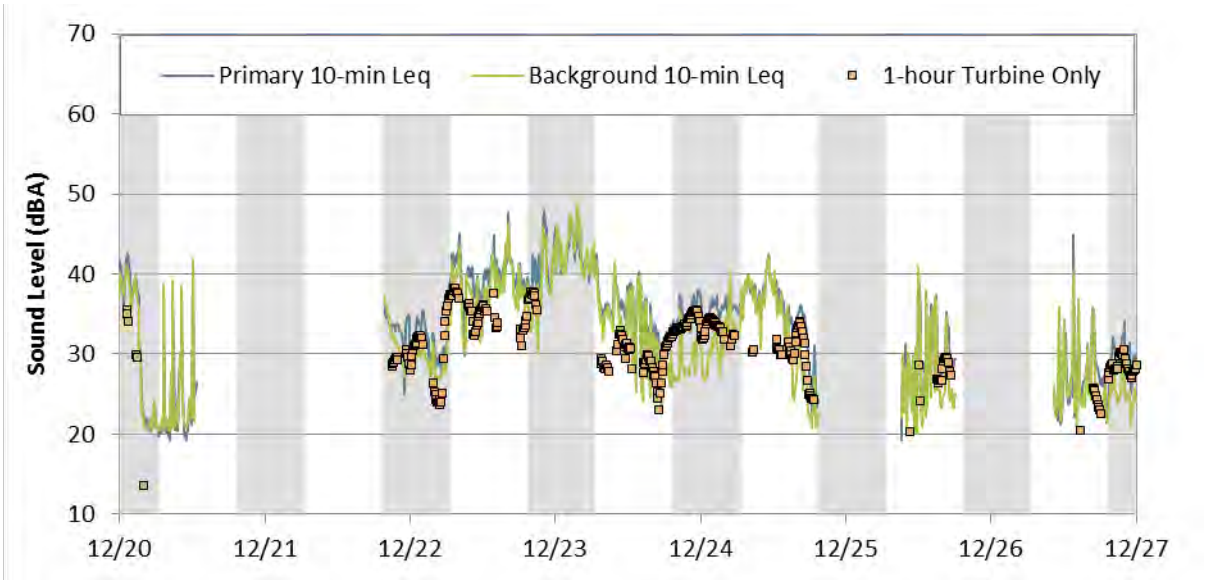


Figure 41: Farm Road Method 3 Analysis Results - Part 3

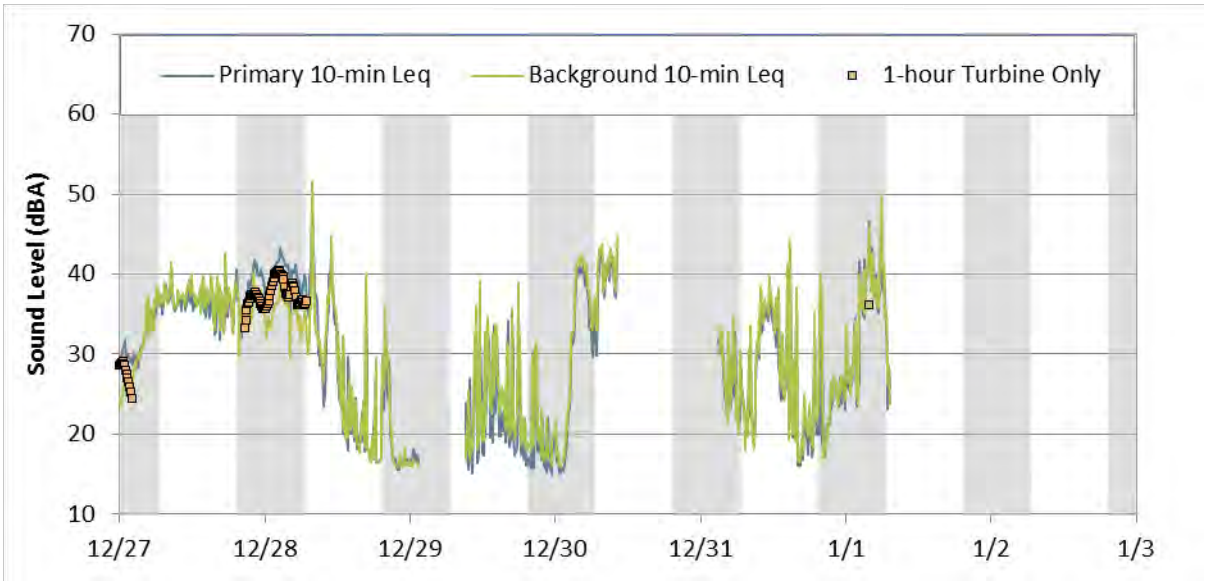


Figure 42: Farm Road Method 3 Analysis Results - Part 4

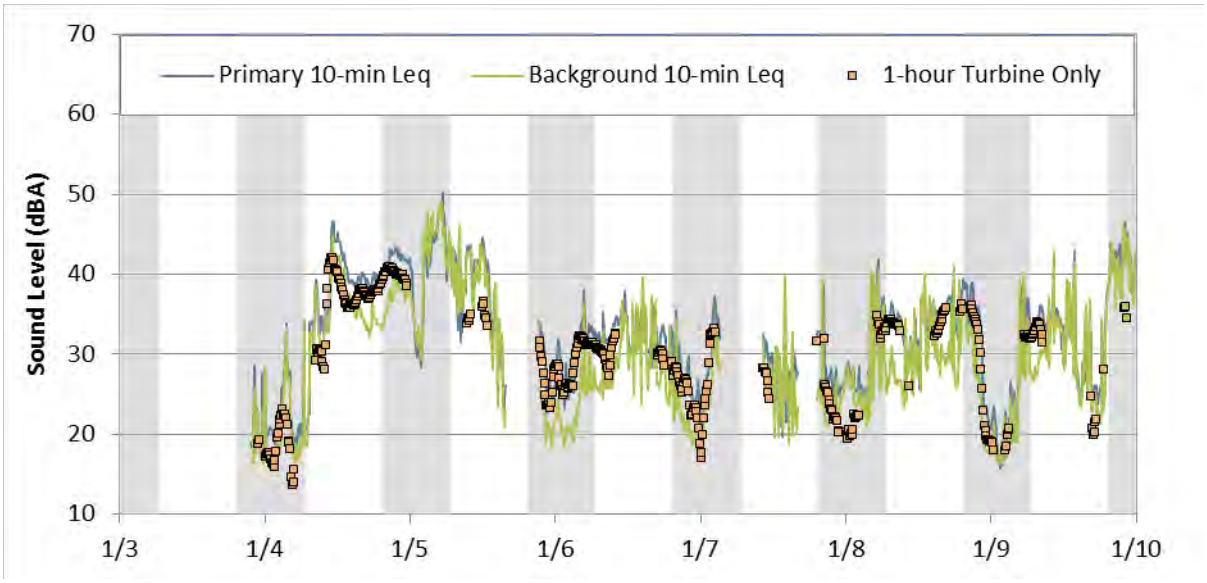


Figure 43: Farm Road Method 3 Analysis Results - Part 5

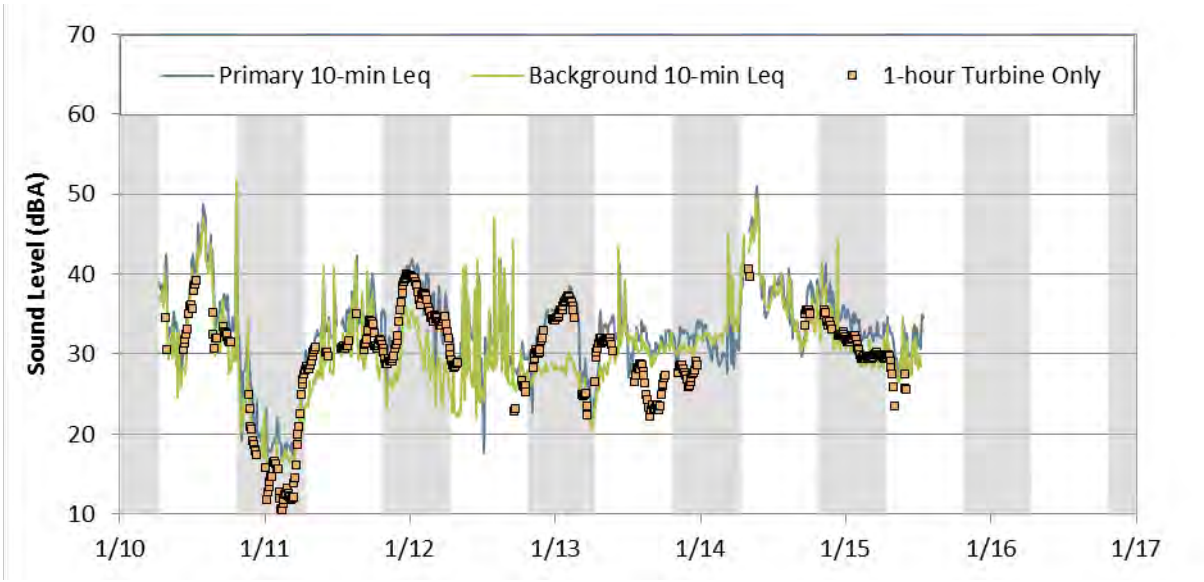


Figure 44: Farm Road Method 3 Analysis Results - Part 6

5.6.2 Background Method 2 Analysis

Utilizing Method 2, there were no periods where turbine only levels were 40 dBA or greater at Monitor D. The highest turbine only level at Monitor D was 39 dBA. As such, compliance analysis results for Monitor D using background Method 2 are provided in Appendix C. There were no exceedances of the 45 dBA outdoor limit at Monitor D using Method 2.

5.6.3 Tonality Analysis

Spectra from the curtailment analysis were analyzed in accordance with ANSI 12.9 part 3 tonality's definition, to determine the existence of any tones. The worst-case results of this analysis are provided in Figure 45. Out of 38 periods analyzed at Monitor D, there were none that showed a prominent discrete tone.

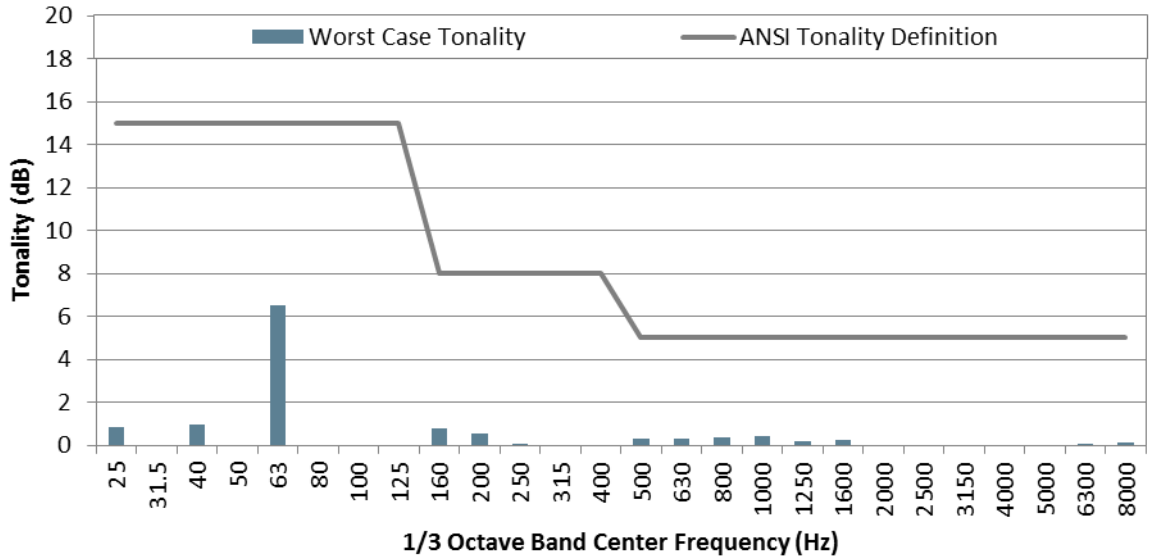


Figure 45: Farm Road Worst Case Tonality

6.0 POTENTIAL EXCEEDANCES OF CPG LIMITS

6.1 Potential Exceedances of the Overall Sound Level Limit

There were no potential exceedances of the 45 dBA ($Leq_{1\text{-hour}}$) exterior limit indicated by the Method 2 analysis.

There were two potential exceedances indicated by the Method 3 analysis. Both exceedances occurred at Monitor A (Nelson) during the same overlapping timeframe with one occurring from 1:10 AM to 2:10 AM on January 12 and the other occurring from at 1:20 AM to 2:20 AM on the same day. During this timeframe winds were out of the south-southwest with hub-height wind speeds between 10 and 14 m/s at the closest turbines and the total power output of the project was between 2.5 and 6.2 MW with 10 to 14 turbines in operation. Wind speeds at the microphone height at Monitor A were between 0 and 2.5 m/s. During this period, the project was under sector management, which involves shutting down selective turbines to reduce inflow turbulence.

