BARLOW SOLAR ENERGY CENTRE

Acoustic Audit Report

EDF Renewables Canada, Inc.

Document No.: 10160644-HOU-R-01
Issue: B**, Status:** FINAL
Date: 24 January 2020

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Project name:	Barlow Solar Energy Centre	DNV GL - Energy
Report title:	Acoustic Audit Report	GL Garrad Hassan Canada, Inc.
Customer:	EDF Renewables Canada, Inc.	70 Richmond Street East
	Barlow Energy Centre LP	Suite 315, M5C 1N8
	53 Jarvis Street, Ste 300	Toronto, Canada
	Toronto, Ontario M5C 2H2	Enterprise No.: 860480037
Contact person:	Ariane Côté	
Date of issue:	24 January 2020	
Project No.:	10160644	
Work Order:	183094-HOU-P-01-A	
Document No.:	10160644-HOU-R-01	
Issue/Status:	B/FINAL	

Task and objective:
This report contains acoustic analysis of the Barlow Solar Energy Centre conducted by DNV GL on behalf of EDF Renewables Canada, Inc.

Prepared by:	Verified by:	Approved by:
K. Varnik Senior Acoustic Engineer	A. Nercessian Project Analyst	G. Constantin Project Manager

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Keywords:
Solar, Acoustic Audit, Ontario

Issue	Date	Reason for Issue	Prepared by	Verified by	Approved by
A	13 December 2019	Draft	K. Varnik	A. Nercessian	G. Constantin
B	24 January 2020	Final	K. Varnik	A. Nercessian	G. Constantin

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1 INTRODUCTION

EDF Renewables Canada, Inc. ("EDF" or the "Customer") retained GL Garrad Hassan Canada, Inc. ("DNV GL") to provide an acoustic audit for the operational Barlow Solar Energy Centre (the "Project" or "Barlow") located approximately 10 kilometers (km) west of the City of Cornwall, in the Township of South Stormont. This report presents the results of DNV GL's analysis.

This audit was conducted to demonstrate compliance with Condition D1 of the Renewable Energy Approval (REA) [1] for the Project in accordance to the requirements of *O. Reg 359/09* and the *Environmental Protection Act,* RSO 1990, c.E,19, Section 47.4. The intent of this audit is to provide an evaluation of the actual noise at receptors due to the operation of the Project (immission) and evaluate the actual noise emission of the inverter/transformer clusters (emission). The methodology for the audit was discussed with the Ontario Ministry of Environment, Conservation and Parks (MECP) prior to conducting the measurements [2].

This report is written to conform to Ministry of Environment (MOE) Publications NPC-103 [3], NPC-233 [4], NPC-300 [5] and the conditions of the REA approval [1].

Section 2 describes the physical and acoustic environment at the measurement points, as well as the applicable regulations. Section 3 details the equipment used. Section 4 covers the methodology employed. The results of the measurement campaign are presented in Section 5, and general conclusions with respect to the results obtained are summarized in Section 6.

2 SITE DESCRIPTION

2.1 Project location

The Project is located on the northern side of Cornwall Centre Road, southwest of Highway 401, within the Township of South Stormont, and approximately 10 km west of the City of Cornwall. Notable activity near the Project area include a scrapyard, active train tracks, the Cornwall motor speedway, as well as an airspace and a runway for model aircraft used by the Cornwall Aeromodellers[1]. A map illustrating the site plan and all significant noise sources is presented in Figure 2-1. The measurement locations for the survey are closer than all the nearest receptors in each cardinal direction (West, South, and East).

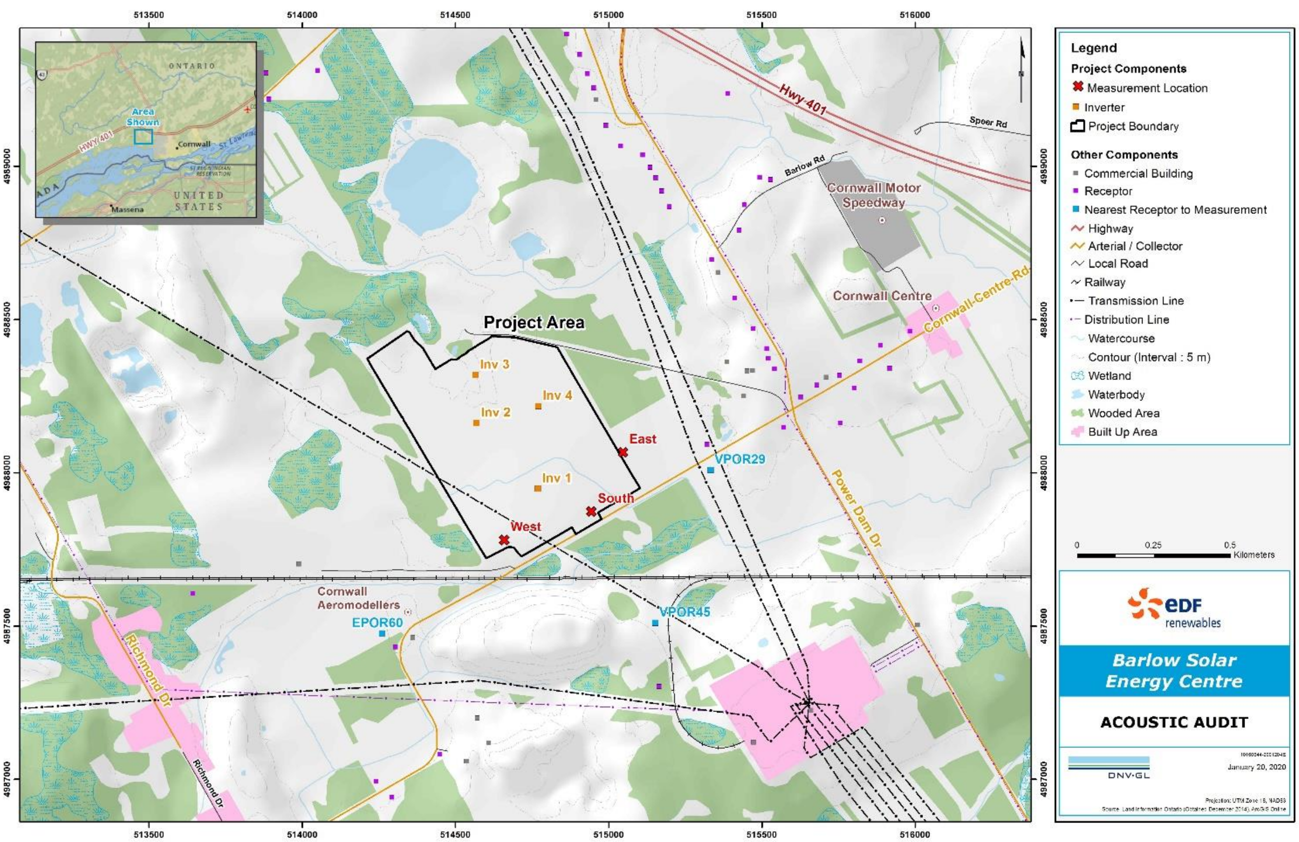

Figure 2-1 Site plan identifying sound sources and receptors

[1] https://www.cornwallaeromodellers.ca/

2.2 Solar facility description

The primary noise sources belonging to the Project are the four (4) inverter/transformer clusters. Photographs of all 4 clusters are shown in Appendix A.

Specifically, the Project has the following noise sources:

- Four (4) Power Electronics HEC 1500V model 2.5MW inverter units; and
- Four (4) inverter step-up transformers rated at 3.0 MVA.

Since the Project operates from sunrise to sunset, strict operating hours are not defined.

The DNV GL field engineer confirmed that the installed inverters were Power Electronics HEC 1500V and were contained inside geometric area enclosures as described in the pre-construction Acoustic Assessment Report (AAR) prepared by Stantec [6] and were located within the allowable polygons outlined in the REA [1]. The Project does not include a substation step-up transformer, which was specified in the REA.

A list of the equipment, IDs, coordinates and allowable polygons is shown in Table 2-1. This report will be using the on-site ID in the first column of Table 2-1 when describing equipment throughout the report, unless otherwise specified.

Table 2-1 Coordinates of Project components

As-built equipment			Allowable polygon per REA Schedule B for inverter and transformer		
On-Site ID	**Easting (m)**	**Northing (m)**	**Schedule B Source ID**	**Easting (m)**	**Northing (m)**
Inv 1	514766	4987936	inv_02 trans_02	514983 514767 514681 514688	4988000 4987876 4987892 4988125
Inv 2	514570	4988161	inv_01 trans_01	514755 514681 514463 514469	4988097 4987892 4988021 4988218
Inv 3	514567	4988313	inv_04 trans_04	514763 514711 514422 514625	4988371 4988150 4988273 4988395
Inv 4	514766	4988213	inv_03 trans_03	514711 514763 514823 514982	4988150 4988371 4988360 4988045

Note: Exact locations of the inverter clusters do not appear in the REA permit. Instead, an allowable polygon in which each inverter and transformer may be placed was listed.

2.3 Regulatory approval

The Project was granted an approval of the REA application on 3 April 2018 to engage in a renewable energy project in respect of Class 3 solar facility consisting of the construction, installation, operation, use, and retiring of such a facility with a capacity of up to approximately 10 MW [1].

For the purposes of this report, an "Acoustic Audit" means an investigative procedure consisting of measurements of all sources of noise emissions due to the operation of the equipment assessed to determine compliance with the Noise Performance Limits set out in the Approval. This study demonstrates compliance with condition D1 of the REA.

In accordance with the Approval, an AAR was prepared by Stantec [6] in October 2017 to reflect the Project facilities modelled noise emissions. As such, DNV GL can be considered an Independent Acoustical Consultant for the purpose of conducting the audit.

2.4 Points of reception

Three receptors in different cardinal directions, among those identified in the pre-construction AAR conducted by Stantec [6], were selected to be representative Points of Reception (PoR) for the purpose of conducting the Acoustic Audit. These measurement locations were based on the closest and/or loudest modeled receptors in each cardinal direction (except north of the Project where there is no nearby receptor) in the AAR and were provided to a MECP acoustic reviewer [2]. According to the AAR [6], the most impacted PoR was a vacant lot receptor (VPOR45) located on Cornwall Centre Road, to the southeast.

The locations of all measurements and associated PoRs according to the AAR [6] are presented in Table 2-2 and on the site map in Figure 2-1. The closest Project noise source for all the measurement locations and receptor locations is Inverter 1 (Inv 1). The AAR contains multiple layout scenarios, and the loudest modeled value from the preconstruction acoustic assessment is presented for each PoR.

Table 2-2 Measurement locations

Measurement locations						Corresponding AAR receptors				
ID	**Height (m)**	**Easting (m)**	**Northing (m)**	**Distance to nearest source (m)**	**Nearest Source ID**	**ID**	**Easting (m)**	**Northing (m)**	**Distance to nearest source (m)**	**Modeled sound level (dBA)**
East	1.5	515045	4988067	308	Inv 1	VPOR29	515333	4988010	572	34
South	1.5	514942	4987874	187	Inv 1	VPOR45	515152	4987511	574	33
West	1.5	514657	4987781	189	Inv 1	EPOR60	514260	4987476	684	30

The nearest and/or loudest receptors were not accessible, or landowner access was not provided; therefore, on-site constraints caused the measurement locations to be relocated closer to the Project facility, which allowed DNV GL to better capture any Project contribution. Photographs of the monitoring stations at each measurement location are shown in Appendix B. A history of the communication with the landowners is shown in Appendix D.

