NCIA Regional Noise Management Plan (RNMP) Report

(covering the 2019 Calendar Year)

Prepared for the

Albert Energy Regulator (AER)

And

The Alberta Utilities Commission (AUC)

December 2020

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NCIA Regional Noise Management Plan (RNMP)

Annual Report to the Alberta Energy Regulator (AER) and

The Alberta Utilities Commission (AUC)

2020 (covering the calendar year 2019)

1 Executive Summary

Field validation measurements for the Regional Noise Model were completed in 2019 (conducted by ACI Acoustical Consultants Inc.). The field validation measurements are compared to the 2018 RNM in Section 4. In general, the model over predicts the measured values, as one would expect, given that the model assumes that a facility is operating with worst-case noise outputs.

Measured versus modeled results for the 2019 field data are shown in Table 5 and Figure 3 and 4. A discussion of the results is presented in Section 4 of this report.

Figure 5 shows trend analysis that was completed for any location that had at least 4 years or more of data. It is evident from this Figure that there are no significant trends (either up or down) in the sound levels of the measured data over time when one considers the variability created by the meteorological conditions. These are best identified by the upper and lower ranges found in Figures 3.

2 AER Audits of NCIA Member Facilities

No Audits of NCIA member companies' Regional Noise Management Plans were conducted by AER in 2019.

3 Correction to Regional Noise Model Cases

Tables 1 to 3 are reproduced from Appendix 1 and show the current state of the site level models that make up the 2018 NCIA Regional Noise Model.

Table 4 in the NCIA Regional Noise Model 2018 Noise Model Update was found to contain a few errors. It has been corrected and the entire report is included here as Appendix 1. The corrected Table 4 is reproduced below and shows the list of facilities included in the modeled cases.

Table 1
Site Noise Models in 2018 RNM Prepared by SLR

Company	Plant / Unit	Model Date
Nutrien	**Redwater Fertilizer Operations Plant**	**February, 2017**
Air Liquide	Cogeneration Unit	June, 1998
Cenovus	North American Terminal Operations	March, 2010
Dow Chemical Canada	Ethylene; Fractionator; Polyethylene I, II & III; Ethylene Oxide / Ethylene Glycol; Ethane Storage; Power & Utilities; Cogeneration plants	December 15, 2014
Plains Midstream	**Fractionation and storage**	**October, 2016**
North West Redwater Partnership	Sturgeon Refinery (3 units)	November 22, 2007
Pembina	**RFS1; ROF**	**June, 2018**
Shell Canada	**Refinery; Upgrader (base plant and expansion plant); Cogen**	**December, 2016**
Shell Chemicals	**Styrene; MEG**	**November, 2016**
Sherritt Fort Saskatchewan Integrated Site:		
Nutrien	Nitrogen production	January, 2003
Corefco	Metal production	February, 2006 *
Sherritt International	Metal production	February, 2006
Oerlikon-Metco	Chemical preparation	February, 2006
Umicore	Metal products	February, 2006 *

* integrated into Sherritt model

Table 2
Site Noise Models in 2018 RNM Prepared by Others

Company	Plant / Unit	Acoustical Consultant	Model Date
Aux Sable	**Off-Gas Plant**	**Patching Associates**	**June, 2018**
Wolf Midstream	Sturgeon Terminal	FFA	July, 2010
Value Chain Solutions	Oilsands Upgrader	RWDI	May, 2004
Suncor	Fort Hills Sturgeon Upgrader	RWDI	September, 2008
Pembina	RFS2 Expansion	Stantec	June, 2013
Pembina	RFS3 Expansion	Stantec	December, 2014
Pembina	**Co-generation Plant**	**Stantec**	**March, 2016**
Keyera Energy	**Fractionation and storage**	**Patching Associates**	**July, 2018**

Table 3
Heartland Plants where Basic Noise Models were included in the 2018 RNM

Company	Plant / Unit	Data Provided	Model Date
Aux Sable Canada*	Extraction Plant	Sound Power Levels	September, 2010
Evonik Canada Inc.	Hydrogen Peroxide Plant	Fenceline Measurements	June, 2010
Chemtrade Logistics	Central Service Center	Diagnostic Measurements	September, 2010
Chemtrade Logistics	Sulfides Facility	Diagnostic Measurements	September, 2010
Praxair Canada Inc.	Air Separation Plant	Fenceline Measurements	June, 2010
Praxair Canada Inc.	Carbon Dioxide Plant	Fenceline Measurements	June, 2010
ATCO Midstream	Liquid Extraction Plant	Sound Power Levels	June 2011

* based on PWL's provided by the facility's acoustical specialist

Table 4

List of Facilities included in the modeled cases

Company	Plant	Case 1	Case 2	Case 3
Air Liquide	Cogeneration Unit	•	•	•
ATCO Midstream	Liquid Extraction Plant			•
Aux Sable	Off-Gas Plant	•	•	•
	Extraction Plant		•	
Cenovus	North American Terminal Operations	•	•	•
Chemtrade Logistics	Central Service Center	•	•	•
	Sulfides Facility	•	•	•
Corefco - Sherritt Integrated Site	Metal production	•	•	•
Dow Chemical Canada	Ethylene; Fractionator; Polyethylene I, II & III; Ethylene Oxide / Ethylene Glycol; Ethane Storage; Power & Utilities; Cogeneration plants	•	•	•
Evonik Canada Inc.	Hydrogen Peroxide Plant	•	•	•
Keyera Energy	Fractionation and storage	•	•	•
North West Redwater Partnership	Sturgeon Refinery (3 units)		•	
Nutrien	Redwater Fertilizer Operations Plant	•	•	•
	Nitrogen production	•	•	•
Oerlikon-Metco - Sherritt Integrated Site	Chemical preparation	•	•	•
Pembina	RFS1 & ROF	•	•	•
	RFS2 Expansion	•	•	•
	RFS3 Expansion	•	•	•
	Co-generation Plant		•	
Plains Midstream	Fractionation and storage	•	•	•
Praxair Canada Inc.	Air Separation Plant	•	•	•
	Carbon Dioxide Plant	•	•	•
Shell Canada	Refinery; Upgrader (base plant and expansion plant); Cogen	•	•	•
Shell Chemicals	Styrene; MEG	•	•	•
Sherritt International - Sherritt Integrated Site	Metal production	•	•	•
Suncor	Fort Hills Sturgeon Upgrader		•	
Umicore - Sherritt Integrated Site	Metal products	•	•	•

Company	Plant	Case 1	Case 2	Case 3
Value Chain Solutions	Oilsands Upgrader		•	
Wolf Midstream	Sturgeon Terminal	•	•	•

4 2019 Monitoring results for Regional Noise Model (Appendix 2)

aci Acoustical Consultants Inc., of Edmonton AB, was retained by the Northeast Capital Industrial Association (NCIA) to conduct an environmental noise survey within Alberta's Industrial Heartland (AIH). The purpose of the study was to conduct a single 48-hour noise monitoring at eleven (11) pre-specified locations within the AIH. An additional noise monitoring, spanning three (3) 48-hour periods, was conducted at a 12th monitoring location (referred to as Location 12) as an independent control/reference point. The noise monitoring was conducted in support of the NCIA's Regional Noise Management Plan. In addition, the results from these noise monitoring's will be used to validate the Regional Noise Level Assessment Model (the Regional Noise Model). All noise monitoring procedures and equipment used was in accordance with the requirements of the Alberta Energy Regulator (AER) Directive 038 on Noise Control. Site work was conducted for aci in July, September and October 2019 by P. Froment, B.Sc., P.L.(Eng.).

As part of the study, a total of fourteen (14) 48-hour noise monitoring's were conducted throughout the Alberta's Industrial Heartland. In many cases, due to unfavorable weather conditions during one of the two night-time periods, it would be anticipated that the results from only one-night period would be most reflective (in comparison to previous years) of the typical noise climate of their given area. It was found that the isolated LeqNight broadband and 1/3 octave band Leq sound levels were similar to those from previous measurements.

The noise levels at most locations consisted of low frequency components with occasional mid/high frequency components that could be attributed to the nearest facility relative to each individual noise monitoring location. Despite the noise being relatively low in frequency, none of the sites indicated any low frequency tonal components. The noise from train passages was again prevalent at all locations and tended to dominate the noise climate as they passed through. This was particularly true for locations within proximity to a rail line and for locations further away from any of the large industrial sites.

The noise monitoring locations were the same for 2019 as in previous years and are shown in Table 5 and Figure 2 below. The complete details can be found in Appendix 2 of this report.

Measured versus modeled results are shown in Table 6 and Figures 3 and 4 below. Figure 5 below presents a multi-year trend analysis.

The results in Table 6 indicate some fairly large differences between measured and predicted sound levels at several locations. In previous assessments, it was noted that the field measured results often varied quite significantly between the two nighttime periods which made it difficult to draw conclusions on the data. Therefore, it was suggested that instead of comparing measured sound levels to predicted sound levels for a specific meteorological condition, it would be more meaningful to compare the measured levels to predicted levels based on a range of possible meteorological conditions.

The meteorological conditions used to define the extents of the predicted range are representative of temperature lapse conditions (calm wind with Pasquill Stability Class “b”), and temperature inversion conditions (calm wind with Pasquill Stability Class “F”). These represent the reasonable extremes of meteorological conditions that may exist at any given time in the region. The Case 3 model was run with these parameters to define the lower and upper limits of predicted sound levels at each monitoring location, and the measured sound levels are compared to these ranges, as shown in Figures 3.

Table 5
Monitoring Location Details

Monitoring Location	UTM Coordinates (Approximate)		Start Time	End Time
	Easting (m)	Northing (M)		
1C	355210	5954157	7/22/19 16:00	7/24/19 16:00
2	358256	5957216	7/22/19 15:00	7/24/19 15:00
3B	358361	5959283	7/22/19 15:00	7/24/19 15:00
4C	361665	5960870	10/21/19 11:00	10/23/19 11:00
5	361777	5964711	7/22/19 15:00	7/24/19 15:00
6	364322	5967894	9/18/19 13:00	9/20/19 13:00
8A	358897	5965430	7/22/19 13:00	7/24/19 13:00
9	355872	5957574	7/22/19 12:00	7/24/19 12:00
10	355925	5955818	7/22/19 15:00	7/24/19 15:00
11	358430	5963804	7/22/19 13:00	7/24/19 13:00
12B (1st 48-hour)			7/22/19 14:00	7/24/19 14:00
12B (2nd 48-hour)	368223	5963070	9/18/19 13:00	9/20/19 13:00
12B (3rd 48-hour)			10/21/19 11:00	10/23/19 11:00
13	358667	5970180	9/18/19 13:30	9/20/19 13:30

The complete report is included as Appendix 2 of this report.

Figure 2: NCIA Regional Noise Monitoring Locations (as per Table 5)

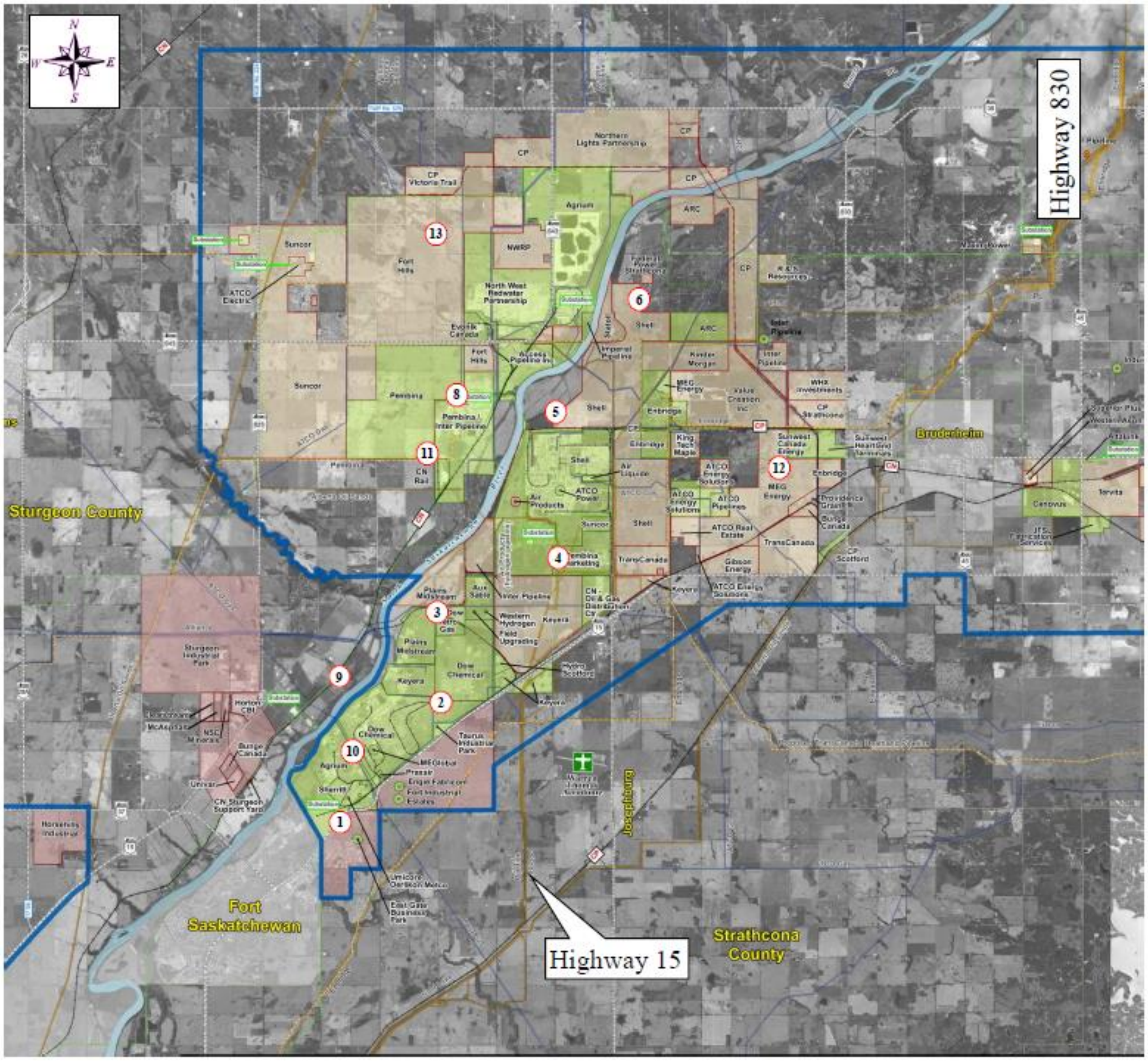
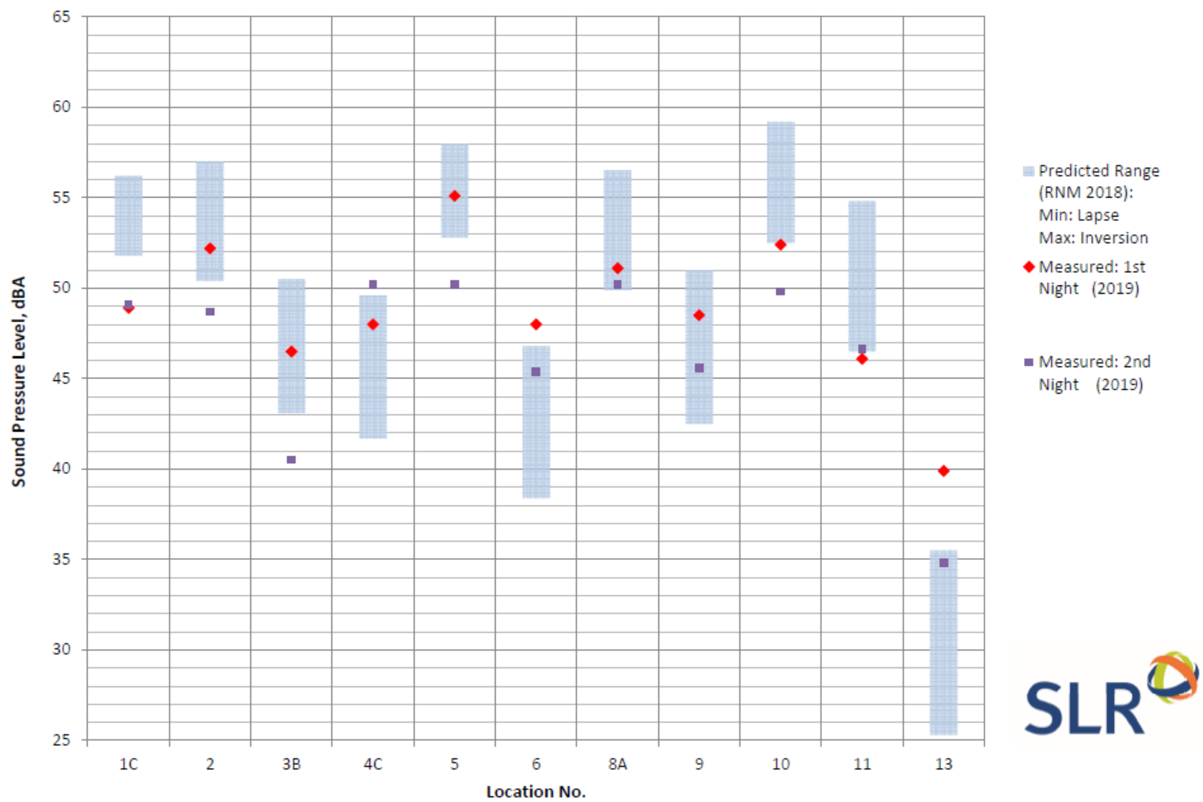


Table 6
Comparison of Measured versus Modelled (predicted) results for 2019

Location	1st Nighttime Period			2nd Nighttime Period			Average Difference (dBA)
	Measured	Predicted	delta (Predicted - Measured)	Measured	Predicted	delta (Predicted - Measured)	
1C	48.9	55.4	6.5	49.1	55.9	6.8	6.7
2	52.2	54.0	1.8	48.7	55.1	6.4	4.1
3B	46.5	44.4	-2.1	40.5	43.1	2.6	0.3
4C	48.0	43.8	-4.2	50.2	50.1	-0.1	-2.2
5	55.1	53.1	-2.0	50.2	52.1	1.9	-0.1
6	48.0	46.1	-1.9	45.4	46.7	1.3	-0.3
8A	51.1	51.6	0.5	50.2	52.2	2.0	1.3
9	48.5	44.3	-4.2	45.6	46.1	0.5	-1.9
10	52.4	55.0	2.6	49.8	55.8	6.0	4.3
11	46.1	52.7	6.6	46.6	54.1	7.5	7.1
12B (1st 48 hour)	38.1	26.9	-11.2	31.6	24.0	-7.6	-9.4
12B (2nd 48 hour)	35.8	32.6	-3.2	38.5	32.0	-6.5	-4.9
12B (3rd 48 hour)	40.8	24.8	-16.0	41.4	33.1	-8.3	-12.2
13	39.9	33.9	-6.0	34.8	33.0	-1.8	-3.9

Figure 3: Predicted Range versus Measured Sound Levels (2019)



For the 2019 comparison, the model over-predicts the noise level at receptors 1C, 2, 10 and 11 by about 5dBA. It under-predicts the noise levels at receptors 12B and 13. Location 13 is affected by the Sturgeon Refinery, which is not included in the Existing Case model yet. Based on the predicted range (Figure 3 above) the agreement between measured and modeled results is reasonable given this type of model and the many variables that affect measurements in the field.

Figure 4: Comparison of 2019 Field Measurements to Model Predictions

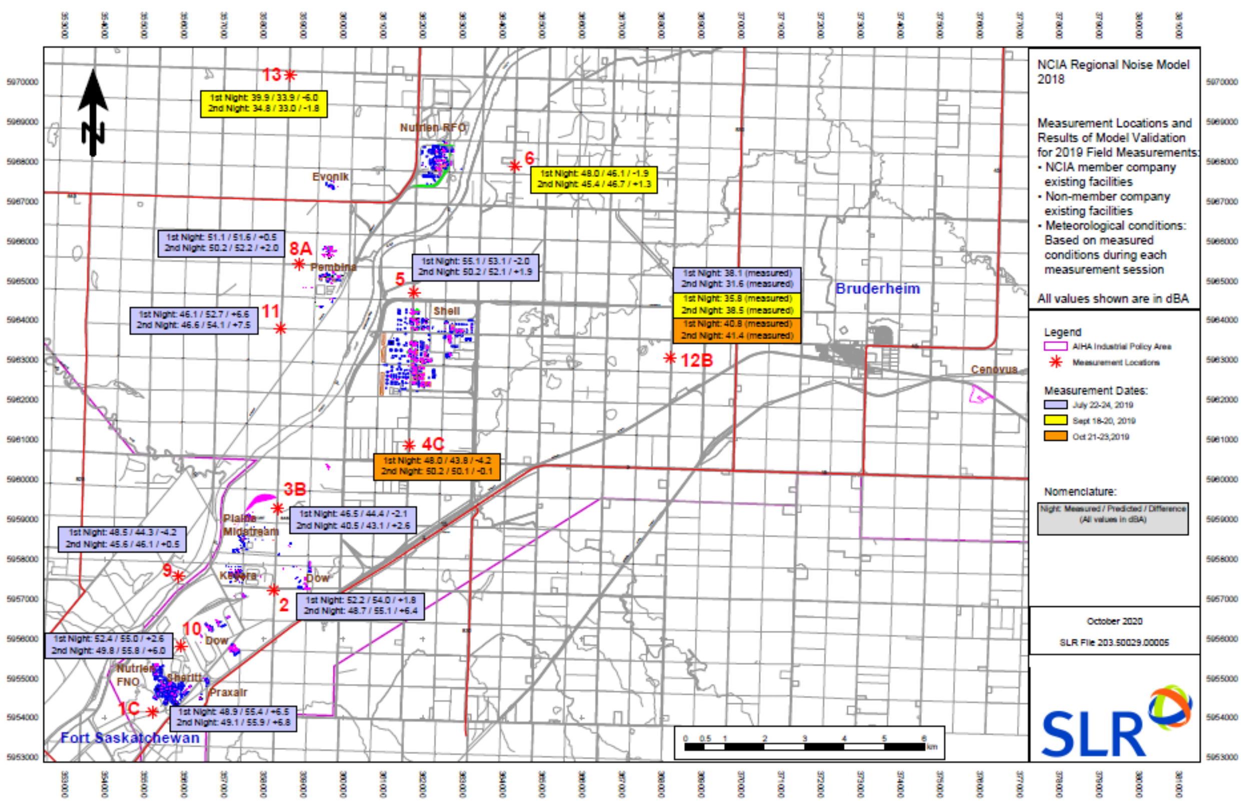
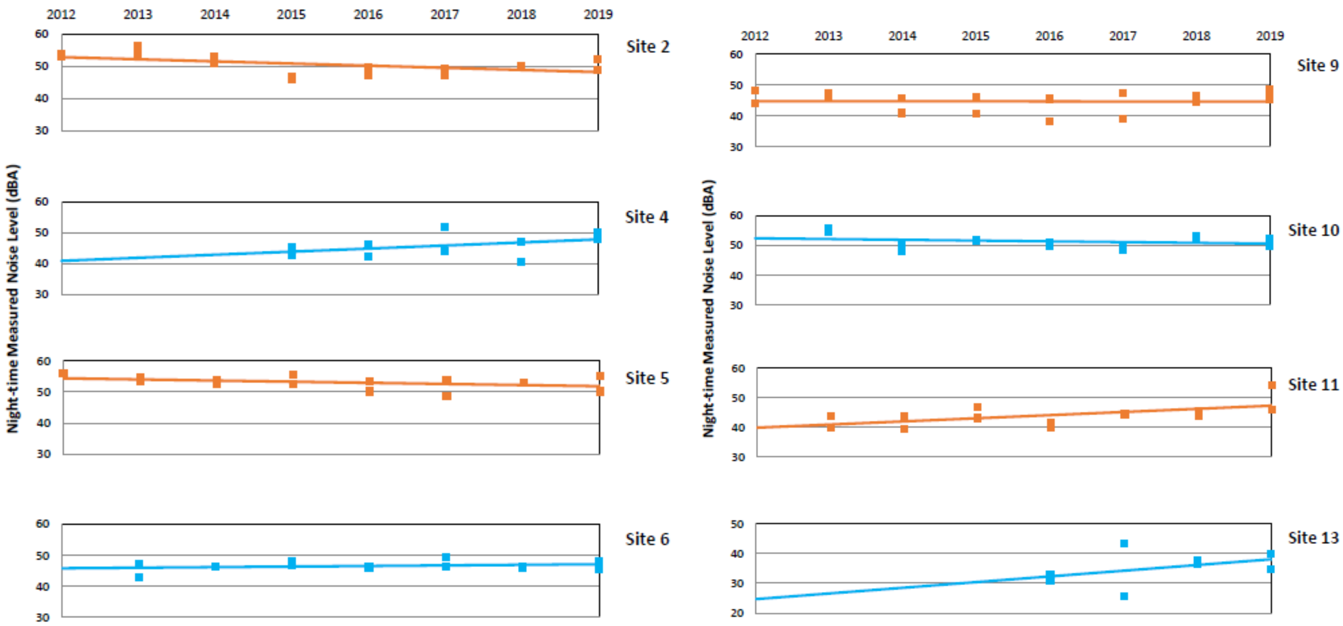


Figure 5: Trend Analysis of Measured Data (2012 to 2019)



As we saw for the previous trend report the data is pretty scattered, indicating that there is no clear trend in noise levels across the region. Location 13 was added to the trend analysis as it meets the criteria (4 years of data) to be included.

5 NCIA Member Compliance

Table 7 summarizes the compliance requirements for NCIA member and non-member companies' vis-a-vis the NCIA RNMP.

Table 7
Compliance Requirements for NCIA Member Companies

NCIA Member	AER Regulated	RNMP Participant	Compliance Vehicle
Yes	Yes	Yes	NCIA - RNMP
No	Yes	No	AER to Determine
Yes	No	No	Municipality/AEP
Yes	No	Yes	NCIA - RNMP
No	No	Yes	Potential NCIA-RNMP
No	No	No	Other Regulatory Jurisdictions

As of this date, Table 8 summarizes the NCIA member companies and their status with respect to Table 8 above.

Table 8
Summary of NCIA Member Company Information for RNMP

NCIA Member[1]	AER Regulated Status for Noise Control Directive 038	Filed an Annual Update with NCIA for 2019 (Appendix 3)	Developed a Site Noise Management Plan
ACCEL Energy	AER regulated under Noise Control Directive 038.	No	No
Air Liquide Canada	Not regulated	Yes	Yes
Aux Sable Canada	Regulated under Section 11 of the OSCA and therefore D-038.	Yes	Yes
Cenovus Energy	Not regulated	Yes	Yes
Chemtrade West	Not regulated	Yes	Yes
Dow Chemical Canada	Regulated under D-038 Operator No. 0F05	Yes	Yes
Enbridge Pipelines	Is regulated	Yes	Yes
Evonik	Not regulated	Yes	Yes
Keyera Corp.	Regulated under D-038 Operator No. A5W1 LSD - 02-14-055-22W4 Facility No. F-12695	Yes	Yes
MEG Energy	Has no noise generating assets in the region now	Covered by Wolf Midstream	NA[2]
MEGlobal	Not regulated	Included with Dow's submission	Yes
North West Redwater Partnership	Is regulated. LSD - E1/2-18-56-21-W4M	No	Yes
Nutrien Fort Saskatchewan	Not regulated	Yes	Yes
Nutrien Redwater	Not regulated	Yes	Yes
Oerlikon Metco (Canada)	Not regulated	Yes	Yes
Pembina NGL Corporation	Regulated under D-038	Yes	Yes
Plains Midstream Canada	Regulated under D-038 Operator No. 60 LSD - 14-55-22 W4M Facility No. 12699	Yes	Yes

NCIA Member[1]	AER Regulated Status for Noise Control Directive 038	Filed an Annual Update with NCIA for 2019 (Appendix 3)	Developed a Site Noise Management Plan
Praxair Canada	Not regulated	No	Partly
Shell Chemicals	Not regulated	Yes	Yes
Shell Refinery	Regulated under Section 11 of the OSCA and therefore Noise Control Directive 038. AER Approval No. 11640.	Yes	Yes
Shell Upgrader	AER Approval No. 8522 regulated under D-038.	Yes	Yes
Sherritt International	Not regulated	Yes	Yes
Umicore Canada	Not regulated	Yes	Yes
Value Chain Solutions	Not operational. Will be regulated.	No	No
Wolf Midstream	AER regulated under Noise Control Directive 038.	Yes	Yes

[1]**Bold** type in the above table signifies that these members have operational assets on the ground within Alberta's Industrial Heartland.

[2] NA means Not Applicable as the entity was either not a member of NCIA, or their project was cancelled along with their membership in NCIA.

6 Regional Noise Model General

6.1 Improvements/Corrective Actions implemented in 2019 (Appendix 4)

1. Aux Sable – A sound study was completed in May 2019. This study found that there were no significant changes to the facility and was reviewed by senior site leaders. Full documentation is available on request.
2. Cenovus – In 2019 a noise impact assessment was completed by SLR in response to the licensing (by AER) of an injection building in the Manifest area of the Bruderheim Energy Terminal. The terminal noise model was also updated as part of this program. Predicted sound levels were estimated to be lower than permissible sound levels determined using AER Directive 38.
3. Keyera – Completed the installation of two additional C5+ injection pumps. These pumps were installed within a building that was designed to mitigate noise impact. At present there has been no update to the site noise model.
4. Nutrien – Nutrien Redwater shut down the phosphoric acid unit permanently in April of 2019 and the sulphuric acid #2 unit permanently in October of 2019.
5. Pembina – RFS II/III Cogen commenced operations in April 2019. This did not create any significant impacts to the noise level output for the facility. Actual measurements for the Cogen unit were completed in 2019 by SLR to update the site noise model with measured data instead of theoretical values.
6. Sherritt International – Fence line monitoring was completed in 2019 by SLR Consulting (Canada) Ltd. The five measurement locations used were the same as the ones used in previous surveys. The results for the 2019 survey are generally lower than the 2011 values. The 2013 survey results are generally consistent with the measurement results from the 2019 survey. At this time, it is believed that an updated Site model is not required as a result of the 2019 survey.

6.2 Other Items for Follow-up Based on 2019 Field Measurements

1. The NWR Sturgeon Refinery not yet included in the Existing Case RNM (that will change for the next RNM update in 2022).
2. The IPL Heartland Petrochemical Complex that is not yet included in the RNM but will be for the next update in 2022.
3. We will continue to conduct annual field monitoring and compare it to the RNM predicted ranges.
4. As noted with the trend analysis, Figure 5 of this report, there is no clear trend (up or down) of measured noise levels in the region.

6.3 Next Steps for 2020/2021

1. Keyera – Replacement of the Hot Oil Heater in Frac 1 will be completed in 2020 which will reduce the overall site noise level when the new heater is commissioned in Q2 2020. Engineering and regulatory groups will determine, following replacement, if an updated noise model will be provided to NCIA in late 2020/early 2021.
2. Nutrien – Nutrien Redwater approved projects have been deferred. In terms of the 30# Steam vents, Noise Curtains are now scheduled to be installed during the turnaround in 2020.
3. Plains Midstream – The Facility will be installing new pumps to support cavern storage activities. These activities may result in changes that require the facility to update the Regional Noise Model. This will be evaluated as we proceed with expansion activities. An update, if required, will be conducted in conjunction with the next regional noise model update.

APPENDIX 1

NCIA Regional Noise Model
2018 Noise Model Update (rev 2)

NCIA Regional Noise Model

Northeast Capital Industrial Association

2018 Noise Model Update **(rev2)**

SLR Project No.: 203.50029.00003

September 2020

NCIA REGIONAL NOISE MODEL
2018 NOISE MODEL UPDATE (rev2)

SLR PROJECT NO.: 203.50029.00003

Prepared By
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September 22, 2020

This document has been prepared by SLR Canada. The material and data in this report were prepared under the supervision and direction of the undersigned.

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Permit to Practice P05449

Distribution: 1 copy (PDF) – Northeast Capital Industrial Association
1 copy – SLR Consulting (Canada) Ltd.

EXECUTIVE SUMMARY

The 2018 NCIA Regional Noise Model provides an update and additions to the previous model update, being the 2015 NCIA Regional Noise Model. This project involved gathering updated noise databases in various formats from many NCIA member company facilities. All of the acquired data was converted into a format acceptable for a common software platform, being SoundPLAN 8.0, and subsequently imported into one large, region-encompassing computer noise model.

The Regional Noise Model was designed and built with independent sets of input data for each facility, in order to allow for separation of its output data, to be able to depict independent noise contributions from: ● NCIA member company existing regulated facilities; ● NCIA member company proposed facilities (with regulatory approval); ● non-member company existing facilities (voluntary participation); ● road noise contribution; ● rail noise contribution; and ● modeling parameter of downwind conditions. This report contains example output results of combined sound level contours for commonly used scenarios of: ● an Existing Regulatory Case; ● a Future Regulatory Case; and ● four Model Validation Cases.

The results are formatted in such a way that an NCIA user can download pre-run Regional Noise Model contour results files. This can be done in both SoundPLAN and in CadnaA formats, being two of the major computer noise model software platforms in widespread use by acoustical consultants. The user could then combine these results with their separately run results for their proposed facility, and that resultant contour would then be representative of the cumulative effects in the region. Accordingly, results from this Regional Noise Model can be used in future environmental assessment applications, comparisons of the change in noise environment in the region over time, and as a tool to illustrate various sound assessment aspects to the public. The Regional Noise Model database is also set up to allow for special model runs such as the determination of the relative sound level contributions from neighbouring facilities.

The results presented in this report will serve as an updated baseline since 2015 and are representative of the noise environment at the time of this report. Furthermore, the Regional Noise Model has been developed in such a way as to keep it as versatile as possible for future work.

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1. PURPOSE

The Regional Noise Management Plan Steering Committee of the Northeast Capital Industrial Association ("NCIA") developed a Regional Noise Management Plan ("RNMP") for their member companies in Alberta's Industrial Heartland, in collaboration with the Alberta Energy Regulator and the Alberta Utilities Commission that took effect in 2012. As part of the ongoing development of the Regional Noise Model, SLR Consulting (Canada) Ltd. ("SLR") (previously HFP Acoustical Consultants Ltd.) was asked by NCIA to perform various tasks to keep the evolution of the Regional Noise Model current. This report has been prepared to present the results of this project.

This report presents the 2018 update to NCIA's Regional Noise Model. The initial version of the model was previously presented in a report entitled "NCIA Regional Noise Model Project", dated March 12, 2012, as issued by HFP, and a subsequent revision of the model was presented in a report entitled "NCIA Regional Noise Model, 2015 Noise Model Update", dated June 18, 2015, as issued by SLR.

2. SCOPE OF WORK

The scope of work for NCIA's 2018 Regional Noise Model update was sub-divided into seven "Tasks", as follows:

- Update NCIA's Regional Noise Model
- Provide Contours of Modeled Differences
- Create Tables & Figures of 2017 Measured Differences
- Create On-line Access to Interactive Model Predictions
- Update Road Noise Contributions
- Update Rail Noise Contributions
- Provide SoundPLAN and CadnaA Output Files with Microsoft SharePoint Coordination

2.1 UPDATE NCIA'S REGIONAL NOISE MODEL

An overview of the Alberta Industrial Heartland area, with the various industrial landholdings, is presented in Figure 1.

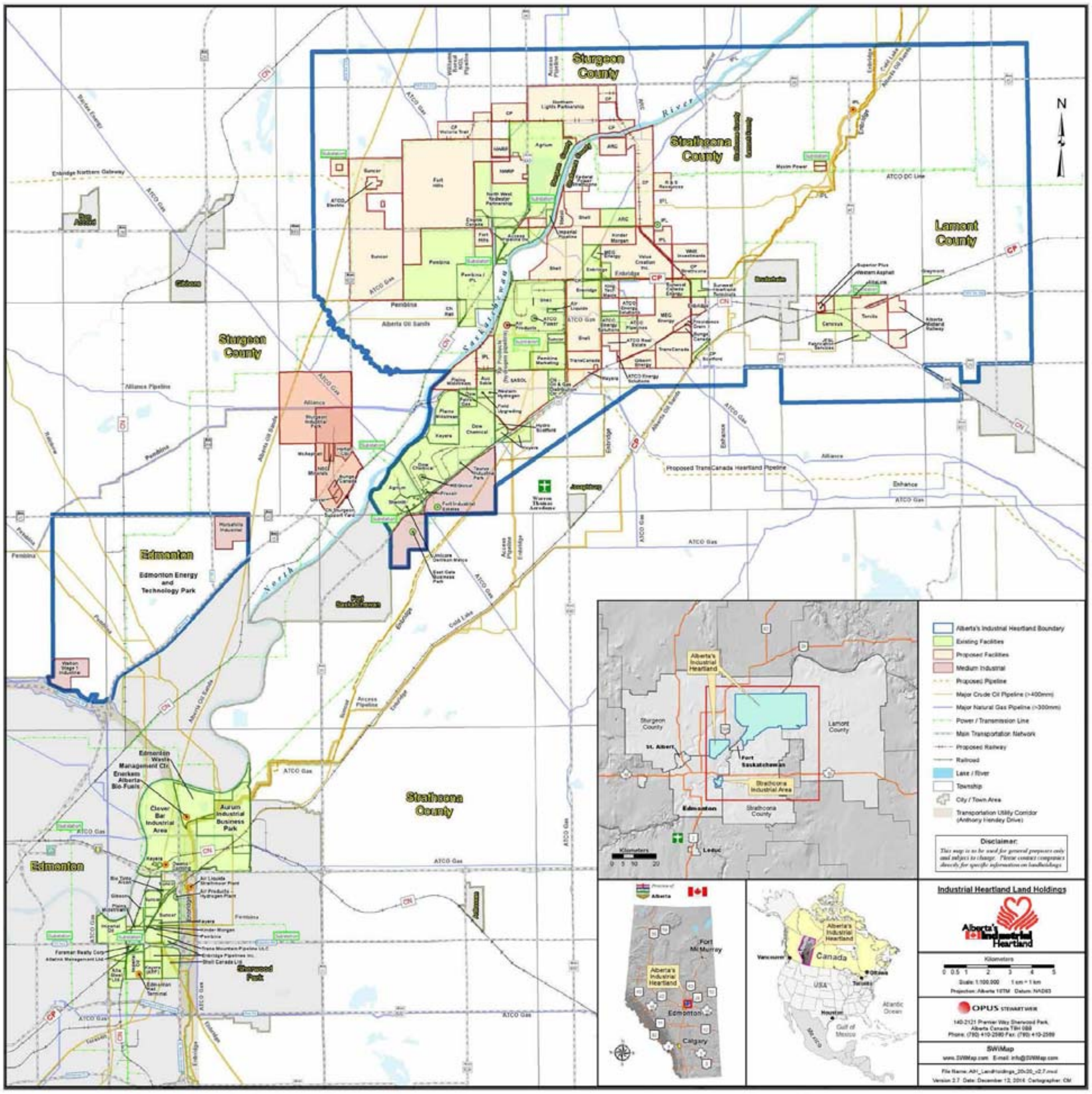
NCIA implemented a strategy to update the Regional Noise Model periodically, as required by the Alberta Energy Regulator ("AER"). These periodic updates are to be performed when a sufficient amount of individual site computer noise models have been updated. This process has been developed to involve the following steps:

- Each NCIA member company[1] works independently with their own acoustical consultant, to periodically update their site's computer noise model, as part of each site's independent **Noise Management Plan**, when significant site changes have occurred. This should be performed as defined by Site Modeling Requirements, as separately presented to member companies. Each

[1] Or NCIA non-member company, on a voluntary basis, as well – inferred throughout this document

NCIA member company then provides this updated computer noise model, in electronic database format, to NCIA.

Figure 1
Regional Map of Facilities in the Alberta Industrial Heartland



- NCIA, through their acoustical consultant, then compiles all of the received site computer noise models. This may include conversion of the site noise model to SoundPLAN, coordinate transformations and ground elevation changes, and upgrade NCIA's Regional Noise Model into the then-current software version. Once compiled, the Regional Noise Model is run to produce updated regional noise contours. The results are provided to NCIA along with interactive imaging files for public distribution. A composite report is prepared for NCIA to provide to the AER, as per their regulatory agreement.

- Pre-run component / contour results files are then provided by NCIA, in a format compatible with SoundPLAN and CadnaA, on their SharePoint site, so that each NCIA member company can continue working with their own acoustical consultant to perform cumulative effects modeling (results already include the contributions of all existing facilities) to suit their own site's purposes.

Table 1, as presented below, lists the individual site computer models included in the Regional Noise Model that have been prepared by SLR, and indicates when each model was last updated. Updated site computer models were received from third-parties for inclusion in the Regional Noise Model as well. These Heartland area plants, for which other acoustical consultants had prepared the computer noise models, and which were provided through their client to NCIA, are listed in Table 2, as presented below. All site computer models were then upgraded to SoundPLAN 8.0 for inclusion in this 2018 update to the Regional Noise Model. Entries shown in **bold** font represent facilities with updated site models for the 2018 Regional Noise Model whereas the other facilities are based on the same site model that was previously included in the 2015 Regional Noise Model.

Table 1
Site Noise Models in 2018 Regional Noise Model Prepared by SLR

Company	Plant / Unit	Model Date
Nutrien	**Redwater Fertilizer Operations Plant**	**February, 2017**
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Pembina	RFS2 Expansion	Stantec	June, 2013
Pembina	RFS3 Expansion	Stantec	December, 2014
Pembina	**Co-generation Plant**	**Stantec**	**March, 2016**
Keyera Energy	**Fractionation and storage**	**Patching Associates**	**July, 2018**

In order to be able to encompass each individual plant operation's contribution into the Regional Noise Model, in 2012 HFP created a number of "Basic Noise Models". This was undertaken by conducting noise measurements around the perimeter of these plant sites and creating a simplified computer noise model. These facilities are listed in Table 3, and are explained in more detail and presented in Table 3 in Appendix C. Some facility Basic Noise Models remain unchanged from 2012's Regional Noise Model, while others have been replaced by detailed site noise models in the 2018 Regional Noise Model. Note that the Basic Noise Models for the facilities shown in Table 3 have not been updated since the first Regional Noise Model in 2012.

Table 3
Heartland Plants where Basic Noise Models were included in the 2018 Regional Noise Model

Company	Plant / Unit	Data Provided	Model Date
Aux Sable Canada*	Extraction Plant	Sound Power Levels	September, 2010
Evonik Canada Inc.	Hydrogen Peroxide Plant	Fenceline Measurements	June, 2010
Chemtrade Logistics	Central Service Center	Diagnostic Measurements	September, 2010
Chemtrade Logistics	Sulfides Facility	Diagnostic Measurements	September, 2010
Praxair Canada Inc.	Air Separation Plant	Fenceline Measurements	June, 2010
Praxair Canada Inc.	Carbon Dioxide Plant	Fenceline Measurements	June, 2010
ATCO Midstream	Liquid Extraction Plant	Sound Power Levels	June 2011

* based on PWL's provided by the facility's acoustical specialist

The 2018 update of the Regional Noise Model was run for the following scenarios and presented in the corresponding figures listed below:

- Case 1 – Existing Regulatory Case (AER & AUC); Figure 2
  - NCIA member company existing facilities
  - Downwind conditions
- Case 2 – Future Regulatory Case (AER & AUC); Figure 3
  - NCIA member company existing facilities
  - NCIA member company proposed facilities
  - Downwind conditions
- Sound Level Contour Differences Figure 4
- 2018 RNM minus 2015 RNM – Case 1;
  - NCIA member company existing facilities
  - Downwind conditions
- Case 3a – Model Validation Case; Figure D - 1
  - NCIA member company existing facilities
  - Non-member company existing facilities
  - Calm wind conditions
- Case 3b – Model Validation Case; Figure D - 2
  - NCIA member company existing facilities
  - Non-member company existing facilities
  - Road Noise Contribution
  - Calm wind conditions
- Case 3c – Model Validation Case; Figure D - 3
  - NCIA member company existing facilities
  - Non-member company existing facilities
  - Rail Noise Contribution
  - Calm wind conditions
- Case 3d – Model Validation Case; Figure D - 4
  - NCIA member company existing facilities
  - Non-member company existing facilities
  - Road & Rail Noise Contributions
  - Calm wind conditions.

All facility models listed in Table 1, Table 2 and Table 3, as presented above, are included in Cases 1, 2 and/or 3 in various combinations. A list of facilities that are included in each case is shown in Table 4.

Tabular results for the Regional Noise Model include the following:

- A computer noise model input database, in spreadsheet format, depicting the following;
    - Plant equipment;
        - Description (e.g. name, tag number)
        - Grid coordinates and elevations
        - Octave band Sound *Power* Levels

These technical parameters are described in greater detail in Appendix B.

Graphical results for the Regional Noise Model consist of colour contour maps, depicting the A-weighted equivalent sound level. Figure 2 presents predicted noise contributions for Case 1, and Figure 3 presents predicted noise contributions for Case 2, as presented below. Figures for Cases 3a to 3d are presented in Appendix D.

Table 4
List of facilities included in the modeled cases

Company	Plant	Case 1	Case 2	Case 3
Air Liquide	Cogeneration Unit	•	•	•
ATCO Midstream	Liquid Extraction Plant			•
Aux Sable	Off-Gas Plant	•	•	•
	Extraction Plant		•	
Cenovus	North American Terminal Operations	•	•	•
Chemtrade Logistics	Central Service Center	•	•	•
	Sulfides Facility	•	•	•
Corefco - Sherritt Integrated Site	Metal production	•	•	•
Dow Chemical Canada	Ethylene; Fractionator; Polyethylene I, II & III; Ethylene Oxide / Ethylene Glycol; Ethane Storage; Power & Utilities; Cogeneration plants	•	•	•
Evonik Canada Inc.	Hydrogen Peroxide Plant	•	•	•
Keyera Energy	Fractionation and storage	•	•	•
North West Redwater Partnership	Sturgeon Refinery (3 units)		•	
Nutrien	Redwater Fertilizer Operations Plant	•	•	•
	Nitrogen production	•	•	•

Company	Plant	Case 1	Case 2	Case 3
Oerlikon-Metco - Sherritt Integrated Site	Chemical preparation	•	•	•
Pembina	RFS1 & ROF	•	•	•
	RFS2 Expansion	•	•	•
	RFS3 Expansion	•	•	•
	Co-generation Plant		•	
Plains Midstream	Fractionation and storage	•	•	•
Praxair Canada Inc.	Air Separation Plant	•	•	•
	Carbon Dioxide Plant	•	•	•
Shell Canada	Refinery; Upgrader (base plant and expansion plant); Cogen	•	•	•
Shell Chemicals	Styrene; MEG	•	•	•
Sherritt International - Sherritt Integrated Site	Metal production	•	•	•
Suncor	Fort Hills Sturgeon Upgrader		•	
Umicore - Sherritt Integrated Site	Metal products	•	•	•
Value Creation	Oilsands Upgrader		•	
Wolf Midstream	Sturgeon Terminal	•	•	•

2.2 CONTOURS OF MODELED DIFFERENCES

SLR has generated "***contours of the modeled differences***", which are the differences between the calculated results of the 2018 Regional Noise Model update as compared to the calculated results of the 2015 Regional Noise Model. Figure 4 presents the difference contour for Case 1. These differences account for all changes to the Regional Noise Model arising from the 2018 update, including any slight differences between SoundPLAN calculation kernels for version 7.3 in 2015 and version 8.0 in 2018.

2.2.1 INTERPRETATION

The 2018 update to the Regional Noise Model contains more data than the previous 2015 model did. This is mostly because some of the facilities which were not updated for a number of years, have updated their databases with more accurate models representing changes and/or expansions to their facilities. Some of these updates were based upon actual on-site noise measurements, providing a greater level of accuracy to the overall noise model. The contour differences shown in Figure 4 can be explained by the following updates to the Regional Noise Model:

- For the Pembina Redwater Fractionation & Storage Facility, the apparent increase in sound levels is the result of performing detailed site noise measurements and updating the site noise model for the ROF and RFS1 units. The RFS2 expansion unit has not yet been updated and remains unchanged in the site model as theoretical data. The RFS3 expansion unit is also based on theoretical data, yet the expansion has now been built so the model is included in Case 1.
- For the Nutrien Redwater Fertilizer Operations plant, the apparent increase in sound levels is the result of performing detailed site noise measurements for a number of areas in the plant that had not been updated for several years.
- For the Shell Scotford site, a number of updates were made to the site models based on detailed site noise measurements. In particular, updates were made to include the Quest expansion, as well as the Chemicals unit to improve the accuracy of the site noise models. These updates resulted in small localized increases in noise in areas within the plant site, yet a net decrease in noise is seen off site.
- For the Aux Sable facility, the Off-gas Plant was updated based on site noise measurements to replace the previous theoretical based noise model, resulting in a net decrease in predicted sound levels.
- For the Keyera facility, site noise measurements were conducted to replace the previous theoretical based model, resulting in localized differences in predicted noise levels, but an insignificant net change in the surrounding area.
- For the Plains Midstream facility, there have been some expansions to the site which have been captured in the most recent site noise model. The expansions are based on theoretical data and result in a small localized increase in predicted sound levels.
- There are some changes to the predicted noise levels that appear around the Nutrien FNO and Sherritt Integrated Site, yet there have not been any changes to the facility site models in this area. It is expected that these slight differences appear due to improvements to the SoundPLAN modeling software’s calculation kernel. Specifically, improvements that were made to the side diffraction calculations in SoundPLAN version 8.0.

2.3 TABLES OF MEASURED DIFFERENCES

Annual noise monitoring surveys are conducted at several locations in the AIH by ACI Acoustical Consultants. The noise monitoring data for the 2017 surveys (from the ACI report dated November 14, 2017) are compared with the 2018 RNM results in this report section. This comparison is presented as the “***tables of measured differences***”, which are the differences between the predictions of the 2018 update to the Regional Noise Model in SoundPLAN 8.0 as compared to the measured results from the noise monitoring surveys conducted by ACI Acoustical Consultants in 2017. SLR completed a model run of the updated 2018 Regional Noise Model using the meteorological conditions encountered during the 2017 field survey and generated predictions for the locations chosen for the noise monitoring surveys. Table 5 presents a comparison of the differences between the measurement results and the updated modeled predictions.

2.4 INTERACTIVE MAP UPDATE

For the 2018 Regional Noise Model update, SLR has created an interactive map using the ESRI ArcGIS Online platform[2]. This online cloud-based platform allows for users to access the latest model output maps through a web-based application. SLR has uploaded colour noise contours for the six scenarios described in Section 2.1. These maps geo-reference the contours to the correct coordinates and coordinate system, using Graphical Information Systems (GIS) to provide interactive zoom-dependent levels of information and infinite image resolution, including selectable reference values on the contour maps. It is important to note that these contours are not suitable for regulatory applications, but rather are provided for public information.

2.4.1 3D BUILDINGS

SLR has included 3D buildings in the interactive maps to provide a virtual 3D representation of all major structures within the company facilities. This consisted of exporting all geographic position and height information from structures, vessels, buildings and other obstacles contained in each company noise model for inclusion in the interactive ArcGIS maps. This adds a level of enhancement to the interactive colour contours, by allowing viewers to tilt the view and see all the relevant structures affecting the noise propagation.

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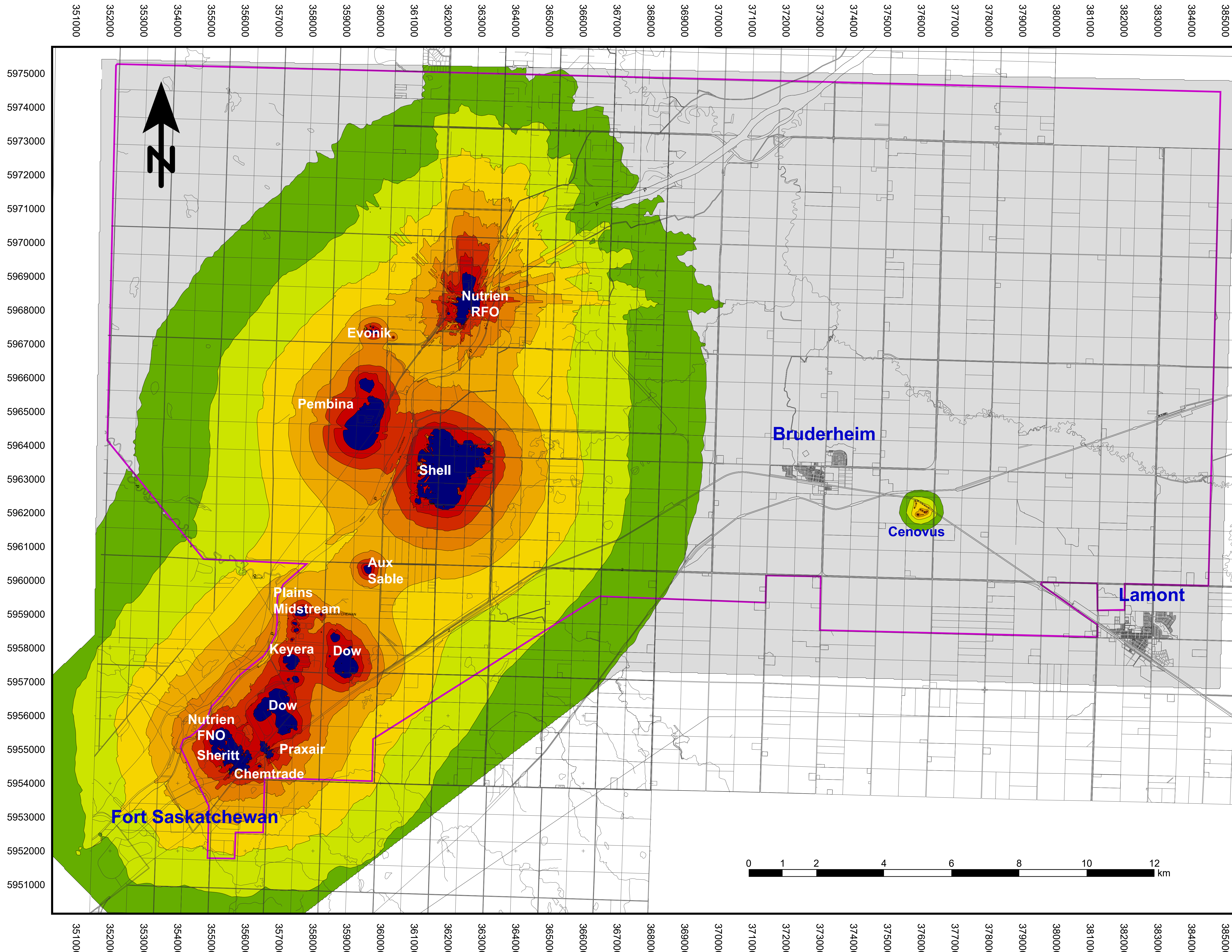
[2] The maps can be accessed at the following link:
https://slr-pro.maps.arcgis.com/apps/webappviewer3d/index.html?id=08e0ea98bf89443aafe8ea76d438eb99



NCIA Regional Noise Model 2018

Figure 2:
Predicted Sound Level Contours

Case 1:
Existing Regulatory Case
- NCIA member company existing facilities
- Downwind conditions

Legend

AIHA Industrial Policy Area

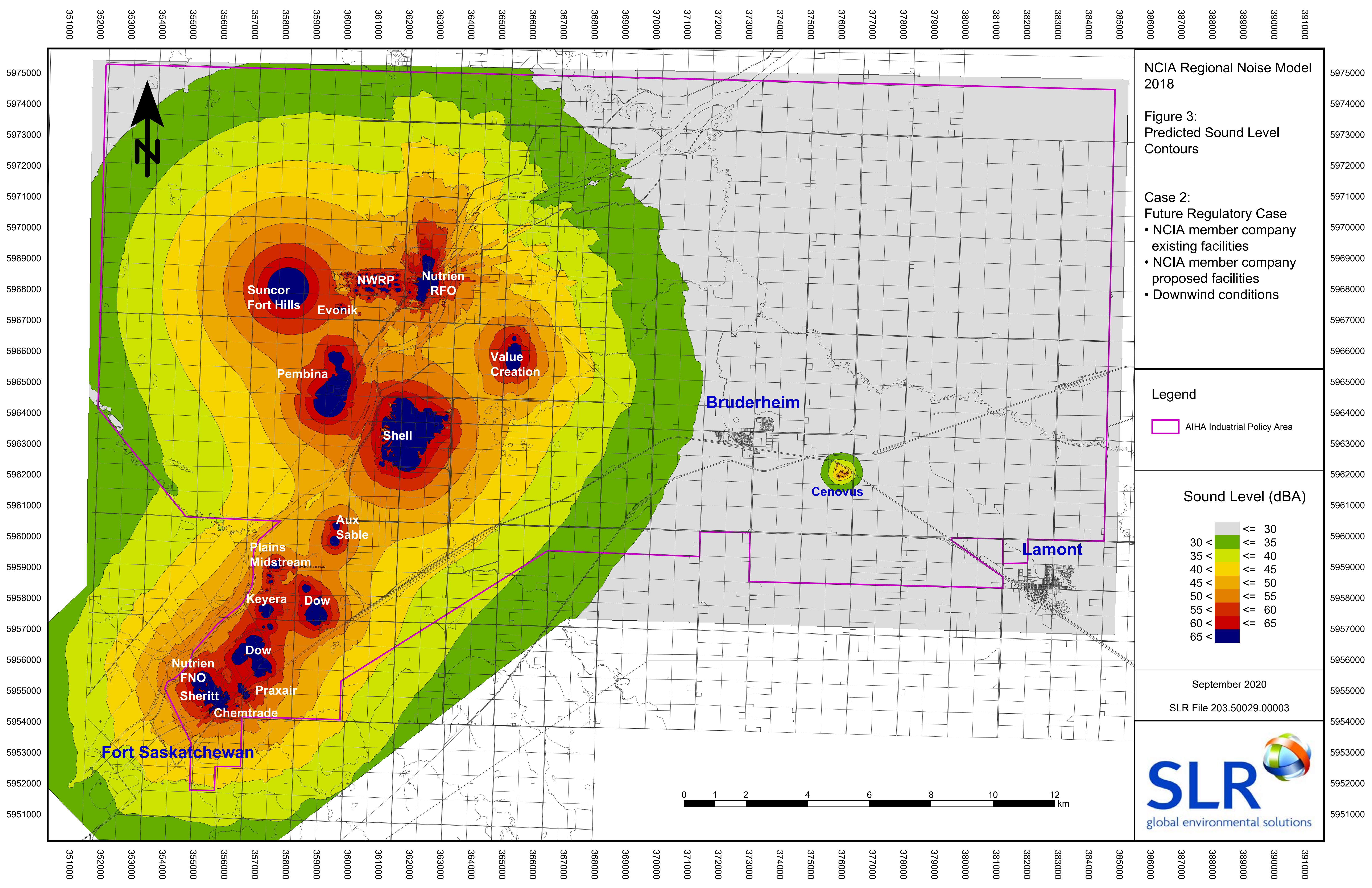
Sound Level (dBA)

	<= 30
30 <	<= 35
35 <	<= 40
40 <	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	<= 65
65 <	

September 2020

SLR File 203.50029.00003

SLR global environmental solutions



NCIA Regional Noise Model 2018
Figure 3:
Predicted Sound Level Contours
Case 2:
Future Regulatory Case
• NCIA member company existing facilities
• NCIA member company proposed facilities
• Downwind conditions
Legend
AIHA Industrial Policy Area
Sound Level (dBA)
<= 30
30 < <= 35
35 < <= 40
40 < <= 45
45 < <= 50
50 < <= 55
55 < <= 60
60 < <= 65
65 <
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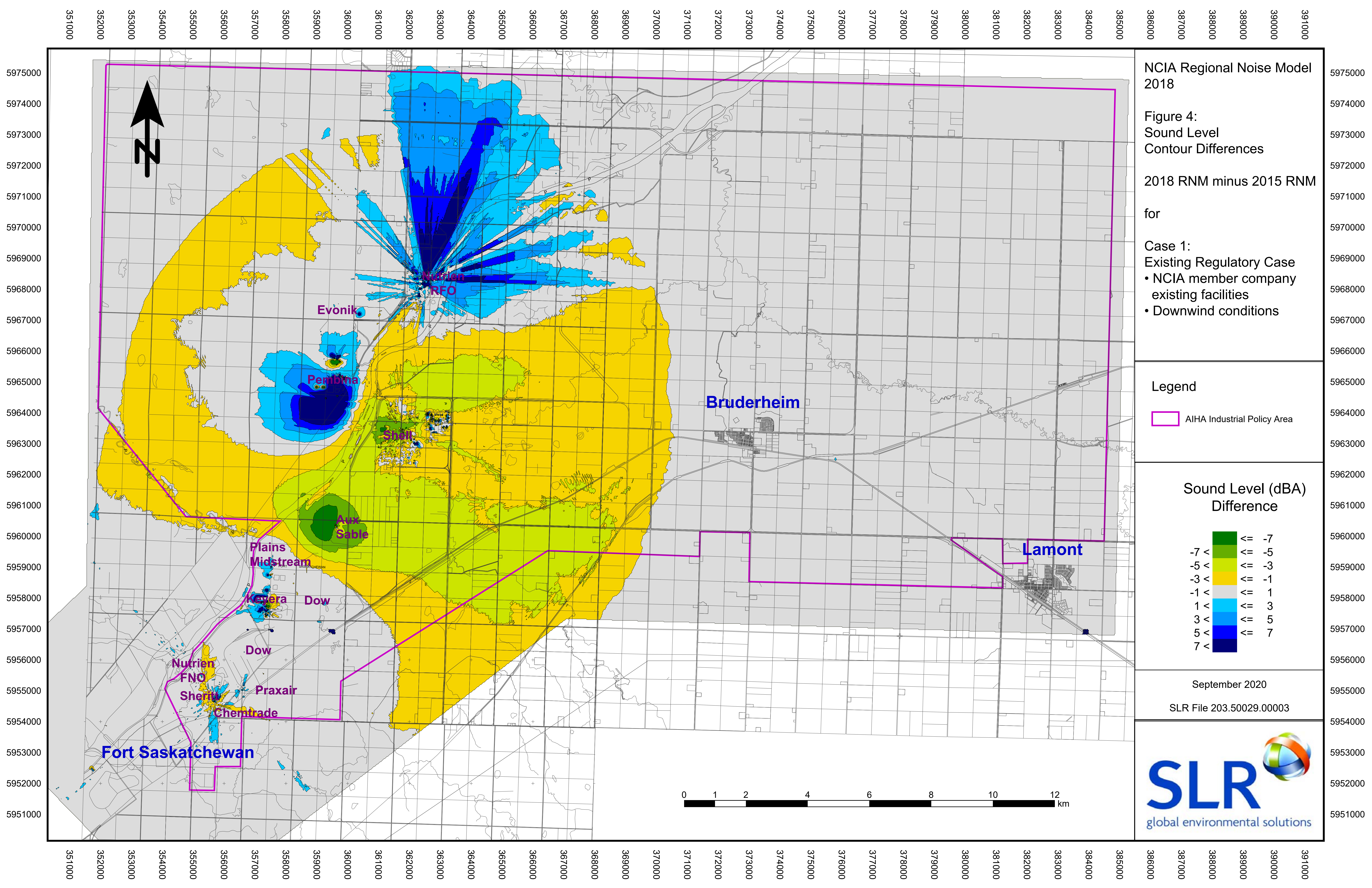
Suncor Fort Hills
NWRP
Nutrien RFO
Evonik
Value Creation
Pembina
Shell
Bruderheim
Cenovus
Aux Sable
Plains Midstream
Keyera
Dow
Dow
Nutrien FNO
Sheritt
Praxair
Chemtrade
Fort Saskatchewan
Lamont
0 1 2 4 6 8 10 12 km



NCIA Regional Noise Model 2018
Figure 4:
Sound Level Contour Differences
2018 RNM minus 2015 RNM
for
Case 1:
Existing Regulatory Case
• NCIA member company existing facilities
• Downwind conditions
Legend
AIHA Industrial Policy Area
Sound Level (dBA) Difference
<= -7
-7 < <= -5
-5 < <= -3
-3 < <= -1
-1 < <= 1
1 < <= 3
3 < <= 5
5 < <= 7
7 <
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N
Nutrien RFO
Evonik
Pembina
Shell
Aux Sable
Plains Midstream
Keyera
Dow
Dow
Nutrien FNO
Sherritt
Praxair
Chemtrade
Fort Saskatchewan
Bruderheim
Lamont
0 1 2 4 6 8 10 12 km
351000 352000 353000 354000 355000 356000 357000 358000 359000 360000 361000 362000 363000 364000 365000 366000 367000 368000 369000 370000 371000 372000 373000 374000 375000 376000 377000 378000 379000 380000 381000 382000 383000 384000 385000 386000 387000 388000 389000 390000 391000
5975000 5974000 5973000 5972000 5971000 5970000 5969000 5968000 5967000 5966000 5965000 5964000 5963000 5962000 5961000 5960000 5959000 5958000 5957000 5956000 5955000 5954000 5953000 5952000 5951000

2.5 UPDATE ROAD NOISE CONTRIBUTIONS

Road traffic data was updated for the 2018 Regional Noise Model based on average hourly traffic volumes as derived from Annual Average Daily Traffic (AADT) data for 2017 (Alberta Highways 1-986, Traffic Volume, Vehicle Classification, Travel and ESAL Statistics Report 2017, produced March 5, 2018). This was the most current data available at the time of the assessment. Sound level values are calculated separately for daytime and nighttime traffic, as there may be a substantial difference between daytime and nighttime traffic volumes and noise. The assumed day / night traffic volume splits used are 90% / 10% for all roads in the region. The daytime sound levels for traffic noise are presented in the contour maps. As most of the roads have a similar distribution of vehicle types, a global correction factor of -7.3 dB can be applied to the daytime level to arrive at approximated nighttime noise levels. Similarly, a correction factor of -1.4 dB can be applied to the daytime level to arrive at approximated $L_{eq(24\ hr)}$ noise levels.

2.6 UPDATE RAIL NOISE CONTRIBUTIONS

In previous versions of the Regional Noise Model, the railway noise data was estimated based on limited information. Substantial changes were made to the rail noise predictions in the 2018 Regional Noise Model. Average rail volumes and speeds were obtained from both Canadian National (CN) and Canadian Pacific (CP) for the main rail lines throughout the region. A total of 12 separate track segments were included and modeled using the Ontario MoE Sound from Trains Environmental Analysis Method (STEAM) calculation method to determine the source sound power levels and then modeled with the Calculation of Railway Noise (CoRN) calculation standard to determine the environmental sound levels. This represents a significant improvement in the predicted railway noise levels in the region over past models.

The calculated rail noise values are 24-hour equivalent continuous sound levels. These values represent the composite average of the daytime and nighttime sound levels, calculated for a typical day and night when the rail line movements occur. These values are not maximum hourly values; however, they do incorporate the effects of higher hourly results.

2.7 SOUNDPLAN AND CADNA/A OUTPUT FILES

SLR provided, under separate cover, pre-run component / contour results files in formats compatible with both SoundPLAN and CadnaA. NCIA has uploaded each set of files (separate file formats are required for SoundPLAN and CadnaA) to their SharePoint site, so that each NCIA member company can continue working with their own acoustical consultant to perform cumulative effects modeling to suit their own site's purposes.

3. COMPUTER NOISE MODEL VALIDATION

As part of the quality assurance procedure, to ensure that the Regional Noise Model represents the reality of the facility's noise emission characteristics, it is vital that each facility's computer noise model be validated. This is a step to ensure the facility's computer noise model's accuracy. Validation methodologies utilized are from SLR's best practical experience. As meteorological conditions and ground conditions have a significant effect on sound propagation, it is important to recognize that the

Regional Noise Model should be validated to the local weather conditions experienced at each monitored location.

Together with NCIA, 10 locations were initially selected as validation measurement locations in 2012. The measurement locations have since been altered to accommodate site conditions and some were added to further enhance the validation program. The most recent validation program consists of 12 measurement locations in the region. This selection was based on covering the majority of the Heartland area evenly, not being too close to major roadways, and with locations where the predominant noise contribution is from industry in the area. A map of the chosen validation measurement locations is shown in Figure 5.

ACI Acoustical Consultants Inc. (ACI) was responsible for carrying out the validation measurements in 2017. The 2017 validation survey consisted of 11 locations, plus a 12th control location.

The reported validation noise measurements most closely match Case 3a, the Model Validation Case. The weather conditions were monitored at several locations during the measurements. These weather conditions were then used to determine the average weather conditions during the nighttime periods which, in turn were incorporated into the Regional Noise Model to produce the model predictions for the validation noise measurement locations. Although ambient effects are sometimes analyzed alongside modeled results, ambient values themselves are typically not incorporated into industrial facility noise models. Further information about the validation procedure is available from SLR upon request.

The results of the validation noise measurements are reported in Table 5. Therein, one can observe both the noise model predictions and the measurement results. Furthermore, the difference between the noise model predictions and the measurement results are also shown. The presented sound levels are L_{eq} values. Location 12 was not included as a receptor point, as it was a control location chosen to measure ambient sound levels in the region, absent of industrial noise contributions.

Table 5
2018 Noise Measurement Locations and Results for Model Validation

Receptor Number	Receptor Location Change	Measured (M) and Predicted (P) Nighttime Sound Levels (Isolated dBA Leq)						Average Difference: (dBA)
		1st Nighttime Period			2nd Nighttime Period			
		Measured	Predicted	Delta (Predicted minus Measured)	Measured	Predicted	Delta (Predicted minus Measured)	
1b	Moved in 2017	49.1	54.6	+5.5	47.1	54.5	+7.4	+6.5
2		49.0	54.1	+5.1	47.2	53.7	+6.5	+5.8
3b	Moved in 2017	50.9	45.2	-5.7	51.2	45.0	-6.2	-6.0
4b	Moved in 2015	51.7	45.9	-5.8	44.0	46.3	+2.3	-1.8
5		54.0	54.9	+0.9	48.7	54.1	+5.4	+3.2
6		49.5	40.1	-9.4	46.5	41.3	-5.2	-7.3
7		Monitoring not conducted						
8d	Moved in 2016	52.7	52.0	-0.7	46.9	53.0	+6.1	+2.7
9		47.6	44.9	-2.7	39.2	46.1	+6.9	+2.1
10		48.6	55.7	+7.1	50.4	55.2	+4.8	+6.0
11		44.8	48.9	+4.1	44.4	52.2	+7.8	+6.0
12 (Period 1)		37.3	n/a	n/a	34.8	n/a	n/a	n/a
12 (Period 2)		37.3	n/a	n/a	33.0	n/a	n/a	n/a
13	New in 2016	43.3	27.6	-15.7	25.7	28.4	+2.7	-6.5

The results in the table indicate some fairly large differences between measured and predicted sound levels at several monitoring locations. In previous assessments, it was noted that the measurement results often varied quite significantly between the two nighttime periods which made it difficult to draw conclusions on the data. Therefore, it was suggested that instead of comparing measured levels to predicted levels for a specific meteorological condition, it would be more meaningful to compare the measured levels to predicted levels based on a range of possible meteorological conditions.

The meteorological conditions used to define the extents of the predicted range are representative of temperature lapse conditions (calm wind with Pasquill Stability Class "B"), and temperature inversion conditions (calm wind with Pasquill Stability Class "F"). These represent the reasonable extremes of meteorological conditions that may exist at any given time in the region. The Case 3 model was run with these parameters to define the lower and upper limits of predicted sound levels at each monitoring location, and the measured sound levels are compared to these ranges, as shown in Figure 6.

The results indicate that the Regional Noise Model is generally over-predicting the noise level at most receptors by up to approximately 5 dBA, with exception to locations 3b, 4b and 6 where measured levels are up to approximately 3 dBA higher than the upper predicted level. While over-predicting by this amount is not ideal, it points to the fact that some conservatism is built in to the overall model and the noise levels are higher as a result, as would be expected for a model of this type where every facility is assumed to be operating with worst-case noise outputs.

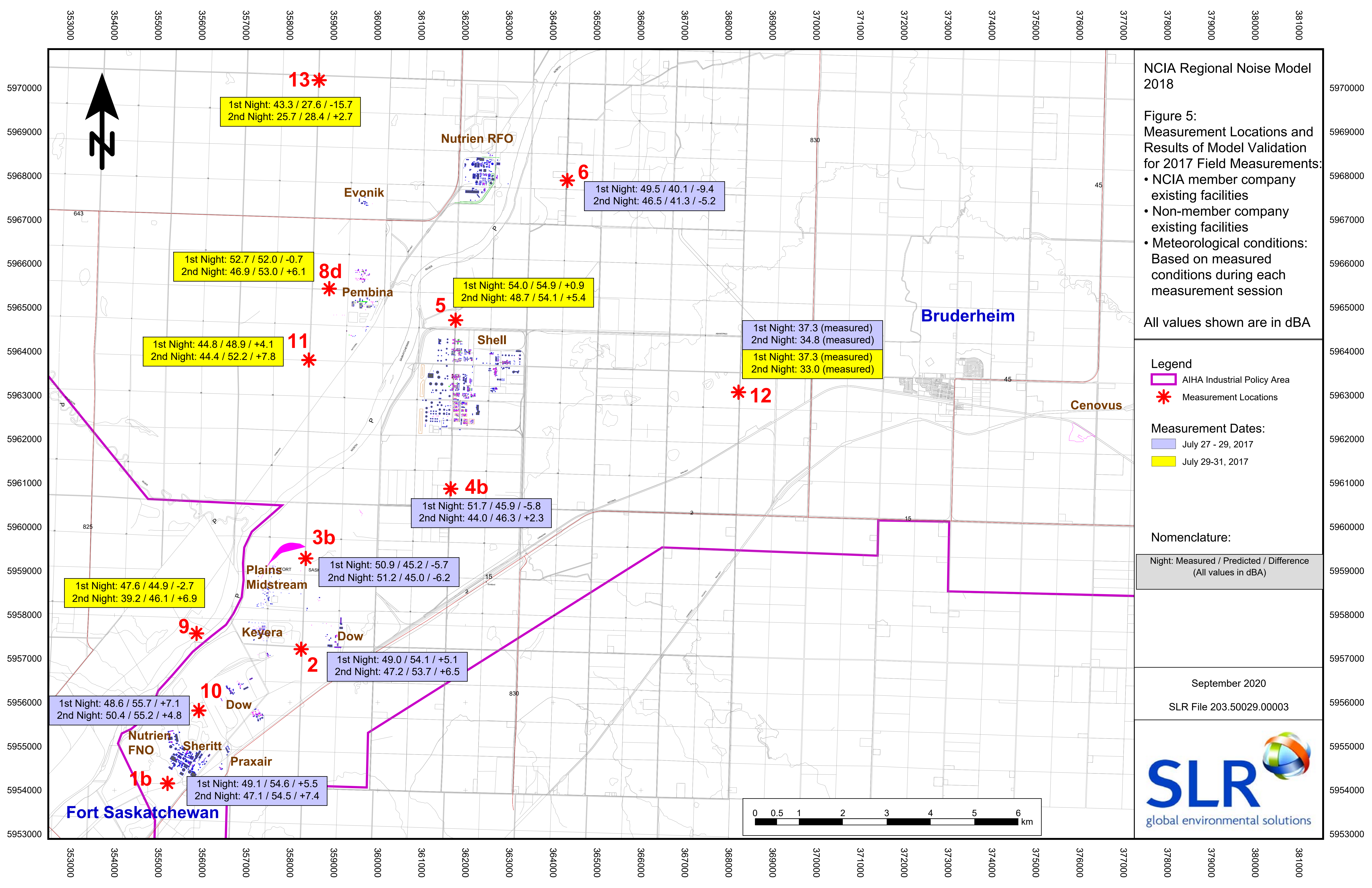
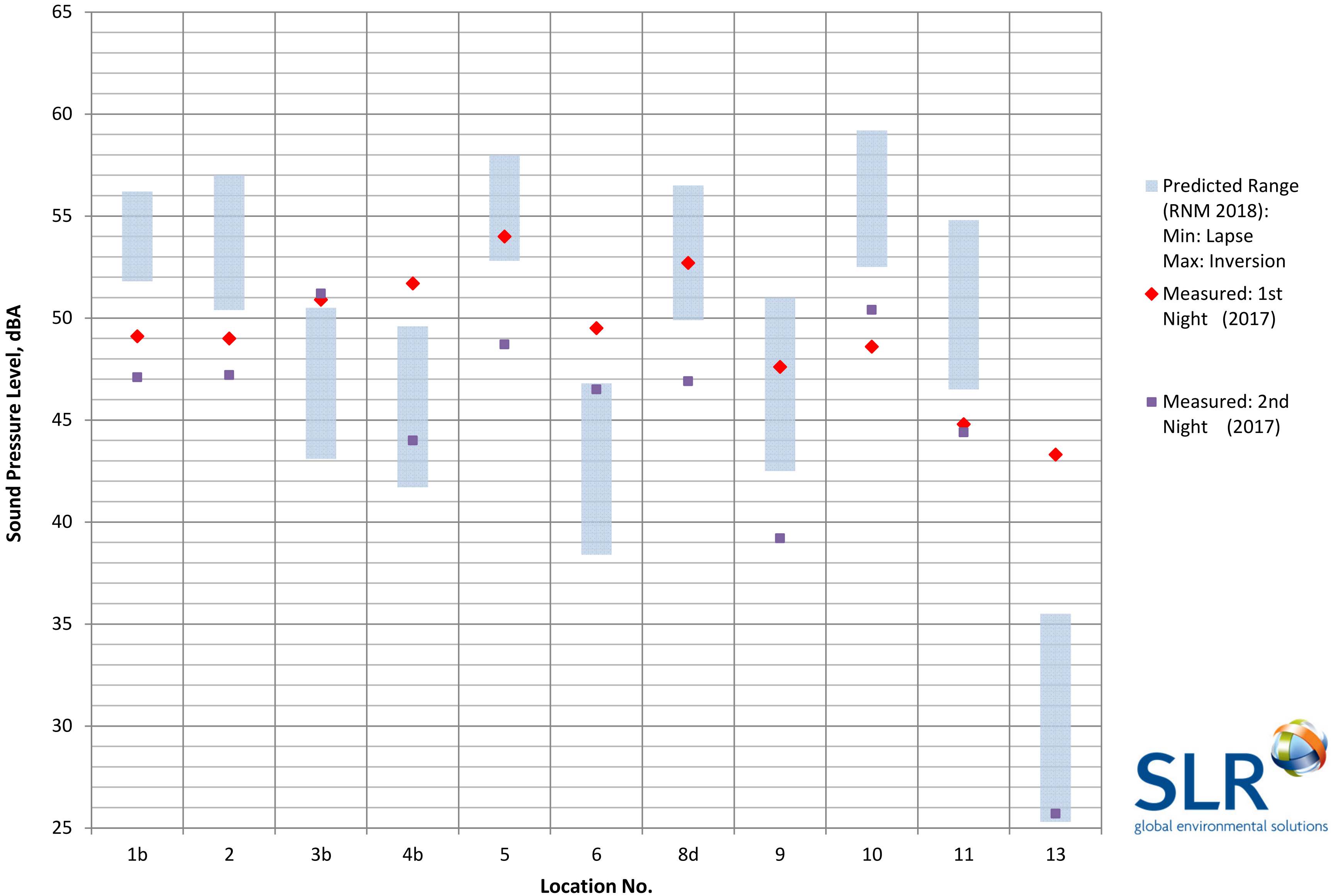

NCIA Regional Noise Model 2018
Figure 5:
Measurement Locations and Results of Model Validation for 2017 Field Measurements:
• NCIA member company existing facilities
• Non-member company existing facilities
• Meteorological conditions: Based on measured conditions during each measurement session
All values shown are in dBA
Legend
AIHA Industrial Policy Area
Measurement Locations
Measurement Dates:
July 27 - 29, 2017
July 29-31, 2017
Nomenclature:
Night: Measured / Predicted / Difference
(All values in dBA)
September 2020
SLR File 203.50029.00003
global environmental solutions
13
1st Night: 43.3 / 27.6 / -15.7
2nd Night: 25.7 / 28.4 / +2.7
6
1st Night: 49.5 / 40.1 / -9.4
2nd Night: 46.5 / 41.3 / -5.2
8d
1st Night: 52.7 / 52.0 / -0.7
2nd Night: 46.9 / 53.0 / +6.1
5
1st Night: 54.0 / 54.9 / +0.9
2nd Night: 48.7 / 54.1 / +5.4
11
1st Night: 44.8 / 48.9 / +4.1
2nd Night: 44.4 / 52.2 / +7.8
12
1st Night: 37.3 (measured)
2nd Night: 34.8 (measured)
1st Night: 37.3 (measured)
2nd Night: 33.0 (measured)
4b
1st Night: 51.7 / 45.9 / -5.8
2nd Night: 44.0 / 46.3 / +2.3
3b
1st Night: 50.9 / 45.2 / -5.7
2nd Night: 51.2 / 45.0 / -6.2
9
1st Night: 47.6 / 44.9 / -2.7
2nd Night: 39.2 / 46.1 / +6.9
2
1st Night: 49.0 / 54.1 / +5.1
2nd Night: 47.2 / 53.7 / +6.5
10
1st Night: 48.6 / 55.7 / +7.1
2nd Night: 50.4 / 55.2 / +4.8
1b
1st Night: 49.1 / 54.6 / +5.5
2nd Night: 47.1 / 54.5 / +7.4
Nutrien RFO
Evonik
Pembina
Shell
Bruderheim
Cenovus
Plains Midstream
Keyera
Dow
Dow
Nutrien FNO
Sheritt
Praxair
Fort Saskatchewan
0 0.5 1 2 3 4 5 6 km

Figure 6
Predicted Range versus Measured Sound Levels (2017)



4. REGIONAL NOISE MODEL RESULTS

This Regional Noise Model report includes pre-run model results for 14 selected scenarios, as listed in Table 6. The results are provided as both SoundPLAN and CadnaA native component results files. These will allow a user to combine various files to generate a desired scenario. An identification of what constitutes Case 1 and Case 2, the two base cases selected as an example within this report, is depicted in Table 7. Within the noise modeling software, one can combine multiple pre-run contour results files, to assemble a specific desired scenario. This way, each user can decide the following:

- Whether to select or omit NCIA member company plants that have received AER (or AUC) regulatory approval but are not yet constructed and / or not yet operating
- Whether to select or omit non-member plants that are not under the jurisdiction of the AER (or AUC)
- Whether to select or omit the road noise contribution
- Whether to select or omit the rail noise contribution
- Whether the Model should include or not include omnidirectional downwind sound propagation effects.