Two potential causes of higher sound levels during this time period is associated with the direction of the wind:

1. Winds out of the south-southwest run parallel to the turbine array and have the potential to cause turbulence between the wind turbines causing higher sound levels from the operation of the wind turbines.
2. Winds out of the south-southwest run parallel to the ridgeline and have the potential to cause greater vegetation-induced noise as the wind passes through the forest. This type of sound would be picked up more by the primary monitor at Monitor A, and the background monitor at Monitor A would be shielded from this type of sound. This is a potential issue with the use of Method 3 in accounting for background sound levels.

Since the operation exceeded the sound level limits for a very limited amount of time, 2 periods out of 703 hours of testing, we will continue to pay close attention to potential exceedances in future monitoring periods, especially to the conditions under which they occur.

6.2 Potential Exceedances of the Prominent Discrete Tones Clause

As discussed in Section 5.4.3, there were prominent discrete tones at Monitor B in the 160 Hz and octave band. The discrete tone was not present when the turbines were curtailed, but were indicated in the spectrograms for this site when turbines were operating. The prominent discrete tone only occurred twice out of 82 curtailment periods analyzed at Monitor B, and both periods were during the first and second day of the monitoring during the initial startup of the project. All of the periods analyzed after those days did not contain a prominent discrete tone as defined by ANSI S12.9 part 3. Since the prominent discrete tone was only logged twice during the first two days of monitoring during the initial startup of the project, we will continue to pay close attention to the potential for a prominent discrete tone at 160 Hz during future monitoring periods.

7.0 CONCLUSIONS

RSG conducted Fall sound compliance testing at Kingdom Community Wind (KCW) from December 6, 2012 to January 15, 2013. The monitoring was conducted in accordance with the *Final Monitoring Protocol: Kingdom Community Wind* (the Monitoring Protocol) dated April 2012 as required by the project's Certificate of Public Good (CPG). For this round of monitoring, we utilized both background sound Method 3 and Method 2 of the Monitoring Protocol

Conclusions from the testing are as follows:

1. There were no potential exceedances of the 45 dBA ($Leq_{1\text{-hour}}$) exterior limit indicated by the Method 2 analysis for any of the four monitoring locations
2. There were two potential exceedances of the 45 dBA ($Leq_{1\text{-hour}}$) exterior limit indicated by the Method 3 analysis for overlapping time-periods at Monitor A (Nelson). The sound level of the exceedances was 45.3 dBA and occurred during a south-southwest wind regime while the project was producing between 2.5 and 6.2 MW. Two potential causes of the higher sound levels during the exceedance periods are:
    a. Winds out of the south-southwest run parallel to the turbine array and have the potential to cause turbulence between the wind turbines causing higher sound levels from the operation of the wind turbines.

   b. Winds out of the south-southwest run parallel to the ridgeline and have the potential to cause greater vegetation-induced noise as the wind passes through the forest. This type of sound would be picked up more by the primary monitor at Monitor A, and the background monitor at Monitor A would be shielded from this type of sound. This is a potential issue with background Method 3.

3. There was a prominent discrete tone at Monitor B in the 160 Hz 1/3 octave band which occurred during two different periods during the first two days of monitoring. No discrete tones were detected after the first two days of monitoring.
4. The potential exceedance of the overall limit at Monitor A and the prominent discrete tone at Monitor B, happened over very short periods during the beginning of the monitoring period which corresponded with the initial startup of the project. We will address whether these are ongoing issues based on the results of the next monitoring period.