Since the selected measurement locations are not shielded by other structures and are closer to the Project than the corresponding receptor, they can be considered conservative and more likely to capture the acoustic contribution from the Project.

2.5 Determination of existing background sounds

The general area consists of industrial land. The land usage is typical of rural areas in southern Ontario with dwellings built near the roadways.

Sound measurements were therefore dominated by vehicular traffic. Traffic counts from the City of Cornwall based on Annual Average Daily Traffic (AADT) [7] and the Ontario Ministry of Transportation [8] were gathered in order to determine the average predicted sound levels from the traffic. AADT counts in year 2018 were obtained for traffic along Cornwall Centre Road, and modeled with STAMSON. Traffic counts during a period of approximately sixty (60) minutes were also conducted by the DNV GL field engineer during the measurements. Data from the counts were averaged out to a period of 1 hour. Table 2-3 presents the traffic data and associated sound levels obtained at the three measurement locations.

Table 2-3 Traffic count and estimated traffic sound levels

Measurement location and date	Distance from road (m)	Annual Average Daily Traffic (AADT)		Field measurement count	
		Cars (averaged to 1 hour)	Modeled traffic noise [dBA]	Cars (averaged to 1 hour)	Modeled traffic noise [dBA]
South 17 Sept 2019	39	98	53	90	48
East 10 October 2019	168	98	37	57	35
East (Hwy 401) 10 October 2019	1275	937	35[A]	N/A	N/A
West 19 October 2019	89	98	41	61	40

[A] Extrapolated from modeled value of 43.5 dBA at 500 meters to 35 dBA at 1275 m.

In order to determine a predicted ambient sound level due to traffic, the MECP ORNAMENT model, implemented in the MECP-provided STAMSON software, was used [9]. This model is widely implemented in Ontario. It is used by acoustic professionals in Ontario to provide a good representation of ambient sound produced by vehicular traffic.

As a matter of conservatism, all vehicles were assumed to be cars. Neither data set contains truck counts, which would have increased the modeled traffic noise. The input parameters and results printout from STAMSON can be found in Appendix E. The on-site vehicle counts are also presented in Table 2-3.

Measurements at the East location contained a continuous audible noise from Hwy 401 that influenced the results. The AADT for the nearest exit on Hwy 401 is 22,500 vehicles [8]. The STAMSON software does not allow distances greater than 500 meters from the road location to be modeled. The calculated LA_{eq} value at 500 meters is 43.5 dBA. Extrapolating this value to the eastern monitoring location at 1275 m using simple geometric spreading[2], results in a value of approximately 35 dBA.

The terrain was flat, and the layout was simple, therefore, no terrain screening, physical barrier or ground cover effects were considered in the model.

[2] Equivalent to assuming 6 dB reduction for doubling of distance.

3 EQUIPMENT

The acoustic and meteorological measurements data gathered in the context of this study were obtained using the instruments listed in Table 3-1 (see Appendix B for photographs at sound measurement locations).

Table 3-1 Equipment for acoustic measurements

Equipment	Serial number
Larson Davis sound meter model 831C Class I	10368
Free Field ½ inch microphone model 377B02	303859
Preamplifier model PRM831	051224
Vaisala WXT520 Weather Sensor	P1320473

The sound meter used by DNV GL meets the International Electrotechnical Commission (IEC) 61672 Class 1 specifications [10]. The accuracy of the sound meter calibration was verified on site before and after each measurement with a Larson Davis CAL200 Class I calibrator; the differential calibration was never greater than 0.5 dBA. The calibration certificates of all instruments can be found in Appendix C.

It should be noted that in addition to measuring sound levels, the Larson Davis sound meter also recorded audio files throughout the measurement period. In addition to observations from the DNV GL field engineer, this facilitates the screening of events and determining if the corresponding high sound level is representative of the ambient noise or if it is a transient event that can be removed from analysis.

4 METHODOLOGY

The REA permit for this Project [1] requires measurements of the actual sound propagation (immission) from the operation of the facility in order to determine the Project's contribution the sound levels at nearby residences and its compliance with MECP prescribed limits. Additionally, the REA has requested that the actual sound levels of the inverter/transformer clusters and the substation be evaluated (emission). No substation will be built at this site, and therefore no substation transformer assessment is included in this report.

The methodology employed in the present study is based on the following standards related to acoustic noise measurements:

- Basic Comprehensive CofA (Air) – User Guide (Appendix B), Ontario MOE, Environmental Assessment and Approvals Branch (2011);
- NPC-103, Ministry publication of the Model Municipal Noise Control By-Law (1978);
- International Standards for Environmental Noise Measurement ISO 1996 (-1, -2); and
- IEEE Std C57.12.90, Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers.

Environmental noise measurements are often influenced by weather, namely wind and rain. To reduce the undesired effect of wind-induced noise, DNV GL uses a foam wind screen. According to industry best practices and the specifications of the wind screen, the wind-induced noise is kept within an acceptable range for wind speeds below approximately 5.5 m/s at the measurement height (1.5 m above ground level [agl]). Humidity is monitored to confirm the absence of rain during the measurement period. Measurements taken during periods of rain, if any, are not considered valid due to the influence of rain-induced noise. The manufacturer of the sound meter confirms that humidity levels above 90% do not affect noise measurements, but might only affect the associated uncertainty, which remains within an acceptable range for this campaign. In addition, the measurements were attended and properly planned to be conducted during sunny weather, with low winds. Humidity and high winds are therefore not typically encountered during solar facility acoustic auditing.

4.1 Noise source measurements (emission)

Sound pressure level (SPL) measurements were carried out at Inv 2: the inverter/transformer cluster chosen on site in consultation with the facility operator. The Project layout is shown in Figure 2-1.

The measurement locations around the inverter cluster were based on the ANSI/IEEE C57.12.90 standard [11]. These measurement locations are illustrated in Figure 4-1.

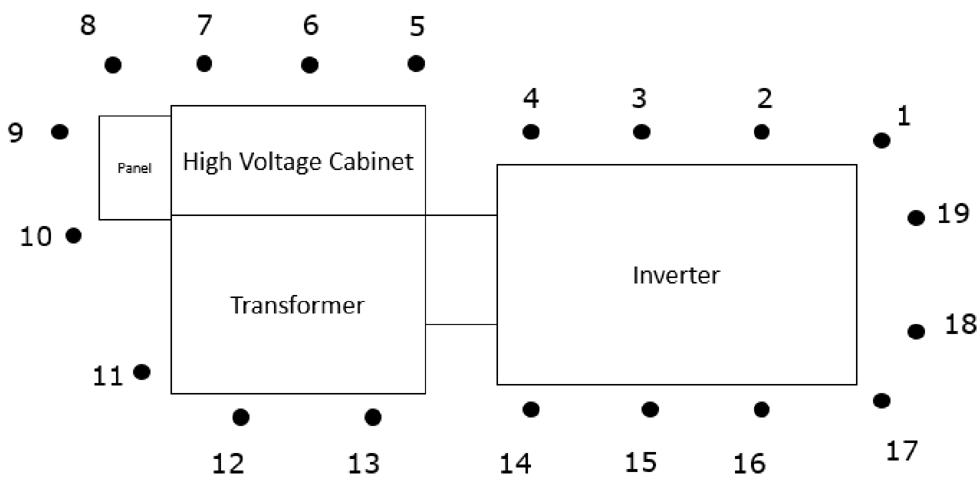

Figure 4-1 E-Test Measurement Locations at Inverter/Transformer Cluster Inv 2

At each measurement point, 30-second measurements of equivalent continuous A-weighted sound levels (LA_{eq}) were taken.

The measurements were taken during full production hours, on a sunny day, with equipment reaching full capacity.

The sound power levels (PWL) of the inverter/transformer cluster were then calculated according to ANSI/IEEE C57.12.90 [11]. The results for the inverter/transformer cluster are presented in Section 5.1.

4.2 Measurements to evaluate noise levels at PoRs (immission)

Three representative PoRs were selected and agreed upon in discussions with the MECP [2]. The three impacted PoRs were chosen on the south, southwest, and southeast sides of the solar facility. The measurements were taken according to NPC-103, which allows intermittent sounds to be filtered, provided that the accumulated valid time is at least 20 minutes to represent the 1-hour LA_{eq}. The measurement locations are shown on the site map in Figure 2-1. Photographs of each point are presented in Appendix B.

All measurements were taken at a height of 1.5 m agl.

Measurements of the equivalent continuous A-weighted sound levels (LA_{eq}) were taken at 1-second intervals for a 1-hour minimum period. The ninetieth percentile A-weighted sound levels (LA_{90}) were then calculated for the measurement period. The lowest 60-second LA_{eq} levels were identified. The results are presented in Section 5.2.

The original measurements were taken on 18 September 2019, during sunny conditions when the equipment was operating at full capacity. Subsequent measurements at the East and South locations were redone on 19 October, after it was determined that the plant did not reach full capacity during the original east and west measurements.

Table 4-1 Coordinates of all measurement points (UTM18 NAD83)

ID	Easting (m)	Northing (m)
South	514942	4987874
East	515045	4988067
West	514657	4987781

5 ANALYSIS AND RESULTS

All measurements recorded by the sound level meters were analyzed. The meteorological instruments and the DNV GL field engineer confirmed that all sound levels presented in this report were measured at wind speeds below 5.5 m/s (20 km/h) at 1.5 m. Although not included in the analysis, the maximum wind speed briefly reached 5.9 m/s during the measurement period, but wind speeds were generally calm. Relative humidity did not exceed 90% during the measurement period. Importantly, the Project reached full operational capacity during the measurement period. Hourly weather data from Environment Canada is shown in Appendix F.

5.1 Inverter/transformer cluster (emission)

5.1.1 Determination of broadband sound power level (PWL)

A methodology based on ANSI/IEEE C57.12.90 [11] was used for the PWL calculation of the inverter/transformer cluster. The microphones were placed 0.3 m from the sides of the cluster. The overall inverter/transformer cluster dimensions are shown in Table 5-1. The locations of the measurements are shown in Figure 4-1.

Table 5-1 Inverter / transformer cluster dimensions

L1	Length	8.3 m
L2	Width	3.2 m
L3	Height	2.5 m

The measurement locations at the inverter/transformer cluster are based on the ANSI/IEEE C57.12.90 approach and pictures are presented in Appendix A. The PWL emitted by the inverter/transformer cluster was evaluated from the nineteen measurement locations and the corresponding measurement surface (S), as defined in the standard [11]. The PWL was then calculated for each measurement location and logarithmically averaged across all measurements.

Table 5-2 summarizes the pertinent information for all measurement points that were used to assess the PWL of the inverter/transformer cluster. This unit was identified as Inv 6 in the Stantec AAR [6] and Inv 2 on-site. The notes indicate whether the microphone was next to the inverter, transformer (TF) or near the transformer high voltage cabinet (HVC).

It should be noted that inverters were fully operating as shown in Figure 5-5. Ventilation in the sheds is with passive air flow through vents. No air flow was coming out of the vents during the measurements.