The model results are organized this way for a distinct purpose, in that NCIA prefers not taking a position on how environmental Noise Impact Assessments or other internal reporting are strategized, how work should be performed, or what data they should contain. Giving the user the ability to select or to omit various components and features provides flexibility, allowing the Regional Noise Model to facilitate differing strategic options. As an example, for meteorological conditions to meet the requirements of AER Directive 038 (or AUC Rule 012), the datasets for Downwind Conditions can be selected. As another example, to include for cumulative effects, the datasets for Proposed Regulatory Facilities can be selected. Also, to include for road and / or rail noise contributions, their respective datasets can be selected. In summary, these strategic decisions become user choices; with NCIA providing the databases only.

The hyperlinks in Table 6 lead the user to NCIA's SharePoint website to obtain the pre-run Regional Noise Model contour results files. The permissioned user must be a member of NCIA or must be an authorized consultant and must have the appropriate password to access these files. In the modeling software, the user combines these results with the separately run results of a specific computer noise model that they have built for their proposed facility, and that resultant contour would therefore be representative of the predicted cumulative effects in the region.

Several examples of commonly utilized combinations of these pre-run computer noise model results have also been prepared. Case 1, termed the "Existing Regulatory Case", represents what would typically be regarded as a pre-existing baseline condition, before a new development occurs. It incorporates existing facilities from NCIA member companies, modeled for a downwind situation. Case 2, termed the "Future Regulatory Case", also represents a pre-existing baseline condition before a new development occurs, but in addition to the Case 1 situation also incorporates proposed facilities that have already been approved by the AER (or by the AUC) but are not yet constructed.

Table 6
Pre-Run Computer Noise Model Component Results Available

	Downloadable Hyperlinks from NCIA's SharePoint™ Website	
	Calm Wind Conditions	**Downwind Conditions**
Existing regulated facilities – NCIA member companies	01. Existing NCIA Regulated Facilities - Calm Conditions-2015	02.Existing NCIA Regulated Facilities - Downwind Conditions-2015
Proposed regulated facilities – NCIA member companies (with regulatory approval)	03. Proposed NCIA Regulated Facilities - Calm Conditions-2015	04. Proposed NCIA Regulated Facilities - Downwind Conditions-2015
All existing facilities – including non-member companies (voluntary participation)	05. All Existing Facilities - Calm Conditions-2015	06. All Existing Facilities - Downwind Conditions-2015
Road noise contribution	07. Road Noise Contribution -2015	Not available *
Rail noise contribution	08. Rail Noise Contribution	Not available *
Existing facilities + road	09. Existing Facilities (Calm) + Road Contribution-2015	10. Existing Facilities (Downwind) + Road Contribution-2015
Existing facilities + rail	11. Existing Facilities (Calm) + Rail Contribution-2015	12. Existing Facilities (Downwind) + Rail Contribution-2015
Existing facilities + road + rail	13. Existing Facilities (Calm) + Road + Rail Contribution-2015	14. Existing Facilities (Downwind) + Road + Rail Contribution-2015

* the chosen road and rail calculation standards do not provide the opportunity to choose different wind settings

If the user of the Regional Noise Model were assembling an environmental Noise Impact Assessment for a newly proposed facility as a regulatory application to the AER under Directive 038 (or to the AUC under Rule 012), then Case 1 or Case 2 can include information that is typically desired representing the "baseline" condition; equivalent to what may be determined by conducting "background" (with industrial presence) noise monitoring. In either of these cases, the concept of "downwind in all directions" has been selected. This is a worst-case scenario, simulating wind blowing downwind in all directions simultaneously. The *downwind in all directions* concept is based upon noise propagation standard ISO 9613-2. Downwind conditions are accepted by and consistent with the "representative conditions" as defined within AER Directive 038 (and AUC Rule 012), for which shorter-term compliance monitoring (i.e. 24 hours) and regulatory modeling is performed. Alternatively, if the user of the Regional Noise Model is seeking typical representative values, then omitting the downwind conditions defaults to "calm wind conditions". This concept could be judged to be more representative of reality (e.g. reviewing yearly changes to a facility for an internal review). Calm wind conditions are more consistent with the long-term noise environment (i.e. months). This is because "such a period will normally include a variety of meteorological conditions, both favourable and unfavourable to sound propagation" (ISO 9613). Also, over the long-term, the wind blows in multiple directions, and calm wind results correspond with long-term averages

After the user has generated a computer noise model of their proposed facility, the user would then logarithmically combine the Case 1 or Case 2 component results files with those of their computer noise model of their proposed facility, to form a new case representing the proposed cumulative effects of other facilities and their proposed facility. This logarithmic summing of different contour results files is performed within the noise modeling software. An identification of what constitutes Case 1, the Existing Regulatory Case, and Case 2, the Future Regulatory Case, is described in Table 7.

The contour results for Case 1, the Existing Regulatory Case, were shown in Figure 2; and the contour results for Case 2, the Future Regulatory Case, were shown in Figure 3.

Table 7
Computer Noise Model Results Presented in Report Body

	Case 1 Existing Regulatory Case	Case 2 Future Regulatory Case	Sound Level Contour Differences
Existing regulated facilities – NCIA member companies	included	included	included
Proposed regulated facilities – NCIA member companies (with regulatory approval)	not included	included	not included
Existing facilities – non-member companies (voluntary participation)	not included	not included	not included
Road noise contribution	not included	not included	not included
Rail noise contribution	not included	not included	not included
Downwind condition	included	included	included

Case 3, termed the "Model Validation Case", represents sound levels that would be expected to be measured during noise monitoring under calm wind conditions. Herein, Case 3 has been subdivided into four slightly differing sub-cases, including various considerations of selecting or omitting road noise and / or rail noise. An identification of what constitutes Cases 3a, 3b, 3c, and 3d, the four Model Validation Cases, is depicted in Table 8.

Table 8
Computer Noise Model Results Presented in Report Appendix D

	Case 3a	Case 3b	Case 3c	Case 3d
	Model Validation Cases			
Existing regulated facilities – NCIA member companies	included	included	included	included
Proposed regulated facilities – NCIA member companies (with regulatory approval)	not included	not included	not included	not included
Existing facilities – non-member companies (voluntary participation)	included	included	included	included

	Case 3a	Case 3b	Case 3c	Case 3d
Road noise contribution	not included	included	not included	included
Rail noise contribution	not included	not included	included	included
Downwind contribution	not included	not included	not included	not included

The contour results for Cases 3a, 3b, 3c, and 3d, the Model Validation Cases, are presented in Figure D - 1, Figure D - 2, Figure D - 3, and Figure D - 4, respectively, which are presented in Appendix D of this report.

Differences between the results previously presented in Table 5, and the graphical presentation for Case 3 result from identified differences. Some of those differences could be explained as being due to variations in facility operating conditions. Other differences can occur due to variations between actual weather conditions during the validation noise measurements and the defined weather parameters for the projected Case 3 results. When comparing validation noise measurement results to computer noise modeled results, the specific weather conditions that occurred during the validation measurement period were input into the Regional Noise Model for these specialized calculations. For the Case 3 results, calm weather condition parameters were used for the computer noise model calculations.

5. FORECAST

The results presented in this report for the Regional Noise Model are valid for the situation within the Alberta Industrial Heartland area at the time of acquiring the updated site models and preparation of this report. The results are a depiction of the current sound situation in the Heartland area. Since an industrial area of this size is not a static entity and will undergo many changes over time, periodic updates to the Regional Noise Model will be required to keep the Model valid. Updates to the Model will also provide the opportunity to assess the changes of the noise situation in the area over time (i.e. mitigation effects), and to predict the noise impact of future changes (i.e. cumulative effects).

Recommendation for future areas of investigation is as follows:

- Establishing procedures for future facility additions and software updates to the Regional Noise Model are imperative. Due to the size and complexity of the computer noise modeling databases, it is not recommended for third-parties to be allowed to simply make changes or additions (e.g. a new facility model) to the existing database. Similarly, allowing a software change (e.g. software version update) without first studying its implications is not recommended. Accordingly, NCIA needs to keep close control of those permitted to access and change the Regional Noise Model database.

Recommendations for future model enhancements are as follows:

- Improving the model validation exercise, by taking into account atypical facility operating conditions not considered in member company's models, as some facilities have noisy intermittent operations (e.g. steam header steam vents, furnace boiler deaerator vents) which can significantly increase a facility's short-term noise footprint.

- Inclusion of C-weighting analysis, for producing contours of the dBC minus dBA results, which could be useful as a tool for evaluating whether a low frequency noise (LFN) issue might be prevalent.
- Some situations of individual site computer noise models were based on situations from years ago. Improved accuracy could be achieved by updating older site computer noise models as they become out-dated, to be more representative of the actual current situation.
- Improved accuracy could be achieved by updating the remaining Basic Noise Models with detailed diagnostic computer noise models developed using accepted noise modeling formats.
- Validation of the rail noise predictions would be useful to verify the noise levels currently being predicted. This would be achieved by conducting long-term measurements along some sections of rail in the region.
- The continued development of a prescribed calculation methodology for all the Heartland area is helpful. A standardized approach allows easier comparison between environmental Noise Impact Assessment reports and the accompanying imported computer noise models in the Regional Noise Model.
- Prepare a greatly abridged version of this report for public use and assist NCIA in the public participation process.

It is expected that the Regional Noise Model will continue to evolve and improve over time as further detailed and updated information from facilities becomes available in the future. One of the main intentions when developing the Regional Noise Model was to try to keep the Model as versatile as possible, to be able to use it for yet unknown applications in the future.

6. CONCLUSIONS

This report presents the 2018 update to NCIA's Regional Noise Model. It represents a significant update since the first model run in 2012 and the previously issued Regional Noise Model update in 2015. For the 2018 update, many of the various NCIA member companies have updated their own site's computer noise models as part of each site's independent Noise Management Plan, and these updated site models have been imported into the 2018 Regional Noise Model. Furthermore, while improvements in the SoundPLAN computer noise modeling software have occurred by updating from version 7.3 to 8.0, these software changes have minimal effect on the sound level predictions for the Regional Noise Model.

7. STATEMENT OF LIMITATIONS

This report has been prepared and the work referred to in this report has been undertaken by SLR Consulting (Canada) Ltd. (SLR) for the Northeast Capital Industrial Association, hereafter referred to as the "Client". The report has been prepared in accordance with the Scope of Work and agreement between SLR and the Client. It is intended for the sole and exclusive use of Client. Other than by the Client and as set out herein, copying or distribution of this report or use of or reliance on the information contained herein, in whole or in part, is not permitted unless payment for the work has been made in full and express written permission has been obtained from SLR.

This report has been prepared for specific application to this site and site conditions existing at the time work for the report was completed. Any conclusions or recommendations made in this report reflect SLR's professional opinion.

Information contained within this report may have been provided to SLR from third party sources. This information may not have been verified by a third party and/or updated since the date of issuance of the external report and cannot be warranted by SLR. SLR is entitled to rely on the accuracy and completeness of the information provided from third party sources and no obligation to update such information.

Nothing in this report is intended to constitute or provide a legal opinion. SLR makes no representation as to the requirements of compliance with environmental laws, rules, regulations or policies established by federal, provincial or local government bodies. Revisions to the regulatory standards referred to in this report may be expected over time. As a result, modifications to the findings, conclusions and recommendations in this report may be necessary.

The Client may submit this report to environmental regulatory authorities or persons for review and comment purposes.

Appendix A
Environmental Acoustics

Northeast Capital Industrial Association
NCIA Regional Noise Model
2018 Noise Model Update (rev2)
SLR Project No.: 203.50029.00003

A-1. ENVIRONMENTAL NOISE DESCRIPTORS

Environmental noise is typically not steady but varies over time. For environmental noise in the vicinity of an industrial facility, there is usually a continuous background noise from facility sources that varies over time mainly because of changes in atmospheric and/or ground cover conditions. Along with the continuous background noise there may also be intermittent, fluctuating, higher-level noises. These are usually associated with road, rail or air traffic in the surrounding area. Other sources of environmental noise may include community or agricultural activity and natural sounds.

To account for the time-varying nature of environmental noise, a single number descriptor known as equivalent continuous sound level (L_{eq}) is typically used. This descriptor quantifies sound that varies over time, such as that commonly occurring in outdoor environments. L_{eq} is the average sound level (based on acoustical energy) of time varying sound measured over a specific time period. Time periods commonly used for L_{eq} sound levels are 1-hour, daytime (07:00 to 22:00), nighttime (22:00 to 07:00), and 24-hours. L_{eq} is generally accepted and used for environmental noise measurements and criteria. It is also the noise descriptor used by Alberta Utilities Commission (AUC) Rule 012.

Sound is acoustic pressure waves that propagate through air. Because the range of audible sound pressures is very wide, sound is measured on a logarithmic scale in units of decibels (dB). The logarithmic scale compresses the range of audible sound pressures into a range that approximately corresponds to human hearing perception. When comparing sound level values, the following rule of thumb may be used:

- A difference in sound level of 3 dB is barely perceptible to human hearing;
- A difference of 5 dB is noticeable;
- A difference of 10 dB corresponds to a halving or doubling in perceived loudness; and
- A difference of 20 dB corresponds to a four-fold difference in perceived loudness.

Sound level values for environmental noise are normally A-weighted and expressed in units of A-weighted decibels (dBA). The A-weighting accounts for the frequency content of the sound and assesses it with a frequency response similar to that of human hearing. As with human hearing, the A-weighting is most sensitive to audible sound in the mid-frequency range; its sensitivity to high frequency sound is moderately lower and its sensitivity to low frequency sound is substantially lower.

Some types of industrial noise sources can produce significant low frequency sound energy. The presence of low frequency sound can potentially cause adverse effects if it occurs at high sound levels (e.g., perceptible vibration in building structures). Since the A-weighted frequency response filters out sound in the low frequency range, A-weighted sound levels are not a good descriptor for environmental noise containing significant low frequency sound components. The C-weighted frequency response provides a much better measurement of low frequency sound because it has a uniform sensitivity to sound over most of the audible frequency range (except at highest and lowest frequencies where it diminishes moderately). Although the C-weighting is not similar to the frequency response of human hearing at low to moderate sound levels, it is significantly more sensitive to low frequency sound than the A-weighting.

In environmental noise assessments, the daytime and nighttime periods are normally differentiated, especially for areas where ambient sound levels may be affected by community or traffic noise sources. Ambient sound levels are typically higher during the daytime as a result of increased community and traffic activity. During the nighttime, ambient sound levels are usually lower because community and traffic activity is significantly reduced. In order to understand the range of sound levels typically occurring in outdoor environments, Table A - 1 shows typical outdoor sound levels* at various locations ranging from a rural setting to an urban environment.

Table A - 1: Typical Sound Levels at Various Outdoor Locations

Location Description	Sound Level (dBA)	
	Daytime	Nighttime
Farm in Valley	35 - 45	29 - 37
Suburban Residential at City Outskirts	42 - 58	35 - 45
Urban Residential	48 - 59	45 - 57

* Harris, C.M., ed., Handbook of Noise Control, Second Edition, McGraw-Hill, 1979, p. 35-11

Appendix E presents a glossary of acoustical terms for the reader's reference.

A-2. OUTDOOR SOUND PROPAGATION

Outdoor sound propagation between a sound source and a receptor is affected by several sound attenuation mechanisms. These include the following:

- Geometric spreading: sound naturally decreases with increasing distance from a source;
- Ground attenuation: sound is absorbed by the ground that it passes over;
- Atmospheric attenuation: sound is absorbed by the atmosphere it passes through;
- Barrier attenuation: sound can be blocked by physical barriers (e.g., buildings or hills);
- Foliage attenuation: sound can be absorbed by extensive areas of bush or forest;
- Sound is affected by wind gradients: a distant noise source will be louder under downwind conditions than it will be under calm conditions; a distant source will be quieter under upwind conditions than it will be under calm conditions; and
- Sound is affected by temperature gradients: a distant noise source will be louder under atmospheric inversion conditions than it will be under neutral conditions; a distant source will be quieter under atmospheric lapse conditions than it will be under neutral conditions.

Temperature and relative humidity do have effects on some of these sound attenuation mechanisms, however, they do not have specific sound propagation effects associated with them.

Ground cover throughout the study area consists of predominantly rough fields and pasture, with some areas of tree cover and a large river. This type of ground cover would be sound absorptive during summer conditions, apart from the river which is a reflective surface. During the winter, variations in the sound absorption may occur with different ground surface conditions (e.g. frozen ground or crusty snow - reflective; fresh snow - absorptive).

The effects of wind gradients on outdoor sound propagation can cause variations in the sound level of a distant facility. Similar effects are caused by temperature gradients in the atmosphere. The sound level variations caused by wind and temperature gradients are most pronounced for large source/receptor distances. Sound from a distant facility that propagates in a downwind direction (and/or during atmospheric inversion conditions) results in higher sound levels at a receptor than for calm conditions and a neutral atmosphere. This effect is caused by the downward refraction (or bending) of sound rays as they propagate through the atmosphere. Conversely, sound propagating in an upwind direction (and/or during lapse conditions in the atmosphere) is refracted upwards, which results in lower sound levels at the receptor. Sound propagating in a crosswind direction (and a neutral atmosphere) does not exhibit refraction effects and is essentially the same as sound propagation during calm conditions and a neutral atmosphere. The Alberta Energy Regulator (AER) requires noise assessments to be conducted for atmospheric conditions that produce moderate downward refraction. This condition results in efficient outdoor sound propagation between a source and receptor, and is representative of adverse noise impact effects associated with meteorological factors.

Appendix B
Computer Noise Modeling

Northeast Capital Industrial Association
NCIA Regional Noise Model
2018 Noise Model Update (rev2)
SLR Project No.: 203.50029.00003

B-1. COMPUTER NOISE MODEL DEVELOPMENT – BACKGROUND INFORMATION

B-1-1 INTRODUCTION

Advanced computer noise modeling software is commonly utilized for the prediction and mitigation of industry related noise. Computer noise modeling software predicts what changes may happen to environmental sound levels as a result of the construction and operation of proposed facilities. The development of detailed and accurate computer noise models typically provides a means to clearly identify which industries might impact receptor areas before facilities are in place. The advantage of using computer noise models are realized in their ability to forecast environmental noise impacts by order-ranking various contributing plants in an industrial area with a significant amount of facilities.

The accuracy and usefulness of the NCIA Regional Noise Model is critically dependent on the quality of inputs that are provided. These inputs include the Sound Power Levels (PWL) of specific noise emitting equipment, barrier effects as a result of buildings and related structures within a facility and the terrain surrounding the facility, sound absorption by ground cover, and other sound attenuations caused by atmospheric and meteorological conditions. Good computer noise modeling utilizes three-dimensional topographical and structure / building databases, to ensure that the environment is accurately modeled. The computer noise modeling takes into account these environmental factors when performing sound level calculations and predictions. The output of computer noise modeling may include sound level isopleths in the form of colour sound level contours.

One computer noise modeling software product that was considered for this project was "**SoundPLAN**", as developed by Braunstein + Berndt GmbH of Germany. An alternate software product that that was considered was "**CadnaA**", as developed by DataKustic GmbH of Germany. The use of either the SoundPLAN or the CadnaA software is consistent with the guidance provided in various regulatory codes, as they represent an industry best practices approach. After detailed investigation, the computer noise modeling software which was selected was SoundPLAN for the following reasons:

- The only accepted sound propagation standards mentioned in AER Noise Directive 038 (or AUC Rule 12) which can be used are ISO 9613 and CONCAWE, thus allowing SoundPLAN, CadnaA, and Predictor
- Both SoundPLAN and CadnaA are widely used throughout North America
- NCIA wanted the ability to model under various wind conditions and wind directions; which implied the full implementation of the CONCAWE standard would be necessary (ISO 9613 will not do this, it only considers downwind in all directions)
- SoundPLAN was the only widely used software package to offer the CONCAWE standard implemented correctly and functionally (at the time the decision was made)
- The majority of the existing large-scale models were already developed in previous versions of SoundPLAN

- Importation of data between different software packages is very time consuming and may involve a significant amount of model reconstruction and cross checking. Upgrading within a software package is generally easier because the program recognizes the specific items used. Therefore, staying with SoundPLAN was more time efficient and minimized potential errors in model development
- SoundPLAN's integrated organizational structure is well suited for NCIA's Regional Noise Model.

The CONCAWE algorithms for ground attenuation, meteorological effects, and source height effects that SoundPLAN utilizes are defined in CONCAWE Report No. 4/81. An evaluation was conducted by CONCAWE, whereby they analyzed predictions using their standard, for a petrochemical plant and an oil refinery, together having 1,145 receptor points around the two facilities, at distances up to 1.3 km from the process areas. The predicted results were compared to octave band Sound Pressure Level measurements taken over a period of one year. The average difference between predicted and measured values (i.e. measured minus predicted) were +0.5 dBA for neutral wind and temperature gradients, and +0.5 dBA for strong downwind (> 10 km/hr.) or strong inversion conditions. The 95% confidence limits for the predicted sound levels were +/-5.7 dBA for neutral wind and temperature gradients, and +/-4.5 dBA for strong downwind (> 10 km/hr.) or strong inversion conditions. (This information appears in a report "*The CONCAWE Model for Calculating the Propagation of Noise from Open-Air Industrial Plants*" by K.J. Marsh, dated January 4, 1982.

B-1-2 SOUND POWER LEVELS

Sound Power Levels (PWL) from a plant's mechanical, rotating, and process equipment are required for input into the computer noise models. Sound Power Levels are intrinsic properties indicating the total acoustical energy radiated by the operating equipment. For existing facilities, these Sound Power Levels can be calculated from noise measurements of Sound Pressure Levels taken close to the operating equipment. The approaches taken are highly specialized, and experienced acoustical specialists have developed their own procedures to conduct these studies. (It is necessary to understand that sound pressure is a measurable quantity, indicating loudness at a prescribed distance – whereas sound power is not measurable, yet is a theoretical quantity, indicating total acoustical energy radiated regardless of distance.) For proposed facilities in design where direct noise measurements cannot be taken, Sound Pressure Levels are usually determined or estimated from one of the following approaches:

- From noise measurements made on similar equipment
- From data in SLR's database from past projects (only accessible without contractual confidentiality agreements)
- From manufacturer's data (which in itself may be derived from noise measurements of similar equipment)
- From algorithms within international standards (ISO, ANSI, CONCAWE, ASA etc.)
- From data in the technical literature.

B-1-3 EQUIPMENT NOISE MEASUREMENTS

Those well versed with the complexities of industrial plant sound measurements isolate the independent noise radiation effects of various plant equipment, to enable noise modeling of individual equipment noise sources. Diagnostic noise measurements are conducted to "isolate" the individual noise emissions from each source, independent of noise from other equipment that may be operating nearby. This is usually done with a standard Type 1 microphone but may include specialized noise measurement instruments and techniques.

B-1-4 MODELING INPUTS

The inputs to the computer noise models were:

- Equipment Sound Power Levels (per octave band sound frequency)
- Equipment noise source type (radiation as a point source, line source, or area source)
- Equipment noise source coordinates, elevation and radiation directivity
- Building size, geometric and physical location
- Building wall and roof construction
- Reflection parameters for buildings and structures
- Temperature and relative humidity
- Ground cover type
- Terrain elevations (topographic contours)
- Algorithm (calculation standard)
- Time variance of noise sources
- Noise control mitigation (where installed or proposed).

B-1-5 NOISE SOURCE DIRECTIVITY

Some types of equipment do not radiate noise equally in all directions, and the directivity characteristics of certain types of noise sources (e.g. stacks and vents) are well understood. Directivity factors are utilized as appropriate, to account for directional sound radiation from these noise sources. Modeling of directional noise sources are thus accomplished using an industry best practices approach. Each acoustical specialist makes appropriate decisions in these regards, and alterations to source directivity parameters determined by others were not necessary nor considered.

B-1-6 SOUND PROPAGATION MECHANISMS

The computer noise modeling takes into account the following important outdoor sound propagation mechanisms:

- Geometric spreading (which is the geometrical dissipation of sound with respect to distance)
- Ground attenuation (which is the effect of sound absorption by the ground as sound passes over various types of open terrain)
- Atmospheric absorption (which is the effect of sound absorption by the atmosphere between source and receiver)
- Barrier attenuation (which is a noise shielding effect caused by intervening buildings, landforms, etc. between source and receiver)

- Wind effects (which enhance sound propagation in downwind directions and attenuate sound propagation in upwind directions)
- Temperature gradient effects (which enhance sound propagation under atmospheric inversion conditions and attenuate sound propagation under atmospheric lapse conditions).

Temperature and relative humidity do have effects on some of the mechanisms already mentioned above, although they are not in themselves a consideration with respect to sound propagation.

The computer noise models utilize three-dimensional topographical and structure / building databases to ensure that industrial facility environments are accurately modeled. Weather parameters and ground cover are also utilized in the program in order that the modeled sound propagation from the site may be compared to measured data.

Computer noise models typically define ground attenuation values for the plant site and for surrounding off-site areas. Plant site ground is generally considered as a more or less hard surface, with a ground absorption factor ranging from “0” to “0.4”. Off-site areas are generally considered as more or less absorbing, with ground absorption factors ranging from “0.7” to “1”. In order to provide consistency in the Regional Noise Model, all plant site areas have been assigned a ground absorption factor of “0.2” and all off-site areas have been assigned a ground absorption factor of “0.8”. Large bodies of water such as large containment ponds and the North Saskatchewan River have been considered as perfect reflecting surfaces with a ground absorption factor of “0”. In some cases, the extents of ground absorption areas have been adjusted to fit the plant site, to ensure that ground absorption areas do not overlap. A comparison between the calculation of the Regional Noise Model with the submitted ground absorption areas and the Regional Noise Model with uniform ground absorption areas (as described above) resulted in minor (up to plus 1 dB) to no differences. The values referenced above are appropriate for this project.

B-1-7 WEATHER (WIND SPEED AND DIRECTION)

Various scenarios can be modeled that take into account weather conditions (temperature and wind direction) and plant operating conditions. The wind speed, direction, and profile (how the wind speed changes with height) and the temperature profile are the most significant factors associated with the variations in outdoor sound propagation due to weather conditions. Upwind of a noise source, variations of up to a 20 dB may be observed. Downwind, the variation is typically on the order of 5 dB, depending upon distance from a facility. These meteorological effects may be calculated using the methods outlined in CONCAWE (the Oil Companies International Study Group For Conservation Of Clean Air And Water – Europe) Report No. 4/81, *"The Propagation Of Noise From Petroleum And Petrochemical Complexes To Neighboring Communities"*, Prepared by C.J. Manning M.Sc., M.I.O.A. Acoustic Technology Limited (Ref.AT 931) CONCAWE, Den Haag, May 1981.

B-1-8 MODELING ACCURACY

The accuracy of detailed computer noise models, whereby the inputs are derived from accurate individual plant equipment noise measurements, are typically as follows:

- Within +/– 1½ dBA at plant perimeter, based upon actual noise measurements of operating plants
- Within +/– 3 dBA at 1 – 2 km [*], based upon actual noise measurements of operating plants
- Within +/– 3 dBA at plant perimeter, based upon assumptions during new plant design
- Within +/– 5 dBA at 1 – 2 km [*], based upon assumptions during new plant design.

[*] over flat ground under calm weather conditions

Appendix C
Regional Noise Model Development

Northeast Capital Industrial Association
NCIA Regional Noise Model
2018 Noise Model Update (rev2)
SLR Project No.: 203.50029.00003

C-1. PHASE 2 – REPRESENTATIVE COMPUTER NOISE MODELING DEVELOPMENT

C-1-1 BACKGROUND

In 2012, the work approach for the NCIA RNMP was to provide a cost-effective methodology, with the intent of achieving a usable Regional Noise Model. Computer noise modeling requires significant time and effort, and accordingly all efforts were made to reduce the extent of new detailed modeling necessary for development of the Regional Noise Model. To this end, SLR utilized the following noise information for Regional Noise Model facilities, as presented in their descending order of precision:

- Input files of existing computer noise models that were prepared by SLR
- Input files of existing computer noise models that were prepared by other acoustical specialists (i.e. acoustical engineer, acoustical consultant)
- Noise data (octave band or A–weighted) of plant / unit noise contributions, as available from reliable sources
- Sound level isopleths (contours), as available from published environmental Noise Impact Assessments results of any other noise studies available.

For any facility where the above noise data was not available (or not adequate), non-diagnostic plant measurements were conducted and a "Basic Noise Model" of the facility was created, as follows:

- Conduct noise measurements around the plant site perimeter (within the fenceline), and at various distances and directions from the plant site
- Calculate octave band Sound Power Levels that were reasonably representative of the entire facility
- Quantify the ground cover conditions and weather conditions for the day of the measurements
- Build a simple computer noise model
- Validate the model, based upon the noise measurements conducted
- Utilize the model as representative of the facility's composite acoustical energy.

It must be understood that the level of detail for required for a Basic Noise Model, which utilizes composite plant noise measurements, produces representative results that are NOT diagnostic. This means that the results are the generalized composite sound level contribution of the plant, with no definition of individual sound level contributions of specific plant equipment. In certain cases where plant equipment was significantly separated from the main plant area itself, e.g. a bank of cooling towers, then attempts were made to treat the equipment as a separate source within the Basic Noise Model.

C-1-2 DEVELOP REGIONAL MAP WITHIN COMPUTER NOISE MODEL

Building the Regional Noise Model required a digital map to be imported, encompassing the entire region including all of the plants and neighbouring communities. The digital map included all ground elevation data, highways, local roads, railway lines and communities. All individual plant plot plans were added into this base map. An overview of the Alberta Industrial Heartland area, with the various industrial landholdings, was previously presented in Figure 1.

C-1-3 INPUT EACH PLANT'S COORDINATE LOCATION

The base map for the Regional Noise Model consists of topographical data based on the 6-degree Universal Transverse Mercator coordinate system (UTM 12), as referenced to the NAD83 datum. Some of the computer noise models were already modeled in UTM coordinates and did not need any coordinate transformation. Other models were modeled using other coordinate systems that did not coincide with the UTM grid. These were relocated within the UTM coordinate system by appropriate coordinate transformation (i.e., translation and rotation). After coordinate transformation, the new location of the facility was verified based upon the UTM grid map, and with other maps such as Google Earth and a map of Heartland's landholdings provided by NCIA.

C-1-4 CONNECT EACH PLANT'S OVERALL SOUND POWER LEVELS

A common obstacle when import attempts are made from one software package to another, or when common database libraries have been used, is a disconnection between plant equipment grid coordinate locations and plant equipment Sound Power Levels compiled in the model's noise source library. In such cases, plant equipment Sound Power Levels need to be re-linked to their new grid coordinate locations and verified by cross-checking. After re-linking, this information is retained in the model and updates to newer versions of SoundPLAN do not require re-linking of noise sources to the source library.

C-1-5 INPUT ROADWAY LOCATIONS AND TRAFFIC FLOW PARAMETERS

The accuracy of road traffic noise calculations is an important aspect of the NCIA Regional Noise Model. Firstly, the accuracy depends on the estimation of sound emissions from vehicle traffic traveling on diverse pavements. Secondly, the ground effects must account for the shallow angles of reflection when the sources (i.e., engine and tire/pavement noise) are nearly at grade, and for the greater distances required for calculations of sound propagation within the NCIA region. Thirdly, there should be future flexibility for modeling the refractive, sound-curving effects of wind profiles and temperature gradients.

The calculation method chosen by SLR for the road noise model is the Traffic Noise Model (TNM), 1998, developed by the US Federal Highway Administration (FHWA). The traffic noise algorithms used by this program are very similar to other traffic noise models used in North America, such as the Canada Mortgage and Housing Corporation (CMHC) road traffic noise model and the Ontario Ministry of the Environment (MOE) Stamson road traffic noise model. SLR considered the various standards available and deemed that the TNM computer noise model would best represent the sound emissions from road traffic and pavements within the Heartland. There are few engineering differences between sound emissions from all types of North American vehicles, whereas there are documented differences in source heights between heavy trucks manufactured for use in Canada as compared to those for the European market.

The computer noise modeling software calculates equivalent continuous sound levels (L_{eq}) for road traffic noise, based on traffic data (vehicles per hour, percentage cars / trucks), and road data (posted speed, pavement types, road gradients). Average hourly traffic volumes for automobiles and heavy vehicles (i.e. buses and trucks), are derived from Annual Average Daily Traffic (AADT) data published by Alberta Transportation. Predicted traffic noise levels are considered separately for daytime and nighttime traffic, as there may be a substantial difference between daytime and nighttime traffic volumes. The day / night traffic volume splits used for the AIH roadways are 90% / 10%. Posted speeds and pavement types consistent with the Alberta road system are assumed in the model, and road gradient data is computed by the model based on the digital ground elevation data in the AIH regional map (Section C-1-2).

The predicted traffic noise levels calculated by the road model are considered to be accurate within 250 m of the roadway. The traffic noise prediction results do not include the effects of background noise in the study area, such as noise from minor roads, community activity or other transportation sources, such as trains and aircraft.

C-1-6 INPUT MAINLINE RAILWAY LOCATIONS AND TRAFFIC FLOW PARAMETERS

Previous version of the Regional Noise Model assessed rail noise based on estimated volumes and modeled the track segments as industrial line sources. For the 2018 Regional Noise Model, average rail volumes and speeds were obtained for all main rail lines in the region from the rail operators. There are a total of 12 separate track segments that were identified for the Heartland region. An average Sound Power Level for each segment was calculated, based on the Ontario Ministry of Environment (MoE) Sound from Trains Environmental Analysis Method (STEAM). The propagation of noise from the rail line was modeled using the Calculation of Railway Noise (CoRN) calculation standard.

The calculated rail noise values are 24-hour equivalent continuous sound levels. These values represent the composite average of the daytime and nighttime sound levels, calculated for a typical day and night when the rail line movements occur. These values are not maximum hourly values; however they incorporate the effects of higher hourly results.

C-2. DETAILED COMPUTER NOISE MODELING RUNS

In 2012, SLR had 37 computer noise model databases in all for Regional Noise Model facilities. This represented approximately 50% of the computer noise models that exist for the Heartland area plants. Many of the computer noise models existed in several scenarios, ranging from preliminary conceptual designs, to engineering design changes, to optimization options with different noise control mitigating measure alternatives (not all of which were implemented). Time was spent to re-assemble the most current and most appropriate model per plant / unit. Also, all calculated results were checked to ensure that data incorporated into the Regional Noise Model matched up with the data presented in reports. Some differences occurred due to the use of different calculation standards and calculation settings between original model reports and the Regional Noise Model, and the upgrade to higher versions within SoundPLAN. There are situations in which the original model was calculated, for example, with the ISO 9613 standard, whereas the Regional Noise Model calculates on the basis of CONCAWE. Also differences in settings, for example, the air absorption standards, resulted in some variations. Furthermore, discrepancies sometimes occur between software versions, e.g. with industrial buildings or floating barriers. All of these aspects were normalized to the best extent possible on a case-by-case basis.

C-2-1 REVIEW ALL AVAILABLE MODEL ELECTRONIC FILES PER PLANT

SLR requested provision of computer noise modeling databases from NCIA member companies who have facilities where computer noise modeling may have been conducted, as well as from non-member companies who have facilities where computer noise modeling may have been conducted. Provision of databases from NCIA member companies was deemed compulsory by NCIA. Provision of databases from non-member companies was voluntary; and NCIA appreciates those non-member’s cooperation.

Contacting facilities, retrieving permissions to use their noise data, making sure that computer noise models were current, and retrieving data from facilities that utilized other noise consultants was all an extensive exercise

The computer noise models received from other acoustical consultants ranged from very simple models with a few sound sources representing whole units, to very detailed models with many sound sources. SLR did not alter the models received, as those models presumably were used for regulatory applications which had been approved. The models were reviewed to verify modelling procedures only. SLR imported the models as delivered. When converting models from CadnaA to SoundPLAN, some adjustments needed to be made. SLR believes the quality of some of those simpler models was approximately the same as a Basic Noise Model survey previously referenced, with the same limitations as listed under Task 1.3.

The general context of computer noise model development for the Regional Noise Model is summarized in tabular format, as presented in Table C-1 below.

Table C - 1
General Context of Computer Noise Modeling Development

Comparative Feature	Detailed Computer Noise Modeling
Includes all NCIA member facilities	Yes
Includes road transportation noise	Yes
Includes railway transportation noise	Yes
Type of noise data used when models exist	Complete existing computer noise models, somewhat detailed
Type of noise data used when models do not exist	Fenceline noise measurements (Basic Noise Model), diagnostic noise measurements when fenceline noise measurements are not possible, or Sound Power Levels
Diagnostic capability to identify plant / unit contributions	Yes
Diagnostic capability to identify individual plant equipment noise contributions	No – however NCIA holds database to be able to do so upon specific requests
Accuracy of representing current sound levels	+/– 3 dBA at 1 – 2 km
Predictive capability for new plants	+/– 5 dBA at 1 – 2 km
Predictive capability for expansions / debottleneckings	+/– 5 dBA at 1 – 2 km
Identified data gaps for further follow-up	Some models need updating or detailing
Updatable and expandable	Yes
Annual maintenance work suggested to maintain model	Determine site-specific noisy plant equipment changes, and update models accordingly – on a regular interval, as requested by a facility – there is no established process for such updates
Model input files provided	On individual equipment basis
Model output files provided – tabular results order–ranking	Plant / unit order-ranked lists

C-2-2 UPDATE FILES WITHIN CADNAA® OR SOUNDPLAN® TO CURRENT VERSION

Older CadnaA models were converted to the current version of CadnaA, and then imported into SoundPLAN. Older SoundPLAN models were converted to the current version of SoundPLAN.

Most computer noise models were "validated" (i.e., calibrated) with noise measurements when they were individually developed, which required extensive efforts to accomplish. Recalibration of computer noise models would have been too time-consuming and cost prohibitive for this project. SLR evaluated the options below, and then along with the NCIA Noise Committee selected option C as the most opportune methodology:

A. Recalibrate the models, requiring a significant expansion to the Scope of Work

B. Recalibrate the models, using correction factors, without detailed justification

C. Update the models to the current version of SoundPLAN "as-is" without further calibration

D. Keep the models in SoundPLAN 6.5 without further calibration.

The validation exercise for the 2018 Regional Noise Model is discussed in Section 3 of this report, which reports on the validation evaluation with the 2017 noise monitoring surveys conducted by ACI Acoustical Consultants.

C-2-3 EXPORT / IMPORT INTO COMMON MODEL PLATFORM

Another issue was that even though a computer noise model may have been "validated" in one software package, it may not provide identical results in the other software package. Also, differences between calculation standards and calculation settings between the facility model and the Regional Noise Model may lead to other differences. As previously discussed, updating to newer versions of SoundPLAN could also result in changes in calculation results.

In order to assure that the facility models were imported properly into the Regional Noise Model, firstly the original model was recalculated to ensure that the data in the report matched up with the selected model. Models were converted to SoundPLAN, and recalculated with the original calculation settings, to preserve the work already performed, leaving only the differences due to the software update. The next step, when necessary, involved coordinate transformation of the model to the common grid system. The model was then recalculated with the Regional Noise Model digital ground model and the Regional Noise Model calculation settings. The input data of this model was then imported in a test version of the Regional Noise Model. A calculation was run with the Regional Noise Model settings, and the results of this calculation were compared to the previous calculation of the original model with Regional Noise Model settings. If results matched up, the test model was coded, grouped and imported into the Regional Noise Model. Another calculation run of the model was performed to ensure that the results still matched up with those from before the importation. If they did, then the import was deemed successful. In various steps of this exercise, discrepancies arose and were investigated. Certain causes were beyond our control, like changes due to software upgrade, differences between absolute and relative objects, items not imported, or items in the wrong geofile. All such discrepancies were resolved.

C-2-4 REVIEW AND ORGANIZE MODEL DATA

The success of producing a usable model is based upon good organization and documentation of the computer noise model's data files. This is necessary for future diagnostic model runs. Allowing for all these scenarios required accomplishing a common database organization set-up procedure. SoundPLAN's integrated organizational structure is well suited for this task. The terminology of SoundPLAN's structure includes equipment noise "source groups", "geofiles", and "situations", which are explained as follows:

- Source Groups: SoundPLAN structure permits organizing the noise sources into noise "***source groups***", to enable separate model runs (e.g. with various noise control mitigation scenarios). Where possible, equipment noise sources have been added to source groups to ensure possible future uses to address noise source groups. The noise source groups are derived from the noise source types, which were developed in a previous project for the NCIA Regional Noise Management Plan and reported in a document entitled "*Report on Noise Reduction Strategies, Noise Best Practices Sub-Committee, Northeast Capital Industrial Association, HFP Project 05-C 1773-2.0*", dated March 15, 2006.
- Geofiles: Each situation consists of a number of "***geofiles***", which consist of several noise modeling elements representing the noise sources, receivers; ground absorption, buildings / barriers, and other relevant information for the specific computer noise model for a facility. The geofiles names start with a code indicating the facility and the unit in question.
- Situations: SoundPLAN permits compiling geofiles into "***situations***" (i.e. a selected set of modeling compositions). Situations are compiled with a selected calculation standard [e.g. ISO 9613 or CONCAWE], selected weather conditions and selected calculation parameters to enable noise model runs. Each facility is organized in one "situation". Noise model runs for any combination of facilities can be made by combining various situations.

C-2-5 PERFORM COORDINATE TRANSFORMATION TO COMMON GRID

A common grid coordinate system is required for the Regional Noise Model. All plant coordinates were adjusted using a standard coordinate transformation process, so all plant process areas and buildings have their grid coordinates based on the common grid coordinate system.

Most plant models used a local plant-based coordinate system, which was reassigned to the common grid coordinate system. This allowed plant equipment locations from existing individual plant computer noise models to be imported to the Regional Noise Model. Similarly, in some cases, elevations also needed to be reassigned.

C-2-6 BUILDING BASIC NOISE MODELS

SLR created "Basic Noise Models" for plants that did not already have detailed diagnostic noise models. In most cases, this was undertaken by conducting non-diagnostic noise measurements around the perimeter of these plant sites and validating the computer noise model to the measured sound levels, utilizing the acoustical specialist's expertise. Basic Noise Model reports were separately presented to the plants where this work was performed. The noise sources in the Regional Noise Model for these facilities should not be considered diagnostic. However, in some cases where fenceline noise measurements were not possible because of the significant influence of neighbouring plants, diagnostic noise measurements were conducted. Also, a number of Basic Noise Models have been developed, based on delivered Sound Power Levels for plant equipment. These Basic Noise Models did not need to be further validated, as they represent field measured values. Some operating and meteorological conditions were recorded and presented in the Basic Noise Model reports. The Basic Noise Models currently in the Regional Noise Model are discussed in Section 2 of this report.

C-2-7 RUN INDIVIDUAL PLANT MODELS

Individual plant models can be run by selecting the situation for the facility in question. For each calculation run, different calculation settings may be chosen, with results presented for the selected model situation. In the case where a number of surrounding facilities are of interest as well, a new situation combining all geofiles for these facilities and the facility in question can be made and calculated. Results will then show the combined contribution of all the selected facilities. Contributions per facility are generated by running the situations for the facilities separately and then comparing them to each other by exporting result files to a spreadsheet. Future specialized model runs will allow the opportunity to provide a source order–ranking for any desired resident or receptor.

C-2-8 RUN DETAILED REGIONAL COMPUTER NOISE MODEL

The Regional Noise Model has been run as a whole, without dividing the area into smaller segments. Since SoundPLAN® provides provisions to combine selected geofiles into one model situation for calculation, it was therefore not deemed necessary to break the Regional Noise Model into pieces. Running the Model as a whole to calculate noise contours takes several days to complete, because of the large size of the area and large number of noise sources in the model. Future optimization and future changes in processor speed will likely improve calculation times.

C-2-9 COMPILE TABULAR RESULTS

Tabular results within the Regional Noise Model include the following:

- A computer noise model <u>input</u> database, in spreadsheet format, depicting the following;
    - Plant equipment;
        - Description (e.g. name, tag number)
        - Grid coordinates and elevations
        - Octave band Sound *<u>Power</u>* Levels
        - Directivity (if applicable)
        - Acoustic source type (e.g. area source, line source, point source)
    - Identification, dimensions and coordinates of buildings, structures and barriers
    - Identification of noise sources inside buildings
- A computer noise model <u>output</u> database, in spreadsheet format, depicting the following;
    - <u>Plant / unit</u> order–ranked lists for selected receptor locations
        - Description (e.g. plant or unit name)
        - Octave band Sound <u>Pressure</u> Level contributions at receptor

   - › A–weighted sound level contribution at receptor
  - Sum of octave band Sound Pressure Level contributions per receptor location assessed
  - Sum of A–weighted sound level contributions per receptor location assessed.

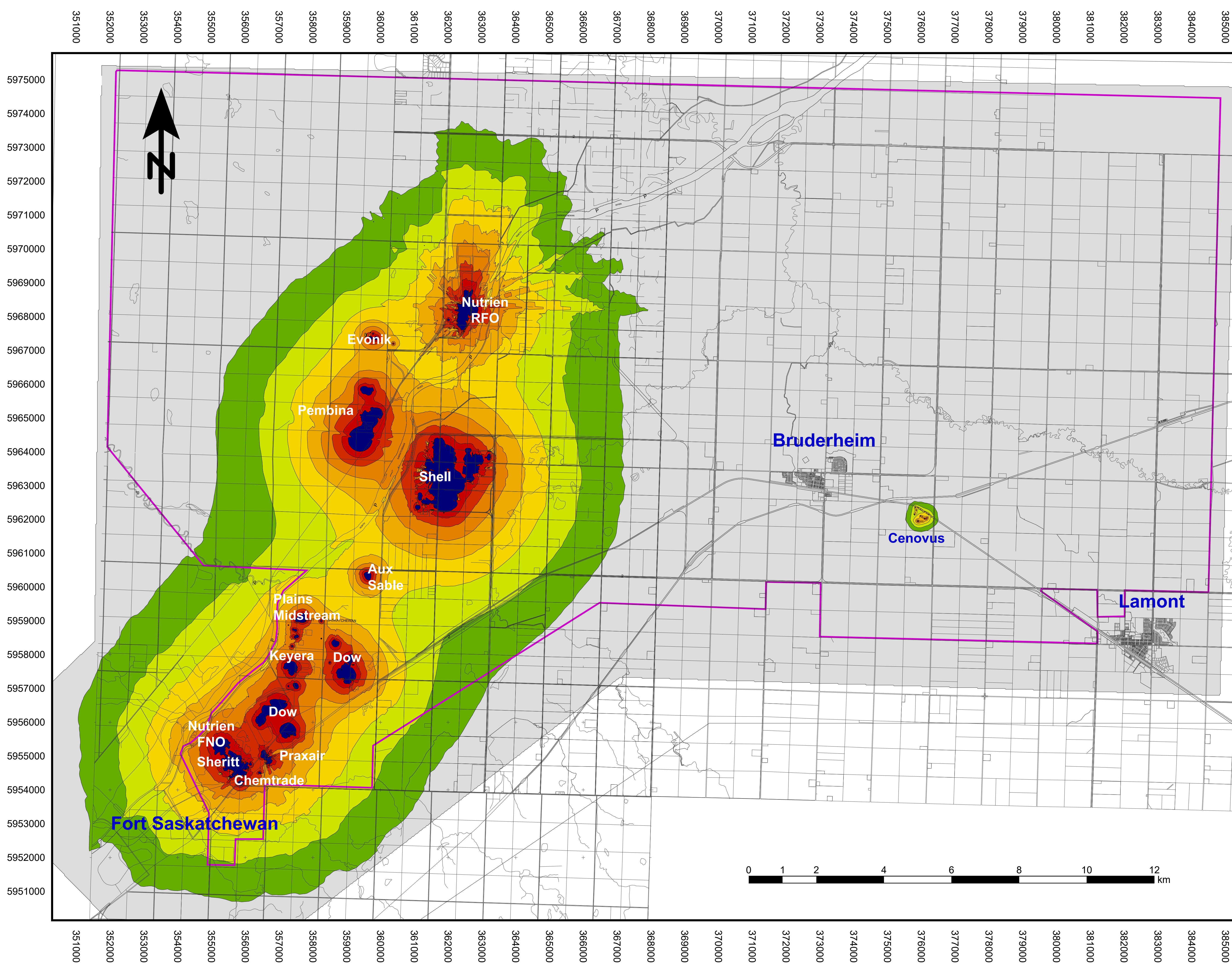
C-2-10 COMPILE GRAPHICAL RESULTS

Graphical results within the Regional Noise Model include the following:

- A computer noise model output database, in isopleth format, depicting the following;
  - Physical layout of the region
  - Rivers, roads, railway lines, communities, etc.
  - Plant locations, identified by fencelines and labelled names
  - A–weighted sound level isopleths (contours)
  - Above performed for the entire Heartland area
  - Above performed for a multiple number of pre-determined sub-regions or areas.
  - Topography (see Figure 1).

Appendix D
Sound Level Contours

Northeast Capital Industrial Association
NCIA Regional Noise Model
2018 Noise Model Update (rev2)
SLR Project No.: 203.50029.00003



NCIA Regional Noise Model 2018

Figure D-1: Predicted Sound Level Contours

Case 3a:
Model Validation Case
• NCIA member company existing facilities
• Non-member company existing facilities
• Calm wind conditions

Legend

AIHA Industrial Policy Area

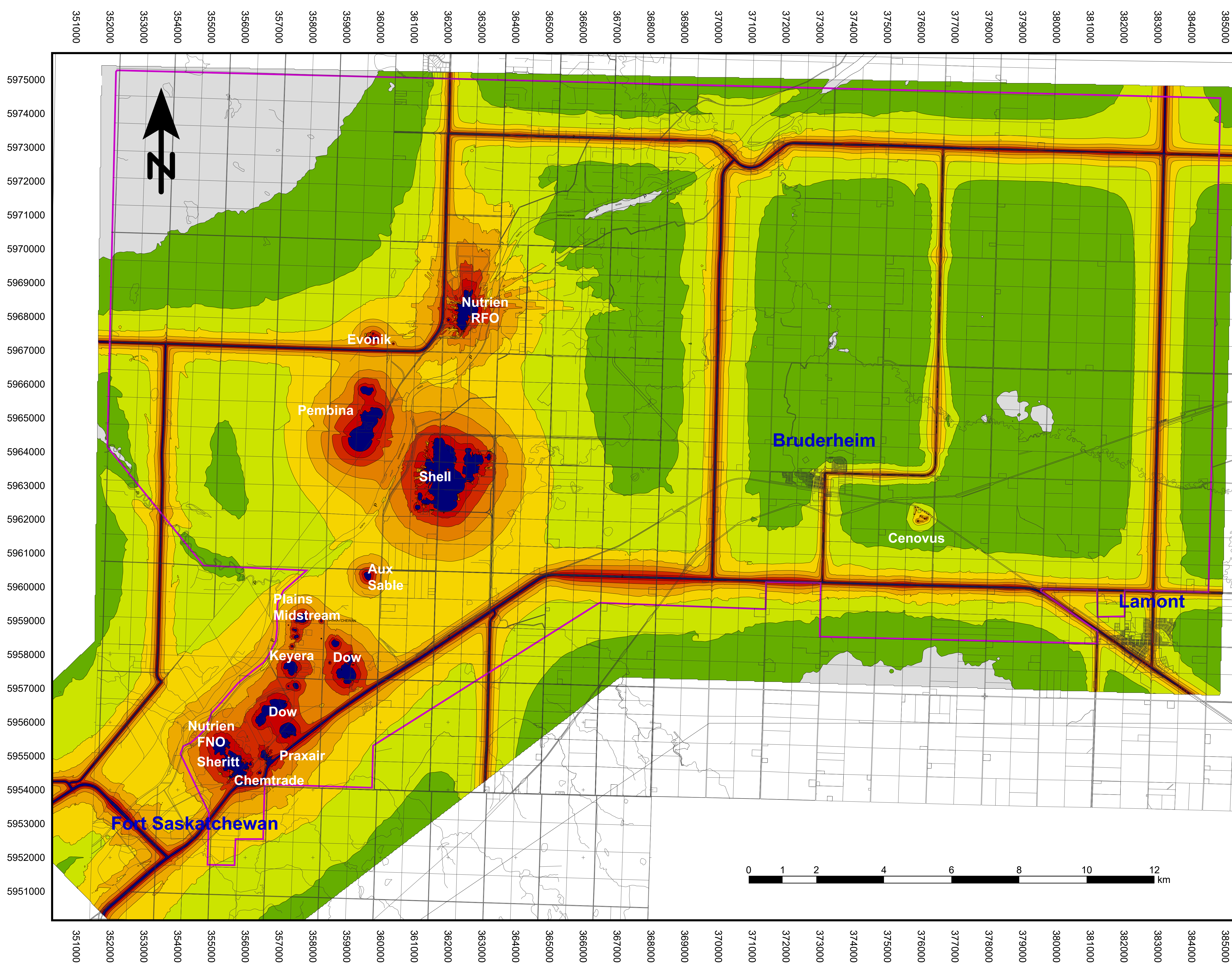
Sound Level (dBA)

	<= 30
30 <	<= 35
35 <	<= 40
40 <	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	<= 65
65 <	

September 2020

SLR File 203.50029.00003

SLR global environmental solutions



NCIA Regional Noise Model 2018

Figure D-2:
Predicted Sound Level Contours

Case 3b:
Model Validation Case
- NCIA member company existing facilities
- Non-member company existing facilities
- Road noise contribution
- Calm wind conditions

Legend

AIHA Industrial Policy Area

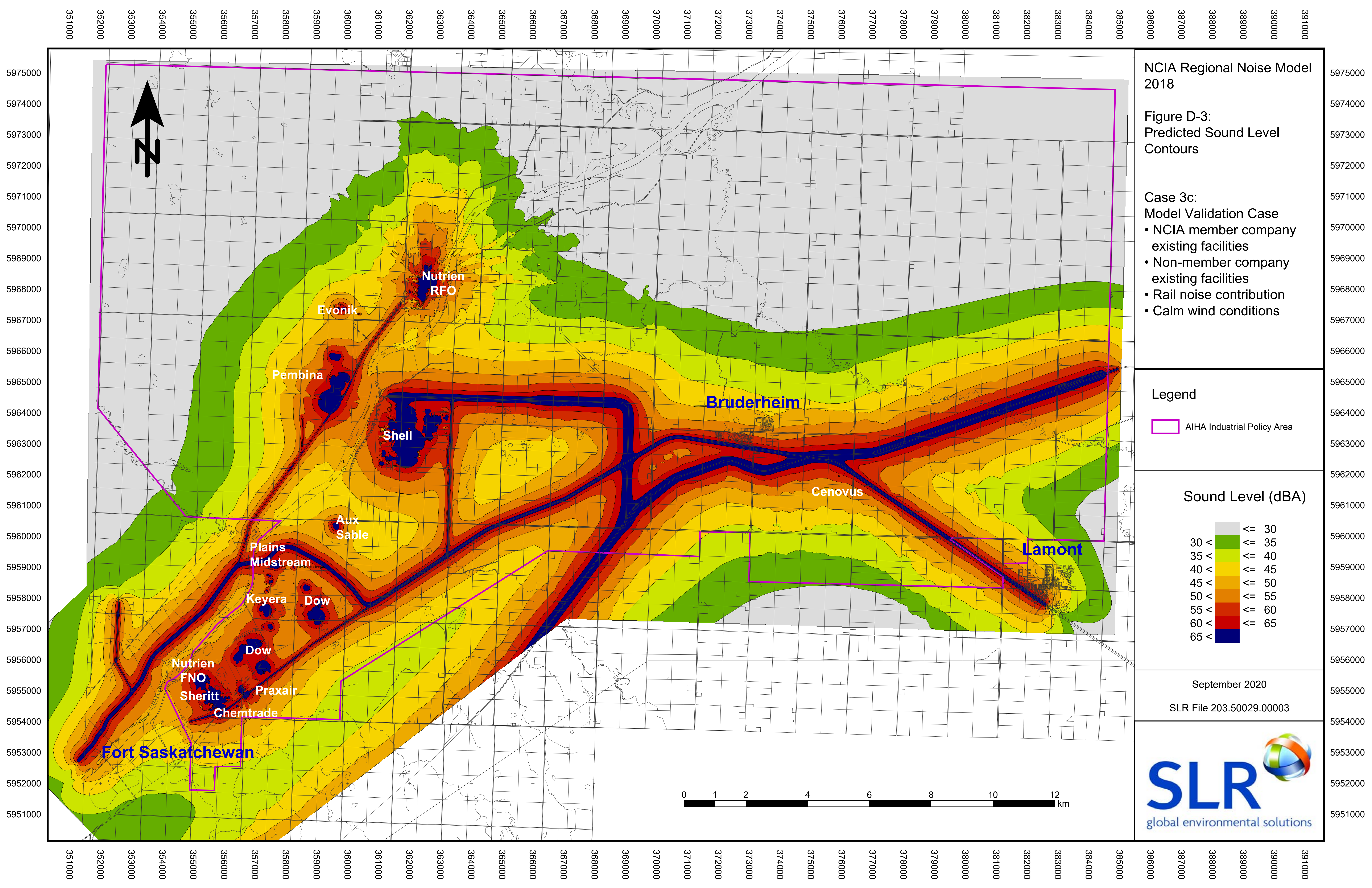
Sound Level (dBA)

<= 30
30 < <= 35
35 < <= 40
40 < <= 45
45 < <= 50
50 < <= 55
55 < <= 60
60 < <= 65
65 <

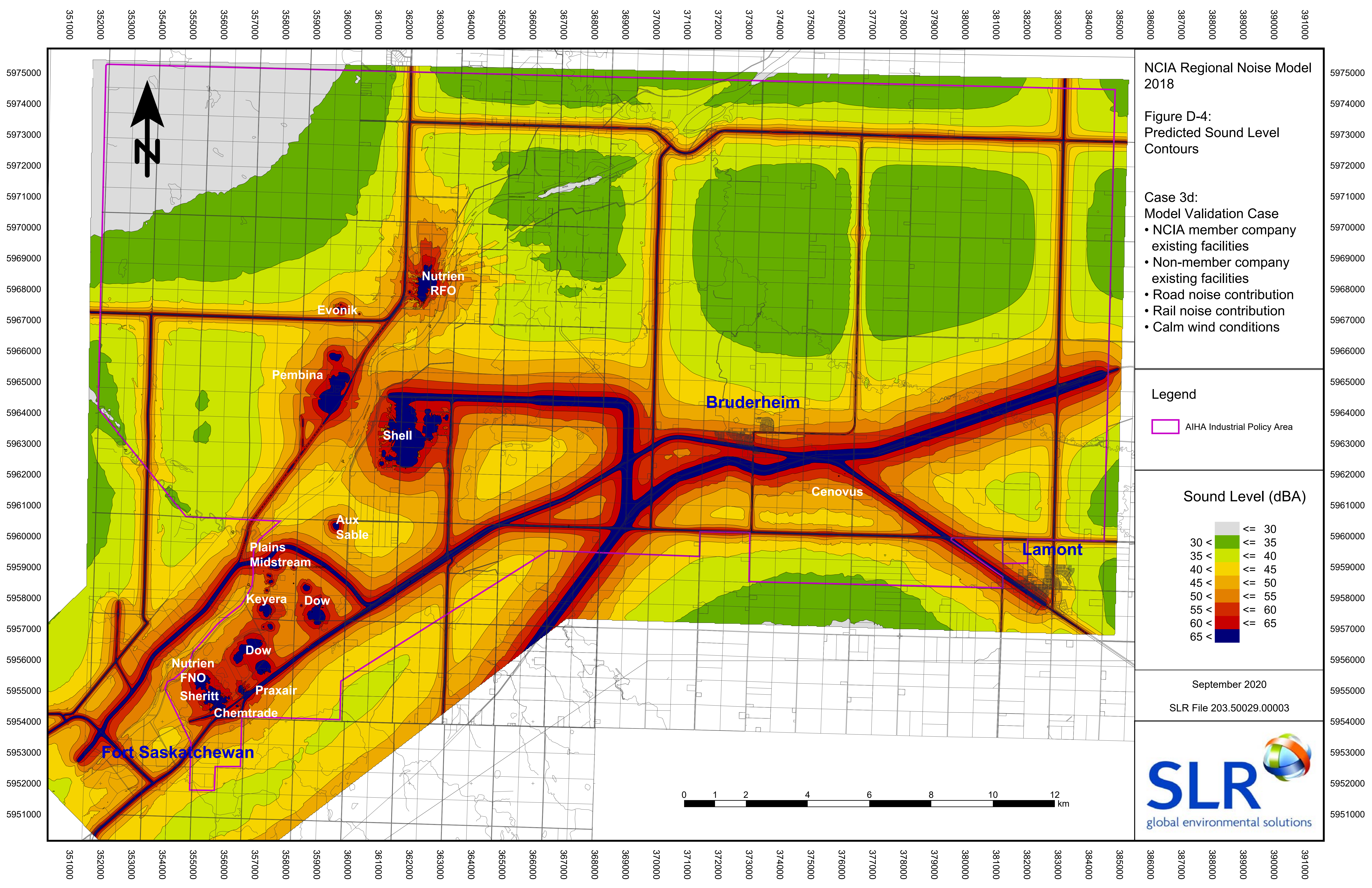
September 2020

SLR File 203.50029.00003

SLR global environmental solutions



NCIA Regional Noise Model 2018
Figure D-3:
Predicted Sound Level Contours
Case 3c:
Model Validation Case
• NCIA member company existing facilities
• Non-member company existing facilities
• Rail noise contribution
• Calm wind conditions
Legend
AIHA Industrial Policy Area
Sound Level (dBA)
<= 30
30 < <= 35
35 < <= 40
40 < <= 45
45 < <= 50
50 < <= 55
55 < <= 60
60 < <= 65
65 <
September 2020
SLR File 203.50029.00003
SLR
global environmental solutions
Nutrien RFO
Evonik
Pembina
Shell
Bruderheim
Cenovus
Aux Sable
Plains Midstream
Keyera
Dow
Dow
Nutrien FNO
Sheritt
Praxair
Chemtrade
Fort Saskatchewan
Lamont
0 1 2 4 6 8 10 12 km



NCIA Regional Noise Model 2018
Figure D-4:
Predicted Sound Level Contours
Case 3d:
Model Validation Case
• NCIA member company existing facilities
• Non-member company existing facilities
• Road noise contribution
• Rail noise contribution
• Calm wind conditions
Legend
AIHA Industrial Policy Area
Sound Level (dBA)
<= 30
30 < <= 35
35 < <= 40
40 < <= 45
45 < <= 50
50 < <= 55
55 < <= 60
60 < <= 65
65 <
September 2020
SLR File 203.50029.00003
SLR
global environmental solutions
Nutrien RFO
Evonik
Pembina
Shell
Bruderheim
Cenovus
Aux Sable
Plains Midstream
Keyera
Dow
Dow
Nutrien FNO
Sheritt
Praxair
Chemtrade
Fort Saskatchewan
Lamont
0 1 2 4 6 8 10 12 km
351000 352000 353000 354000 355000 356000 357000 358000 359000 360000 361000 362000 363000 364000 365000 366000 367000 368000 369000 370000 371000 372000 373000 374000 375000 376000 377000 378000 379000 380000 381000 382000 383000 384000 385000 386000 387000 388000 389000 390000 391000
5975000 5974000 5973000 5972000 5971000 5970000 5969000 5968000 5967000 5966000 5965000 5964000 5963000 5962000 5961000 5960000 5959000 5958000 5957000 5956000 5955000 5954000 5953000 5952000 5951000

Appendix E
Glossary of Acoustical Terms

Northeast Capital Industrial Association
NCIA Regional Noise Model
2018 Noise Model Update (rev2)
SLR Project No.: 203.50029.00003

A-weighted Sound Level or dBA: A measurement of overall Sound Pressure Level which accounts for the frequency content of the measured sound and assesses it with a frequency response similar to that of the human ear.

Ambient or Background Noise: The noise in the environment, other than the noise from the source of interest.

Atmospheric Attenuation: The effect of sound absorption by moisture in the air.

Attenuation: A reduction in sound level that occurs with sound propagation over distance by means of physical dissipation or absorption mechanisms, or a reduction in sound level that occurs by means of noise control measures applied to a sound source.

Barrier Diffraction or Attenuation: The effect of an acoustical shadow created by building or landform interposed between a source and a receiver.

Broadband Noise: A noise with frequency components distributed over a broad frequency range, e.g. noise from distant road traffic.

C-weighted Sound Level or dBC: A measurement of overall Sound Pressure Level with a frequency response that has essentially no filtering of sound between 50 and 5000 Hz. C-weighted sound levels are a better indicator of the presence of low frequency sound than A-weighted sound levels.

Comprehensive Sound Level: A measurement of the overall Sound Pressure Level at a location which includes the effects of all noise sources affecting the location.

Distance Dissipation: The geometrical dissipation of sound with distance.

Equivalent Continuous Sound Level or L_{eq}: A single number descriptor commonly used for environmental noise measurements and criteria. It is used to quantify sound which constantly varies over time, such as that commonly occurring in outdoor environments. It is defined as the average Sound Pressure Level over a specific time period that has the same acoustic energy as the actual fluctuating Sound Pressure Levels during the same time period. Time periods commonly used for L_{eq} measurements and criteria are the daytime (07:00 - 22:00 hrs) and nighttime (22:00 - 07:00 hrs) periods.

Free Sound Field (Free Field): A sound field in which the effects of obstacles or boundaries on propagating sound are negligible.

Frequency: The number of wave oscillations per second (hertz) of an acoustic pressure wave propagating through the air. The same as the pitch, or highness or lowness of a sound.

Ground Attenuation: The effect of sound absorption by the ground separating the source and receiver.

Increase in Sound Level: The perceived increase in loudness of a sound does not correspond directly to numerical increases in dBA values. Typically, an increase of less than 3 dBA is barely noticeable, an increase of 5 dBA is noticeable, an increase of 10 dBA is perceived as a doubling in apparent loudness, and an increase of 20 dBA is perceived as a four-fold increase in apparent loudness.

Narrow-Band: A segment of the frequency spectrum which spans a few hertz or tenths of hertz.

Narrow-Band Sound Pressure Level: The total Sound Pressure Level of sound components in a specific narrow-band frequency segment. Narrow-band Sound Pressure Levels are used to identify the presence of tonal components in a sound.

Octave: The interval in frequency between two sounds having a frequency ratio of two.

Octave Band: A segment of the frequency spectrum which spans one octave.

Octave Band Sound Pressure Level: The total sound pressure level of sound components in a specific octave band.

Pink Noise: A broadband noise characterized by a spectrum that uniformly decreases by 3 dB/octave with increasing octave band frequency. This noise is characterized by a "hushing" sound.

Sound Level Contribution: The contribution of noise from one or more sources to the overall sound level from all sources affecting a particular location.

Sound Power Level: A measurement of the acoustic energy of a sound source, which utilizes a logarithmic scale and which is normally calculated from Sound Pressure Level measurements near the source.

Sound Pressure Level: A physical measurement of sound, which utilizes a logarithmic scale and which quantifies the amplitude or volume of acoustic pressure waves propagating through the air.

Spectrum: The quantification of the components of a sound as a function of frequency.

Statistical Sound Level or L_n: The proportion of time a sound of interest is present at a specific level. Statistical sound levels are expressed as L_n values, which is the sound level exceeded N percent of the time.

Third-Octave: The interval in frequency between two sounds having a ratio of 2 to the one-third power, or approximately 1.26.

Third-Octave Band: A segment of the frequency spectrum which spans one-third octave.

Third-Octave Band Sound Pressure Level: The total sound pressure level of sound components in a specific one-third octave band.

Urban Hum: The more or less steady, continuous background noise in or near an urban area caused by distant road traffic and urban activity.

APPENDIX 2

2019 Regional Noise Model Annual Field Validation Monitoring Report

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Edmonton, Alberta, Canada T6M 0A8
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www.aciacoustical.com

2019 Environmental Noise Survey

For The

Regional Noise Model Annual Field Validation Monitoring

Prepared for:

Northeast Capital Industrial Association

Prepared by:
P. Froment, B.Sc., B.Ed., P.L.(Eng.)
aci Acoustical Consultants Inc.
Edmonton, Alberta
APEGA Permit to Practice #P7735

01/25/2021

aci Project #: 19-030
January 25, 2021

Executive Summary

aci Acoustical Consultants Inc., of Edmonton AB, was retained by the Northeast Capital Industrial Association (NCIA) to conduct an environmental noise survey within Alberta's Industrial Heartland (AIH). The purpose of the study was to conduct a single 48-hour noise monitoring at eleven (11) pre-specified locations within the AIH. An additional noise monitoring, spanning three (3) 48-hour periods, was conducted at a 12th monitoring location (referred to as Location 12) as an independent control/reference point. The noise monitoring was conducted in support of the NCIA's Regional Noise Management Plan. In addition, the results from these noise monitoring's will be used to validate the Regional Noise Level Assessment Model (the Regional Noise Model). All noise monitoring procedures and equipment used was in accordance with the requirements of the Alberta Energy Regulator (AER) Directive 038 on Noise Control. Site work was conducted for aci in July, September and October 2019 by P. Froment, B.Sc., P.L.(Eng.).

As part of the study, a total of fourteen (14) 48-hour noise monitoring's were conducted throughout the Alberta's Industrial Heartland. In many cases, due to unfavorable weather conditions during one of the two night-time periods, it would be anticipated that the results from only one-night period would be most reflective (in comparison to previous years) of the typical noise climate of their given area. It was found that the isolated L_{eq}Night broadband and 1/3 octave band L_{eq} sound levels were similar to those from previous measurements.

The noise levels at most locations consisted of low frequency components with occasional mid/high frequency components that could be attributed to the nearest facility relative to each individual noise monitoring location. Despite the noise being relatively low in frequency, none of the sites indicated any low frequency tonal components. The noise from train passages was again prevalent at all locations and tended to dominate the noise climate as they passed through. This was particularly true for locations within proximity to a rail line and for locations further away from any of the large industrial sites.

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1.0 Introduction

aci Acoustical Consultants Inc., of Edmonton AB, was retained by the Northeast Capital Industrial Association (NCIA) to conduct an environmental noise survey within Alberta's Industrial Heartland (AIH). The purpose of the study was to conduct a single 48-hour noise monitoring at eleven (11) pre-specified locations within the AIH. An additional noise monitoring, spanning three (3) 48-hour periods, was conducted at a 12th monitoring location (referred to as Location 12) as an independent control/reference point. The noise monitoring was conducted in support of the NCIA's Regional Noise Management Plan. In addition, the results from these noise monitoring's will be used to validate the Regional Noise Level Assessment Model (the Regional Noise Model). All noise monitoring procedures and equipment used was in accordance with the requirements of the Alberta Energy Regulator (AER) Directive 038 on Noise Control. Site work was conducted for aci in July, September and October 2019 by P. Froment, B.Sc., P.L.(Eng.).

2.0 Location Description

Alberta's Industrial Heartland (AIH) is located northeast of Edmonton, AB and extends into five different municipalities as indicated in Figure 1. This includes 533 km^2 within the City of Fort Saskatchewan and the Counties of Lamont, Strathcona and Sturgeon, in addition to 49 km^2 in the City of Edmonton's "Edmonton Energy and Technology Park". The area has 40+ companies in various sectors that include producing and processing oil, gas and petrochemicals in addition to advanced manufacturing.

Topographically, the AIH does have some varying elevation changes however in general it can be considered relatively flat with no substantial hills. Areas with more significant changes in elevation are found adjacent to the North Saskatchewan River (the River) which divides the AIH from the southwest to the northeast (excluding the AIH area within the City of Edmonton's limits). The vegetation varies from open grain fields to thick dense vegetation. Due to the relative distance from the noise monitoring locations to the nearby facilities (apart from Noise Monitor Location 12) and the relatively low frequency nature of the industrial noise, the level of vegetative sound absorption is considered negligible to low.

3.0 Measurement Methods

As part of the study, a total of fourteen (14) 48-hour noise monitoring's were conducted at 12 locations[1] throughout the AIH, as indicated in Figure 2. The monitoring's were conducted under summer/fall conditions (i.e. no snow cover) trying to avoid times of precipitation and high wind-speeds. It should be noted however that the 2019 weather conditions were the most unfavorable of any of the previous years conducting these measurements. In addition, there were more significant, in terms of duration and number, of periods in which facilities were shut-down. Thus, the monitoring was conducted over the course of three (3) separate 48-hour periods.

All noise monitoring locations were identical to those conducted during the 2018 Noise Survey. The noise monitoring was conducted collecting broadband A-weighted and C-weighted as well as 1/3 octave band sound levels and were conducted during "typical" operations at all facilities[2]. In particular, the chosen noise monitoring periods avoided any major shut-downs or outages[3] of nearby facilities that could adversely affect the "typical" noise levels (either louder or quieter) for a given region. Each noise monitoring was accompanied by a 48-hour digital audio recording for more detailed post process analysis.

Three (3) local weather monitoring stations were also used for the three (3) 48-hour time monitoring periods. The weather monitors obtained the wind speed, wind direction, temperature, relative humidity, barometric pressure and rain fall data in 15-second sampling periods. Lastly, it should be noted that all measurements were performed in accordance with the methods described in the AER Directive 038 on Noise Control.

[1] Once again, it should be noted that three (3) 48-hour monitoring were conducted at Monitoring Location 12.
[2] This was verified by all the various company representatives.
[3] This was based on information provided by the various NCIA members.

4.0 Noise Monitoring Location Description

In addition to Table 1, which provides the UTM coordinates and the start and end times for each noise monitoring, a brief discussion of each noise monitoring location can be found below. All noise measurement instrumentation was calibrated at the start of the measurements and then checked afterwards to ensure that there had been no significant calibration drift over the duration of the measurements. Refer to Appendix I for a detailed description of the measurement equipment used and for all calibration records.

Table 1. Noise Monitoring Locations with Start and End Times[1]

Monitoring Location	UTM Coordinates (Approximate)		Start Time	End Time
	Easting (m)	Northing (M)		
1C	355210	5954157	7/22/19 16:00	7/24/19 16:00
2	358256	5957216	7/22/19 15:00	7/24/19 15:00
3B	358361	5959283	7/22/19 15:00	7/24/19 15:00
4C	361665	5960870	10/21/19 11:00	10/23/19 11:00
5	361777	5964711	7/22/19 15:00	7/24/19 15:00
6	364322	5967894	9/18/19 13:00	9/20/19 13:00
8A	358897	5965430	7/22/19 13:00	7/24/19 13:00
9	355872	5957574	7/22/19 12:00	7/24/19 12:00
10	355925	5955818	7/22/19 15:00	7/24/19 15:00
11	358430	5963804	7/22/19 13:00	7/24/19 13:00
12B (1st 48-hour)	368223	5963070	7/22/19 14:00	7/24/19 14:00
12B (2nd 48-hour)			9/18/19 13:00	9/20/19 13:00
12B (3rd 48-hour)			10/21/19 11:00	10/23/19 11:00
13	358667	5970180	9/18/19 13:30	9/20/19 13:30

4.1. Noise Monitor Location 1

The noise monitor at Location 1 was located approximately 10 m south of 100 Avenue, 175 m west of 114 Street and approximately 370 m northwest of Highway 15 as indicated in Figure 2 and Figure 3. This put the noise monitor approximately 410 m southwest of the Sherritt International Corporation facility. This is the southernmost noise monitoring location found within the AIH. At this location, there was direct line-of-sight to 100 Avenue, Mel Martin's Transfer Facility and the Sherritt International Corporation facility. There was no significant vegetation between the noise monitor and the facilities to the north. Note

[1] The letters accompanying the noise monitoring location refers to their location.

also that a weather monitor was placed at this location, adjacent to the noise monitor for the duration of the July 22 – 24, 2019 noise monitoring period.

4.2. Noise Monitor Location 2

The noise monitor at Location 2 was located approximately 90 m southeast of 125 Street and approximately 1.0 km north of Highway 15 as indicated in Figure 2 and Figure 4. This put the noise monitor approximately 120 m west of the Dow yard, 170 m north of the Dow rail yard and approximately 850 m east-southeast of the Keyera Facility. At this location, there was direct line-of-sight to Dow's main site to the east and to the rail yard to the south. There was no significant vegetation between the noise monitor and the facilities.

4.3. Noise Monitor Location 3

The noise monitor at Location 3 was located approximately 10 m east of 125 Street, 275 m south of the CN Rail line 55 m east of the north entrance to the Plains Midstream Facility and approximately 125 m north of the entrance to the Petrogas northern entrance as indicated in Figure 2 and Figure 5. This put the noise monitor approximately 230 m northwest of the Petrogas facility and approximately 380 m east of major equipment at the Plains Midstream Facility. At this location, there was direct line-of-sight to the Plains Midstream Facility but not to the Petrogas site. There was no significant vegetation between the noise monitor and the facilities.

4.4. Noise Monitor Location 4

The noise monitor at Location 4 was located approximately 1.2 km south of the south fence line of the Shell Scotford site and approximately 1.6 km east of Range Road 220 (130 Street) as indicated in Figure 2 and Figure 6. This put the noise monitor at 490 m south of the entrance to the electrical substation to the northwest. At this location, there was direct line-of-sight to the Shell Scotford site but not to the electrical substation to the northwest. There was no significant vegetation between the noise monitor and the Shell Scotford facility. A weather monitor was placed at this location, adjacent to the noise monitor for the duration of the October 21 – 23, 2019 noise monitoring period.

4.5. Noise Monitor Location 5

The noise monitor at Location 5 was located approximately 200 m north of Township Road 560A and 5 m east of Range Road 215 as indicated in Figure 1 and Figure 7. This put the noise monitor approximately 300 m north of the north fence line for the Shell Scotford facility and approximately 135 m west of an industrial yard to the east. At this location, there was direct line-of-sight to the Shell Scotford site but not the industrial yard (due to the topography of the area). There was no significant vegetation between the noise monitor and the Shell Scotford facility.

4.6. Noise Monitor Location 6

The noise monitor at Location 6 was located approximately 1.0 km north of Township Road 562 and 3 m east of Range Road 213A as indicated in Figure 1 and Figure 8. This put the noise monitor approximately 1.6 km east of the Nutrien Redwater facility. Due to favorable topography between the noise monitor and Nutrien there was direct line-of-sight to the Nutrien site through a small row of deciduous trees across the road. There was no significant vegetation between the noise monitor and the Nutrien facility. A weather monitor was placed at this location, adjacent to the noise monitor for the duration of the September 18 – 20, 2019 noise monitoring period..

4.7. Noise Monitor Location 8

The noise monitor at Location 8 was located approximately 1.6 km south of Highway 643 (eastbound) and 365 m east of Range Road 221 as indicated in Figure 2 and Figure 9. This put the noise monitor approximately 30 m north of the northern fence line for the Pembina/Williams facility. At this location, there was direct line-of-sight to the Pembina/Williams site through a thin row of deciduous trees. There was no significant vegetation between the noise monitor and the aforementioned facilities.

4.8. Noise Monitor Location 9

The noise monitor at Location 9 was located approximately 5 m southwest of the intersection of Lamoureux Drive and Godbout Avenue as indicated in Figure 2 and Figure 10. This put the noise monitor approximately 1.2 km northwest of the major structures at the Dow facility and approximately 1.3 km west of the Keyera facility. Due to favorable topography, there was direct line-of-sight to the facilities across the River through a thin row of deciduous trees[1]. Despite the thin row of trees there was no significant vegetation between the noise monitor and the aforementioned facilities.

4.9. Noise Monitor Location 10

The noise monitor at Location 10 was located approximately 30 m west of 119 Street and 12 m north of the access road to the Nutrien Fort Saskatchewan facility as indicated in Figure 2 and Figure 11. This put the noise monitor approximately 750 m northeast of the major structures at the Nutrien facility and approximately 180 m west of the west fence-line of the Dow facility. There was direct line-of-sight to the

[1] This was observable during the night-time period.

Dow facility but not to the Nutrien facility (due to the topography of the area). There was no significant vegetation between the noise monitor and the aforementioned facilities. Note also that a weather monitor was placed at this location, adjacent to the noise monitor for the duration of the noise monitoring periods.

4.10. Noise Monitor Location 11

The noise monitor at Location 11 was located approximately 3 m northwest of the intersection of Range Road 221 and Township Road 560 as indicated in Figure 2 and Figure 12. This put the noise monitor approximately 1.7 km southwest of the major structures at the Pembina/Williams facility and approximately 330 m west of the Pembina/Williams rail yard. At this location, there was direct line-of-sight to the Pembina/Williams facility but not to the rail yard (due to the topography of the area). There was no significant vegetation between the noise monitor and the facilities. A weather monitor was placed approximately 400 m to the west of this location for the duration of the July 22 – 24, 2019 noise monitoring period.

4.11. Noise Monitor Location 12

The noise monitor at Location 12 was the independent control/reference point. It was located approximately 15 m east of Range Road 211 and 450 m south of Township Road 560 as indicated in Figure 2 and Figure 13. This placed the noise monitor approximately 1.6 km west of Highway 830 and approximately 2.7 km north of Highway 15. At this location, there was direct line-of-sight to the west of the AIH region. The noise monitor was bordered on all sides by a combination of open grassy fields. Due to the distance from the noise monitor to the existing major facilities within the AIH, the vegetative absorption between the noise monitor and these facilities would be considered significant. Note also that a weather monitor was placed at this location for the duration of all noise monitoring periods.

4.12. Noise Monitor Location 13

The noise monitor at Location 13 was located approximately 3 m east of Range Road 221 and 100 m south of Township Road 564 as indicated in Figure 2 and Figure 14. This put the noise monitor approximately 1.1 km northwest of the lay down yard for the NWR facility and is the north easternmost noise monitoring location found within the AIH. At this location, there was no direct line-of-sight to any facilities. There was moderate vegetation between the noise monitor and the aforementioned facilities.