A. Appendix A – Graphs Evaluating Background Monitoring Methodology 3

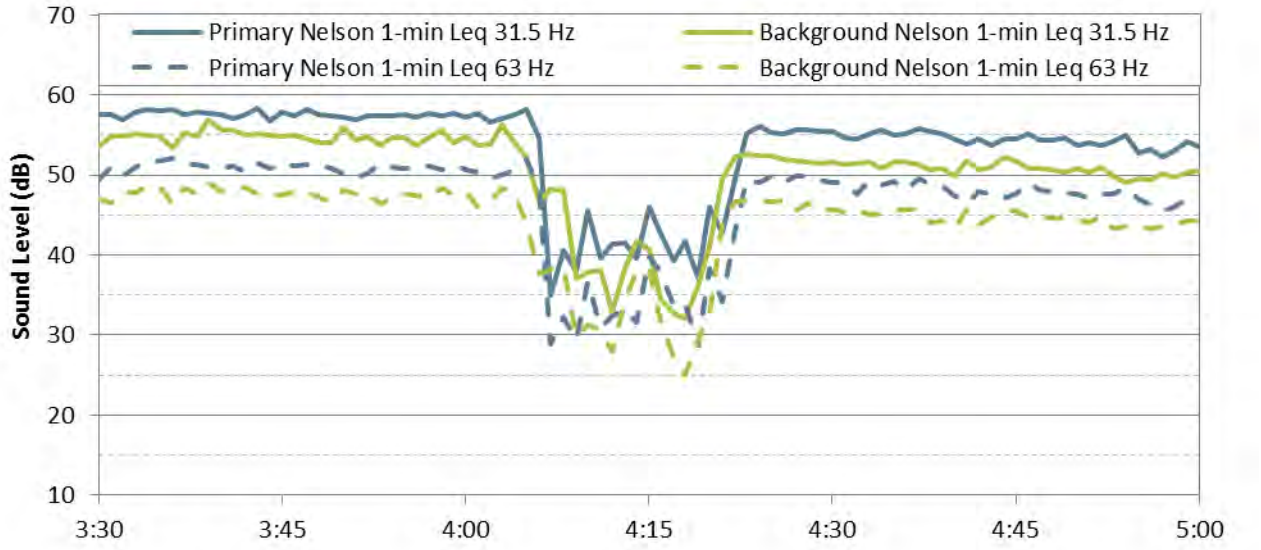


Figure 46: Nelson Method 2/3 Comparison - 31.5 and 63 Hz

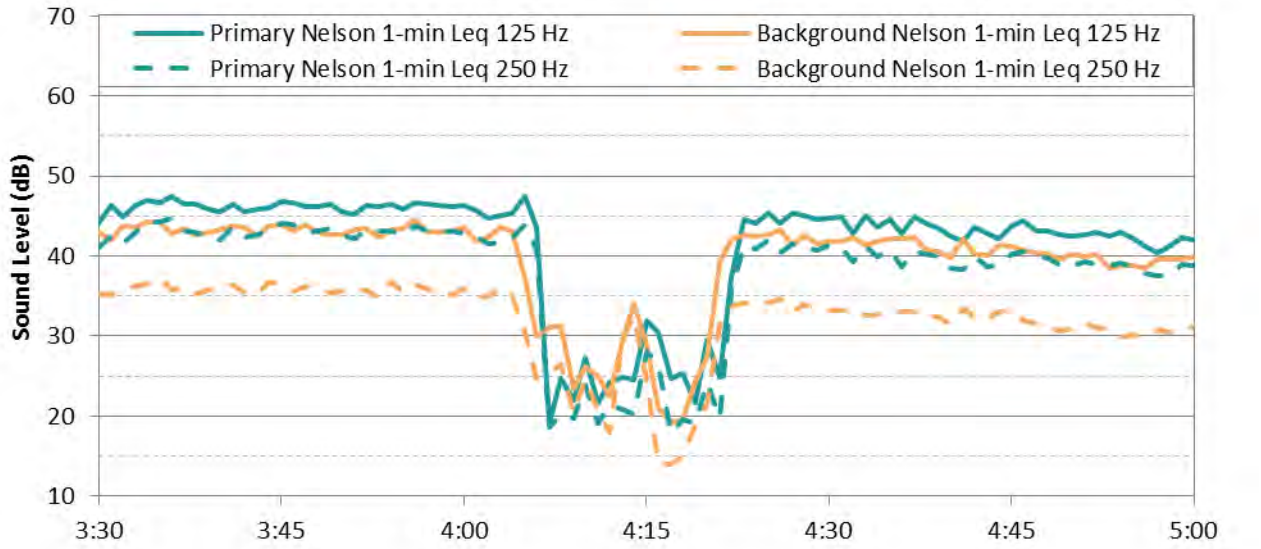


Figure 47: Nelson Method 2/3 Comparison - 125 and 250 Hz

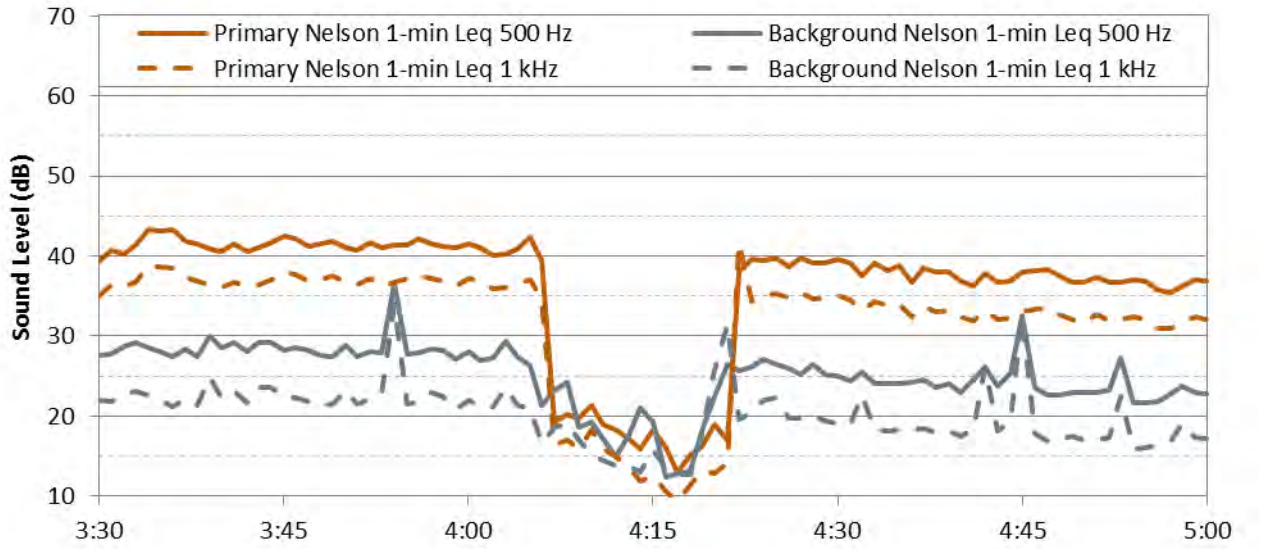


Figure 48: Nelson Method 2/3 Comparison - 500 Hz and 1 kHz

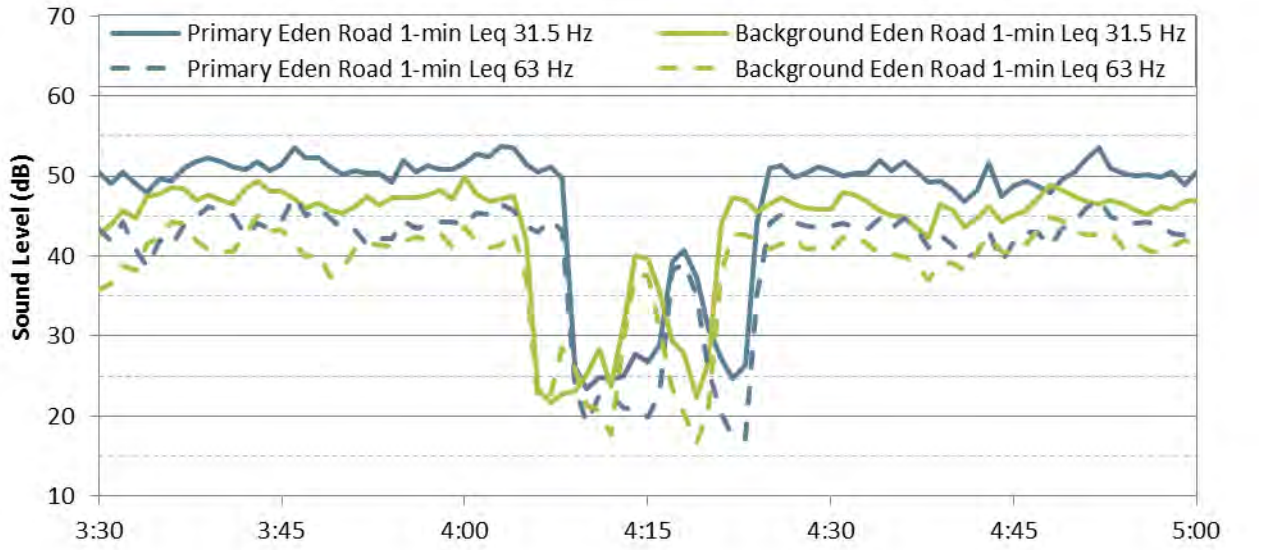


Figure 49: Eden Road Method 2/3 Comparison - 31.5 and 63 Hz

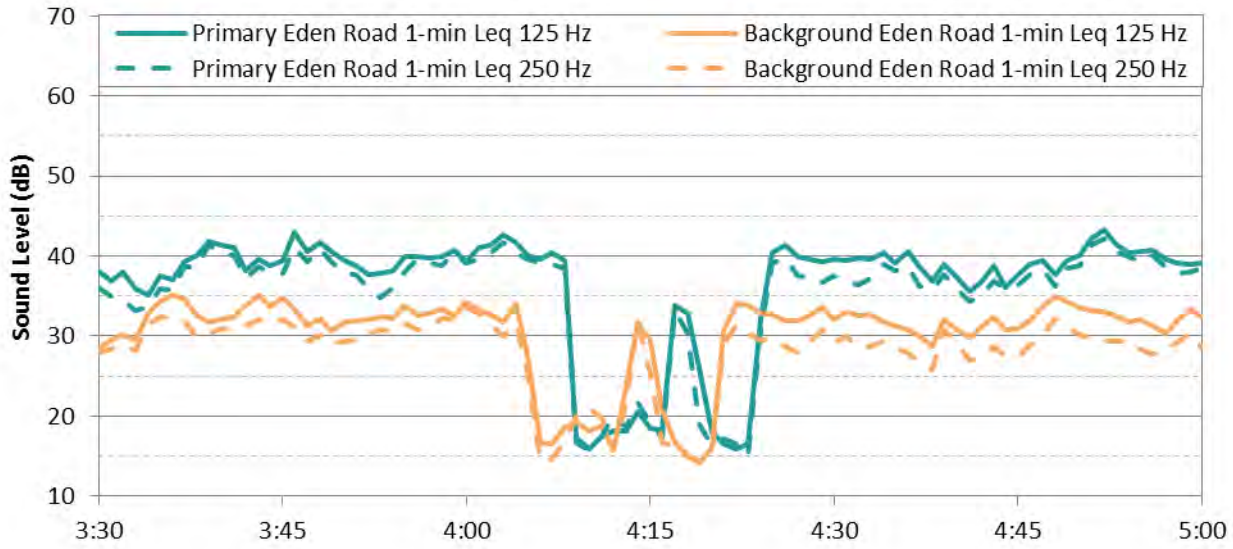


Figure 50: Eden Road Method 2/3 Comparison - 125 and 250 Hz

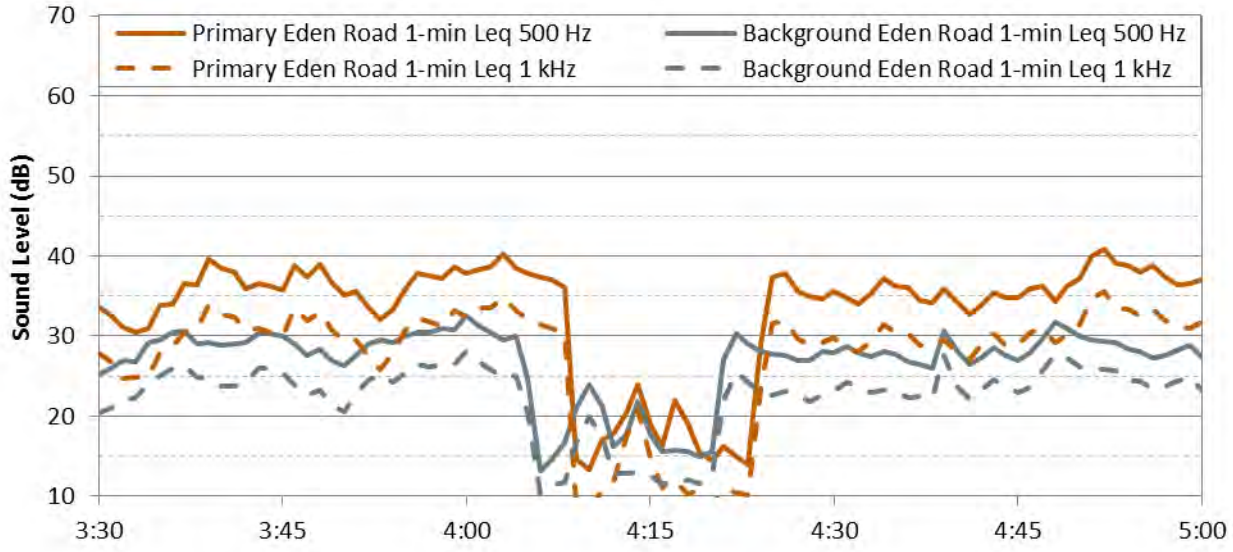


Figure 51: Eden Road Method 2/3 Comparison - 500 Hz and 1 kHz

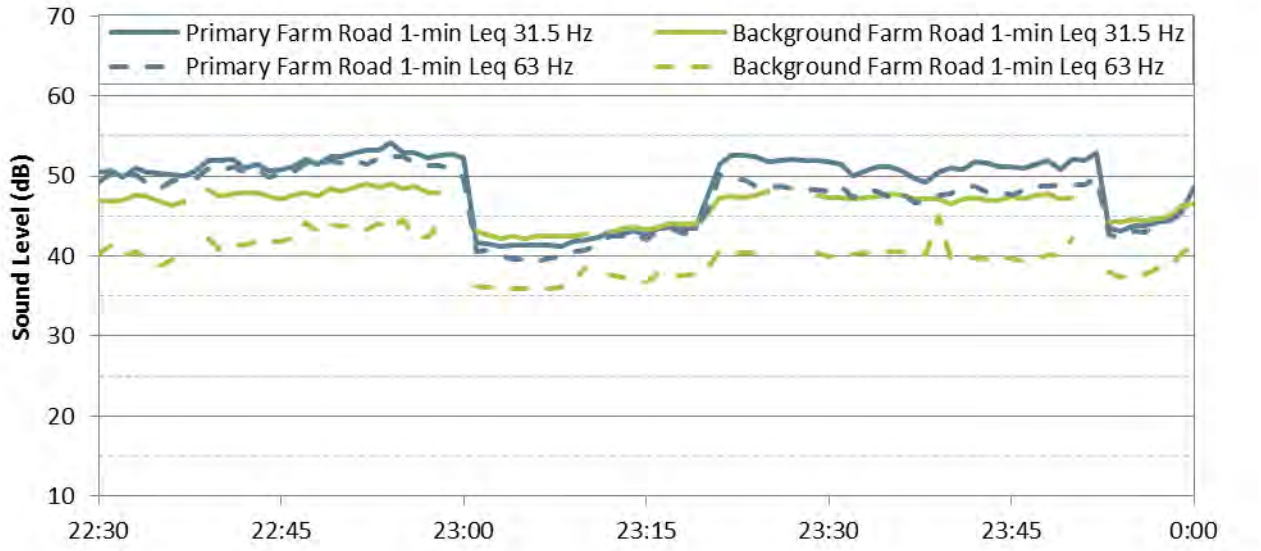


Figure 52: Farm Road Method 2/3 Comparison - 31.5 and 63 Hz

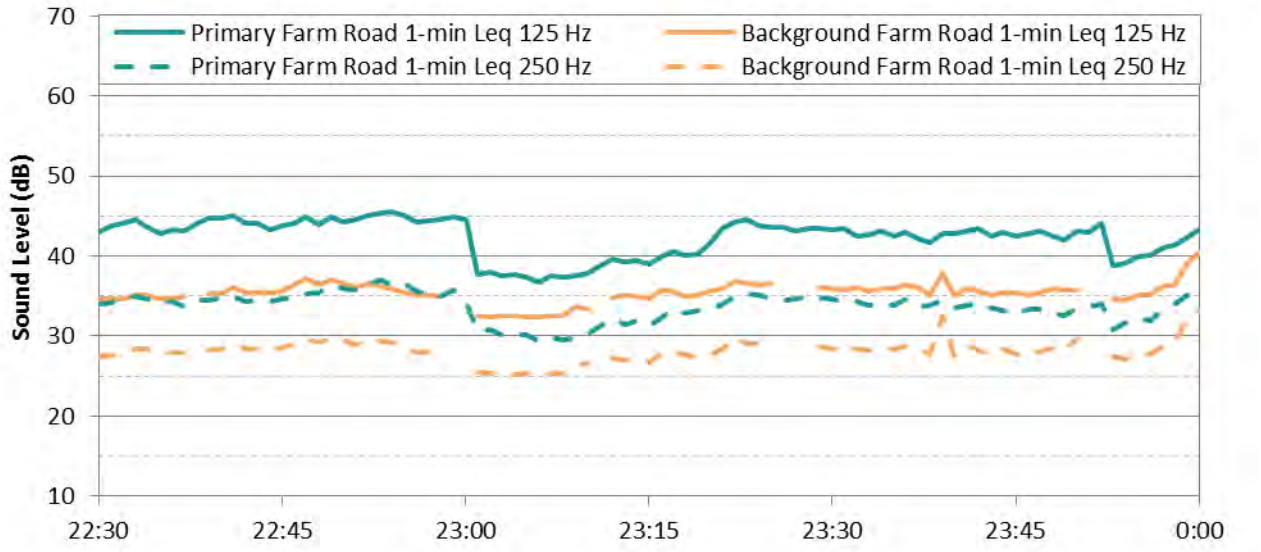


Figure 53: Farm Road Method 2/3 Comparison - 125 and 250 Hz

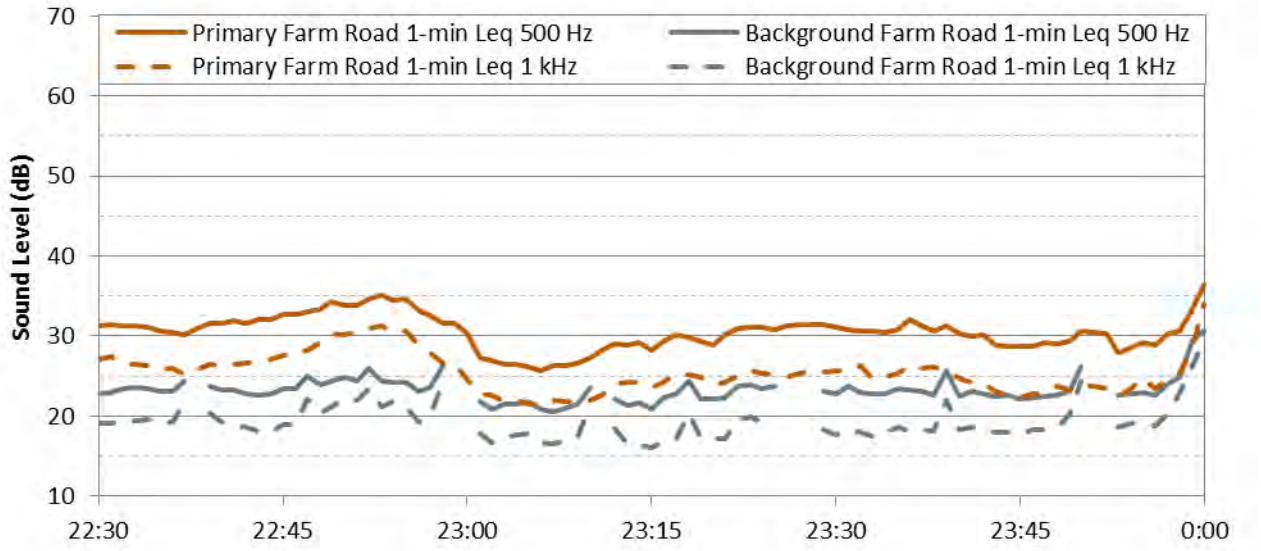


Figure 54: Farm Road Method 2/3 Comparison - 500 Hz and 1 kHz

B. Appendix B – Sound Monitoring Time History Results

7.1.1 Monitor A – Nelson Farm

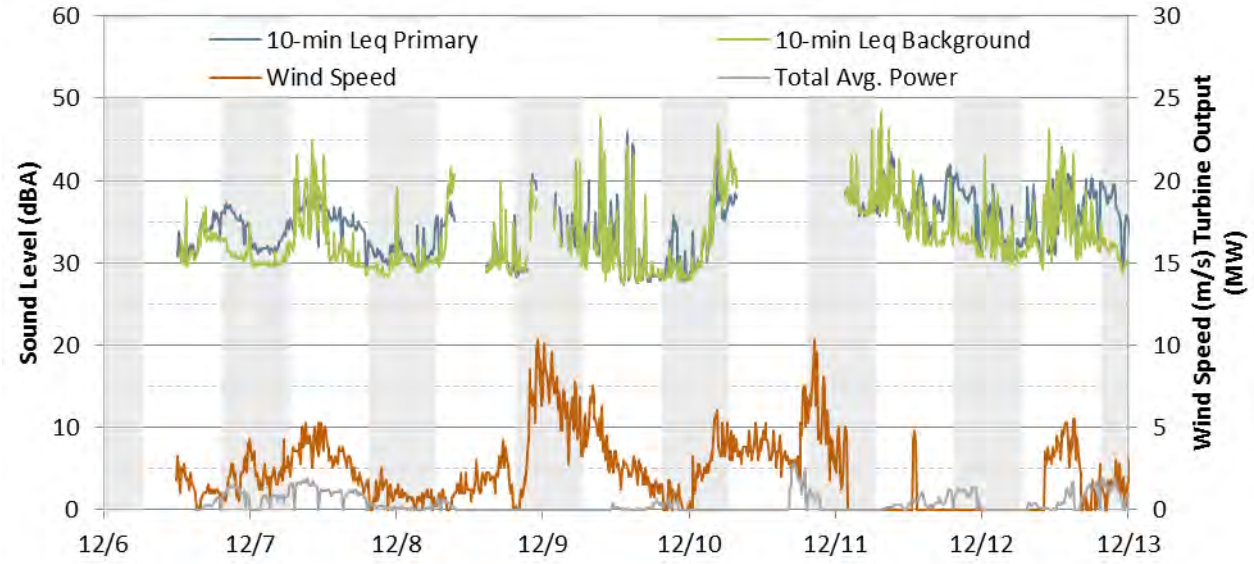


Figure 55: Nelson Time History Results - Part 1

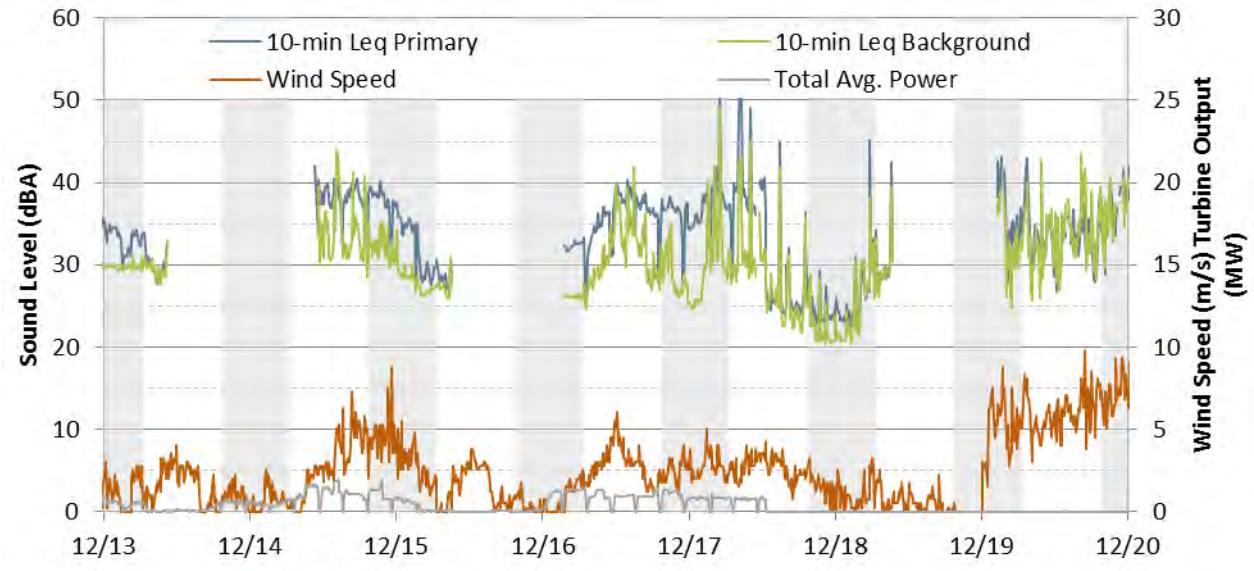


Figure 56: Nelson Time History Results - Part 2

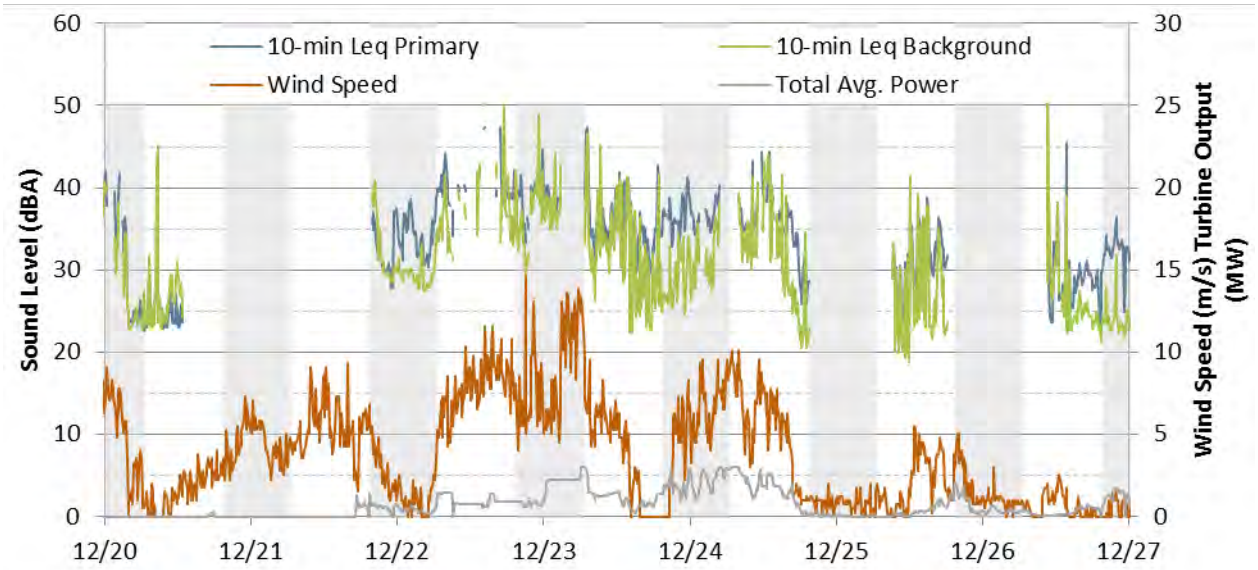


Figure 57: Nelson Time History Results - Part 3

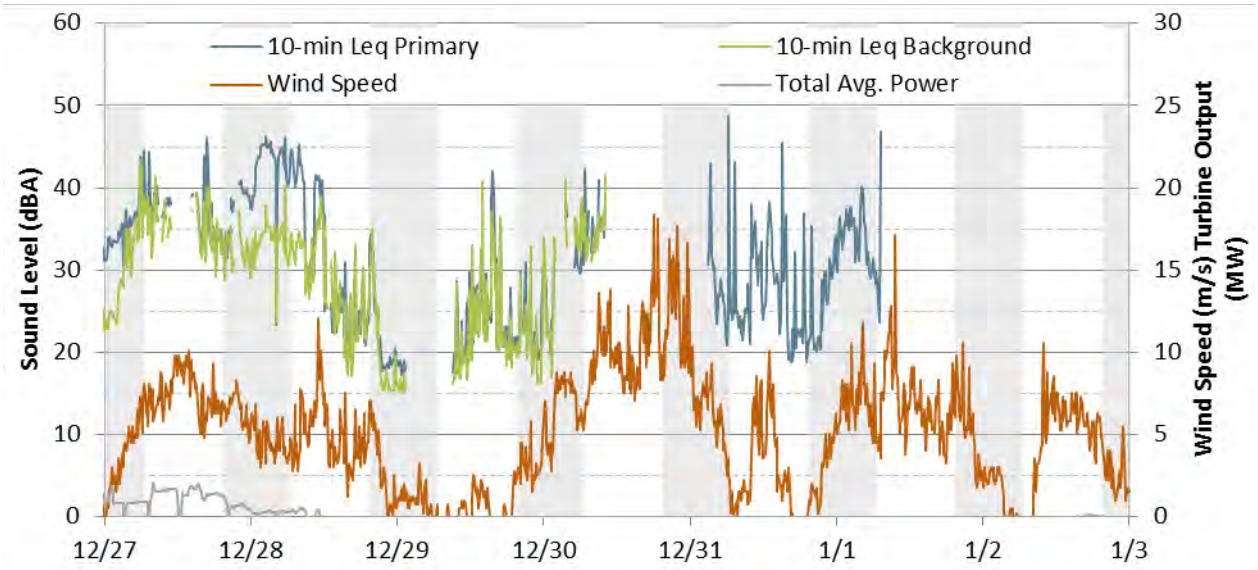


Figure 58: Nelson Time History Results - Part 4

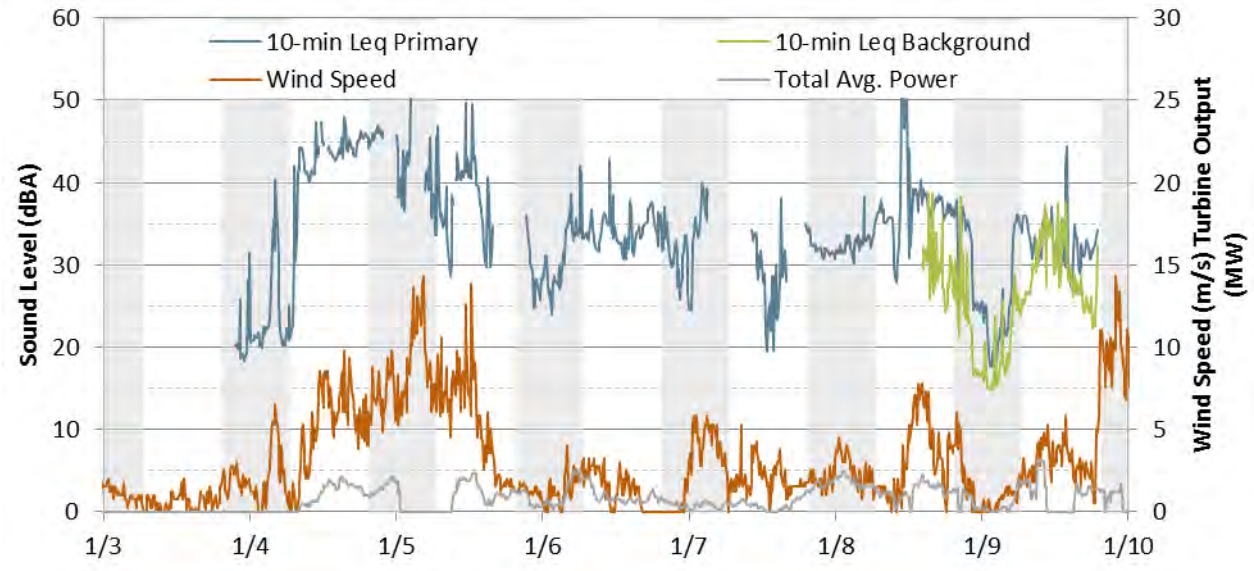


Figure 59: Nelson Time History Results - Part 5