Table 5-2 Summary of inverter/transformer cluster sound power measurements (Inv2)

Measurement Location		**MS: Measurement surface**				**Source**
ID	**LAeq [30 sec]**	**Method used**	**Distance from cluster (d) [m]**	**Measured from**	**Area of Measurement surface (S) [m²]**	**PWL [dBA]**
1	74.4	C57.12.90	0.3	Inverter Corner	40.7	90.5
2	75.7			Inverter Side		91.8
3	76.7			Inverter Side		92.8
4	78.5			Inverter Corner		94.6
5	77.7			TF corner (Behind HVC)	31.6	92.7
6	70.0			TF Side (Behind HVC)		85.0
7	67.7			TF Side (Behind HVC)		82.7
8	67.7			TF corner (Behind HVC)		82.7
9	65.6			TF corner (Behind HVC)		80.6
10	70.5			TF Side		85.5
11	77.0			TF corner		92.0
12	76.6			TF Side		91.6
13	77.8			TF Side		92.8
14	76.7			Inverter Corner	40.7	92.8
15	75.5			Inverter Side		91.6
16	75.7			Inverter Side		91.8
17	75.7			Inverter Corner		91.8
18	78.0			Inverter Side		94.1
19	77.6			Inverter Side		93.7
Average LA_{eq} [30 sec]	74.5			**Transformer Only**	31.6	**89.4[a]**
	76.6			**Inverter Only**	40.7	**92.7[a]**

[a] Does not include tonal penalty

Measurements taken by DNV GL were performed at 0.3 m per IEEE C57.12.90. Surface areas were calculated per C57.12.90 based on the dimensions of each component. Both the inverter and transformer remained operational throughout the test. It is not possible to perfectly isolate the noise from each component. Separate values for the individual components are presented, based on averaging individual measurements and specifying a different measurement surface (S) for each component. The measurement locations were separated between the transformer and inverter, based on proximity to the closest component.

The measured sound power value was 92.7 dBA for the inverter and 89.4 dBA for the transformer. In the AAR, the sound power values were 91.7 dBA and 82.4 dBA for the inverter and transformer respectively, which included a 5-dB tonal penalty on both components. The combined value of the noise sources in the AAR was 92.2 dBA and the combined value of measurements was 94.4 dBA. The reported sound levels are likely to be slightly louder than the true sound levels of each component, since the adjacent equipment influences the measurements. Therefore, the measured source sound levels in this report can be considered conservative. However, as shown in Table 5-3, the combined values of the components are similar to the REA limits and pre-construction noise assessment and all receptors were in compliance with the MECP limits.

Table 5-3 Sound power levels for the Inverter/Transformer Cluster

Source description	**Measured sound power level [dBA]**	**Modeled sound power level from the AAR [a] [dBA]**	**REA allowable sound power level [a] [dBA]**
Inverter unit	92.7	91.7	92
Transformer	89.4	82.4	82
Combined Value of Inverter and Transformer	94.4	92.2	92.4
	[a] Includes 5-dB tonal penalty		

5.1.2 Determination of a tonal component

Tonality checks at the source were based on the ISO 1996-2 [12]. The 19 sets of 1/3 octave band measurements were averaged to determine a total LA_{eq} spectrum representative of the inverter cluster. Table 5-4 and Figure 5-1 present the averaged 1/3 octave band SPL spectrum.

As defined in ISO 1996-2 [12], a tonal component represents a peak within the spectrum with a difference of 5 dB or more with both adjacent 1/3 octave bandwidths. As shown in Table 5-4 and Figure 5-1, no tonality was emitted from the device. No tonality penalty has been applied to the sound sources.

Table 5-4 One-third octave band frequency spectrum of Inverter/Transformer Cluster Inv2

Frequency [Hz]	**6.3**	**8**	**10**	**12.5**	**16**	**20**	**25**	**31.5**	**40**	**50**	**63**	**80**
SPL [dBA]	-32.6	-22.4	-14.0	-5.7	1.0	9.2	16.7	23.5	32.1	37.0	40.0	42.8

Frequency [Hz]	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**
SPL [dBA]	47.2	51.6	54.7	57.0	60.7	68.2	72.8	66.1	65.2	66.6	64.3	64.9

Frequency [Hz]	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**	**12500**	**16000**	**20000**
SPL [dBA]	66.6	67.2	60.5	57.4	50.8	46.5	47.8	48.2	40.0	28.9	23.5	16.1

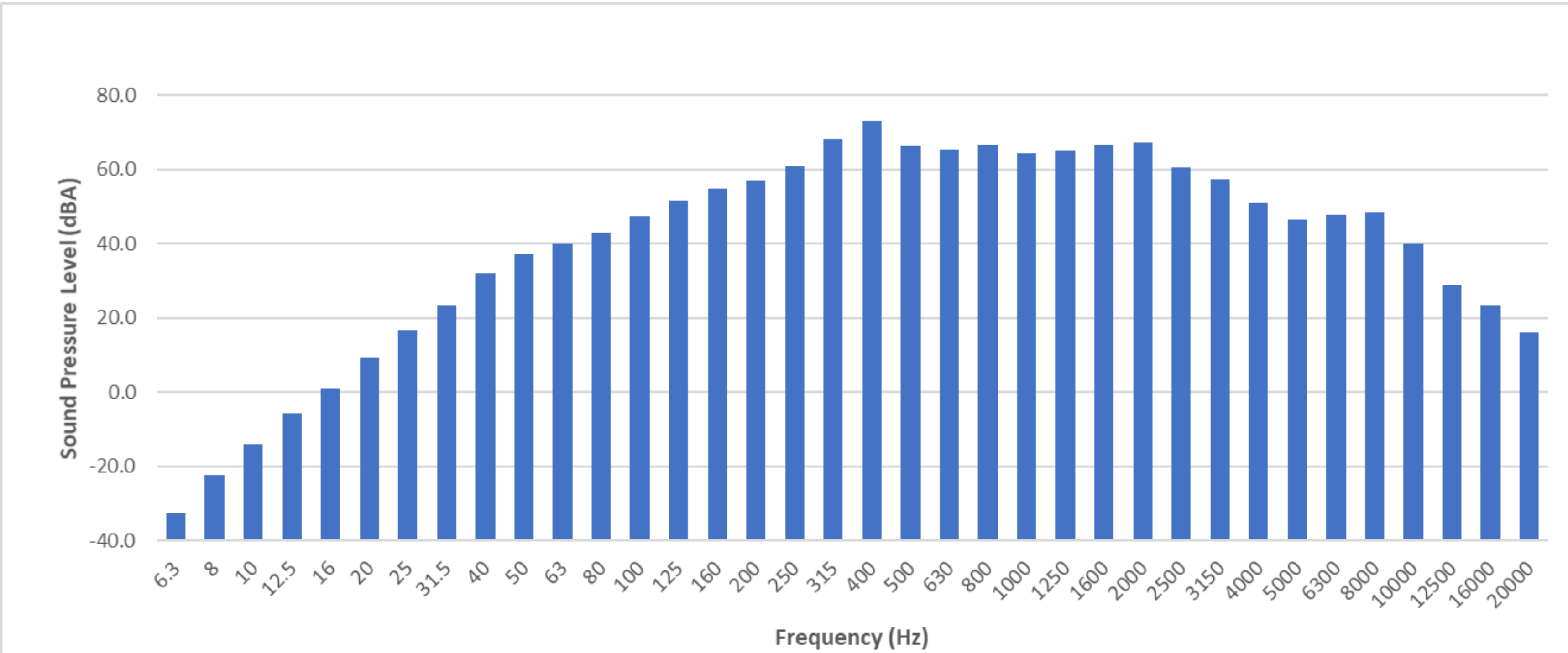

Figure 5-1 Measured SPL One-third octave bands of Inverter/Transformer Cluster Inv2

5.2 Points of reception (immission)

5.2.1 Determination of sound pressure levels at PoRs

The noise environment, as recorded by the instrumentation and perceived by DNV GL staff during the measurement campaign, was mainly characterized by the following:

- Steady vehicular traffic on Cornwall Centre Road;
- Natural sounds including insect noise, migrating birds, and brush;
- Continuous highway traffic noise from Highway 401;
- Model aircraft noise from the nearby Aeromodellers;
- Noise from Cornwall motor speedway; and
- Noise from a nearby industrial lot from trucks and metal working activities.

In order to capture the ambient noise level, the averaging interval of the sound meter was set to 1 second. The LA_{eq} – or Equivalent Continuous Level – recorded by the sound meter is the equivalent continuous sound that would contain the same sound energy as the time varying sound. The LA_{90} – or ninetieth percentile A-weighted sound levels – is the level exceeded for 90% of the time and is calculated from the LA_{eq}, 1-second measurements.

The reported LA_{eq} at the East location is 39.6 dBA. This includes the removal of the estimated 35 dBA steady traffic noise from Hwy 401, with 22,500 AADT, as described in Section 2.5.

Table 5-5 presents a summary of the results of the measurement campaign at the receptors.

Table 5-5 Summary of results obtained from measurement campaign

Measurement point ID	**Measurement date (2019)**	**Measurement period (EDT)**	**Audible sound levels (dBA)**				**Class 3 NPC-300 sound level limits (Day/Night)**
			Reported LA_{eq}	**Unfiltered LA_{eq}**	**Lowest LA_{90} (60 sec) [b]**	**Lowest LA_{eq} (60 sec) [b]**	
South	17 September	14:14 – 15:34	**45.0**	55.2	41.2	43.3	45 / 40
East	19 October	09:30 – 11:00	**39.6[a]**	46.0	38.3	40.9	45 / 40
West	19 October	11:36 – 13:10	**39.5**	61.7	35.4	36.1	45 / 40

[a] Adjusted for continuous traffic noise from Hwy 401 as described in section 2.5

[b] This represents the lowest 1 minute LA_{90} and LA_{eq} when the plant was at full capacity.

The unfiltered raw LA_{eq} demonstrate that the acoustic environment surrounding the Project has elevated sound levels. Since it is difficult to assess the 1-hour LA_{eq} Project contribution within the existing complex sound environment, multiple metrics are used to describe the acoustic environment and estimate the Project contribution. These metrics, along with the graphics and figures in this section, are presented to illustrate the filtering that was used, and to support the conclusions.

Measurements were originally performed on Tuesday, 17 September 2019. Two measurements (points East and West) performed on 17 September were discarded and were re-performed on Saturday, 19 October 2019, because the Project was not operating near its full capacity at the end of 17 September.

Traffic noise is the biggest influence on the sound in this area, and overall traffic levels were louder during weekdays.

The unfiltered LA_{eq} is presented with sound levels between 46.0 and 61.7 dBA. Samples with high background sounds were removed from the data set, following the guidelines set forth in NPC-103 [3]. For the weekday measurement on 17 September 2019, when traffic was heavier, the filtered LA_{eq} value is similar to the modeled traffic noise value presented in Section 2.5. For the weekend measurements on 19 October 2019, there are enough measurements (20 minutes per NPC-103) between audible noise events to show that combined one-hour LAeq sound levels for the Project meet the NPC-300 class 3 nighttime 40-dBA limit. The 39.6 dBA value for the East takes into account the removal of the estimated 35 dBA steady traffic noise from Hwy 401, with 22,500 AADT.