5.0 Equivalent Sound Level & Statistical Descriptors

Environmental noise levels from industry are commonly described in terms of equivalent sound levels or L_{eq}. This is the level of a steady sound having the same acoustic energy, over a given time period, as the fluctuating sound. The concept is that the same amount of annoyance occurs from a sound having a high level for a short period of time as from a sound at a lower level for a longer period of time. In addition, this energy averaged sound level is often A-weighted to account for the reduced sensitivity of average human hearing to low frequency sounds and/or C-weighted to allow for more low frequency noise to be considered. These L_{eq} in dBA/dBC, which are the most common environmental noise measure, are often given for day-time (07:00 to 22:00) L_{eq}Day and night-time (22:00 to 07:00) L_{eq}Night while other criteria use the entire 24-hour period as L_{eq}24.

Another method of conveying long term noise levels utilizes statistical descriptors. These are calculated from a cumulative distribution of the sound levels over the entire measurement duration and then determining the sound level at xx % of the time. These descriptors can be used to provide a more detailed analysis of the varying noise climate.

For purposes of this study, the following equivalent sound levels and statistical descriptors will be presented and discussed:

L_{eq}Day	- Measured over the daytime (07:00 – 22:00)
L_{eq}Night	- Measured over the night-time (22:00 – 07:00)
L_{10}	- Sound level that was exceeded only 10% of the time. - Good measure of intermittent or intrusive noise
L_{50}	- Sound level that was exceeded 50% of the time (arithmetic average) - Good to compare to L_{eq} to determine steadiness of noise
L_{90}	- sound level that was exceeded 90% of the time - Good indicator of typical “ambient” noise levels

For further information, refer to Appendix II for a description of the acoustical terminology and Appendix III for a list of common noise sources and their associated noise levels.

6.0 Results and Discussion

6.1. Environmental Noise Monitoring

The results of the fourteen (14) 48-hour noise monitoring's have been provided in Table 2[1] and are presented in Figures 15 – 112. The figures include the 15-second broadband dBA and dBC L_{eq} sound levels[2], 1-hour dBA and dBC, L_{90}, L_{50}, L_{10} sound levels[3] and the 1/3 octave band L_{eq} sound levels[3] for each noise monitoring location. Table 2 provides results of each of the three daytime periods in addition to the isolated and non-isolated values for the two night-time periods. The isolation analysis for the night-time periods was performed in accordance with Section 4.3.2 of the AER Directive 038. A list of all non-typical noise events removed from each of the fourteen (14) noise monitoring's are provided in Appendix IV. Each event removed has been dated with its corresponding time period as well as the rationale for its removal. A detailed discussion of the results for each monitoring location can be found below.

Table 2. L_{eq} 24-Hour Results[4]

Monitoring Location	1st Daytime Period	1st Night-time Period (Unisolated)	1st Night-time Period (Isolated)	2nd Daytime Period	2nd Night-time Period (Unisolated)	2nd Night-time Period (Isolated)	3rd Daytime Period
1C	54.7	54.4	48.9	58.1	55.7	49.1	57.4
2	53.2	56.2	52.2	52.7	54.4	48.7	54.3
3B	54.1	53.4	46.5	58.5	54.7	40.5	51.8
4C	47.5	48.2	48.0	47.9	50.4	50.2	50.2
5	53.5	56.4	55.1	51.0	57.0	50.2	53.4
6	61.7	49.8	48.0	62.7	47.9	45.4	64.4
8a	50.0	51.5	51.1	49.4	53.0	50.2	49.3
9	54.6	50.8	48.5	50.7	51.9	45.6	54.2
10	54.2	56.6	52.4	55.8	54.1	49.8	61.2
11	48.3	52.0	46.1	53.4	53.8	46.6	50.1
12b (1st 48-hour)	46.9	47.7	38.1	49.3	54.9	31.6	48.8
12b (2nd 48-hour)	54.7	46.0	35.8	52.8	47.3	38.5	55.6
12b (3rd 48-hour)	51.2	47.6	40.8	51.2	48.7	41.4	51.9
13	47.2	42.7	39.9	49.5	40.0	34.8	49.8

[1] The results of each location will be discussed individually.
[2] The data provided in the 15-second L_{eq} traces shows the 24-hour time period with the isolated night-time results, after removal of non-typical noise levels. This was done to indicate the relative steadiness of the noise levels and to make it easier to view the night-time data.
[3] Isolated and Non-isolated values are presented.
[4] The letters accompanying the noise monitoring location refers to their location.

6.1.1. Noise Monitoring Location 1C

The results of the noise monitoring conducted at Location 1 are provided in Table 2 and in Figures 15 - 21 The isolated L_{eq}Night values from Table 2 and the traces found in Figures 15 – 18 indicate relatively consistent noise levels at the start of the first night-time period and then from 00:00 – 04:00 on the second night-time period. As indicated in Figure 16, there was a significant period of time removed from the calculation during the July 23 – 24, 2019 night-time period which can be attributed to a storm. However, despite the removal of data the isolated noise levels are very similar. This was again reflected in the 1/3 octave band L_{eq} sound levels for both nights. They are both relatively broadband with a decrease in the higher frequencies (1.25 kHz and above) and an elevated peak in the 25 Hz band, which is consistent with previous noise surveys.

When comparing the results and subjective observations from this year to previous years, the isolated values of both nights are representative of the typical noise climate of this area.

6.1.2. Noise Monitoring Location 2

The results of the noise monitoring conducted at Location 2 are provided in Table 2 and in Figures 22 - 28. The isolated L_{eq}Night values from Table 2 and the traces found in Figures 22 – 23 indicate relatively consistent noise levels. Similarly to Location 1C, there was a significant period of time removed during the July 23 – 24, 2019 night-time period which can be attributed to a storm. The isolated 1/3 octave figures indicate relatively broadband noise levels, particularly in the mid-frequency bands, with elevated noise levels in the lower (below 125 Hz) frequency bands which is consistent with previous noise surveys The 1/3 octave between the night-time periods are similar, however the noise levels are higher during the first night, which could be attributed to the more favorable weather conditions. This could potentially reflect "worse-case" conditions (i.e. loudest) for this location, where the results from the second night are more reflective of "typical" conditions.

As noted in Appendix IV, the "non-typical" incidents included a relatively significant amount of rail activity. The removal of data due to the rail yard is consistent with previous years.

Based on the results and subjective observations from previous years, the isolated values are representative of the typical noise climate of this area.

6.1.3. Noise Monitoring Location 3B

The results of the noise monitoring conducted at Location 3 are provided in Table 2 and in Figures 29 - 35. The isolated L_{eq}Night values vary significantly between the two night-time periods. The traces between the two night-time periods in Figures 29 – 30. are relatively consistent, however the noise levels during the second night-time period are significantly lower than the first night. When examining the 1/3 octave band spectral data between the two nights, the trace is relatively similar with elevated noise levels below the 100 Hz centre frequency band. However, again, the noise levels for the second night-time period are significantly less.

When comparing the values of each night-time period to previous years the results of the first night are more indicative of the noise climate of the area.

6.1.4. Noise Monitoring Location 4C

The results of the noise monitoring conducted at Location 4 are provided in Table 2 and in Figures 36 - 42. The isolated L_{eq}Night values from Table 2 and the traces found in Figures 36 – 39 indicate relatively consistent noise levels from 22:00 – 03:00 for the first night-time period while the second night has consistent noise levels throughout the entire night-time period. In reviewing the weather conditions, found in Appendix V, there were no parameters (wind speed, wind direction, etc.) that would account for the variance in noise levels during the first night. However, it should be noted that this variation in noise level has occurred in previous measurement years at this location. In addition, subjective observations made in previous years have indicated that this location is highly influenced by small variations in meteorological conditions. Therefore, it is possible, that the variation can be attributed to small fluctuations in the weather conditions.

In comparison to previous years however, the 1/3 octave band spectral data is again not consistent between the two overnight periods. This would indicate that it is possible that there was a change in the operational conditions at the site to the north. Based on the results (particularly the 1/3 octave band spectral data) and from subjective observations the isolated values of the October 21 – 22, 2019 night-time period would be more representative of the typical noise climate of this area.

6.1.5. Noise Monitoring Location 5

The results of the noise monitoring conducted at Location 5 are provided in Table 2 and in Figures 43 - 49. Figures 43 – 46 indicate very consistent isolated 15-second L_{eq} traces for the first night-time period while the second night has significantly more fluctuations, which based on previous years, it an anomaly. This variance can be attributed to the less favorable weather conditions during the July 23 – 24, 2019 night-time period. As noted in Appendix IV, there were significantly more "non-typical" incidents removed this year for rail activity when compared to previous years.

Based on the results (particularly the 1/3 octave band spectral data) and from subjective observations the isolated values of the July 22 – 23, 2019 night-time period would be more representative of the typical noise climate of this area due to the more favorable weather conditions.

6.1.6. Noise Monitoring Location 6

The results of the noise monitoring conducted at Location 6 are provided in Table 2 and in Figures 50 - 56. The isolated L_{eq}Night values from Table 2 and the traces found in Figures 50 – 53 indicate relatively consistent noise levels for both night-time periods. In addition, the isolated L_{eq}Night values and the 1/3 octave band spectral data are very similar between both noise monitoring periods, apart from small differences in the higher frequencies. The fluctuation in the noise levels between the two nights can be attributed to the windspeed and direction being slightly more favorable for the sound propagation during the first night.

Based on the measured results and the 1/3 octave band spectral data, it would be anticipated that the results from the 2019 noise monitoring are reflective (in comparison to previous years) of the high and low ends of the "typical" noise climate of this area.

6.1.7. Noise Monitoring Location 8A

The results of the noise monitoring conducted at Location 8 are provided in Table 2 and in Figures 57 - 63. The isolated L_{eq}Night values indicate relatively consistent noise levels for the first night-time period and then from 00:00 – 03:00 on the second night-time period. There was a significant period of time removed during the July 23 – 24, 2019 night-time period which can be attributed to a storm throughout the Heartland region. However, despite the removal of data the isolated noise levels are relatively similar which is also reflected in the 1/3 octave band L_{eq} sound levels for both nights. They are both relatively broadband with a decrease in the higher frequencies (1.25 kHz and above) which is consistent with previous noise surveys.

When comparing the results and subjective observations from the 2019 noise monitoring to previous years, the isolated values of both 2019 night-time periods are representative of the typical noise climate of this area.

6.1.8. Noise Monitoring Location 9

The results of the noise monitoring conducted at Location 9 are provided in Table 2 and in Figures 64 - 70. The isolated L_{eq}Night values indicate relatively consistent noise levels for the first night-time period and then from 00:00 – 03:00 on the second night-time period. There was a significant period of time removed during the July 23 – 24, 2019 night-time period as illustrated in Figure 65, which can be attributed to a storm throughout the Heartland region. The trace of the isolated L_{eq}Night 1/3 octave band spectral data are very similar between both noise monitoring periods, despite the differences in the traces. The isolated L_{eq}Night values for the first night-time period are higher than the second night due to the windspeed and direction being slightly more favorable for the sound propagation during the first night.

Based on the measured results and the 1/3 octave band spectral data, it would be anticipated that the results from the 2019 noise monitoring are reflective (in comparison to previous years) of the typical range of noise levels for this area.

6.1.9. Noise Monitoring Location 10

The results of the noise monitoring conducted at Location 10 are provided in Table 2 and in Figures 71 - 77. As noted in Appendix IV, there were a large number of "non-typical" incidents, which included a relatively significant amount of vehicle traffic removed from the calculation. Additionally, data was also removed due to human activity near the monitor and from the storm during the July 23 – 24, 2019 night-time period. This would account for the significant variance between the non-isolated and isolated 1/3 octave band L_{eq} sound levels, as illustrated in Figure 77.

The 1/3 octave band L_{eq} sound levels are very consistent with previous years in that the noise levels are relatively broadband from 100 Hz – 2kHz before they decrease as the frequency increases.

Based on the measured results and the 1/3 octave band spectral data, it would be anticipated that the results from the 2019 noise monitoring are reflective (in comparison to previous years) of the typical range of noise levels for this area.

6.1.10. Noise Monitoring Location 11

The results of the noise monitoring conducted at Location 11 are provided in Table 2 and in Figures 78 - 84. Similarly to the 2017 & 2018 noise monitoring periods, apart from the data removed during the July 23 – 24, 2019 night-time period, the isolated L_{eq}Night values from Table 2 indicate relatively consistent values between the two nights however the trace of the 1/3 octave band L_{eq} sound levels found in Figure 84 indicate varying noise levels in the higher frequency bands (above 1.25 kHz).

As noted in Appendix IV, the "non-typical" incidents included a relatively significant amount activity directly associated with the nearby rail yard which is consistent with previous years.

When comparing the results and subjective observations from the 2019 noise monitoring to previous years, the isolated values of both 2019 night-time periods are representative of the high range of the typical noise climate of this area.

6.1.11. Noise Monitoring Location 12

The results of the noise monitoring conducted at Location 12 are provided in Table 2 and in Figures 85 - 105. As previously mentioned, this location was the independent control/reference point. Therefore, the results from this location span three (3) 48-hour monitoring periods.

Similarly to previous years, all night-time periods show a significant difference between the non-isolated L_{eq}Night noise levels in comparison to the isolated L_{eq}Night noise levels. This can be attributed to this location being relatively far any major facility[1], therefore most instances of vehicular traffic on Range Road 211 or rail activity along the nearby CP rail line dominate the noise climate. In addition, during the six (6) night-time periods there were significant noise contributions from crickets/frogs and after approximately 04:00, the morning rush (on Highway 211) and the morning chorus (birds chirping). These noise sources totally dominated the noise climate and thus large portions of this time period were removed.

In the absence of the vehicular or rail activity the 1/3 octave band L_{eq} sound levels indicate a similar trace to the other monitoring locations with elevated noise levels in the lower frequency bands (50 Hz – 80 Hz) that gradually decrease as the frequency increases. However, the presence of the contributions from the crickets (3.15 kHz) is very pronounced for the first 48-hour noise monitoring period, as illustrated in Figure 91.

[1] This location is approximately 2.3 km northeast of the ATCO Natural Gas Salt Cavern Storage Site.

6.1.12. Noise Monitoring Location 13

The results of the noise monitoring conducted at Location 13 are provided in Table 2 and in Figures 106 - 112. The isolated L_{eq}Night values from Table 2 and the traces found in Figures 106 - 107 indicate relatively significant difference between the two night-time periods. The primary difference is illustrated in Figure 106 for the first night-time period where the noise levels are relatively low (between 20 – 30 dBA) until approximately 00:00. The opposite occurred during the second night-time period in which the noise levels were high and then decreased relatively quickly after 00:00. These variances can most likely be attributed to the operations at the facilities southeast of this site as there was no major change in weather conditions that would account for the large change in noise level.

Similarly to the 2017 noise monitoring period, the 1/3 octave band spectral data has greater variation between the two noise monitoring night-time periods. As a result, it would be anticipated that the noise climate for this area has not yet stabilized.

6.2. 2019 General Subjective Observations and Notes from Site Visits and Data Analysis

- The weather conditions during the 2019 summer were significantly less favorable in comparison to the 2018 monitoring period.
- The isolated noise levels and 1/3 octave band L_{eq} sound levels were relatively consistent to previous years.
- The noise arriving at most monitor locations consisted primarily of low frequency components that gradually decreased in noise level as the frequency increased.
- None of the sites indicated any specific low frequency tonal components.
- The noise from train passages was prevalent at all locations and tended to dominate the noise climate as they passed through, particularly when there were train whistles. The number of train whistles and train passages subjectively appeared to be similar to the 2018 noise monitoring period.
- At two locations, the rail activity (not just passages) dominated the noise climate and were very frequent.
- Similarly to the 2017 and 2018 noise surveys, the train passages were not as subjectively observed during the site visits, however the isolation analysis indicated a similar number of rail passages when compared to earlier years.

6.3. Night-time Weather Conditions

As previously mentioned, local weather monitoring stations were used throughout all noise monitoring periods to obtain the wind speed, wind direction, temperature, relative humidity, barometric pressure and rain fall data in 1-minute sampling periods. All weather data are presented in Appendix V. A brief discussion of each night-time period can be found below. There were times in which the wind speeds during certain night-time periods were above the limits of AER Directive 038. However, for these instances, the data was removed from the L_{eq}Night calculations, therefore, the results found within Table 2 are considered in compliance with AER Directive 038.

6.3.1. July 22 – 23, 2019

Weather Monitor near Noise Monitor Location 1

The wind conditions during the night-time period were considered calm (below 5 km/hr). The wind direction varied[1] during the night-time period but was generally from the west. The temperature ranged from 13°C to 21°C and the relative humidity ranged from approximately 72% - 91%. The barometric pressure was consistent and flat at approximately 94 kPa. Lastly, there was no precipitation.

Weather Monitor near Noise Monitor Location 11

The wind conditions during the night-time period were considered moderate to calm (between 1 – 9 km/hr, respectively). The wind direction varied[2] during the night-time period but was primarily from the south followed by the northwest. The temperature ranged from 13°C to 21°C and the relative humidity ranged from approximately 72% - 93%. The barometric pressure was consistent and flat at approximately 94 kPa. Lastly, there was no precipitation.

Weather Monitor near Noise Monitor Location 12

The wind conditions during the night were considered moderate to calm (between 3 – 10 km/hr, respectively). The wind direction was generally from the east-northeast. The temperature ranged from 12°C to 17°C and the relative humidity ranged from approximately 82% - 90%. The barometric pressure was consistent and flat at approximately 94 kPa and there was no precipitation.

[1] The wind direction fluctuates more greatly when wind speeds are below 5 km/hr and are essentially calm. In these instances, the wind direction has a minimal influence of the propagation of the sound.

6.3.2. July 23 – 24, 2019

Weather Monitor near Noise Monitor Location 1

The wind conditions during the night-time period were considered moderate (between 5 - 10 km/hr, respectively) apart from a short duration in which the wind increased above 20 km/hr. The wind direction varied during the night-time period but was generally from the north. The temperature ranged from 19°C to 23°C and the relative humidity ranged from approximately 55% - 84%. The barometric pressure was consistent and flat at approximately 94 kPa. There was precipitation from 04:30 to 05:10 on July 24, 2019.

Weather Monitor near Noise Monitor Location 11

The wind conditions during the night-time period were considered moderate (above 5 - 15 km/hr, respectively) apart from a short duration in which the wind increased above 20 km/hr. The wind direction varied during the night-time period but was generally from the east-northeast. The temperature ranged from 18°C to 23°C and the relative humidity ranged from approximately 67% - 89%. The barometric pressure was consistent and flat at approximately 94 kPa. There was precipitation from 04:45 to 05:10 on July 24, 2019.

Weather Monitor near Noise Monitor Location 12

The wind conditions during the night-time period were considered moderate (above 5 - 10 km/hr, respectively) until 04:00 after which the wind was high (above 15 km/hr) and remained high until then past the end of the night-time period (07:00). The wind direction varied during the night-time period but was generally from the east direction. The temperature ranged from 18°C to 22°C and the relative humidity ranged from approximately 75% - 89%. The barometric pressure was consistent and flat at approximately 94 kPa. There was heavy precipitation from 04:55 to 05:30 and again from 06:45 – 07:15 on July 24, 2019.

6.3.3. September 18 - 19, 2019

Weather Monitor near Noise Monitor Location 6

The wind conditions throughout the night-time period were considered calm to moderate (below 10 km/hr). The wind direction was generally from the southwest. The temperature ranged from 4°C to 12°C and the relative humidity ranged from approximately 68% - 91%. The barometric pressure was consistent and relatively flat at approximately 94 kPa. Lastly, there was no precipitation.

Weather Monitor near Noise Monitor Location 12

The wind conditions throughout the night-time period were considered calm to moderate (primarily below 10 km/hr). The wind direction was generally from the southwest. The temperature ranged from 6°C to 12°C and the relative humidity ranged from approximately 67% - 91%. The barometric pressure was consistent and relatively flat at approximately 94 kPa. Lastly, there was no precipitation.

6.3.4. September 19 - 20, 2019

Weather Monitor near Noise Monitor Location 6

The wind conditions throughout the night-time period were considered moderate (approximately 10 km/hr). The wind direction was generally from the southwest. The temperature ranged from 9°C to 13°C and the relative humidity ranged from approximately 68% - 91%. The barometric pressure was consistent and relatively flat at approximately 93 kPa. Lastly, there was no precipitation.

Weather Monitor near Noise Monitor Location 12[1]

The wind conditions during the night-time period were considered moderate (primarily between 5 - 10 km/hr, respectively) until 03:30 after which the wind was high (above 15 km/hr) and remained high until then past the end of the night-time period (07:00). The wind direction was primarily from the south-southwest. The temperature ranged from 10°C to 13°C and the relative humidity ranged from approximately 66% - 83%. The barometric pressure was consistent and relatively flat at approximately 93 kPa. Apart from very light rain from 03:04 – 03:08, there was no precipitation.

[1] Due to issues with cellular connectivity, there is no data from 09:45 – 13:00 on September 20, 2019.

6.3.5. October 21 - 22, 2019

Weather Monitor near Noise Monitor Location 4

The wind conditions throughout the night-time period were considered calm to moderate (below 10 km/hr). The wind direction varied[1] during the night-time period with no dominant direction. The temperature ranged from -7°C to 1°C and the relative humidity ranged from approximately 82% - 92%. The barometric pressure was consistent and relatively flat at approximately 94 kPa. Lastly, there was no precipitation.

Weather Monitor near Noise Monitor Location 12

The wind conditions throughout the night-time period were considered calm to moderate (below 10 km/hr). The wind direction varied[1] during the night-time period with no dominant direction. The temperature ranged from -5°C to 2°C and the relative humidity ranged from approximately 80% - 92%. The barometric pressure was consistent and relatively flat at approximately 94 kPa. Lastly, there was no precipitation.

6.3.6. October 22 - 23, 2019

Weather Monitor near Noise Monitor Location 4

The wind conditions throughout the night-time period were considered high (primarily above 15 km/hr). The wind direction was generally from the northwest. The temperature ranged from 1°C to 3°C and the relative humidity ranged from approximately 68% - 84%. The barometric pressure was consistent and relatively flat at approximately 94 kPa. Lastly, there was no precipitation.

Weather Monitor near Noise Monitor Location 12

The wind conditions throughout the night-time period were considered high (primarily above 15 km/hr). The wind direction was generally from the northwest. The temperature ranged from 1°C to 3°C and the relative humidity ranged from approximately 71% - 84%. The barometric pressure was consistent and relatively flat at approximately 94 kPa. Lastly, there was no precipitation.

[1] The wind direction fluctuates more greatly when wind speeds are below 5 km/hr and are essentially calm. In these instances, the wind direction has a minimal influence of the propagation of the sound.

7.0 Conclusion

As part of the study, a total of fourteen (14) 48-hour noise monitoring's were conducted throughout the Alberta's Industrial Heartland. In many cases, due to unfavorable weather conditions during one of the two night-time periods, it would be anticipated that the results from only one-night period would be most reflective (in comparison to previous years) of the typical noise climate of their given area. It was found that the isolated L_{eq}Night broadband and 1/3 octave band L_{eq} sound levels were similar to those from previous measurements.

The noise levels at most locations consisted of low frequency components with occasional mid/high frequency components that could be attributed to the nearest facility relative to each individual noise monitoring location. Despite the noise being relatively low in frequency, none of the sites indicated any low frequency tonal components. The noise from train passages was again prevalent at all locations and tended to dominate the noise climate as they passed through. This was particularly true for locations within proximity to a rail line and for locations further away from any of the large industrial sites.

8.0 References

- *Environmental Noise Survey for the Regional Noise Model Annual Field Validation Monitoring*, prepared for the NCIA by aci Acoustical Consultants Inc., (2015 – 2018)
- Alberta Energy Regulator (AER), *Directive 038 on Noise Control*, *2007*, Calgary, Alberta
- International Organization for Standardization (ISO), *Standard 1996-1, Acoustics – Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures*, *2003*, Geneva Switzerland.
- International Organization for Standardization (ISO), *Standard 9613-1, Acoustics – Attenuation of sound during propagation outdoors – Part 1: Calculation of absorption of sound by the atmosphere*, *1993*, Geneva Switzerland.
- International Organization for Standardization (ISO), *Standard 9613-2, Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*, *1996*, Geneva Switzerland.

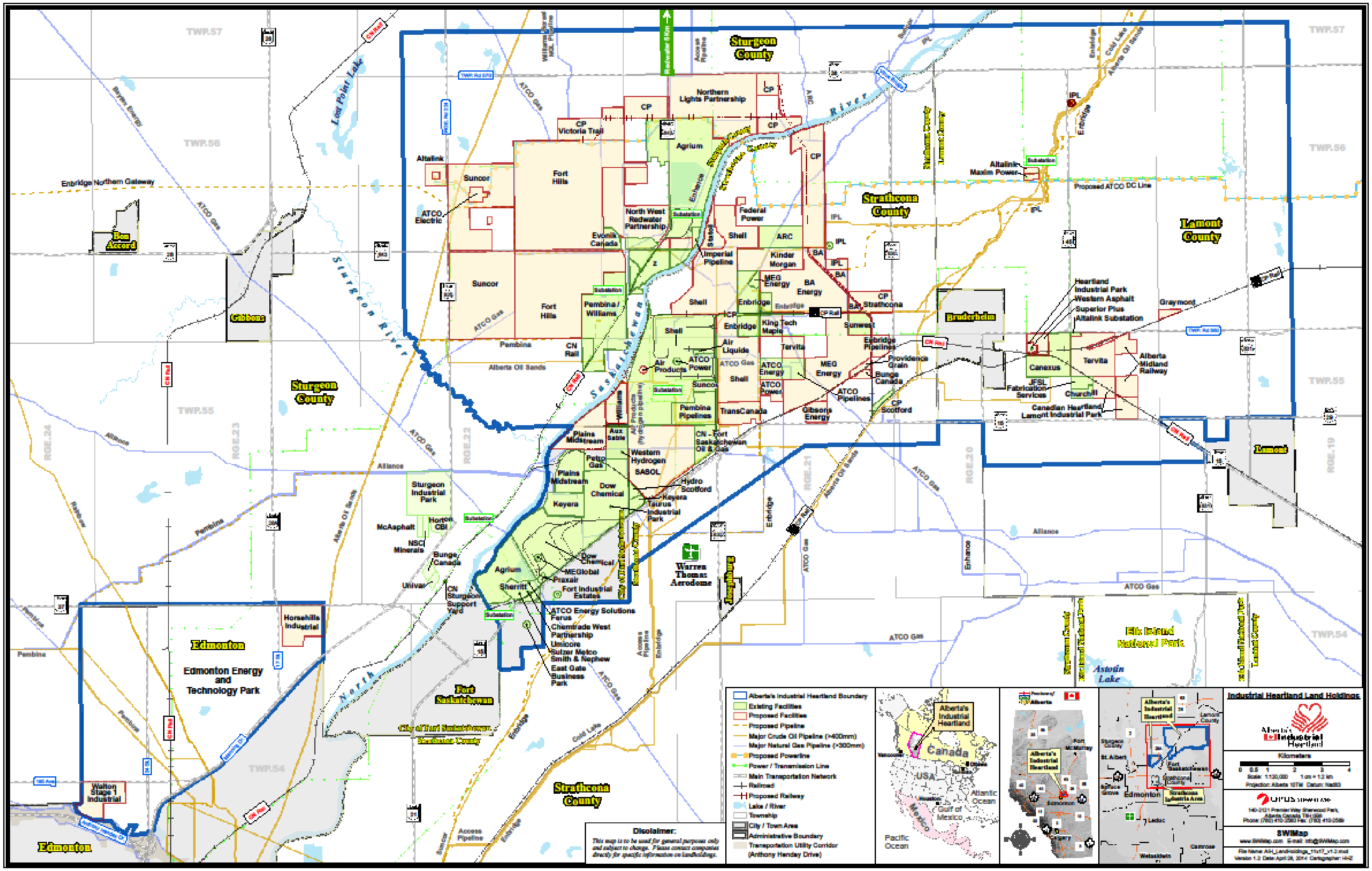

Figure 1. Study Area

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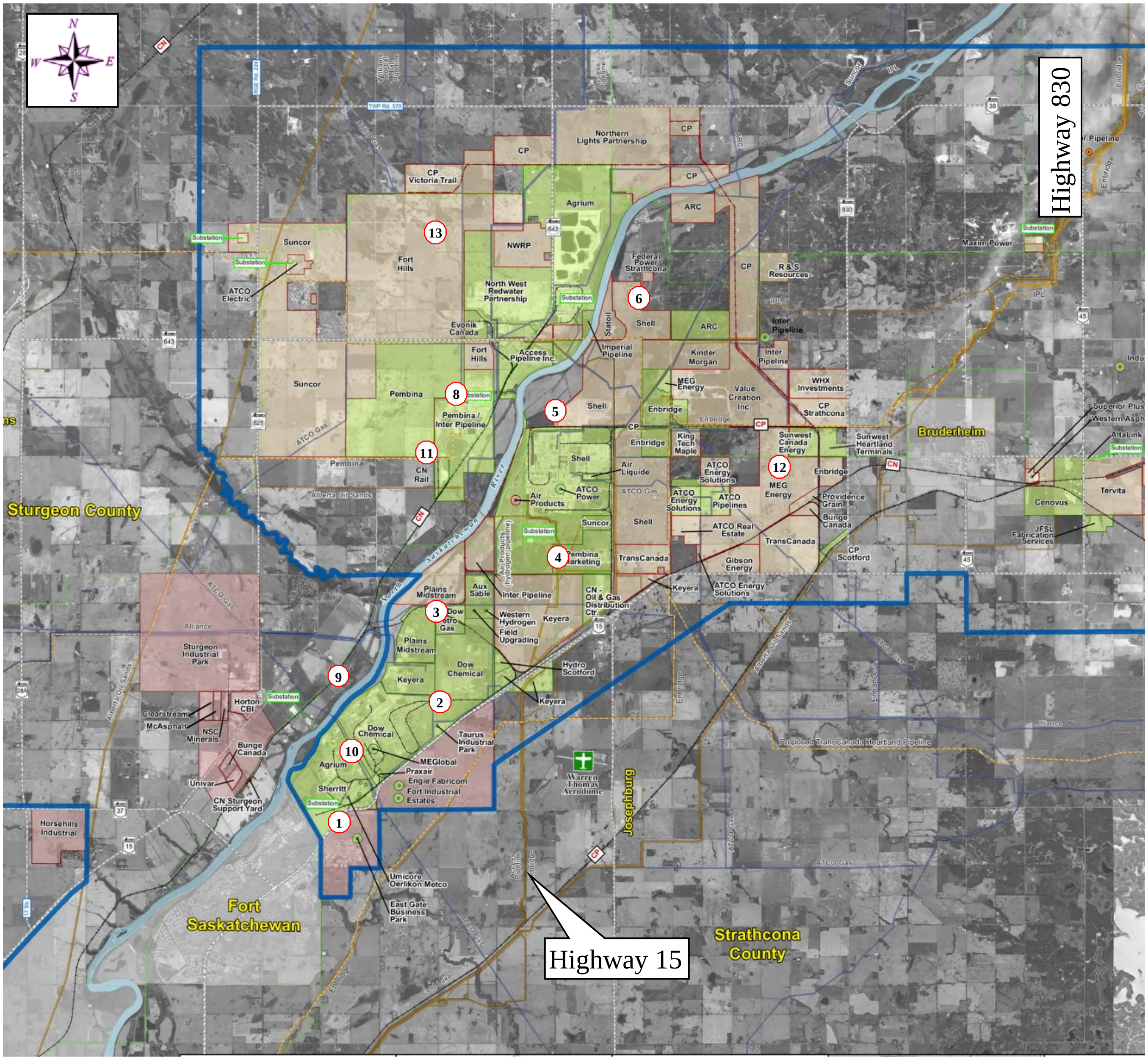


Figure 2. 2019 Study Area (With Noise Monitoring Locations)

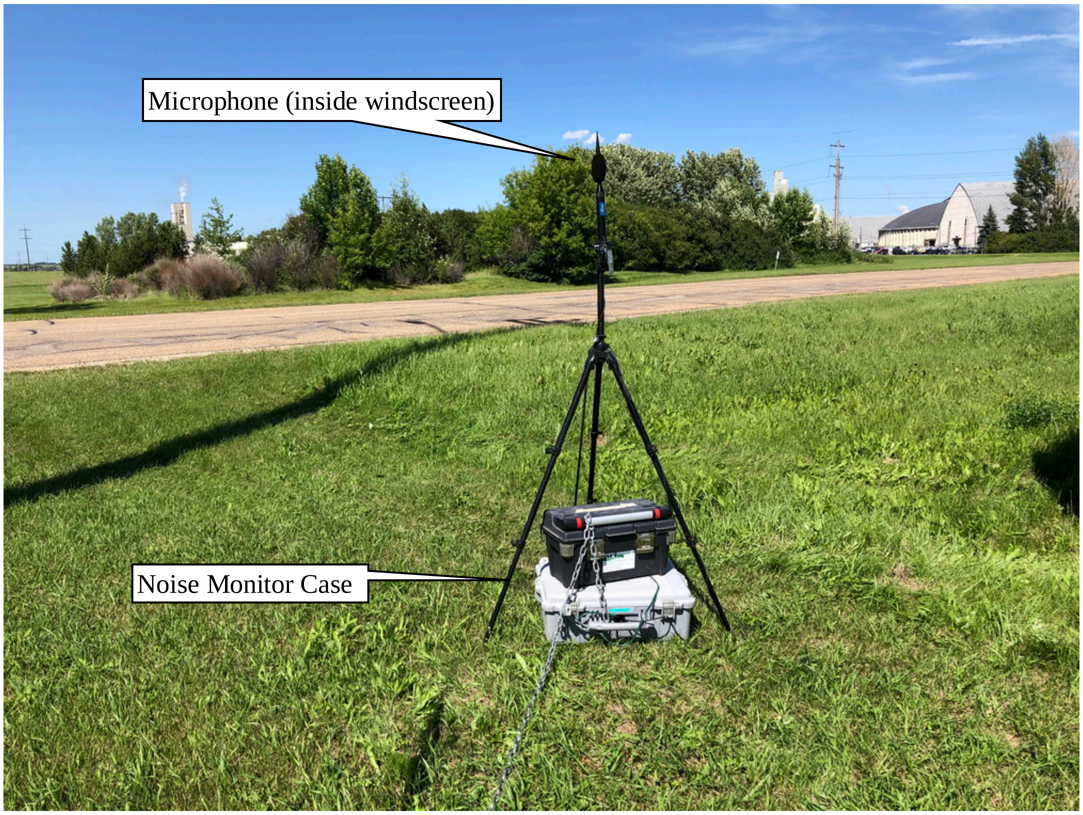


Figure 3. Noise Monitor #1 (With Weather Monitor)

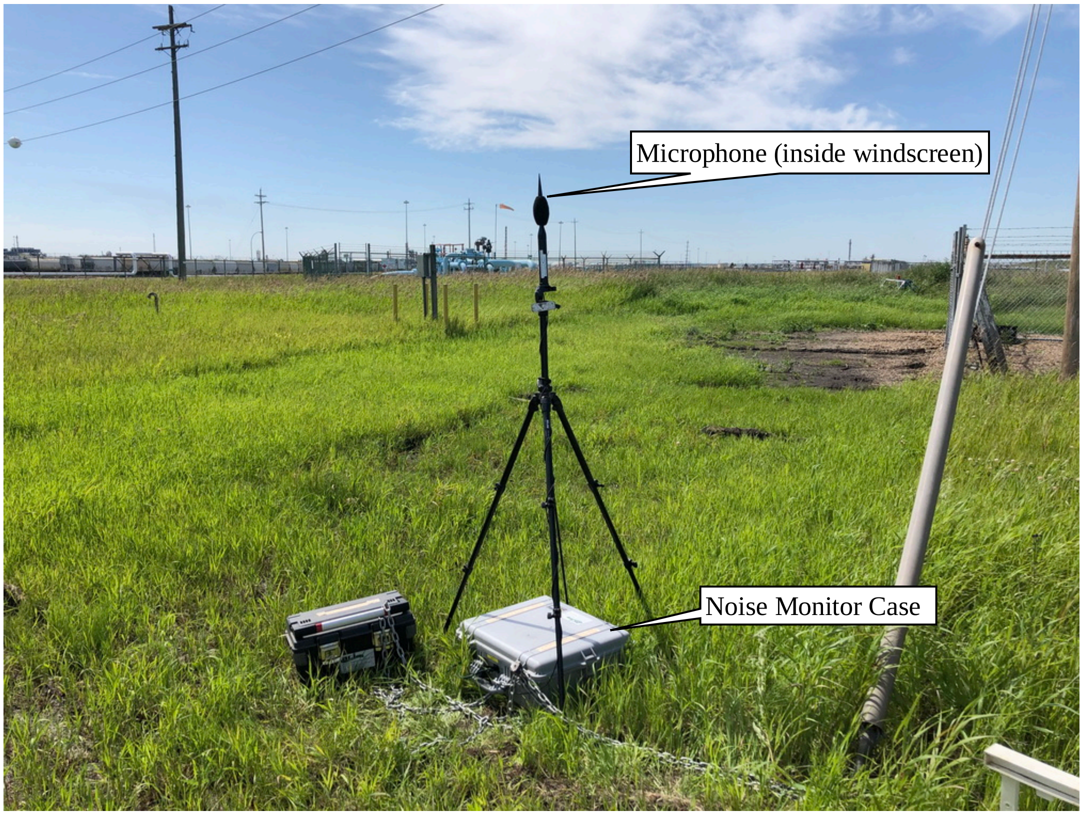


Figure 4. Noise Monitor #2

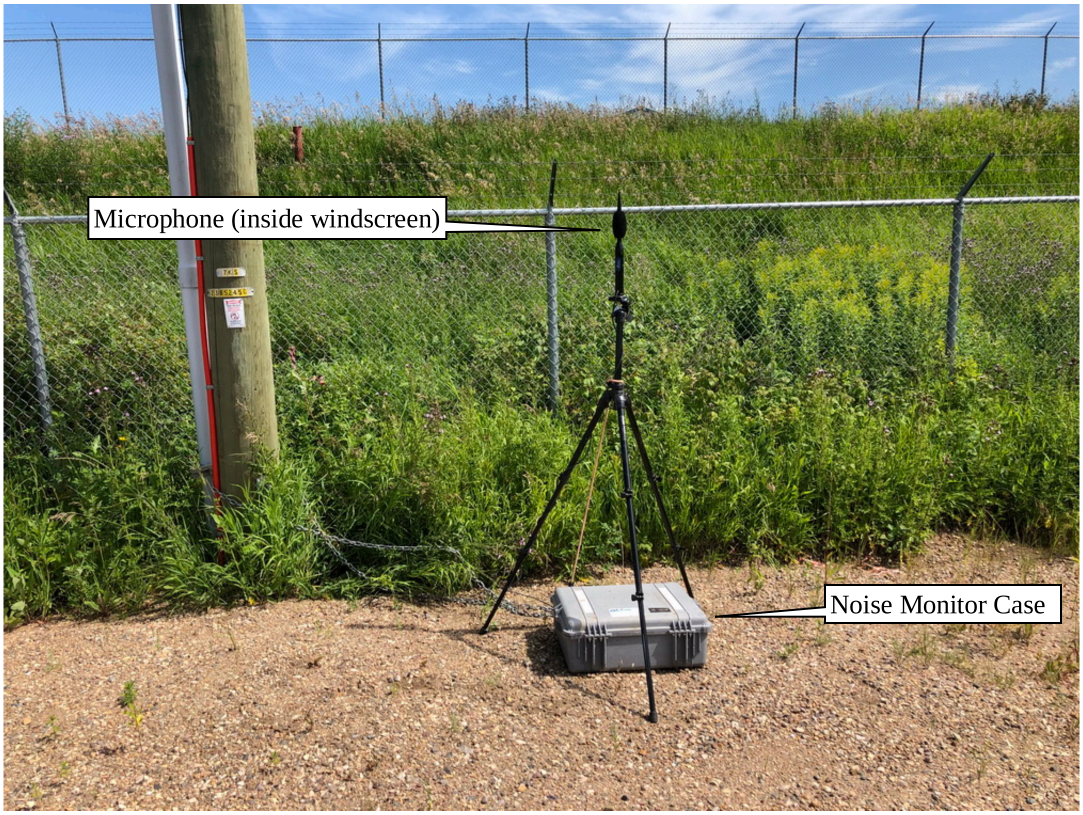


Figure 5. Noise Monitor #3

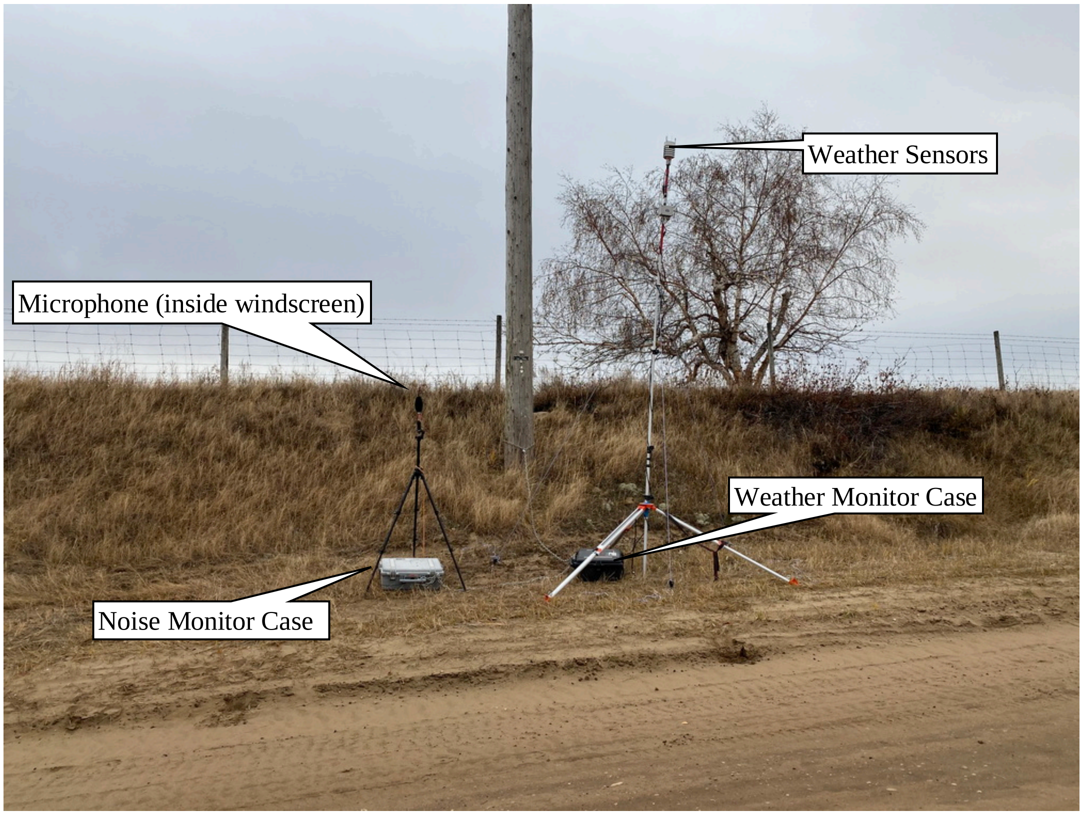


Figure 6. Noise Monitor #4

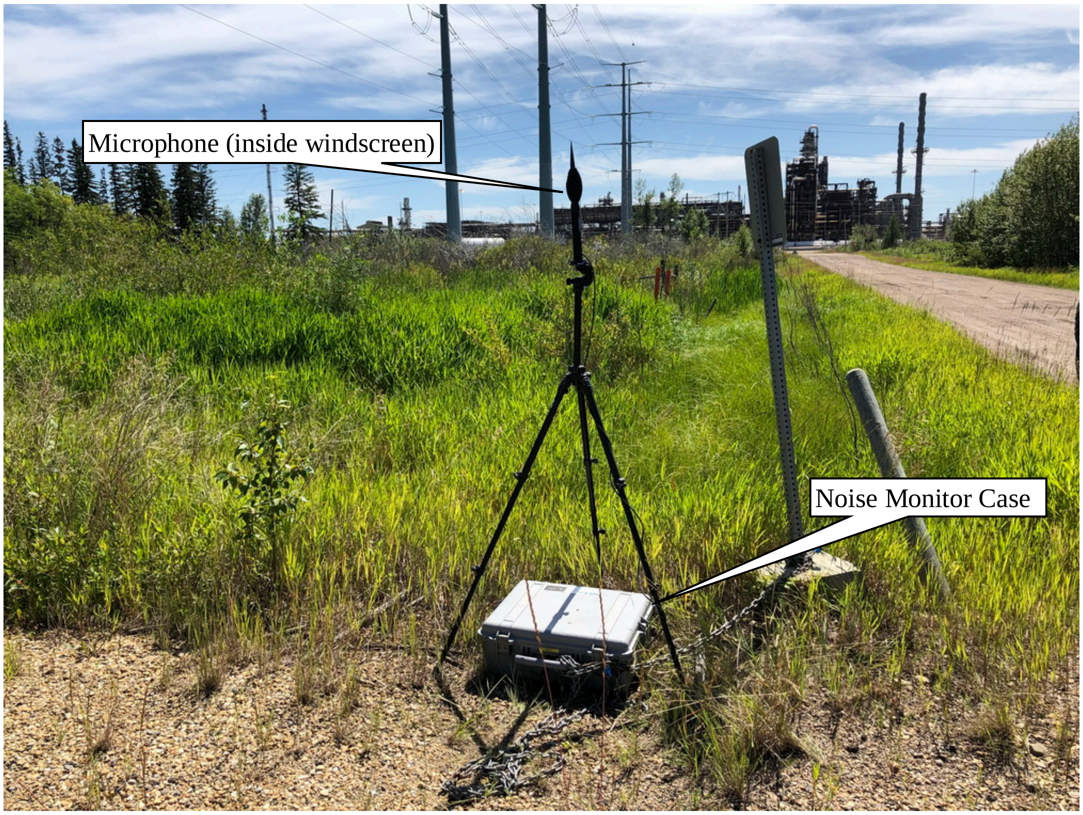


Figure 7. Noise Monitor #5

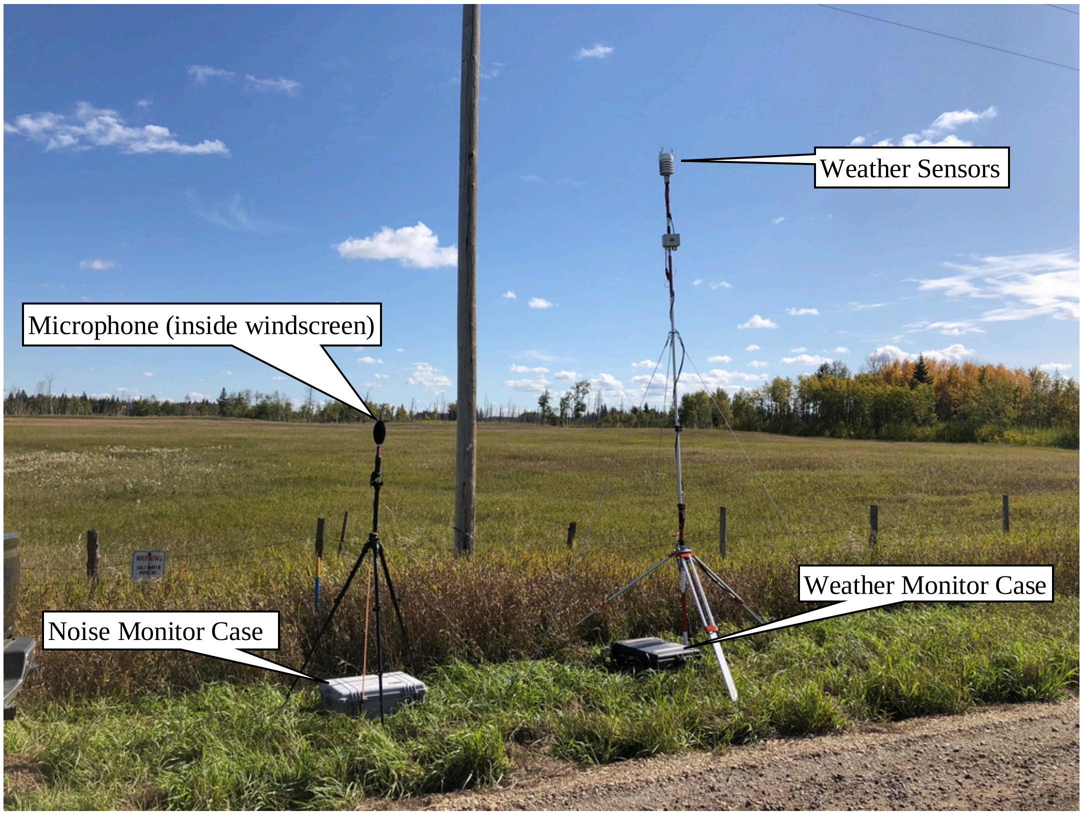


Figure 8. Noise Monitor #6

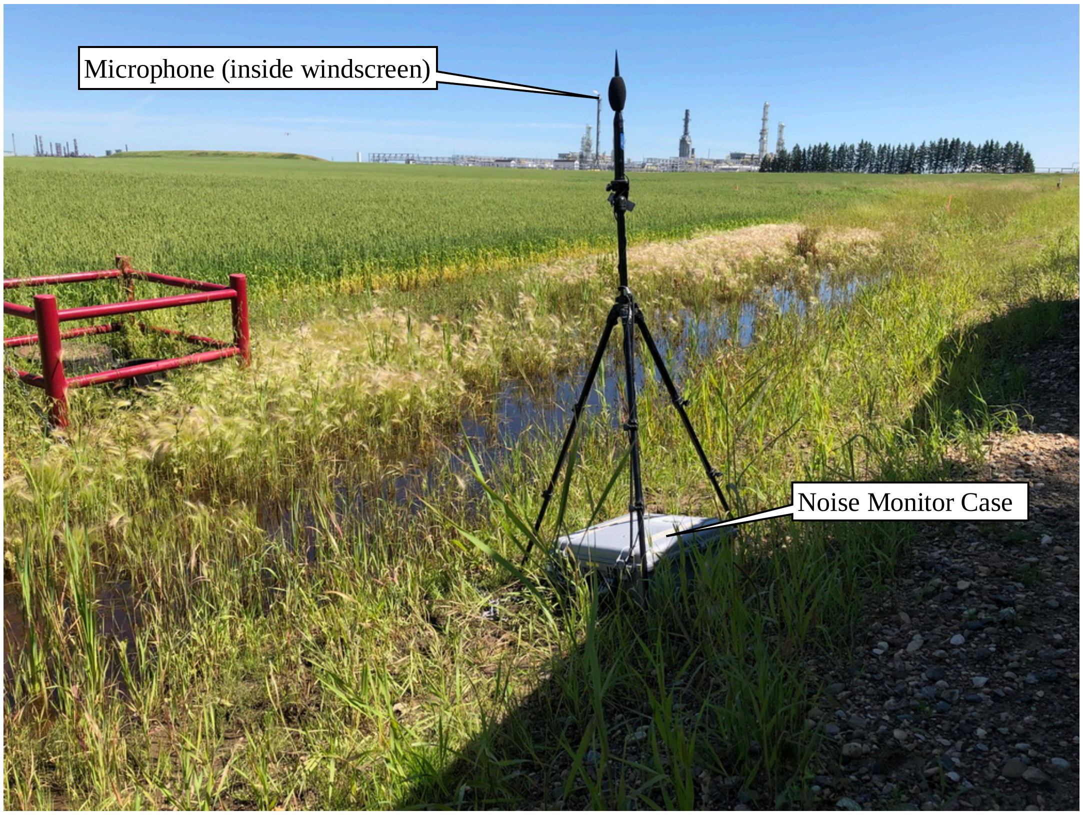


Figure 9. Noise Monitor #8

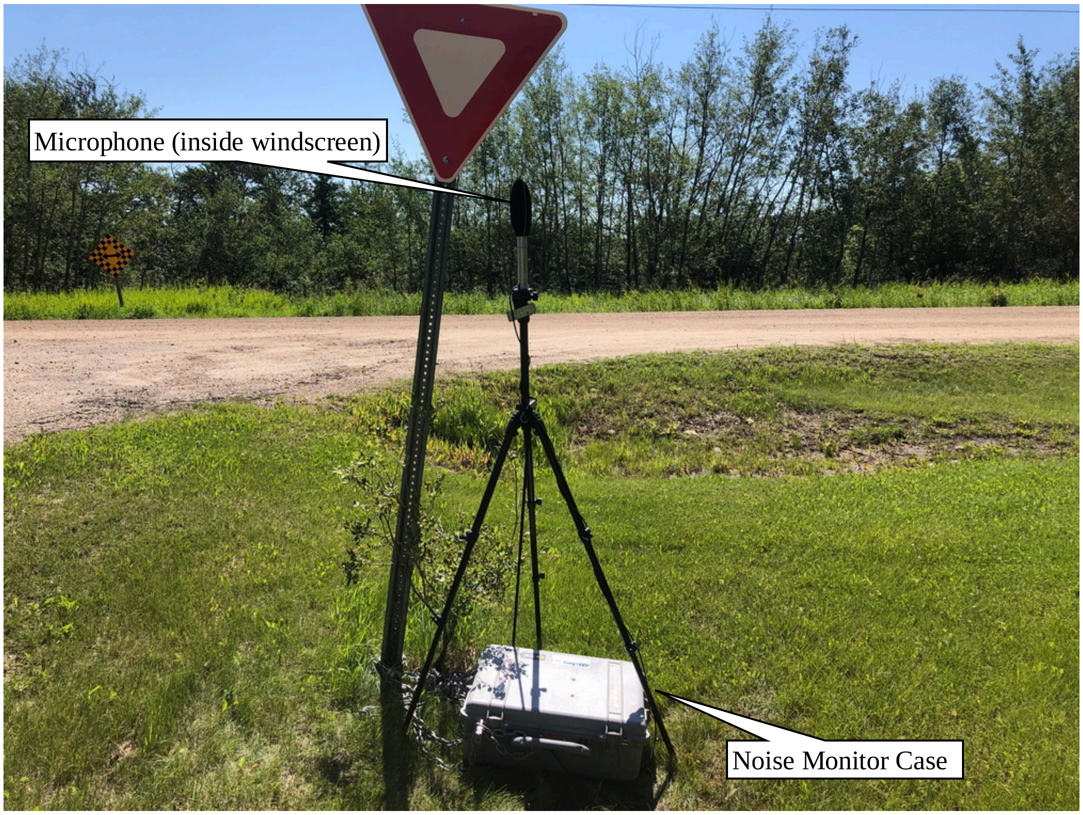


Figure 10. Noise Monitor #9

Figure 11. Noise Monitor #10

Figure 12. Noise Monitor #11

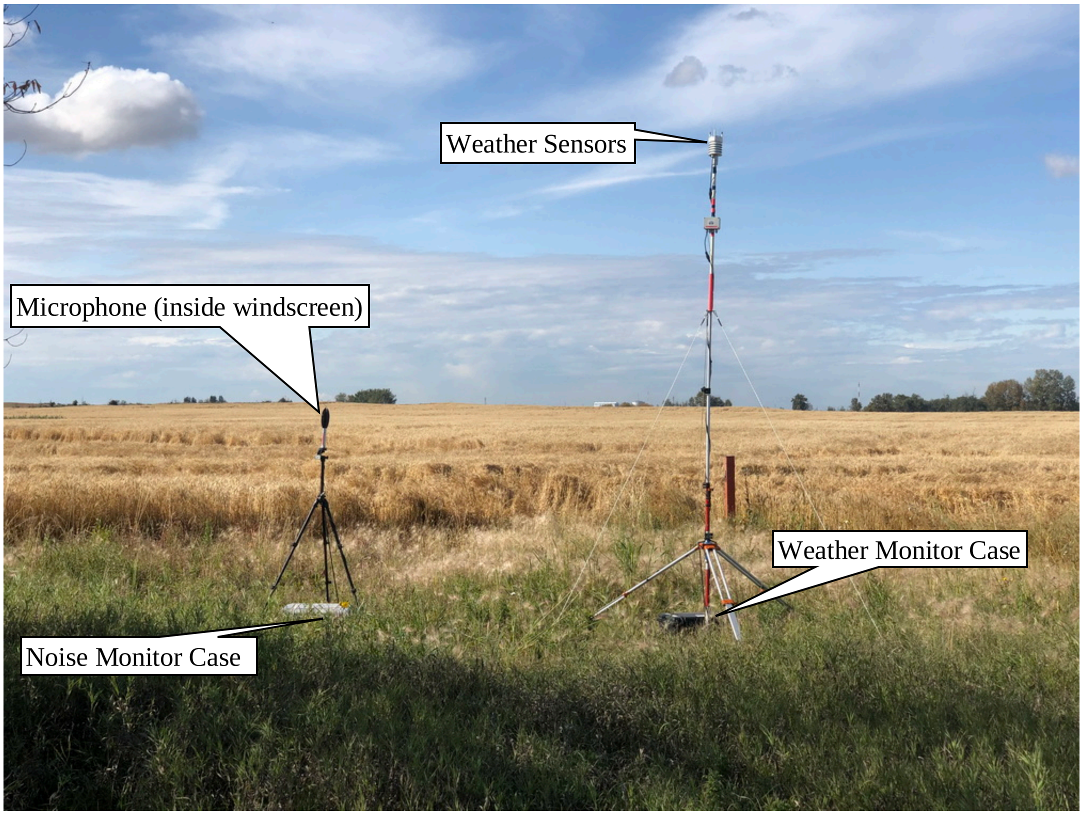


Figure 13. Noise Monitor #12 (Control Site w/ Weather Monitor)

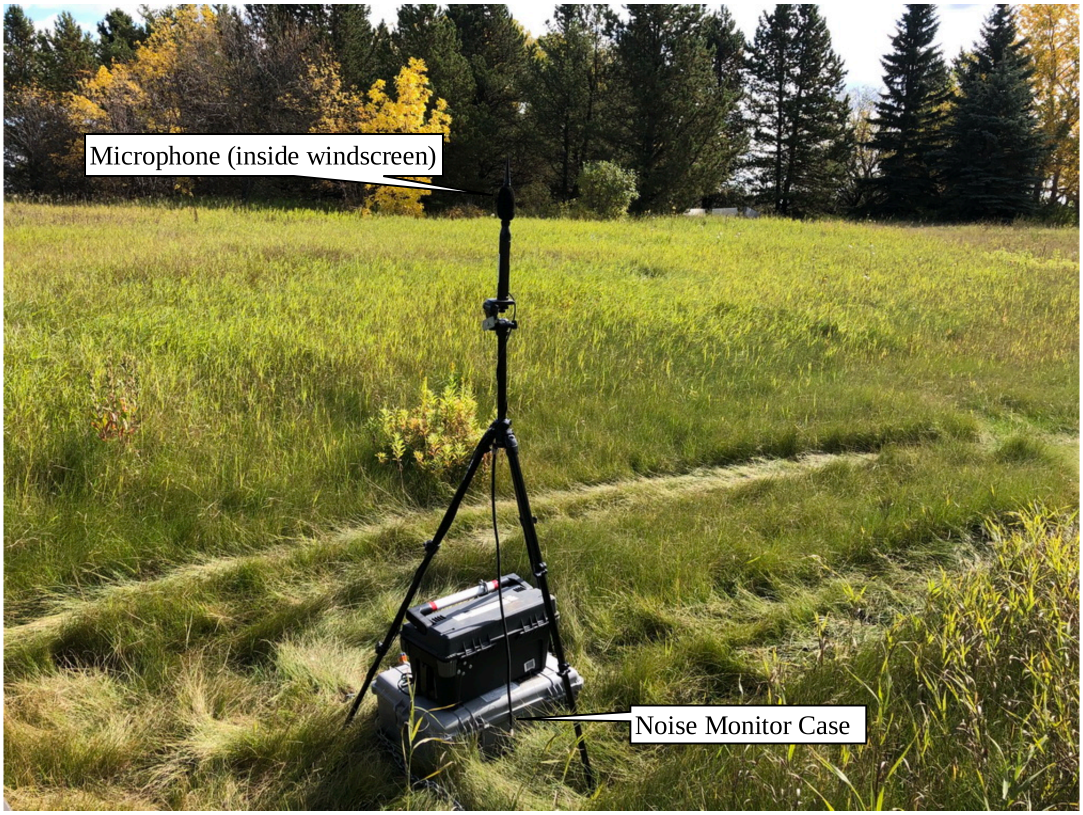


Figure 14. Noise Monitor #13

Noise Monitor #1

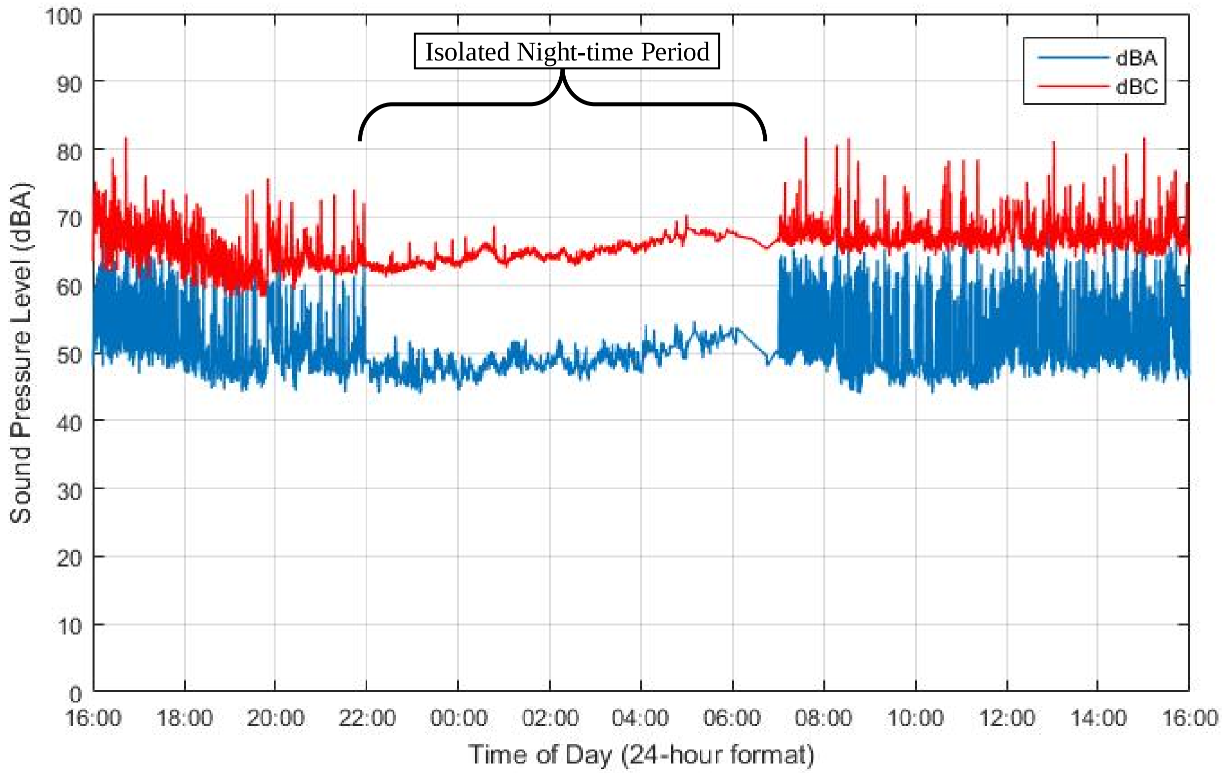


Figure 15. Noise Monitor #1, 15-Second L_{eq} Sound Levels (July 22 - 23, 2019)

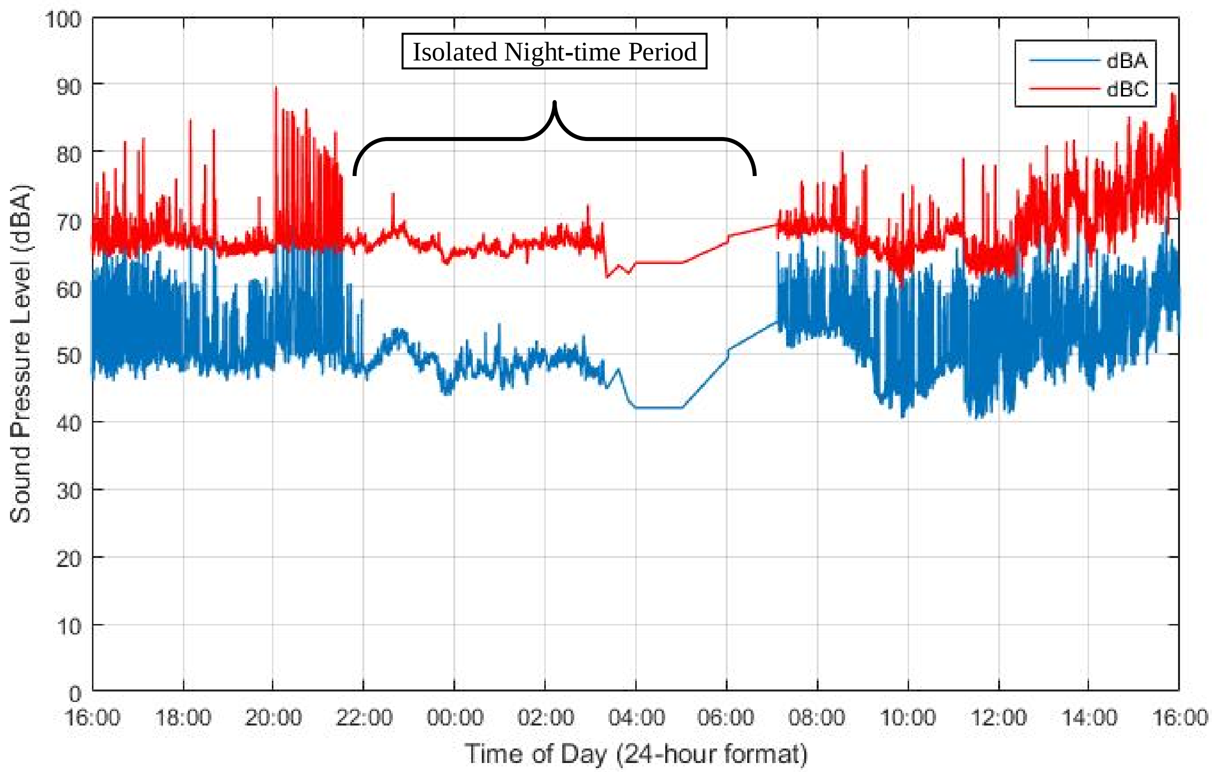


Figure 16. Noise Monitor #1, 15-Second L_{eq} Sound Levels (July 23 - 24, 2019)

Noise Monitor #1

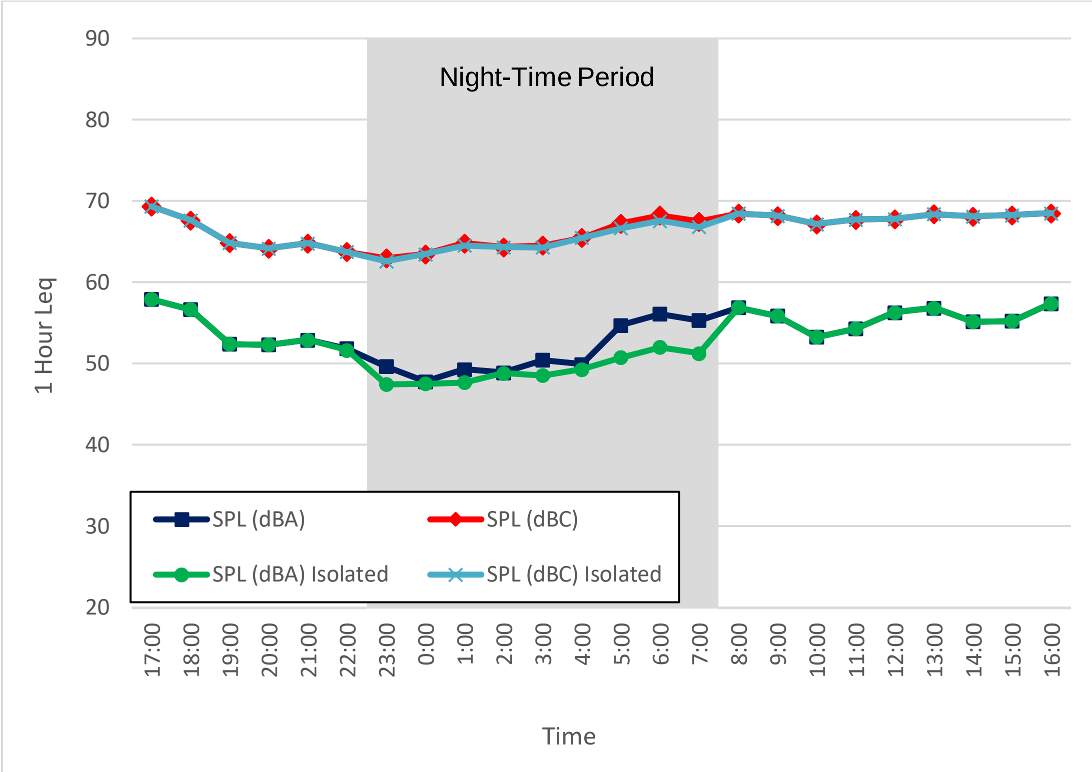


Figure 17. Noise Monitor #1, 1-Hour L_{eq} Sound Levels (July 22 - 23, 2019)

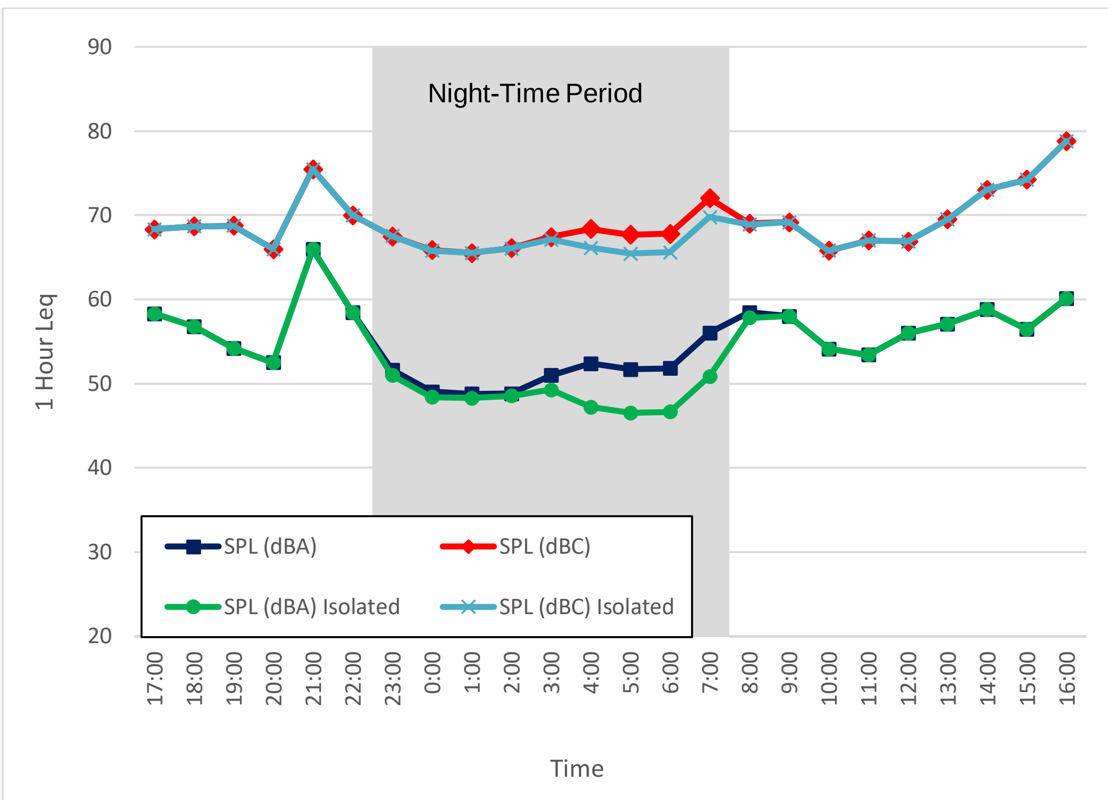


Figure 18. Noise Monitor #1, 1-Hour L_{eq} Sound Levels (July 23 - 24, 2019)

Monitor #1

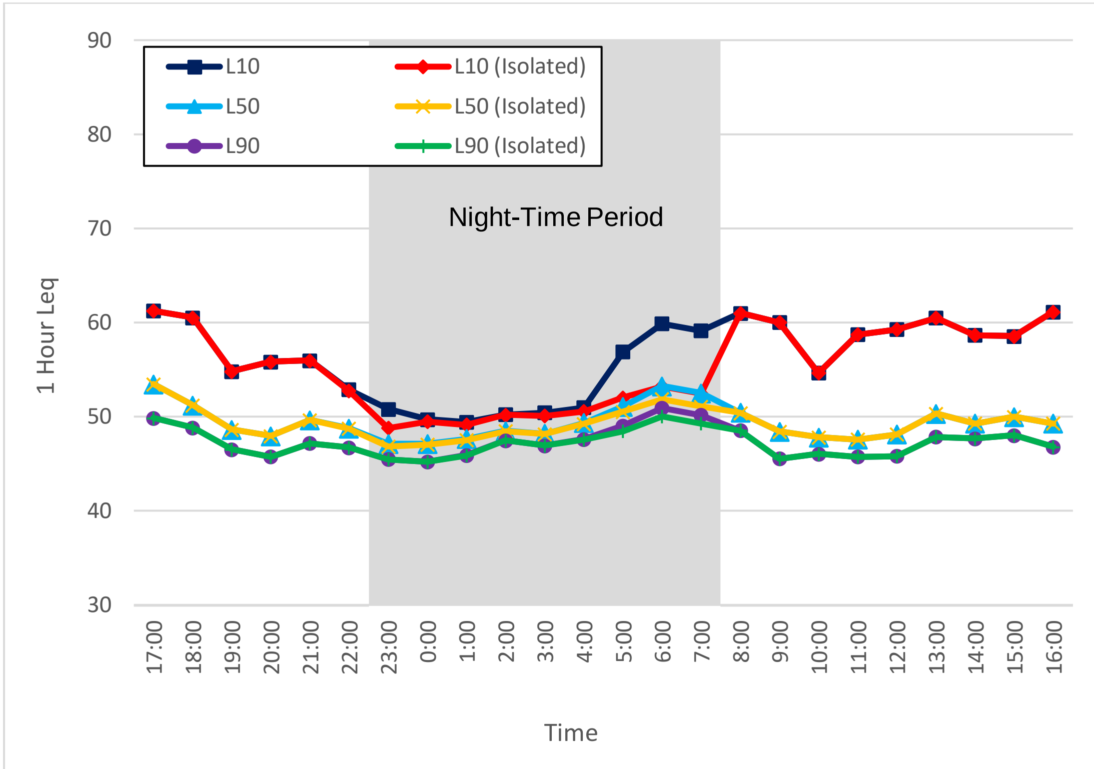


Figure 19. Noise Monitor #1, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (July 22 - 23, 2019)

Noise

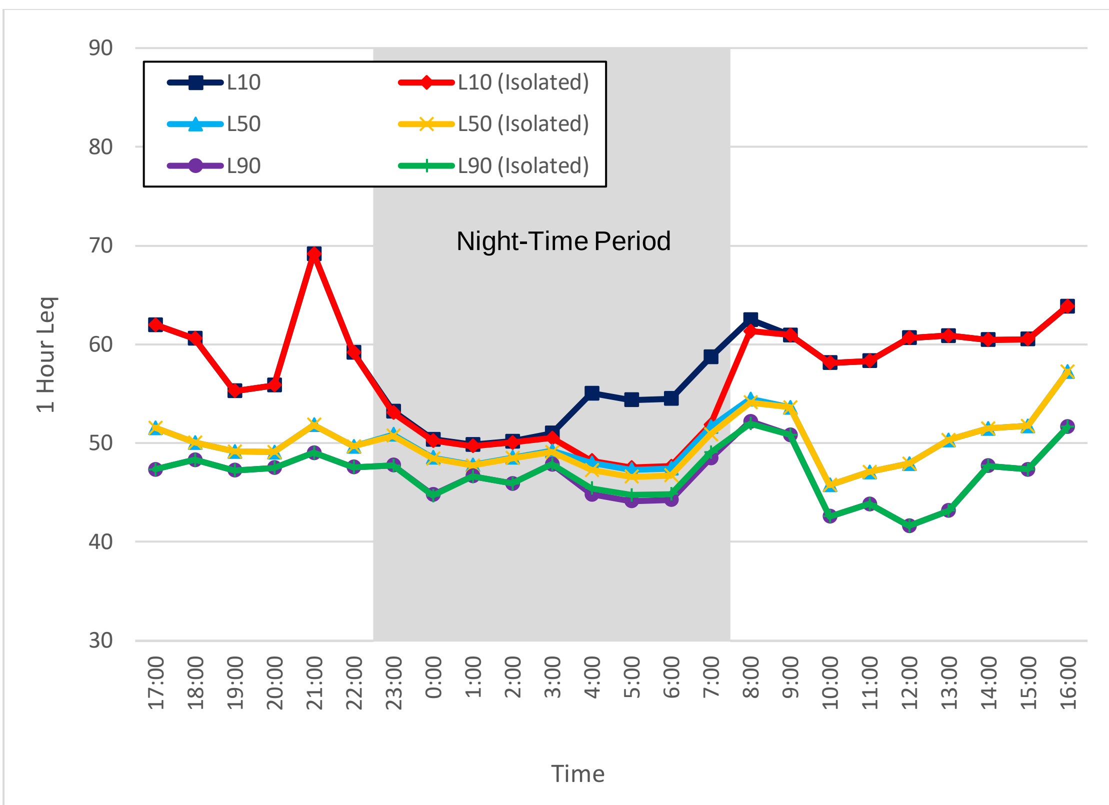
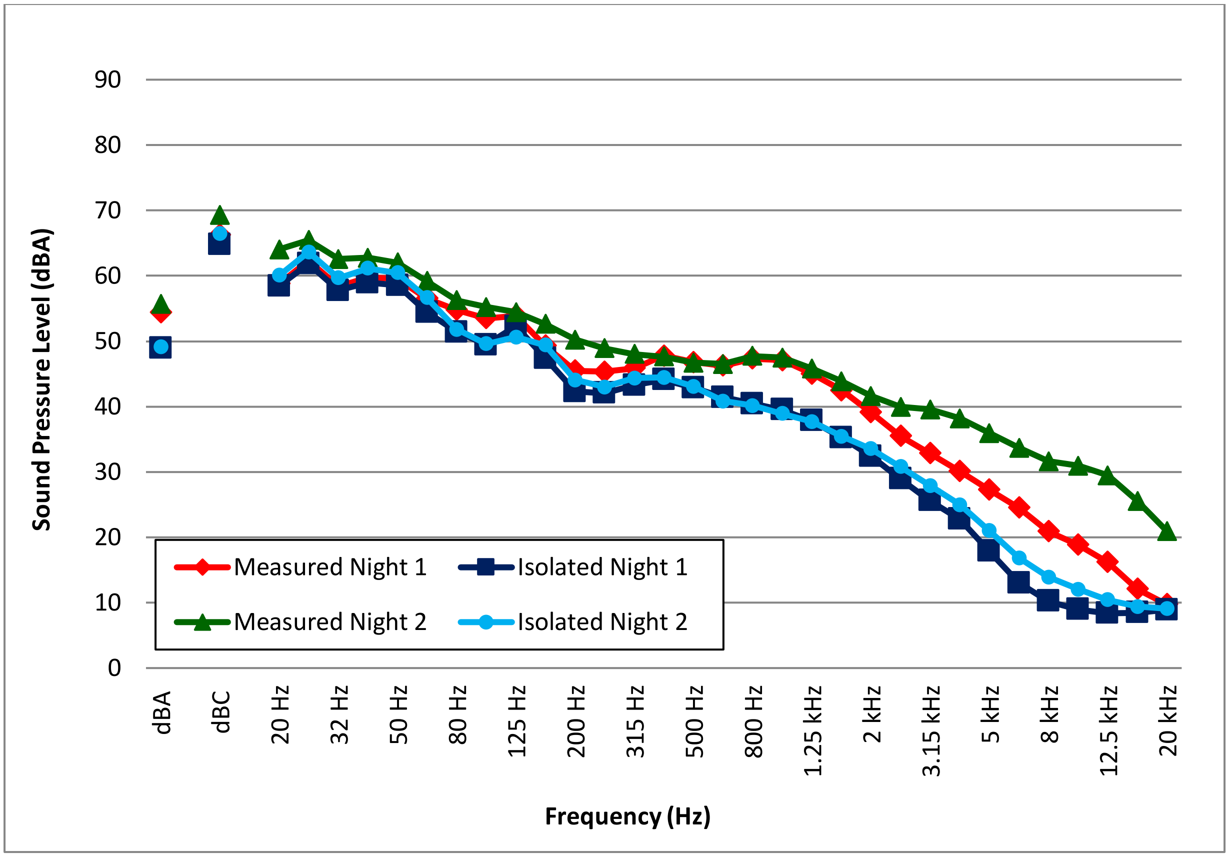


Figure 20. Noise Monitor #1, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (July 23 - 24, 2019)



Noise Monitor #1

Figure 21. Noise Monitor #1, 1/3 Octave L_{eq} Sound Levels (July 22 - 24, 2019)