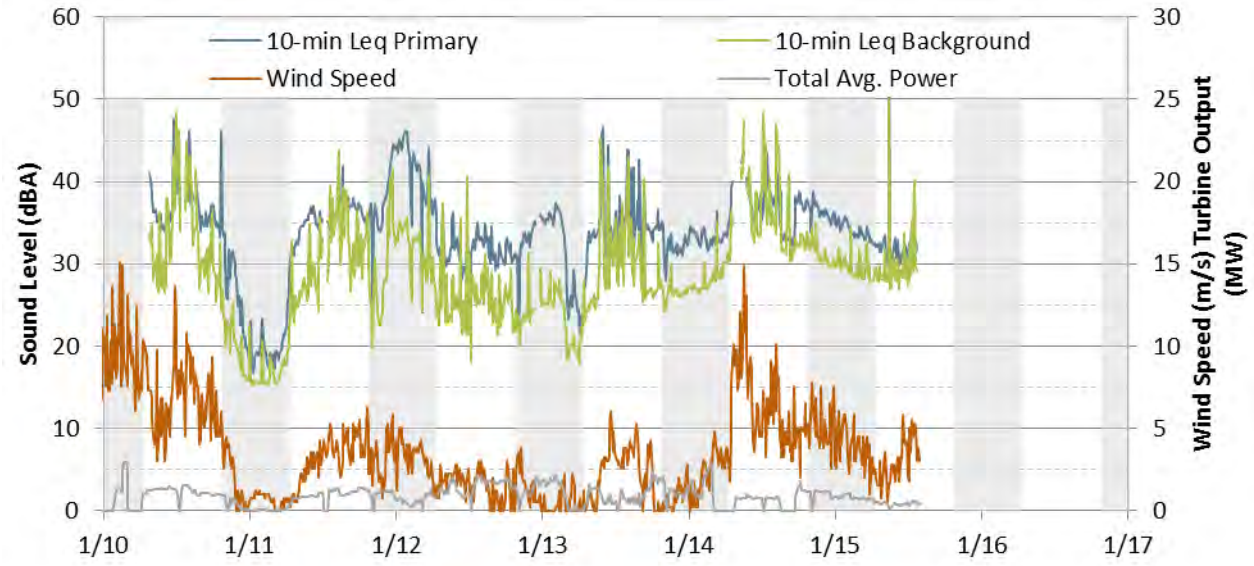


Figure 60: Nelson Time History Results - Part 6

7.1.2 Monitor B – Eden Road

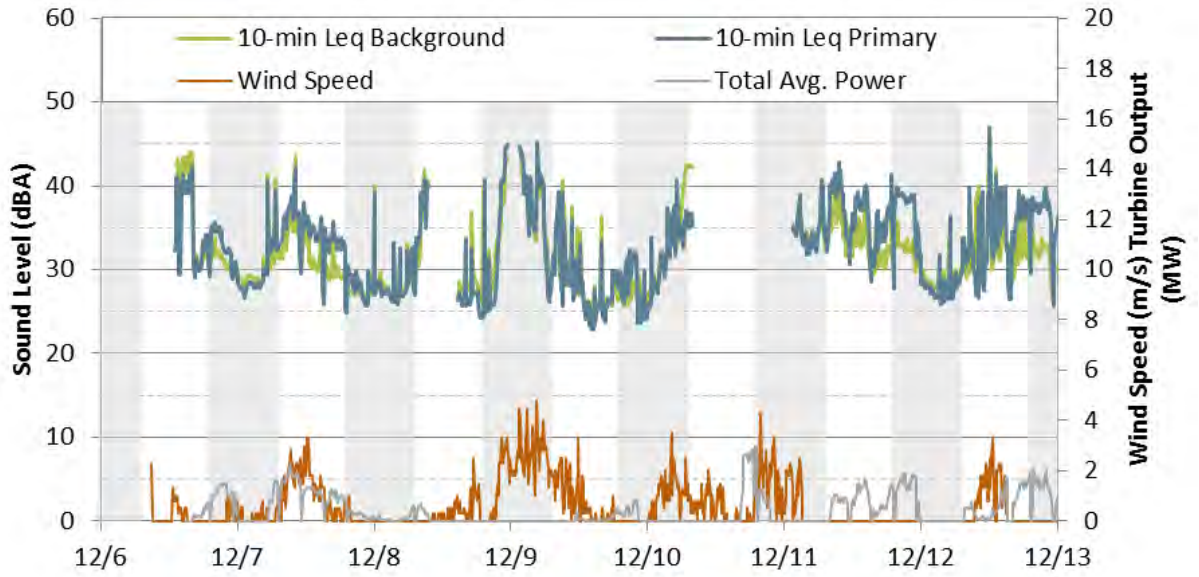


Figure 61: Eden Road Time History Results - Part 1

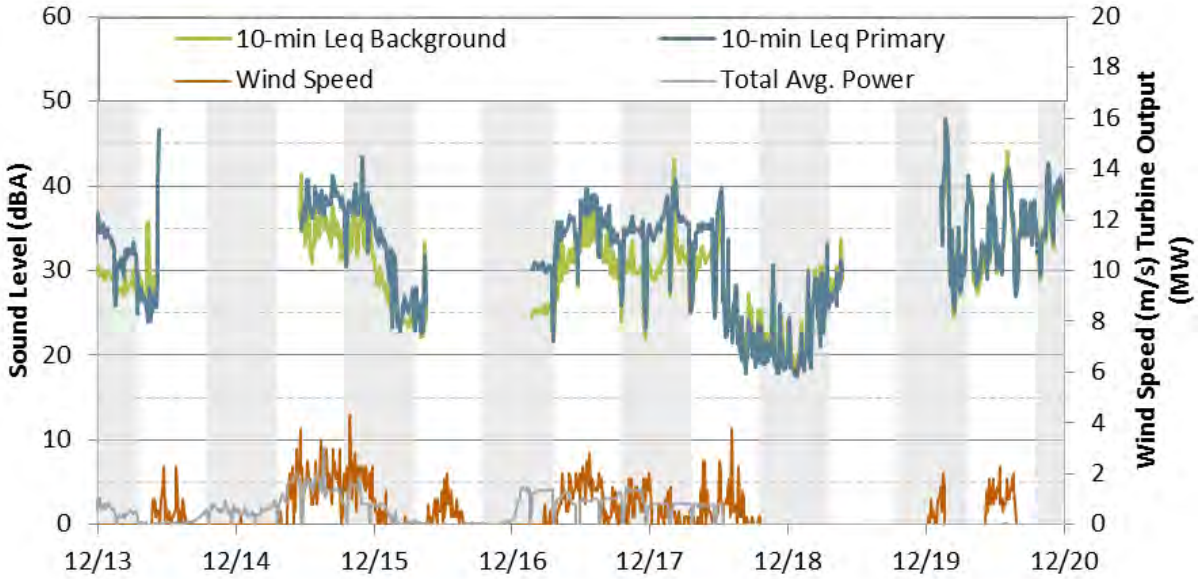


Figure 62: Eden Road Time History Results - Part 2

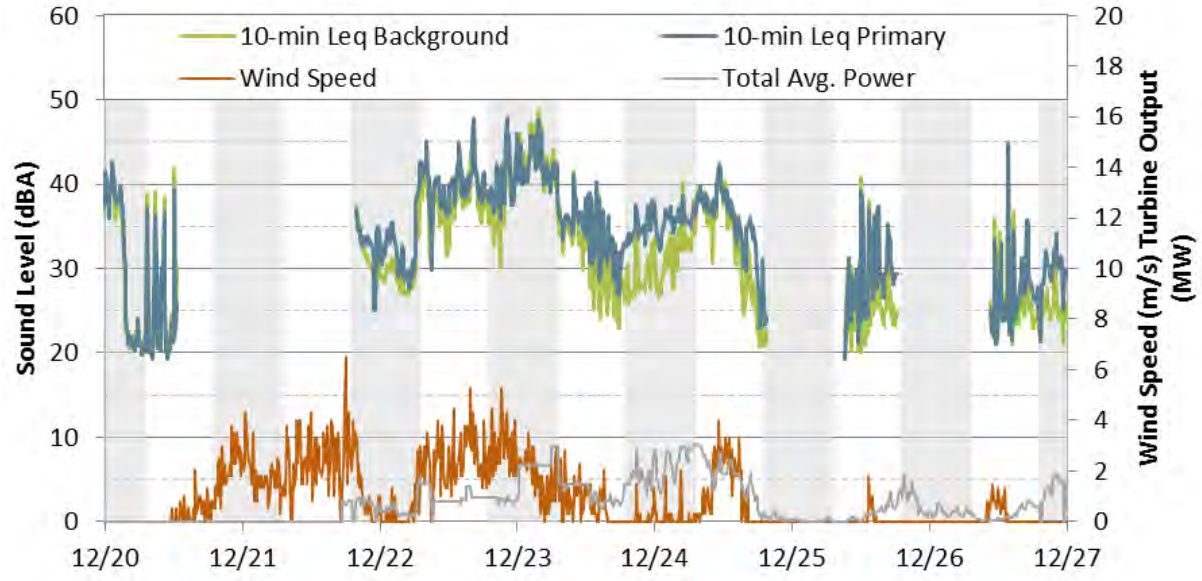


Figure 63: Eden Road Time History Results - Part 3

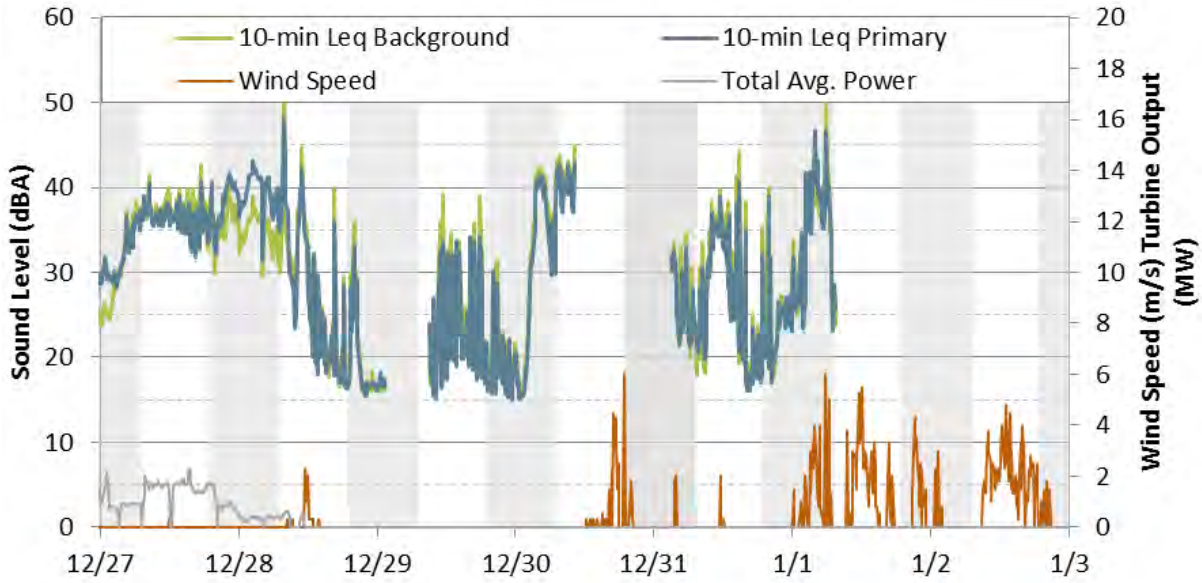


Figure 64: Eden Road Time History Results - Part 4

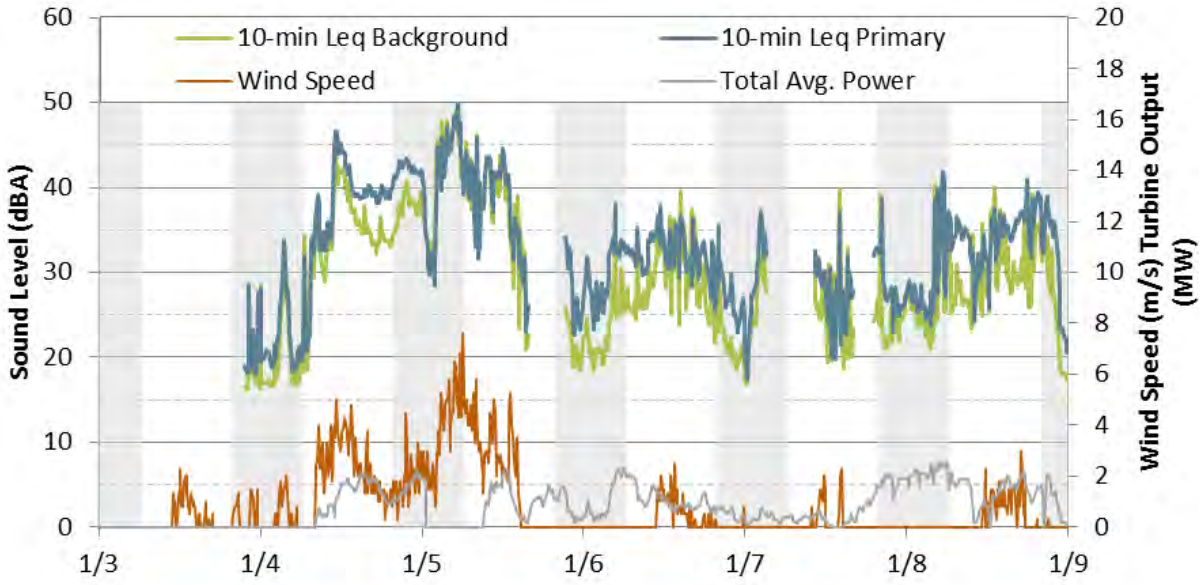


Figure 65: Eden Road Time History Results - Part 5

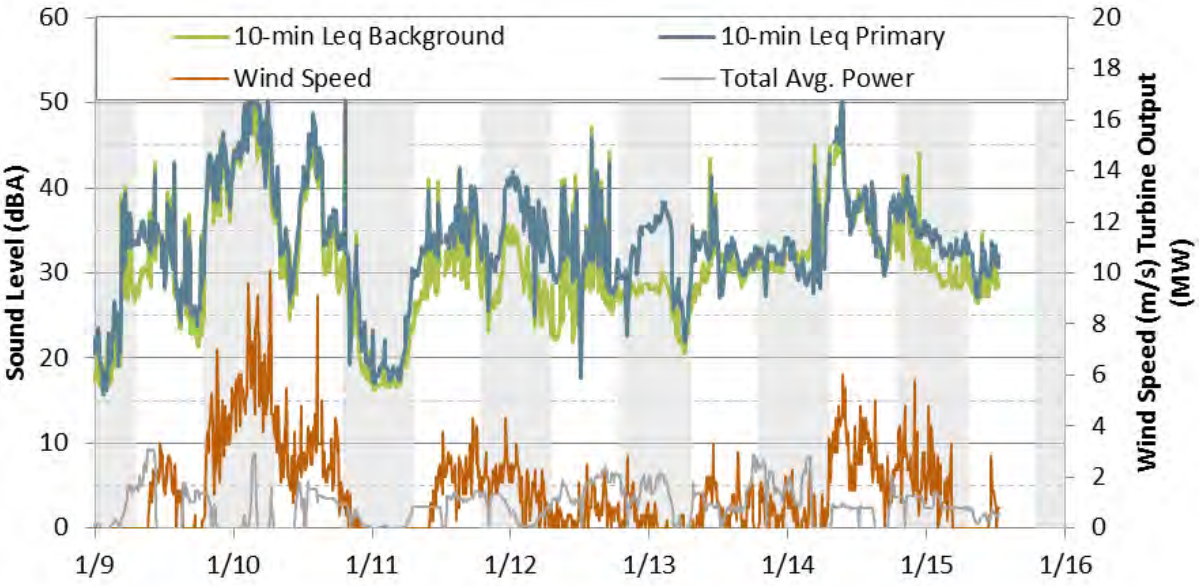


Figure 66: Eden Road Time History Results - Part 6

7.1.3 Monitor C – VT 100

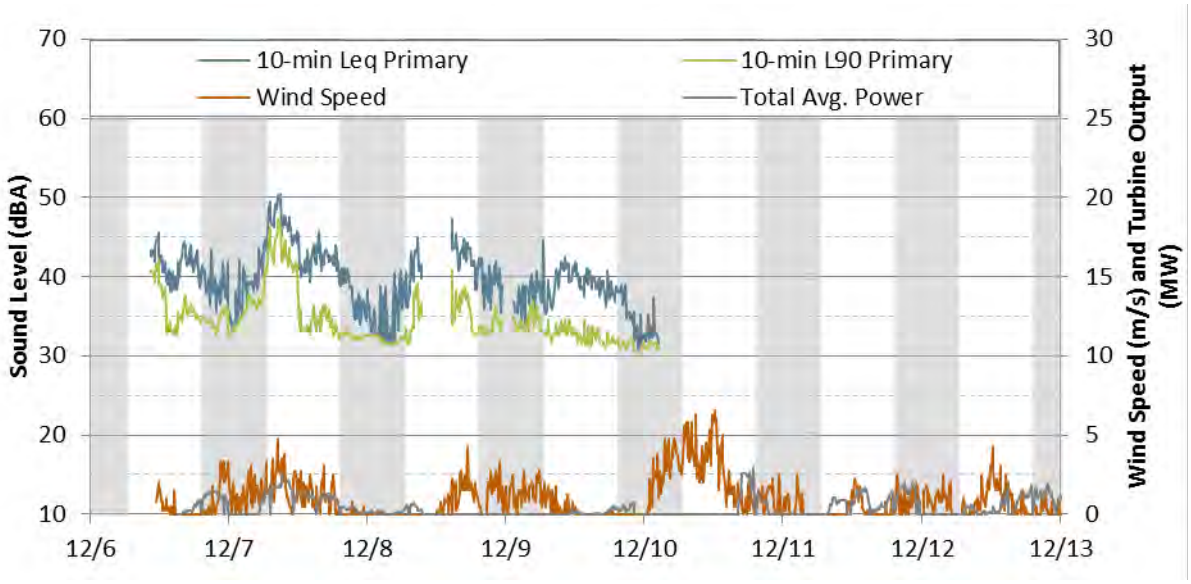


Figure 67: VT100 Time History Results - Part 1

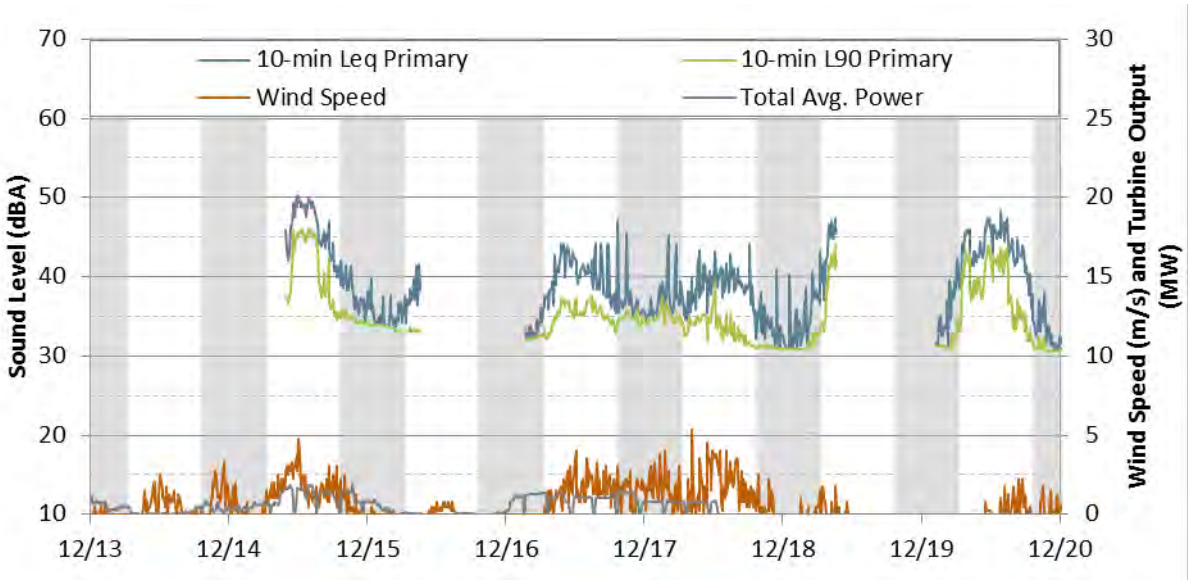


Figure 68: VT100 Time History Results - Part 2

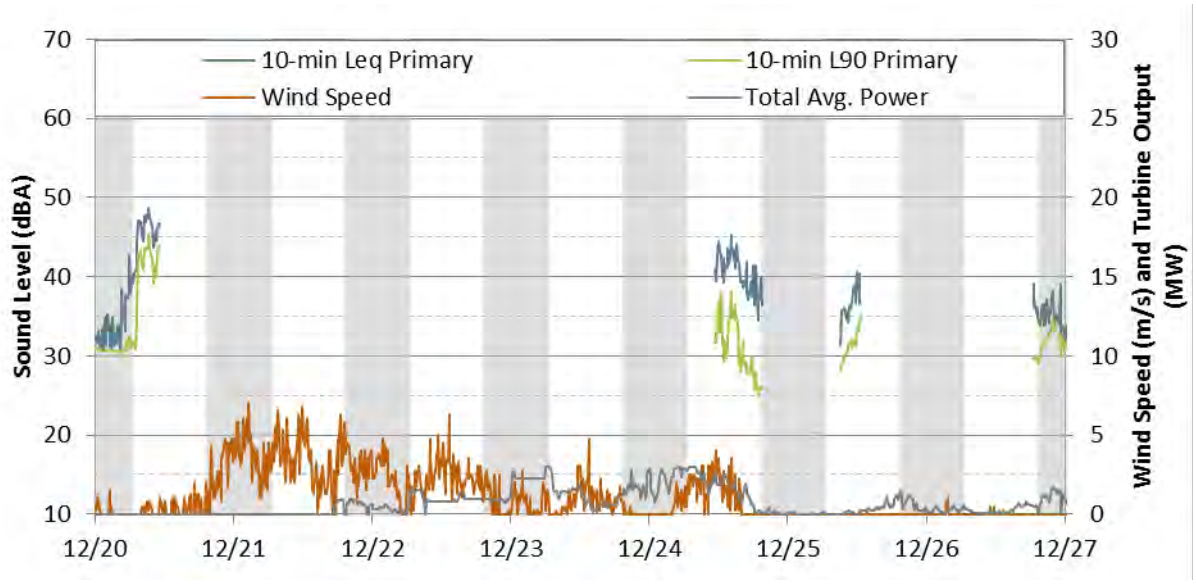


Figure 69: VT100 Time History Results - Part 3

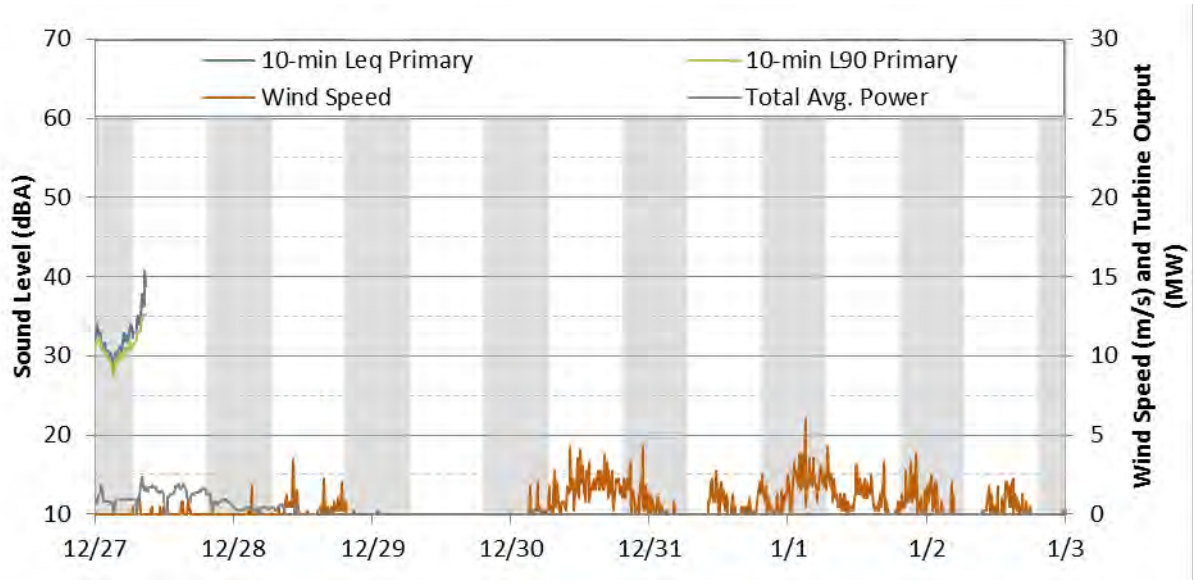


Figure 70: VT100 Time History Results - Part 4

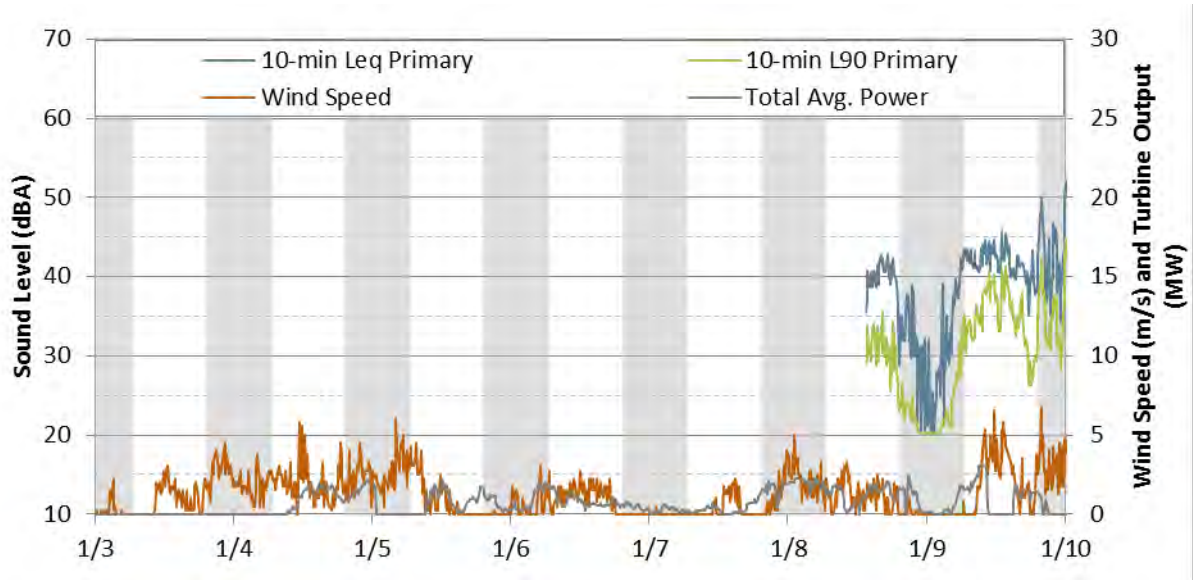


Figure 71: VT100 Time History Results - Part 5

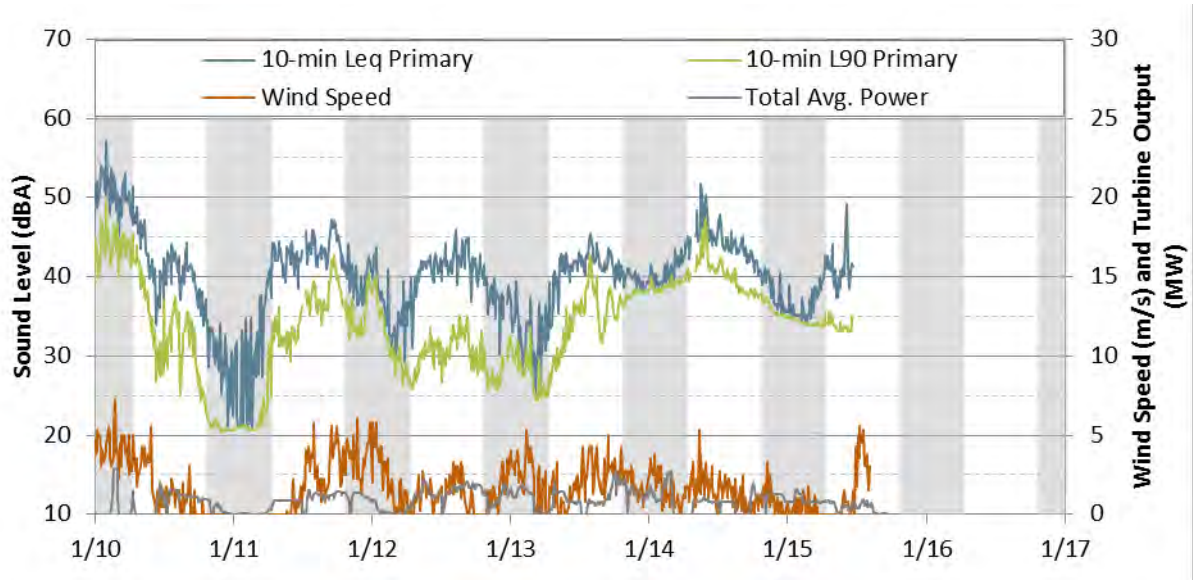


Figure 72: VT100 Time History Results - Part 6

7.1.4 Monitor D – Farm Road

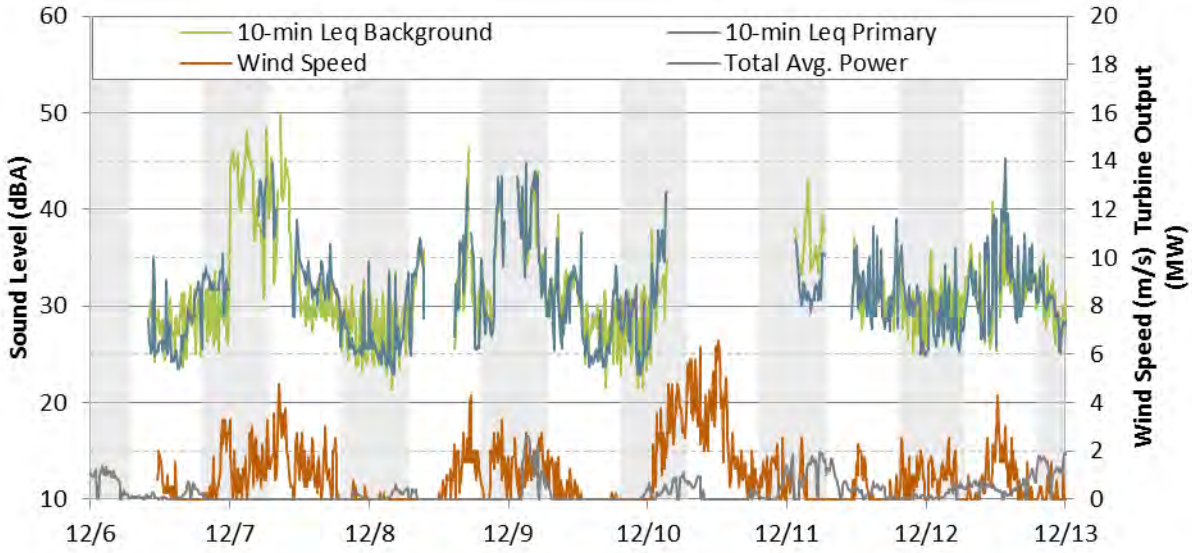


Figure 73: Farm Road Time History Results - Part 1

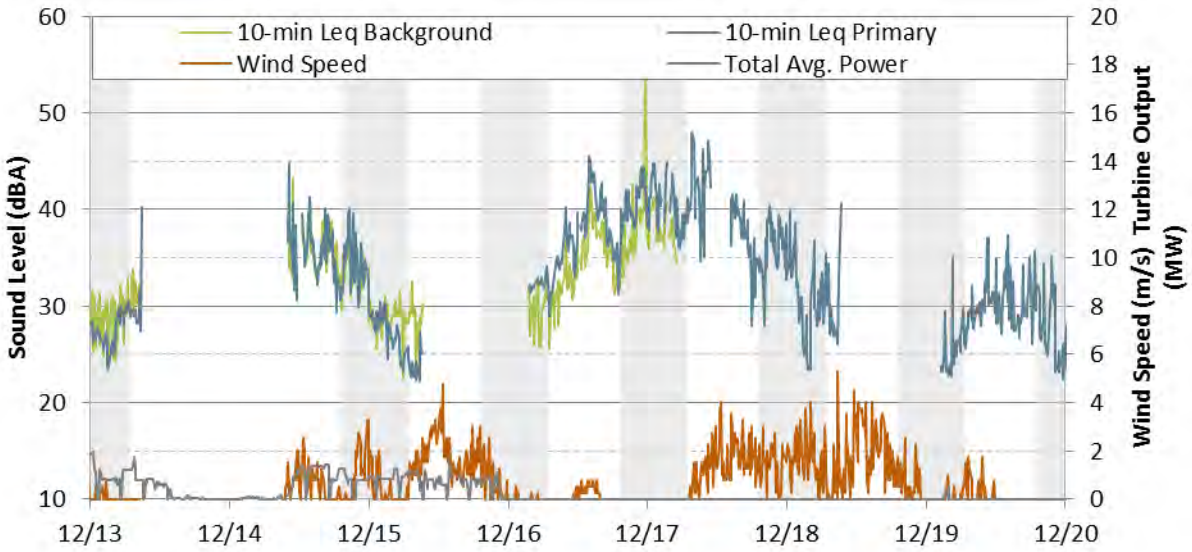


Figure 74: Farm Road Time History Results - Part 2

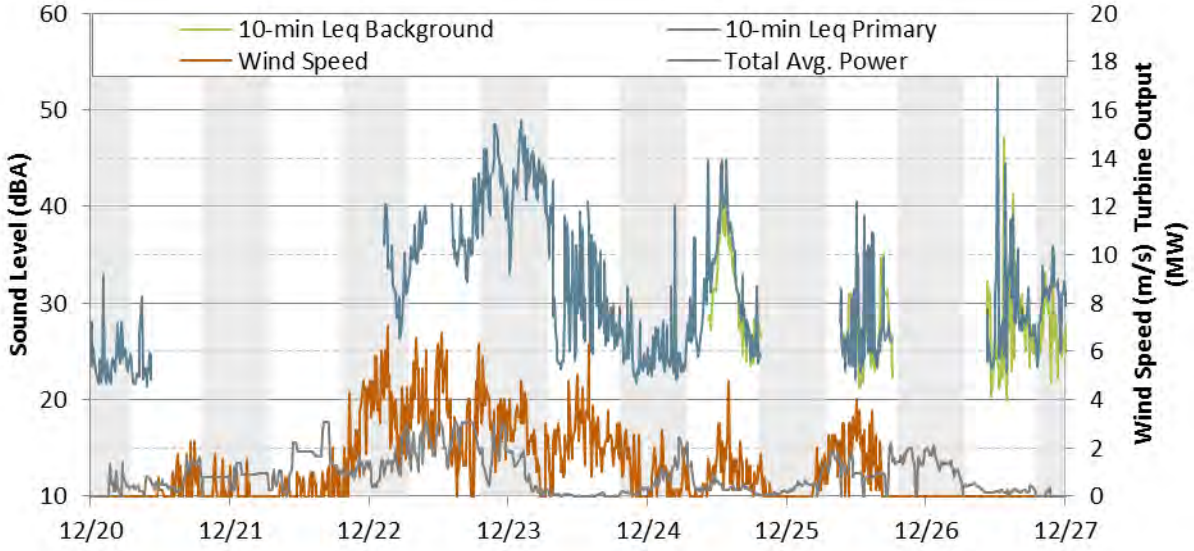


Figure 75: Farm Road Time History Results - Part 1