Table 5-6 Summary of sound sample filtering

	Unfiltered number of recorded samples	**Unfiltered LA_{eq}**	**Number of remaining samples**	**Reported LA_{eq}**
South	4796	55.2	2988	45.0
East	5457	46.0	1274	39.6[a]
West	5471	61.7	3248	39.5
[a] Includes additional adjustment for continuous noise from Hwy 401				

Figure 5-2 and Figure 5-3 present the temporal variation of $LA_{eq,10\ sec}$. These figures provide a snapshot of the fluctuations of sound levels during the measurement periods and the E-test. They also show the LA_{90}, LA_{50} and unfiltered LA_{eq} calculated for each of the periods corresponding to each receptor. The energy production data is also shown for the day of the measurements. The time stamp is in Eastern Daylight Time.

The temporal variation of the LA_{eq} measurements is presented for each measurement location individually in Figure 5-4 to Figure 5-6. These graphs also show the short-term unfiltered (1-second LA_{eq} during the measurement period of each measurement location.

The East and West graphs show many points below the 40 dBA nighttime noise limit in NPC-300, including the lowest 1-minute LA_{eq}. Since the noise contribution for a solar facility is steady, the lowest 1-minute LA_{eq} can be considered an alternative method of evaluating the steady state contribution of the solar facility by filtering out ambient noise. This is supported by NPC-103.3.4.e: Procedure for Measurement of Steady or Impulsive Sound:

> *a minimum of three observations with a minimum observation time of 15 s each shall be made. The observed average reading for each of the observations shall be noted as well as the minimum and the maximum of the range of sound levels*
> *during each observation period. If the difference between any two observed average readings is greater than 3 dB, a minimum of six observations shall be made. For the purpose of adjustments for intermittency the duration of the sound in any one hour shall be noted.*

However, since the existing noise environment is dominated by traffic noise which causes sound levels to fluctuate throughout the monitoring periods, additional analysis is presented. The 1-minute values are provided as supporting evidence to demonstrate the contribution of the steady state noise source is negligible.

Additionally, DNV GL notes that the Reported LA_{eq} at the South point (45 dBA) is similar to the traffic noise predicted by STAMSON at that point using the vehicle count during the measurement period (48 dBA). This indicates that Project contribution was likely negligible at this location

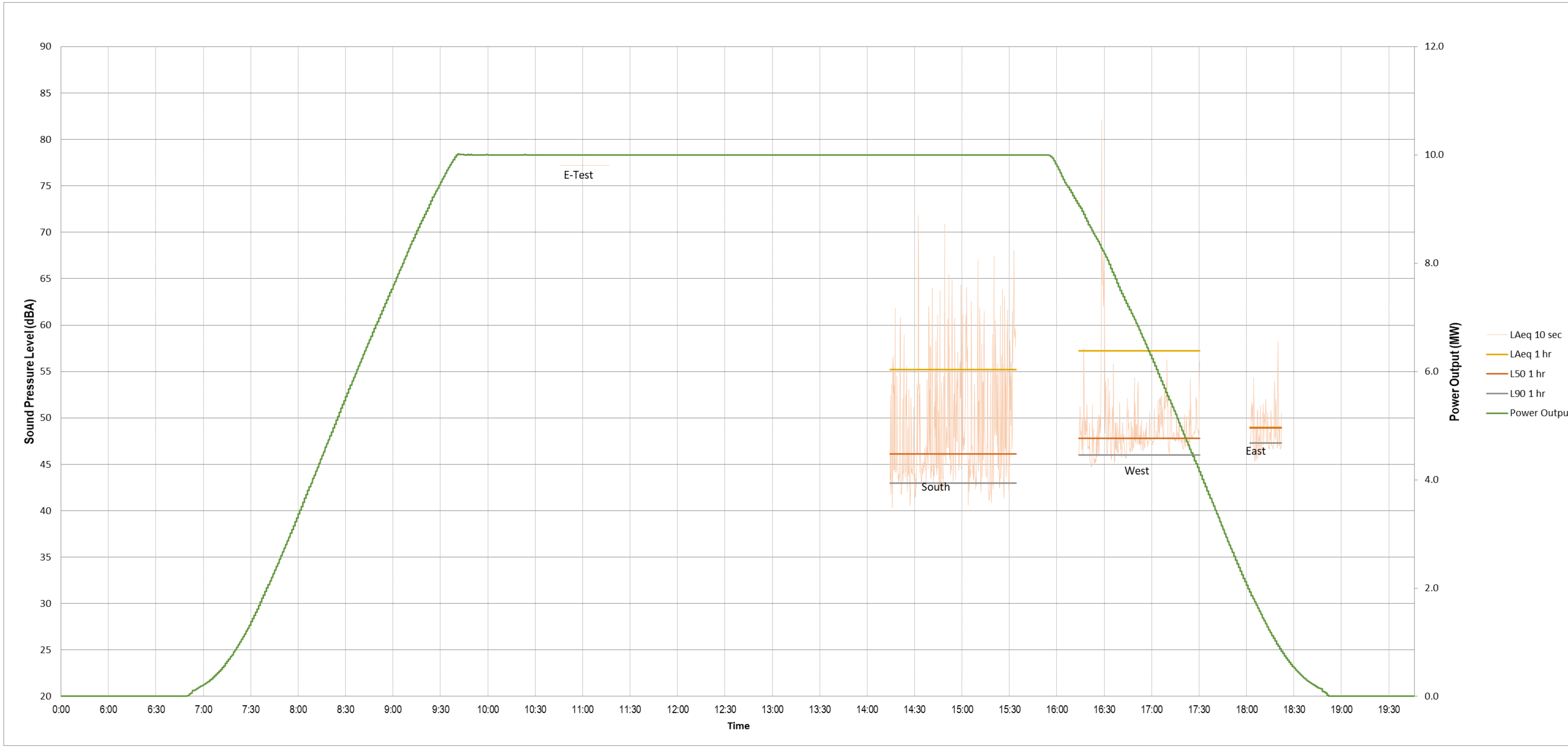

Figure 5-2 Measured SPL at Barlow 17 September 2019 (EDT)

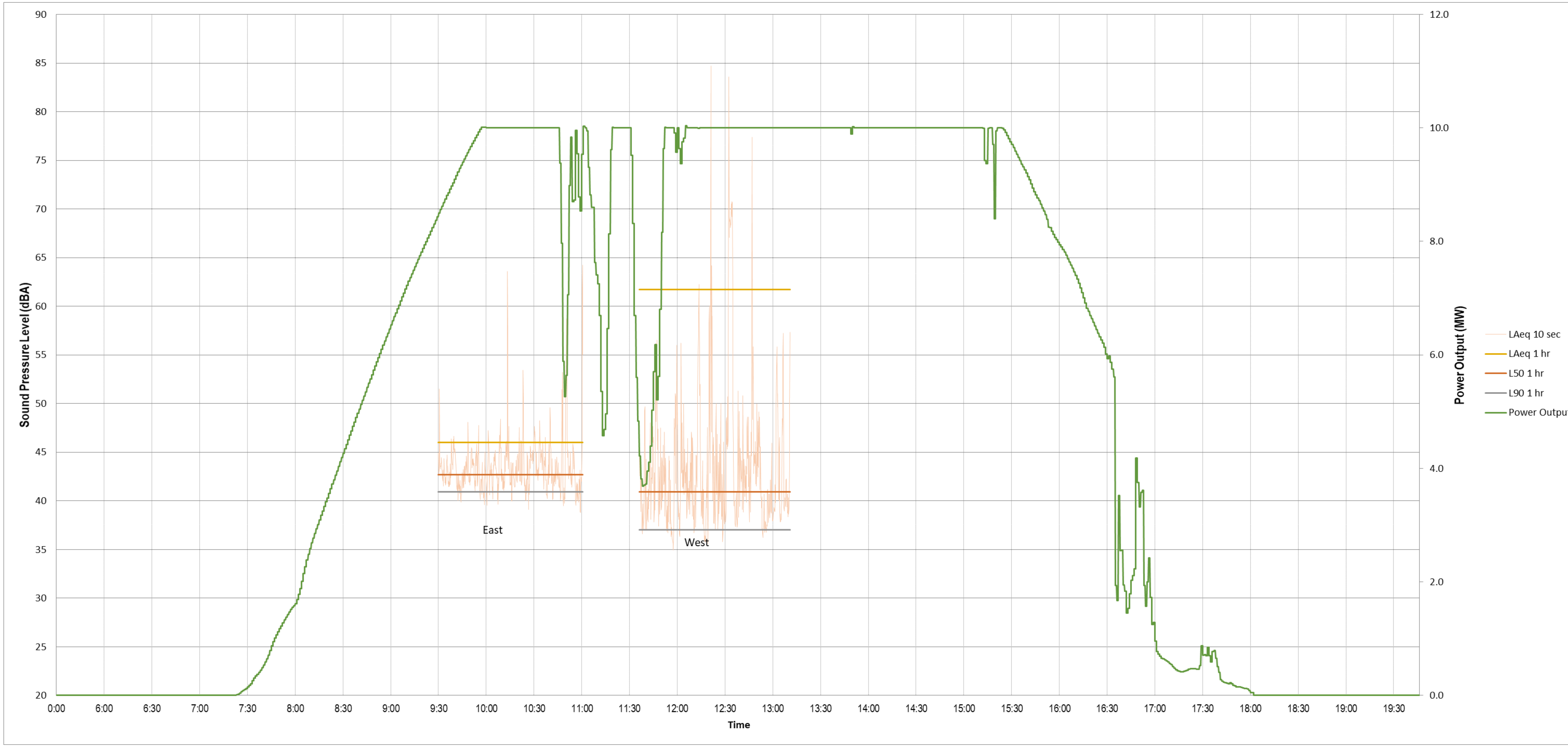

Figure 5-3 Measured SPL at Barlow 19 October 2019 (EDT)