Noise Monitor #2

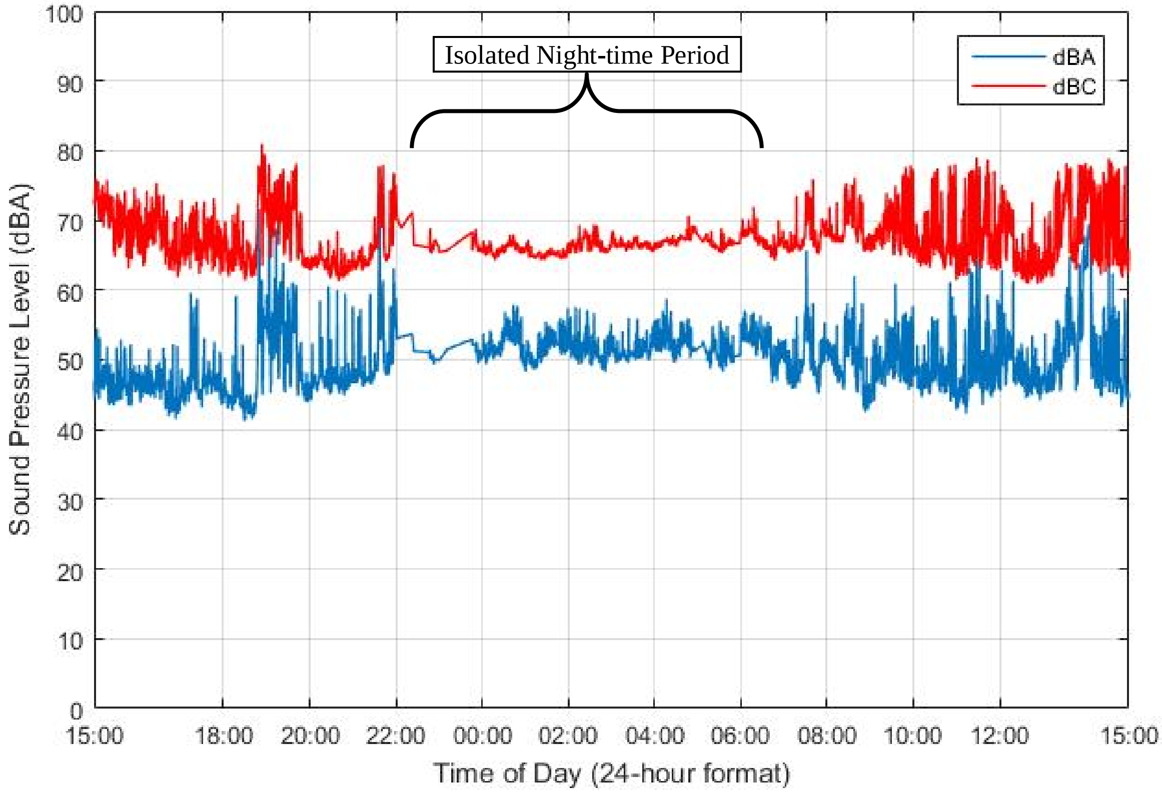


Figure 22. Noise Monitor #2, 15-Second L_{eq} Sound Levels (July 22 - 23, 2019)

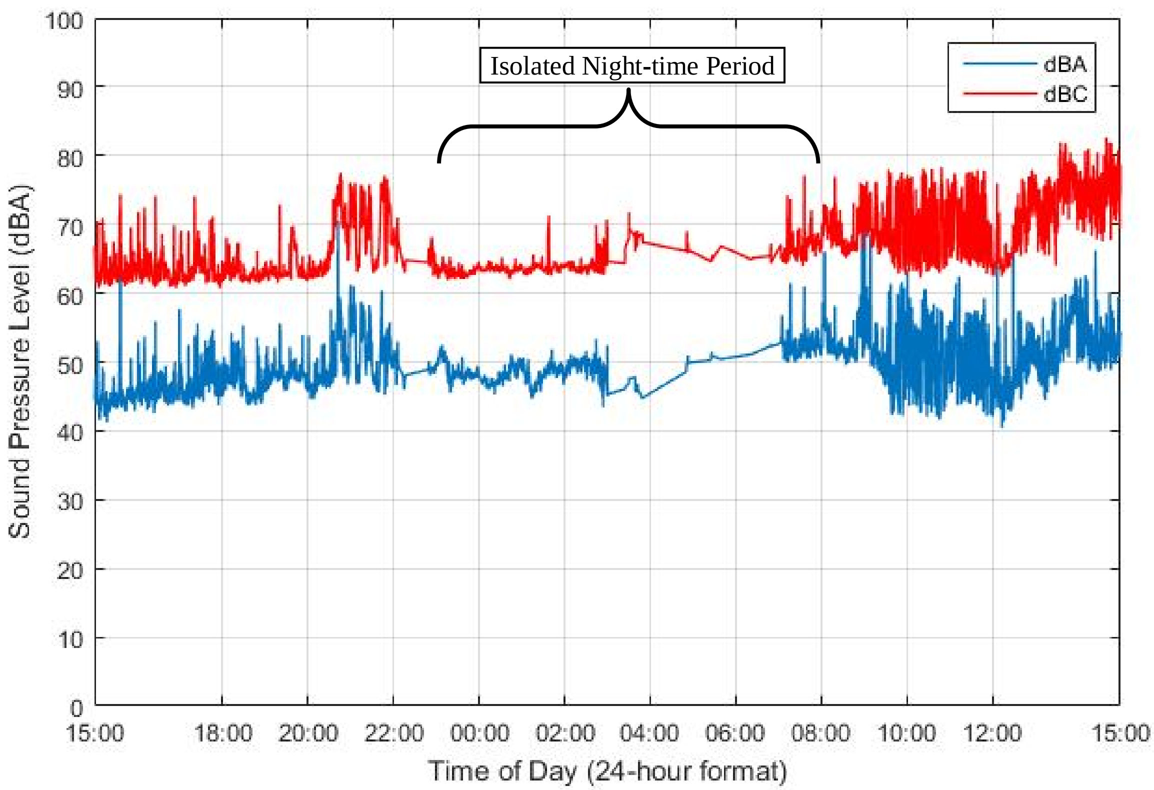


Figure 23. Noise Monitor #2, 15-Second L_{eq} Sound Levels (July 23 - 24, 2019)

Noise Monitor #2

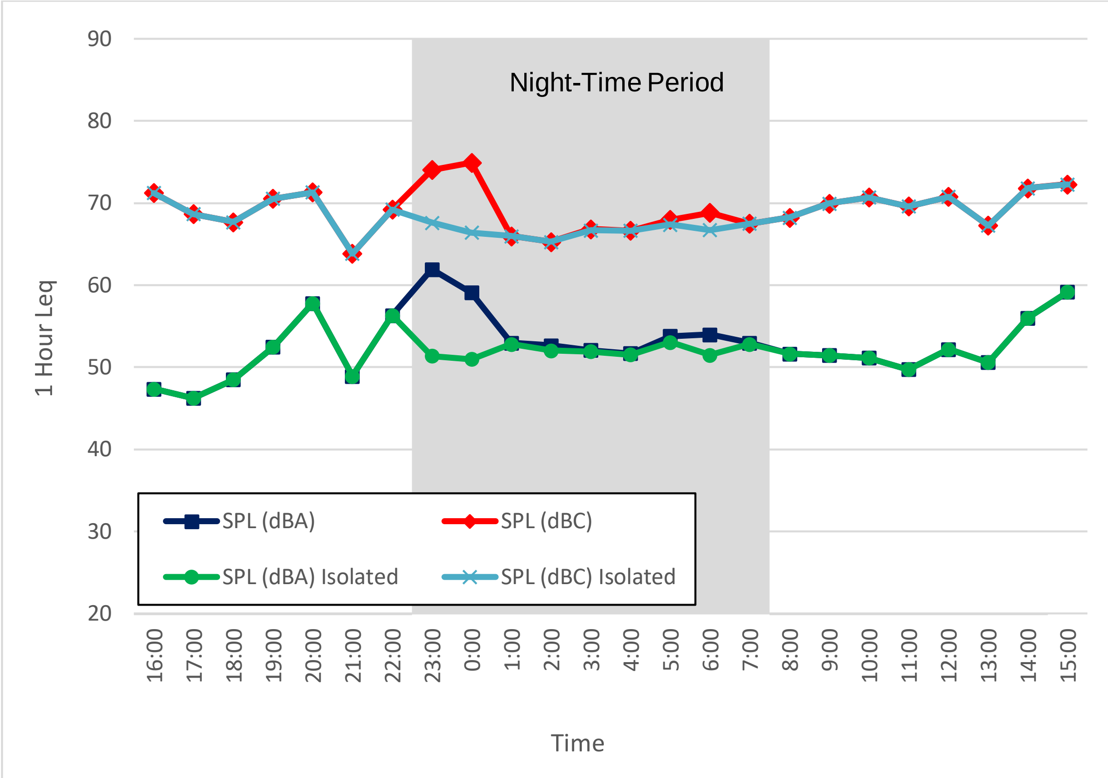


Figure 24. Noise Monitor #2, 1-Hour L_{eq} Sound Levels (July 22 - 23, 2019)

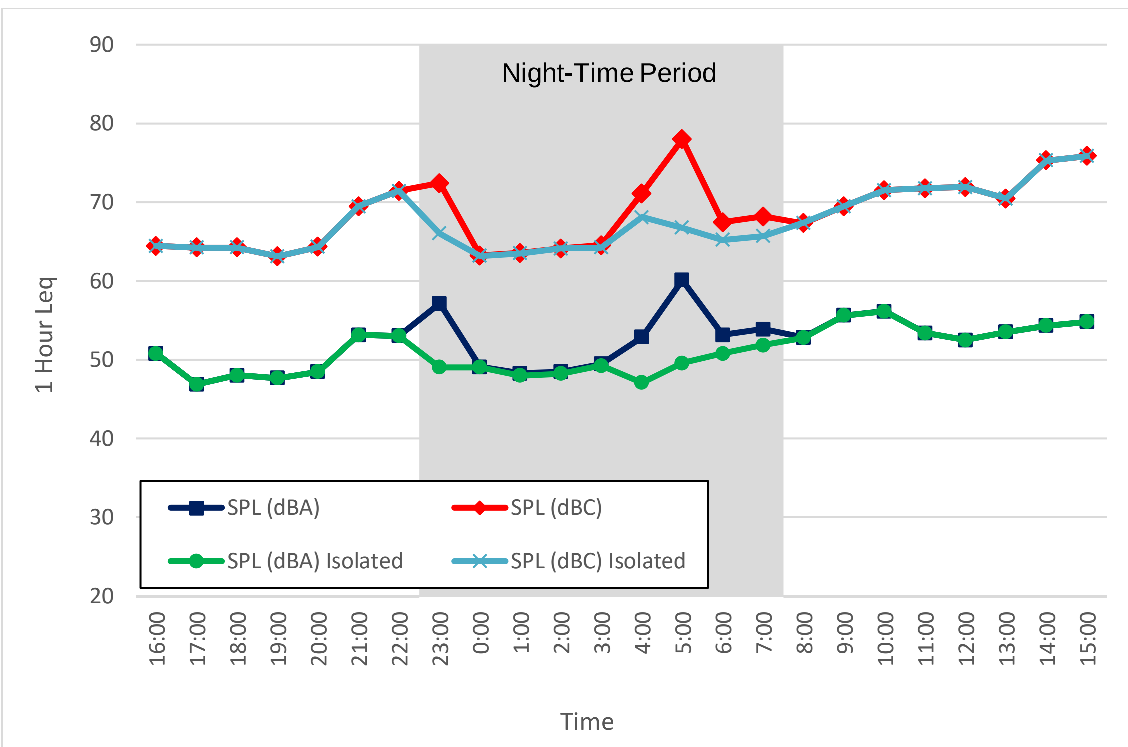


Figure 25. Noise Monitor #2, 1-Hour L_{eq} Sound Levels (July 23 - 24, 2019)

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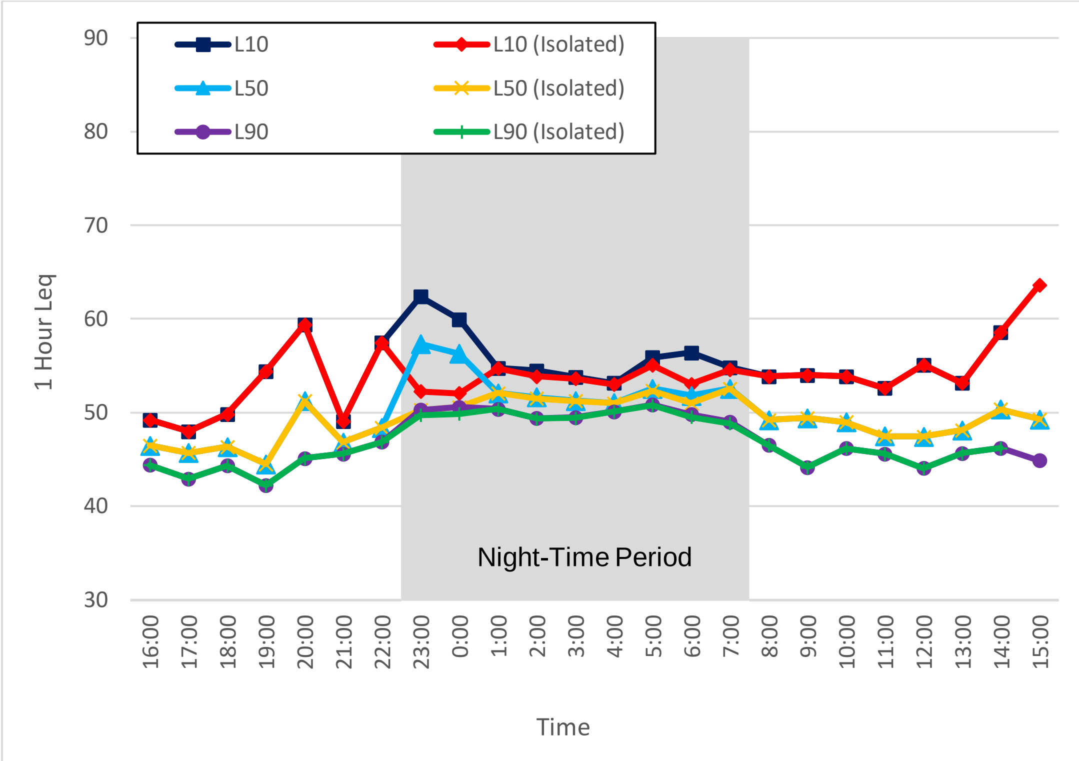

Figure 26. Noise Monitor #2, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (July 22 - 23, 2019)

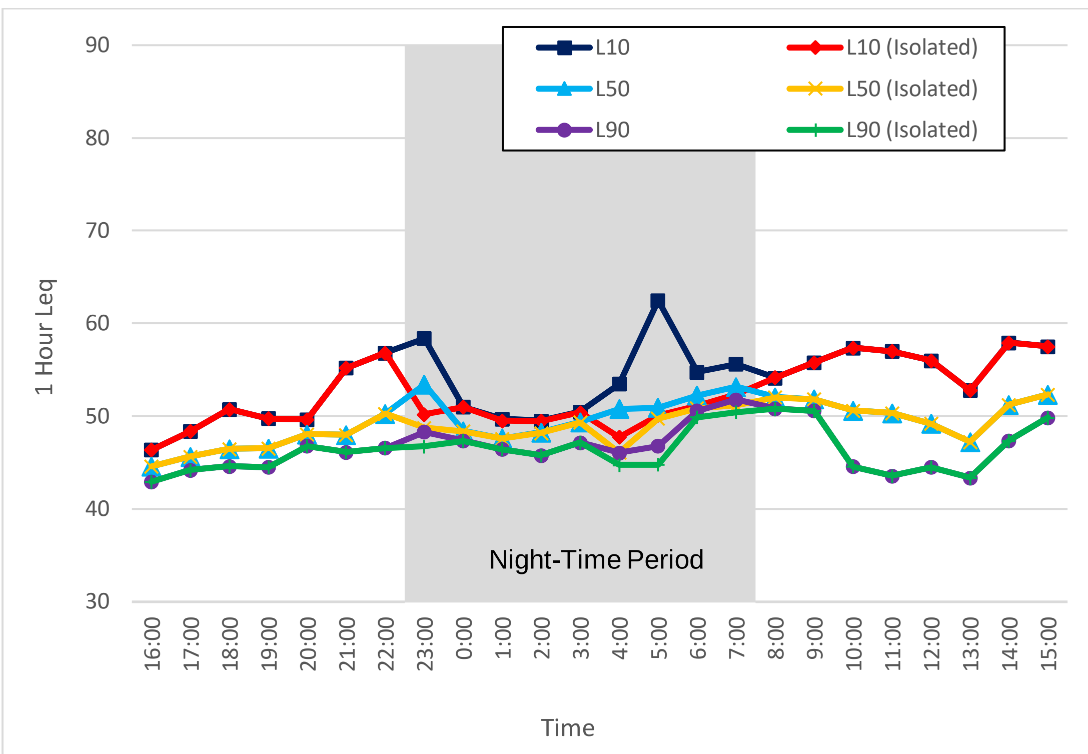

Figure 27. Noise Monitor #2, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (July 23 - 24, 2019)

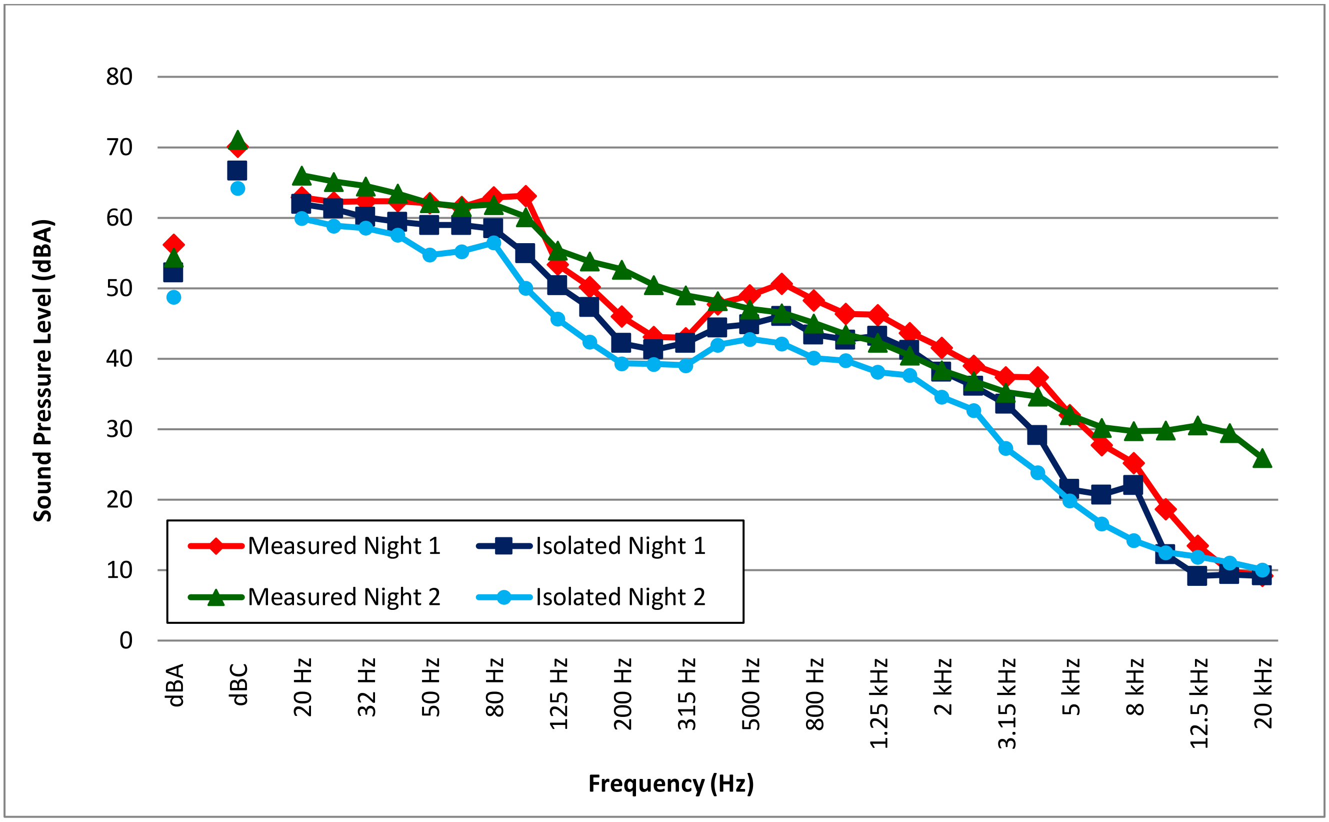

Figure 28. Noise Monitor #2, 1/3 Octave L_{eq} Sound Levels (July 22 - 24, 2019)

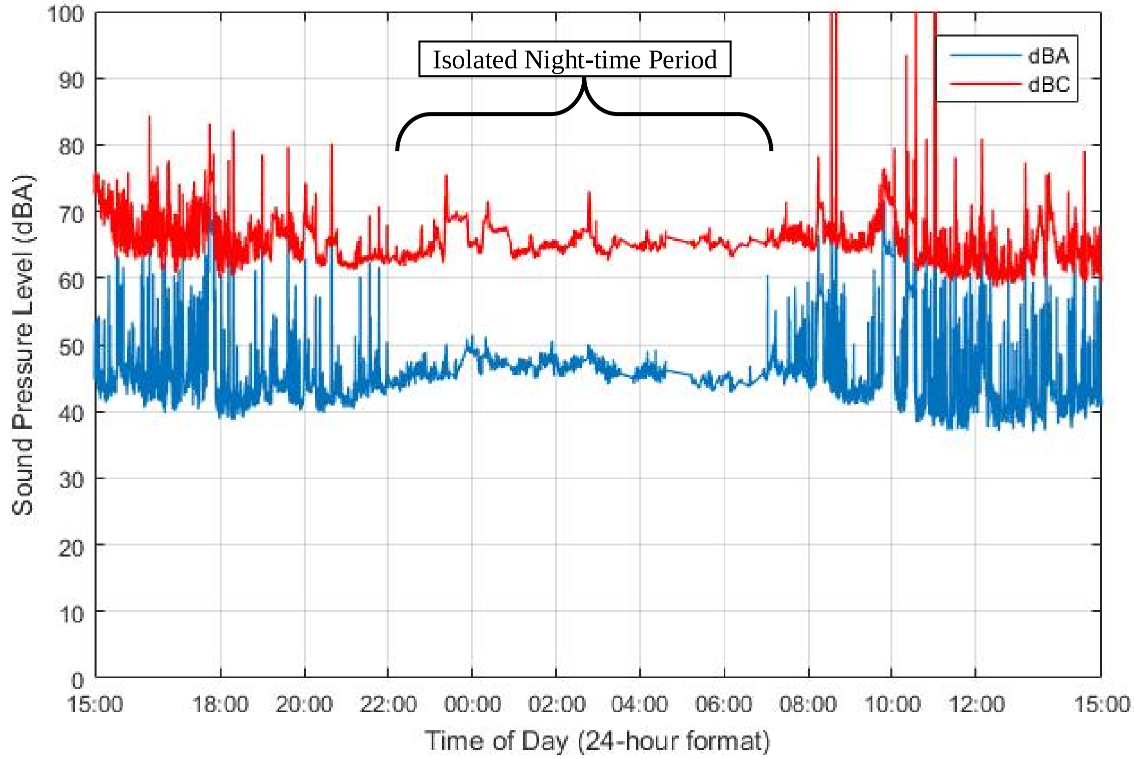

Figure 29. Noise Monitor #3, 15-Second L_{eq} Sound Levels (July 22 - 23, 2019)

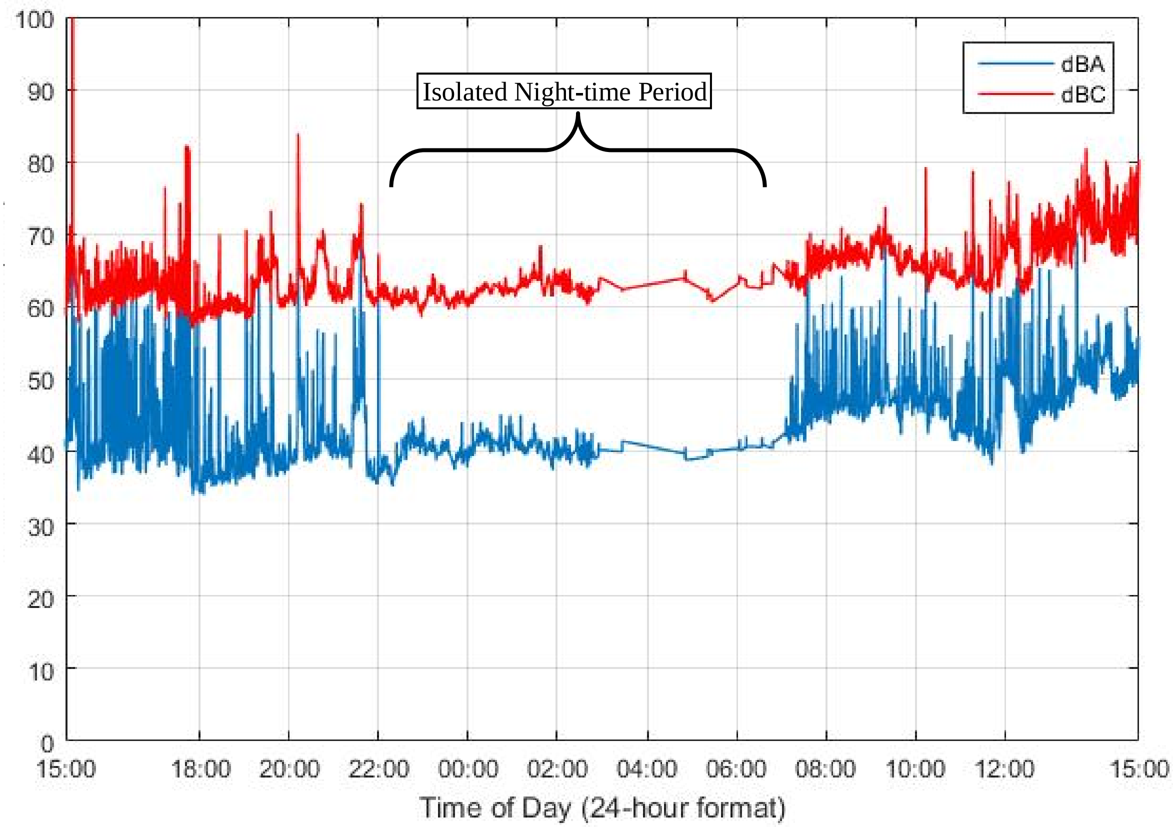

Figure 30. Noise Monitor #3, 15-Second L_{eq} Sound Levels (July 23 - 24, 2019)

Noise Monitor #3

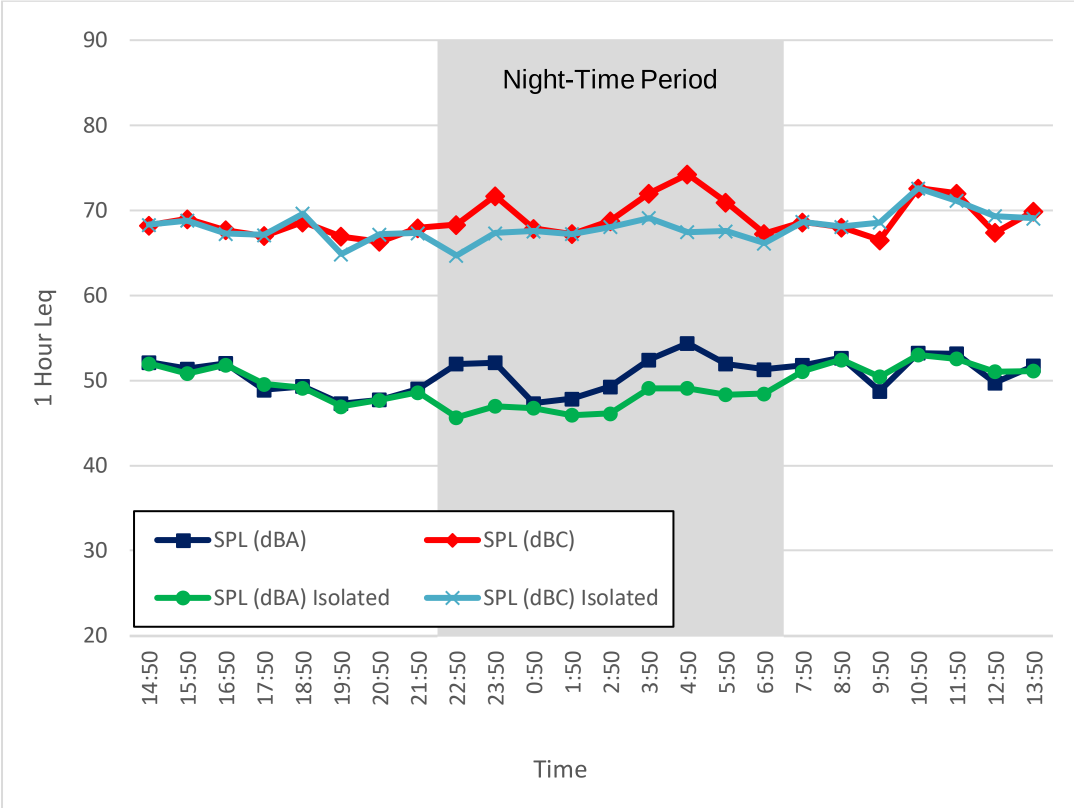

Figure 31. Noise Monitor #3, 1-Hour L_{eq} Sound Levels (July 22 - 23, 2019)

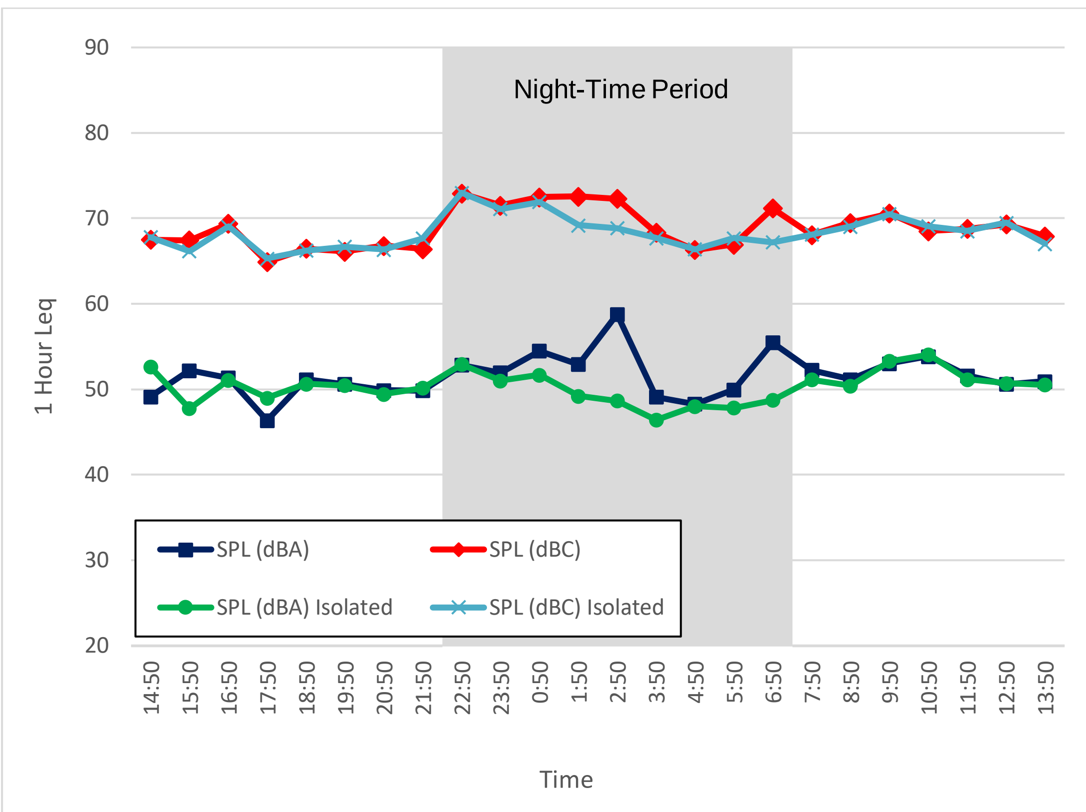

Figure 32. Noise Monitor #3, 1-Hour L_{eq} Sound Levels (July 23 - 24, 2019)

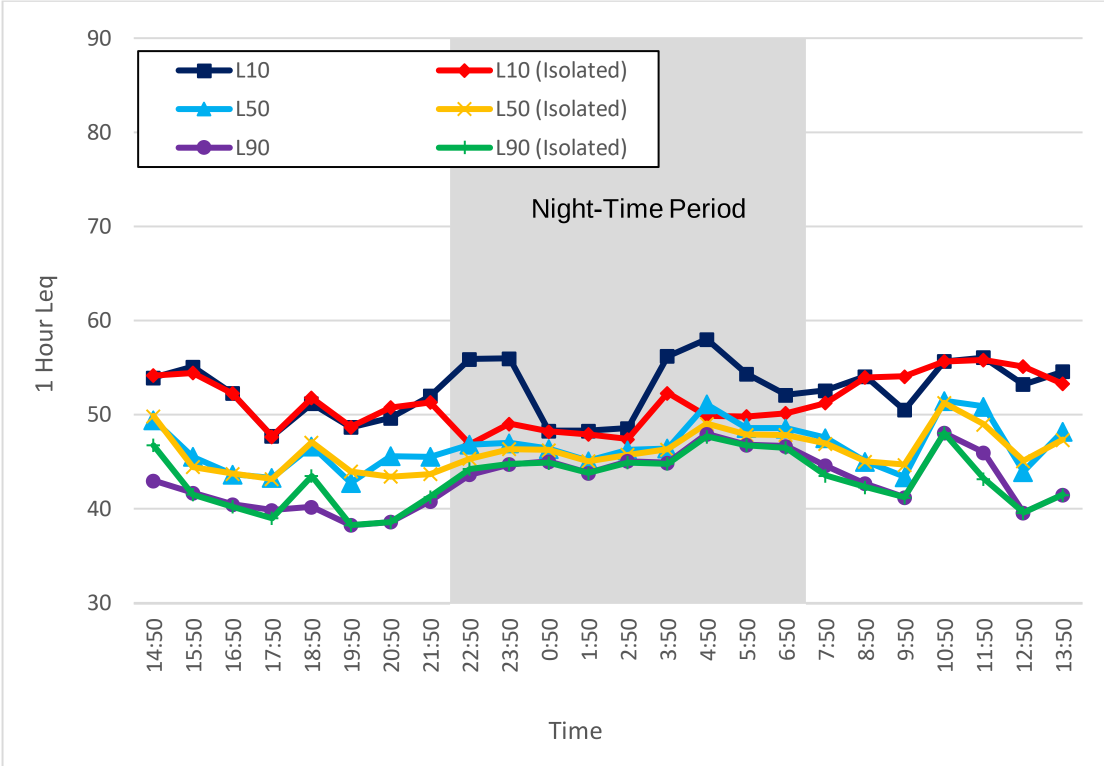

Figure 33. Noise Monitor #3, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (July 22 - 23, 2019)

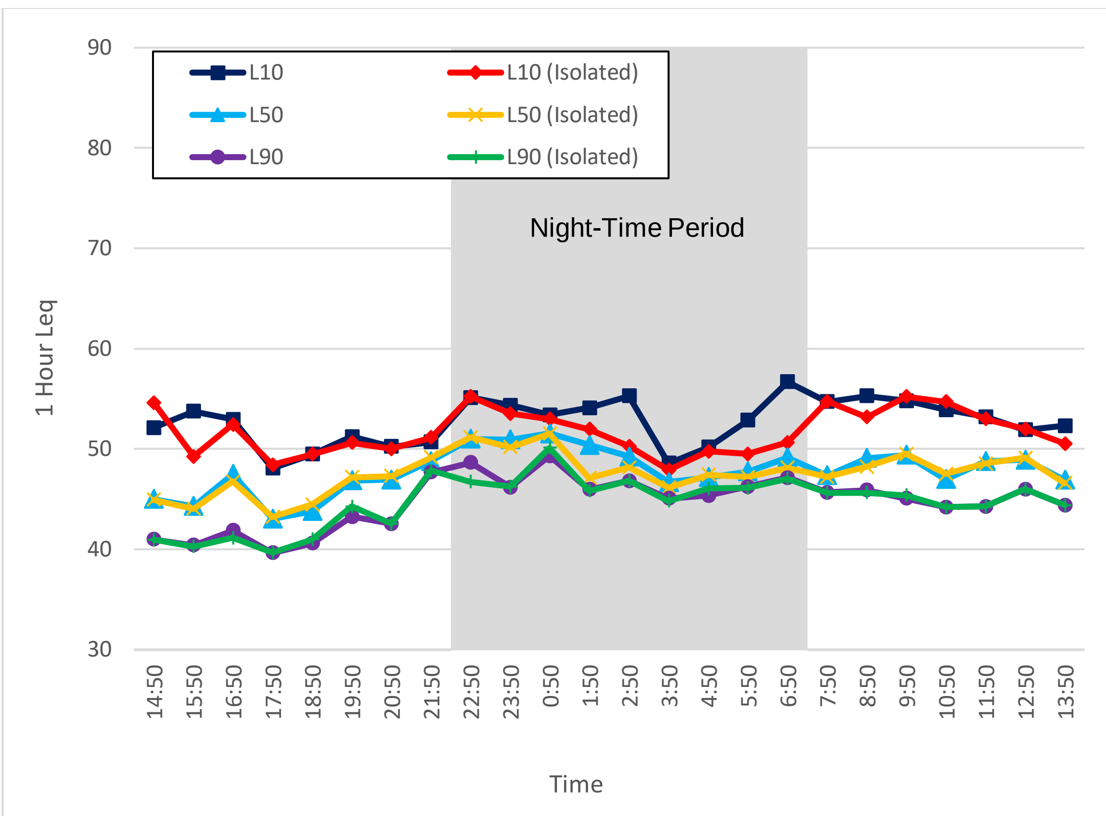

Figure 34. Noise Monitor #3, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (July 23 - 24, 2019)

Noise Monitor #3

Noise Monitor #3

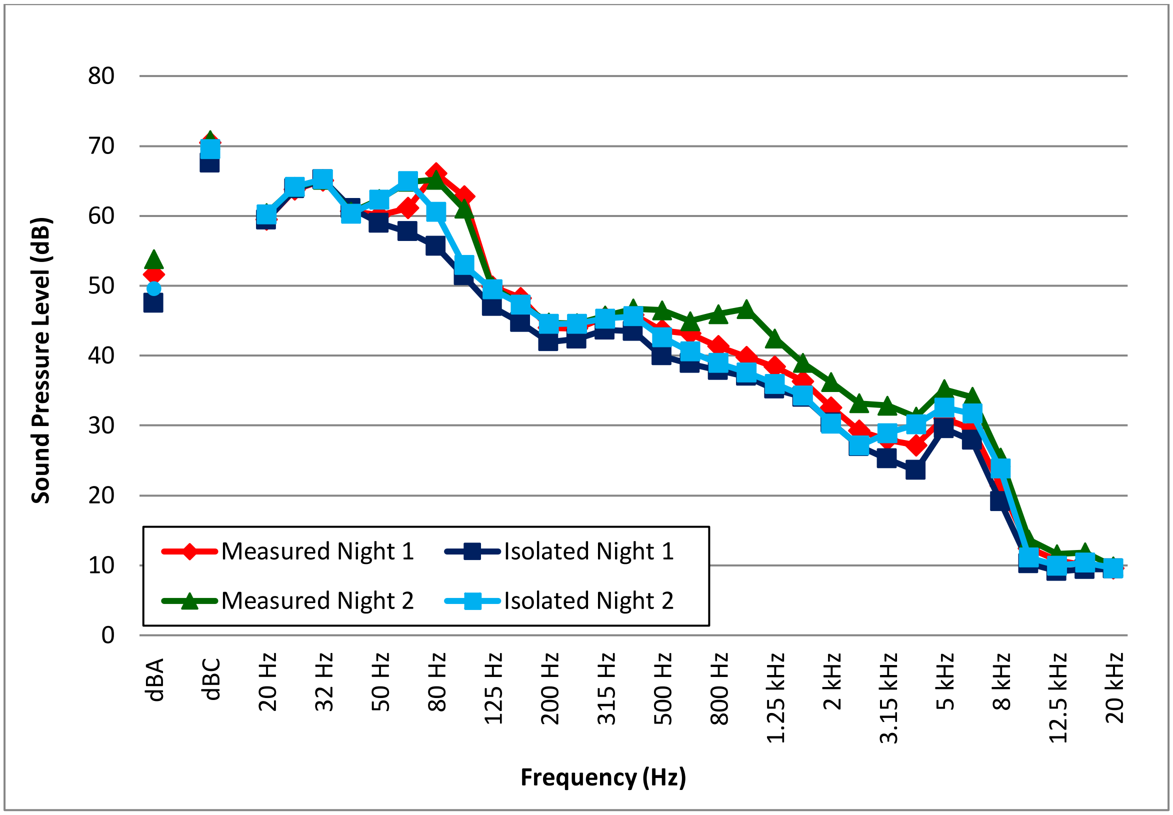

Figure 35. Noise Monitor #3, 1/3 Octave L_{eq} Sound Levels (July 22 - 24, 2019)

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Noise Monitor #4

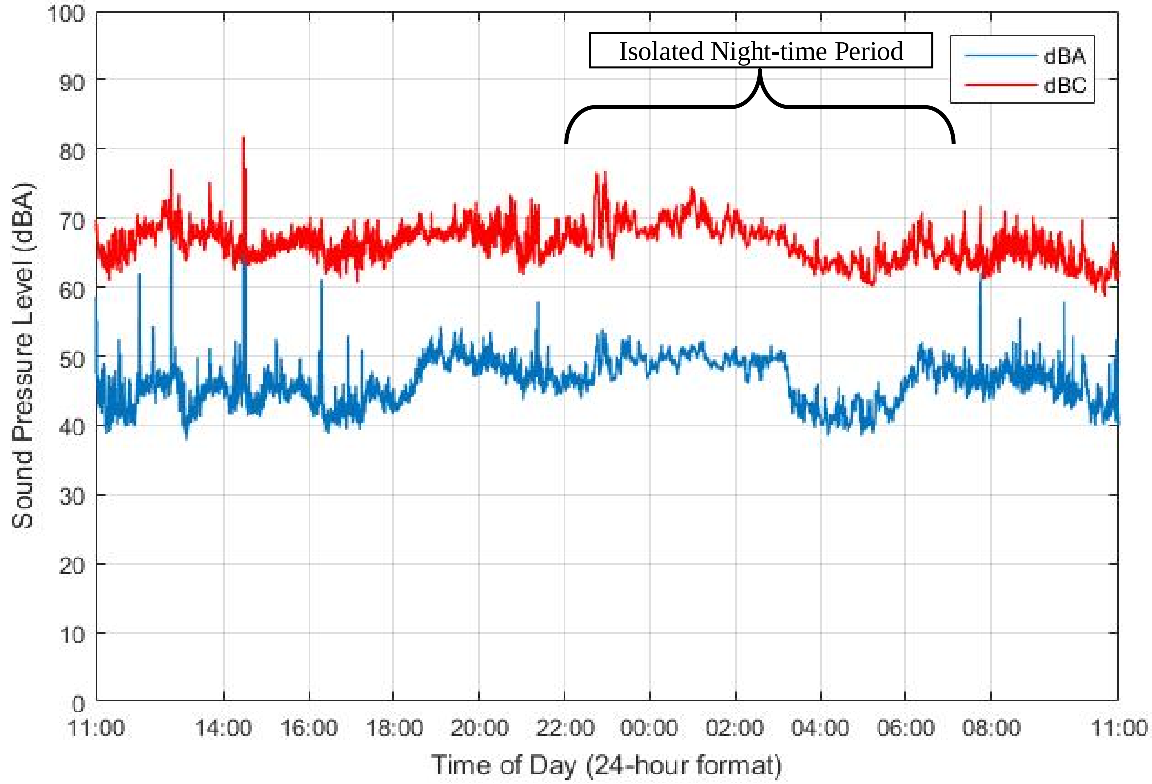

Figure 36. Noise Monitor #4, 15-Second L_{eq} Sound Levels (October 21 - 22, 2019)

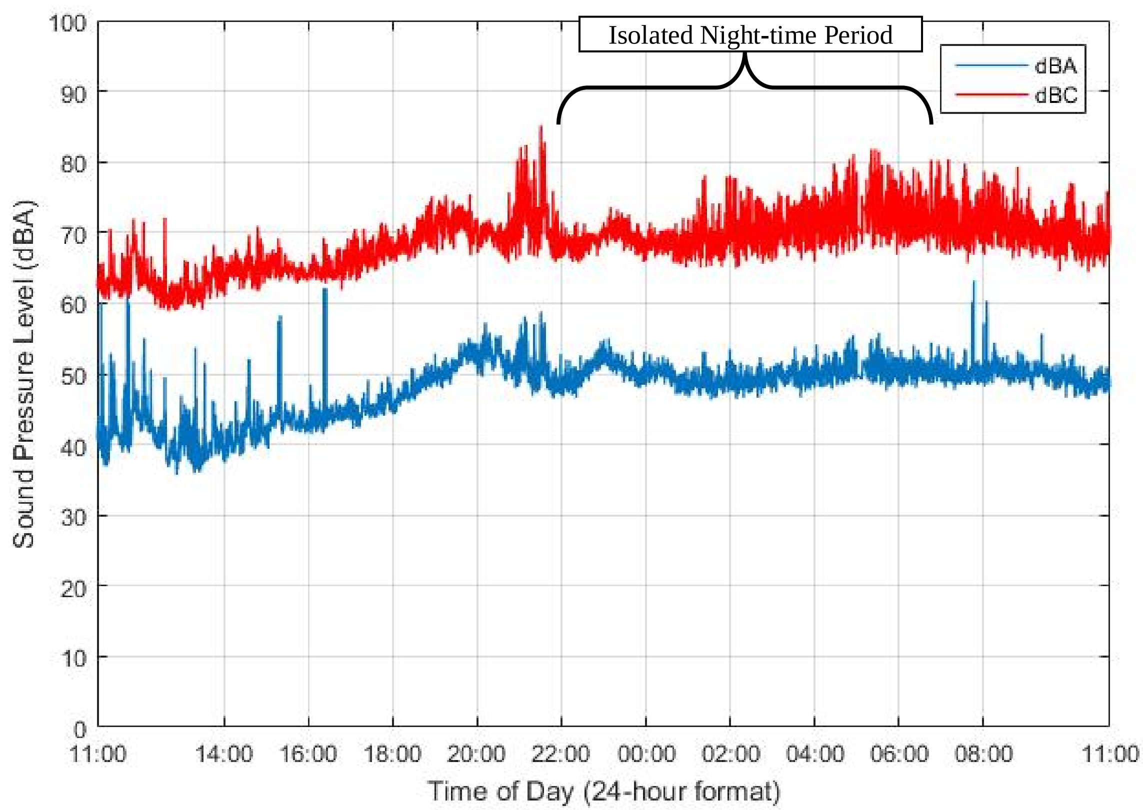

Figure 37. Noise Monitor #4, 15-Second L_{eq} Sound Levels (October 22 - 23, 2019)

Noise Monitor #4

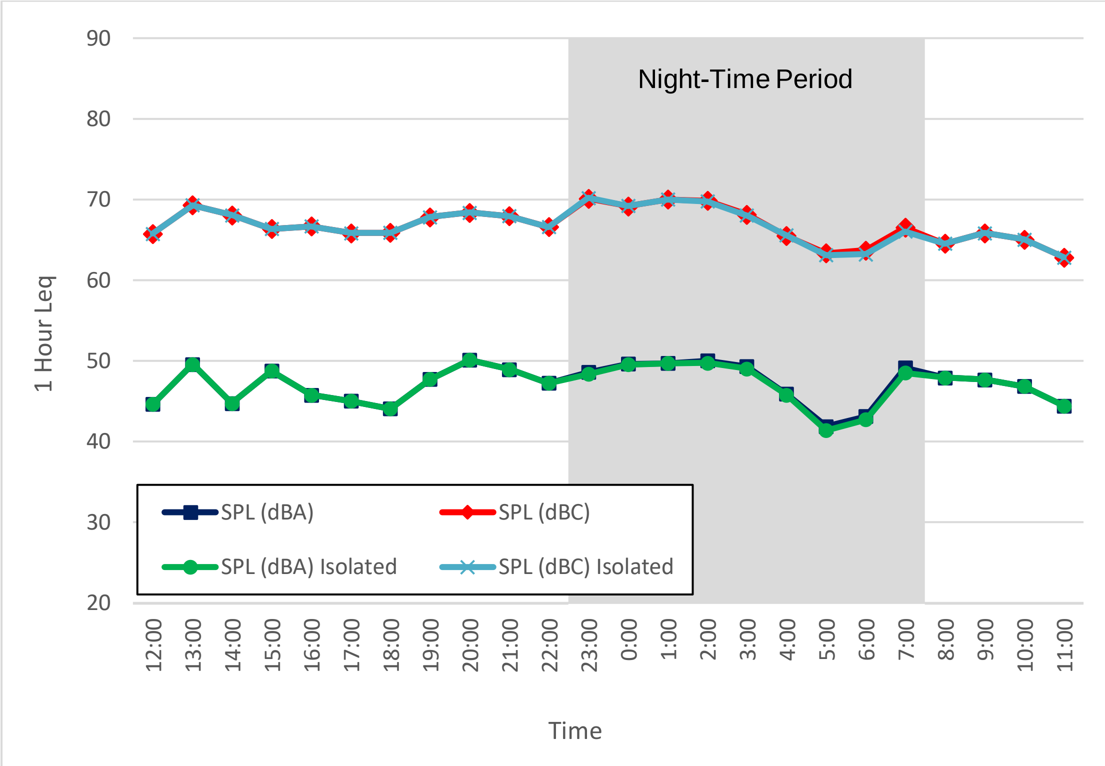

Figure 38. Noise Monitor #4, 1-Hour L_{eq} Sound Levels (October 21 - 22, 2019)

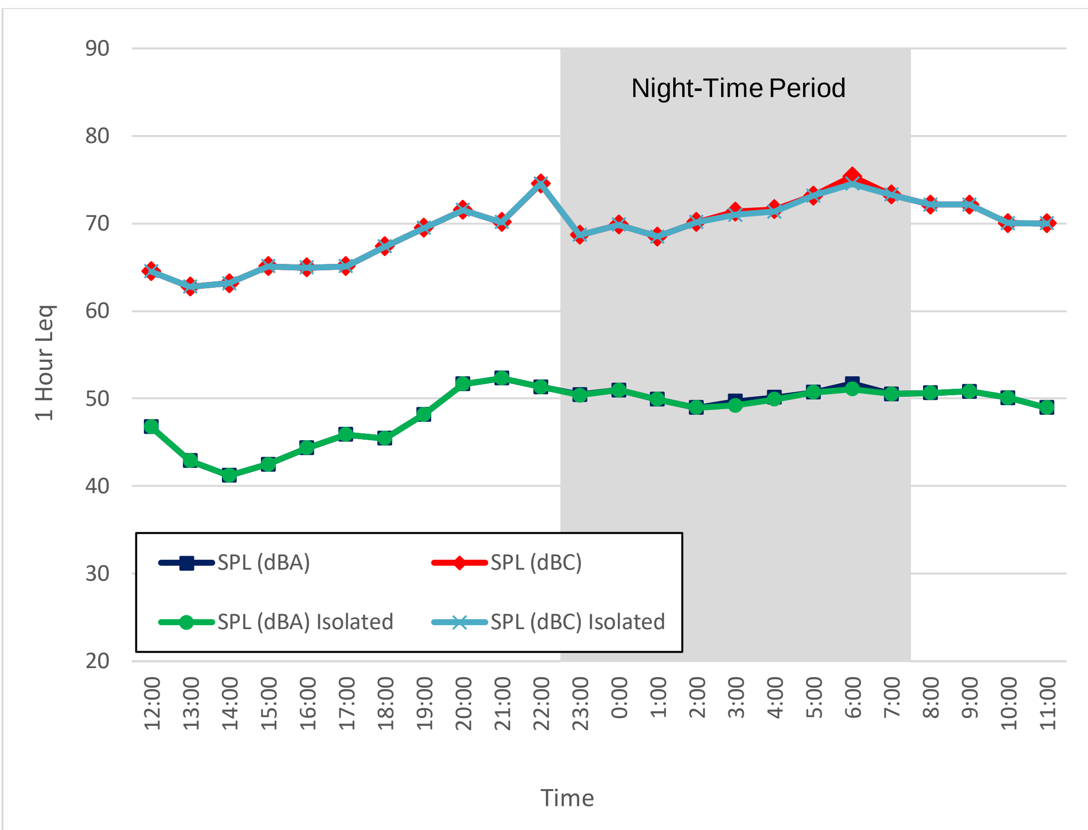

Figure 39. Noise Monitor #4, 1-Hour L_{eq} Sound Levels (October 22 - 23, 2019)

Noise Monitor #4

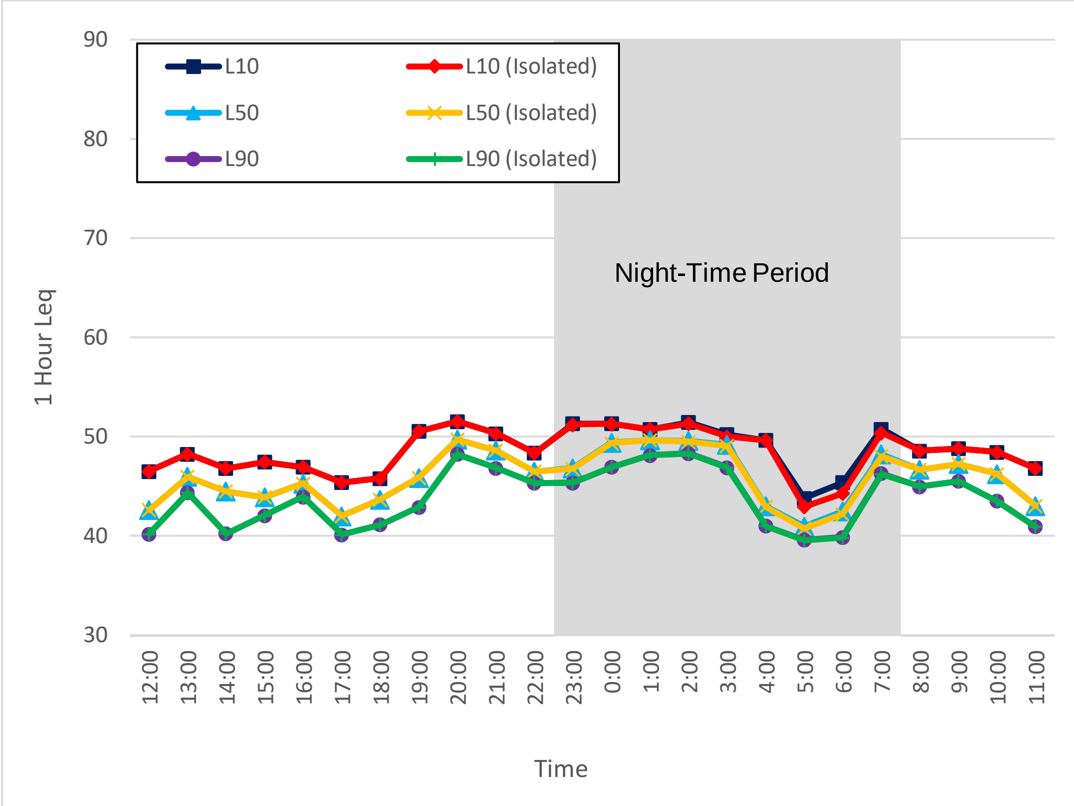

Figure 40. Noise Monitor #4, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (October 21 - 22, 2019)

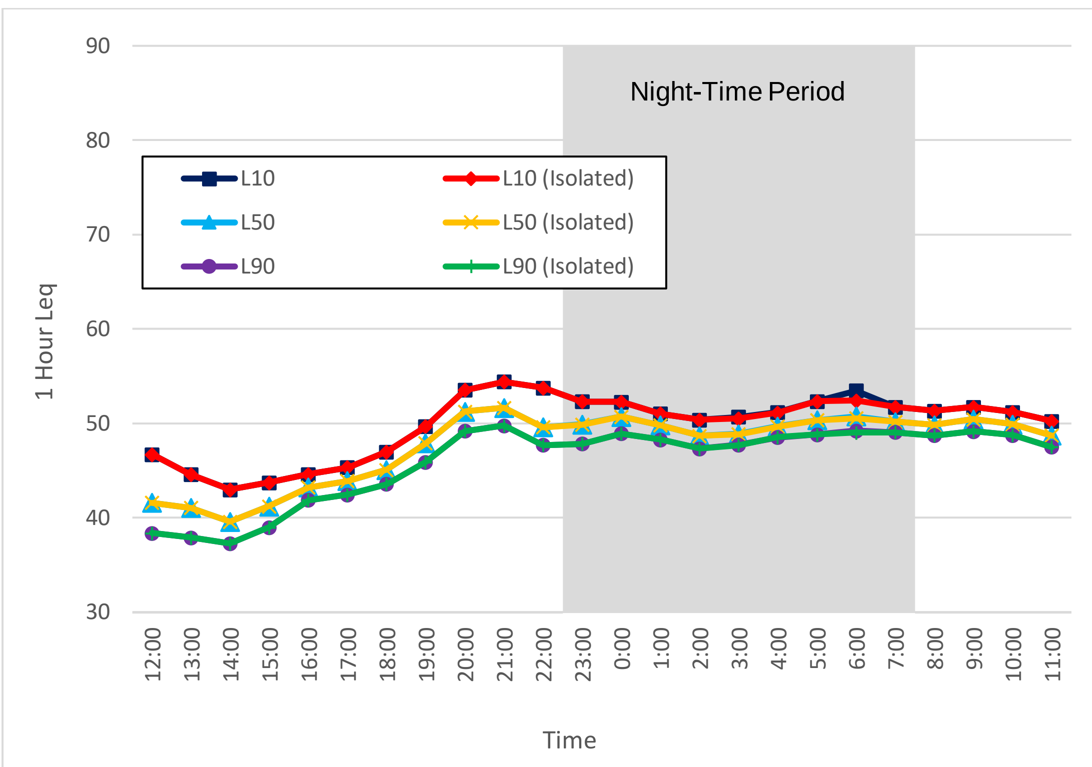

Figure 41. Noise Monitor #4, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (October 22 - 23, 2019)

Noise Monitor #4

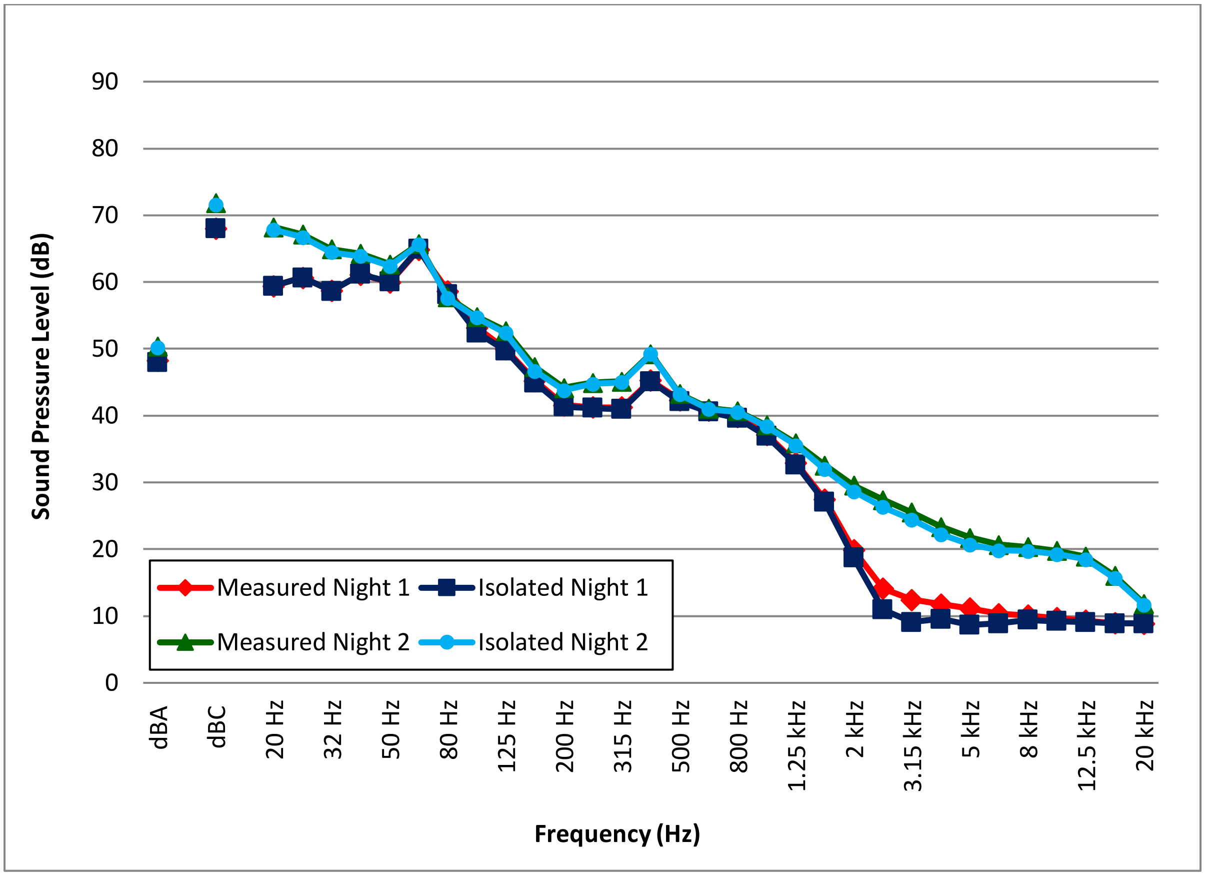

Figure 42. Noise Monitor #4, 1/3 Octave L_{eq} Sound Levels (October 21 - 23, 2019)

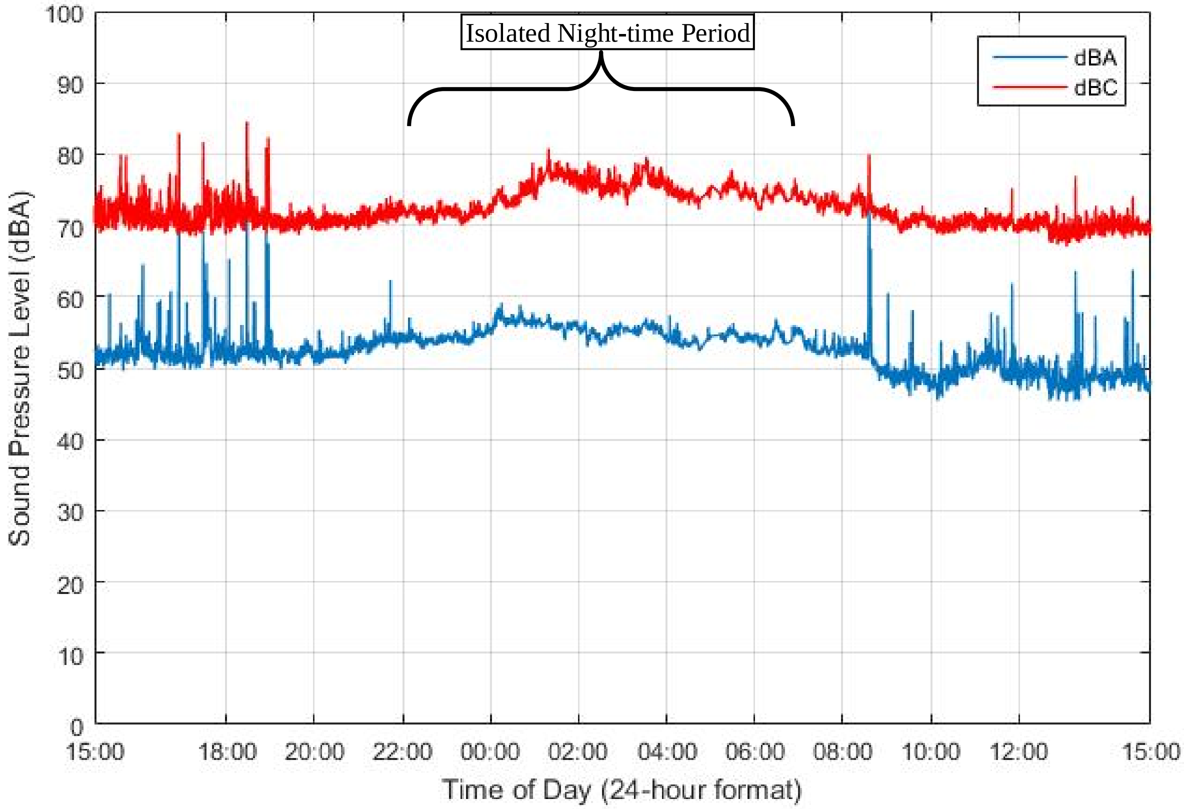

Figure 43. Noise Monitor #5, 15-Second L_{eq} Sound Levels (July 22 – 23, 2019)

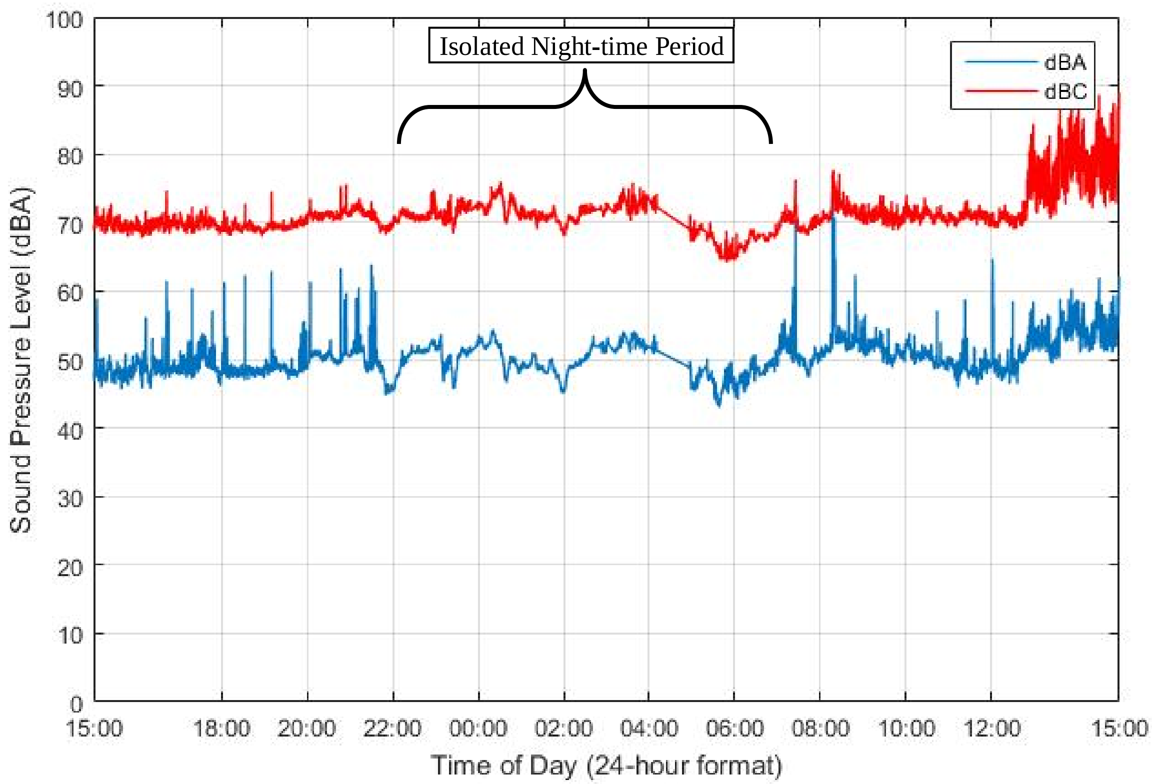

Figure 44. Noise Monitor #5, 15-Second L_{eq} Sound Levels (July 23 – 24, 2019)

Noise Monitor #5

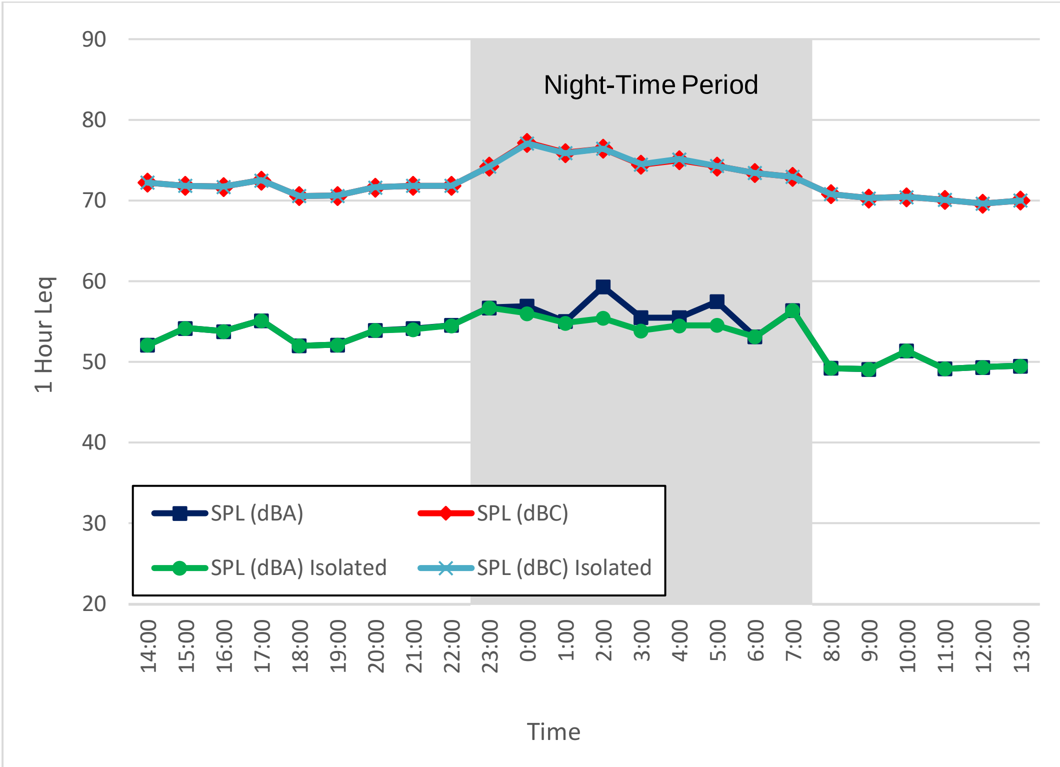

Figure 45. Noise Monitor #5, 1-Hour L_{eq} Sound Levels (July 22 – 23, 2019)

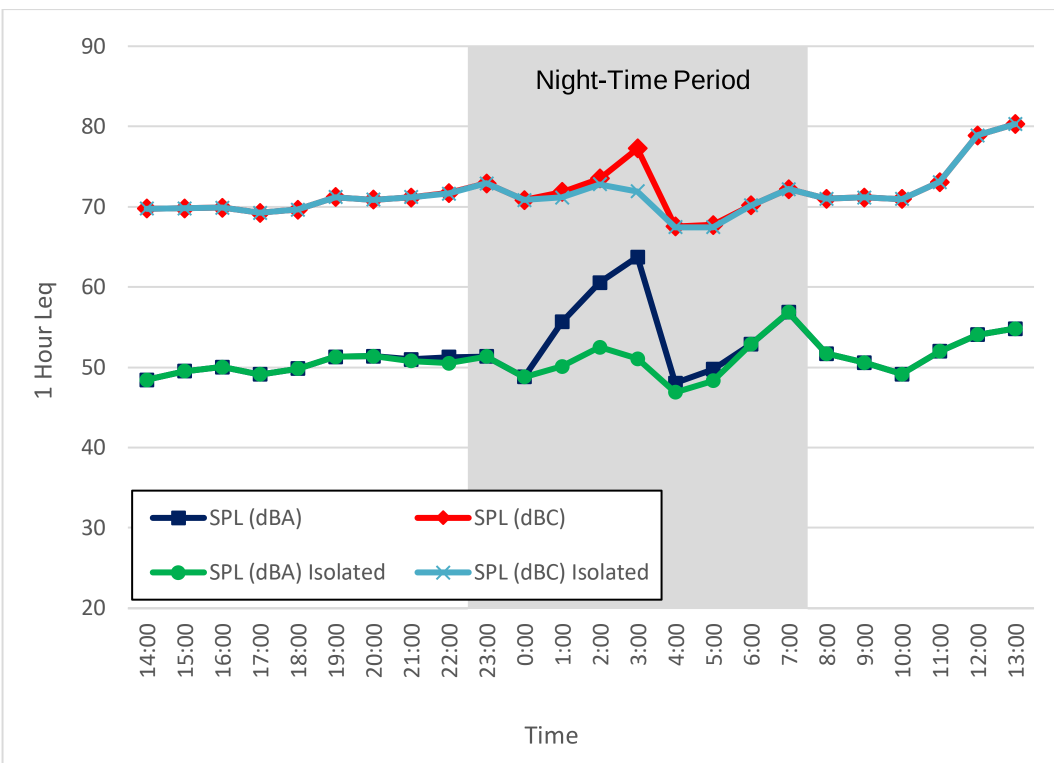

Figure 46. Noise Monitor #5, 1-Hour L_{eq} Sound Levels (July 23 – 24, 2019)

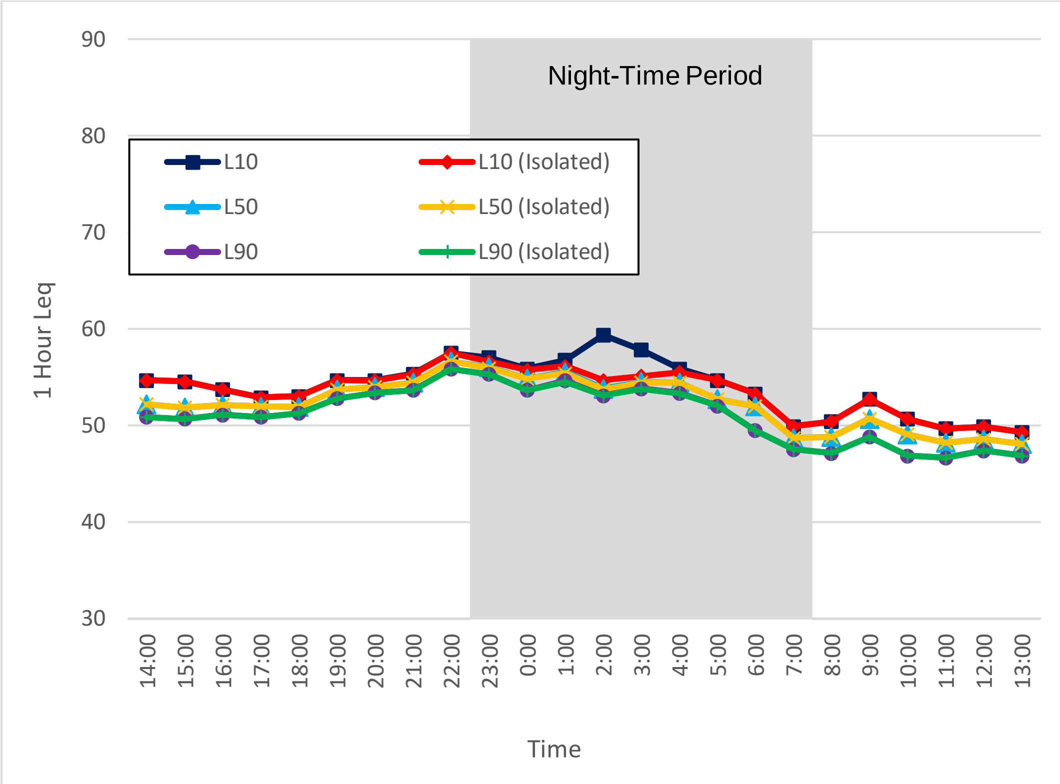

Figure 47. Noise Monitor #5, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (July 22 – 23, 2019)

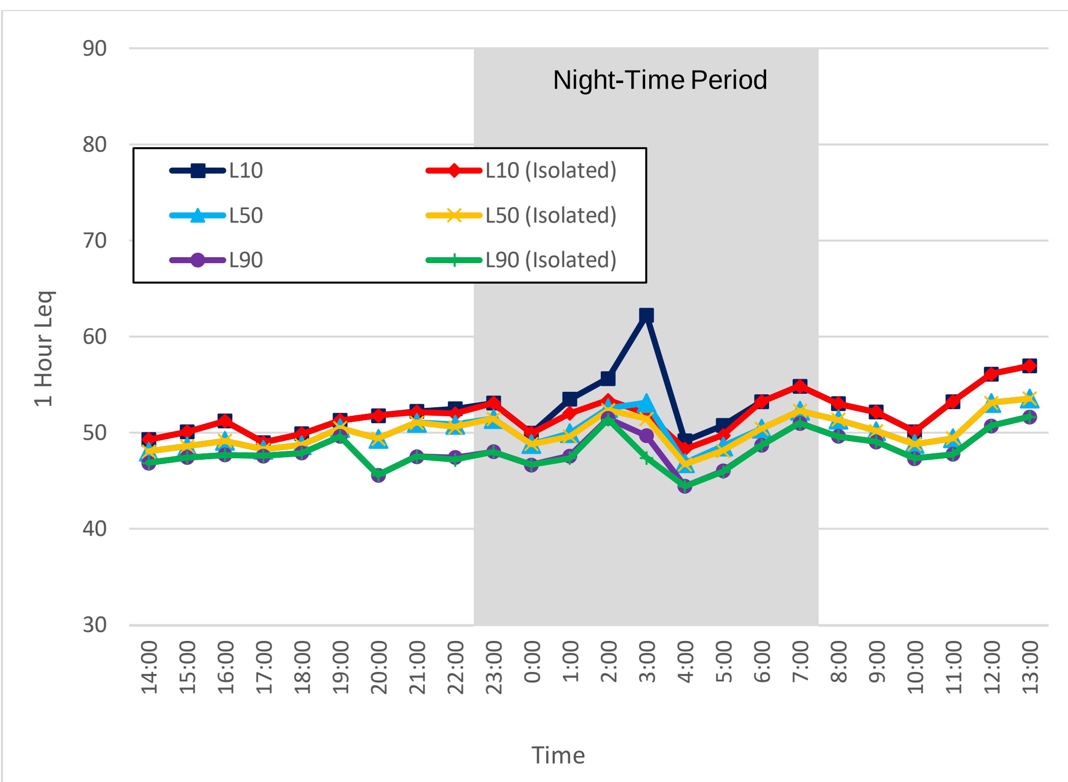

Figure 48. Noise Monitor #5, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (July 23 – 24, 2019)

Noise Monitor #5

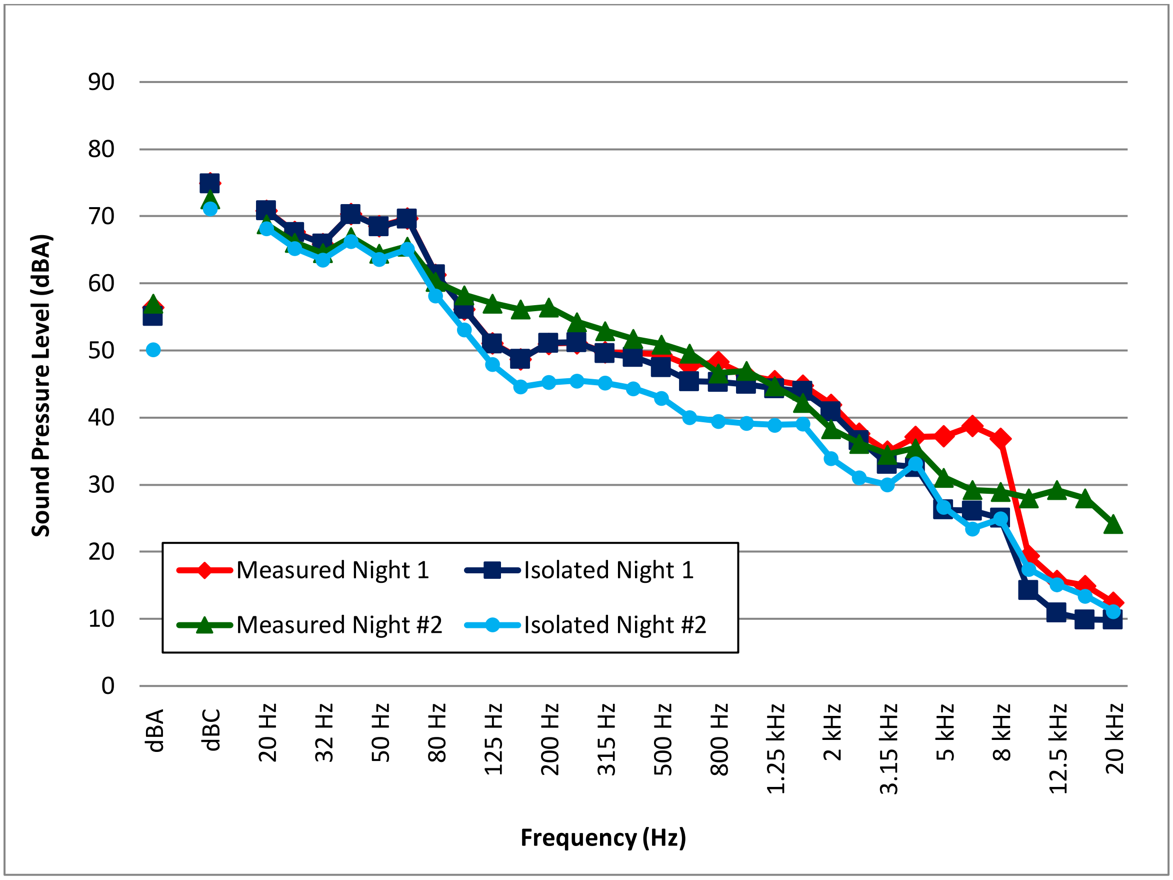

Figure 49. Noise Monitor #5, 1/3 Octave L_{eq} Sound Levels (July 22 – 24, 2019)