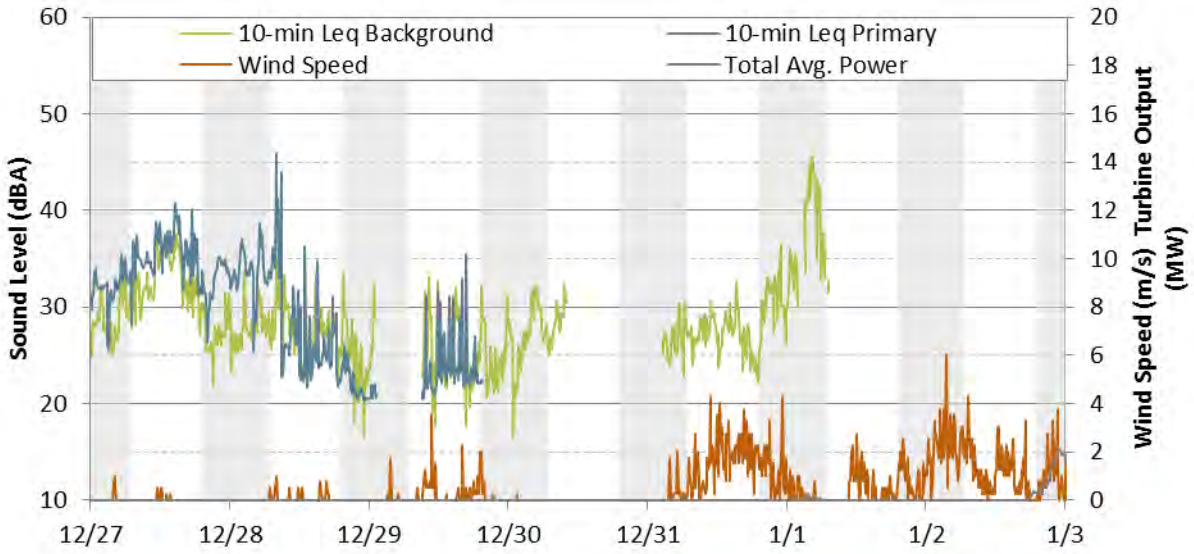


Figure 76: Farm Road Time History Results - Part 4

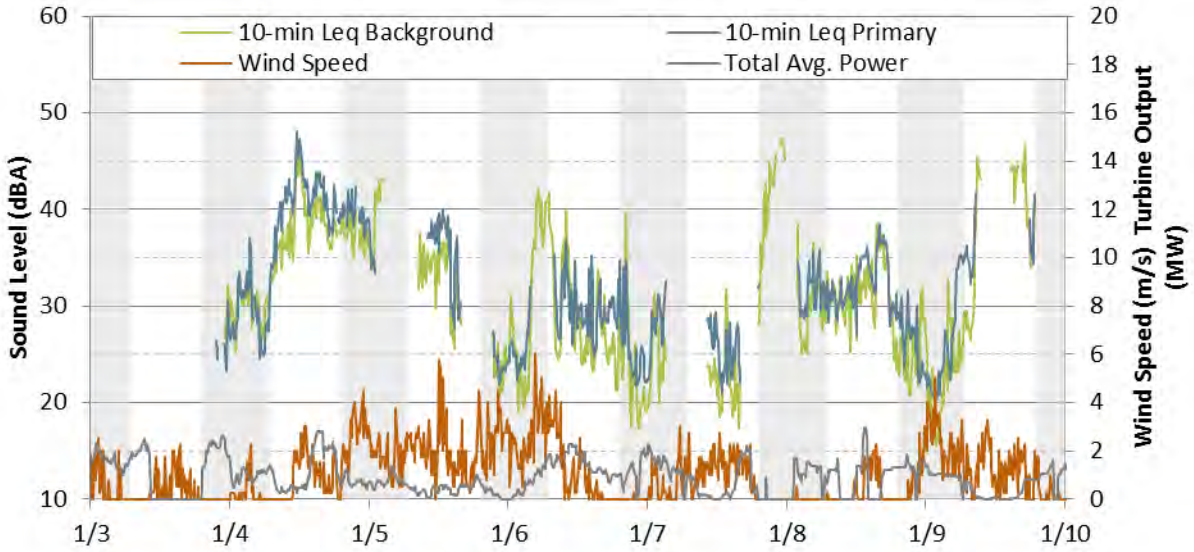


Figure 77: Farm Road Time History Results - Part 5

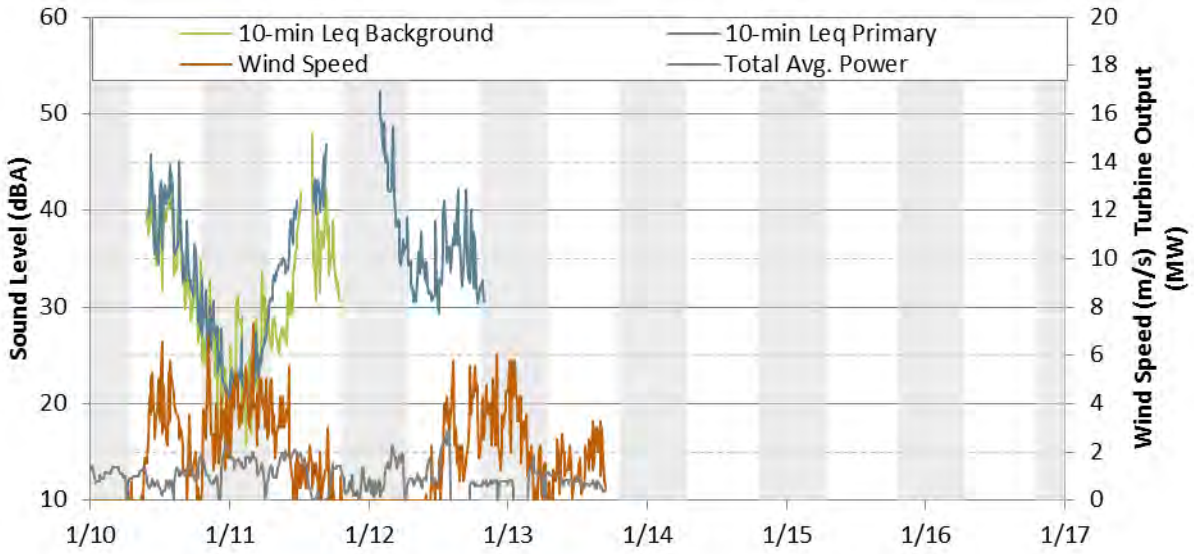


Figure 78: Farm Road Time History Results - Part 6

C. Appendix C – Full Compliance Analysis Results Using Background Method 2

Table 7: Monitor A - Full Compliance Analysis Results, Method 2

Curtailment Period		Sound level (dBA)			Turbine Only Sound Level (dBA)	
Beginning	End	Curtailment Period	Hour Before	Hour After	Hour Before	Hour After
12/6/12 19:02	12/6/12 19:22	33	36	37	32.1	33.7
12/6/12 23:01	12/6/12 23:20	32	35	34	32.4	29.8
12/7/12 15:01	12/7/12 15:21	31	36	35	34.2	32.9
12/7/12 15:01	12/7/12 15:21	31	36	35	34.2	32.9
12/8/12 7:01	12/8/12 7:22	31	34	35	32.3	33.6
12/11/12 19:01	12/11/12 19:21	33	40	40	39.6	39.1
12/11/12 23:02	12/11/12 23:21	32	39	34	37.9	29.6
12/12/12 7:00	12/12/12 7:22	32	32	37	25.4	34.9
12/12/12 19:02	12/12/12 19:24	32	39	39	37.8	38.5
12/12/12 23:01	12/12/12 23:21	29	36	35	34.8	33.6
12/13/12 3:01	12/13/12 3:21	29	34	32	31.6	27.6
12/13/12 6:56	12/13/12 7:21	30	33	30	31.0	20.5
12/14/12 19:01	12/14/12 19:20	31	38	39	36.5	38.1
12/14/12 15:00	12/14/12 15:21	33	39	38	37.5	36.6
12/15/12 3:10	12/15/12 3:23	27	35	32	33.9	29.8
12/16/12 7:01	12/16/12 7:23	26	33	33	31.8	31.8
12/16/12 15:00	12/16/12 15:20	39	39	38	34.9	32.4
12/16/12 19:00	12/16/12 19:25	28	36	37	35.4	36.4
12/16/12 23:00	12/16/12 23:25	28	36	36	35.3	35.6
12/17/12 7:00	12/17/12 7:21	28	37	39	35.9	39.1
12/17/12 3:11	12/17/12 3:37	35	38	40	37.4	39.4