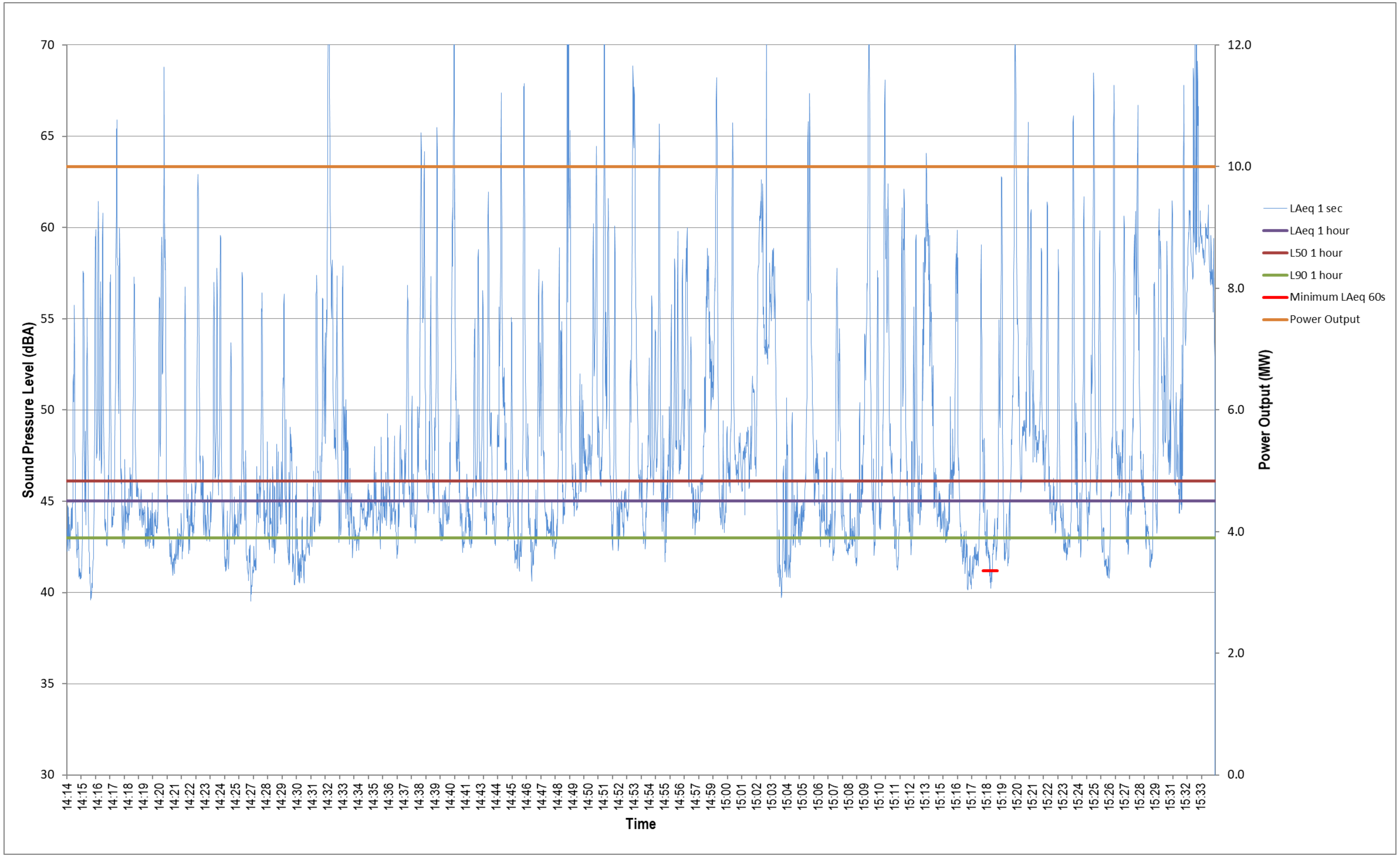

Figure 5-4 Measured SPL at South Location 17 September 2019 (EDT)

/

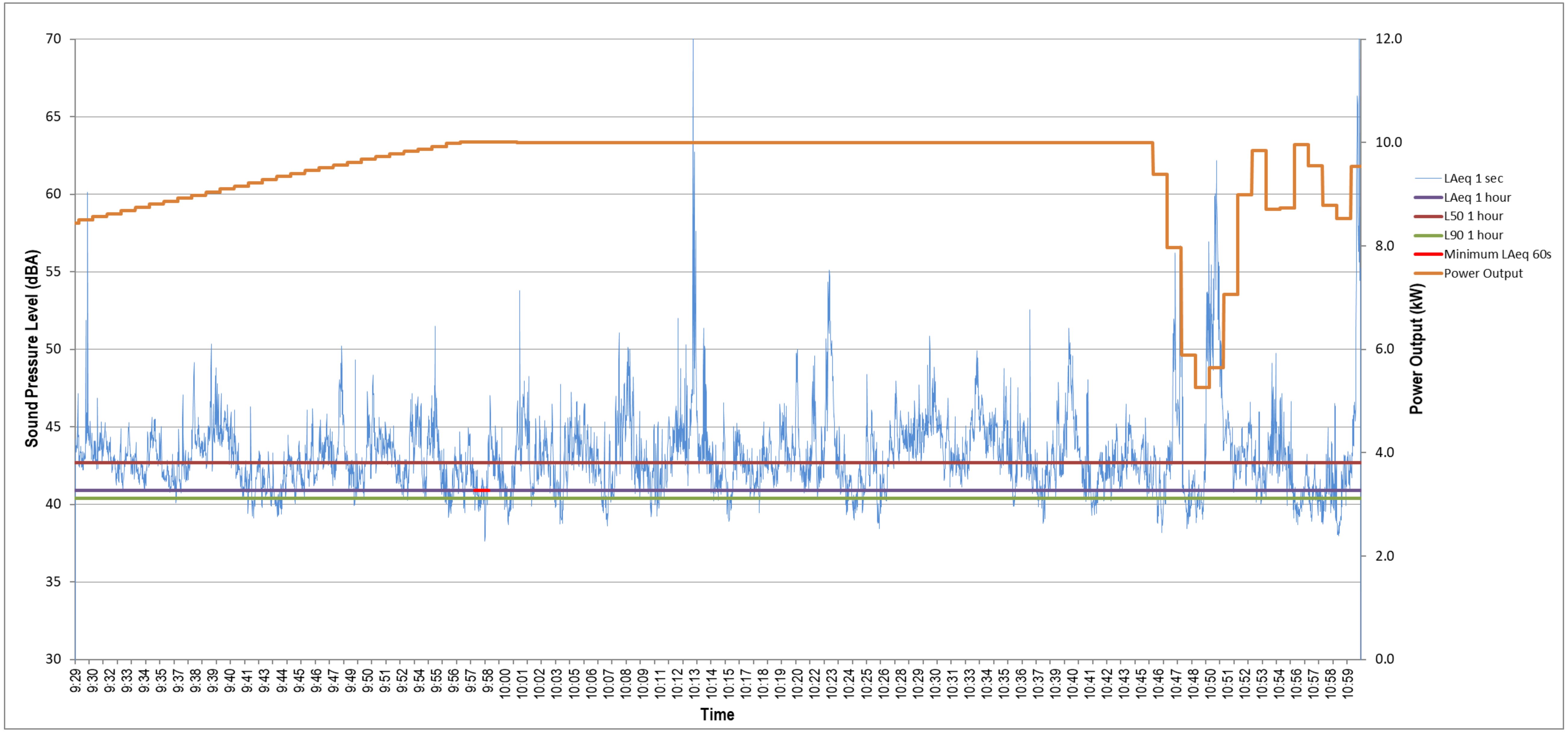

Figure 5-5 Measured SPL at East Location 19 October 2019 (EDT)

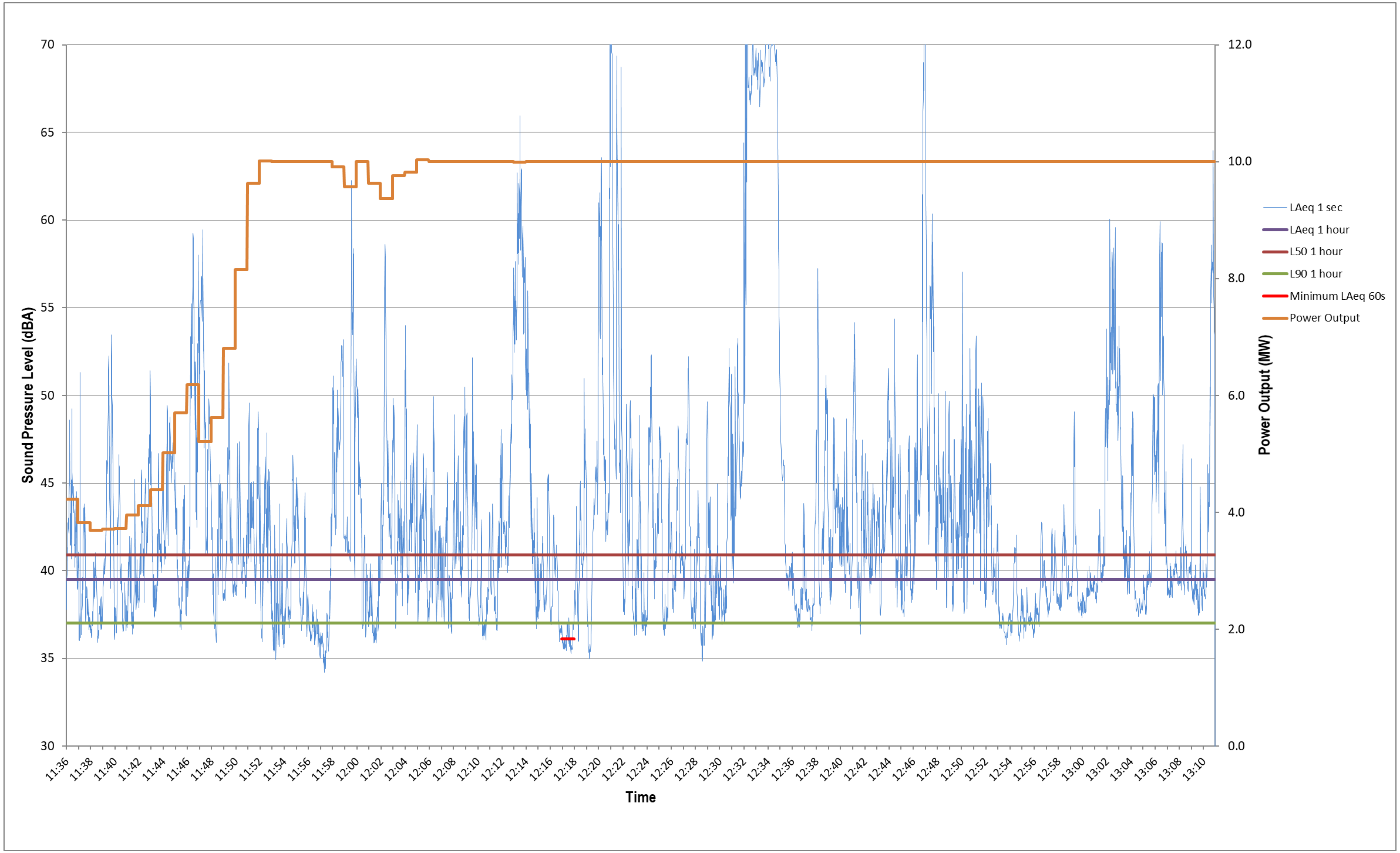

Figure 5-6 Measured SPL at West Location 19 October 2019 (EDT)

5.2.2 Determination of tonality at PoRs

The LA_{eq} 1/3 octave band sound pressure levels were averaged over the entire measurement period for each measurement location to determine a long-term audible LA_{eq} spectrum. The averaged 1/3 octave band SPL spectrums are presented in Table 5-7 through Table 5-9. It should be noted that these are values represent the unfiltered values of what was measured on-site, and not the reported values in Table 5-5.