Noise Monitor #6

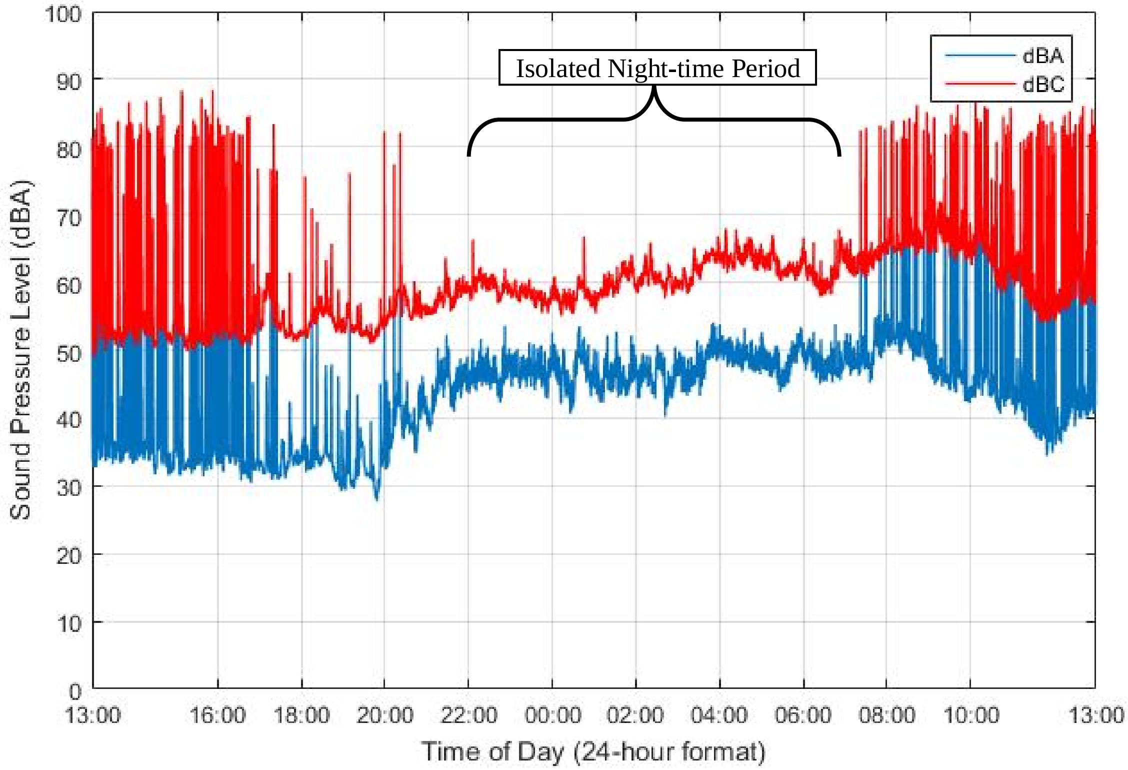

Figure 50. Noise Monitor #6, 15-Second L_{eq} Sound Levels (September 18 – 19, 2019)

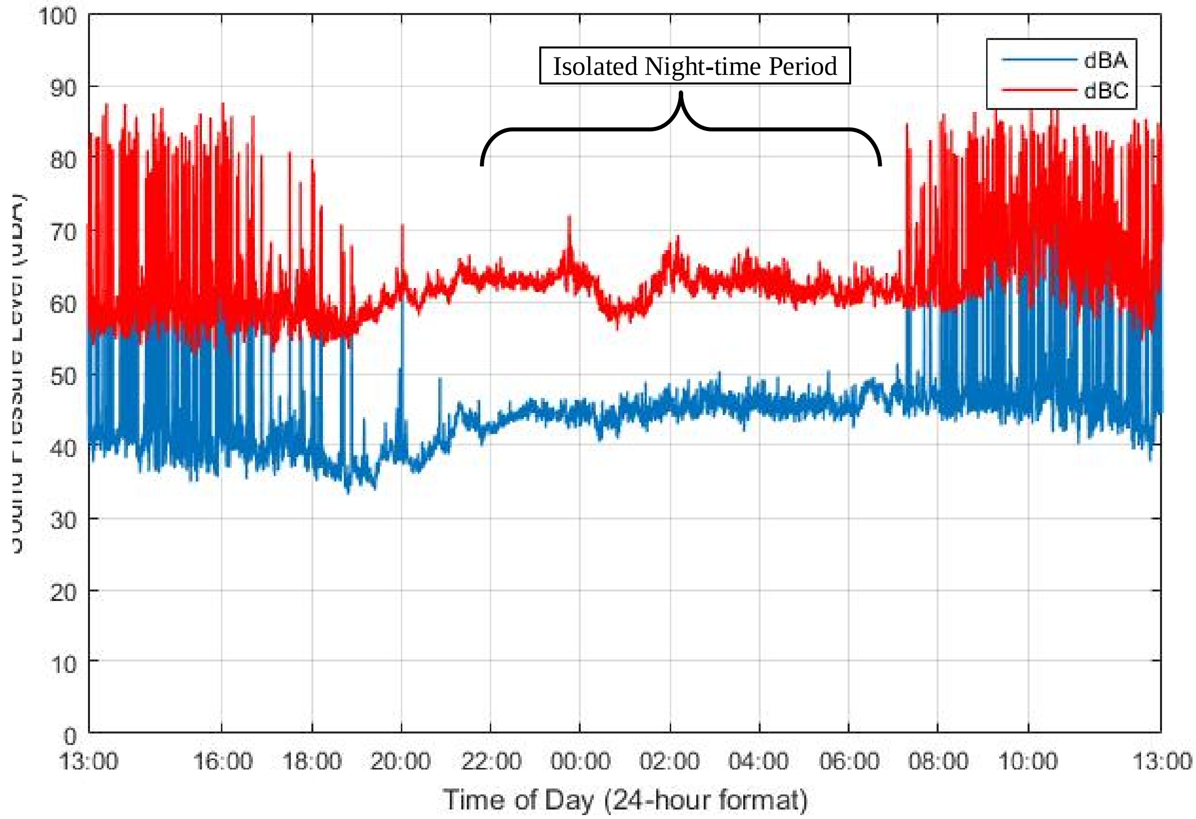

Figure 51. Noise Monitor #6, 15-Second L_{eq} Sound Levels (September 19 – 20, 2019)

Noise Monitor #6

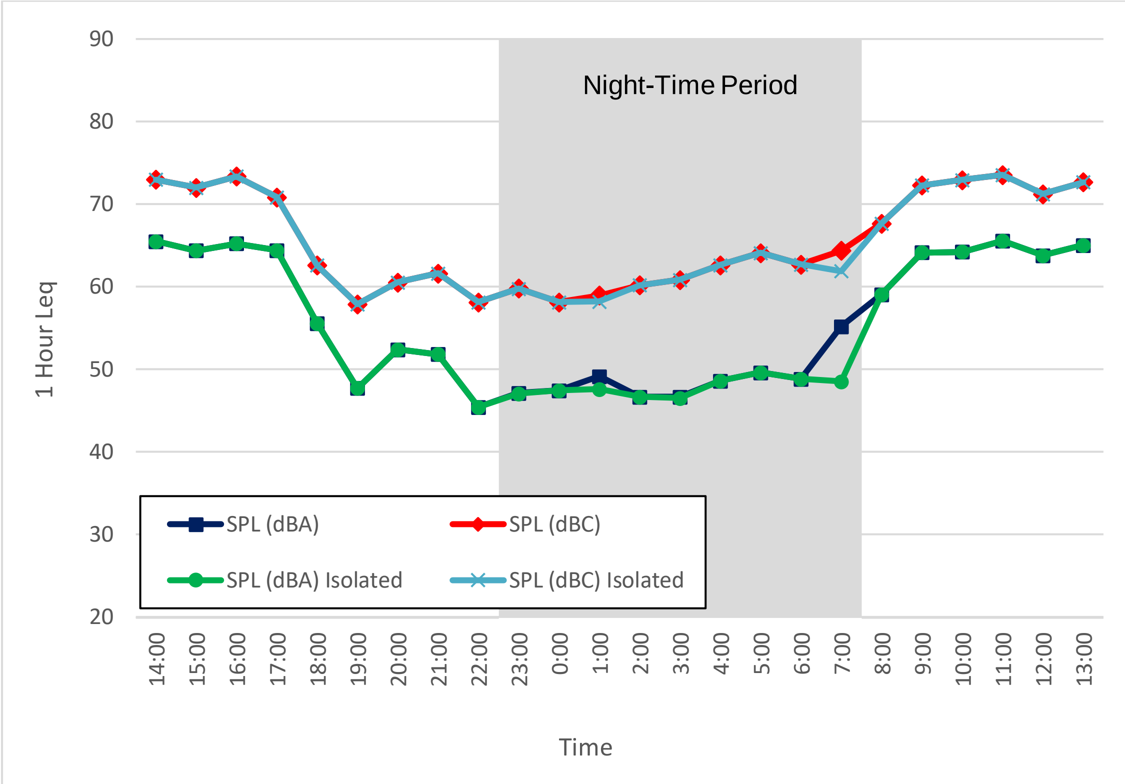

Figure 52. Noise Monitor #6, 1-Hour L_{eq} Sound Levels (September 18 – 19, 2019)

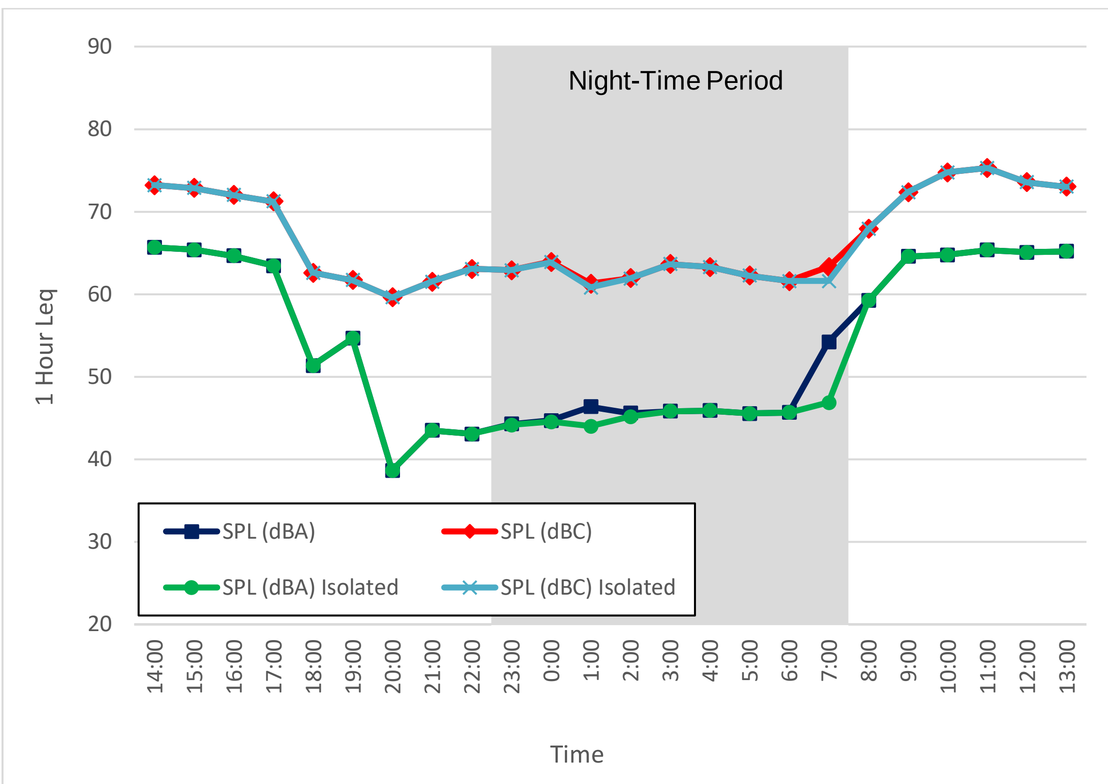

Figure 53. Noise Monitor #6, 1-Hour L_{eq} Sound Levels (September 19 – 20, 2019)

Noise Monitor #6

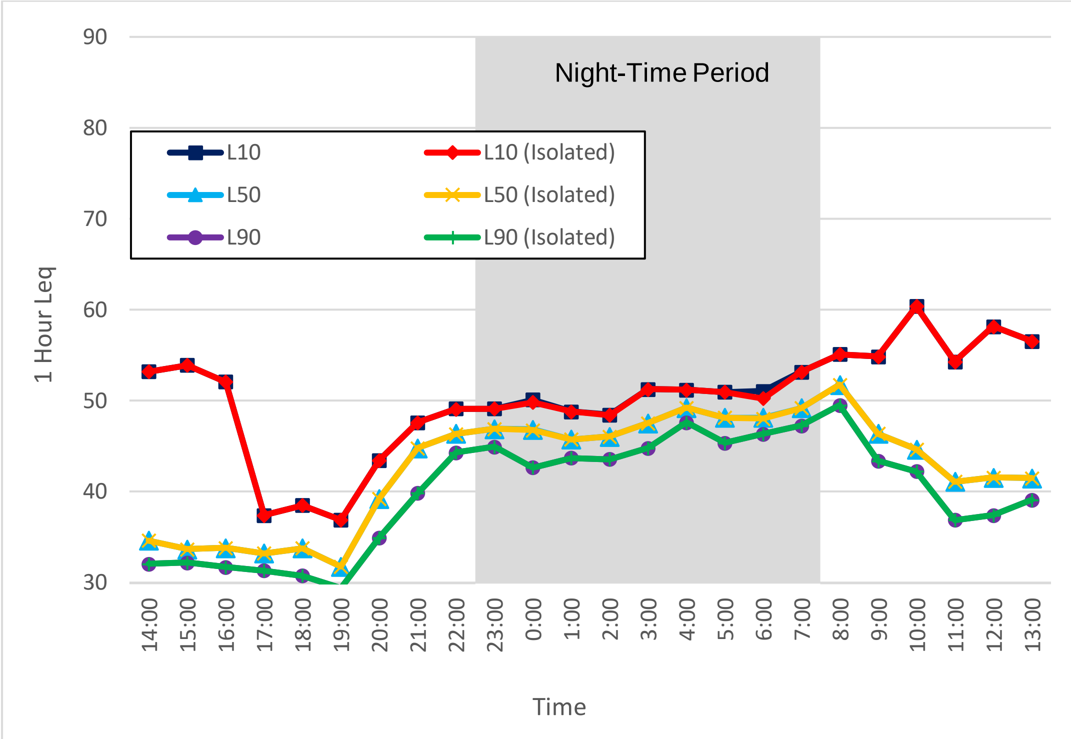

Figure 54. Noise Monitor #6, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (September 18 – 19, 2019)

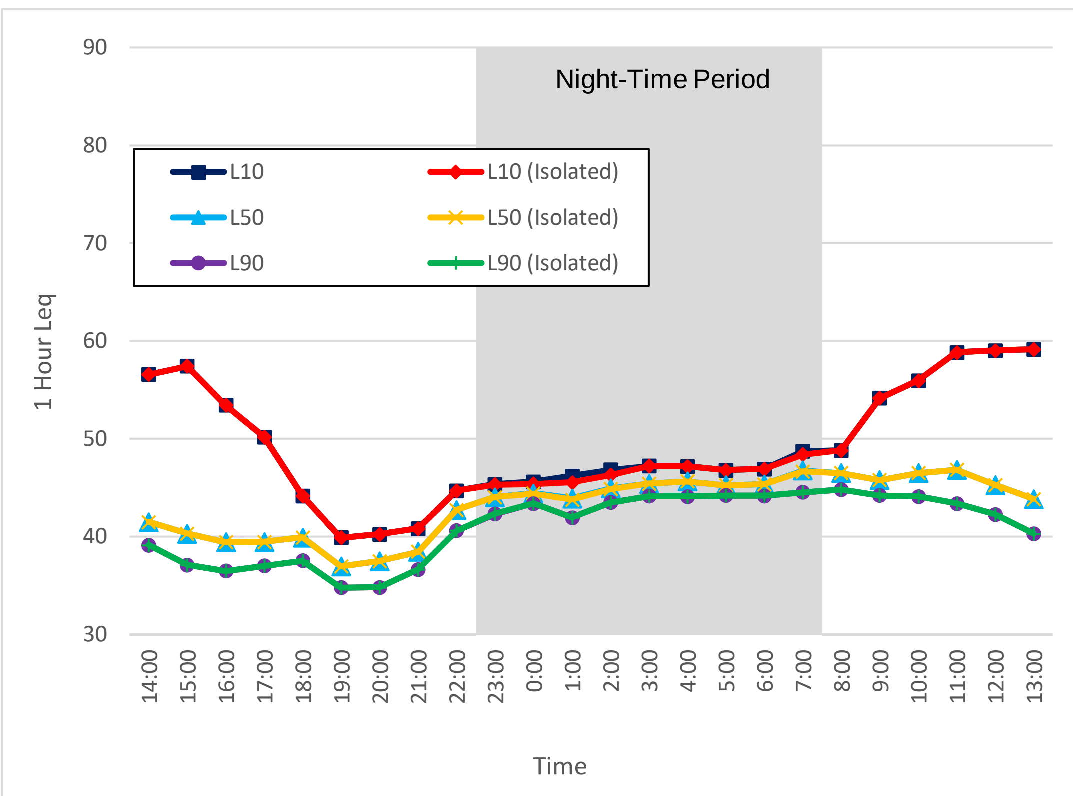

Figure 55. Noise Monitor #6, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (September 19 – 20, 2019)

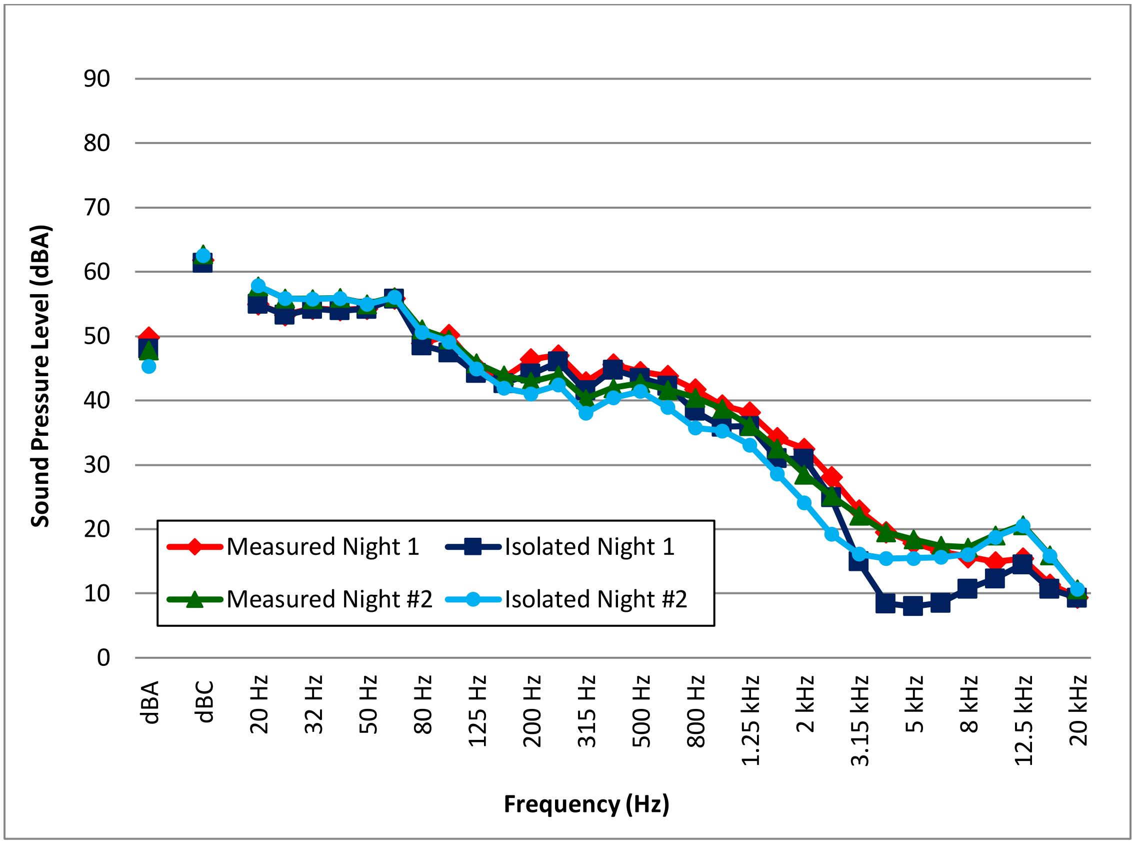

Figure 56. Noise Monitor #6, 1/3 Octave L_{eq} Sound Levels (September 18 – 20, 2019)

Noise Monitor #8

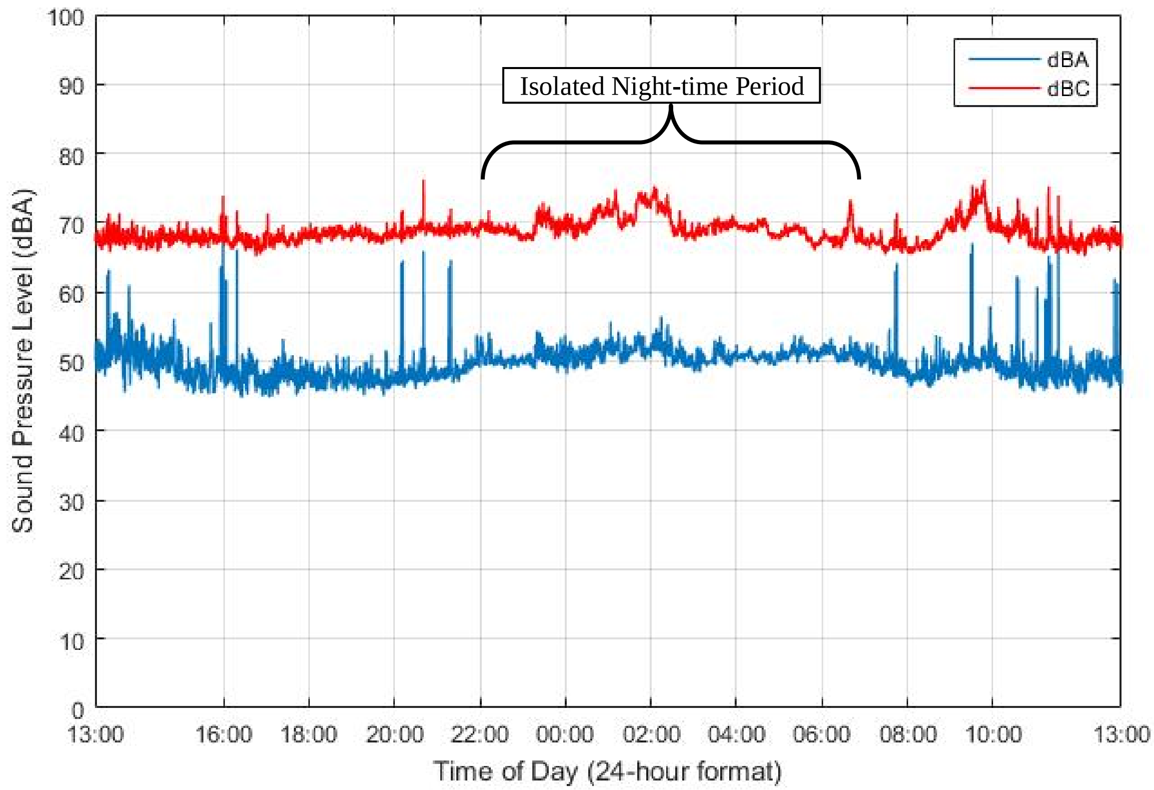

Figure 57. Noise Monitor #8, 15-Second L_{eq} Sound Levels (July 22 - 23, 2019)

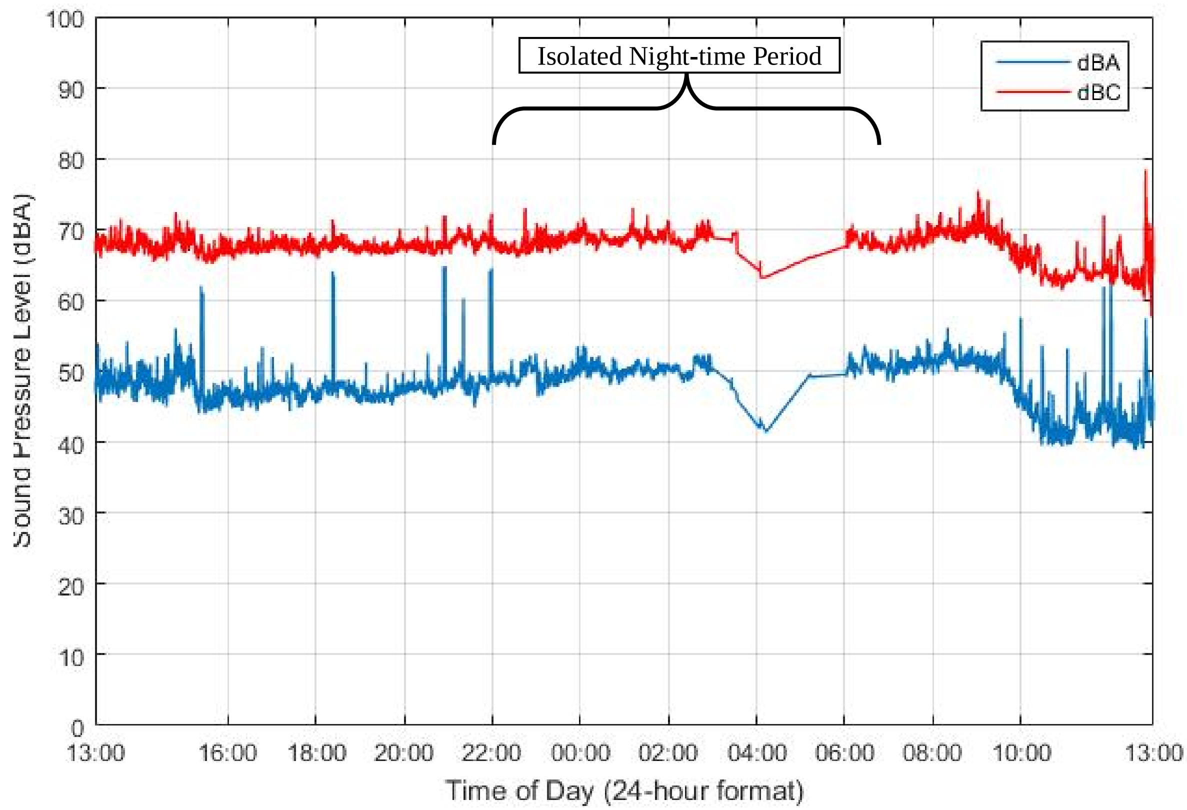

Figure 58. Noise Monitor #8, 15-Second L_{eq} Sound Levels (July 23 - 24, 2019)

Noise Monitor #8

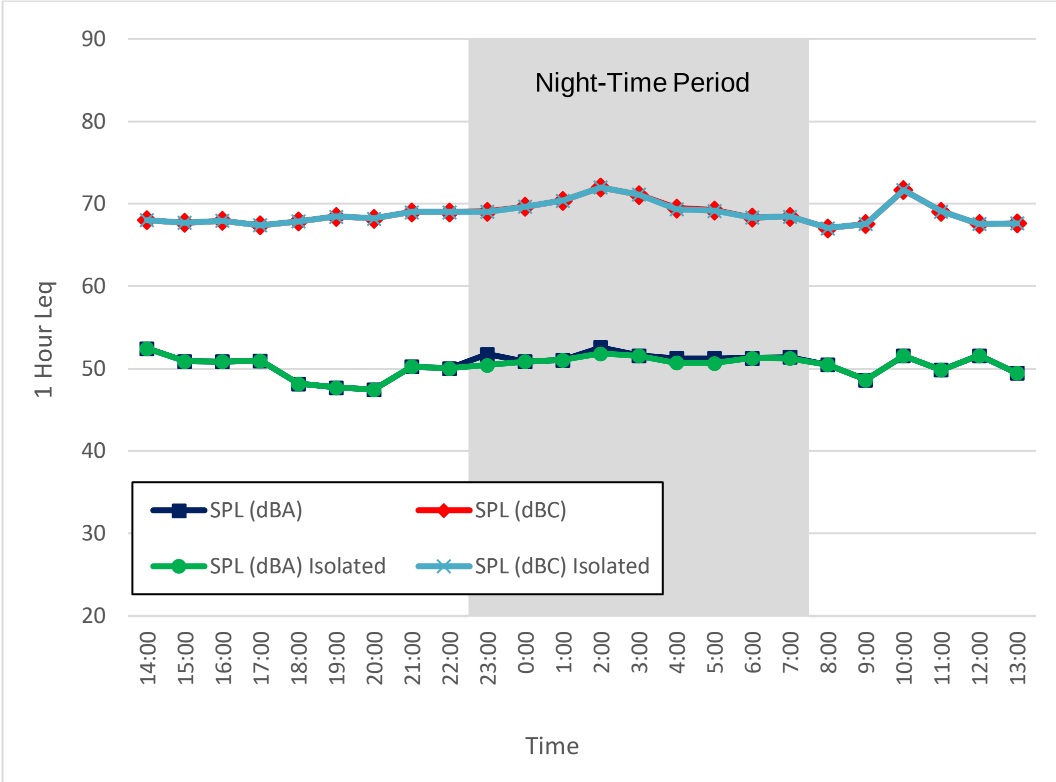

Figure 59. Noise Monitor #8, 1-Hour L_{eq} Sound Levels (July 22 - 23, 2019)

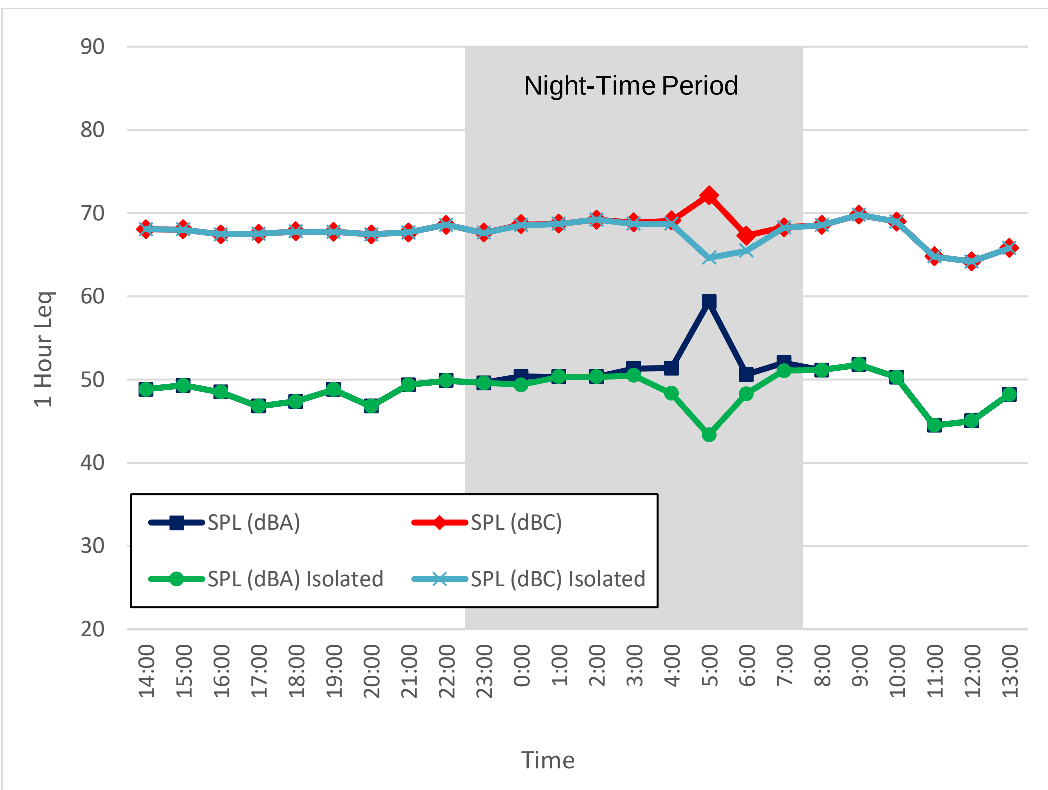

Figure 60. Noise Monitor #8, 1-Hour L_{eq} Sound Levels (July 23 - 24, 2019)

Monitor #8

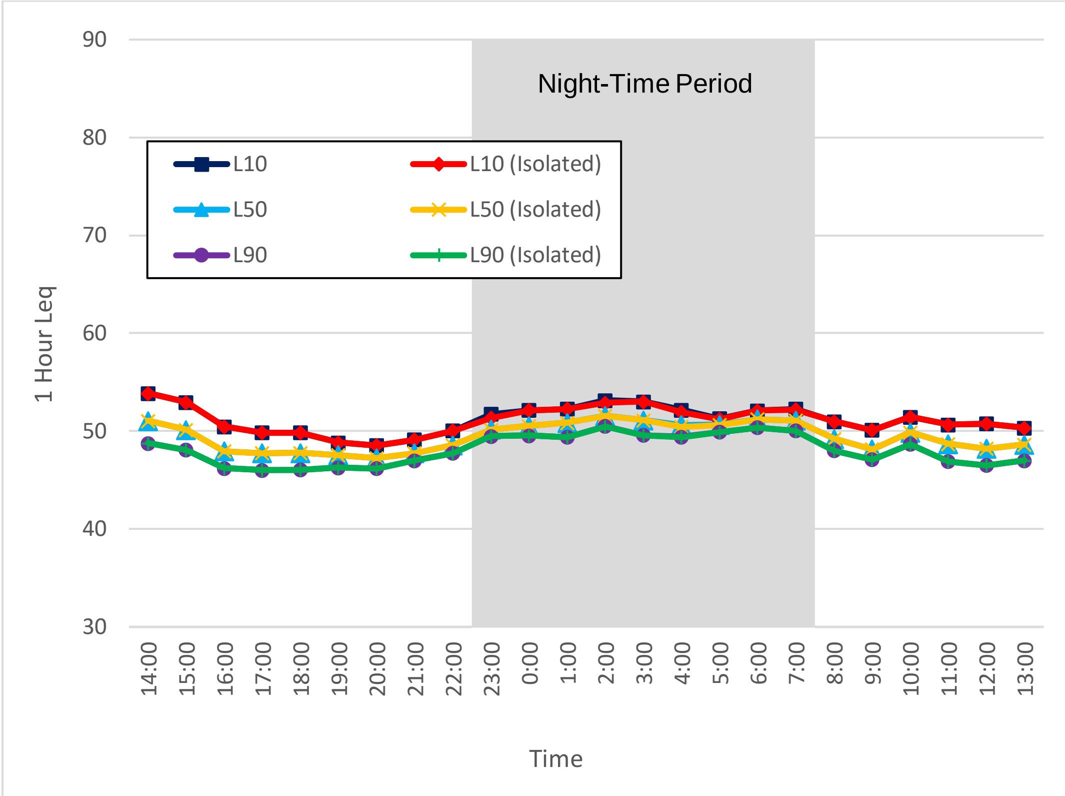

Figure 61. Noise Monitor #8, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (July 22 - 23, 2019)

Noise

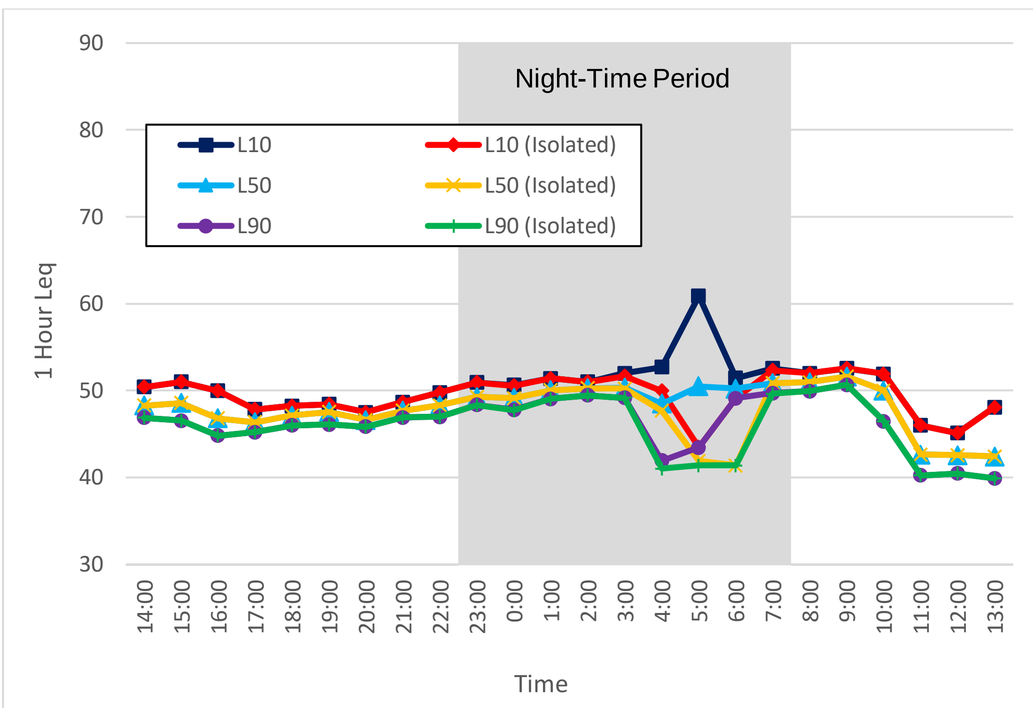

Figure 62. Noise Monitor #8, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (July 23 - 24, 2019)

Noise Monitor #8

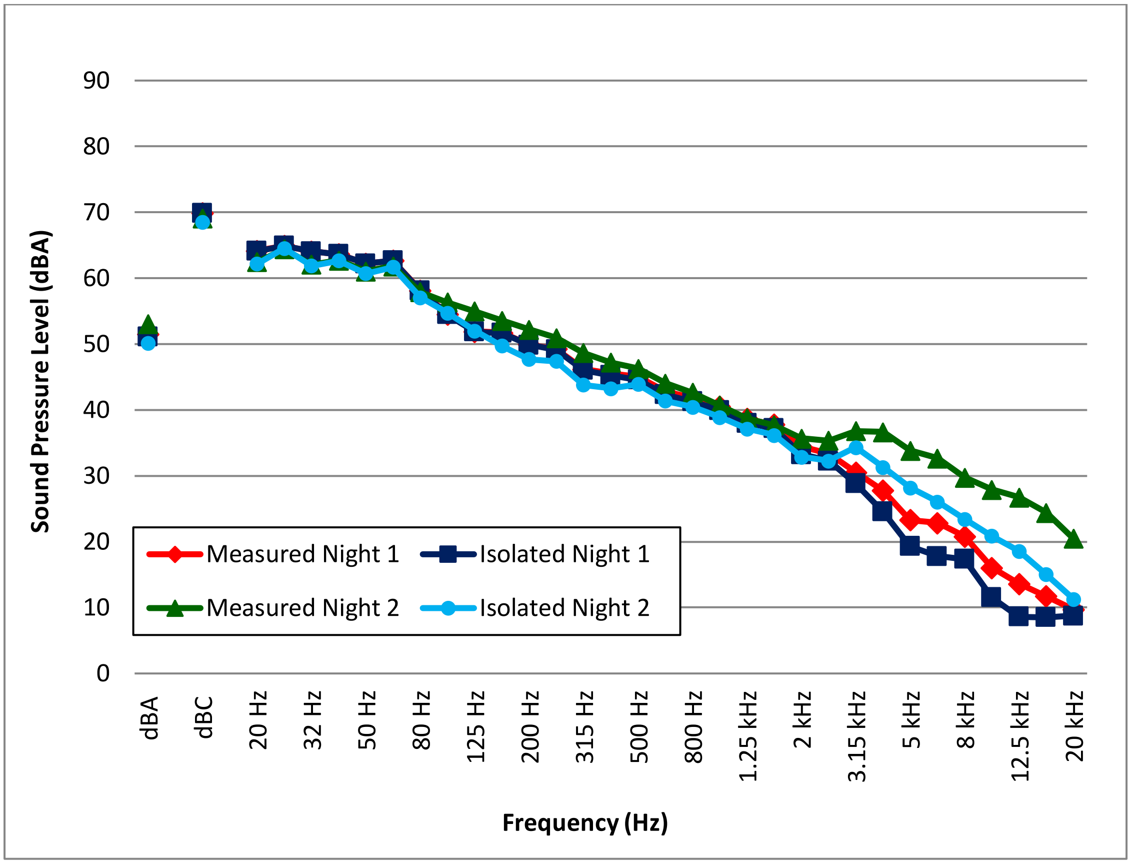

Figure 63. Noise Monitor #8, 1/3 Octave L_{eq} Sound Levels (July 22 - 24, 2019)

Noise Monitor #9

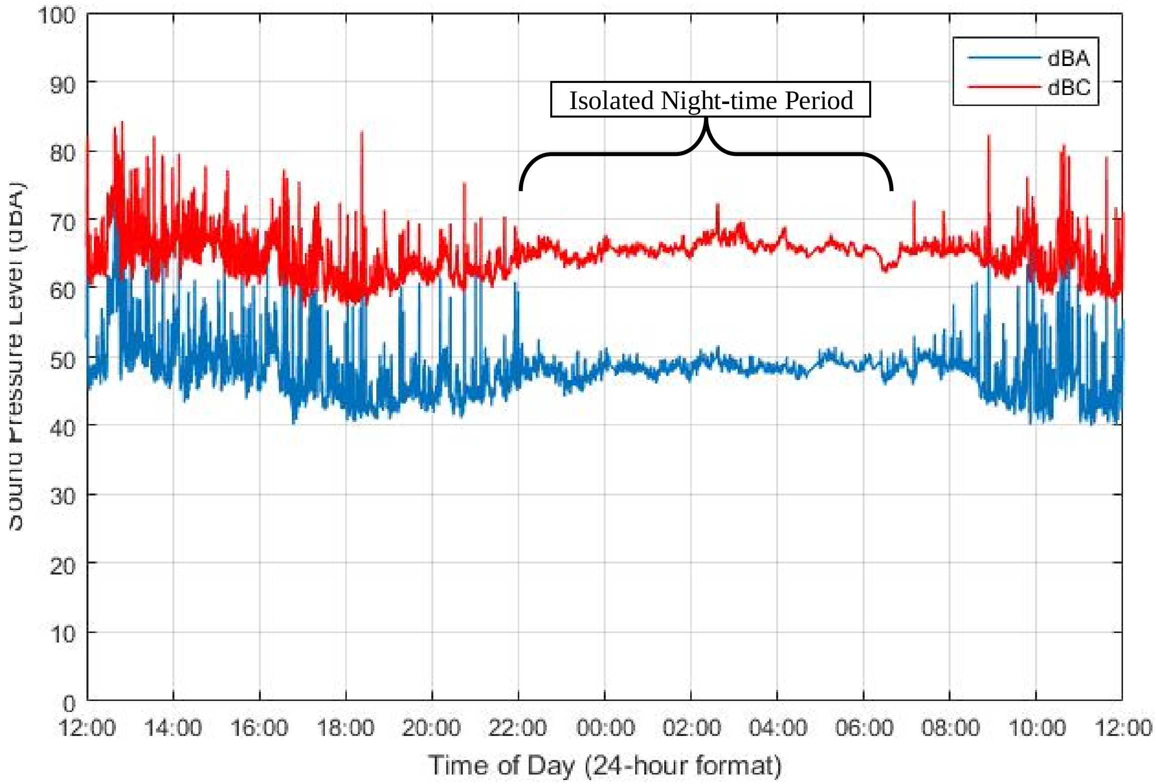

Figure 64. Noise Monitor #9, 15-Second L_{eq} Sound Levels (July 22 - 23, 2019)

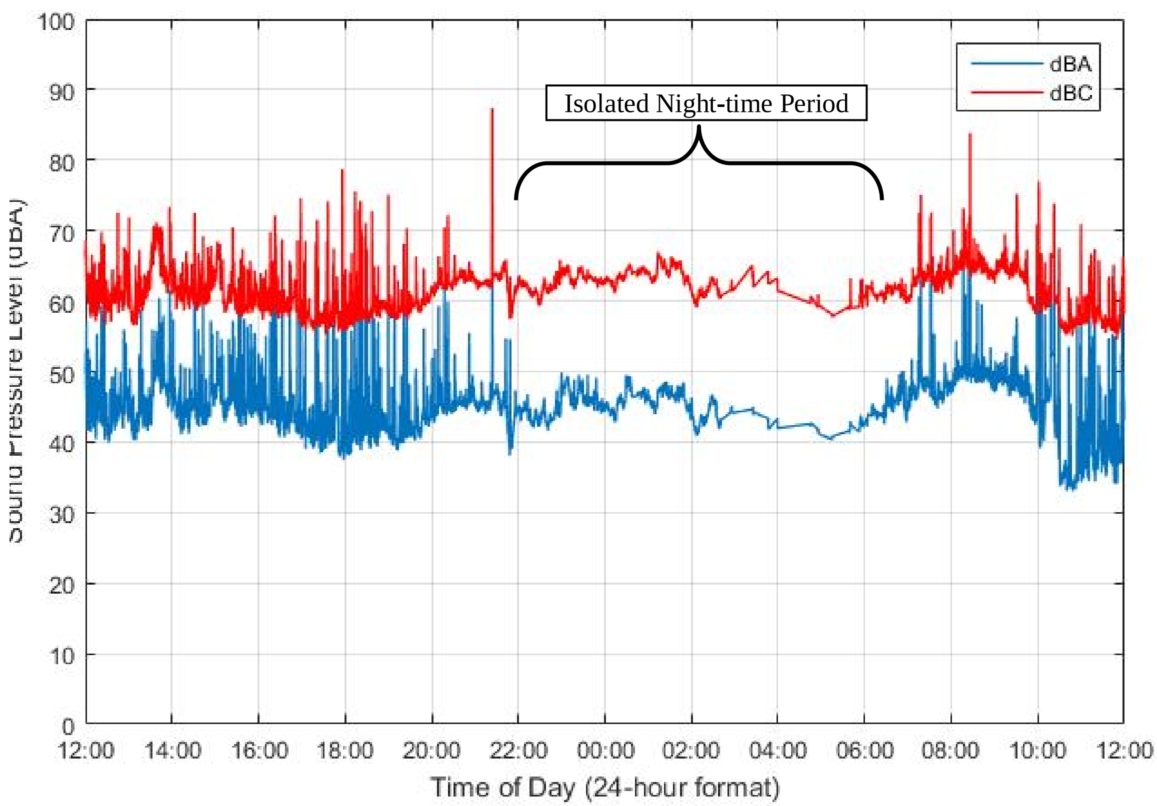

Figure 65. Noise Monitor #9, 15-Second L_{eq} Sound Levels (July 23 - 24, 2019)

Noise Monitor #9

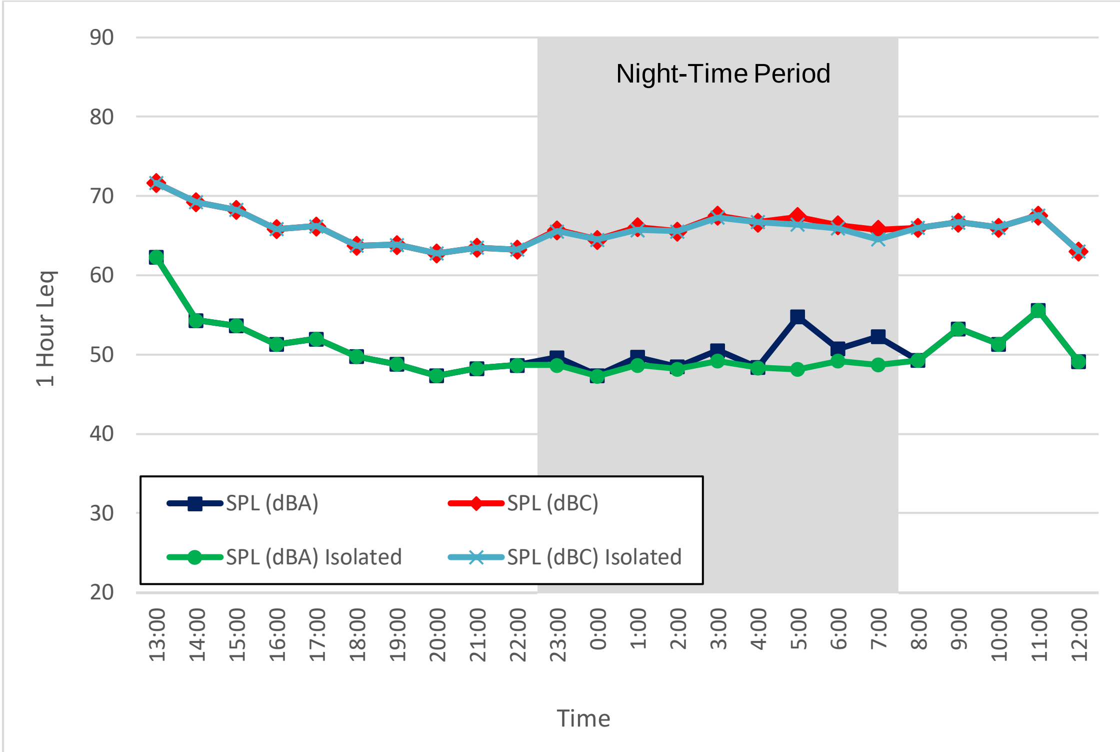

Figure 66. Noise Monitor #9, 1-Hour L_{eq} Sound Levels (July 22 - 23, 2019)

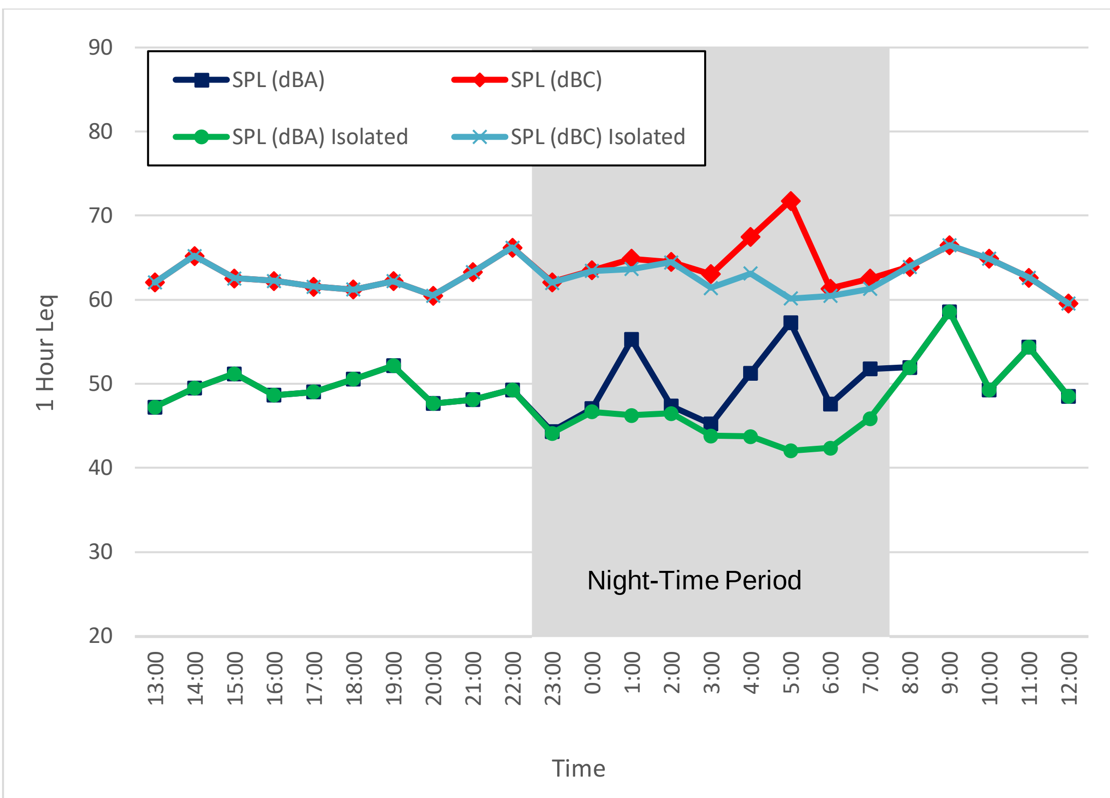

Figure 67. Noise Monitor #9, 1-Hour L_{eq} Sound Levels (July 23 - 24, 2019)

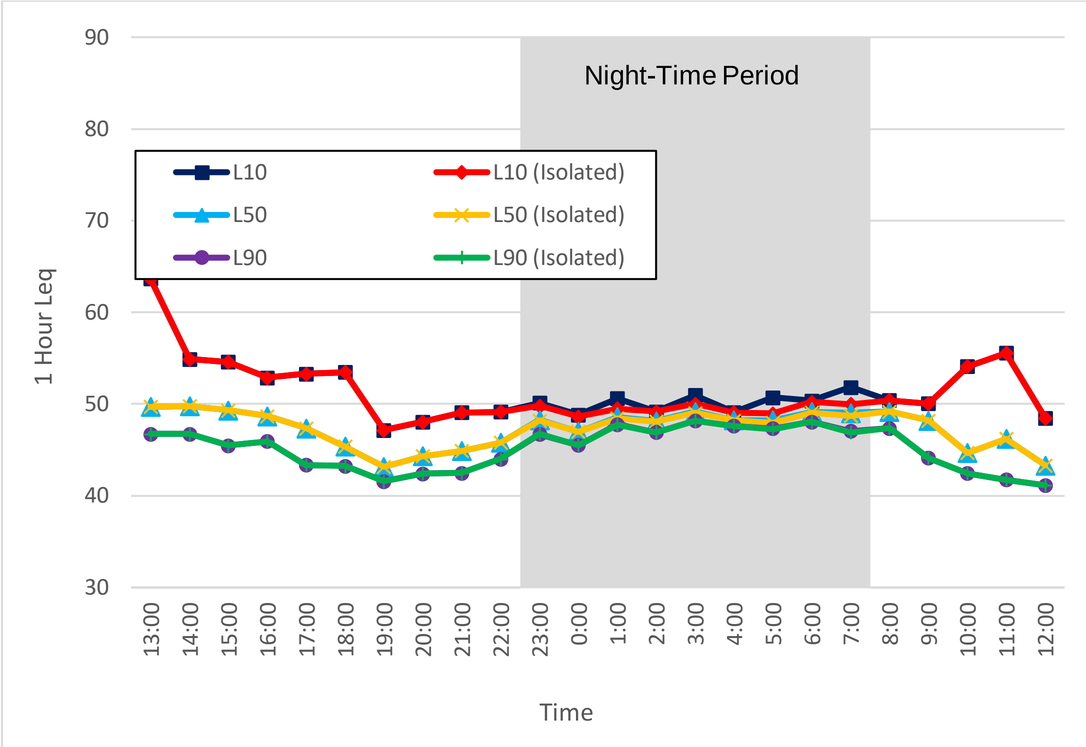

Figure 68. Noise Monitor #9, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (July 22 - 23, 2019)

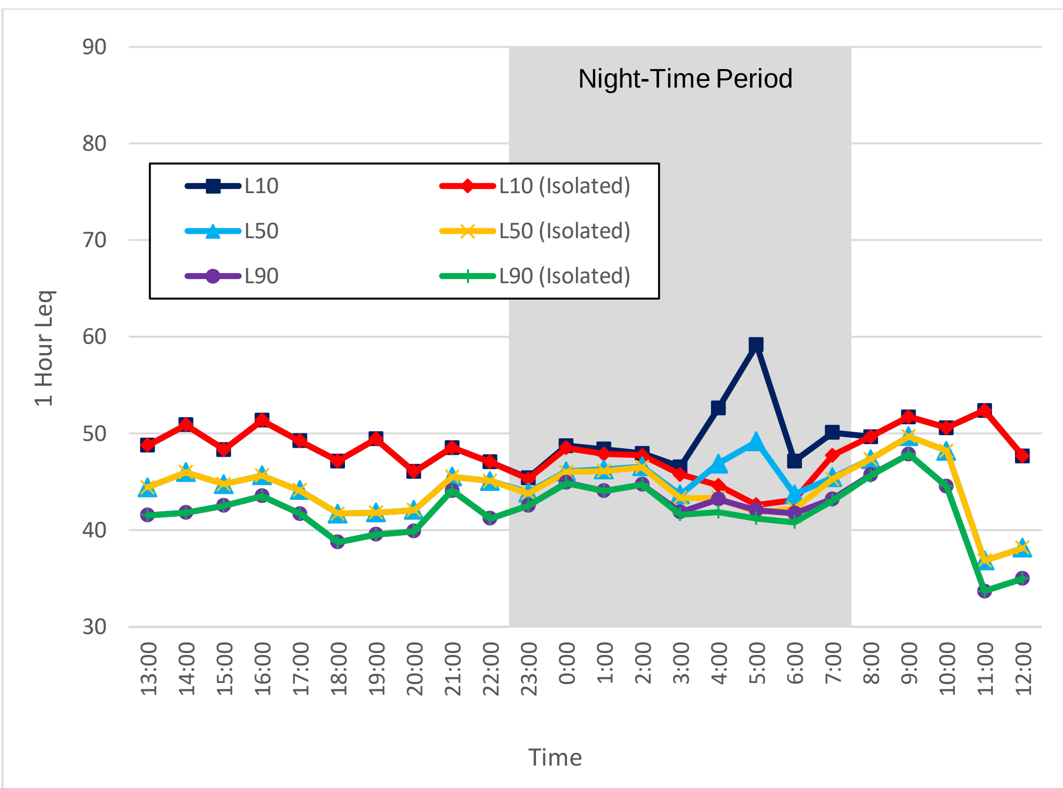

Figure 69. Noise Monitor #9, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (July 23 - 24, 2019)

Noise Monitor #9

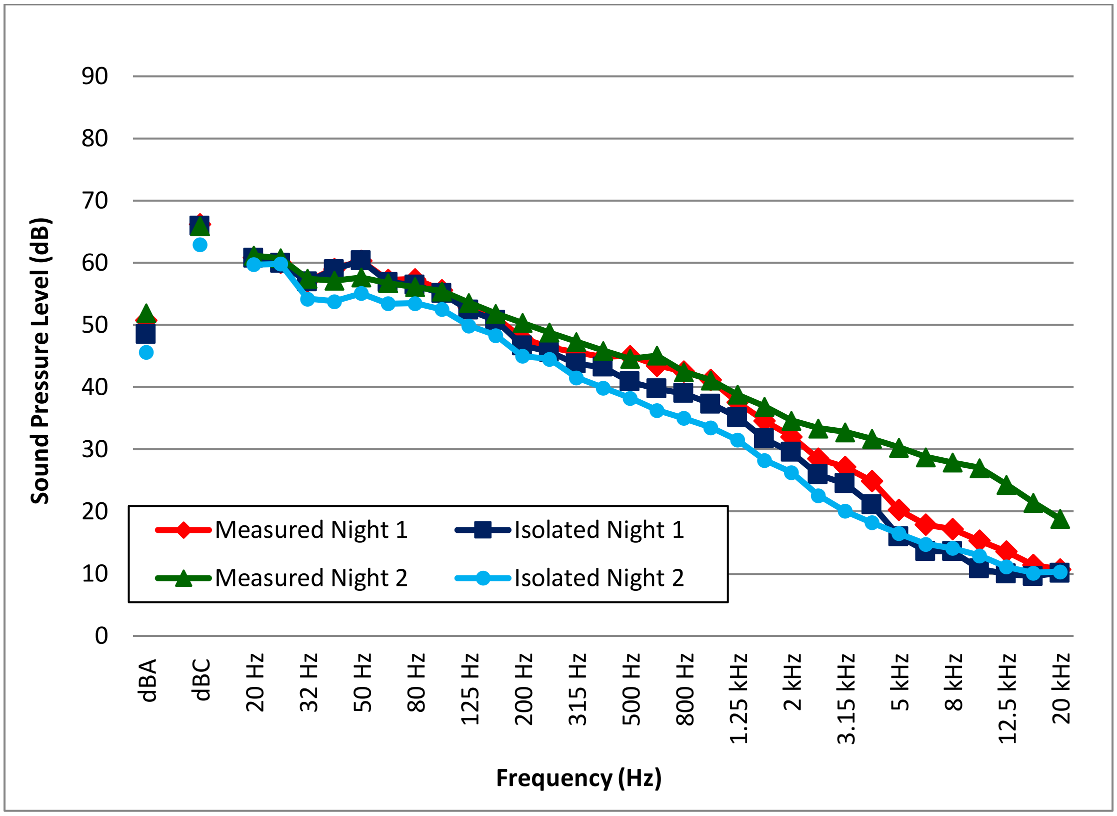

Figure 70. Noise Monitor #9, 1/3 Octave L_{eq} Sound Levels (July 22 - 24, 2019)

Noise Monitor #10

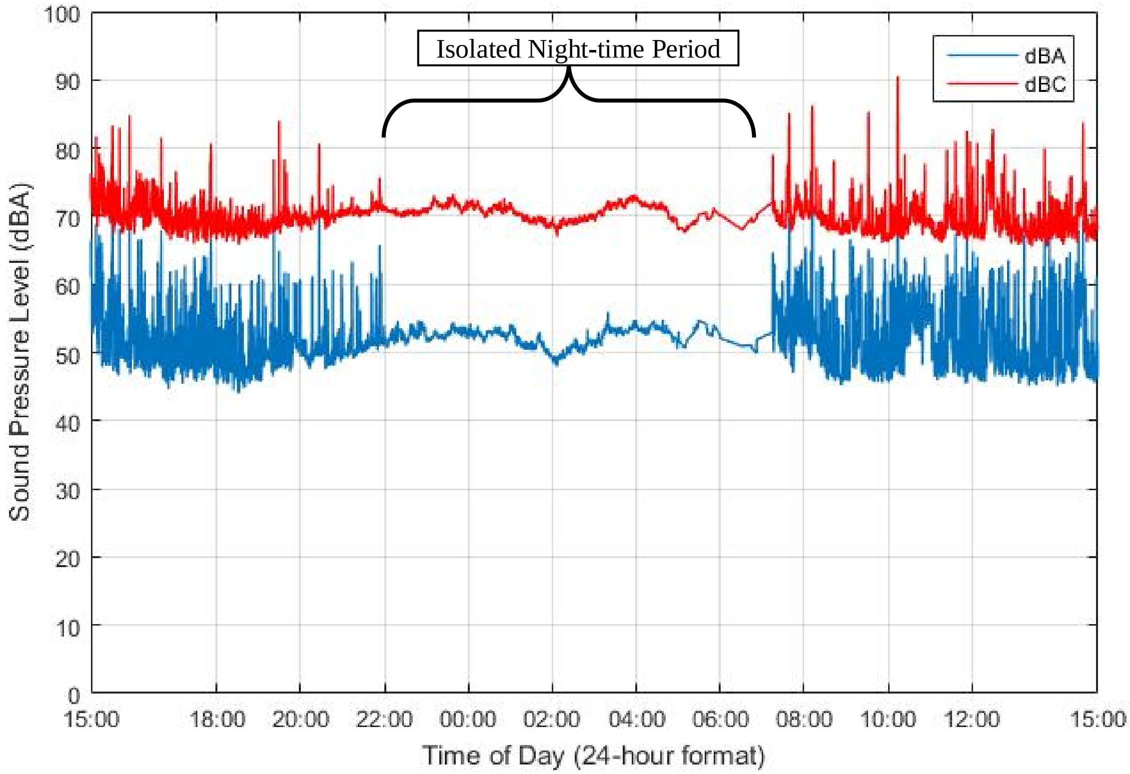

Figure 71. Noise Monitor #10, 15-Second L_{eq} Sound Levels (July 22 - 23, 2019)

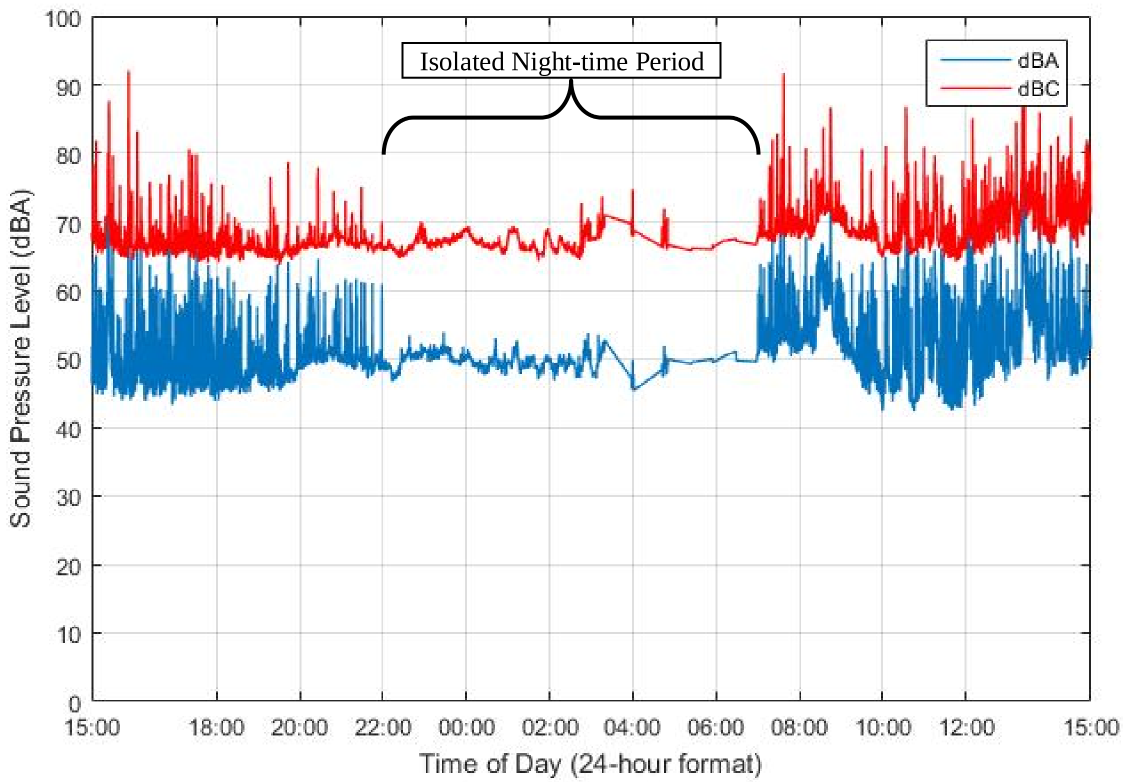

Figure 72. Noise Monitor #10, 15-Second L_{eq} Sound Levels (July 23 - 24, 2019)

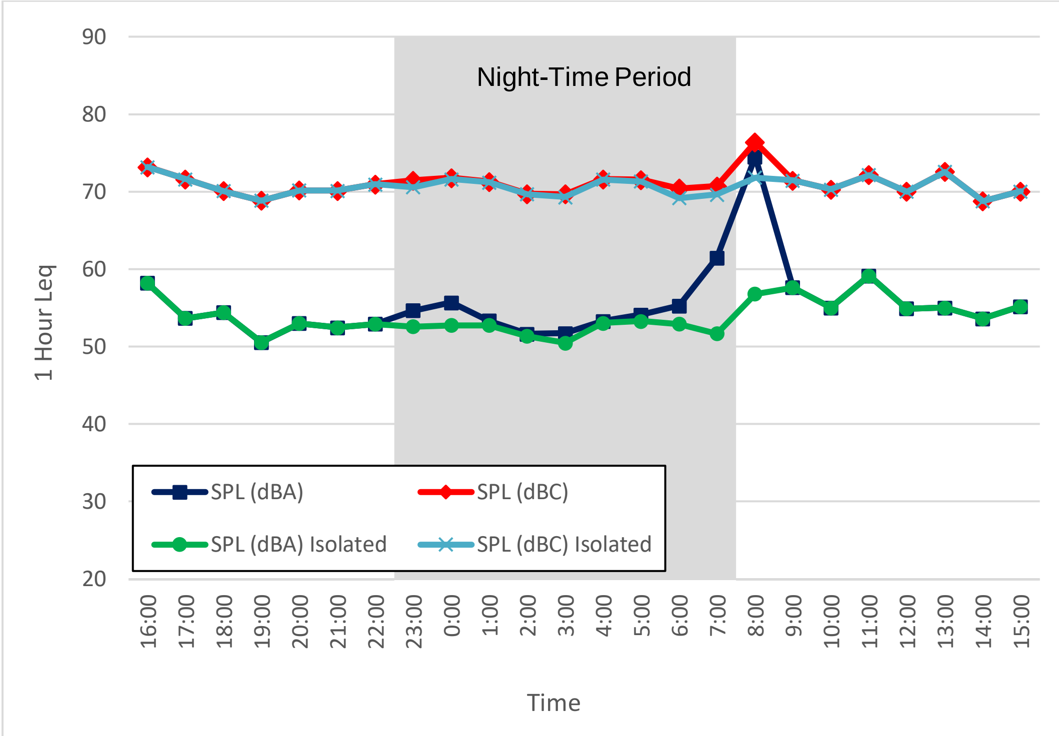

Figure 73. Noise Monitor #10, 1-Hour L_{eq} Sound Levels (July 22 - 23, 2019)

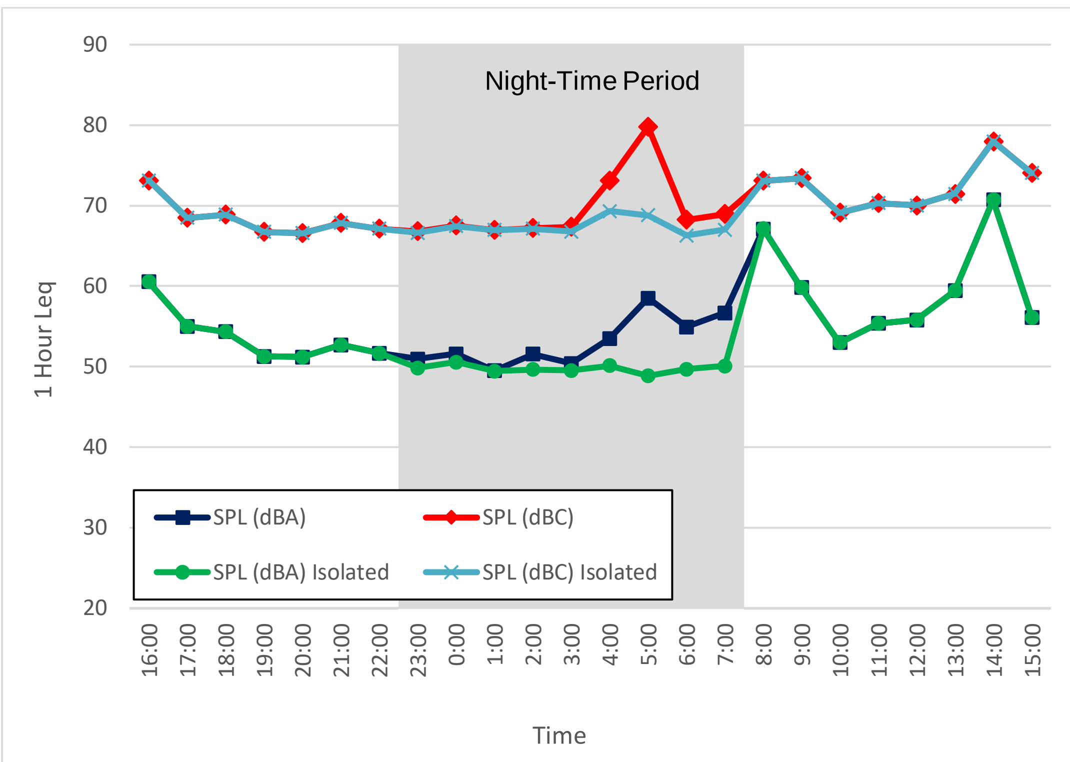

Figure 74. Noise Monitor #10, 1-Hour L_{eq} Sound Levels (July 23 - 24, 2019)

Monitor #10

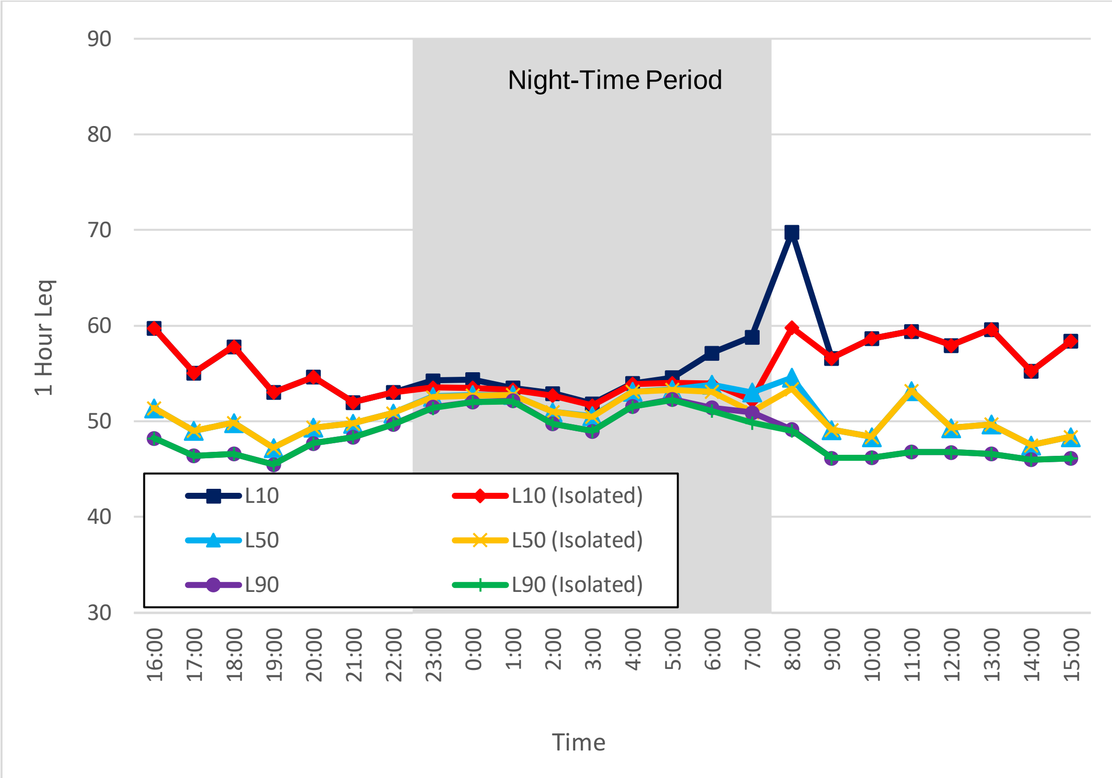

Figure 75. Noise Monitor #10, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (July 22 - 23, 2019)

Noise

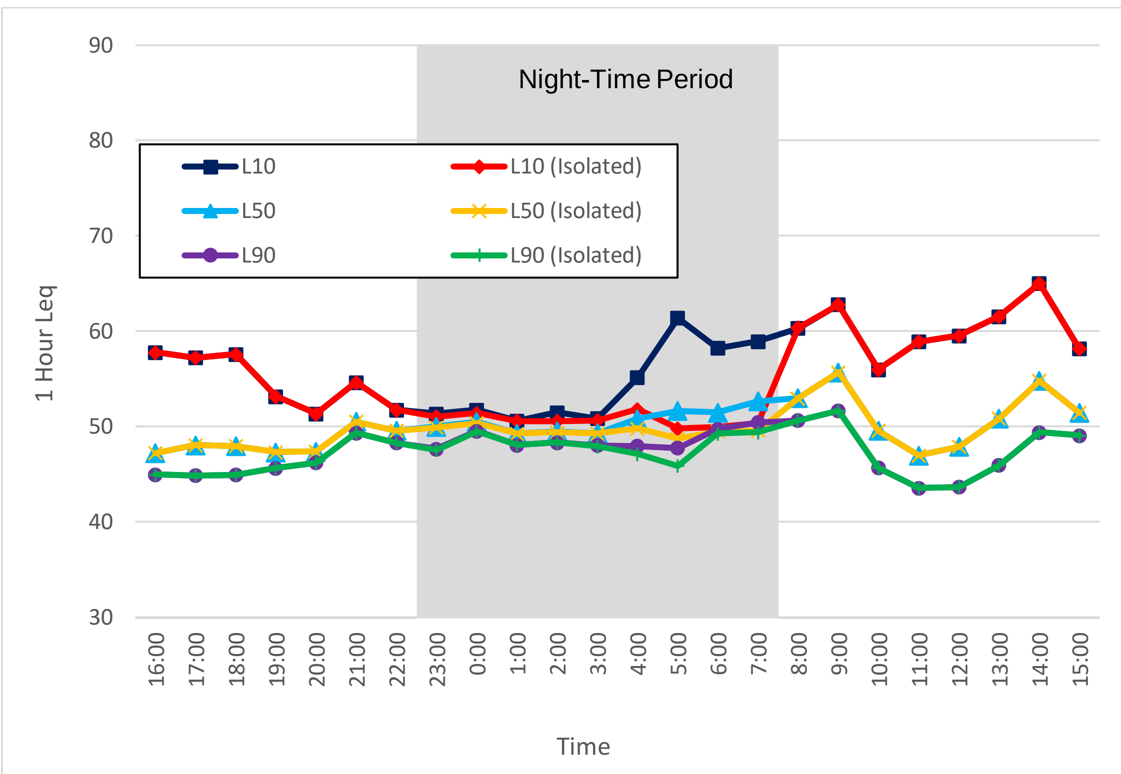

Figure 76. Noise Monitor #10, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (July 23 - 24, 2019)

Noise Monitor #10

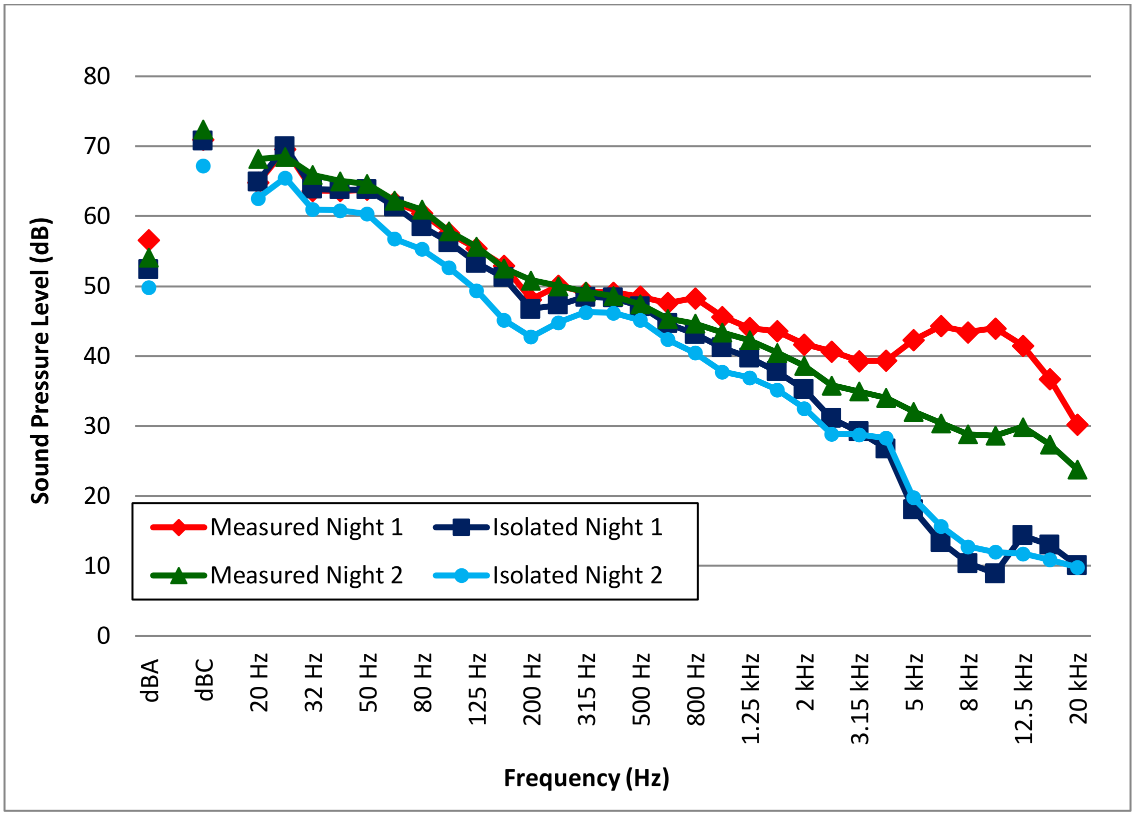

Figure 77. Noise Monitor #10, 1/3 Octave L_{eq} Sound Levels (July 22 - 24, 2019)

Noise Monitor #11

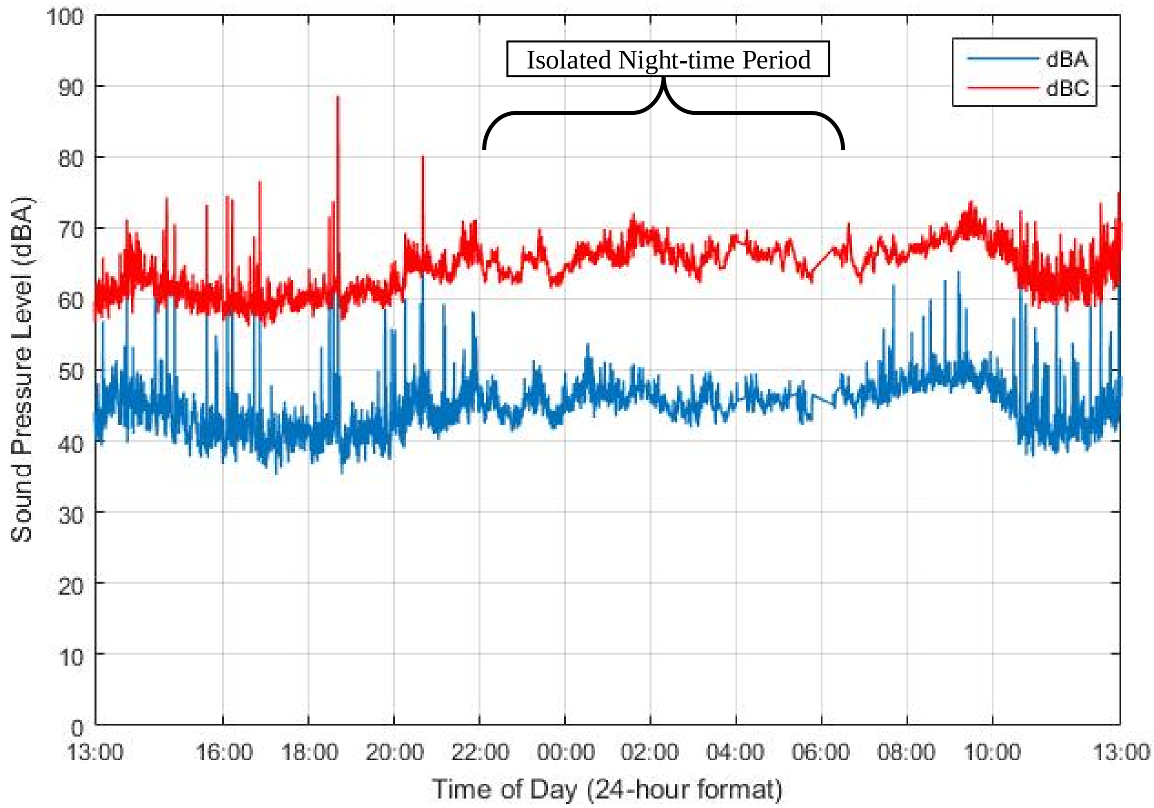

Figure 78. Noise Monitor #11, 15-Second L_{eq} Sound Levels (July 22 - 23, 2019)