12/21/12 23:00	12/21/12 23:20	28	30	36	26.4	35.5
12/26/12 23:10	12/26/12 23:25	23	33	32	32.7	31.5
12/28/12 4:06	12/28/12 4:25	22	45	44	44.5	44.4
1/8/13 20:07	1/8/13 20:35	27	36	36	35.9	35.1
1/11/13 20:02	1/11/13 20:21	25	36	36	35.7	35.0
1/12/13 4:07	1/12/13 4:22	21	42	38	41.7	38.0
1/12/13 12:01	1/12/13 12:22	28	30	33	27.7	31.6
1/12/13 20:00	1/12/13 20:17	22	31	33	28.6	31.3
1/13/13 20:02	1/13/13 20:21	28	35	33	33.9	31.2
1/14/13 19:59	1/14/13 20:18	35	37	37	36.9	37.1

Table 8: Monitor B - Full Compliance Analysis Results, Method 2

Curtailment Period		Sound level (dBA)			Turbine Only Sound Level (dBA)	
Beginning	End	Curtailment Period	Hour Before	Hour After	Hour Before	Hour After
12/6/2012 19:02	12/6/2012 19:22	29	34	35	31.7	33.6
12/6/2012 23:01	12/6/2012 23:20	29	32	30	29.1	23.0
12/7/2012 7:02	12/7/2012 7:22	32	35	34	32.2	30.7
12/7/2012 11:01	12/7/2012 11:21	31	36	36	35.1	34.1
12/7/2012 15:01	12/7/2012 15:21	26	34	33	33.1	31.9
12/7/2012 19:00	12/7/2012 19:21	25	33	30	31.4	26.0
12/7/2012 23:01	12/7/2012 23:21	25	26	33	14.1	31.1
12/8/2012 7:01	12/8/2012 7:23	27	31	36	28.2	34.6
12/11/2012 15:01	12/11/2012 15:23	29	38	32	37.8	29.1
12/11/2012 19:02	12/11/2012 19:22	28	38	39	37.1	38.5
12/11/2012 23:03	12/11/2012 23:23	31	39	32	37.8	27.2
12/12/2012 7:04	12/12/2012 7:24	30	29	32	14.6	29.2
12/12/2012 19:04	12/12/2012 19:22	29	37	38	36.5	37.0
12/12/2012 23:02	12/12/2012 23:22	26	37	35	36.4	34.7
12/13/2012 3:02	12/13/2012 3:22	26	33	31	32.5	29.4
12/14/2012 15:00	12/14/2012 15:21	35	38	38	35.3	34.8
12/14/2012 23:01	12/14/2012 23:19	31	37	37	36.1	35.2