Table 5-7 One-third octave band frequency spectrum at South measurement Location

Frequency [Hz]	**6.3**	**8.0**	**10.0**	**12.5**	**16.0**	**20.0**	**25.0**	**31.5**	**40.0**	**50.0**	**63.0**	**80.0**
SPL [dBA]	-25.8	-20.1	-14.1	-6.0	1.0	9.6	12.4	17.3	22.6	28.1	32.8	37.3

Frequency [Hz]	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**
SPL [dBA]	37.7	40.3	38.7	40.2	41.8	41.9	41.9	45.4	45.5	47.1	47.0	45.2

Frequency [Hz]	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**	**12500**	**16000**	**20000**
SPL [dBA]	42.6	39.1	35.8	34.2	36.7	29.8	23.3	27.1	20.5	5.7	6.4	-0.4

Table 5-8 One-third octave band frequency spectrum at East measurement location

Frequency [Hz]	**6.3**	**8.0**	**10.0**	**12.5**	**16.0**	**20.0**	**25.0**	**31.5**	**40.0**	**50.0**	**63.0**	**80.0**
SPL [dBA]	-26.4	-20.7	-15.7	-11.2	-4.1	3.5	7.8	10.6	13.8	20.3	27.7	27.0

Frequency [Hz]	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**
SPL [dBA]	28.8	32.4	31.8	31.0	32.3	34.0	33.5	36.5	37.5	38.0	37.1	34.2

Frequency [Hz]	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**	**12500**	**16000**	**20000**
SPL [dBA]	31.6	28.1	26.6	25.5	23.8	21.5	17.2	13.7	10.1	5.1	1.4	-1.2

Table 5-9 One-third octave band frequency spectrum at West measurement location

Frequency [Hz]	**6.3**	**8.0**	**10.0**	**12.5**	**16.0**	**20.0**	**25.0**	**31.5**	**40.0**	**50.0**	**63.0**	**80.0**
SPL [dBA]	-26.8	-20.0	-13.8	-3.2	2.0	8.5	15.9	21.7	27.1	36.4	36.3	38.4

Frequency [Hz]	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**
SPL [dBA]	39.1	38.6	39.4	39.9	42.3	45.9	50.3	52.8	51.9	54.9	55.4	50.3

Frequency [Hz]	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**	**12500**	**16000**	**20000**
SPL [dBA]	50.0	46.5	41.9	37.7	33.5	30.7	18.9	17.6	15.4	3.7	0.5	-1.2

As defined in ISO 1996-2 [12], a tonal component represents a peak within the 1/3 octave spectrum with a difference of 5 dB or more with both adjacent 1/3 octave bandwidths.

As shown in Figure 5-7 through Figure 5-9, no audible tonality as defined in [12] occurs for any of the three receptors. No tone was perceived by the DNV GL field engineer at the measurement locations during the measurements. Thus, no 5-dB tonal penalty was applied to the measured sound levels at the measurement locations.

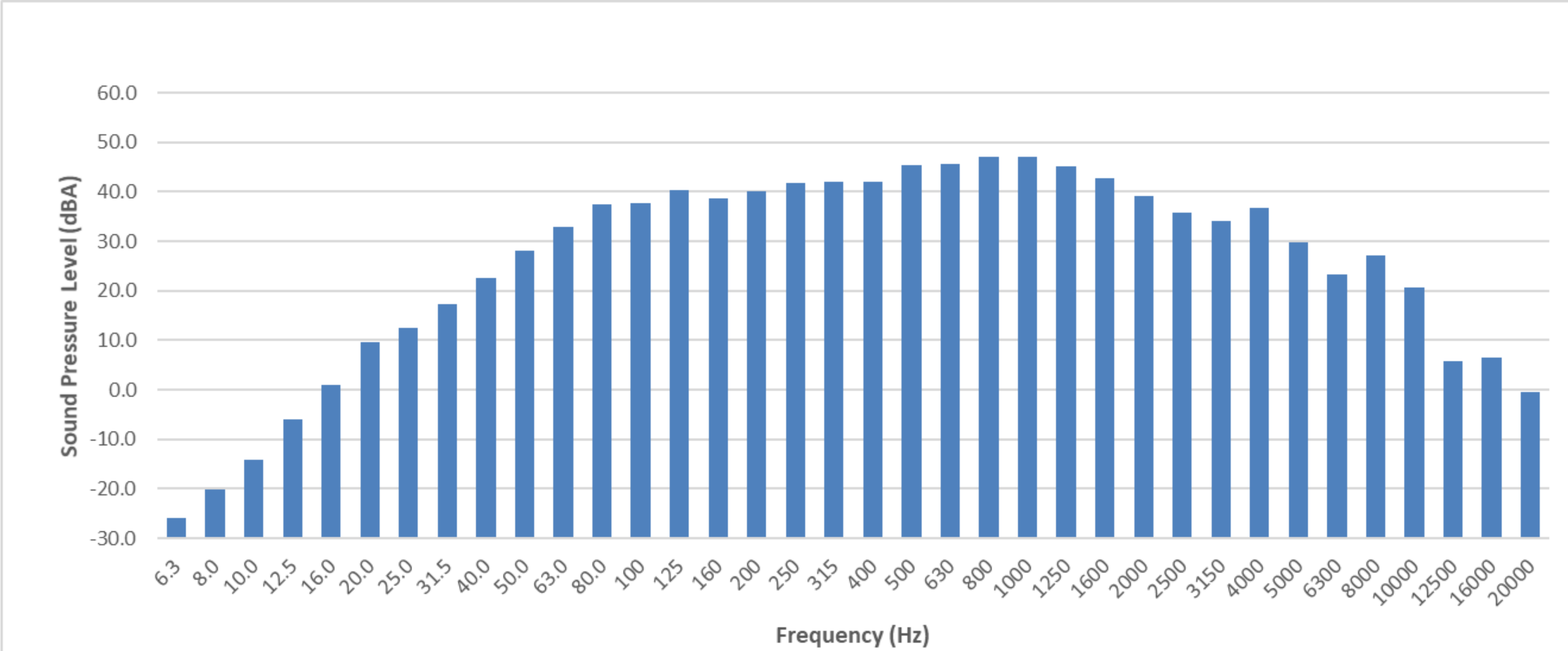

Figure 5-7 One-third octave band spectrum at South monitoring location

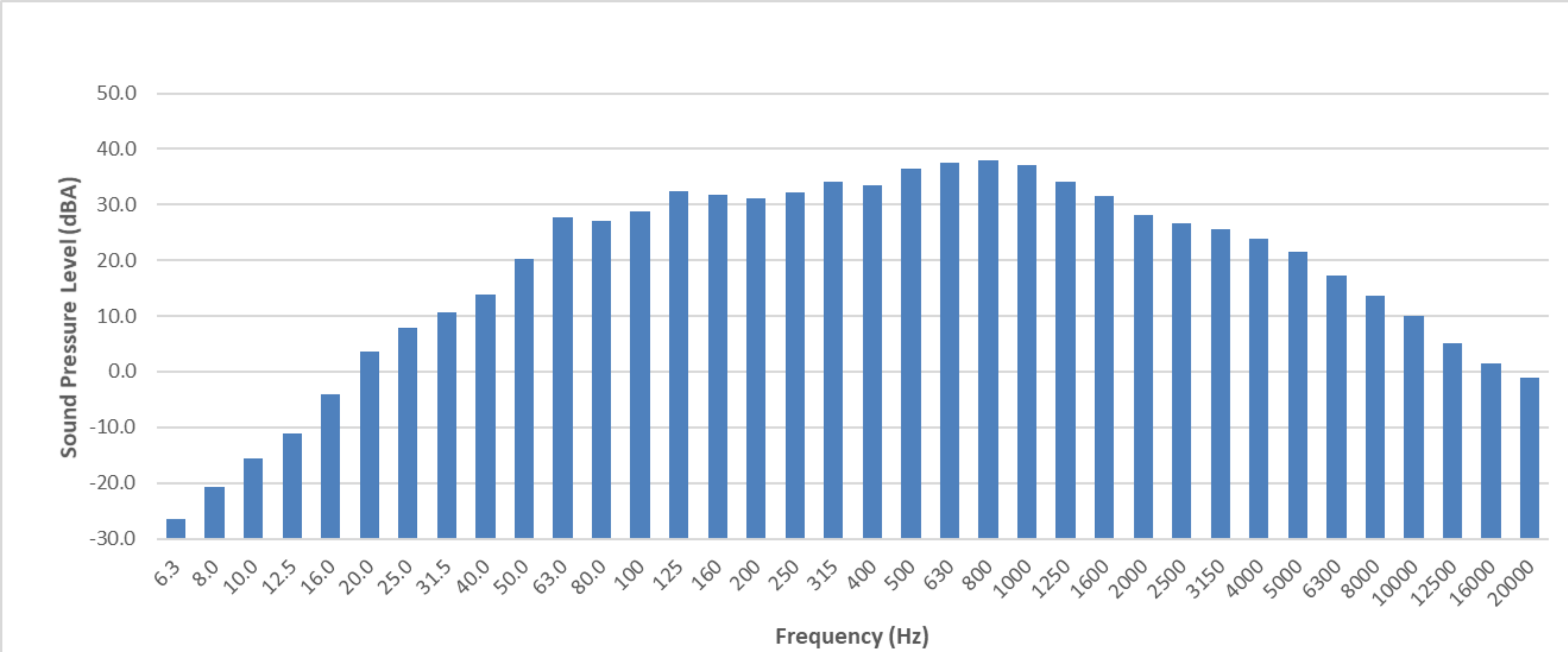

Figure 5-8 One-third octave band spectrum at East monitoring location

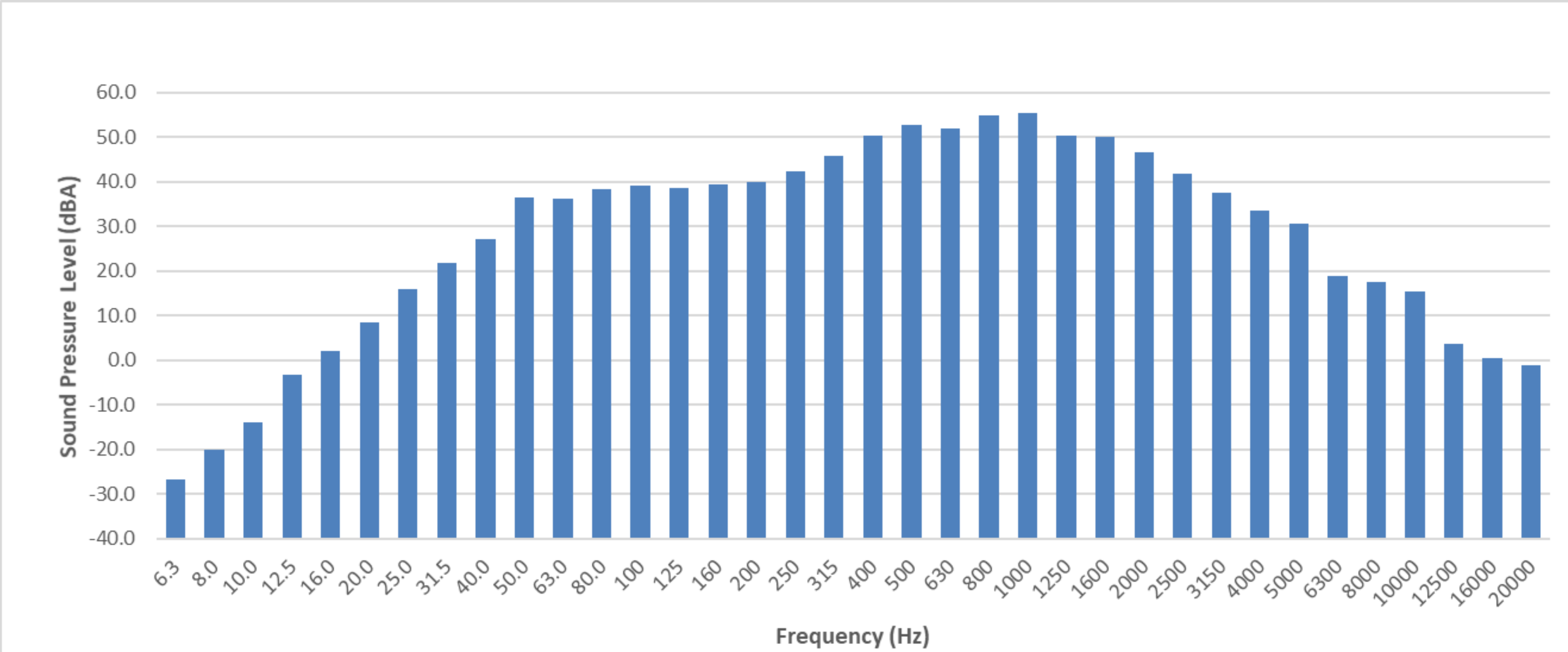

Figure 5-9 One-third octave band spectrum at West monitoring location

6 CONCLUSION

DNV GL performed an Acoustic Audit of the Barlow Solar Energy Centre in order to demonstrate compliance with Condition D1 of the Project REA [1]. The methodology was discussed with the MECP prior to conducting the measurements and was agreed upon [2]. The objectives of this analysis were twofold:

- To assess and characterize the actual noise emitted by the inverter/transformer clusters (emission); and
- To verify that the Project's contribution to the noise levels at the residences or vacant lot receptors complies with prescribed limits (immission).