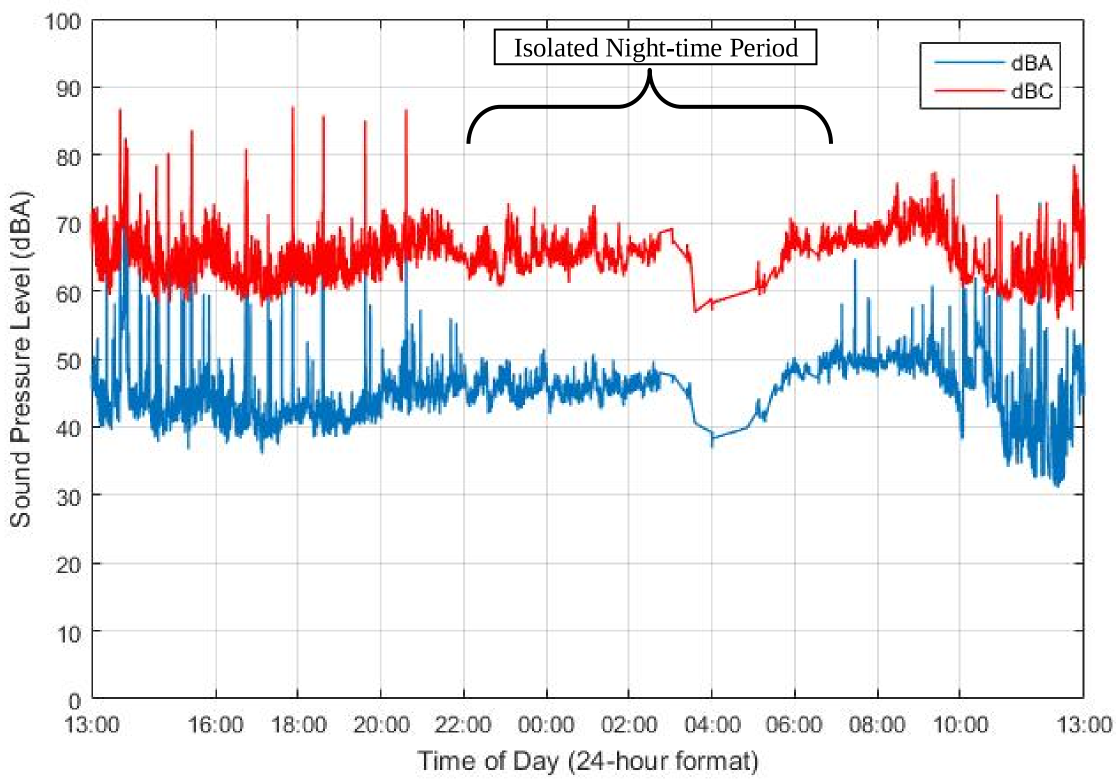

Figure 79. Noise Monitor #11, 15-Second L_{eq} Sound Levels (July 23 - 24, 2019)

Noise Monitor #11

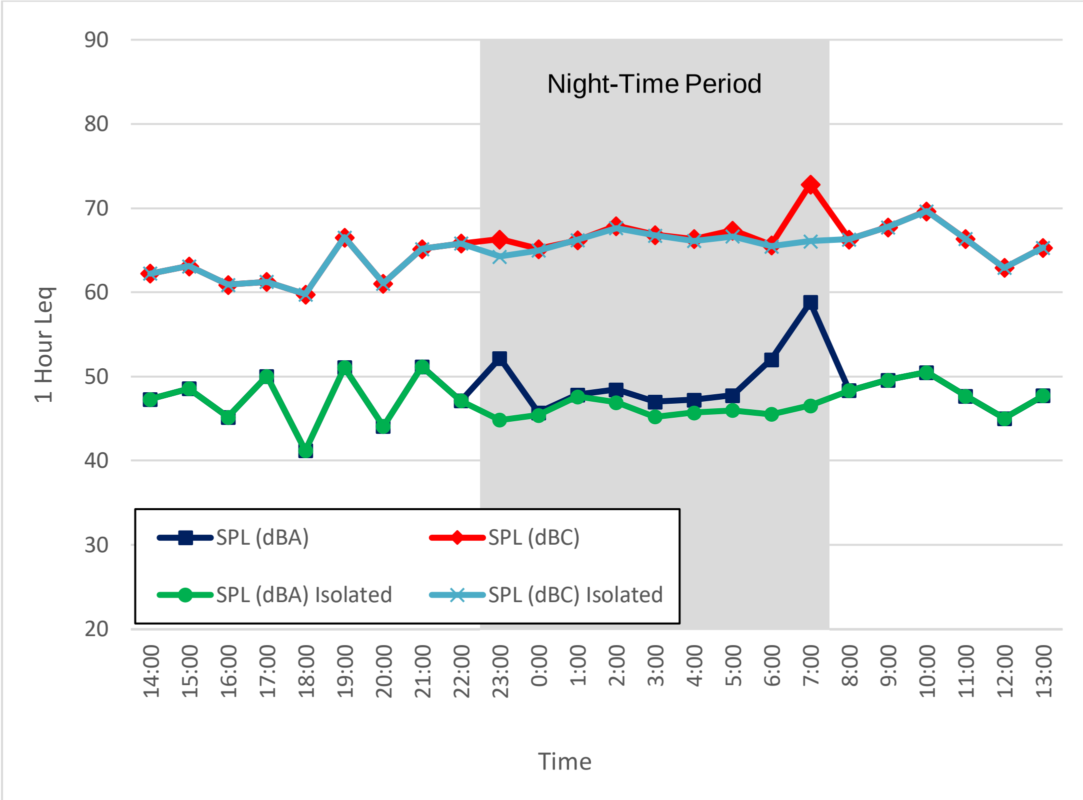

Figure 80. Noise Monitor #11, 1-Hour L_{eq} Sound Levels (July 22 - 23, 2019)

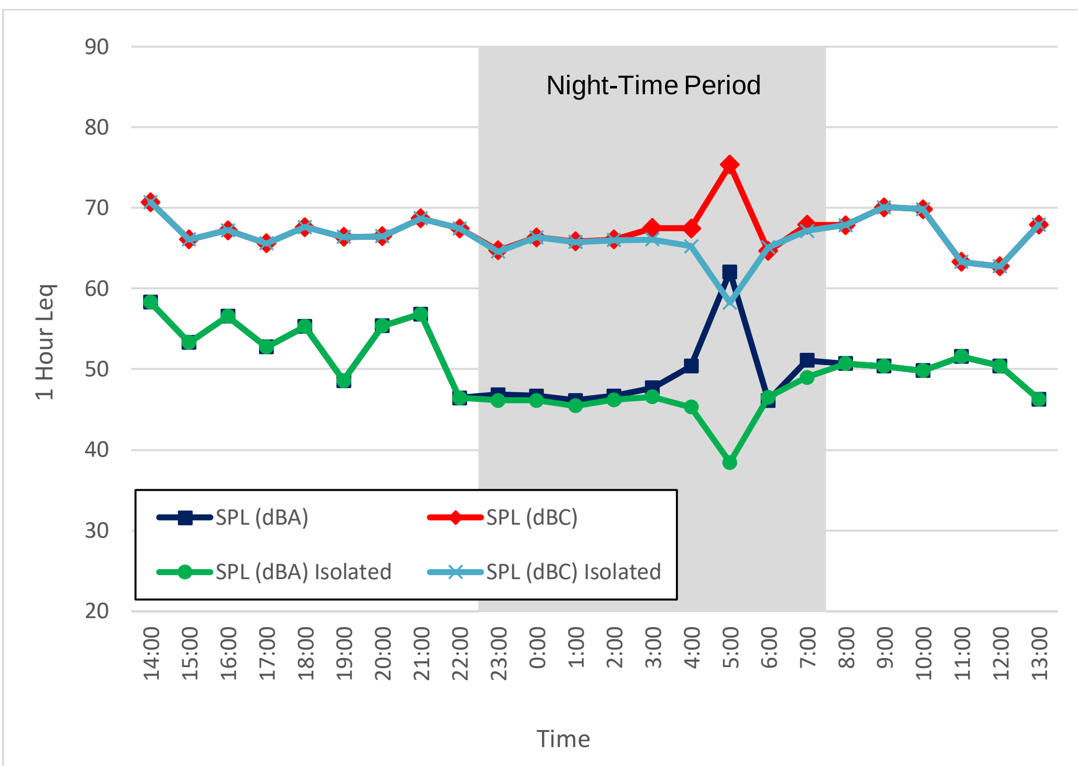

Figure 81. Noise Monitor #11, 1-Hour L_{eq} Sound Levels (July 23 - 24, 2019)

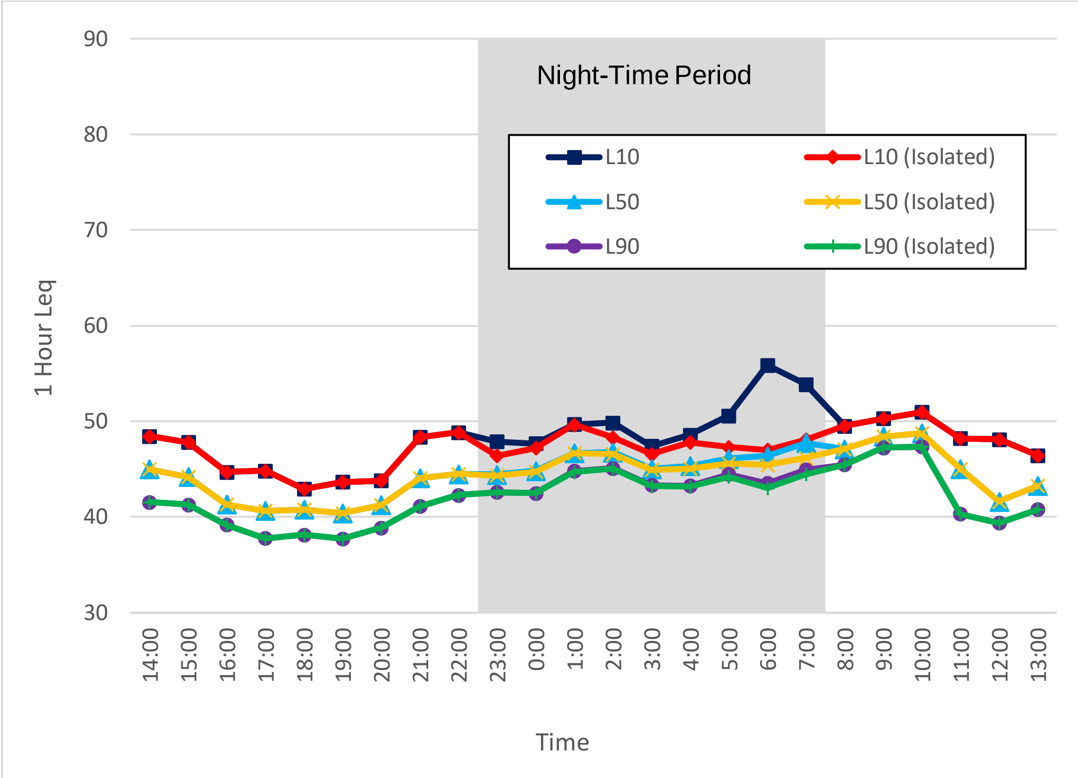

Figure 82. Noise Monitor #11, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (July 22 - 23, 2019)

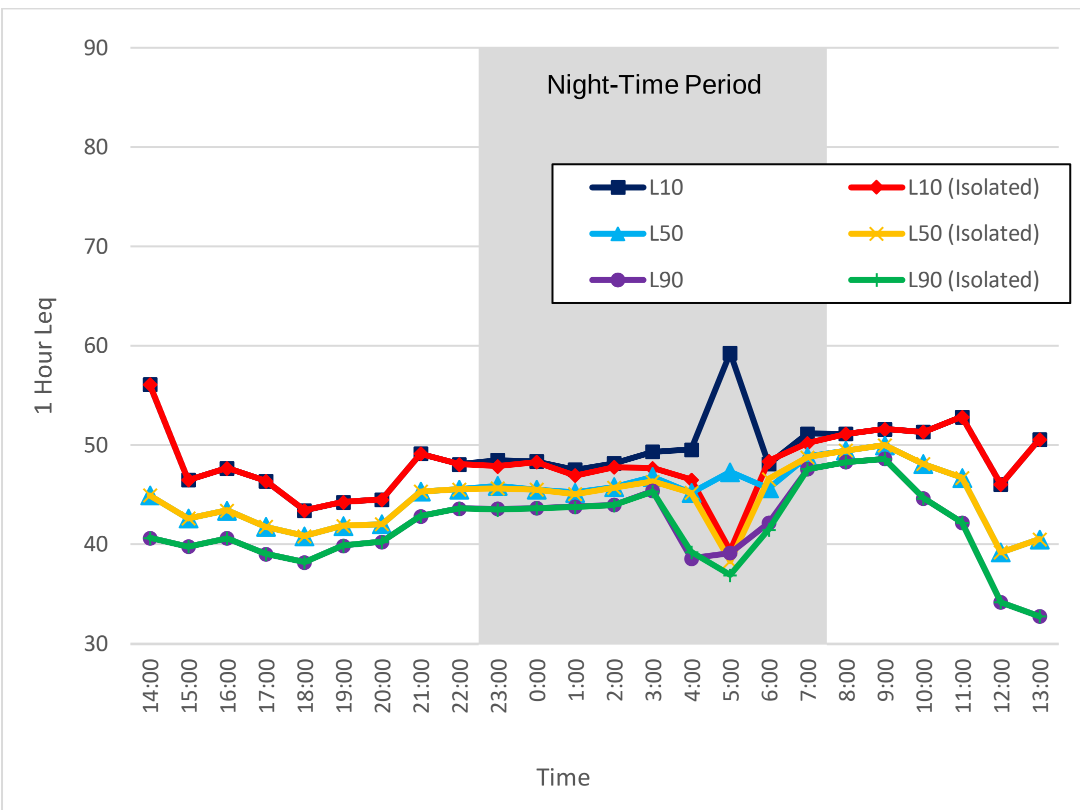

Figure 83. Noise Monitor #11, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (July 23 - 24, 2019)

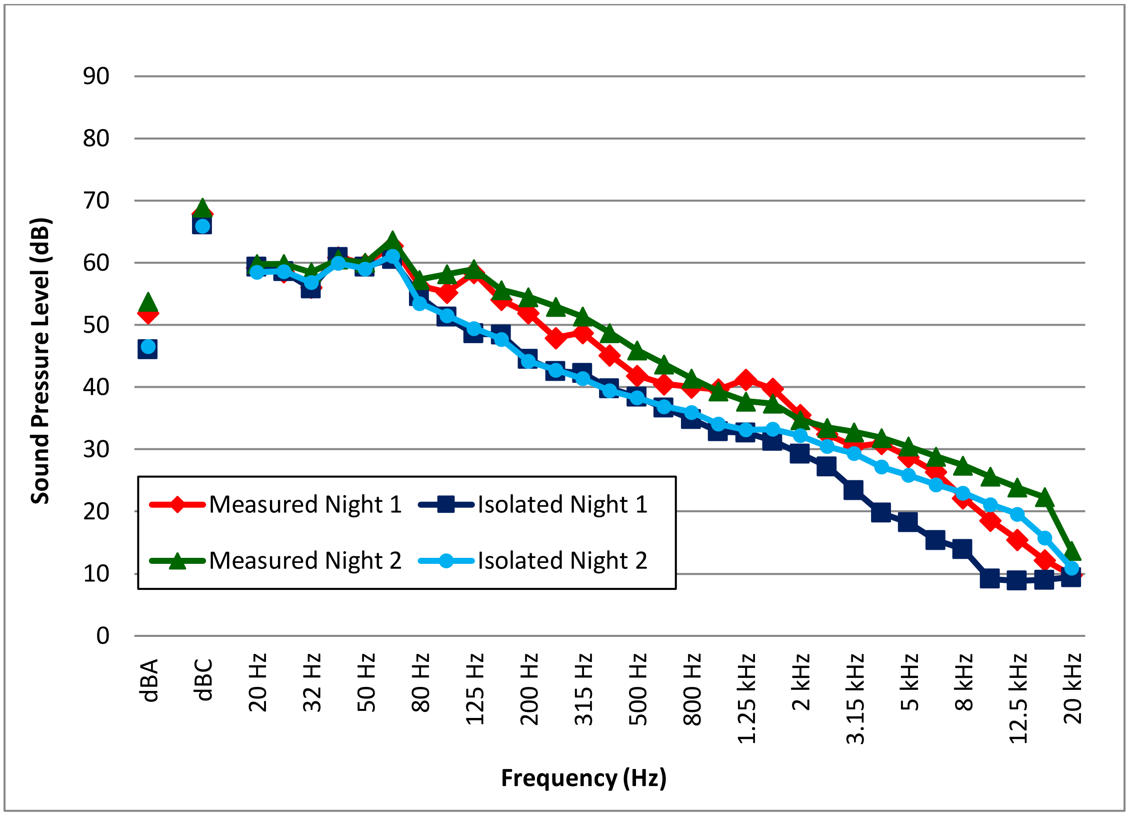

Figure 84. Noise Monitor #11, 1/3 Octave L_{eq} Sound Levels (July 22 - 24, 2019)

Noise Monitor #12 - Period 1

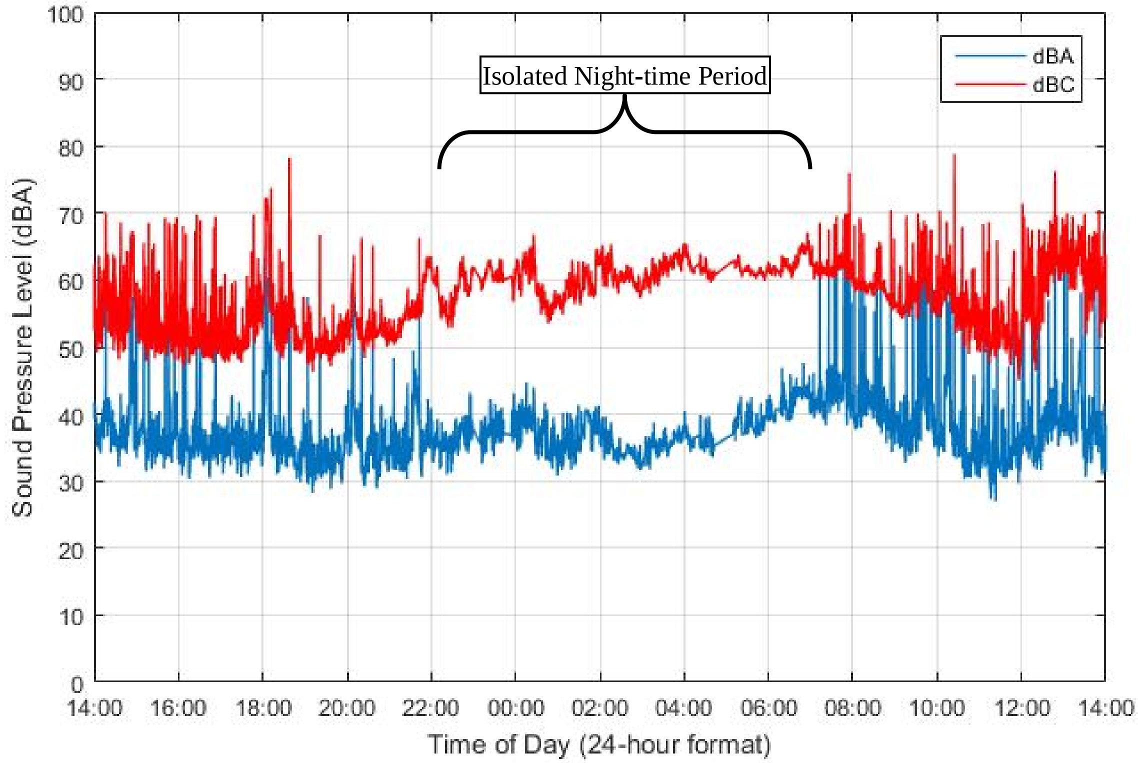

Figure 85. Noise Monitor #12, 15-Second L_{eq} Sound Levels (July 22 - 23, 2019)

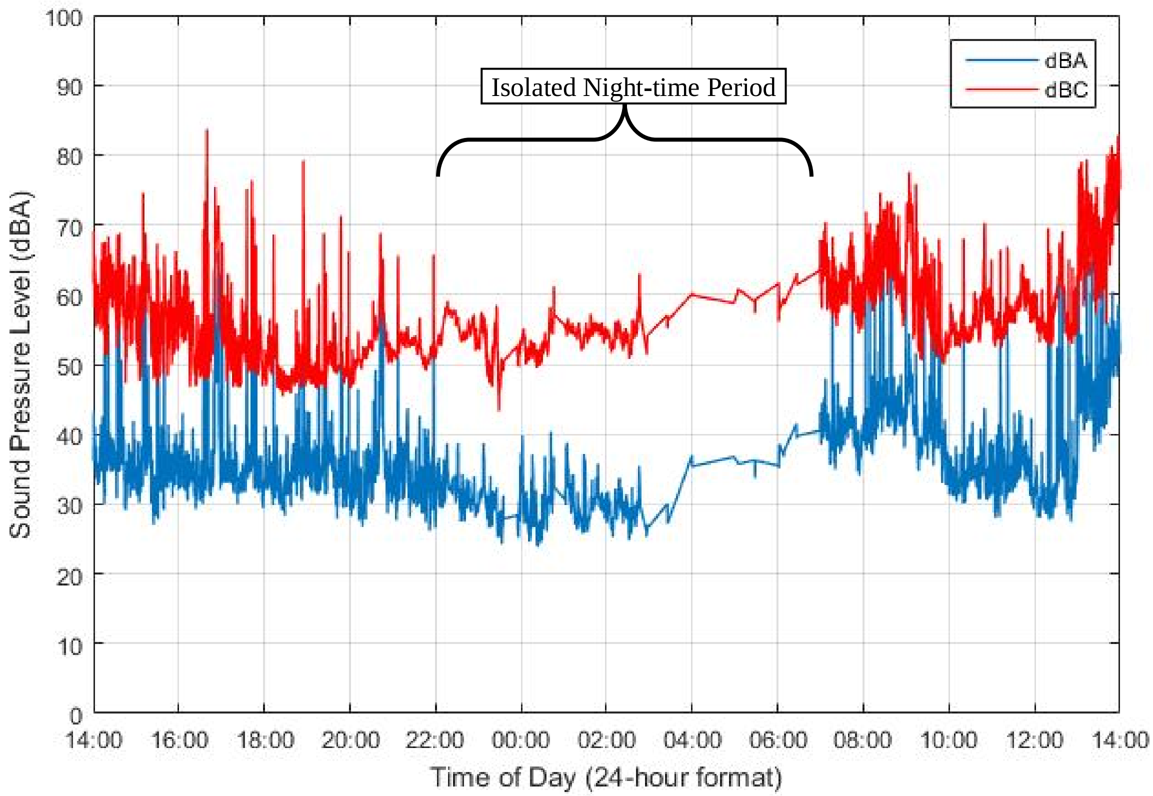

Figure 86. Noise Monitor #12, 15-Second L_{eq} Sound Levels (July 23 - 24, 2019)

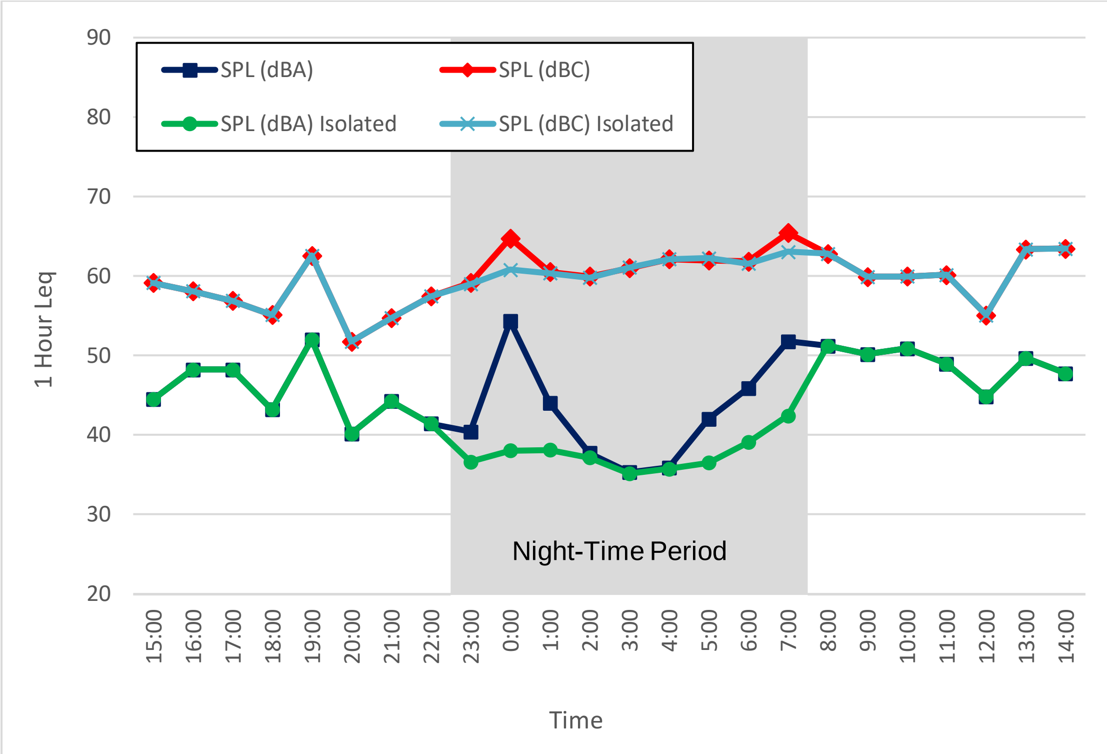

Figure 87. Noise Monitor #12, 1-Hour L_{eq} Sound Levels (July 22 - 23, 2019)

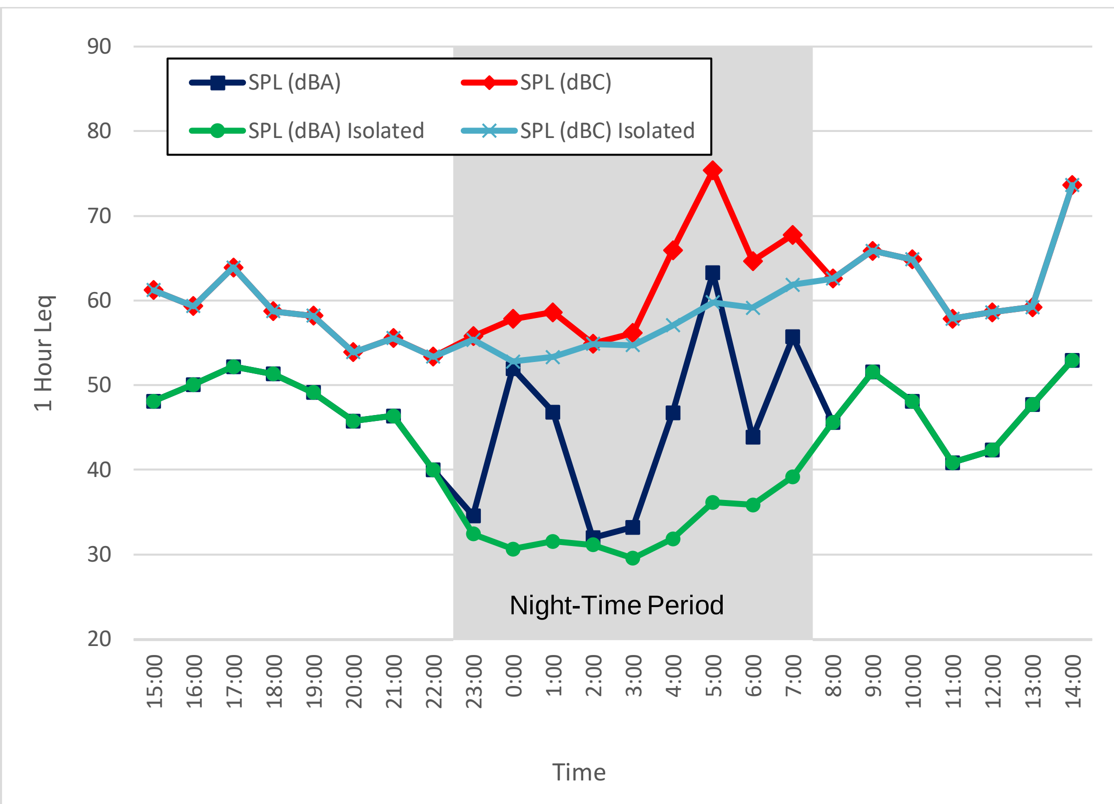

Figure 88. Noise Monitor #12, 1-Hour L_{eq} Sound Levels (July 23 - 24, 2019)

Noise Monitor #12 - Period 1

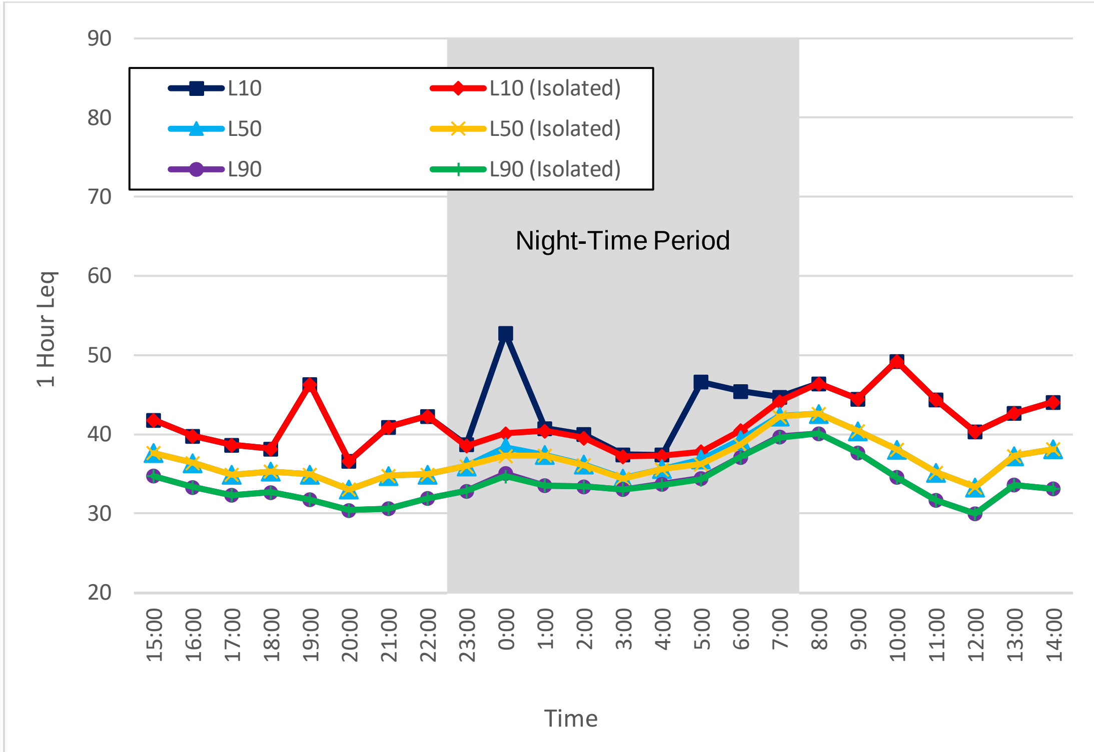

Figure 89. Noise Monitor #12, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (July 22 - 23, 2019)

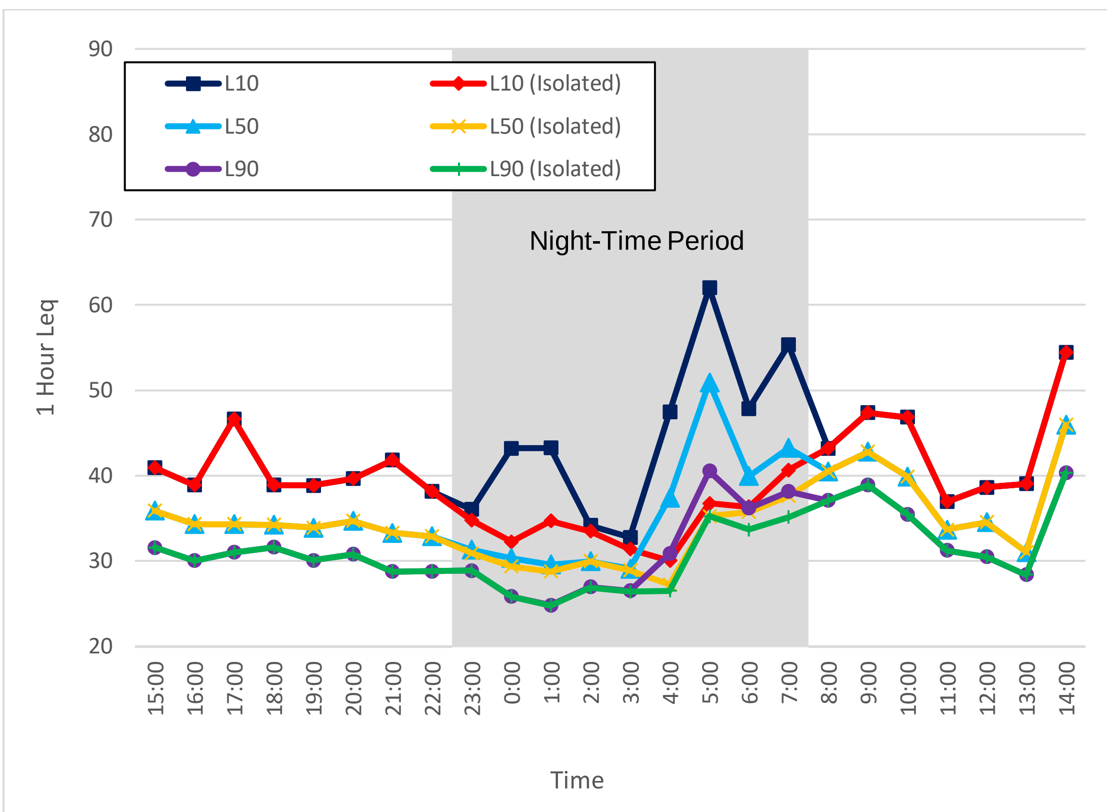

Figure 90. Noise Monitor #12, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (July 23 - 24, 2019)

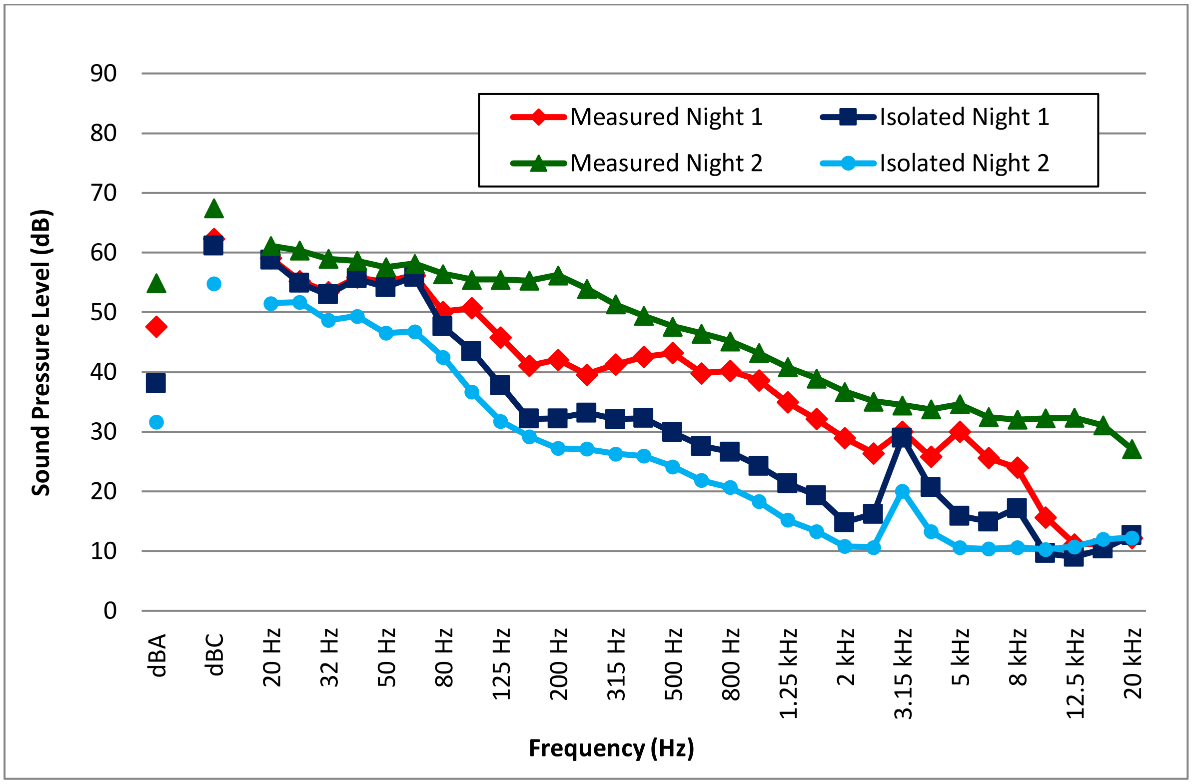

Figure 91. Noise Monitor #12, 1/3 Octave L_{eq} Sound Levels (July 22 - 24, 2019)

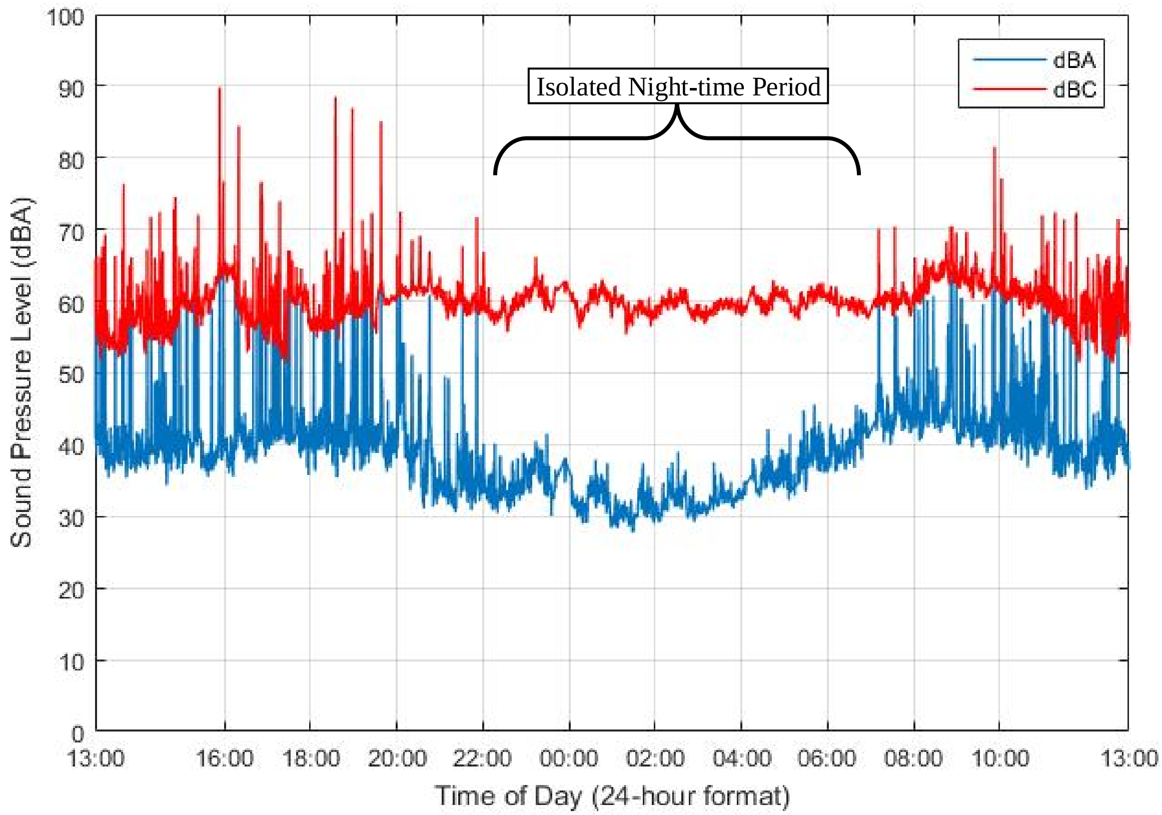

Figure 92. Noise Monitor #12, 15-Second L_{eq} Sound Levels (September 18 – 19, 2019)

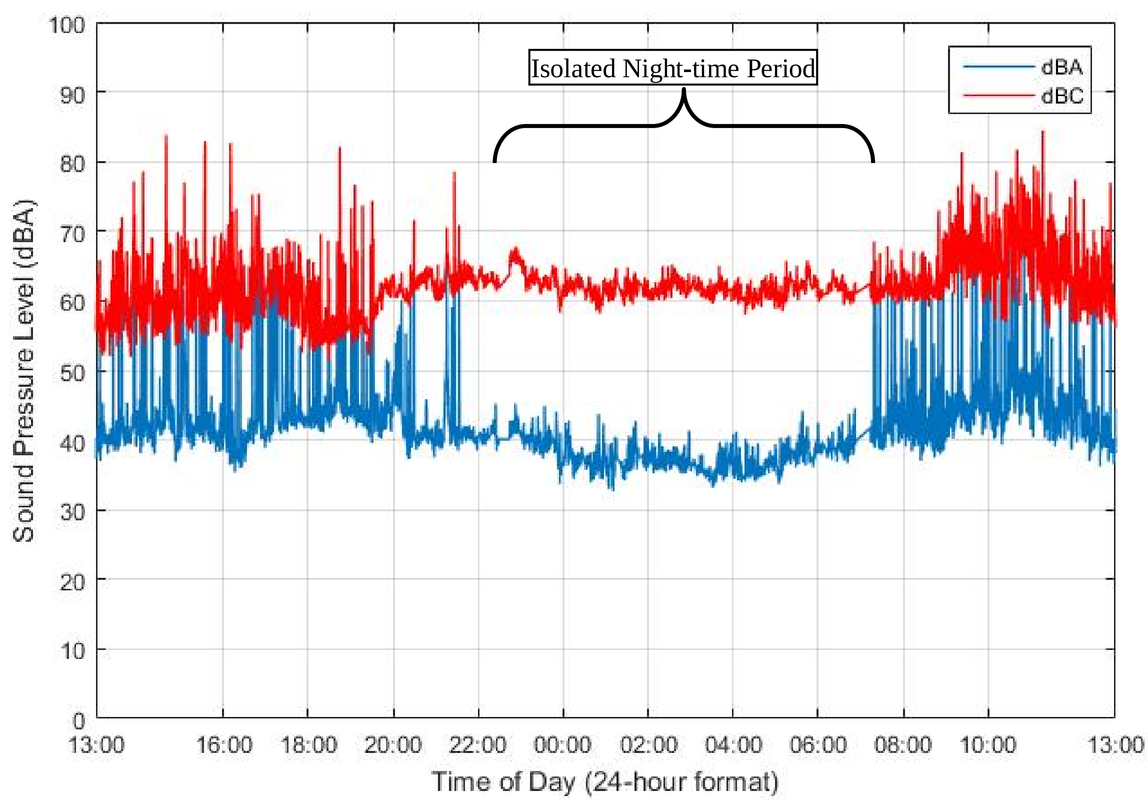

Figure 93. Noise Monitor #12, 15-Second L_{eq} Sound Levels (September 19 – 20, 2019)

Noise Monitor #12 - Period 2

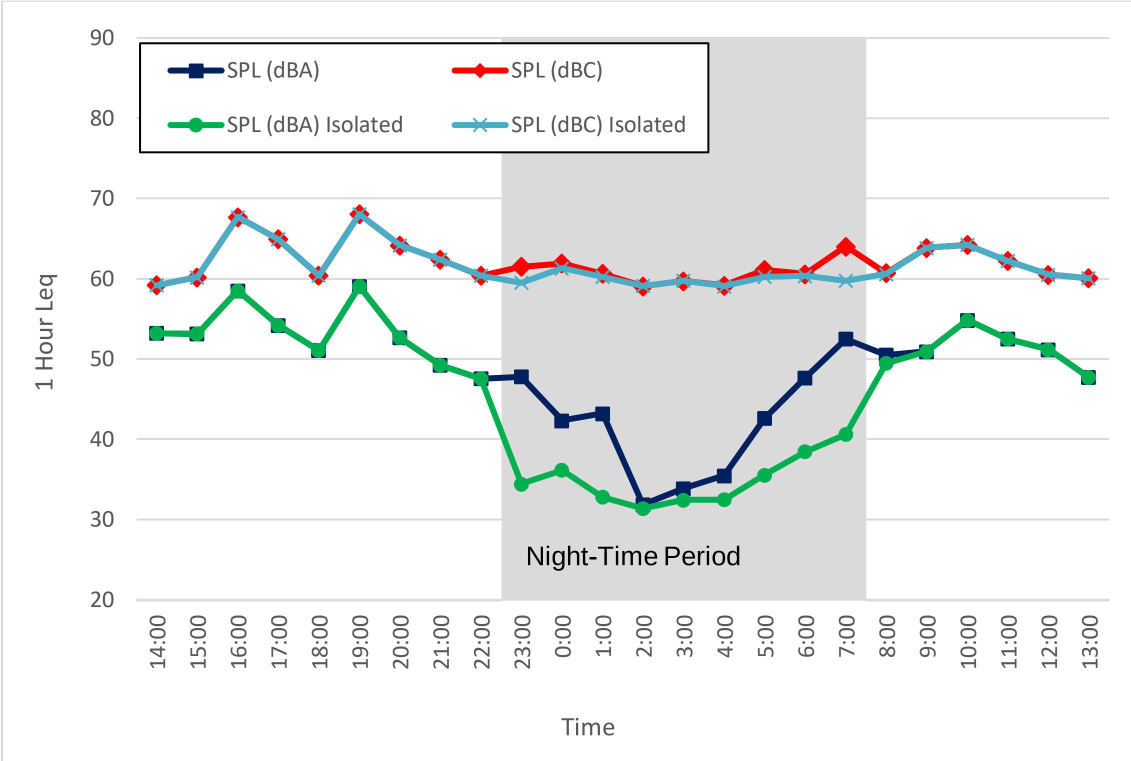

Figure 94. Noise Monitor #12, 1-Hour L_{eq} Sound Levels (September 18 – 19, 2019)

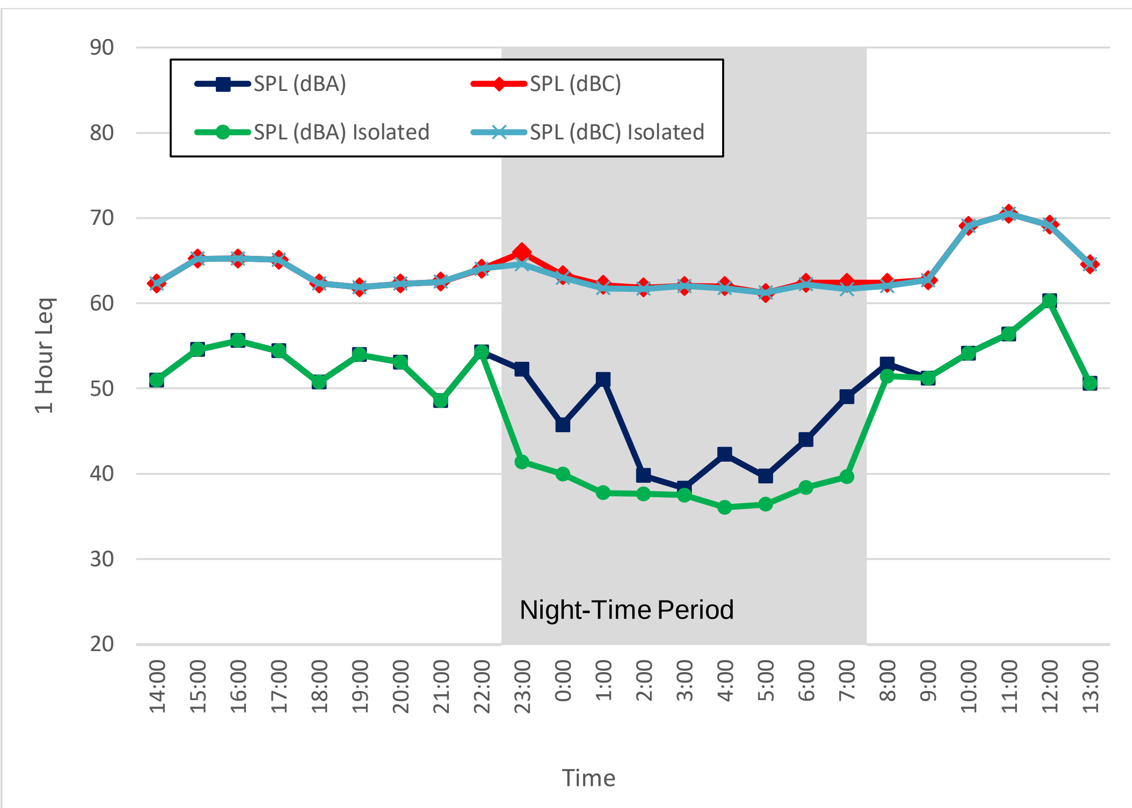

Figure 95. Noise Monitor #12, 1-Hour L_{eq} Sound Levels (September 19 – 20, 2019)

Noise Monitor #12 - Period 2

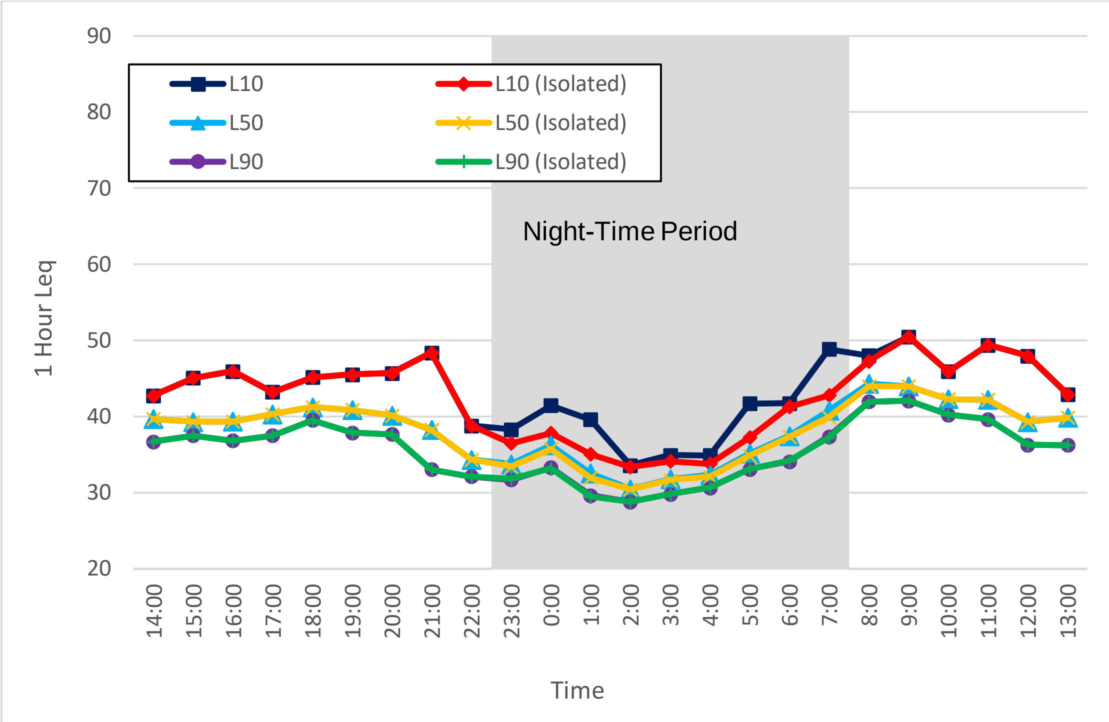

Figure 96. Noise Monitor #12, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (September 18 – 19, 2019)

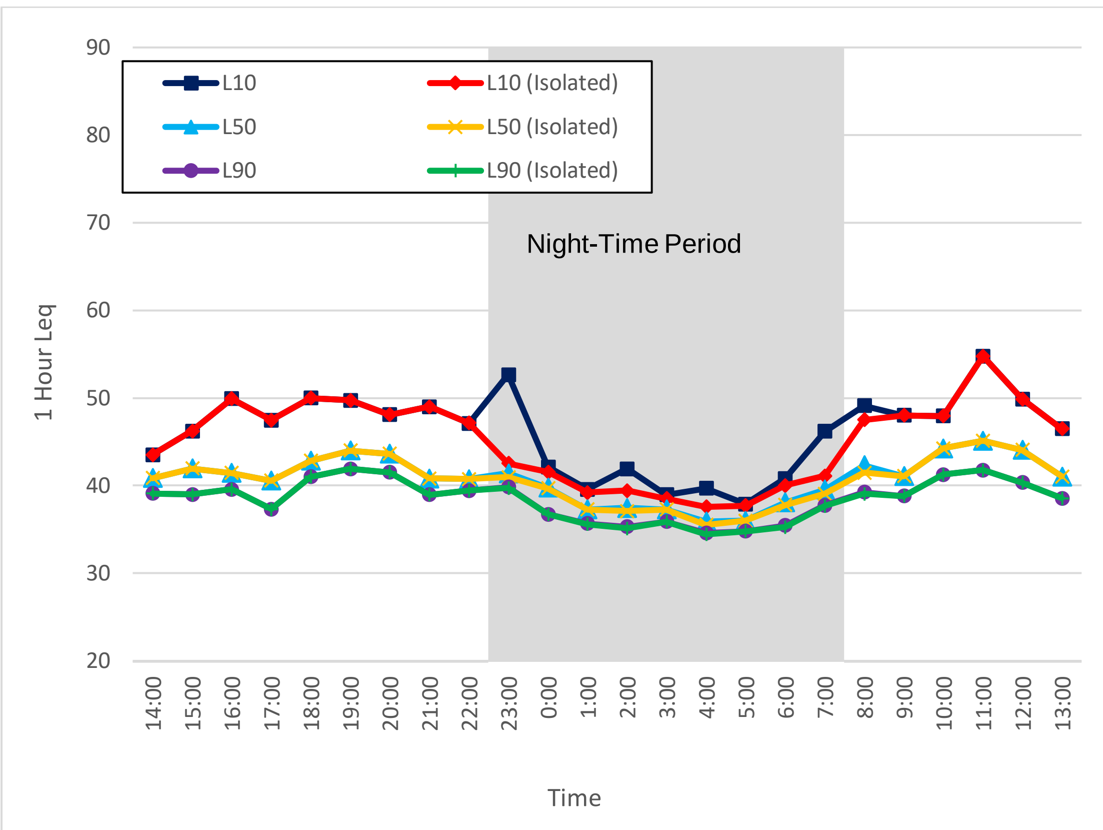

Figure 97. Noise Monitor #12, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (September 19 – 20, 2019)

Noise Monitor #12 - Period 2

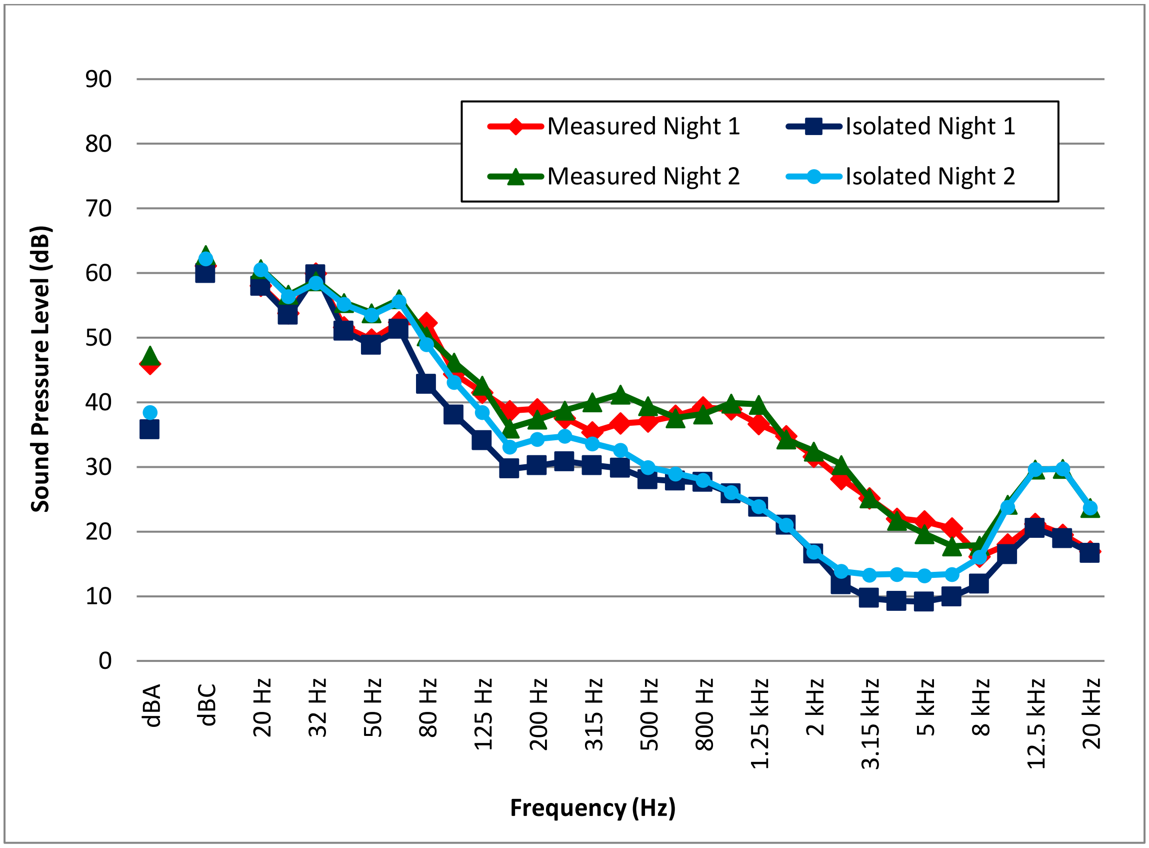

Figure 98. Noise Monitor #12, 1/3 Octave L_{eq} Sound Levels (September 18 – 20, 2019)

Noise Monitor #12 - Period 3

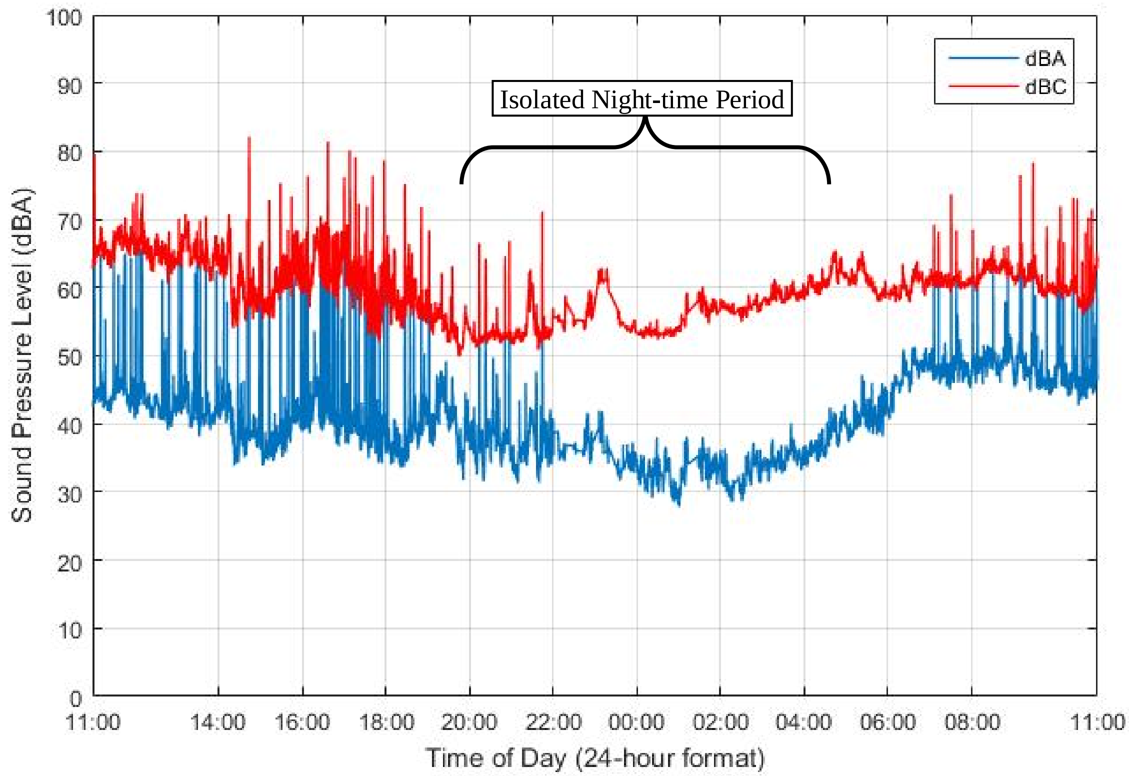

Figure 99. Noise Monitor #12, 15-Second L_{eq} Sound Levels (October 21 – 22, 2019)

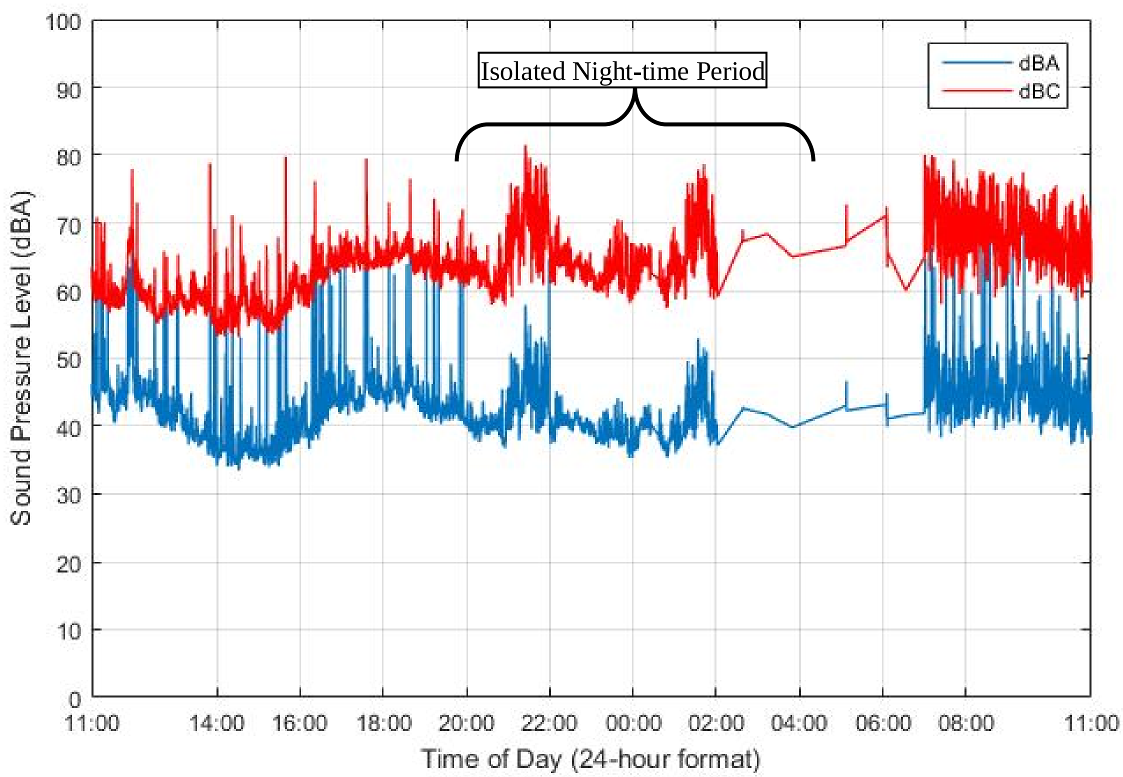

Figure 100. Noise Monitor #12, 15-Second L_{eq} Sound Levels (October 22 – 23, 2019)

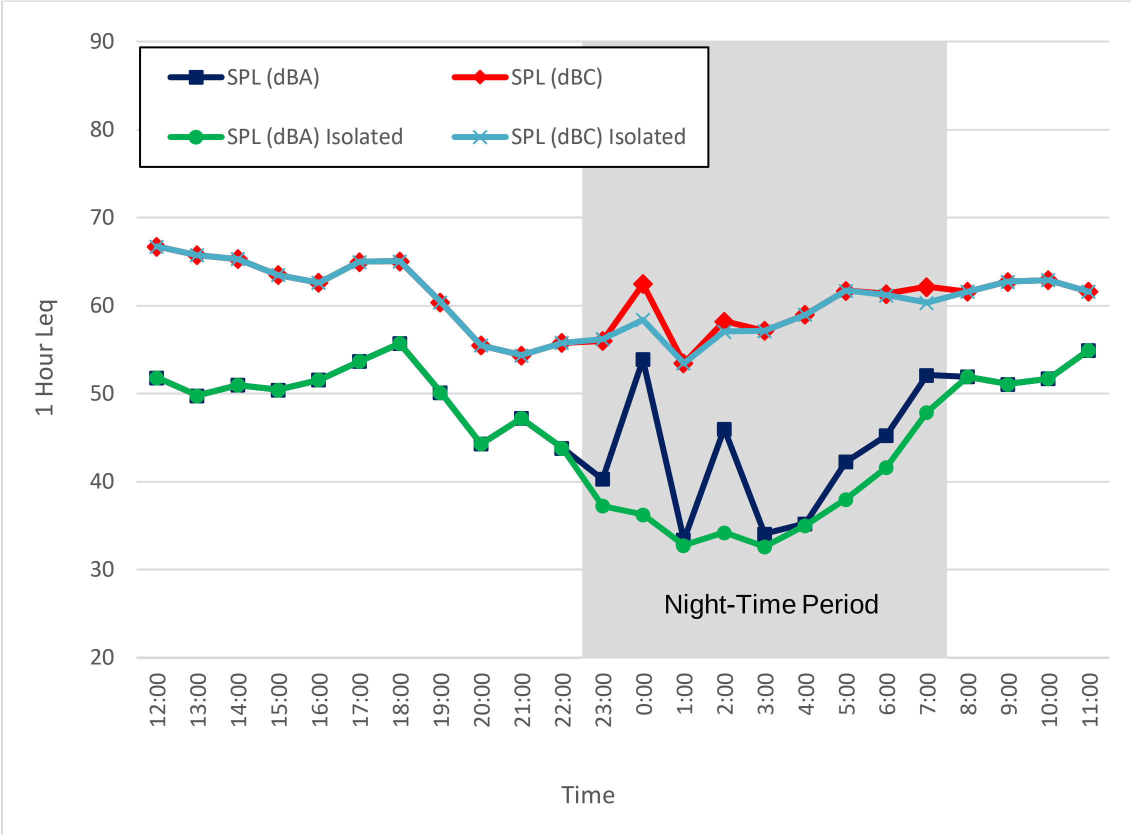

Figure 101. Noise Monitor #12, 1-Hour L_{eq} Sound Levels (October 21 – 22, 2019)

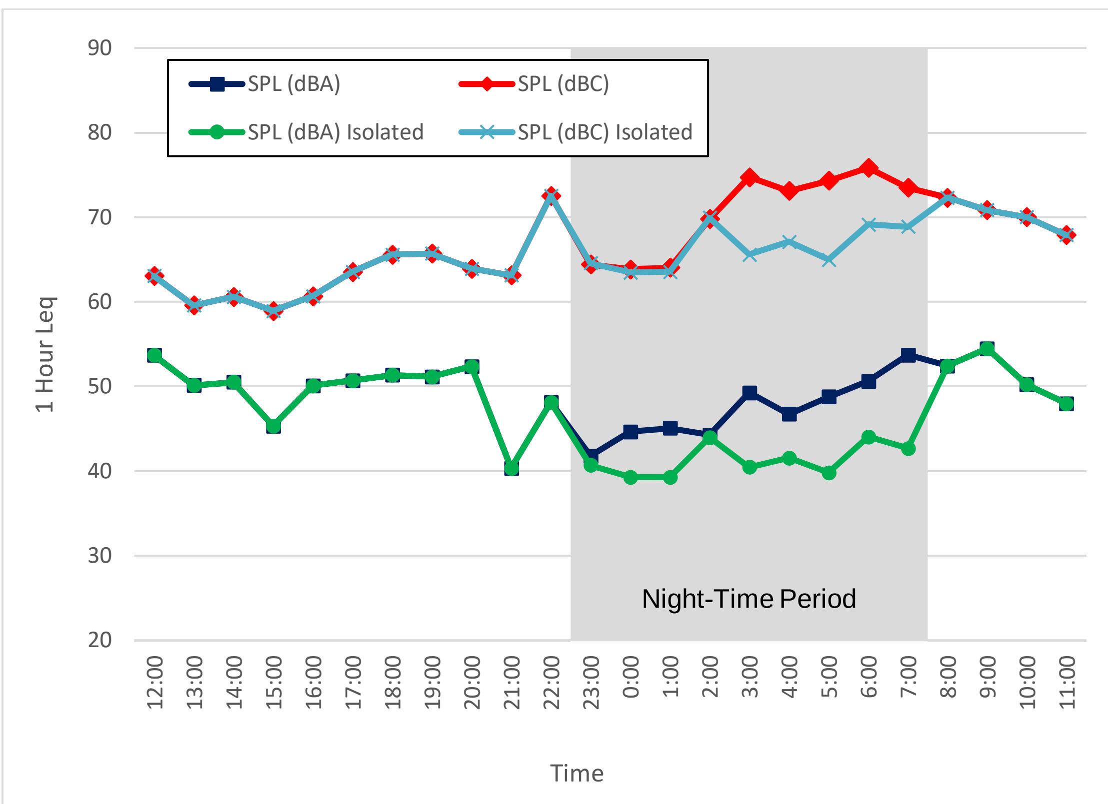

Figure 102. Noise Monitor #12, 1-Hour L_{eq} Sound Levels (October 22 – 23, 2019)

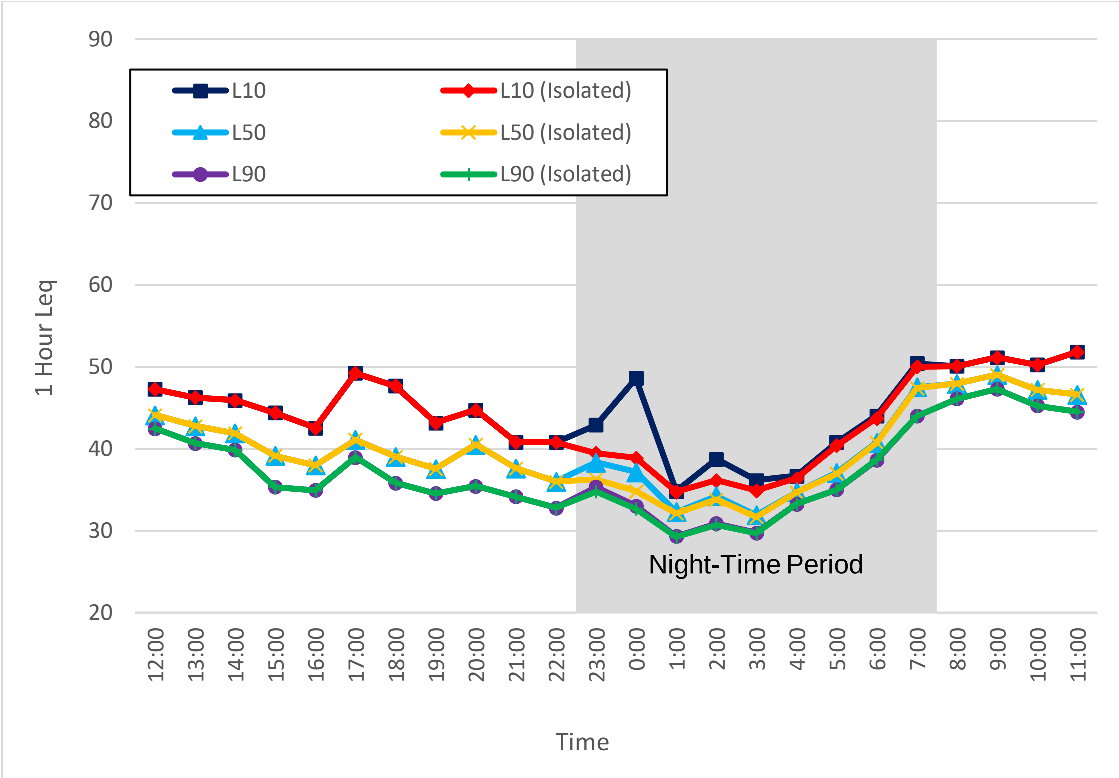

Figure 103. Noise Monitor #12, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (October 21 – 22, 2019)

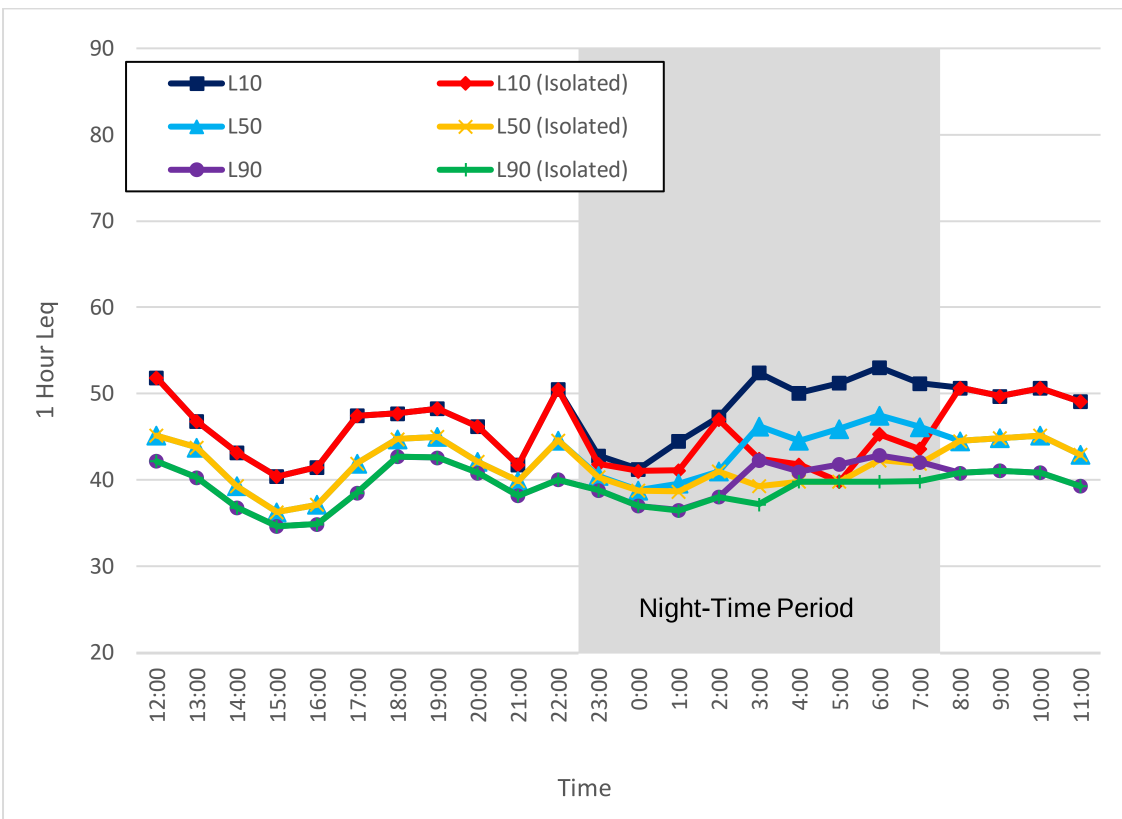

Figure 104. Noise Monitor #12, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (October 22 – 23, 2019)

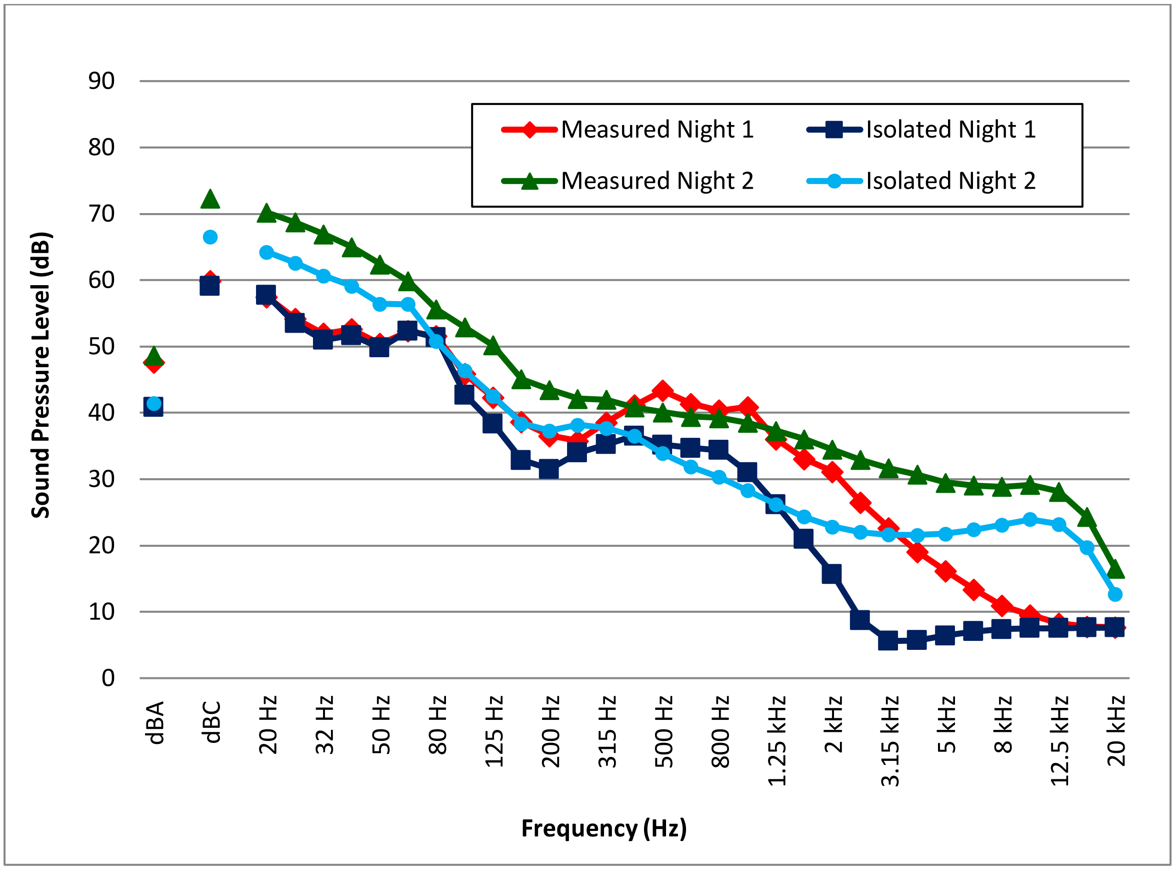

Figure 105. Noise Monitor #12, 1/3 Octave L_{eq} Sound Levels (October 21 – 23, 2019)

Noise Monitor #13

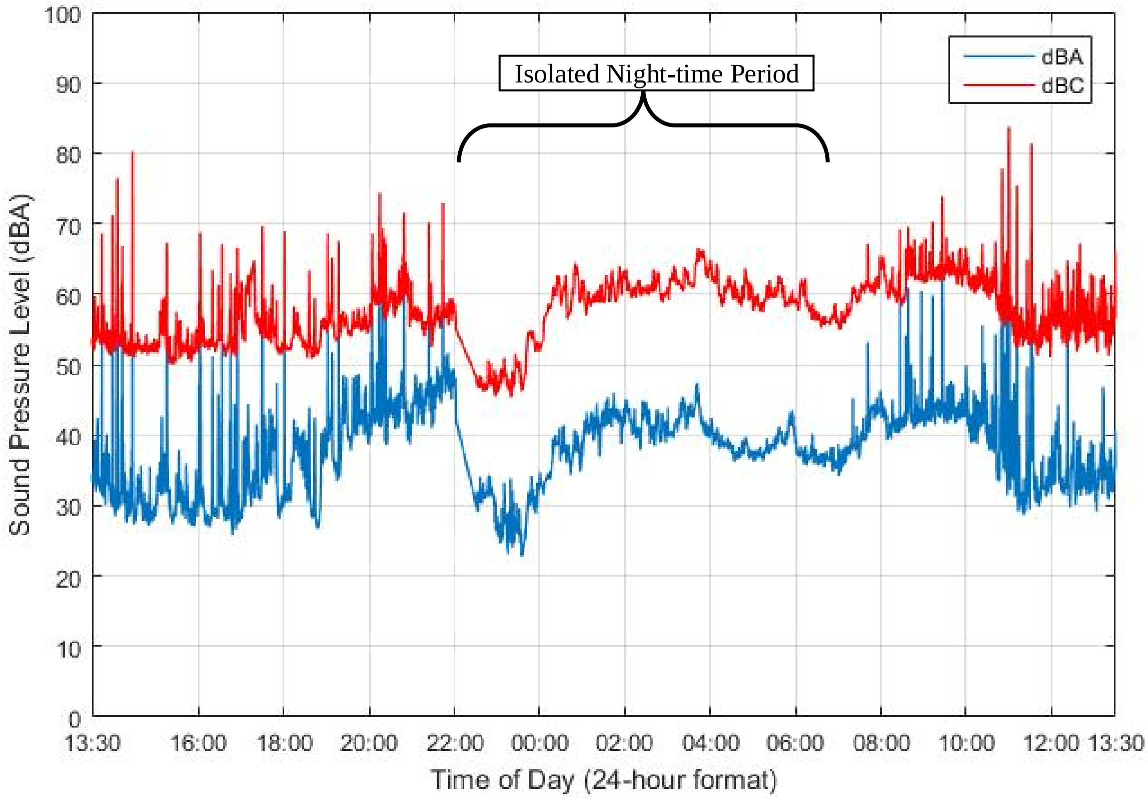

Figure 106. Noise Monitor #13, 15-Second L_{eq} Sound Levels (September 18 – 19, 2019)