12/15/2012 3:10	12/15/2012 3:24	23	31	29	30.5	28.1
12/15/2012 7:04	12/15/2012 7:24	24	26	25	23.7	20.5
12/15/2012 23:02	12/15/2012 23:20	20	23	24	19.9	21.8
12/16/2012 7:02	12/16/2012 7:22	22	30	32	29.7	32.1
12/16/2012 15:00	12/16/2012 15:20	32	38	36	37.3	34.9
12/16/2012 19:00	12/16/2012 19:26	27	34	35	32.6	34.0
12/16/2012 23:01	12/16/2012 23:26	24	35	34	34.6	34.0
12/17/2012 3:12	12/17/2012 3:38	31	38	39	37.0	38.1
12/21/2012 23:00	12/21/2012 23:20	25	33	33	31.9	32.8
12/22/2012 6:00	12/22/2012 6:20	31	29	41	10.5	40.0
12/22/2012 8:58	12/22/2012 9:14	29	42	39	41.3	39.0
12/26/2012 19:06	12/26/2012 19:26	21	27	29	25.2	28.8
12/26/2012 23:12	12/26/2012 23:26	20	31	29	30.4	29.0
12/27/2012 20:09	12/27/2012 20:23	33	36	37	34.0	34.5
12/28/2012 4:07	12/28/2012 4:26	30	41	41	40.9	40.2
1/5/2013 0:31	1/5/2013 1:01	33	41	31	40.6	11.6
1/10/2013 20:06	1/10/2013 20:27	20	32	30	32.1	29.4
1/11/2013 20:04	1/11/2013 20:24	27	34	31	33.6	29.4
1/12/2013 4:08	1/12/2013 4:24	27	36	36	35.9	35.1
1/12/2013 12:03	1/12/2013 12:25	18	30	32	29.7	31.4
1/12/2013 20:03	1/12/2013 20:20	23	30	31	28.7	30.4
1/13/2013 4:03	1/13/2013 4:22	24	36	28	35.7	24.8
1/13/2013 20:04	1/13/2013 20:23	27	32	33	30.5	31.4
1/14/2013 17:00	1/14/2013 17:22	31	32	37	22.9	36.2
1/14/2013 20:02	1/14/2013 20:20	36	38	39	32.9	35.8

Table 9: Monitor D - Full Compliance Analysis Results, Method 2

Curtailment Period		Sound level (dBA)			Turbine Only Sound Level (dBA)	
Beginning	End	Curtailment Period	Hour Before	Hour After	Hour Before	Hour After
12/15/12 3:10	12/15/12 3:23	34	34	34	23.8	19.0