An emission test (E-test) was performed at the noise inverter cluster, when the facility was operating at full capacity, to the fulfill requirements of the Project REA. There was no tonality observed and measured at the sources. The inverter/transformer cluster sound levels are similar to the value used in the Acoustic Assessment Report [6] for the pre-construction noise simulation. The sound emitted from the components could not be fully isolated from each other. Therefore, the presented levels for each component can be considered conservative because the noise from adjacent equipment would increase the measured value of each component. The sources are therefore considered to be in line with the overall equipment sound level limits in the Project REA [1] and the pre-construction AAR.

The measurement program has demonstrated that noise levels originating from the solar facility are compliant with the sound level limits as described within NPC-300. These measurement locations were based on the closest and/or loudest modeled receptors in each direction in the AAR except north of the Project, since no nearby receptors are present to the north. The receptor locations were selected to be the closet and/or worst-case locations. The maximum modeled sound level of these locations was 34 dBA based on the AAR. The model inputs from the AAR have been field validated by the E-test, which increases the confidence of the pre-construction modeled values.

For this study, measurement locations are situated closer to the Project than the corresponding receptors. At closer distances, the noise contribution from the Project would be greater. Conversely, the contribution from the Project would be even smaller than the measured values at greater distances at the actual receptors. The audible sound was found to be dominated by vehicular traffic along Cornwall Centre Road and Hwy 401. Estimated traffic noise alone was louder than the values from the pre-construction AAR of the nearest receptors as shown in Table 2-2 and Table 2-3.

A solar facility will generally operate during the daytime period where the NPC-300 class 3 limits are 45 dBA. Even with the heavy contribution of traffic noise, all reported LAeq values are within this limit. There will be some weeks of the year with extended sunlight hours, and the Project may run during hours considered as evening or nighttime. The measurements are well below the daytime 45 dBA limit, and after consideration for the existing soundscape and the conservative placement of the measurement points, the Project contribution can be shown to be below 40 dBA at all three selected PoRs.

For the South location, the measurement campaign has demonstrated that measured sound levels agree with the estimated traffic noise at this area (45 dBA). Ninety cars per hour passed the South measurement location during the measurement period, and there were only a few instances where the noise level was below 40 dBA. The pre-construction sound model, with inputs validated by E-test (emission) measurements, indicated that the loudest receptor in this direction was 34 dBA, well below the existing ambient conditions.

Measurements at farther distances were not feasible, and there is no discernable contribution from the solar facility.

For the East location, traffic noise dominates the acoustic landscape. After filtering out intermittent sounds from the measurement period, the filtered value was 40.9 dBA. Although the measurement location was set back further from Cornwall Centre Road to reduce the influence of intermittent traffic, this point was closer to Hwy 401 than the other locations. The steady noise from the highway 401 was estimated to be 35 dBA. Thus, the 35 dBA contribution from Hwy 401 was removed from that filtered value, and the reported LAeq value at the location is 39.6 dBA. This demonstrates that the Project contribution at the Project boundary is below the 1-hour NPC-300 nighttime Class 3 limit of 40 dBA. Receptors farther to the east would not only experience more noise from Hwy 401, but lower noise contribution from the Project.

For the West location, intermittent noise was filtered out. The filtered LAeq value was 39.5 dBA. This demonstrates that at a location closer than any receptor, the Project is within the applicable noise limits required by the REA. All receptors farther away from this point would experience less noise from the Project.

The Project shows that during periods when there is a pause in the traffic, measurements are below the sound level limits described in NPC-300 at the east and west locations. This can be shown both in the visual graphs, as well as with the lowest measured 1-minute L90 and 1-minute LA_{eq}. Per NPC-103, a minimum of three observations with a minimum observation time of 15 seconds each shall be made for a steady noise source, such as a solar facility. There are many 15 second periods, between intermittent sounds, where 15 second samples show sound levels below 40 dBA.

No tonality was measured or observed during the measurement period at any of the three measurement locations. No tonal penalty was applied to the measured sound levels at receptors. The measurements were conducted on sunny days. All equipment was in full operation, with the energy production reaching its maximal capacity.

Considering the various metrics and conservative placement of the measurement points, the Project was found to be in compliance with Condition D1 of the REA.

7 REFERENCES

[1] Ontario Ministry of the Environment and Climate Change. Barlow Solar Energy Centre, Renewable Energy Approval, number 0173-AW6HLN. 3 April 2018.

[2] Noise Monitoring Protocol (DNV GL) presented to Miroslav Ubovic (MECP), and subsequent emails, dated 2 and 4 June 2019.

[3] MOE Publication NPC-103, Procedures. 1978.

[4] MOE Publication NPC-233, Information to be submitted for approval of stationary sources of sound. 1995.

[5] MOE Publication NPC-300, Environmental Noise Guideline, Stationary and Transportation Sources - Approval and Planning Publication NPC-300", August 2013.

[6] Stantec. Barlow Solar Energy Centre Acoustic Assessment Report. File 160950879. 5 October 2017.

[7] Lalonde, 2018 Daily Traffic Counts. City of Cornwall: Infrastructure and Municipal Works. December 2018.

[8] Ontario Ministry of Transportation. Traffic Volumes 2016

[9] MOE. Ontario Road Noise Analysis Method for Environment and Transportation (ORNAMENT). Implemented in STAMSON 5.0 software. September 1999.

[10] International Electrotechnical Commission, “IEC 61672 Electroacoustics – Sound Level Meter,” First Edition 2002-05.

[11] IEEE Std C57.12.90 - Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers. 2015.

[12] ISO 1996-2 “Acoustics -- Description, measurement and assessment of environmental noise – Part 2: Determination of environmental noise levels”.

APPENDIX A – PICTURES OF INVERTER CLUSTERS

Figure A-1 Inverter cluster 1

Figure A-2 Inverter cluster 2

Figure A-3 Inverter cluster 3

Figure A-4 Inverter cluster 4

APPENDIX B – PICTURES OF SOUND MEASUREMENT LOCATIONS

Figure B-1 East measurement location (facing west to project, and facing northeast toward scrapyard)

Figure B-2 South measurement location (facing north to project, and a facing south to Cornwall Centre Road)

Figure B-3 West measurement location (facing northeast to project, facing southwest away from project)

APPENDIX C – INSTRUMENT CALIBRATION CERTIFICATES

Calibration Certificate

Certificate Number 2019004758
Customer:
GL Garrad Hassan Canada
4100 Rue Molson Suite 100
Montreal,QC H1Y 3N1,Canada

Model Number	831C	***Procedure Number***	D0001.8384		
Serial Number	10368	***Technician***	Ron Harris		
Test Results	**Pass**	***Calibration Date***	18 Apr 2019		
Initial Condition	AS RECEIVED same as shipped	***Calibration Due***	18 Apr 2020		
		Temperature	23.83	°C	± 0.25 °C
Description	Larson Davis Model 831C Class 1 Sound Level Meter Firmware Revision: 03.3.0R3	***Humidity***	48.8	%RH	± 2.0 %RH
		Static Pressure	87.26	kPa	± 0.13 kPa

Evaluation Method ***Tested with:*** ***Data reported in dB re 20 μPa.***

Larson Davis PRM831. S/N 051224
PCB 377B02. S/N 303859
Larson Davis CAL200. S/N 9079
Larson Davis CAL291. S/N 0108

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8378:

IEC 60651:2001 Type 1	ANSI S1.4-2014 Class 1
IEC 60804:2000 Type 1	ANSI S1.4 (R2006) Type 1
IEC 61260:2014 Class 1	ANSI S1.11-2014 Class 1
IEC 61672:2013 Class 1	ANSI S1.43 (R2007) Type 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005.
Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Correction data from Larson Davis SoundAdvisor Model 831C Reference Manual, I831C.01 Rev B, 2017-03-31

For 1/4" microphones, the Larson Davis ADP024 1/4" to 1/2" adaptor is used with the calibrators and the Larson Davis ADP043 1/4" to

VAISALA

Test report no. H31-18130045

TEST REPORT

Product family	WXT530 series
Product type	WXT536
Order code	6B1B2A1D1A1B
Serial number	P1320473
Manufacturer	Vaisala Oyj, Finland
Test date	27 March 2018

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

Test results

Test	Result	Lower limit	Upper limit	Unit
Rain response	394	345	575	mV
Zero wind speed	0	0	0.4	m/s
Pressure difference	-0.14	-1	1	hPa
Temperature difference	0.04	-2	2	°C
Humidity difference	-1	-10	10	%RH
Heating current	0.72	0.6	0.8	A
Current (service port)	0.96	0.5	2	mA
Communication (service port)	pass	PASS	PASS	-
Current (main port)	0.61	0.5	2	mA
Communication (main port)	pass	PASS	PASS	-

Ambient conditions / Humidity 15.7 ±5 %RH, Temperature 23.2 ±1 °C, Pressure 1013.07 ±1 hPa.

Signature

Technician

This report shall not be reproduced except in full, without the written approval of Vaisala. *DOC233154-A.doc*

Vaisala Oyj | PO Box 26, FI-00421 Helsinki, Finland

APPENDIX D – LANDOWNER REQUESTS

Parcel Name	Pin	Address / Location	Notes
"Property 5" Parcel to the east of the Project area	602200111	N STORMONT/ S STORMONT	Access granted.
EPOR60	602200100	Nearest AAR receptor to the west	Access denied.
VPOR29	602190074	Nearest AAR receptor to the south	No response. The land agent called the landowner and left a voicemail explaining the purpose of the call. (28 July 2019, and 1 August 2019)
VPOR45	602190069	Nearest AAR receptor to the south	No response. The land agent called the landowner and left a voicemail explaining the purpose of the call. (28 July 2019, and 1 August 2019)
VPOR69	602200146		Alterative site, "Property #5" has already accepted the study.
VPOR43	602190067	N/A	Access granted, but close to busy road.
VPOR44	602190077	N/A	Access granted, but not accessible.