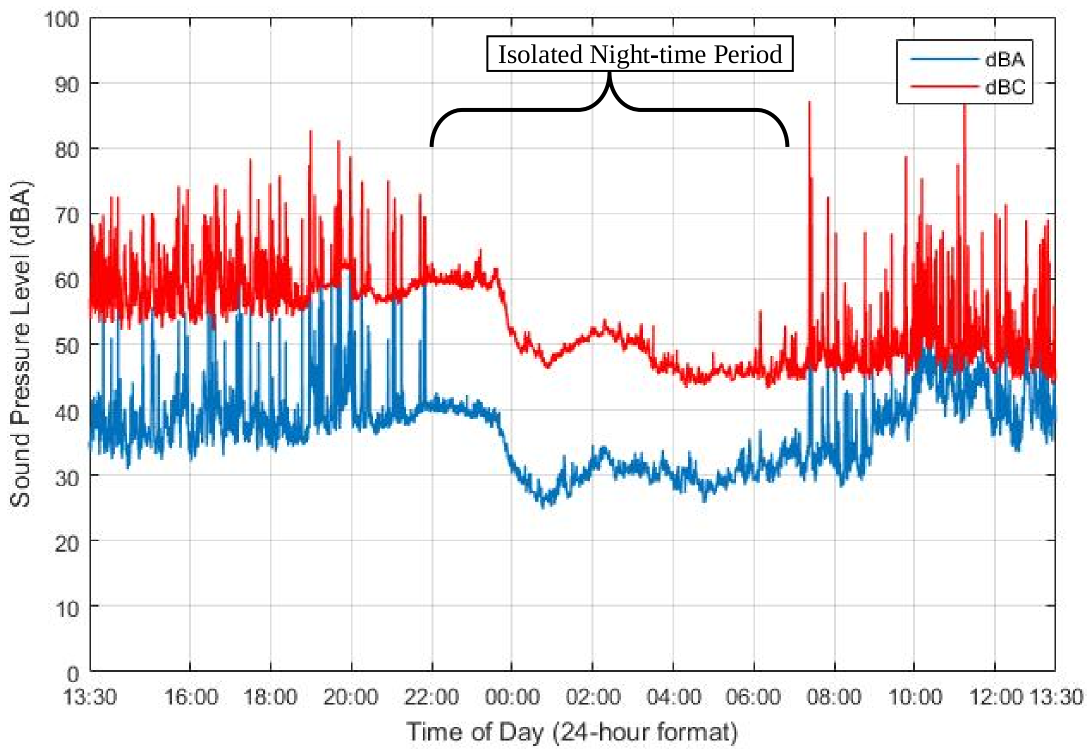

Figure 107. Noise Monitor #13, 15-Second L_{eq} Sound Levels (September 19 – 20, 2019)

Noise Monitor #13

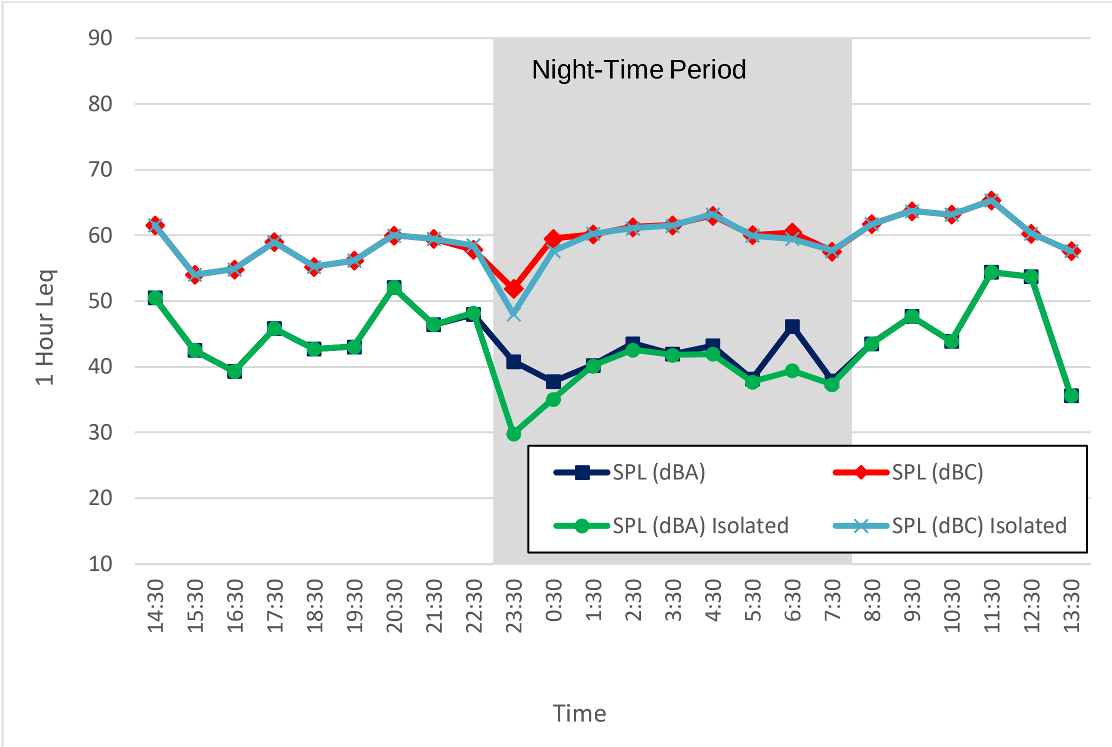

Figure 108. Noise Monitor #13, 1-Hour L_{eq} Sound Levels (September 18 – 19, 2019)

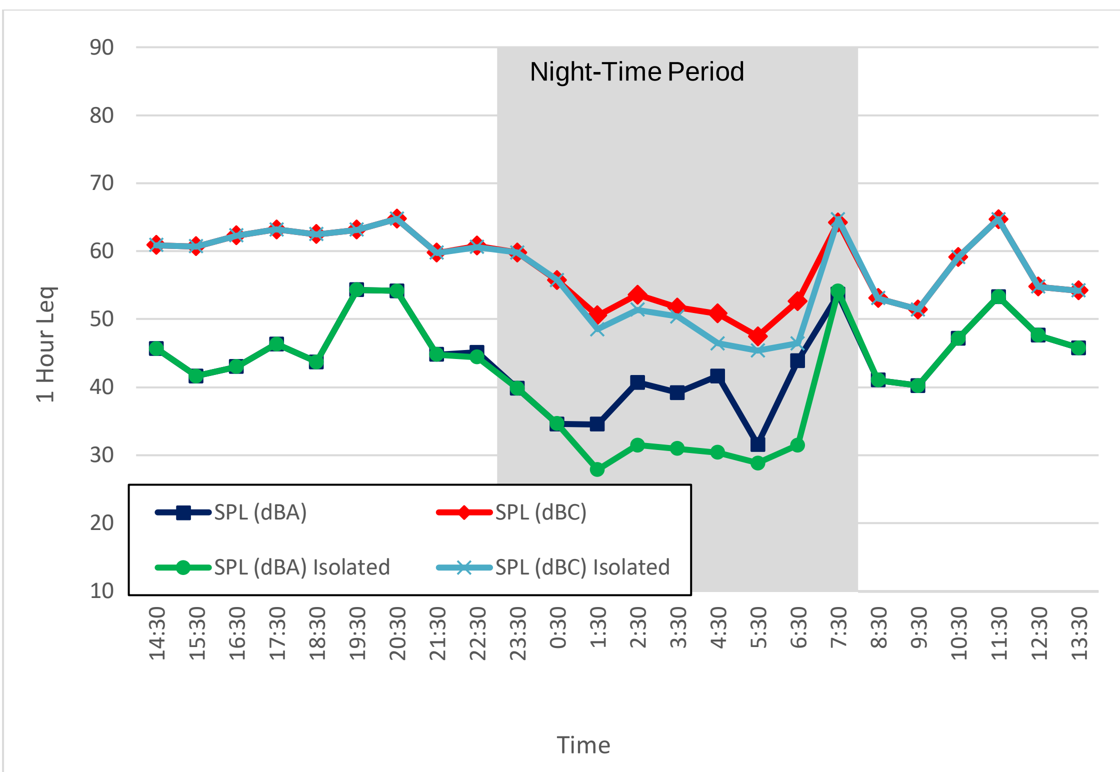

Figure 109. Noise Monitor #13, 1-Hour L_{eq} Sound Levels (September 19 – 20, 2019)

Noise Monitor #13

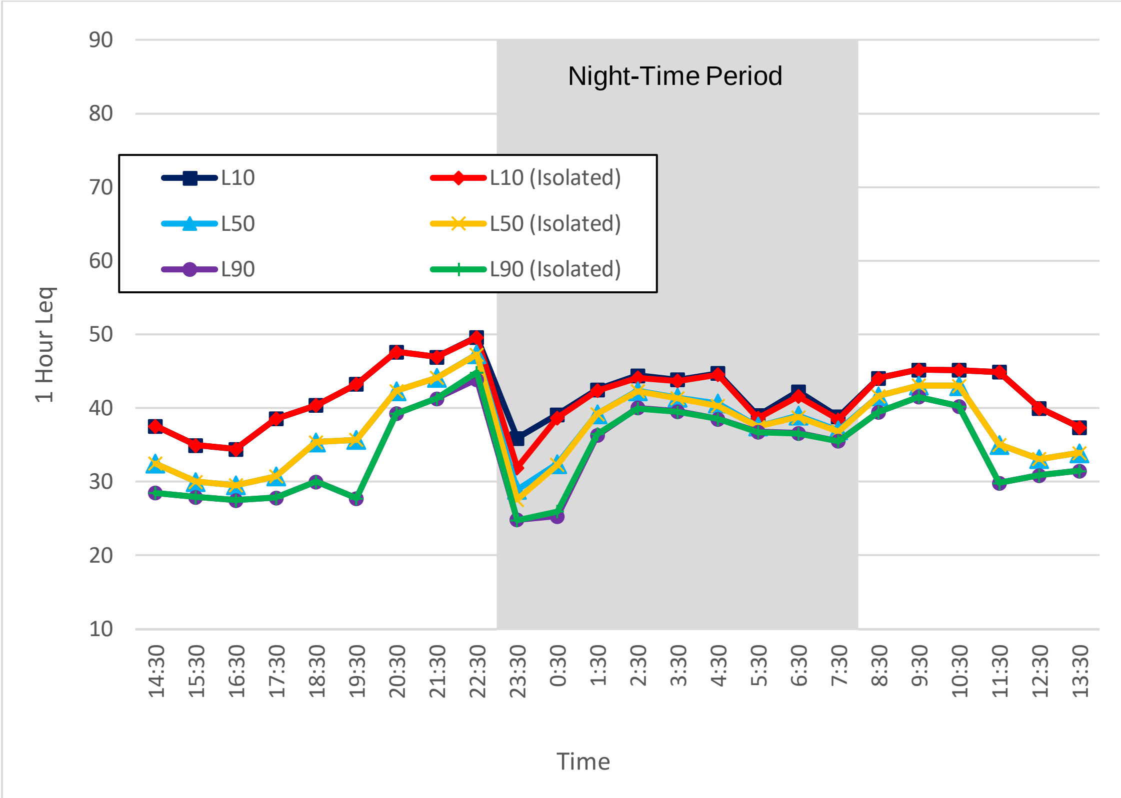

Figure 110. Noise Monitor #13, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (September 18 – 19, 2019)

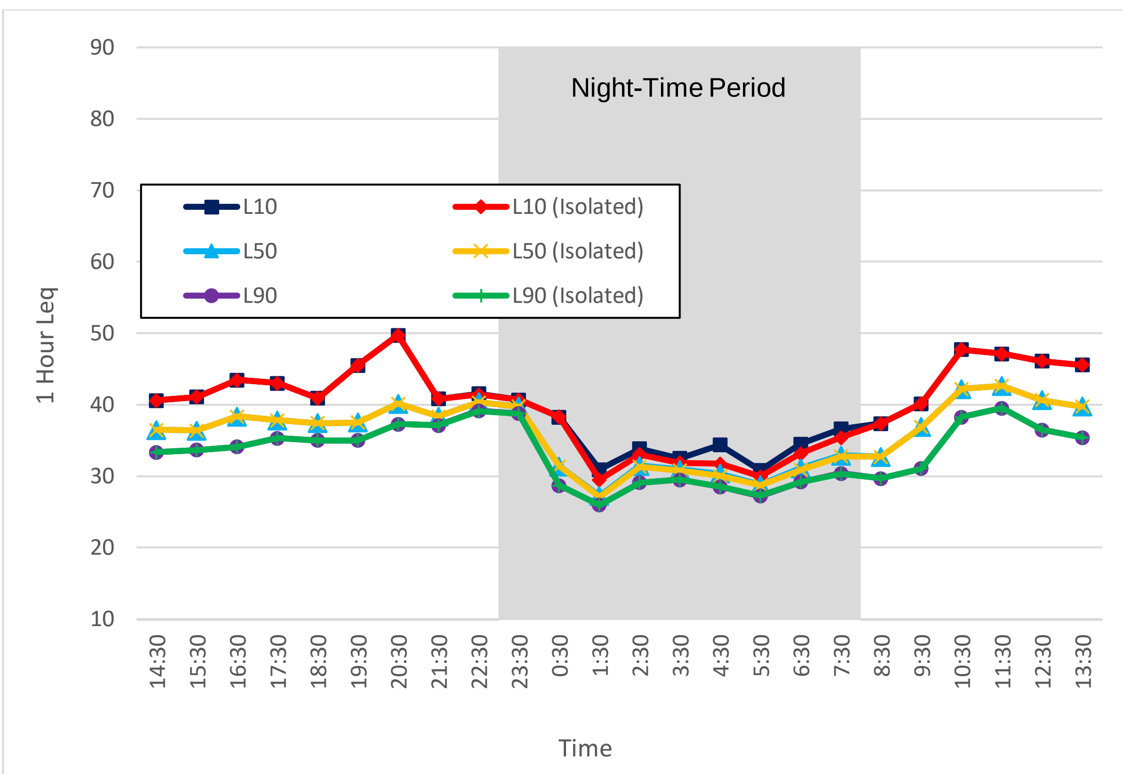

Figure 111. Noise Monitor #13, 1-Hour L_{10}, L_{50}, L_{90} L_{eq} Sound Levels (September 19 – 20, 2019)

Noise Monitor #13

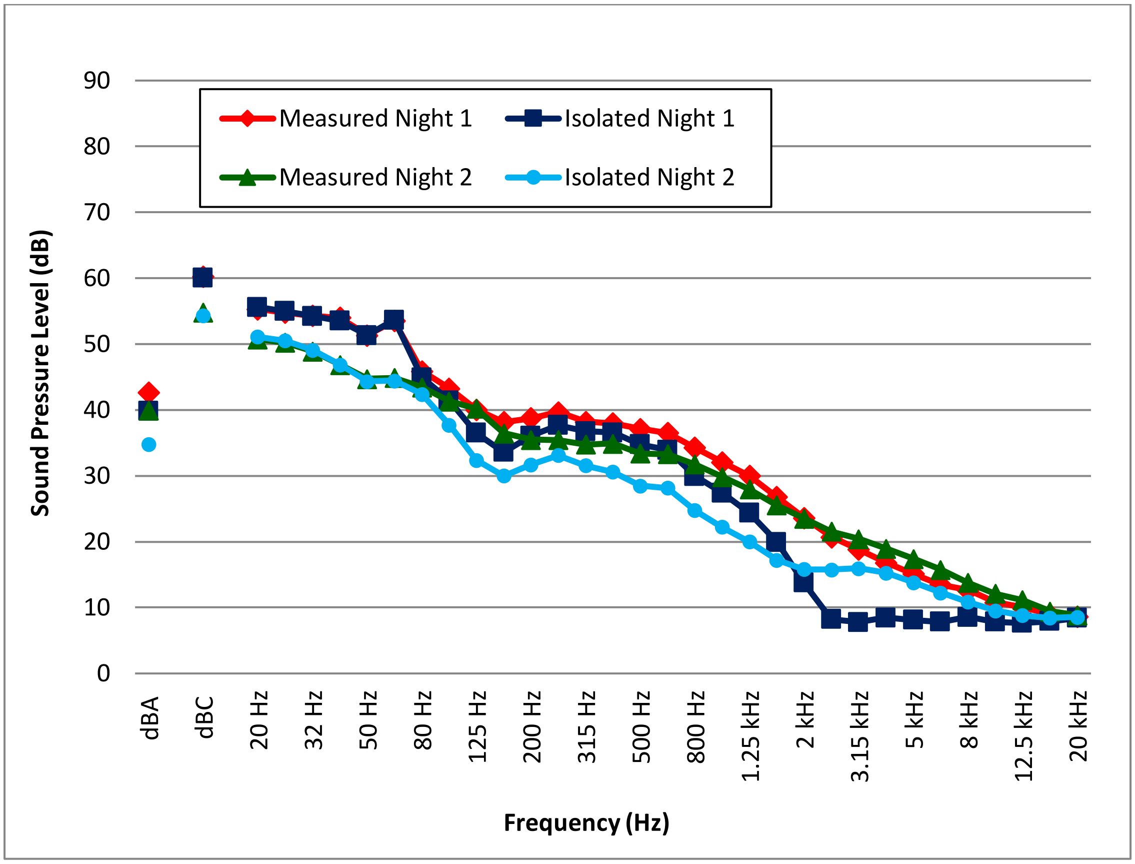

Figure 112. Noise Monitor #13, 1/3 Octave L_{eq} Sound Levels (September 18 – 20, 2019)

Appendix I MEASUREMENT EQUIPMENT USED

Noise Monitors

The environmental noise monitoring equipment used consisted of a Brüel and Kjær Type 2250/2270 Precision Integrating Sound Level Meter enclosed in an environmental case, a tripod, a weather protective microphone hood, and in certain cases, an external battery. The system acquired data in 15-second L_{eq} samples using 1/3 octave band frequency analysis and overall A-weighted and C-weighted sound levels. The sound level meter conforms to Type 1, ANSI S1.4, ANSI S1.43, IEC 61672-1, IEC 60651, IEC 60804 and DIN 45657. The 1/3 octave filters conform to S1.11 – Type 0-C, and IEC 61260 – Class 0. The calibrator conforms to IEC 942 and ANSI S1.40. The sound level meter, pre-amplifier and microphone were certified on May 14, 2019 / January 31, 2019 / January 31, 2019 / November 27, 2018 / November 28, 2018 / August 16, 2018 / April 25, 2018 / March 28, 2019 / May 14, 2019 and the calibrator (type B&K 4231) was certified on January 30, 2019 by a NIST NVLAP Accredited Calibration Laboratory for all requirements of ISO 17025: 1999 and relevant requirements of ISO 9002:1994, ISO 9001:2000 and ANSI/NCSL Z540: 1994 Part 1. All measurement methods and instrumentation conform to the requirements of the AER Directive 038. Simultaneous digital audio was recorded directly on the sound level meter using a 8 kHz sample rate for more detailed post-processing analysis. Refer to the next section in the Appendix for a detailed description of the various acoustical descriptive terms used.

Weather Monitors

Each weather monitoring system used for the study consisted of an Orion Weather Station 9510-A-1 with a WXT520 Self-Aspirating Radiation Shield Sensor Unit, a Weather MicroServer 9590 Data-logger, and a Lightning Arrestor. The Data-logger and batteries were located in a grounded, weather protective case. The Sensor Unit was mounted on a sturdy survey tripod (with supporting guy-wires) at approximately 5.0 m above ground. The system was set up to record data in 1-minute samples obtaining the wind-speed, peak wind-speed, and wind-direction in a rolling 2-minute average as well as the 1-minute temperature, relative humidity, barometric pressure, rain rate and total rain accumulation.

Record of Calibration Results

Description	Date	Time	Pre / Post	Calibration Level	Calibrator Model	Serial Number
Monitor #1	22-Jul-19	14:55	Pre	93.9 dBA	B&K 4231	2656414
Monitor #1	25-Jul-19	15:35	Post	93.8 dBA	B&K 4231	2656414
Monitor #2	22-Jul-19	14:40	Pre	93.9 dBA	B&K 4231	2656414
Monitor #2	25-Jul-19	15:00	Post	93.8 dBA	B&K 4231	2656414
Monitor #3	22-Jul-19	14:20	Pre	93.9 dBA	B&K 4231	2656414
Monitor #3	25-Jul-19	14:50	Post	93.9 dBA	B&K 4231	2656414
Monitor #4	21-Oct-19	10:05	Pre	93.9 dBA	B&K 4231	2656414
Monitor #4	23-Oct-19	12:45	Post	93.8 dBA	B&K 4231	2656414
Monitor #5	22-Jul-19	14:00	Pre	93.9 dBA	B&K 4231	2656414
Monitor #5	25-Jul-19	14:25	Post	93.9 dBA	B&K 4231	2656414
Monitor #6	18-Sep-19	12:40	Pre	93.9 dBA	B&K 4231	2656414
Monitor #6	20-Sep-19	13:25	Post	93.9 dBA	B&K 4231	2656414
Monitor #8	22-Jul-19	12:45	Pre	93.9 dBA	B&K 4231	2656414
Monitor #8	25-Jul-19	16:35	Post	93.8 dBA	B&K 4231	2656414
Monitor #9	22-Jul-19	11:45	Pre	93.9 dBA	B&K 4231	2656414
Monitor #9	25-Jul-19	16:10	Post	93.9 dBA	B&K 4231	2656414
Monitor #10	22-Jul-19	14:55	Pre	93.9 dBA	B&K 4231	2656414
Monitor #10	25-Jul-19	15:10	Post	93.9 dBA	B&K 4231	2656414
Monitor #11	22-Jul-19	12:30	Pre	93.9 dBA	B&K 4231	2656414
Monitor #11	25-Jul-19	16:25	Post	93.9 dBA	B&K 4231	2656414
Monitor #12 #1	22-Jul-19	13:30	Pre	93.9 dBA	B&K 4231	2656414
Monitor #12 #1	25-Jul-19	14:10	Post	93.8 dBA	B&K 4231	2656414
Monitor #12 #2	18-Sep-19	12:05	Pre	93.9 dBA	B&K 4231	2656414
Monitor #12 #2	20-Sep-19	14:10	Post	93.8 dBA	B&K 4231	2656414
Monitor #12 #3	21-Oct-19	9:30	Pre	93.9 dBA	B&K 4231	2656414
Monitor #12 #3	23-Oct-19	12:05	Post	93.8 dBA	B&K 4231	2656414
Monitor #13	18-Sep-19	13:25	Pre	93.9 dBA	B&K 4231	2656414
Monitor #13	20-Sep-19	13:45	Post	93.9 dBA	B&K 4231	2656414

B&K 2250 Unit #1 SLM Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.42870

Instrument:	**Sound Level Meter**	*Date Calibrated:* **5/14/2019** *Cal Due:*		
Model:	**2250**	*Status:*	**Received**	**Sent**
Manufacturer:	**Brüel and Kjær**	*In tolerance:*	**X**	**X**
Serial number:	**2488495**	*Out of tolerance:*		
Tested with:	**Microphone 4189 s/n 2471133** **Preamplifier ZC0032 s/n 3271**	*See comments:*		
		Contains non-accredited tests: __ **Yes** X **No**		
Type (class):	**1**	*Calibration service:* __ **Basic** X **Standard**		
Customer:	**ACI Acoustical Consultants Inc.**	*Address:* **5031 - 210 Street, Edmonton, Alberta, CANADA T6M 0A8**		
Tel/Fax:	**780-414-6373 / 780-414-6376**			

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/26/2015
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31052	Oct 31, 2018	Scantek, Inc./ NVLAP	Oct 31, 2019
DS-360-SRS	Function Generator	33584	Oct 24, 2017	ACR Env./ A2LA	Oct 24, 2019
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Oct 1, 2018	ACR Env. / A2LA	Oct 1, 2019
HM30-Thommen	Meteo Station	1040170/39633	Nov 13, 2018	ACR Env./ A2LA	Nov 13, 2019
PC Program 1019 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Nov 11, 2018	Scantek, Inc./ NVLAP	Nov 11, 2019

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK).

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
23.6	99.61	45.1

Calibrated by:	Lydon Dawkins	**Authorized signatory:**	Steven E. Marshall
Signature	Lydon Dawkins	Signature	Steven E Marshall
Date	5/14/2019	Date	5/15/2019

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B&K 2250 Unit #1 Microphone Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®
CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.42871

Instrument:	**Microphone**	*Date Calibrated:* **5/14/2019** *Cal Due:*		
Model:	**4189**	*Status:*	**Received**	**Sent**
Manufacturer:	**Brüel & Kjær**	*In tolerance:*	**X**	**X**
Serial number:	**2471133**	*Out of tolerance:*		
Composed of:		*See comments:*		
		Contains non-accredited tests: __Yes X No		
Customer:	**ACI Acoustical Consultants Inc.**	*Address:*	**5031 - 210 Street, Edmonton, Alberta, CANADA T6M 0A8**	
Tel/Fax:	**780-414-6373/780-414-6376**			

Tested in accordance with the following procedures and standards:
Calibration of Measurement Microphones, Scantek, Inc., Rev. 2/25/2015

Instrumentation used for calibration: N-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31052	Oct 31, 2018	Scantek, Inc./ NVLAP	Oct 31, 2019
DS-360-SRS	Function Generator	33584	Oct 24, 2017	ACR Env./ A2LA	Oct 24, 2019
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Oct 1, 2018	ACR Env. / A2LA	Oct 1, 2019
HM30-Thommen	Meteo Station	1040170/39633	Nov 13, 2018	ACR Env./ A2LA	Nov 13, 2019
PC Program 1017 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1253-Norsonic	Calibrator	28326	Nov 11, 2018	Scantek, Inc./ NVLAP	Nov 11, 2019
1203-Norsonic	Preamplifier	14059	Feb 28, 2019	Scantek, Inc./ NVLAP	Feb 28, 2020
4180-Brüel&Kjær	Microphone	2246115	Oct 24, 2017	DANAK / DPLA	Oct 24, 2019

Instrumentation and test results are traceable to SI - BIPM through standards maintained by NPL (UK) and NIST (USA)

Calibrated by:	Lydon Dawkins	Authorized signatory:	Steven E. Marshall
Signature	Lydon Dawkins	Signature	Steven E. Marshall
Date	5/14/2019	Date	5/15/2019

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B&K 2270 Unit #2 SLM Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®
CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.42223

Instrument:	**Sound Level Meter**	*Date Calibrated:* **1/31/2019**	*Cal Due:*
Model:	**2270**	*Status:*	**Received** / **Sent**
Manufacturer:	**Brüel and Kjær**	*In tolerance:*	X / X
Serial number:	**3002718**	*Out of tolerance:*	
Tested with:	**Microphone 4189 s/n 2850742** **Preamplifier ZC0032 s/n 18754**	*See comments:*	
Type (class):	**1**	*Contains non-accredited tests:*	__Yes X No
Customer:	**ACI Acoustical Consultants Inc.**	*Calibration service:*	__ Basic X Standard
Tel/Fax:	**780-414-6373 / 780-414-6376**	*Address:*	**5031 - 210 Street** **Edmonton, Alberta** **CANADA T6M 0A8**

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/26/2015
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31061	Jul 30, 2018	Scantek, Inc./ NVLAP	Jul 30, 2019
DS-360-SRS	Function Generator	61646	Sep 7, 2018	ACR Env./ A2LA	Sep 7, 2020
34401A-Agilent Technologies	Digital Voltmeter	MY47022043	Sep 17, 2018	ACR Env./ A2LA	Sep 17, 2019
HM30-Thommen	Meteo Station	1040170/39633	Nov 13, 2018	ACR Env./ A2LA	Nov 13, 2019
PC Program 1019 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Nov 11, 2018	Scantek, Inc./ NVLAP	Nov 11, 2019

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK).

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
21.9	101.84	39.7

Calibrated by:	Jeremy Gotwalt	**Authorized signatory:**	Steven E. Marshall
Signature	*Jeremy Gotwalt*	Signature	*Steven E. Marshall*
Date	1/31/19	Date	1/31/2019

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B&K 2270 Unit #2 Microphone Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ilac MRA signatory)

NVLAP®
CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.42224

Instrument: **Microphone**
Model: **4189**
Manufacturer: **Brüel & Kjær**
Serial number: **2850742**
Composed of:

Customer: **ACI Acoustical Consultants Inc.**
Tel/Fax: **780-414-6373/780-414-6376**

Date Calibrated: **1/30/2019** *Cal Due:*

Status:	Received	Sent
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: __Yes _X_ No
Address: **5031 - 210 Street**
Edmonton, Alberta
CANADA T6M 0A8

Tested in accordance with the following procedures and standards:
Calibration of Measurement Microphones, Scantek, Inc., Rev. 2/25/2015

Instrumentation used for calibration: N-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31061	Jul 30, 2018	Scantek, Inc./ NVLAP	Jul 30, 2019
DS-360-SRS	Function Generator	61646	Sep 7, 2018	ACR Env./ A2LA	Sep 7, 2020
34401A-Agilent Technologies	Digital Voltmeter	MY47022043	Sep 17, 2018	ACR Env./ A2LA	Sep 17, 2019
HM30-Thommen	Meteo Station	1040170/39633	Nov 13, 2018	ACR Env./ A2LA	Nov 13, 2019
PC Program 1017 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1253-Norsonic	Calibrator	28326	Nov 11, 2018	Scantek, Inc./ NVLAP	Nov 11, 2019
1203-Norsonic	Preamplifier	21270	Aug 3, 2018	Scantek, Inc./ NVLAP	Aug 3, 2019
4180-Brüel&Kjær	Microphone	2246115	Oct 24, 2017	DANAK / DPLA	Oct 24, 2019

Instrumentation and test results are traceable to SI - BIPM through standards maintained by NPL (UK) and NIST (USA)

Calibrated by:	Jeremy Gotwalt	Authorized signatory:	Steven E. Marshall
Signature		Signature	Steven E Marshall
Date	1/30/19	Date	1/31/2019

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B&K 2270 Unit #3 SLM Calibration Certificates

Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.42221

Instrument: **Sound Level Meter**
Model: **2270**
Manufacturer: **Brüel and Kjær**
Serial number: **3002730**
Tested with: **Microphone 4189 s/n 2850741**
Preamplifier ZC0032 s/n 18750
Type (class): **1**
Customer: **ACI Acoustical Consultants Inc.**
Tel/Fax: **780-414-6373 / 780-414-6376**

Date Calibrated: **1/31/2019** *Cal Due:*

Status:	Received	Sent
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: __Yes X No
Calibration service: __ Basic X Standard
Address: **5031 - 210 Street**
0Edmonton, Alberta
CANADA T6M 0A8

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/26/2015
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31061	Jul 30, 2018	Scantek, Inc./ NVLAP	Jul 30, 2019
DS-360-SRS	Function Generator	61646	Sep 7, 2018	ACR Env./ A2LA	Sep 7, 2020
34401A-Agilent Technologies	Digital Voltmeter	MY47022043	Sep 17, 2018	ACR Env./ A2LA	Sep 17, 2019
HM30-Thommen	Meteo Station	1040170/39633	Nov 13, 2018	ACR Env./ A2LA	Nov 13, 2019
PC Program 1019 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Nov 11, 2018	Scantek, Inc./ NVLAP	Nov 11, 2019

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK).

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
23.1	99.67	36.4

Calibrated by:	Jeremy Gotwalt	**Authorized signatory:**	Steven E. Marshall
Signature	[signature]	Signature	Steven E Marshall
Date	1/31/19	Date	1/31/2019

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B&K 2270 Unit #3 Microphone Calibration Certificates

Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®
CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.42222

Instrument: **Microphone**
Model: **4189**
Manufacturer: **Brüel & Kjær**
Serial number: **2850741**
Composed of:

Date Calibrated: **1/30/2019** *Cal Due:*

Status:	Received	Sent
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: __Yes _X_ No

Customer: **ACI Acoustical Consultants Inc.**
Address: **5031 - 210 Street, Edmonton, Alberta, CANADA T6M 0A8**
Tel/Fax: **780-414-6373/780-414-6376**

Tested in accordance with the following procedures and standards:
Calibration of Measurement Microphones, Scantek, Inc., Rev. 2/25/2015

Instrumentation used for calibration: N-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31061	Jul 30, 2018	Scantek, Inc./ NVLAP	Jul 30, 2019
DS-360-SRS	Function Generator	61646	Sep 7, 2018	ACR Env./ A2LA	Sep 7, 2020
34401A-Agilent Technologies	Digital Voltmeter	MY47022043	Sep 17, 2018	ACR Env./ A2LA	Sep 17, 2019
HM30-Thommen	Meteo Station	1040170/39633	Nov 13, 2018	ACR Env./ A2LA	Nov 13, 2019
PC Program 1017 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1253-Norsonic	Calibrator	28326	Nov 11, 2018	Scantek, Inc./ NVLAP	Nov 11, 2019
1203-Norsonic	Preamplifier	21270	Aug 3, 2018	Scantek, Inc./ NVLAP	Aug 3, 2019
4180-Brüel&Kjær	Microphone	2246115	Oct 24, 2017	DANAK / DPLA	Oct 24, 2019

Instrumentation and test results are traceable to SI - BIPM through standards maintained by NPL (UK) and NIST (USA)

Calibrated by:	Jeremy Gotwalt	Authorized signatory:	Steven E. Marshall
Signature	[signature]	Signature	Steven E. Marshall
Date	1/30/19	Date	1/31/2019

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B&K 2270 Unit #4 SLM Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.41885

Instrument: **Sound Level Meter**
Model: **2270**
Manufacturer: **Brüel and Kjær**
Serial number: **2644639**
Tested with: **Microphone 4189 s/n 2643219**
Preamplifier ZC0032 s/n 8255
Type (class): **1**
Customer: **ACI Acoustical Consultants Inc.**
Tel/Fax: **780-414-6373 / 780-414-6376**

Date Calibrated: **11/27/2018** *Cal Due:*

Status:	**Received**	**Sent**
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: __Yes X No
Calibration service: __ Basic X Standard
Address: **5031 - 210 Street**
Edmonton, Alberta, CANADA
T6M 0A8

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/26/2015
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31061	Jul 30, 2018	Scantek, Inc./ NVLAP	Jul 30, 2019
DS-360-SRS	Function Generator	61646	Sep 7, 2018	ACR Env./ A2LA	Sep 7, 2020
34401A-Agilent Technologies	Digital Voltmeter	MY47022043	Sep 17, 2018	ACR Env./ A2LA	Sep 17, 2019
HM30-Thommen	Meteo Station	1040170/39633	Nov 13, 2018	ACR Env./ A2LA	Nov 13, 2019
PC Program 1019 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Nov 11, 2018	Scantek, Inc./ NVLAP	Nov 11, 2019

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK).

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
23.5	98.91	44.7

Calibrated by:	Jeremy Gotwalt	Authorized signatory:	Steven E. Marshall
Signature	Jeremy Gotwalt	Signature	Steven E. Marshall
Date	11/27/18	Date	11/28/2018

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B&K 2270 Unit #4 Microphone Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®
CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.41886

Instrument:	**Microphone**	*Date Calibrated:* **11/26/2018** *Cal Due:*			
Model:	**4189**	*Status:*		**Received**	**Sent**
Manufacturer:	**Brüel & Kjær**	*In tolerance:*		**X**	**X**
Serial number:	**2643219**	*Out of tolerance:*			
Composed of:		*See comments:*			
		Contains non-accredited tests: __Yes **X** No			
Customer:	**ACI Acoustical Consultants Inc.**	*Address:*	**5031 - 210 Street Edmonton, Alberta, CANADA T6M 0A8**		
Tel/Fax:	**780-414-6373/780-414-6376**				

Tested in accordance with the following procedures and standards:
Calibration of Measurement Microphones, Scantek, Inc., Rev. 2/25/2015

Instrumentation used for calibration: N-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31061	Jul 30, 2018	Scantek, Inc./ NVLAP	Jul 30, 2019
DS-360-SRS	Function Generator	61646	Sep 7, 2018	ACR Env./ A2LA	Sep 7, 2020
34401A-Agilent Technologies	Digital Voltmeter	MY47022043	Sep 17, 2018	ACR Env./ A2LA	Sep 17, 2019
HM30-Thommen	Meteo Station	1040170/39633	Nov 13, 2018	ACR Env./ A2LA	Nov 13, 2019
PC Program 1017 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1253-Norsonic	Calibrator	28326	Nov 11, 2018	Scantek, Inc./ NVLAP	Nov 11, 2019
1203-Norsonic	Preamplifier	21270	Aug 3, 2018	Scantek, Inc./ NVLAP	Aug 3, 2019
4180-Brüel&Kjær	Microphone	2246115	Oct 24, 2017	DANAK / DPLA	Oct 24, 2019

Instrumentation and test results are traceable to SI - BIPM through standards maintained by NPL (UK) and NIST (USA)

Calibrated by:	Jeremy Gotwalt	**Authorized signatory:**	Steven E. Marshall
Signature	Jeremy Gotwalt	Signature	Steven E Marshall
Date	11/26/18	Date	11/28/2018

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B&K 2250 Unit #6 SLM Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.41889

Instrument: **Sound Level Meter**
Model: **2250**
Manufacturer: **Brüel and Kjær**
Serial number: **2661161**
Tested with: **Microphone 4189 s/n 2650730**
Preamplifier ZC0032 s/n 9935
Type (class): **1**
Customer: **ACI Acoustical Consultants Inc.**
Tel/Fax: **780-414-6373 / 780-414-6376**

Date Calibrated: **11/28/2018** *Cal Due:*

Status:	**Received**	**Sent**
In tolerance:	**X**	**X**
Out of tolerance:		
See comments:		

Contains non-accredited tests: __ **Yes** **X** **No**
Calibration service: __ **Basic** **X** **Standard**
Address: **5031 - 210 Street**
Edmonton, Alberta, CANADA
T6M 0A8

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/26/2015
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31061	Jul 30, 2018	Scantek, Inc./ NVLAP	Jul 30, 2019
DS-360-SRS	Function Generator	61646	Sep 7, 2018	ACR Env./ A2LA	Sep 7, 2020
34401A-Agilent Technologies	Digital Voltmeter	MY47022043	Sep 17, 2018	ACR Env./ A2LA	Sep 17, 2019
HM30-Thommen	Meteo Station	1040170/39633	Nov 13, 2018	ACR Env./ A2LA	Nov 13, 2019
PC Program 1019 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Nov 11, 2018	Scantek, Inc./ NVLAP	Nov 11, 2019

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK).

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
23.0	99.25	41.3

Calibrated by:	Jeremy Gotwalt	**Authorized signatory:**	Steven E. Marshall
Signature	Jeremy Gotwalt	Signature	Steven E. Marshall
Date	11/28/18	Date	11/28/2018

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This Calibration Certificate or Test Reports shall not be used to claim product certification, approval or endorsement by NVLAP, NIST, or any agency of the federal government.
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B&K 2250 Unit #6 Microphone Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®
CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.41890

Instrument:	**Microphone**	*Date Calibrated:* **11/27/2018** *Cal Due:*		
Model:	**4189**	*Status:*	**Received**	**Sent**
Manufacturer:	**Brüel & Kjær**	*In tolerance:*	**X**	**X**
Serial number:	**2650730**	*Out of tolerance:*		
Composed of:		*See comments:*		
		Contains non-accredited tests: __Yes **X** No		
Customer:	**ACI Acoustical Consultants Inc.**	*Address:*	**5031 - 210 Street Edmonton, Alberta, CANADA T6M 0A8**	
Tel/Fax:	**780-414-6373/780-414-6376**			

Tested in accordance with the following procedures and standards:
Calibration of Measurement Microphones, Scantek, Inc., Rev. 2/25/2015

Instrumentation used for calibration: N-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31061	Jul 30, 2018	Scantek, Inc./ NVLAP	Jul 30, 2019
DS-360-SRS	Function Generator	61646	Sep 7, 2018	ACR Env./ A2LA	Sep 7, 2020
34401A-Agilent Technologies	Digital Voltmeter	MY47022043	Sep 17, 2018	ACR Env./ A2LA	Sep 17, 2019
HM30-Thommen	Meteo Station	1040170/39633	Nov 13, 2018	ACR Env./ A2LA	Nov 13, 2019
PC Program 1017 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1253-Norsonic	Calibrator	28326	Nov 11, 2018	Scantek, Inc./ NVLAP	Nov 11, 2019
1203-Norsonic	Preamplifier	21270	Aug 3, 2018	Scantek, Inc./ NVLAP	Aug 3, 2019
4180-Brüel&Kjær	Microphone	2246115	Oct 24, 2017	DANAK / DPLA	Oct 24, 2019

Instrumentation and test results are traceable to SI - BIPM through standards maintained by NPL (UK) and NIST (USA)

Calibrated by:	Jeremy Gotwalt	Authorized signatory:	Steven E. Marshall
Signature	[signature]	Signature	Steven E. Marshall
Date	11/27/18	Date	11/28/2018

Document stored as: Z:\Calibration Lab\Mic 2018\B&K4189_2650730_M1.doc

Page 1 of 2

B&K 4231 Unit #6 Calibrator Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.42220

Instrument:	**Acoustical Calibrator**	*Date Calibrated:* **1/30/2019** *Cal Due:*		
Model:	**4231**	*Status:*	**Received**	**Sent**
Manufacturer:	**Brüel and Kjær**	*In tolerance:*	**X**	**X**
Serial number:	**2656414**	*Out of tolerance:*		
Class (IEC 60942):	**1**	*See comments:*		
Barometer type:		*Contains non-accredited tests:* __Yes **X** No		
Barometer s/n:				
Customer:	**ACI Acoustical Consultants Inc.**	*Address:*	**5031 - 210 Street**	
Tel/Fax:	**780-414-6373 / 780-414-6376**		**Edmonton, Alberta**	
			CANADA T6M 0A8	

Tested in accordance with the following procedures and standards:
Calibration of Acoustical Calibrators, Scantek Inc., Rev. 10/1/2010

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31061	Jul 30, 2018	Scantek, Inc./ NVLAP	Jul 30, 2019
DS-360-SRS	Function Generator	61646	Sep 7, 2018	ACR Env./ A2LA	Sep 7, 2020
34401A-Agilent Technologies	Digital Voltmeter	MY47022043	Sep 17, 2018	ACR Env./ A2LA	Sep 17, 2019
HM30-Thommen	Meteo Station	1040170/39633	Nov 13, 2018	ACR Env./ A2LA	Nov 13, 2019
140-Norsonic	Real Time Analyzer	1403978	Mar 22, 2018	Scantek, Inc. / NVLAP	Mar 22, 2019
PC Program 1018 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
4192-Brüel&Kjær	Microphone	2854675	Nov 11, 2018	Scantek, Inc. / NVLAP	Nov 11, 2019
1203-Norsonic	Preamplifier	21270	Aug 3, 2018	Scantek, Inc./ NVLAP	Aug 3, 2019

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK)

Calibrated by:	Jeremy Gotwalt	**Authorized signatory:**	Steven E. Marshall
Signature	[signature]	Signature	[signature]
Date	1/30/19	Date	1/31/2019

Document stored as: Z:\Calibration Lab\Cal 2019\BNK4231_2656414_M1.doc

B&K 2250 Unit #7 SLM and Mic Calibration Certificate

Brüel & Kjær
North America Inc.

Calibration Certificate Number 1568.01

The Brüel & Kjær Calibration Laboratory
3079 Premiere Parkway Suite 120
Duluth, GA 30097
Telephone: 770/209-6907
Fax: 770/447-4033
Web site address: http://www.bkhome.com

CERTIFICATE OF CALIBRATION

Certificate No: CAS-321558-B5P7Y9-101 Page 1 of 10

CALIBRATION OF:

Sound Level Meter:	Brüel & Kjær	2250	Serial No: 2722859
Microphone:	Brüel & Kjær	4189	Serial No: 2710791
Preamplifier:	Brüel & Kjær	ZC-0032	Serial No: 13398
Software version:	BZ7222 Version 4.7.4.208		

CLIENT:

ACI Acoustical Consultants Inc
5031-210 Street
Edmonton, AB T6M 0A8

CALIBRATION CONDITIONS:

Preconditioning: 4 hours at 23 ± 3 °C
Environment conditions See actual values in Environmental Condition sections

SPECIFICATIONS:

This document certifies that the instrument as listed under "Model/Serial Number" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$ providing a level of confidence of approximately 95%. Statements of compliance, where applicable, are based on calibration results falling within specified criteria with no reduction by the uncertainty of the measurement. The calibration of the listed instrumentation, was accomplished using a test system which conforms with the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and ISO 10012-1. For "as received" and/or "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation This Certificate and attached data pages shall not be reproduced, except in full, without the written approval of the Brüel and Kjær Calibration Laboratory-Duluth, GA. Results relate only to the items tested. This instrument has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants.

PROCEDURE:

Brüel and Kjær Model 3630 Sound Level Meter Calibration System Software 7763 Version 7.1 - DB: 7.10 Test Collection 2250-4189.

RESULTS:

As Received Condition	As Received Data	Final Data
_X_ Received in good condition	___ Within acceptance criteria	_X_ Within acceptance criteria
___ Damaged - See attached report	___ Outside acceptance criteria	___ Limited test - See attached details
	_X_ Inoperative	
	___ Data not taken	

Date of Calibration: 16 Aug. 2018 Certificate issued: 16 Aug. 2018

John Avitabile
Calibration Technician

Quality Representative

aci acoustical consultants inc

B&K 2250 Unit #8 SLM Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.40635

Instrument: **Sound Level Meter**
Model: **2250**
Manufacturer: **Brüel and Kjær**
Serial number: **3005978**
Tested with: **Microphone 4189 s/n 2851039**
Preamplifier ZC0032 s/n 20742
Type (class): **1**
Customer: **ACI Acoustical Consultants Inc.**
Tel/Fax: **780-414-6373 / 780-414-6376**

Date Calibrated: **4/25/2018** *Cal Due:*

Status:	Received	Sent
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: __Yes X No
Calibration service: __ Basic X Standard
Address: **5031 - 210 Street**
Edmonton, Alberta
CANADA T6M 0A8

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/26/2015
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31061	Jul 28, 2017	Scantek, Inc./ NVLAP	Jul 28, 2018
DS-360-SRS	Function Generator	88077	Sep 15, 2016	ACR Env./ A2LA	Sep 15, 2018
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Sep 20, 2017	ACR Env./ A2LA	Sep 20, 2018
HM30-Thommen	Meteo Station	1040170/39633	Oct 25, 2017	ACR Env./ A2LA	Oct 25, 2018
PC Program 1019 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Nov 10, 2017	Scantek, Inc./ NVLAP	Nov 10, 2018

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK).

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
22.9	99.14	53.5

Calibrated by:	Jeremy Gotwalt	**Authorized signatory:**	Steven E. Marshall
Signature	[signature]	Signature	Steven E Marshall
Date	4/25/18	Date	4/25/2018

Calibration Certificates or Test Reports shall not be reproduced, except in full, without written approval of the laboratory.
This Calibration Certificate or Test Reports shall not be used to claim product certification, approval or endorsement by NVLAP, NIST, or any agency of the federal government.
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Page 1 of 2

B&K 2250 Unit #8 Microphone Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.40636

Instrument:	**Microphone**	*Date Calibrated:* **4/25/2018**	*Cal Due:*		
Model:	**4189**	*Status:*	**Received**	**Sent**	
Manufacturer:	**Brüel & Kjær**	*In tolerance:*	**X**	**X**	
Serial number:	**2851039**	*Out of tolerance:*			
Composed of:		*See comments:*			
		Contains non-accredited tests: __Yes **X** No			
Customer:	**ACI Acoustical Consultants Inc.**	*Address:*	**5031 - 210 Street**		
			Edmonton, Alberta		
Tel/Fax:	**780-414-6373/780-414-6376**		**CANADA T6M 0A8**		

Tested in accordance with the following procedures and standards:
Calibration of Measurement Microphones, Scantek, Inc., Rev. 2/25/2015

Instrumentation used for calibration: N-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31061	Jul 28, 2017	Scantek, Inc./ NVLAP	Jul 28, 2018
DS-360-SRS	Function Generator	88077	Sep 15, 2016	ACR Env./ A2LA	Sep 15, 2018
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Sep 20, 2017	ACR Env./ A2LA	Sep 20, 2018
HM30-Thommen	Meteo Station	1040170/39633	Oct 25, 2017	ACR Env./ A2LA	Oct 25, 2018
PC Program 1017 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1253-Norsonic	Calibrator	28326	Nov 10, 2017	Scantek, Inc./ NVLAP	Nov 10, 2018
1203-Norsonic	Preamplifier	92268	Oct 18, 2017	Scantek, Inc./ NVLAP	Oct 18, 2018
4180-Brüel&Kjær	Microphone	2246115	Oct 24, 2017	DANAK / DPLA	Oct 24, 2019

Instrumentation and test results are traceable to SI - BIPM through standards maintained by NPL (UK) and NIST (USA)

Calibrated by:	Jeremy Gotwalt	**Authorized signatory:**	Steven E Marshall
Signature	[signature]	Signature	Steven E. Marshall
Date	4/25/18	Date	4/25/2018

Calibration Certificates or Test Reports shall not be reproduced, except in full, without written approval of the laboratory.
This Calibration Certificate or Test Reports shall not be used to claim product certification, approval or endorsement by NVLAP, NIST, or any agency of the federal government.
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Page 1 of 2

B&K 2250 Unit #9 SLM Calibration Certificate

Brüel & Kjær

MANUFACTURER'S CERTIFICATE OF CONFORMANCE

We certify that Brüel & Kjær **-2250--D01-** Serial No. **3027810** has been tested and passed all production tests, confirming compliance with the manufacturer's published specification at the date of the test.

The final test has been performed using calibrated equipment, traceable to national or international standards or by ratio measurements.

Brüel & Kjær is certified under ISO 9001 assuring that all test data is retained on file and is available for inspection upon request.

Nærum 28-mar-2019

Torben Bjørn
Vice President, Operations

Please note that this document is not a calibration certificate.
For information on our calibration services please go to www.bksv.com/service.

BA 0238 - 20

Prepolarized Free-field 1/2" Microphone Type 4189

Bruel & Kjær **Calibration Chart**

Serial No:	**3195885**	
Open-circuit Sensitivity*, S_0:	*-26.6*	dB re 1V/Pa
Equivalent to:	*47.0*	mV/Pa
Uncertainty, 95 % confidence level	0.2	dB
Capacitance:	*13.0*	pF
Valid At:		
Temperature:	23	°C
Ambient Static Pressure:	101.3	kPa
Relative Humidity:	50	%
Frequency:	251.2	Hz
Polarization Voltage, external:	0	V

Sensitivity Traceable To:
DPLA: Danish Primary Laboratory of Acoustics
NIST: National Institute of Standards and Technology, USA

IEC 61094-4: Type WS 2 F

Environmental Calibration Conditions:
99.4 kPa 23 °C 48 % RH

Procedure: 704215 **Date:** 29. Jan. 2019 **Signature:** KC

*$K_0 = -26 - S_0$ Example: $K_0 = -26 - (-26.2) = +0.2$ dB

B&K 2250 Unit #10 SLM Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.42868

Instrument: **Sound Level Meter**
Model: **2250**
Manufacturer: **Brüel and Kjær**
Serial number: **3007542**
Tested with: **Microphone 4189 s/n 2978664**
Preamplifier ZC0032 s/n 22379
Type (class): **1**
Customer: **ACI Acoustical Consultants Inc.**
Tel/Fax: **780-414-6373 / 780-414-6376**

Date Calibrated: **5/14/2019** *Cal Due:*

Status:	Received	Sent
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: __Yes X No
Calibration service: __ Basic X Standard
Address: **5031 - 210 Street, Edmonton, Alberta, CANADA T6M 0A8**

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/26/2015
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31052	Oct 31, 2018	Scantek, Inc./ NVLAP	Oct 31, 2019
DS-360-SRS	Function Generator	33584	Oct 24, 2017	ACR Env./ A2LA	Oct 24, 2019
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Oct 1, 2018	ACR Env. / A2LA	Oct 1, 2019
HM30-Thommen	Meteo Station	1040170/39633	Nov 13, 2018	ACR Env./ A2LA	Nov 13, 2019
PC Program 1019 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Nov 11, 2018	Scantek, Inc./ NVLAP	Nov 11, 2019

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK).

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
23.7	99.56	45.2

Calibrated by:	Lydon Dawkins	**Authorized signatory:**	Steven E. Marshall
Signature	Lydon Dawkins	Signature	Steven E Marshall
Date	5/14/2019	Date	5/15/2019

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B&K 2250 Unit #10 Microphone Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®
CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.42869

Instrument:	**Microphone**
Model:	**4189**
Manufacturer:	**Brüel & Kjær**
Serial number:	**2978664**
Composed of:	
Customer:	**ACI Acoustical Consultants Inc.**
Tel/Fax:	**780-414-6373/780-414-6376**

Date Calibrated: **5/14/2019** *Cal Due:*

Status:	**Received**	**Sent**
In tolerance:	**X**	**X**
Out of tolerance:		
See comments:		

Contains non-accredited tests: __Yes X No

Address: **5031 - 210 Street, Edmonton, Alberta, CANADA T6M 0A8**

Tested in accordance with the following procedures and standards:
Calibration of Measurement Microphones, Scantek, Inc., Rev. 2/25/2015

Instrumentation used for calibration: N-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31052	Oct 31, 2018	Scantek, Inc./ NVLAP	Oct 31, 2019
DS-360-SRS	Function Generator	33584	Oct 24, 2017	ACR Env./ A2LA	Oct 24, 2019
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Oct 1, 2018	ACR Env. / A2LA	Oct 1, 2019
HM30-Thommen	Meteo Station	1040170/39633	Nov 13, 2018	ACR Env./ A2LA	Nov 13, 2019
PC Program 1017 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1253-Norsonic	Calibrator	28326	Nov 11, 2018	Scantek, Inc./ NVLAP	Nov 11, 2019
1203-Norsonic	Preamplifier	14059	Feb 28, 2019	Scantek, Inc./ NVLAP	Feb 28, 2020
4180-Brüel&Kjær	Microphone	2246115	Oct 24, 2017	DANAK / DPLA	Oct 24, 2019

Instrumentation and test results are traceable to SI - BIPM through standards maintained by NPL (UK) and NIST (USA)

Calibrated by:	Lydon Dawkins	**Authorized signatory:**	Steven E. Marshall
Signature	Lydon Dawkins	Signature	Steven E Marshall
Date	5/14/2019	Date	5/15/2019

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Page 1 of 2

Appendix II THE ASSESSMENT OF ENVIRONMENTAL NOISE (GENERAL)

Sound Pressure Level

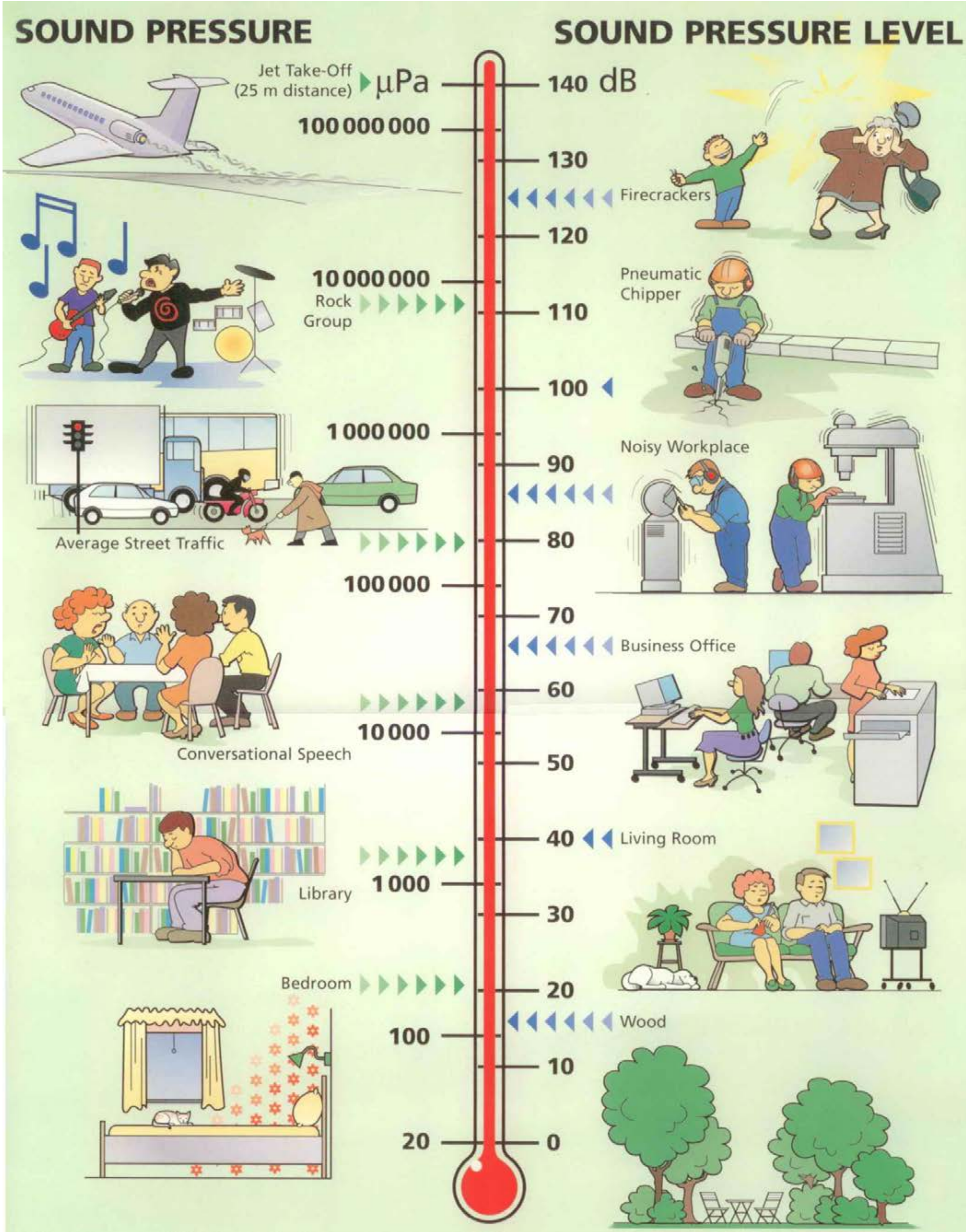
Sound pressure is initially measured in Pascal's (Pa). Humans can hear several orders of magnitude in sound pressure levels, so a more convenient scale is used. This scale is known as the decibel (dB) scale, named after Alexander Graham Bell (telephone guy). It is a base 10 logarithmic scale. When we measure pressure we typically measure the RMS sound pressure.

$$SPL = 10\log_{10}\left[\frac{P_{RMS}^2}{P_{ref}^2}\right] = 20\log_{10}\left[\frac{P_{RMS}}{P_{ref}}\right]$$

Where: SPL = Sound Pressure Level in dB
P_{RMS} = Root Mean Square measured pressure (Pa)
P_{ref} = Reference sound pressure level ($P_{ref} = 2x10^{-5}$ Pa = 20 μPa)

This reference sound pressure level is an internationally agreed upon value. It represents the threshold of human hearing for "typical" people based on numerous testing. It is possible to have a threshold which is lower than 20 μPa which will result in negative dB levels. As such, zero dB does not mean there is no sound!

In general, a difference of 1 – 2 dB is the threshold for humans to notice that there has been a change in sound level. A difference of 3 dB (factor of 2 in acoustical energy) is perceptible and a change of 5 dB is strongly perceptible. A change of 10 dB is typically considered a factor of 2. This is quite remarkable when considering that 10 dB is 10-times the acoustical energy!



acoustical consultants inc

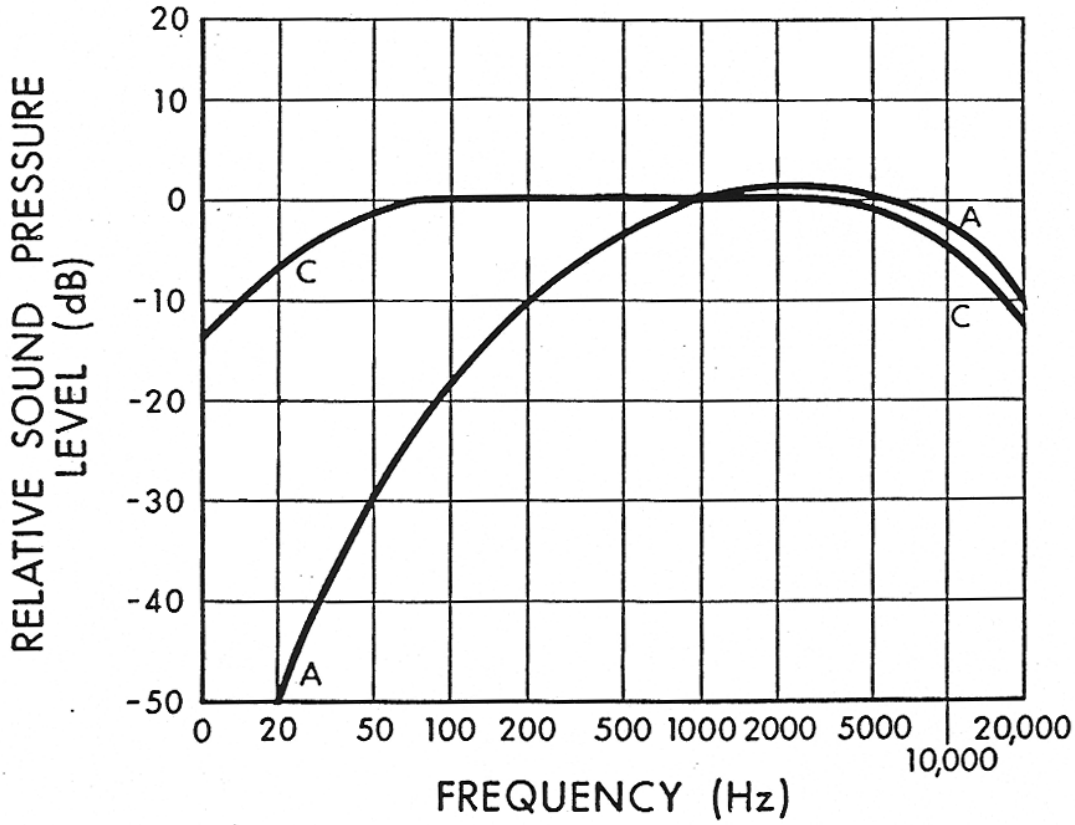
Frequency

The range of frequencies audible to the human ear ranges from approximately 20 Hz to 20 kHz. Within this range, the human ear does not hear equally at all frequencies. It is not very sensitive to low frequency sounds, is very sensitive to mid frequency sounds and is slightly less sensitive to high frequency sounds. Due to the large frequency range of human hearing, the entire spectrum is often divided into 31 bands, each known as a 1/3 octave band.

The internationally agreed upon center frequencies and upper and lower band limits for the 1/1 (whole octave) and 1/3 octave bands are as follows:

Whole Octave Lower Band Limit	Whole Octave Center Frequency	Whole Octave Upper Band Limit	1/3 Octave Lower Band Limit	1/3 Octave Center Frequency	1/3 Octave Upper Band Limit
11	**16**	22	14.1	**16**	17.8
			17.8	**20**	22.4
			22.4	**25**	28.2
22	**31.5**	44	28.2	**31.5**	35.5
			35.5	**40**	44.7
			44.7	**50**	56.2
44	**63**	88	56.2	**63**	70.8
			70.8	**80**	89.1
			89.1	**100**	112
88	**125**	177	112	**125**	141
			141	**160**	178
			178	**200**	224
177	**250**	355	224	**250**	282
			282	**315**	355
			355	**400**	447
355	**500**	710	447	**500**	562
			562	**630**	708
			708	**800**	891
710	**1000**	1420	891	**1000**	1122
			1122	**1250**	1413
			1413	**1600**	1778
1420	**2000**	2840	1778	**2000**	2239
			2239	**2500**	2818
			2818	**3150**	3548
2840	**4000**	5680	3548	**4000**	4467
			4467	**5000**	5623
			5623	**6300**	7079
5680	**8000**	11360	7079	**8000**	8913
			8913	**10000**	11220
			11220	**12500**	14130
11360	**16000**	22720	14130	**16000**	17780
			17780	**20000**	22390

Human hearing is most sensitive at approximately 3500 Hz which corresponds to the ¼ wavelength of the ear canal (approximately 2.5 cm). Because of this range of sensitivity to various frequencies, we typically apply various weighting networks to the broadband measured sound to more appropriately account for the way humans hear. By default, the most common weighting network used is the so-called “A-weighting”. It can be seen in the figure that the low frequency sounds are reduced significantly with the A-weighting.



Combination of Sounds

When combining multiple sound sources the general equation is:

$$\Sigma SPL_n = 10\log_{10}\left[\sum_{i=1}^{n} 10^{\frac{SPL_i}{10}}\right]$$

Examples:

- Two sources of 50 dB each add together to result in 53 dB.
- Three sources of 50 dB each add together to result in 55 dB.
- Ten sources of 50 dB each add together to result in 60 dB.
- One source of 50 dB added to another source of 40 dB results in 50.4 dB

It can be seen that, if multiple similar sources exist, removing or reducing only one source will have little effect.

Sound Level Measurements

Over the years a number of methods for measuring and describing environmental noise have been developed. The most widely used and accepted is the concept of the Energy Equivalent Sound Level (L_{eq}) which was developed in the US (1970's) to characterize noise levels near US Air-force bases. This is the level of a steady state sound which, for a given period of time, would contain the same energy as the time varying sound. The concept is that the same amount of annoyance occurs from a sound having a high level for a short period of time as from a sound at a lower level for a longer period of time.
The L_{eq} is defined as:

$$L_{eq} = 10\log_{10}\left[\frac{1}{T}\int_0^T 10^{\frac{dB}{10}}\,dT\right] = 10\log_{10}\left[\frac{1}{T}\int_0^T \frac{P^2}{P_{ref}^2}\,dT\right]$$

We must specify the time period over which to measure the sound. i.e. 1-second, 10-seconds, 15-seconds, 1-minute, 1-day, etc**. An L_{eq} is meaningless if there is no time period associated**.

In general there a few very common L_{eq} sample durations which are used in describing environmental noise measurements. These include:

- L_{eq}24 - Measured over a 24-hour period
- L_{eq}Night - Measured over the night-time (typically 22:00 – 07:00)
- L_{eq}Day - Measured over the day-time (typically 07:00 – 22:00)
- L_{DN} - Same as L_{eq}24 with a 10 dB penalty added to the night-time

Statistical Descriptor

Another method of conveying long term noise levels utilizes statistical descriptors. These are calculated from a cumulative distribution of the sound levels over the entire measurement duration and then determining the sound level at xx % of the time.

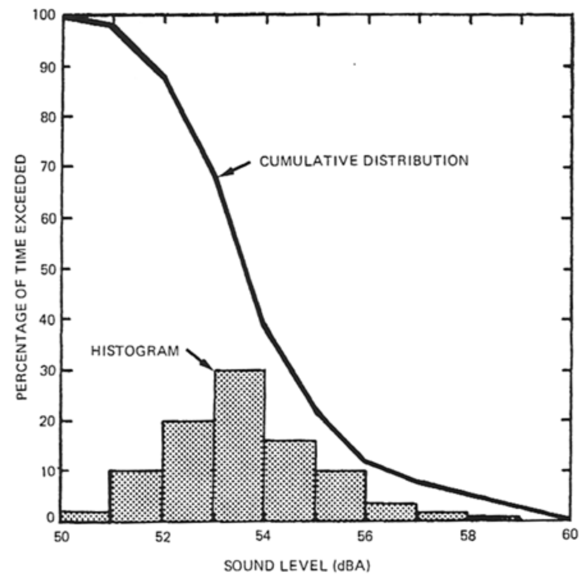


Figure 16.6 Statistically processed community noise showing histogram and cumulative distribution of A weighted sound levels.

Industrial Noise Control, Lewis Bell, Marcel Dekker, Inc. 1994

The most common statistical descriptors are:

L_{min} - minimum sound level measured
L_{01} - sound level that was exceeded only 1% of the time
L_{10} - sound level that was exceeded only 10% of the time.
- Good measure of intermittent or intrusive noise
- Good measure of Traffic Noise

L_{50} - sound level that was exceeded 50% of the time (arithmetic average)
- Good to compare to L_{eq} to determine steadiness of noise

L_{90} - sound level that was exceeded 90% of the time
- Good indicator of typical "ambient" noise levels

L_{99} - sound level that was exceeded 99% of the time
L_{max} - maximum sound level measured

These descriptors can be used to provide a more detailed analysis of the varying noise climate:

- If there is a large difference between the L_{eq} and the L_{50} (L_{eq} can never be any lower than the L_{50}) then it can be surmised that one or more short duration, high level sound(s) occurred during the time period.
- If the gap between the L_{10} and L_{90} is relatively small (less than 15 – 20 dBA) then it can be surmised that the noise climate was relatively steady.

Sound Propagation

In order to understand sound propagation, the nature of the source must first be discussed. In general, there are three types of sources. These are known as 'point', 'line', and 'area'. This discussion will concentrate on point and line sources since area sources are much more complex and can usually be approximated by point sources at large distances.

Point Source

As sound radiates from a point source, it dissipates through geometric spreading. The basic relationship between the sound levels at two distances from a point source is:

$$\therefore SPL_1 - SPL_2 = 20\log_{10}\left(\frac{r_2}{r_1}\right)$$

Where: SPL_1 = sound pressure level at location 1, SPL_2 = sound pressure level at location 2
r_1 = distance from source to location 1, r_2 = distance from source to location 2

Thus, the reduction in sound pressure level for a point source radiating in a free field is **6 dB per doubling of distance**. This relationship is independent of reflectivity factors provided they are always present. Note that this only considers geometric spreading and does not take into account atmospheric effects. Point sources still have some physical dimension associated with them, and typically do not radiate sound equally in all directions in all frequencies. The directionality of a source is also highly dependent on frequency. As frequency increases, directionality increases.

Examples (note no atmospheric absorption):

- A point source measuring 50 dB at 100m will be 44 dB at 200m.
- A point source measuring 50 dB at 100m will be 40.5 dB at 300m.
- A point source measuring 50 dB at 100m will be 38 dB at 400m.
- A point source measuring 50 dB at 100m will be 30 dB at 1000m.

Line Source

A line source is similar to a point source in that it dissipates through geometric spreading. The difference is that a line source is equivalent to a long line of many point sources. The basic relationship between the sound levels at two distances from a line source is:

$$SPL_1 - SPL_2 = 10\log_{10}\left(\frac{r_2}{r_1}\right)$$

The difference from the point source is that the '20' term in front of the 'log' is now only 10. Thus, the reduction in sound pressure level for a line source radiating in a free field is **3 dB per doubling of distance**.

Examples (note no atmospheric absorption):

- A line source measuring 50 dB at 100m will be 47 dB at 200m.
- A line source measuring 50 dB at 100m will be 45 dB at 300m.
- A line source measuring 50 dB at 100m will be 44 dB at 400m.
- A line source measuring 50 dB at 100m will be 40 dB at 1000m.

Atmospheric Absorption

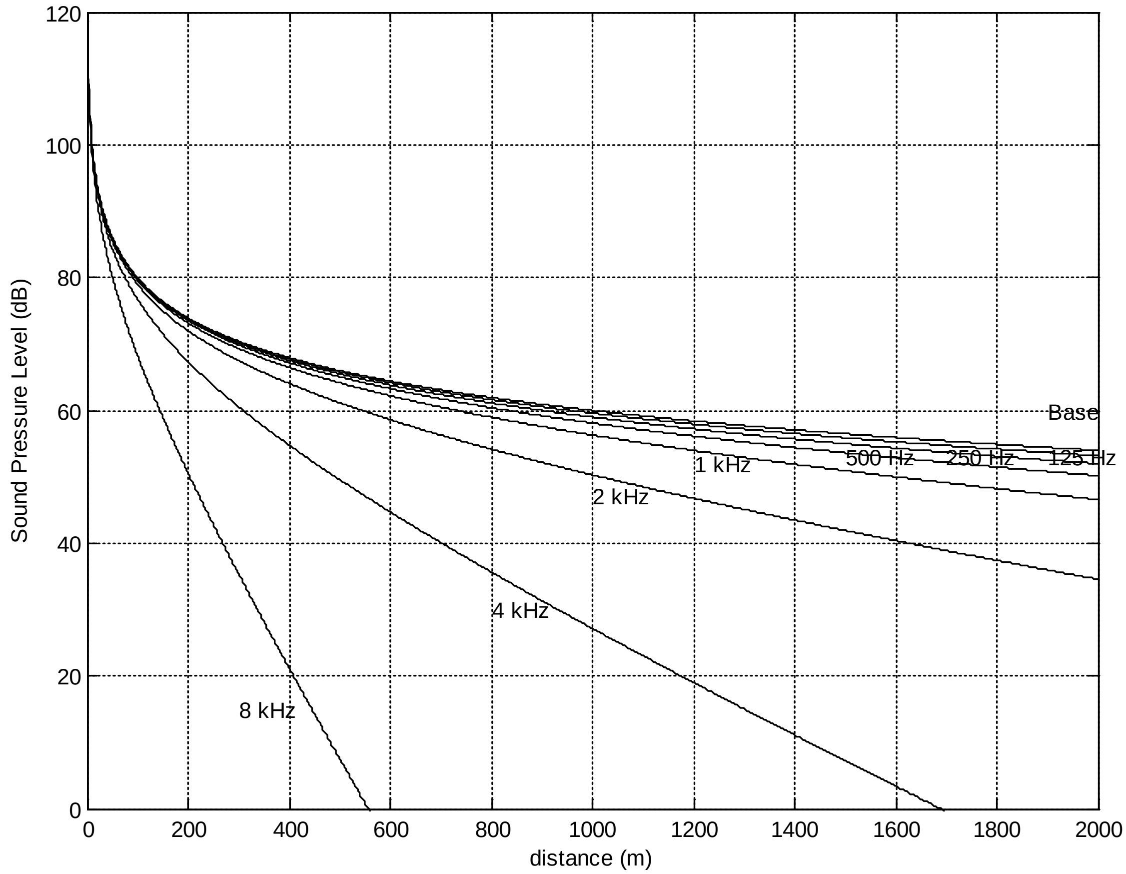
As sound transmits through a medium, there is an attenuation (or dissipation of acoustic energy) which can be attributed to three mechanisms:

1) **Viscous Effects** - Dissipation of acoustic energy due to fluid friction which results in thermodynamically irreversible propagation of sound.
2) **Heat Conduction Effects** - Heat transfer between high and low temperature regions in the wave which result in non-adiabatic propagation of the sound.
3) **Inter Molecular Energy Interchanges** - Molecular energy relaxation effects which result in a time lag between changes in translational kinetic energy and the energy associated with rotation and vibration of the molecules.

The following table illustrates the attenuation coefficient of sound at standard pressure (101.325 kPa) in units of dB/100m.

Temperature °C	Relative Humidity (%)	Frequency (Hz)					
		125	250	500	1000	2000	4000
30	20	0.06	0.18	0.37	0.64	1.40	4.40
	50	0.03	0.10	0.33	0.75	1.30	2.50
	90	0.02	0.06	0.24	0.70	1.50	2.60
20	20	0.07	0.15	0.27	0.62	1.90	6.70
	50	0.04	0.12	0.28	0.50	1.00	2.80
	90	0.02	0.08	0.26	0.56	0.99	2.10
10	20	0.06	0.11	0.29	0.94	3.20	9.00
	50	0.04	0.11	0.20	0.41	1.20	4.20
	90	0.03	0.10	0.21	0.38	0.81	2.50
0	20	0.05	0.15	0.50	1.60	3.70	5.70
	50	0.04	0.08	0.19	0.60	2.10	6.70
	90	0.03	0.08	0.15	0.36	1.10	4.10

- As frequency increases, absorption tends to increase
- As Relative Humidity increases, absorption tends to decrease
- There is no direct relationship between absorption and temperature
- **The net result of atmospheric absorption is to modify the sound propagation of a point source from 6 dB/doubling-of-distance to approximately 7 – 8 dB/doubling-of-distance (based on anecdotal experience)**



Atmospheric Absorption at 10ºC and 70% RH

Meteorological Effects

There are many meteorological factors which can affect how sound propagates over large distances. These various phenomena must be considered when trying to determine the relative impact of a noise source either after installation or during the design stage.

Wind

- Can greatly alter the noise climate away from a source depending on direction
- Sound levels downwind from a source can be increased due to refraction of sound back down towards the surface. This is due to the generally higher velocities as altitude increases.
- Sound levels upwind from a source can be decreased due to a “bending” of the sound away from the earth’s surface.
- Sound level differences of ±10dB are possible depending on severity of wind and distance from source.
- Sound levels crosswind are generally not disturbed by an appreciable amount
- Wind tends to generate its own noise, however, and can provide a high degree of masking relative to a noise source of particular interest.

Temperature

- Temperature effects can be similar to wind effects
- Typically, the temperature is warmer at ground level than it is at higher elevations.
- If there is a very large difference between the ground temperature (very warm) and the air aloft (only a few hundred meters) then the transmitted sound refracts upward due to the changing speed of sound.
- If the air aloft is warmer than the ground temperature (known as an *inversion*) the resulting higher speed of sound aloft tends to refract the transmitted sound back down towards the ground. This essentially works on Snell’s law of reflection and refraction.
- Temperature inversions typically happen early in the morning and are most common over large bodies of water or across river valleys.
- Sound level differences of ±10dB are possible depending on gradient of temperature and distance from source.

Rain

- Rain does not affect sound propagation by an appreciable amount unless it is very heavy
- The larger concern is the noise generated by the rain itself. A heavy rain striking the ground can cause a significant amount of highly broadband noise. The amount of noise generated is difficult to predict.
- Rain can also affect the output of various noise sources such as vehicle traffic.

Summary

- In general, these wind and temperature effects are difficult to predict
- Empirical models (based on measured data) have been generated to attempt to account for these effects.
- Environmental noise measurements must be conducted with these effects in mind. Sometimes it is desired to have completely calm conditions, other times a “worst case” of downwind noise levels are desired.

Topographical Effects

Similar to the various atmospheric effects outlined in the previous section, the effect of various geographical and vegetative factors must also be considered when examining the propagation of noise over large distances.

Topography

- One of the most important factors in sound propagation.
- Can provide a natural barrier between source and receiver (i.e. if berm or hill in between).
- Can provide a natural amplifier between source and receiver (i.e. large valley in between or hard reflective surface in between).
- Must look at location of topographical features relative to source and receiver to determine importance (i.e. small berm 1km away from source and 1km away from receiver will make negligible impact).

Grass

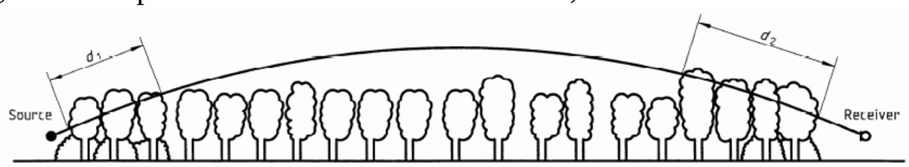
- Can be an effective absorber due to large area covered
- Only effective at low height above ground. Does not affect sound transmitted direct from source to receiver if there is line of sight.
- Typically less absorption than atmospheric absorption when there is line of sight.
- Approximate rule of thumb based on empirical data is:

$$A_g = 18\log_{10}(f) - 31 \qquad (dB/100m)$$

Where: A_g is the absorption amount

Trees

- Provide absorption due to foliage
- Deciduous trees are essentially ineffective in the winter
- Absorption depends heavily on density and height of trees
- No data found on absorption of various kinds of trees
- Large spans of trees are required to obtain even minor amounts of sound reduction
- In many cases, trees can provide an effective visual barrier, even if the noise attenuation is negligible.



NOTE — $d_f = d_1 + d_2$

For calculating d_1 and d_2, the curved path radius may be assumed to be 5 km.

Figure A.1 — Attenuation due to propagation through foliage increases linearly with propagation distance d_f through the foliage

Table A.1 — Attenuation of an octave band of noise due to propagation a distance d_f through dense foliage

Propagation distance d_f	Nominal midband frequency Hz							
m	63	125	250	500	1 000	2 000	4 000	8 000
$10 \leq d_f \leq 20$	Attenuation, dB: 0	0	1	1	1	1	2	3
$20 \leq d_f \leq 200$	Attenuation, dB/m: 0,02	0,03	0,04	0,05	0,06	0,08	0,09	0,12

Tree/Foliage attenuation from ISO 9613-2:1996

Bodies of Water

- Large bodies of water can provide the opposite effect to grass and trees.
- Reflections caused by small incidence angles (grazing) can result in larger sound levels at great distances (increased reflectivity, Q).
- Typically air temperatures are warmer high aloft since air temperatures near water surface tend to be more constant. Result is a high probability of temperature inversion.
- Sound levels can “carry” much further.

Snow

- Covers the ground for approximately 1/2 of the year in northern climates.
- Can act as an absorber or reflector (and varying degrees in between).
- Freshly fallen snow can be quite absorptive.
- Snow which has been sitting for a while and hard packed due to wind can be quite reflective.
- Falling snow can be more absorptive than rain, but does not tend to produce its own noise.
- Snow can cover grass which might have provided some means of absorption.
- Typically sound propagates with less impedance in winter due to hard snow on ground and no foliage on trees/shrubs.