12/16/12 7:02	12/16/12 7:23	34	34	35	24.9	29.5
12/16/12 15:00	12/16/12 15:20	39	40	39	34.8	30.8
12/16/12 18:57	12/16/12 19:26	36	36	36	28.6	28.9
12/16/12 23:00	12/16/12 23:25	36	36	36	28.4	25.9
12/17/12 3:11	12/17/12 3:38	37	37	38	31.5	34.4
12/17/12 7:00	12/17/12 7:22	35	37	36	30.7	29.0
1/12/13 4:07	1/12/13 4:22	30	32	33	28.2	29.6

Table 10: Monitor D - Full Compliance Analysis Results, Method 2

Curtailment Period		Sound level (dBA)			Turbine Only Sound Level (dBA)	
Beginning	End	Curtailment Period	Hour Before	Hour After	Hour Before	Hour After
12/11/2012 19:02	12/11/2012 19:22	30	34	35	32.4	33.3
12/11/2012 23:02	12/11/2012 23:22	25	31	26	29.9	17.6
12/12/2012 19:02	12/12/2012 19:24	31	33	33	30.4	29.5
12/12/2012 23:02	12/12/2012 23:22	25	29	28	27.0	25.4
12/13/2012 3:02	12/13/2012 3:22	24	26	26	23.0	21.5
12/14/2012 15:00	12/14/2012 15:22	33	36	36	33.0	32.9
12/14/2012 19:00	12/14/2012 19:20	31	33	35	26.7	31.9
12/14/2012 23:05	12/14/2012 23:19	31	34	33	31.7	28.7
12/15/2012 7:04	12/15/2012 7:25	23	25	24	22.0	17.7
12/16/2012 7:02	12/16/2012 7:23	29	33	33	30.5	31.0
12/16/2012 19:00	12/16/2012 19:25	33	36	40	32.5	39.1
12/17/2012 7:00	12/17/2012 7:21	36	38	39	32.6	36.0
12/26/2012 23:10	12/26/2012 23:25	24	32	31	31.0	30.1
12/27/2012 7:01	12/27/2012 7:21	30	33	36	31.0	35.0
12/27/2012 20:08	12/27/2012 20:22	26	32	31	31.0	29.6
12/28/2012 4:06	12/28/2012 4:25	25	34	35	33.7	34.6
1/8/2013 12:01	1/8/2013 12:23	27	31	34	29.6	33.7
1/9/2013 4:05	1/9/2013 4:25	22	26	29	23.3	27.8
1/12/2013 4:07	1/12/2013 4:22	42	42	39	35.8	25.0

D. APPENDIX D – WIND TURBINE OPERATIONAL DATA