APPENDIX E – STAMSON – TRAFFIC MODEL OUTPUTS

South Location (Cornwall Centre Road)

```
STAMSON 5.0 NORMAL REPORT Date: 03-12-2019 15:42:36
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: Time Period: 1 hour
Description:


Road data, segment # 1:
------------------------
Car traffic volume: 98 veh/TimePeriod
Medium truck volume: 0 veh/TimePeriod
Heavy truck volume: 0 veh/TimePeriod
Posted speed limit: 70 km/h
Road gradient: 0 %
Road pavement: 1 (Typical asphalt or concrete)

Data for Segment # 1:
----------------------
Angle1 Angle2: -90.00 deg 90.00 deg
Wood depth: 0 (No woods.)
No of house rows: 0
Surface: 1 (Absorptive ground surface)
Receiver source distance: 39.00 m
Receiver height: 1.50 m
Topography: 1 (Flat/gentle slope; no barrier)
Reference angle: 0.00
Results segment # 1:
---------------------

Source height = 0.50 m

ROAD (0.00 + 47.78 + 0.00) = 47.78 dBA
Angle1 Angle2 Alpha RefLeq P.Adj D.Adj F.Adj W.Adj H.Adj B.Adj SubLeq
----------------------------------------------------------------------------
 -90 90 0.66 56.12 0.00 -6.89 -1.46 0.00 0.00 0.00 47.78
----------------------------------------------------------------------------

Segment Leq: 47.78 dBA

Total Leq All Segments: 47.78 dBA
```

TOTAL Leq FROM ALL SOURCES: 47.78

East Location (Cornwall Centre Road)

```
STAMSON 5.0        COMPREHENSIVE REPORT        Date: 03-12-2019 16:40:22
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename:                      Time Period: 1 hours
Description:


Road data, segment # 1:
------------------------
Car traffic volume  :    61 veh/TimePeriod
Medium truck volume :     0 veh/TimePeriod
Heavy truck volume  :     0 veh/TimePeriod
Posted speed limit  :    70 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1:
----------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  89.00 m
Receiver height           :   1.50 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Segment # 1:
-------------

Source height = 0.50 m

ROAD (0.00 + 39.77 + 0.00) = 39.77 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------------
   -90     90   0.66  54.06   0.00 -12.84  -1.46   0.00   0.00   0.00  39.77
----------------------------------------------------------------------------

Segment Leq : 39.77 dBA

Total Leq All Segments: 39.77 dBA
```

TOTAL Leq FROM ALL SOURCES: 39.77

East Location (Hwy 401)

```
STAMSON 5.0        NORMAL REPORT        Date: 04-12-2019 14:51:31
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename:                      Time Period: 1 hours
Description:


Road data, segment # 1:
------------------------
Car traffic volume  :   937 veh/TimePeriod
Medium truck volume :     0 veh/TimePeriod
Heavy truck volume  :     0 veh/TimePeriod
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1:
----------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 500.00 m
Receiver height           :   1.50 m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

Results segment # 1:
---------------------

Source height = 0.50 m

ROAD (0.00 + 43.54 + 0.00) = 43.54 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-----------------------------------------------------------------------------
   -90     90   0.66  70.28   0.00 -25.28  -1.46   0.00   0.00   0.00  43.54
-----------------------------------------------------------------------------

Segment Leq : 43.54 dBA

Total Leq All Segments: 43.54 dBA
```

TOTAL Leq FROM ALL SOURCES: 43.54

APPENDIX F – CORNWALL -ENVIRONMENTAL CANADA WEATHER RECORDS

Français

Government of Canada | Gouvernement du Canada

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MENU

Home > Environment and natural resources > Weather, Climate and Hazard > Past weather and climate > Historical Data

ST-ANICET 1

QUEBEC

Current Station Operator: ECCC - MSC

Latitude:	45°07'15.000" N	**Longitude:**	74°17'22.000" W	**Elevation:**	49.10 m
Climate ID:	702FQLF	**WMO ID:**	71712	**TC ID:**	WBZ

Hourly Data Report for September 17, 2019

TIME	Temp °C	Dew Point °C	Rel Hum %	Wind Dir 10's deg	Wind Spd km/h	Visibility km	Stn Press kPa	Hmdx	Wind Chill	Weather
00:00	7.9	7.1	94	24	2		101.39			NA
01:00	6.1	5.7	97	16	2		101.43			NA
02:00	4.7	4.4	98	24	3		101.44			NA
03:00	3.9	3.7	98	25	1		101.46			NA
04:00	3.6	3.3	98	0	1		101.49			NA
05:00	3.5	3.3	99	25	2		101.55			NA
06:00	3.7	3.5	99	26	3		101.61			NA
07:00	8.1	7.8	98	25	5		101.68			NA
08:00	11.7	10.2	91	25	5		101.72			NA
09:00	15.4	9.5	68	33	2		101.76			NA
10:00	16.7	9.5	62	1	4		101.75			NA
11:00	17.9	9.2	57	6	5		101.73			NA
12:00	18.7	9.5	55	4	6		101.71			NA
13:00	19.0	8.8	52	5	7		101.70			NA
14:00	19.3	8.2	49	5	8		101.66			NA
15:00	20.0	8.6	48	8	4		101.63			NA
16:00	19.9	8.6	48	14	4		101.64			NA
17:00	18.8	8.6	52	14	5		101.64			NA
18:00	13.9	11.0	83		0		101.64			NA
19:00	9.2	8.3	94		0		101.69			NA
20:00	8.4	7.9	97	0	1		101.70			NA
21:00	7.6	7.2	98	6	2		101.73			NA
22:00	7.0	6.7	98	5	3		101.76			NA
23:00	6.2	5.9	98	5	3		101.77			NA

Hourly Data Report for October 19, 2019

TIME	Temp °C	Dew Point °C	Rel Hum %	Wind Dir 10's deg	Wind Spd km/h	Visibility km	Stn Press kPa	Hmdx	Wind Chill	Weather
00:00	1.8	0.5	91	25	5		100.96			NA
01:00	5.3	1.4	76	29	7		101.00			NA
02:00	3.8	1.4	84	29	6		101.02			NA
03:00	2.5	1.0	90	29	6		101.06			NA
04:00	2.9	1.4	90	30	7		101.09			NA
05:00	1.4	0.4	93	28	5		101.11			NA
06:00	-0.7	-1.2	96	25	5		101.16		-2	NA
07:00	0.2	-0.2	98	24	4		101.21			NA
08:00	4.0	2.3	89	24	7		101.26			NA
09:00	6.7	0.8	66	30	10		101.25			NA
10:00	8.0	0.3	58	28	6		101.24			NA
11:00	8.3	-0.7	53	31	8		101.25			NA
12:00	9.8	-0.7	48	29	10		101.19			NA
13:00	10.6	0.1	48	27	10		101.16			NA
14:00	10.8	0.6	49	24	9		101.11			NA
15:00	10.9	0.0	47	26	8		101.07			NA
16:00	10.7	0.1	48	25	7		101.06			NA
17:00	5.4	1.9	78	0	1		101.07			NA
18:00	1.9	0.7	92		0		101.09			NA
19:00	0.2	-0.5	95		0		101.09			NA
20:00	-0.3	-0.7	97	0	1		101.09		-1	NA
21:00	-0.9	-1.3	97		0		101.09			NA
22:00	-0.5	-0.8	98	5	4		101.07		-2	NA
23:00	-0.8	-1.4	96	7	1		101.05		-1	NA

Daily Data Report for September 2019

DAY	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days	Cool Deg Days	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's deg	Spd of Max Gust km/h
01	23.5	5.5	14.5	3.5	0.0		M	5.9			
02	21.7	15.4	18.5	0.0	0.5		M	32.9			
03	20.0	8.8	14.4	3.6	0.0		M	0.0			
04	24.8	12.5	18.7	0.0	0.7		M	15.1		25	52
05	21.2	6.3	13.7	4.3	0.0		M	0.0			
06	22.3	9.0	15.7	2.3	0.0		M	0.0			
07	18.3	10.9	14.6	3.4	0.0		M	5.3			
08	18.7	6.1	12.4	5.6	0.0		M	0.0		27	33
09	18.7	3.5	11.1	6.9	0.0		M	0.0			
10	20.4	1.9	11.2	6.8	0.0		M	0.6			
11	27.0	13.9	20.5	0.0	2.5		M	4.7		28	34
12	19.8	3.8	11.8	6.2	0.0		M	0.0			
13	22.8	2.7	12.7	5.3	0.0		M	0.0			
14	23.2	13.7	18.5	0.0	0.5		M	5.2		25	53
15	18.3	7.1	12.7	5.3	0.0		M	0.0		25	31
16	21.2	5.7	13.5	4.5	0.0		M	0.0			
17	20.6	2.8	11.7	6.3	0.0		M	0.0			
18	19.0	2.9	11.0	7.0	0.0		M	0.0			
19	22.9	0.7	11.8	6.2	0.0		M	0.0			
20	24.4	6.9	15.6	2.4	0.0		M	0.0			
21	27.5	9.7	18.6	0.0	0.6		M	0.0			
22	27.3	11.4	19.3	0.0	1.3		M	0.0		23	38
23	25.4	15.7	20.5	0.0	2.5		M	8.2		23	37

Daily Data Report for October 2019

DAY	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days	Cool Deg Days	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's deg	Spd of Max Gust km/h
01	16.2	9.1	12.7	5.3	0.0		M	9.4			
02	16.0	3.4	9.7	8.3	0.0		M	0.0		6	31
03	9.8	0.9	5.3	12.7	0.0		M	5.4			
04	11.9	-0.3	5.8	12.2	0.0		M	2.8			
05	14.1	-1.5	6.3	11.7	0.0		M	0.0			
06	19.5	1.2	10.3	7.7	0.0		M	0.0			
07	17.2	10.4	13.8	4.2	0.0		M	11.9			
08	17.9	1.0	9.4	8.6	0.0		M	0.0			
09	16.8	-0.7	8.0	10.0	0.0		M	0.0			
10	17.9	0.7	9.3	8.7	0.0		M	0.0		4	33
11	19.6	1.8	10.7	7.3	0.0		M	0.0			
12	19.5	3.7	11.6	6.4	0.0		M	0.0			
13	17.4	0.3	8.9	9.1	0.0		M	0.0			
14	14.8	0.1	7.4	10.6	0.0		M	0.0		23	42
15	14.6	0.7	7.6	10.4	0.0		M	0.0			
16	18.6	2.8	10.7	7.3	0.0		M	17.0			
17	8.8	7.2	8.0	10.0	0.0		M	44.2		3	51
18	8.4	1.7	5.1	12.9	0.0		M	0.0		28	39
19	11.3	-2.0	4.7	13.3	0.0		M	0.2			
20	13.5	-1.7	5.9	12.1	0.0		M	0.0			
21	17.0	-1.2	7.9	10.1	0.0		M	0.0			
22	M	M	M	M	M		M	M		M	M
23	15.4	8.5	12.0	6.0	0.0		M	0.8		25	40

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