Appendix III SOUND LEVELS OF FAMILIAR NOISE SOURCES

Used with Permission Obtained from the Alberta Energy Regulator (AER) Directive 038 (February 2007)

Source[1]	Sound Level (dBA)
Bedroom of a country home	30
Soft whisper at 1.5 m	30
Quiet office or living room	40
Moderate rainfall	50
Inside average urban home	50
Quiet street	50
Normal conversation at 1 m	60
Noisy office	60
Noisy restaurant	70
Highway traffic at 15 m	75
Loud singing at 1 m	75
Tractor at 15 m	78-95
Busy traffic intersection	80
Electric typewriter	80
Bus or heavy truck at 15 m	88-94
Jackhammer	88-98
Loud shout	90
Freight train at 15 m	95
Modified motorcycle	95
Jet taking off at 600 m	100
Amplified rock music	110
Jet taking off at 60 m	120
Air-raid siren	130

[1] Cottrell, Tom, 1980, *Noise in Alberta*, Table 1, p.8, ECA80 - 16/1B4 (Edmonton: Environment Council of Alberta).

SOUND LEVELS GENERATED BY COMMON APPLIANCES

Used with Permission Obtained from the Alberta Energy Regulator (AER) Directive 038 (February 2007)

Source[1]	Sound level at 3 feet (dBA)
Freezer	38-45
Refrigerator	34-53
Electric heater	47
Hair clipper	50
Electric toothbrush	48-57
Humidifier	41-54
Clothes dryer	51-65
Air conditioner	50-67
Electric shaver	47-68
Water faucet	62
Hair dryer	58-64
Clothes washer	48-73
Dishwasher	59-71
Electric can opener	60-70
Food mixer	59-75
Electric knife	65-75
Electric knife sharpener	72
Sewing machine	70-74
Vacuum cleaner	65-80
Food blender	65-85
Coffee mill	75-79
Food waste disposer	69-90
Edger and trimmer	81
Home shop tools	64-95
Hedge clippers	85
Electric lawn mower	80-90

[1] Reif, Z. F., and Vermeulen, P. J., 1979, "Noise from domestic appliances, construction, and industry," Table 1, p.166, in Jones, H. W., ed., *Noise in the Human Environment*, vol. 2, ECA79-SP/1 (Edmonton: Environment Council of Alberta).

Appendix IV DATA REMOVAL

Data Removal Noise Monitoring Location #1

Start Time	End Time	Duration (min)	Reason
7/22/19 21:58	7/22/19 22:00	1.3	Loud Vehicle Passby
7/22/19 22:00	7/22/19 22:01	1.0	Loud Vehicle Passby
7/22/19 22:01	7/22/19 22:02	1.0	Loud Vehicle Passby
7/22/19 22:02	7/22/19 22:04	1.5	Loud Vehicle Passby
7/22/19 22:10	7/22/19 22:11	1.0	Loud Vehicle Passby
7/22/19 22:21	7/22/19 22:24	2.8	Loud Vehicle Passby
7/22/19 22:41	7/22/19 22:42	1.0	Loud Vehicle Passby
7/22/19 22:48	7/22/19 22:49	1.0	Loud Vehicle Passby
7/22/19 22:54	7/22/19 22:54	0.8	Loud Vehicle Passby
7/22/19 23:36	7/22/19 23:37	1.0	Loud Vehicle Passby
7/22/19 23:55	7/22/19 23:55	0.3	Train Passby
7/23/19 0:15	7/23/19 0:16	1.3	Site Visit
7/23/19 0:17	7/23/19 0:18	1.3	Site Visit
7/23/19 0:30	7/23/19 0:33	2.3	Loud Vehicle Passby
7/23/19 0:53	7/23/19 0:54	1.3	Loud Vehicle Passby
7/23/19 1:15	7/23/19 1:16	0.8	Loud Vehicle Passby
7/23/19 2:06	7/23/19 2:07	1.3	Loud Vehicle Passby
7/23/19 2:13	7/23/19 2:14	1.0	Loud Vehicle Passby
7/23/19 2:29	7/23/19 2:30	1.3	Train Passby
7/23/19 2:31	7/23/19 2:33	1.3	Loud Vehicle Passby
7/23/19 3:00	7/23/19 3:04	4.0	Train Passby
7/23/19 3:25	7/23/19 3:26	1.3	Loud Vehicle Passby
7/23/19 3:28	7/23/19 3:28	0.8	Loud Vehicle Passby
7/23/19 3:45	7/23/19 3:47	1.5	Train Passby
7/23/19 3:57	7/23/19 3:58	1.3	Loud Vehicle Passby
7/23/19 4:04	7/23/19 4:05	1.0	Train Passby
7/23/19 4:17	7/23/19 4:18	1.3	Loud Vehicle Passby
7/23/19 4:19	7/23/19 4:20	1.0	Loud Vehicle Passby
7/23/19 4:21	7/23/19 4:22	1.3	Loud Vehicle Passby
7/23/19 4:23	7/23/19 4:24	1.0	Loud Vehicle Passby
7/23/19 4:27	7/23/19 4:29	2.5	Loud Vehicle Passby
7/23/19 4:30	7/23/19 4:32	1.5	Loud Vehicle Passby
7/23/19 4:33	7/23/19 4:35	1.5	Loud Vehicle Passby
7/23/19 4:35	7/23/19 4:36	1.3	Loud Vehicle Passby
7/23/19 4:38	7/23/19 4:44	6.0	Loud Vehicle Passby
7/23/19 4:47	7/23/19 4:49	1.8	Loud Vehicle Passby
7/23/19 4:50	7/23/19 4:52	1.5	Loud Vehicle Passby
7/23/19 4:54	7/23/19 4:57	2.5	Loud Vehicle Passby
7/23/19 5:00	7/23/19 5:01	1.3	Loud Vehicle Passby
7/23/19 5:02	7/23/19 5:09	7.8	Loud Vehicle Passby
7/23/19 5:11	7/23/19 5:18	6.8	Loud Vehicle Passby
7/23/19 5:22	7/23/19 5:23	1.3	Loud Vehicle Passby
7/23/19 5:25	7/23/19 5:27	1.8	Loud Vehicle Passby
7/23/19 5:28	7/23/19 5:29	0.8	Loud Vehicle Passby
7/23/19 5:31	7/23/19 5:32	1.5	Loud Vehicle Passby

Data Removal Noise Monitoring Location #1 Cont.

Start Time	End Time	Duration (min)	Reason
7/23/19 5:34	7/23/19 5:37	3.0	Loud Vehicle Passby
7/23/19 5:38	7/23/19 5:39	1.5	Loud Vehicle Passby
7/23/19 5:40	7/23/19 5:42	1.5	Loud Vehicle Passby
7/23/19 5:45	7/23/19 5:47	2.0	Loud Vehicle Passby
7/23/19 5:47	7/23/19 5:49	1.5	Loud Vehicle Passby
7/23/19 5:49	7/23/19 5:52	3.3	Loud Vehicle Passby
7/23/19 5:52	7/23/19 5:54	1.3	Loud Vehicle Passby
7/23/19 5:54	7/23/19 5:56	2.0	Loud Vehicle Passby
7/23/19 5:56	7/23/19 5:59	2.5	Loud Vehicle Passby
7/23/19 5:59	7/23/19 6:04	4.8	Loud Vehicle Passby
7/23/19 6:05	7/23/19 6:06	0.8	Loud Vehicle Passby
7/23/19 6:06	7/23/19 6:26	19.8	Loud Vehicle Passby
7/23/19 6:26	7/23/19 6:36	10.0	Loud Vehicle Passby
7/23/19 6:36	7/23/19 6:44	8.3	Loud Vehicle Passby
7/23/19 6:45	7/23/19 6:58	12.5	Loud Vehicle Passby
7/23/19 6:58	7/23/19 6:59	1.0	Loud Vehicle Passby
7/23/19 6:59	7/23/19 7:00	0.8	Loud Vehicle Passby
7/23/19 22:12	7/23/19 22:12	0.8	Loud Vehicle Passby
7/23/19 22:15	7/23/19 22:16	1.5	Loud Vehicle Passby
7/23/19 22:19	7/23/19 22:20	0.8	Loud Vehicle Passby
7/23/19 22:25	7/23/19 22:26	0.8	Loud Vehicle Passby
7/23/19 22:27	7/23/19 22:27	0.8	Loud Vehicle Passby
7/23/19 22:30	7/23/19 22:31	1.3	Loud Vehicle Passby
7/23/19 22:37	7/23/19 22:38	1.0	Loud Vehicle Passby
7/23/19 23:14	7/23/19 23:16	1.3	Loud Vehicle Passby
7/23/19 23:35	7/23/19 23:37	1.8	Loud Vehicle Passby
7/24/19 0:19	7/24/19 0:20	1.0	Loud Vehicle Passby
7/24/19 0:35	7/24/19 0:37	1.3	Loud Vehicle Passby
7/24/19 1:49	7/24/19 1:50	1.3	Loud Vehicle Passby
7/24/19 2:00	7/24/19 2:01	1.3	Loud Vehicle Passby
7/24/19 2:17	7/24/19 2:18	1.3	Loud Vehicle Passby
7/24/19 2:35	7/24/19 2:36	1.3	Loud Vehicle Passby
7/24/19 2:38	7/24/19 2:39	1.0	Loud Vehicle Passby
7/24/19 2:43	7/24/19 2:45	2.3	Loud Vehicle Passby
7/24/19 2:54	7/24/19 2:55	1.0	Thunder
7/24/19 2:58	7/24/19 2:59	1.3	Loud Vehicle Passby
7/24/19 3:00	7/24/19 3:02	2.0	Thunder
7/24/19 3:03	7/24/19 3:04	0.5	Thunder
7/24/19 3:04	7/24/19 3:05	1.0	Thunder
7/24/19 3:09	7/24/19 3:10	0.8	Thunder
7/24/19 3:12	7/24/19 3:13	1.3	Loud Vehicle Passby
7/24/19 3:17	7/24/19 3:21	3.8	Loud Vehicle Passby
7/24/19 3:21	7/24/19 3:36	14.5	Excessive Rain Noise
7/24/19 3:36	7/24/19 3:49	12.8	Excessive Rain Noise
7/24/19 3:50	7/24/19 3:59	9.8	Excessive Wind Noise
7/24/19 4:00	7/24/19 5:04	64.3	Excessive Wind Noise

Data Removal Noise Monitoring Location #1 Cont.

Start Time	End Time	Duration (min)	Reason
7/24/19 5:04	7/24/19 6:02	58.0	Excessive Wind Noise
7/24/19 6:02	7/24/19 7:07	64.8	Excessive Wind Noise
	Total Night #1	**154**	
	Total Night #2	**256**	
	Total Data	**410**	

Data Removal Noise Monitoring Location #2

Start Time	End Time	Duration (min)	Reason
7/22/19 22:00	7/22/19 22:01	1.3	Train Passby
7/22/19 22:01	7/22/19 22:07	5.8	Train Passby
7/22/19 22:07	7/22/19 22:11	4.0	Train Passby
7/22/19 22:11	7/22/19 22:22	11.0	Train Passby
7/22/19 22:23	7/22/19 22:24	1.3	Train Passby
7/22/19 22:24	7/22/19 22:46	22.0	Train Passby
7/22/19 22:54	7/22/19 22:59	5.0	Train Passby
7/22/19 23:00	7/22/19 23:09	9.5	Train Passby
7/22/19 23:10	7/22/19 23:46	36.0	Train Passby
7/22/19 23:46	7/22/19 23:50	4.3	Train Passby
7/23/19 0:19	7/23/19 0:20	1.3	Train Passby
7/23/19 1:43	7/23/19 1:46	3.3	Abnormal Noise
7/23/19 2:21	7/23/19 2:22	1.8	Loud Vehicle Passby
7/23/19 3:56	7/23/19 3:58	1.5	Abnormal
7/23/19 4:03	7/23/19 4:04	1.0	Abnormal
7/23/19 4:12	7/23/19 4:13	1.0	Train Passby
7/23/19 4:19	7/23/19 4:20	1.3	Abnormal
7/23/19 4:42	7/23/19 4:43	1.3	Train Passby
7/23/19 4:56	7/23/19 4:57	1.0	Loud Vehicle Passby
7/23/19 4:57	7/23/19 5:06	9.0	Train Passby
7/23/19 5:07	7/23/19 5:12	5.5	Train Passby
7/23/19 5:27	7/23/19 5:30	3.0	Train Passby
7/23/19 5:50	7/23/19 5:58	8.5	Train Passby
7/23/19 6:25	7/23/19 6:26	1.3	Loud Vehicle Passby
7/23/19 6:54	7/23/19 6:56	1.8	Loud Vehicle Passby
7/23/19 22:01	7/23/19 22:03	2.0	Train Passby
7/23/19 22:06	7/23/19 22:13	7.5	Train Passby
7/23/19 22:16	7/23/19 22:48	32.0	Train Passby
7/23/19 23:27	7/23/19 23:29	2.0	Loud Vehicle Passby
7/23/19 23:50	7/23/19 23:51	0.8	Loud Vehicle Passby
7/24/19 0:29	7/24/19 0:30	1.3	Train Passby
7/24/19 0:59	7/24/19 1:00	1.0	Train Passby
7/24/19 1:47	7/24/19 1:48	1.0	Loud Vehicle Passby
7/24/19 2:02	7/24/19 2:02	0.8	Loud Vehicle Passby
7/24/19 2:34	7/24/19 2:35	1.3	Loud Vehicle Passby
7/24/19 2:58	7/24/19 2:58	0.8	Train Passby
7/24/19 3:00	7/24/19 3:24	24.0	Train Passby
7/24/19 3:25	7/24/19 3:30	5.3	Excessive Wind Noise
7/24/19 3:31	7/24/19 3:38	7.8	Excessive Wind Noise
7/24/19 3:39	7/24/19 3:41	2.3	Thunder

Data Removal Noise Monitoring Location #2 Cont.

Start Time	End Time	Duration (min)	Reason
7/24/19 3:43	7/24/19 3:49	6.0	Thunder
7/24/19 3:49	7/24/19 4:04	15.3	Thunder
7/24/19 4:04	7/24/19 4:50	45.3	Excessive Wind Noise
7/24/19 4:50	7/24/19 4:50	0.8	Excessive Wind Noise
7/24/19 4:53	7/24/19 5:03	9.5	Excessive Wind Noise
7/24/19 5:03	7/24/19 5:25	22.0	Excessive Wind Noise
7/24/19 5:27	7/24/19 5:39	12.0	Excessive Wind Noise
7/24/19 5:39	7/24/19 6:22	43.0	Excessive Wind Noise
7/24/19 6:23	7/24/19 6:48	25.5	Excessive Wind Noise
7/24/19 6:50	7/24/19 7:03	13.5	Excessive Wind Noise
	Total Night #1	**142**	
	Total Night #2	**282**	
	Total Data	**425**	

Data Removal Noise Monitoring Location #3

Start Time	End Time	Duration (min)	Reason
7/22/19 22:01	7/22/19 22:06	5.5	Train Passby
7/22/19 22:12	7/22/19 22:15	3.0	Loud Vehicle Passby
7/22/19 22:24	7/22/19 22:26	1.5	Loud Vehicle Passby
7/22/19 22:54	7/22/19 22:57	2.5	Train Passby
7/22/19 23:01	7/22/19 23:03	1.5	Train Passby
7/22/19 23:10	7/22/19 23:13	3.5	Train Passby
7/22/19 23:28	7/22/19 23:33	5.5	Train Passby
7/22/19 23:37	7/22/19 23:42	4.5	Train Passby
7/22/19 23:46	7/22/19 23:50	4.0	Loud Vehicle Passby
7/22/19 23:55	7/22/19 23:57	1.8	Site Visit
7/22/19 23:59	7/22/19 23:59	0.3	Site Visit
7/23/19 0:07	7/23/19 0:08	0.8	Train Passby
7/23/19 0:13	7/23/19 0:16	2.5	Train Passby
7/23/19 0:48	7/23/19 0:55	6.8	Train Passby
7/23/19 0:56	7/23/19 0:58	2.3	Train Passby
7/23/19 1:19	7/23/19 1:20	1.5	Train Passby
7/23/19 1:24	7/23/19 1:28	3.8	Train Passby
7/23/19 2:15	7/23/19 2:18	2.5	Train Passby
7/23/19 2:23	7/23/19 2:24	1.5	Loud Vehicle Passby
7/23/19 2:37	7/23/19 2:45	8.0	Train Passby
7/23/19 2:50	7/23/19 2:52	2.8	Train Passby
7/23/19 3:28	7/23/19 3:30	1.8	Train Passby
7/23/19 3:31	7/23/19 3:50	19.0	Train Passby
7/23/19 3:51	7/23/19 3:54	2.8	Loud Vehicle Passby
7/23/19 3:59	7/23/19 3:59	0.5	Excessive Bird Noise
7/23/19 4:31	7/23/19 4:34	2.5	Train Passby
7/23/19 4:37	7/23/19 5:11	34.5	Train Passby
7/23/19 5:18	7/23/19 5:23	5.0	Loud Vehicle Passby
7/23/19 5:26	7/23/19 5:31	4.5	Loud Vehicle Passby
7/23/19 5:48	7/23/19 5:52	4.8	Loud Vehicle Passby
7/23/19 5:57	7/23/19 6:00	3.0	Loud Vehicle Passby
7/23/19 6:07	7/23/19 6:08	1.3	Loud Vehicle Passby
7/23/19 6:11	7/23/19 6:13	1.3	Loud Vehicle Passby
7/23/19 6:14	7/23/19 6:22	8.3	Loud Vehicle Passby
7/23/19 6:22	7/23/19 6:24	2.0	Loud Vehicle Passby
7/23/19 6:25	7/23/19 6:33	7.5	Loud Vehicle Passby
7/23/19 6:33	7/23/19 6:36	2.5	Loud Vehicle Passby
7/23/19 6:38	7/23/19 6:56	17.3	Loud Vehicle Passby
7/23/19 22:25	7/23/19 22:27	1.8	Aircraft Flyover
7/23/19 22:33	7/23/19 22:35	2.3	Train Passby

Data Removal Noise Monitoring Location #3 (cont.)

Start Time	End Time	Duration (min)	Reason
7/23/19 22:37	7/23/19 22:38	0.8	Train Passby
7/23/19 22:52	7/23/19 22:54	2.5	Train Passby
7/23/19 23:04	7/23/19 23:07	2.8	Loud Vehicle Passby
7/23/19 23:13	7/23/19 23:14	1.3	Loud Vehicle Passby
7/23/19 23:17	7/23/19 23:22	4.3	Loud Vehicle Passby
7/23/19 23:25	7/23/19 23:27	1.3	Loud Vehicle Passby
7/23/19 23:35	7/23/19 23:40	4.5	Train Passby
7/24/19 0:25	7/24/19 0:25	0.3	Loud Vehicle Passby
7/24/19 0:28	7/24/19 0:30	1.8	Train Passby
7/24/19 0:34	7/24/19 0:40	6.5	Train Passby
7/24/19 1:00	7/24/19 1:01	1.5	Abnormal Site Noise
7/24/19 1:44	7/24/19 1:46	2.0	Loud Vehicle Passby
7/24/19 2:18	7/24/19 2:25	6.3	Excessive Bird Noise
7/24/19 2:43	7/24/19 2:45	1.8	Thunder
7/24/19 2:46	7/24/19 2:48	1.8	Thunder
7/24/19 2:49	7/24/19 2:54	5.8	Thunder
7/24/19 2:56	7/24/19 3:26	30.0	Excessive Wind Noise
7/24/19 3:27	7/24/19 3:57	29.8	Excessive Wind Noise
7/24/19 3:57	7/24/19 4:36	39.3	Excessive Wind Noise
7/24/19 4:36	7/24/19 4:50	14.5	Excessive Wind Noise
7/24/19 4:52	7/24/19 5:21	28.8	Excessive Wind Noise
7/24/19 5:22	7/24/19 5:26	3.5	Excessive Wind Noise
7/24/19 5:27	7/24/19 5:33	5.8	Excessive Wind Noise
7/24/19 5:33	7/24/19 6:03	30.3	Excessive Wind Noise
7/24/19 6:05	7/24/19 6:12	7.3	Excessive Wind Noise
7/24/19 6:14	7/24/19 6:16	2.3	Loud Vehicle Passby
7/24/19 6:16	7/24/19 6:17	0.5	Train Passby
7/24/19 6:17	7/24/19 6:33	16.8	Loud Vehicle Passby
7/24/19 6:34	7/24/19 6:48	13.8	Loud Vehicle Passby
7/24/19 6:49	7/24/19 6:59	9.5	Loud Vehicle Passby
7/24/19 6:59	7/24/19 7:05	6.5	Loud Vehicle Passby
	Total Night #1	**184**	
	Total Night #2	**287**	
	Total Data	**471**	

Data Removal Noise Monitoring Location #4

Start Time	End Time	Duration (min)	Reason
10/21/19 22:33	10/21/19 22:34	1.5	Loud Vehicle Passby
10/21/19 22:36	10/21/19 22:37	1.0	Loud Vehicle Passby
10/21/19 23:07	10/21/19 23:09	2.0	Site Visit
10/21/19 23:46	10/21/19 23:49	2.3	Train Passby
10/22/19 1:02	10/22/19 1:06	4.0	Train Passby
10/22/19 1:36	10/22/19 1:37	1.0	Train Passby
10/22/19 1:53	10/22/19 1:55	2.3	Loud Vehicle Passby
10/22/19 2:40	10/22/19 2:41	1.5	Train Passby
10/22/19 2:53	10/22/19 2:58	5.0	Train Passby
10/22/19 3:38	10/22/19 3:43	4.3	Train Passby
10/22/19 3:58	10/22/19 3:59	1.3	Loud Vehicle Passby
10/22/19 4:08	10/22/19 4:10	1.5	Train Passby
10/22/19 4:47	10/22/19 4:48	1.0	Loud Vehicle Passby
10/22/19 4:50	10/22/19 4:53	3.5	Loud Vehicle Passby
10/22/19 5:18	10/22/19 5:20	2.5	Train Passby
10/22/19 5:26	10/22/19 5:28	2.0	Train Passby
10/22/19 5:33	10/22/19 5:35	1.3	Train Passby
10/22/19 6:47	10/22/19 6:53	5.5	Train Passby
10/22/19 22:45	10/22/19 22:46	1.3	Train Passby
10/23/19 2:10	10/23/19 2:11	1.5	Train Passby
10/23/19 2:31	10/23/19 2:33	1.5	Loud Vehicle Passby
10/23/19 2:37	10/23/19 2:38	1.5	Loud Vehicle Passby
10/23/19 3:26	10/23/19 3:27	1.0	Train Passby
10/23/19 3:36	10/23/19 3:37	1.5	Site Visit
10/23/19 5:00	10/23/19 5:06	6.8	Thunder
10/23/19 5:08	10/23/19 5:13	4.3	Thunder
10/23/19 5:58	10/23/19 5:58	0.3	Train Passby
	Total Night #1	**43**	
	Total Night #2	**18**	
	Total Data	**62**	

Data Removal Noise Monitoring Location #5

Start Time	End Time	Duration (min)	Reason
7/22/19 22:30	7/22/19 22:31	1.0	Train Passby
7/22/19 22:33	7/22/19 22:34	0.8	Train Passby
7/22/19 23:33	7/22/19 23:35	1.3	Site Visit
7/23/19 1:10	7/23/19 1:17	6.3	Abnormal Noise From Site
7/23/19 2:57	7/23/19 3:01	4.8	Train Passby
7/23/19 3:08	7/23/19 3:09	1.3	Train Passby
7/23/19 3:10	7/23/19 3:14	4.0	Train Passby
7/23/19 3:22	7/23/19 3:24	1.3	Train Passby
7/23/19 3:24	7/23/19 3:26	2.0	Train Passby
7/23/19 3:27	7/23/19 3:30	2.8	Train Passby
7/23/19 4:04	7/23/19 4:04	0.3	Loud Vehicle Passby
7/23/19 4:18	7/23/19 4:20	1.8	Train Passby
7/23/19 4:45	7/23/19 4:56	10.5	Train Passby
7/23/19 5:01	7/23/19 5:13	12.5	Train Passby
7/23/19 5:49	7/23/19 5:50	1.3	Excessive Bird Noise
7/23/19 5:58	7/23/19 5:59	1.0	Loud Vehicle Passby
7/23/19 6:14	7/23/19 6:15	1.0	Loud Vehicle Passby
7/23/19 6:19	7/23/19 6:20	1.5	Loud Vehicle Passby
7/23/19 6:22	7/23/19 6:23	1.0	Loud Vehicle Passby
7/23/19 6:42	7/23/19 6:51	8.3	Train Passby
7/23/19 22:04	7/23/19 22:06	1.5	Train Passby
7/23/19 22:08	7/23/19 22:09	1.0	Train Passby
7/23/19 22:30	7/23/19 22:31	0.8	Train Passby
7/23/19 23:45	7/23/19 23:46	0.8	Train Passby
7/23/19 23:49	7/23/19 23:57	7.8	Train Passby
7/24/19 2:40	7/24/19 2:40	0.5	Train Passby
7/24/19 2:44	7/24/19 2:51	7.0	Train Passby
7/24/19 2:53	7/24/19 2:54	1.8	Train Passby
7/24/19 2:57	7/24/19 2:58	1.0	Train Passby
7/24/19 3:03	7/24/19 3:10	7.8	Train Passby
7/24/19 3:11	7/24/19 3:12	0.8	Train Passby
7/24/19 3:14	7/24/19 3:15	1.8	Train Passby
7/24/19 3:18	7/24/19 3:19	0.8	Train Passby
7/24/19 3:21	7/24/19 3:22	1.0	Train Passby
7/24/19 3:25	7/24/19 3:29	4.3	Thunder
7/24/19 3:31	7/24/19 3:32	1.3	Thunder
7/24/19 3:44	7/24/19 3:46	2.0	Loud Vehicle Passby
7/24/19 3:47	7/24/19 3:50	2.8	Thunder
7/24/19 3:55	7/24/19 3:57	1.5	Thunder
7/24/19 3:57	7/24/19 4:02	4.5	Thunder

Data Removal Noise Monitoring Location #5 (cont.)

Start Time	End Time	Duration (min)	Reason
7/24/19 4:02	7/24/19 4:04	1.5	Thunder
7/24/19 4:10	7/24/19 4:31	20.8	Excessive Wind Noise
7/24/19 4:31	7/24/19 4:56	25.0	Excessive Wind Noise
7/24/19 4:59	7/24/19 4:59	0.5	Thunder
7/24/19 5:15	7/24/19 5:20	5.3	Excessive Bird Noise
7/24/19 5:36	7/24/19 5:38	1.8	Excessive Bird Noise
7/24/19 5:42	7/24/19 5:45	3.3	Loud Vehicle Passby
7/24/19 6:09	7/24/19 6:10	1.0	Loud Vehicle Passby
7/24/19 6:31	7/24/19 6:33	2.3	Train Passby
7/24/19 6:35	7/24/19 6:41	6.3	Train Passby
7/24/19 6:49	7/24/19 6:52	2.3	Loud Vehicle Passby
7/24/19 6:54	7/24/19 6:55	1.5	Aircraft Flyover
	Total Night #1	**64**	
	Total Night #2	**122**	
	Total Data	**186**	

Data Removal Noise Monitoring Location #6

Start Time	End Time	Duration (min)	Reason
9/18/19 22:13	9/18/19 22:13	0.5	Loud Bangs
9/19/19 0:42	9/19/19 0:43	1.5	Site Visit
9/19/19 0:46	9/19/19 0:47	1.0	Site Visit
9/19/19 2:36	9/19/19 2:36	0.5	Horn/Siren
9/19/19 6:01	9/19/19 6:02	0.8	Loud Bang
9/19/19 6:32	9/19/19 6:33	1.3	Loud Vehicle Passby
9/19/19 6:38	9/19/19 6:39	0.8	Loud Vehicle Passby
9/19/19 6:42	9/19/19 6:44	1.3	Loud Vehicle Passby
9/19/19 6:48	9/19/19 6:49	1.0	Loud Vehicle Passby
9/19/19 6:56	9/19/19 6:57	1.3	Loud Vehicle Passby
9/19/19 22:00	9/19/19 22:01	1.3	Train Passby
9/19/19 22:33	9/19/19 22:34	1.3	Train Passby
9/19/19 23:24	9/19/19 23:27	2.5	Aircraft Flyover
9/19/19 23:27	9/19/19 23:29	1.8	Train Passby
9/19/19 23:39	9/19/19 23:40	1.0	Train Passby
9/20/19 0:15	9/20/19 0:17	2.5	Loud Vehicle Passby
9/20/19 0:18	9/20/19 0:20	2.8	Loud Vehicle Passby
9/20/19 0:30	9/20/19 0:31	0.5	Loud Bang
9/20/19 0:47	9/20/19 0:48	0.8	Loud Vehicle Passby
9/20/19 0:56	9/20/19 0:56	0.5	Loud Bang
9/20/19 1:00	9/20/19 1:02	1.5	Loud Bang
9/20/19 1:06	9/20/19 1:07	1.0	Loud Bang
9/20/19 1:12	9/20/19 1:12	0.5	Loud Bang
9/20/19 1:17	9/20/19 1:18	1.0	Loud Bang
9/20/19 1:38	9/20/19 1:38	0.5	Loud Bang
9/20/19 1:43	9/20/19 1:44	0.5	Loud Bang
9/20/19 6:29	9/20/19 6:30	1.3	Aircraft Flyover
9/20/19 6:44	9/20/19 6:46	1.8	Loud Vehicle Passby
9/20/19 6:48	9/20/19 6:49	1.3	Loud Vehicle Passby
9/20/19 6:52	9/20/19 6:53	1.3	Loud Vehicle Passby
	Total Night #1	**10**	
	Total Night #2	**25**	
	Total Data	**35**	

Data Removal Noise Monitoring Location #8

Start Time	End Time	Duration (min)	Reason
7/22/19 22:50	7/22/19 22:53	2.8	Site Visit
7/22/19 22:55	7/22/19 22:56	1.0	Loud Vehicle Passby
7/23/19 1:32	7/23/19 1:33	1.0	Loud Vehicle Passby
7/23/19 1:35	7/23/19 1:37	1.8	Loud Vehicle Passby
7/23/19 1:56	7/23/19 1:58	1.5	Train Passby
7/23/19 2:33	7/23/19 2:35	1.5	Train Passby
7/23/19 3:20	7/23/19 3:26	6.3	Train Passby
7/23/19 3:58	7/23/19 3:59	1.0	Loud Vehicle Passby
7/23/19 4:01	7/23/19 4:02	1.0	Loud Vehicle Passby
7/23/19 4:30	7/23/19 4:32	2.3	Train Passby
7/23/19 6:00	7/23/19 6:02	1.3	Excessive Bird Noise
7/23/19 23:42	7/23/19 23:43	1.3	Loud Vehicle Passby
7/23/19 23:45	7/23/19 23:47	2.0	Loud Vehicle Passby
7/24/19 2:08	7/24/19 2:09	1.0	Loud Vehicle Passby
7/24/19 2:10	7/24/19 2:11	1.5	Loud Vehicle Passby
7/24/19 2:57	7/24/19 2:59	2.0	Thunder
7/24/19 3:00	7/24/19 3:25	24.5	Excessive Wind Noise
7/24/19 3:28	7/24/19 3:33	5.0	Excessive Wind Noise
7/24/19 3:33	7/24/19 4:04	30.8	Excessive Wind Noise
7/24/19 4:05	7/24/19 4:12	7.3	Excessive Wind Noise
7/24/19 4:13	7/24/19 5:13	60.5	Excessive Wind Noise
7/24/19 5:14	7/24/19 6:02	48.0	Excessive Wind Noise
7/24/19 6:15	7/24/19 6:20	5.0	Loud Vehicle Passby
7/24/19 6:53	7/24/19 6:56	3.5	Excessive Bird Noise
	Total Night #1	**21**	
	Total Night #2	**192**	
	Total Data	**214**	

Data Removal Noise Monitoring Location #9

Start Time	End Time	Duration (min)	Reason
7/22/19 22:15	7/22/19 22:16	1.0	Loud Vehicle Passby
7/22/19 22:18	7/22/19 22:20	1.3	Loud Vehicle Passby
7/22/19 22:30	7/22/19 22:31	1.3	Loud Vehicle Passby
7/22/19 22:46	7/22/19 22:47	1.3	Loud Vehicle Passby
7/22/19 23:44	7/22/19 23:45	1.0	Loud Vehicle Passby
7/23/19 0:07	7/23/19 0:08	1.3	Train Passby
7/23/19 0:08	7/23/19 0:14	6.5	Train Passby
7/23/19 0:33	7/23/19 0:34	0.8	Train Passby
7/23/19 0:49	7/23/19 0:51	1.3	Train Passby
7/23/19 0:57	7/23/19 0:58	1.5	Train Passby
7/23/19 1:35	7/23/19 1:37	1.5	Train Passby
7/23/19 2:16	7/23/19 2:17	1.0	Train Passby
7/23/19 2:19	7/23/19 2:20	1.3	Train Passby
7/23/19 2:30	7/23/19 2:35	4.8	Train Passby
7/23/19 3:31	7/23/19 3:32	1.8	Train Passby
7/23/19 4:22	7/23/19 4:23	0.8	Train Passby
7/23/19 4:35	7/23/19 4:38	2.3	Train Passby
7/23/19 4:41	7/23/19 4:45	3.5	Train Passby
7/23/19 4:45	7/23/19 4:57	12.0	Train Passby
7/23/19 4:58	7/23/19 4:58	0.3	Train Passby
7/23/19 5:05	7/23/19 5:08	2.5	Loud Vehicle Passby
7/23/19 5:41	7/23/19 5:44	2.8	Loud Vehicle Passby
7/23/19 5:53	7/23/19 5:54	1.5	Train Passby
7/23/19 6:04	7/23/19 6:05	1.0	Loud Vehicle Passby
7/23/19 6:06	7/23/19 6:07	0.8	Loud Vehicle Passby
7/23/19 6:10	7/23/19 6:13	2.5	Excessive Bird Noise
7/23/19 6:13	7/23/19 6:22	8.8	Train Passby
7/23/19 6:28	7/23/19 6:29	1.0	Loud Vehicle Passby
7/23/19 6:36	7/23/19 6:38	2.0	Loud Vehicle Passby
7/23/19 6:46	7/23/19 6:47	1.3	Loud Vehicle Passby
7/23/19 6:52	7/23/19 6:53	1.5	Train Passby
7/23/19 6:54	7/23/19 6:56	1.5	Train Passby
7/23/19 22:01	7/23/19 22:02	1.0	Train Passby
7/23/19 22:24	7/23/19 22:26	1.8	Train Passby
7/23/19 23:09	7/23/19 23:10	1.3	Loud Vehicle Passby
7/23/19 23:11	7/23/19 23:12	1.3	Loud Vehicle Passby
7/23/19 23:20	7/23/19 23:21	1.0	Loud Vehicle Passby
7/24/19 0:38	7/24/19 0:39	1.3	Train Passby
7/24/19 0:39	7/24/19 0:44	4.3	Train Passby
7/24/19 1:00	7/24/19 1:02	1.5	Train Passby

Data Removal Noise Monitoring Location #9 Cont.

Start Time	End Time	Duration (min)	Reason
7/24/19 1:27	7/24/19 1:28	1.0	Train Passby
7/24/19 1:43	7/24/19 1:44	1.0	Train Passby
7/24/19 2:32	7/24/19 2:34	1.5	Train Passby
7/24/19 2:40	7/24/19 2:54	14.0	Thunder
7/24/19 2:57	7/24/19 3:05	8.8	Thunder
7/24/19 3:05	7/24/19 3:24	18.8	Excessive Wind Noise
7/24/19 3:26	7/24/19 3:46	20.3	Storm
7/24/19 3:47	7/24/19 3:59	11.5	Storm
7/24/19 3:59	7/24/19 4:45	45.5	Storm
7/24/19 4:45	7/24/19 4:55	9.5	Storm
7/24/19 4:56	7/24/19 5:14	18.5	Storm
7/24/19 5:15	7/24/19 5:38	23.0	Storm
7/24/19 5:41	7/24/19 5:52	11.5	Storm
7/24/19 5:57	7/24/19 6:02	4.5	Loud Vehicle Passby
7/24/19 6:05	7/24/19 6:10	5.0	Loud Vehicle Passby
7/24/19 6:12	7/24/19 6:17	5.5	Loud Vehicle Passby
7/24/19 6:18	7/24/19 6:23	4.3	Loud Vehicle Passby
7/24/19 6:24	7/24/19 6:25	1.0	Loud Vehicle Passby
7/24/19 6:34	7/24/19 6:36	2.3	Loud Vehicle Passby
7/24/19 6:40	7/24/19 6:42	2.3	Loud Vehicle Passby
7/24/19 6:42	7/24/19 6:45	2.5	Loud Vehicle Passby
7/24/19 6:58	7/24/19 7:00	1.3	Loud Vehicle Passby
	Total Night #1	**88**	
	Total Night #2	**211**	
	Total Data	**300**	

Data Removal Noise Monitoring Location #10

Start Time	End Time	Duration (min)	Reason
7/22/19 22:01	7/22/19 22:02	0.8	Loud Vehicle Passby
7/22/19 22:06	7/22/19 22:08	1.5	Loud Vehicle Passby
7/22/19 22:10	7/22/19 22:11	1.0	Loud Vehicle Passby
7/22/19 22:20	7/22/19 22:23	3.3	Loud Vehicle Passby
7/22/19 22:35	7/22/19 22:36	1.0	Loud Vehicle Passby
7/22/19 22:39	7/22/19 22:40	0.5	Loud Vehicle Passby
7/22/19 22:52	7/22/19 22:53	1.0	Train Passby
7/22/19 23:01	7/22/19 23:03	1.3	Loud Vehicle Passby
7/22/19 23:07	7/22/19 23:08	0.8	Loud Vehicle Passby
7/22/19 23:12	7/22/19 23:13	1.0	Loud Vehicle Passby
7/22/19 23:13	7/22/19 23:15	1.3	Loud Vehicle Passby
7/22/19 23:18	7/22/19 23:19	1.3	Loud Vehicle Passby
7/22/19 23:24	7/22/19 23:25	1.5	Loud Vehicle Passby
7/22/19 23:28	7/22/19 23:30	1.8	Loud Vehicle Passby
7/22/19 23:31	7/22/19 23:32	0.8	Loud Vehicle Passby
7/22/19 23:35	7/22/19 23:36	1.5	Loud Vehicle Passby
7/22/19 23:46	7/22/19 23:48	1.5	Loud Vehicle Passby
7/23/19 0:08	7/23/19 0:09	0.8	Loud Vehicle Passby
7/23/19 0:11	7/23/19 0:12	1.0	Loud Vehicle Passby
7/23/19 0:15	7/23/19 0:16	1.0	Loud Vehicle Passby
7/23/19 0:35	7/23/19 0:36	1.0	Loud Vehicle Passby
7/23/19 1:00	7/23/19 1:01	0.8	Loud Vehicle Passby
7/23/19 1:37	7/23/19 1:38	1.0	Train Passby
7/23/19 2:12	7/23/19 2:14	2.0	Loud Vehicle Passby
7/23/19 2:17	7/23/19 2:20	2.8	Loud Vehicle Passby
7/23/19 2:32	7/23/19 2:33	1.0	Loud Vehicle Passby
7/23/19 3:20	7/23/19 3:21	0.8	Loud Vehicle Passby
7/23/19 3:33	7/23/19 3:34	1.3	Loud Vehicle Passby
7/23/19 4:23	7/23/19 4:24	1.0	Train Passby
7/23/19 4:30	7/23/19 4:31	1.3	Train Passby
7/23/19 4:36	7/23/19 4:37	1.3	Train Passby
7/23/19 4:39	7/23/19 4:40	1.8	Train Passby
7/23/19 4:47	7/23/19 4:50	2.5	Loud Vehicle Passby
7/23/19 4:54	7/23/19 4:57	3.3	Loud Vehicle Passby
7/23/19 5:01	7/23/19 5:05	3.8	Loud Vehicle Passby
7/23/19 5:06	7/23/19 5:08	2.5	Loud Vehicle Passby
7/23/19 5:09	7/23/19 5:11	1.5	Loud Vehicle Passby
7/23/19 5:14	7/23/19 5:22	8.0	Loud Vehicle Passby
7/23/19 5:29	7/23/19 5:40	11.0	Loud Vehicle Passby
7/23/19 5:42	7/23/19 5:43	1.0	Loud Vehicle Passby

Data Removal Noise Monitoring Location #10 Cont.

Start Time	End Time	Duration (min)	Reason
7/23/19 5:43	7/23/19 5:45	2.0	Loud Vehicle Passby
7/23/19 5:46	7/23/19 5:47	1.8	Loud Vehicle Passby
7/23/19 5:48	7/23/19 5:50	2.3	Loud Vehicle Passby
7/23/19 5:52	7/23/19 6:00	8.3	Loud Vehicle Passby
7/23/19 6:01	7/23/19 6:32	31.3	Loud Vehicle Passby
7/23/19 6:33	7/23/19 6:45	12.3	Loud Vehicle Passby
7/23/19 6:46	7/23/19 6:52	6.0	Loud Vehicle Passby
7/23/19 6:52	7/23/19 7:15	22.5	Human Activity
7/23/19 22:06	7/23/19 22:07	0.8	Loud Vehicle Passby
7/23/19 22:08	7/23/19 22:09	1.0	Loud Vehicle Passby
7/23/19 22:15	7/23/19 22:16	1.0	Loud Vehicle Passby
7/23/19 22:22	7/23/19 22:23	0.5	Loud Vehicle Passby
7/23/19 22:30	7/23/19 22:32	2.0	Loud Vehicle Passby
7/23/19 22:41	7/23/19 22:42	0.8	Loud Vehicle Passby
7/23/19 22:52	7/23/19 22:53	1.3	Loud Vehicle Passby
7/23/19 23:00	7/23/19 23:04	3.3	Loud Vehicle Passby
7/23/19 23:11	7/23/19 23:13	1.3	Loud Vehicle Passby
7/23/19 23:14	7/23/19 23:15	1.3	Loud Vehicle Passby
7/23/19 23:31	7/23/19 23:32	1.0	Loud Vehicle Passby
7/23/19 23:47	7/23/19 23:48	1.3	Loud Vehicle Passby
7/24/19 0:43	7/24/19 0:44	1.0	Train Passby
7/24/19 1:02	7/24/19 1:02	0.8	Loud Vehicle Passby
7/24/19 1:03	7/24/19 1:04	1.8	Loud Vehicle Passby
7/24/19 1:13	7/24/19 1:14	1.0	Loud Vehicle Passby
7/24/19 1:28	7/24/19 1:30	1.5	Loud Vehicle Passby
7/24/19 1:44	7/24/19 1:49	4.5	Loud Vehicle Passby
7/24/19 1:51	7/24/19 1:52	0.8	Loud Vehicle Passby
7/24/19 1:59	7/24/19 2:00	1.5	Loud Vehicle Passby
7/24/19 2:05	7/24/19 2:05	0.5	Loud Vehicle Passby
7/24/19 2:32	7/24/19 2:33	1.0	Loud Vehicle Passby
7/24/19 2:36	7/24/19 2:37	1.3	Loud Vehicle Passby
7/24/19 2:44	7/24/19 2:46	1.3	Loud Vehicle Passby
7/24/19 2:58	7/24/19 3:02	3.8	Loud Vehicle Passby
7/24/19 3:03	7/24/19 3:06	3.0	Loud Vehicle Passby
7/24/19 3:19	7/24/19 3:57	38.5	Storm
7/24/19 4:01	7/24/19 4:42	40.3	Storm
7/24/19 4:50	7/24/19 5:24	34.0	Storm
7/24/19 5:25	7/24/19 5:54	29.5	Storm
7/24/19 5:55	7/24/19 6:09	14.0	Storm
7/24/19 6:10	7/24/19 6:28	18.8	Storm

Data Removal Noise Monitoring Location #10 Cont.

Start Time	End Time	Duration (min)	Reason
7/24/19 6:29	7/24/19 6:57	28.5	Storm
7/24/19 6:58	7/24/19 7:00	2.5	Storm
	Total Night #1	**150**	
	Total Night #2	**245**	
	Total Data	**405**	

Data Removal Noise Monitoring Location #11

Start Time	End Time	Duration (min)	Reason
7/22/19 22:18	7/22/19 22:19	0.8	Rail
7/22/19 22:37	7/22/19 22:39	2.0	Loud Vehicle Passby
7/22/19 22:41	7/22/19 22:45	4.3	Site Visit
7/22/19 22:48	7/22/19 22:49	1.0	Loud Vehicle Passby
7/22/19 23:10	7/22/19 23:12	2.3	Train Passby
7/23/19 0:02	7/23/19 0:04	2.0	Rail
7/23/19 0:08	7/23/19 0:09	1.0	Loud Vehicle Passby
7/23/19 1:22	7/23/19 1:24	2.0	Loud Vehicle Passby
7/23/19 1:40	7/23/19 1:42	2.0	Loud Vehicle Passby
7/23/19 1:50	7/23/19 1:54	4.3	Train Passby
7/23/19 1:57	7/23/19 1:58	1.8	Train Passby
7/23/19 2:17	7/23/19 2:18	0.8	Train Passby
7/23/19 2:21	7/23/19 2:22	1.0	Train Passby
7/23/19 2:28	7/23/19 2:29	1.0	Loud Vehicle Passby
7/23/19 2:33	7/23/19 2:35	1.8	Train Passby
7/23/19 2:39	7/23/19 2:41	2.0	Train Passby
7/23/19 3:12	7/23/19 3:14	1.5	Loud Vehicle Passby
7/23/19 3:28	7/23/19 3:30	1.8	Train Passby
7/23/19 3:35	7/23/19 3:36	1.3	Rail
7/23/19 3:37	7/23/19 3:43	6.0	Rail Activity
7/23/19 3:47	7/23/19 3:50	2.5	Rail Activity
7/23/19 3:59	7/23/19 4:00	1.0	Train Passby
7/23/19 4:01	7/23/19 4:13	11.5	Train Passby
7/23/19 4:31	7/23/19 4:32	1.5	Rail Activity
7/23/19 4:50	7/23/19 4:52	2.3	Train Passby
7/23/19 4:57	7/23/19 4:57	0.8	Train Passby
7/23/19 5:03	7/23/19 5:04	0.8	Train Passby
7/23/19 5:16	7/23/19 5:25	9.5	Train Passby
7/23/19 5:30	7/23/19 5:30	0.8	Excessive Bird Noise
7/23/19 5:42	7/23/19 5:46	4.3	Excessive Bird Noise
7/23/19 5:47	7/23/19 6:16	28.8	Excessive Bird Noise
7/23/19 6:19	7/23/19 6:20	1.0	Loud Vehicle Passby
7/23/19 6:20	7/23/19 6:27	6.5	Loud Vehicle Passby
7/23/19 6:30	7/23/19 6:32	1.3	Excessive Bird Noise
7/23/19 6:40	7/23/19 6:42	2.3	Loud Vehicle Passby
7/23/19 6:44	7/23/19 6:47	2.5	Excessive Bird Noise
7/23/19 6:49	7/23/19 6:50	1.3	Loud Vehicle Passby
7/23/19 6:51	7/23/19 6:54	2.8	Excessive Bird Noise
7/23/19 22:02	7/23/19 22:05	2.3	Loud Vehicle Passby
7/23/19 22:05	7/23/19 22:07	1.8	Train Passby

Data Removal Noise Monitoring Location #11 Cont.

Start Time	End Time	Duration (min)	Reason
7/23/19 22:23	7/23/19 22:24	1.3	Train Passby
7/23/19 22:47	7/23/19 22:49	2.0	Rail Activity
7/23/19 23:32	7/23/19 23:34	2.0	Loud Vehicle Passby
7/23/19 23:40	7/23/19 23:42	1.5	Loud Vehicle Passby
7/24/19 0:01	7/24/19 0:03	2.0	Train Passby
7/24/19 0:13	7/24/19 0:14	1.0	Rail Activity
7/24/19 0:35	7/24/19 0:37	1.3	Train Passby
7/24/19 0:41	7/24/19 0:42	1.3	Train Passby
7/24/19 1:39	7/24/19 1:40	1.0	Loud Vehicle Passby
7/24/19 1:47	7/24/19 1:49	1.5	Train Passby
7/24/19 1:59	7/24/19 2:01	2.0	Loud Vehicle Passby
7/24/19 2:23	7/24/19 2:26	2.8	Loud Vehicle Passby
7/24/19 2:39	7/24/19 2:39	0.5	Train Passby
7/24/19 2:44	7/24/19 3:02	18.3	Storm
7/24/19 3:03	7/24/19 3:23	20.3	Storm
7/24/19 3:29	7/24/19 3:35	6.5	Storm
7/24/19 3:36	7/24/19 3:59	23.5	Storm
7/24/19 4:01	7/24/19 4:51	50.0	Storm
7/24/19 4:51	7/24/19 5:04	13.0	Storm
7/24/19 5:09	7/24/19 5:13	3.8	Storm
7/24/19 5:18	7/24/19 5:31	13.5	Excessive Wind Noise
7/24/19 5:34	7/24/19 5:40	6.8	Excessive Wind Noise
7/24/19 6:09	7/24/19 6:12	2.5	Loud Vehicle Passby
7/24/19 6:22	7/24/19 6:34	12.5	Loud Vehicle Passby
7/24/19 6:40	7/24/19 6:41	0.5	Excessive Bird Noise
7/24/19 6:52	7/24/19 6:53	1.0	Excessive Bird Noise
	Total Night #1	**121**	
	Total Night #2	**196**	
	Total Data	**317**	

Data Removal Noise Monitoring Location #12 (Night 1)

Start Time	End Time	Duration (min)	Reason
7/22/19 22:10	7/22/19 22:11	1.3	Excessive Bird Noise
7/22/19 22:59	7/22/19 23:09	10.0	Train Passby
7/22/19 23:19	7/22/19 23:21	1.8	Loud Vehicle Passby
7/22/19 23:22	7/22/19 23:23	0.8	Loud Vehicle Passby
7/22/19 23:43	7/22/19 23:54	11.0	Train Passby
7/23/19 0:09	7/23/19 0:10	0.8	Train Passby
7/23/19 0:17	7/23/19 0:19	1.5	Loud Vehicle Passby
7/23/19 0:33	7/23/19 0:34	1.8	Train Passby
7/23/19 1:40	7/23/19 1:42	2.3	Train Passby
7/23/19 2:20	7/23/19 2:21	1.5	Coyotes
7/23/19 2:50	7/23/19 2:51	0.8	Train Passby
7/23/19 2:58	7/23/19 3:02	4.8	Train Passby
7/23/19 4:10	7/23/19 4:11	1.0	Train Passby
7/23/19 4:14	7/23/19 4:21	6.3	Train Passby
7/23/19 4:25	7/23/19 4:27	2.3	Train Passby
7/23/19 4:43	7/23/19 5:09	26.0	Excessive Bird Noise
7/23/19 5:10	7/23/19 5:12	2.0	Train Passby
7/23/19 5:18	7/23/19 5:18	0.5	Excessive Bird Noise
7/23/19 5:23	7/23/19 5:26	3.5	Train Passby
7/23/19 5:34	7/23/19 5:35	0.8	Train Passby
7/23/19 5:38	7/23/19 5:41	3.3	Excessive Bird Noise
7/23/19 5:54	7/23/19 5:57	2.5	Loud Vehicle Passby
7/23/19 5:59	7/23/19 6:00	1.0	Excessive Bird Noise
7/23/19 6:05	7/23/19 6:08	3.0	Loud Vehicle Passby
7/23/19 6:10	7/23/19 6:16	6.5	Loud Vehicle Passby
7/23/19 6:24	7/23/19 6:25	1.3	Loud Vehicle Passby
7/23/19 6:41	7/23/19 6:43	1.3	Loud Vehicle Passby
7/23/19 6:46	7/23/19 6:48	1.8	Loud Vehicle Passby
7/23/19 22:18	7/23/19 22:18	0.5	Train Passby
7/23/19 22:19	7/23/19 22:22	3.0	Loud Vehicle Passby
7/23/19 22:24	7/23/19 22:27	3.0	Loud Vehicle Passby
7/23/19 22:41	7/23/19 22:42	1.3	Aircraft Flyover
7/23/19 23:20	7/23/19 23:20	0.3	Loud Vehicle Passby
7/23/19 23:31	7/23/19 23:32	1.5	Loud Vehicle Passby
7/23/19 23:35	7/23/19 23:54	18.8	Train Passby
7/24/19 0:34	7/24/19 0:35	1.5	Train Passby
7/24/19 0:38	7/24/19 0:40	1.8	Loud Vehicle Passby
7/24/19 0:46	7/24/19 1:01	14.5	Train Passby
7/24/19 1:07	7/24/19 1:07	0.8	Abnormal
7/24/19 1:21	7/24/19 1:24	3.0	Train Passby

Data Removal Noise Monitoring Location #12 (Night 1) Cont.

Start Time	End Time	Duration (min)	Reason
7/24/19 2:47	7/24/19 2:55	8.5	Storm
7/24/19 2:57	7/24/19 3:25	27.5	Storm
7/24/19 3:25	7/24/19 3:29	3.3	Storm
7/24/19 3:29	7/24/19 3:59	30.8	Storm
7/24/19 4:00	7/24/19 4:58	58.3	Storm
7/24/19 4:59	7/24/19 5:04	5.8	Storm
7/24/19 5:05	7/24/19 5:28	23.0	Storm
7/24/19 5:28	7/24/19 5:57	28.5	Storm
7/24/19 5:57	7/24/19 6:01	4.0	Storm
7/24/19 6:02	7/24/19 6:04	2.0	Train Passby
7/24/19 6:04	7/24/19 6:07	3.0	Excessive Wind Noise
7/24/19 6:07	7/24/19 6:08	1.0	Loud Vehicle Passby
7/24/19 6:09	7/24/19 6:26	17.3	Loud Vehicle Passby
7/24/19 6:27	7/24/19 6:59	32.3	Excessive Rain Noise
	Total Night #1	**101**	
	Total Night #2	**295**	
	Total Data	**396**	

Data Removal Noise Monitoring Location #12 (Night 2)

Start Time	End Time	Duration (min)	Reason
9/18/19 22:03	9/18/19 22:05	2.0	Aircraft Flyover
9/18/19 22:06	9/18/19 22:07	1.3	Loud Vehicle Passby
9/18/19 22:10	9/18/19 22:11	1.0	Loud Vehicle Passby
9/18/19 22:20	9/18/19 22:23	2.3	Train Passby
9/18/19 22:26	9/18/19 22:27	1.0	Train Passby
9/18/19 22:31	9/18/19 22:33	1.8	Loud Vehicle Passby
9/18/19 22:46	9/18/19 22:47	1.0	Train Passby
9/18/19 22:49	9/18/19 22:50	1.0	Loud Vehicle Passby
9/18/19 23:14	9/18/19 23:15	1.3	Train Passby
9/18/19 23:33	9/18/19 23:34	1.3	Loud Vehicle Passby
9/18/19 23:36	9/18/19 23:38	1.3	Train Passby
9/18/19 23:42	9/18/19 23:50	8.3	Train Passby
9/18/19 23:50	9/18/19 23:53	3.0	Train Passby
9/18/19 23:56	9/19/19 0:03	7.3	Train Passby
9/19/19 0:05	9/19/19 0:06	0.8	Coyotes
9/19/19 0:11	9/19/19 0:13	2.0	Train Passby
9/19/19 0:20	9/19/19 0:21	1.0	Loud Vehicle Passby
9/19/19 0:22	9/19/19 0:24	2.0	Loud Vehicle Passby
9/19/19 0:27	9/19/19 0:28	0.8	Loud Vehicle Passby
9/19/19 0:28	9/19/19 0:30	1.8	Loud Vehicle Passby
9/19/19 0:31	9/19/19 0:33	1.8	Loud Vehicle Passby
9/19/19 0:34	9/19/19 0:35	1.3	Loud Vehicle Passby
9/19/19 0:41	9/19/19 0:43	1.8	Loud Vehicle Passby
9/19/19 0:47	9/19/19 0:48	0.8	Loud Vehicle Passby
9/19/19 0:54	9/19/19 0:55	1.0	Loud Vehicle Passby
9/19/19 1:26	9/19/19 1:27	0.8	Train Passby
9/19/19 1:30	9/19/19 1:31	1.0	Train Passby
9/19/19 1:31	9/19/19 1:33	1.5	Train Passby
9/19/19 1:33	9/19/19 1:34	1.0	Loud Vehicle Passby
9/19/19 1:52	9/19/19 1:53	0.8	Train Passby
9/19/19 2:11	9/19/19 2:12	1.0	Loud Vehicle Passby
9/19/19 2:14	9/19/19 2:16	1.3	Loud Vehicle Passby
9/19/19 2:38	9/19/19 2:38	0.8	geese
9/19/19 2:46	9/19/19 2:48	1.5	Train Passby
9/19/19 2:50	9/19/19 2:51	1.3	Train Passby
9/19/19 3:17	9/19/19 3:19	2.3	Train Passby
9/19/19 3:25	9/19/19 3:26	1.3	Train Passby
9/19/19 3:36	9/19/19 3:37	1.3	Train Passby
9/19/19 3:43	9/19/19 3:44	1.3	Loud Vehicle Passby
9/19/19 3:50	9/19/19 3:51	1.0	Loud Vehicle Passby

Data Removal Noise Monitoring Location #12 (Night 2) Cont.

Start Time	End Time	Duration (min)	Reason
9/19/19 3:55	9/19/19 3:56	1.5	Loud Vehicle Passby
9/19/19 4:06	9/19/19 4:15	9.0	Train Passby
9/19/19 4:54	9/19/19 4:55	1.3	Loud Vehicle Passby
9/19/19 5:10	9/19/19 5:13	2.5	Loud Vehicle Passby
9/19/19 5:15	9/19/19 5:17	2.8	Loud Vehicle Passby
9/19/19 5:34	9/19/19 5:36	2.3	Loud Vehicle Passby
9/19/19 5:57	9/19/19 5:58	1.5	Loud Vehicle Passby
9/19/19 6:00	9/19/19 6:03	2.3	Loud Vehicle Passby
9/19/19 6:06	9/19/19 6:07	1.0	Loud Vehicle Passby
9/19/19 6:15	9/19/19 6:18	2.8	Loud Vehicle Passby
9/19/19 6:21	9/19/19 6:25	4.0	Loud Vehicle Passby
9/19/19 6:26	9/19/19 6:29	2.8	Train Passby
9/19/19 6:33	9/19/19 6:34	1.3	Train Passby
9/19/19 6:42	9/19/19 6:43	1.0	Loud Vehicle Passby
9/19/19 6:44	9/19/19 6:45	1.0	Loud Vehicle Passby
9/19/19 6:50	9/19/19 6:53	2.5	Loud Vehicle Passby
9/19/19 6:56	9/19/19 7:06	10.0	Excessive Bird Noise
9/19/19 21:59	9/19/19 22:01	1.3	Loud Vehicle Passby
9/19/19 22:02	9/19/19 22:03	1.5	Loud Vehicle Passby
9/19/19 22:10	9/19/19 22:11	0.8	Train Passby
9/19/19 22:14	9/19/19 22:15	1.3	Loud Vehicle Passby
9/19/19 22:16	9/19/19 22:17	1.8	Loud Vehicle Passby
9/19/19 22:29	9/19/19 22:44	14.8	Train Passby
9/19/19 22:56	9/19/19 22:58	1.3	Loud Vehicle Passby
9/19/19 23:00	9/19/19 23:01	1.3	Loud Vehicle Passby
9/19/19 23:43	9/19/19 23:46	3.0	Train Passby
9/19/19 23:51	9/19/19 23:52	1.5	Loud Vehicle Passby
9/20/19 0:27	9/20/19 0:31	3.5	Loud Vehicle Passby
9/20/19 1:15	9/20/19 1:22	6.3	Train Passby
9/20/19 1:46	9/20/19 1:51	5.5	Train Passby
9/20/19 2:03	9/20/19 2:05	1.3	Train Passby
9/20/19 2:17	9/20/19 2:18	1.0	Train Passby
9/20/19 2:54	9/20/19 2:56	1.5	Train Passby
9/20/19 3:01	9/20/19 3:04	3.5	Train Passby
9/20/19 3:06	9/20/19 3:08	2.8	Train Passby
9/20/19 3:17	9/20/19 3:19	1.8	Train Passby
9/20/19 3:22	9/20/19 3:23	1.5	Train Passby
9/20/19 3:28	9/20/19 3:30	1.5	Train Passby
9/20/19 3:37	9/20/19 3:38	1.5	Train Passby
9/20/19 3:52	9/20/19 3:57	4.3	Loud Vehicle Passby

Data Removal Noise Monitoring Location #12 (Night 2) Cont.

Start Time	End Time	Duration (min)	Reason
9/20/19 4:11	9/20/19 4:13	1.8	Loud Vehicle Passby
9/20/19 4:14	9/20/19 4:16	2.5	Loud Vehicle Passby
9/20/19 4:42	9/20/19 4:42	0.8	Loud Vehicle Passby
9/20/19 4:57	9/20/19 4:58	1.5	Loud Vehicle Passby
9/20/19 5:21	9/20/19 5:25	3.3	Train Passby
9/20/19 5:26	9/20/19 5:28	2.0	Loud Vehicle Passby
9/20/19 5:33	9/20/19 5:34	1.0	Loud Vehicle Passby
9/20/19 5:50	9/20/19 5:52	2.5	Loud Vehicle Passby
9/20/19 5:56	9/20/19 5:58	1.8	Loud Vehicle Passby
9/20/19 6:01	9/20/19 6:03	2.3	Loud Vehicle Passby
9/20/19 6:06	9/20/19 6:12	6.5	Loud Vehicle Passby
9/20/19 6:16	9/20/19 6:19	2.3	Loud Vehicle Passby
9/20/19 6:22	9/20/19 6:25	3.3	Loud Vehicle Passby
9/20/19 6:53	9/20/19 7:13	20.3	Loud Vehicle Passby
	Total Night #1	**115**	
	Total Night #2	**116**	
	Total Data	**231**	

Data Removal Noise Monitoring Location #12 (Night 3)

Start Time	End Time	Duration (min)	Reason
10/21/19 22:01	10/21/19 22:06	5.8	Train Passby
10/21/19 22:11	10/21/19 22:13	2.0	Loud Vehicle Passby
10/21/19 22:18	10/21/19 22:28	10.3	Abnormal
10/21/19 22:29	10/21/19 22:31	1.8	Loud Vehicle Passby
10/21/19 22:33	10/21/19 22:42	9.3	Train Passby
10/21/19 22:57	10/21/19 23:05	7.8	Train Passby
10/21/19 23:08	10/21/19 23:08	0.8	Train Passby
10/21/19 23:12	10/21/19 23:16	3.8	Train Passby
10/21/19 23:19	10/21/19 23:32	12.5	Train Passby
10/21/19 23:37	10/21/19 23:39	2.8	Loud Vehicle Passby
10/21/19 23:41	10/21/19 23:45	3.8	Loud Vehicle Passby
10/21/19 23:53	10/21/19 23:54	1.0	Loud Vehicle Passby
10/21/19 23:57	10/21/19 23:59	2.0	Loud Vehicle Passby
10/22/19 0:33	10/22/19 0:36	3.8	Coyotes
10/22/19 1:04	10/22/19 1:07	2.3	Loud Vehicle Passby
10/22/19 1:14	10/22/19 1:27	13.5	Train Passby
10/22/19 1:55	10/22/19 1:59	3.8	Coyotes
10/22/19 2:19	10/22/19 2:25	5.8	Loud Vehicle Passby
10/22/19 2:37	10/22/19 2:39	1.5	Loud Vehicle Passby
10/22/19 2:45	10/22/19 2:46	0.8	Loud Vehicle Passby
10/22/19 2:49	10/22/19 2:51	1.5	Train Passby
10/22/19 3:46	10/22/19 3:47	1.5	Loud Vehicle Passby
10/22/19 4:13	10/22/19 4:15	1.8	Coyotes
10/22/19 4:53	10/22/19 4:57	3.3	Loud Vehicle Passby
10/22/19 4:59	10/22/19 5:02	3.0	Coyotes
10/22/19 5:15	10/22/19 5:15	0.5	Loud Vehicle Passby
10/22/19 5:22	10/22/19 5:22	0.0	Loud Vehicle Passby
10/22/19 5:59	10/22/19 6:01	2.8	Loud Vehicle Passby
10/22/19 6:13	10/22/19 6:14	1.0	Loud Vehicle Passby
10/22/19 6:15	10/22/19 6:15	0.8	Loud Vehicle Passby
10/22/19 6:44	10/22/19 6:47	2.8	Loud Vehicle Passby
10/22/19 6:49	10/22/19 6:50	1.3	Loud Vehicle Passby
10/22/19 22:02	10/22/19 22:03	0.8	Train Passby
10/22/19 22:24	10/22/19 22:25	0.5	Train Passby
10/22/19 22:33	10/22/19 22:34	1.0	Train Passby
10/22/19 22:37	10/22/19 22:39	2.0	Train Passby
10/22/19 22:42	10/22/19 22:43	1.0	Train Passby
10/22/19 22:56	10/22/19 22:57	0.8	Train Passby
10/22/19 23:01	10/22/19 23:02	0.8	Loud Vehicle Passby
10/22/19 23:29	10/22/19 23:31	2.3	Excessive Wind Noise

Data Removal Noise Monitoring Location #12 (Night 2) Cont.

Start Time	End Time	Duration (min)	Reason
10/22/19 23:45	10/22/19 23:47	1.5	Loud Vehicle Passby
10/23/19 0:10	10/23/19 0:11	1.3	Train Passby
10/23/19 0:13	10/23/19 0:14	1.0	Loud Vehicle Passby
10/23/19 0:26	10/23/19 0:36	10.0	Train Passby
10/23/19 1:08	10/23/19 1:11	2.5	Excessive Wind Noise
10/23/19 1:12	10/23/19 1:13	1.0	Train Passby
10/23/19 2:02	10/23/19 2:37	35.5	Excessive Wind Noise
10/23/19 2:38	10/23/19 3:13	34.5	Excessive Wind Noise
10/23/19 3:13	10/23/19 3:49	35.3	Excessive Wind Noise
10/23/19 3:49	10/23/19 4:32	42.8	Excessive Wind Noise
10/23/19 4:32	10/23/19 5:06	34.0	Excessive Wind Noise
10/23/19 5:07	10/23/19 6:04	56.5	Excessive Wind Noise
10/23/19 6:06	10/23/19 6:33	26.5	Excessive Wind Noise
10/23/19 6:33	10/23/19 6:59	25.8	Excessive Wind Noise
	Total Night #1	**115**	
	Total Night #2	**317**	
	Total Data	**432**	

Data Removal Noise Monitoring Location #13

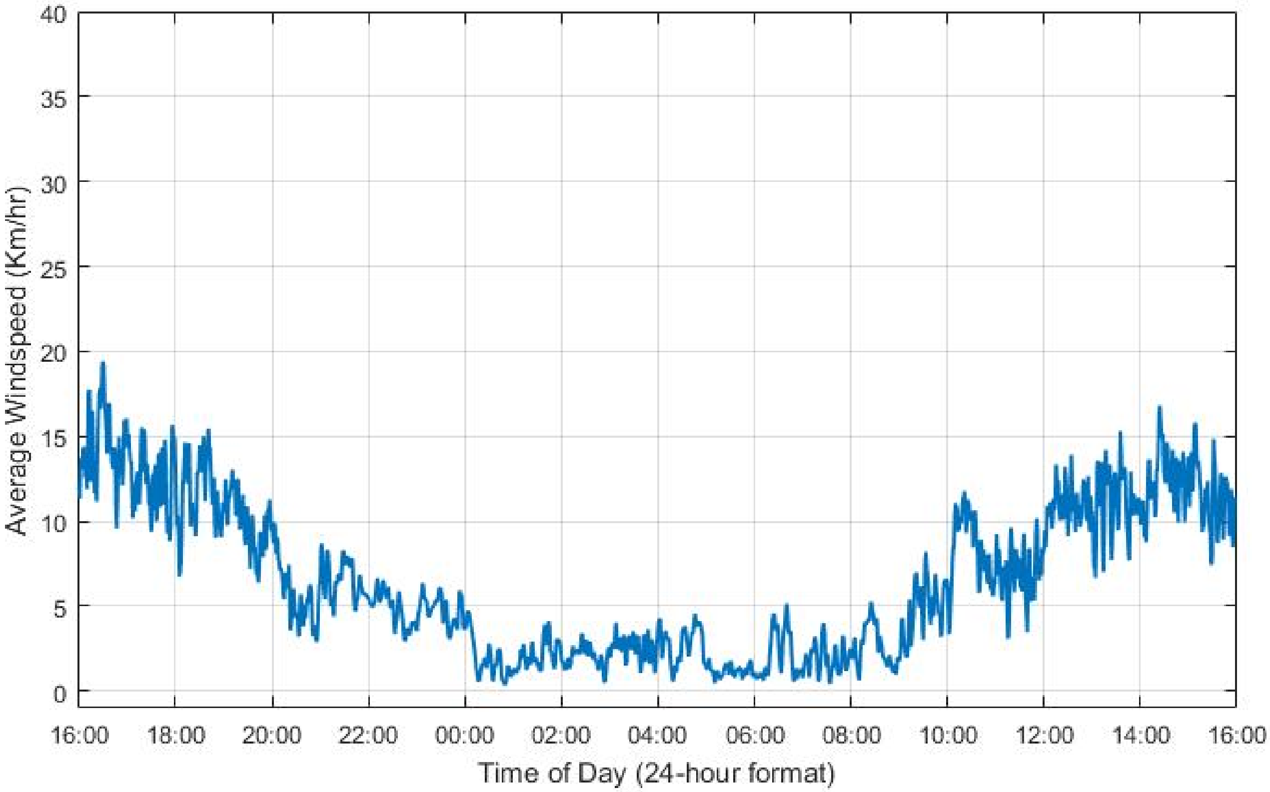
Start Time	End Time	Duration (min)	Reason
9/18/19 22:00	9/18/19 22:01	1.3	Irregular Activity
9/19/19 1:26	9/19/19 1:27	0.8	Loud Bang
9/19/19 1:29	9/19/19 1:30	1.0	Loud Vehicle Passby
9/19/19 1:51	9/19/19 1:52	0.5	Loud Bang
9/19/19 1:52	9/19/19 1:53	1.3	Loud Bang
9/19/19 2:02	9/19/19 2:02	0.5	Loud Bang
9/19/19 2:03	9/19/19 2:03	0.3	Loud Bang
9/19/19 2:08	9/19/19 2:09	0.8	Loud Bang
9/19/19 2:18	9/19/19 2:19	1.5	Loud Bang
9/19/19 2:38	9/19/19 2:39	1.3	Loud Bang
9/19/19 2:49	9/19/19 2:50	1.3	Loud Bang
9/19/19 2:55	9/19/19 2:56	1.0	Loud Bang
9/19/19 3:04	9/19/19 3:06	2.3	Loud Bang
9/19/19 3:10	9/19/19 3:11	1.5	Loud Bang
9/19/19 3:15	9/19/19 3:16	1.3	Loud Bang
9/19/19 3:31	9/19/19 3:32	1.0	Loud Bang
9/19/19 3:35	9/19/19 3:37	2.0	Loud Bang
9/19/19 3:46	9/19/19 3:47	1.0	Loud Bang
9/19/19 3:52	9/19/19 3:53	1.5	Loud Bang
9/19/19 3:57	9/19/19 3:58	1.3	Loud Bang
9/19/19 4:02	9/19/19 4:04	1.8	Loud Bang
9/19/19 4:07	9/19/19 4:08	1.3	Loud Bang
9/19/19 4:12	9/19/19 4:14	1.5	Loud Bang
9/19/19 4:17	9/19/19 4:18	1.0	Loud Bang
9/19/19 4:21	9/19/19 4:24	3.0	Loud Vehicle Passby
9/19/19 4:30	9/19/19 4:32	1.3	Loud Bang
9/19/19 5:27	9/19/19 5:29	2.0	Loud Bang
9/19/19 5:31	9/19/19 5:33	1.3	Loud Bang
9/19/19 5:37	9/19/19 5:39	1.5	Loud Vehicle Passby
9/19/19 5:47	9/19/19 5:48	1.0	Loud Bang
9/19/19 6:01	9/19/19 6:01	0.8	Loud Bang
9/19/19 6:05	9/19/19 6:06	1.5	Loud Vehicle Passby
9/19/19 6:08	9/19/19 6:10	1.8	Loud Vehicle Passby
9/19/19 6:12	9/19/19 6:13	1.3	Loud Bang
9/19/19 6:16	9/19/19 6:19	3.0	Loud Bang
9/19/19 6:33	9/19/19 6:34	0.8	Loud Bang
9/19/19 6:42	9/19/19 6:44	2.0	Loud Bang
9/19/19 6:45	9/19/19 6:48	2.5	Loud Bang
9/19/19 6:50	9/19/19 6:52	1.8	Loud Bang

Data Removal Noise Monitoring Location #13 (cont.)

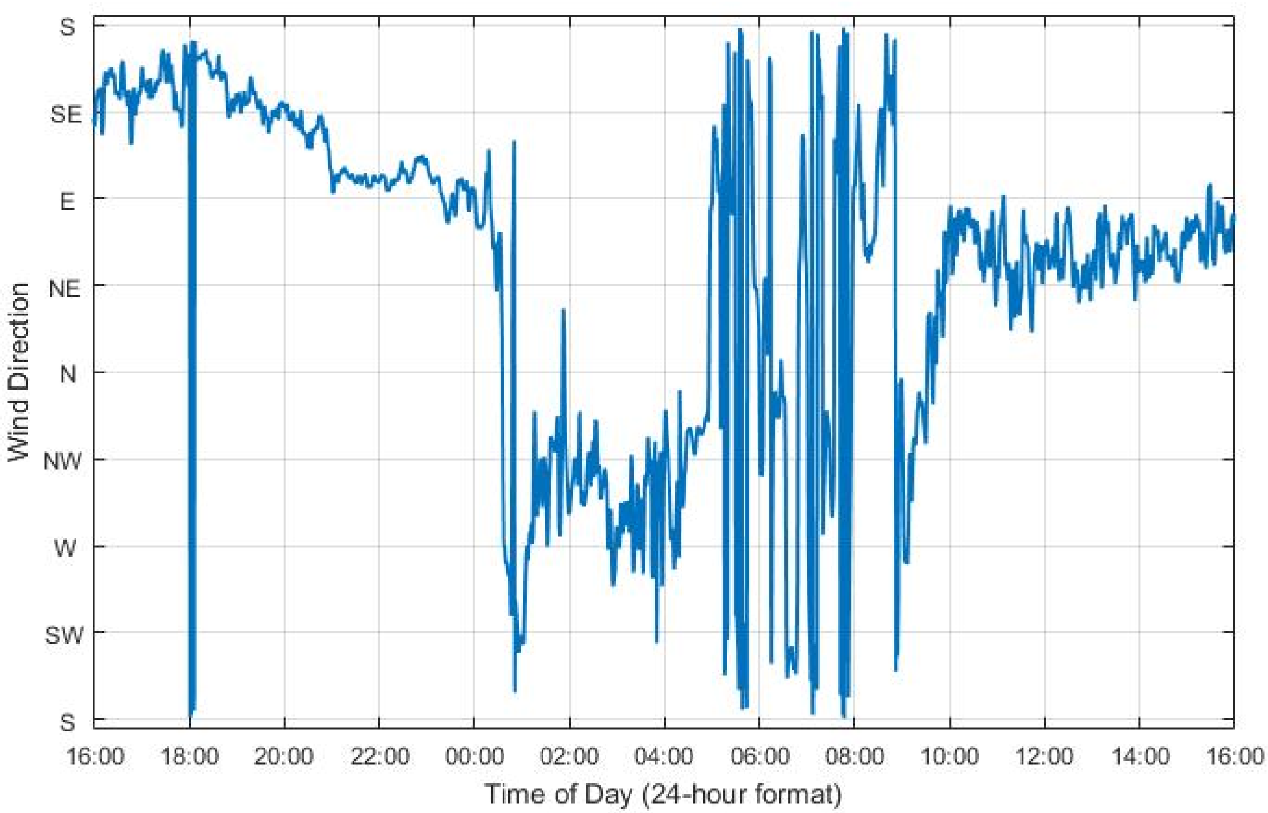
Start Time	End Time	Duration (min)	Reason
9/19/19 22:02	9/19/19 22:02	0.8	Loud Vehicle Passby
9/19/19 22:12	9/19/19 22:14	1.3	Aircraft Flyover
9/20/19 0:28	9/20/19 0:33	5.0	Excessive Rain Noise
9/20/19 0:48	9/20/19 0:50	1.8	Loud Vehicle Passby
9/20/19 0:51	9/20/19 0:53	2.0	Loud Vehicle Passby
9/20/19 1:14	9/20/19 1:15	1.5	Loud Vehicle Passby
9/20/19 1:28	9/20/19 1:29	0.8	Coyotes
9/20/19 1:42	9/20/19 1:44	2.3	Aircraft Flyover
9/20/19 1:47	9/20/19 1:48	1.5	Loud Vehicle Passby
9/20/19 2:15	9/20/19 2:17	2.0	Low frequency noise
9/20/19 2:20	9/20/19 2:22	1.8	Loud Vehicle Passby
9/20/19 2:41	9/20/19 2:43	2.3	Aircraft Flyover
9/20/19 2:49	9/20/19 2:52	3.0	Excessive Rain Noise
9/20/19 3:16	9/20/19 3:18	2.0	Loud Vehicle Passby
9/20/19 3:39	9/20/19 3:41	2.5	Aircraft Flyover
9/20/19 3:53	9/20/19 3:55	2.0	Loud Vehicle Passby
9/20/19 3:56	9/20/19 3:58	2.0	Loud Vehicle Passby
9/20/19 4:08	9/20/19 4:10	2.5	Aircraft Flyover
9/20/19 4:12	9/20/19 4:14	2.0	Aircraft Flyover
9/20/19 4:14	9/20/19 4:17	2.3	Loud Vehicle Passby
9/20/19 4:20	9/20/19 4:21	1.3	Aircraft Flyover
9/20/19 5:10	9/20/19 5:12	1.8	Aircraft Flyover
9/20/19 5:23	9/20/19 5:25	2.0	Loud Vehicle Passby
9/20/19 5:27	9/20/19 5:28	1.8	Loud Vehicle Passby
9/20/19 5:29	9/20/19 5:31	2.5	Loud Vehicle Passby
9/20/19 6:00	9/20/19 6:02	2.3	Aircraft Flyover
9/20/19 6:12	9/20/19 6:14	2.3	Loud Vehicle Passby
9/20/19 6:15	9/20/19 6:18	3.0	Loud Vehicle Passby
9/20/19 6:24	9/20/19 6:26	1.5	Train Passby
9/20/19 6:32	9/20/19 6:34	2.3	Train Passby
9/20/19 6:43	9/20/19 6:46	2.5	Loud Vehicle Passby
9/20/19 6:51	9/20/19 6:53	1.8	Aircraft Flyover
	Total Night #1	**54**	
	Total Night #2	**66**	
	Total Data	**120**	

Appendix V WEATHER DATA

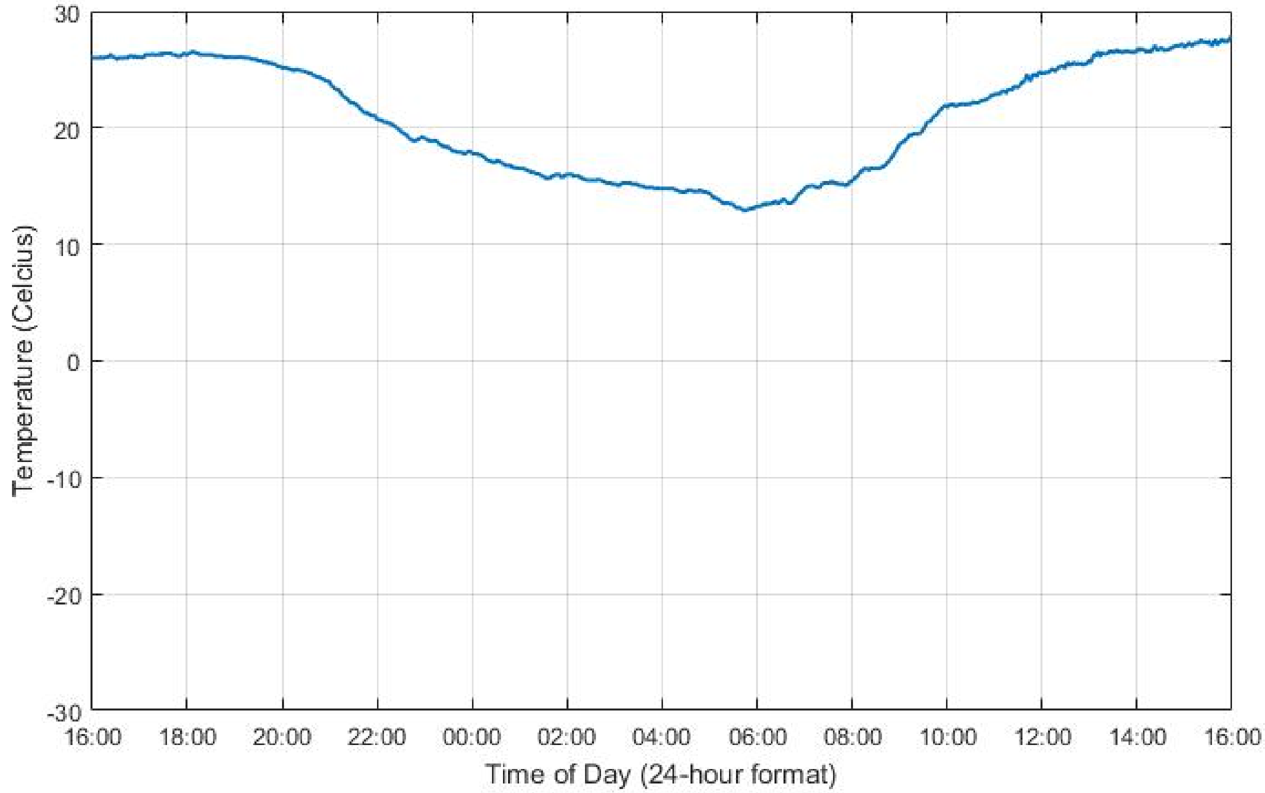
July 22 – 23, 2019 Weather Data



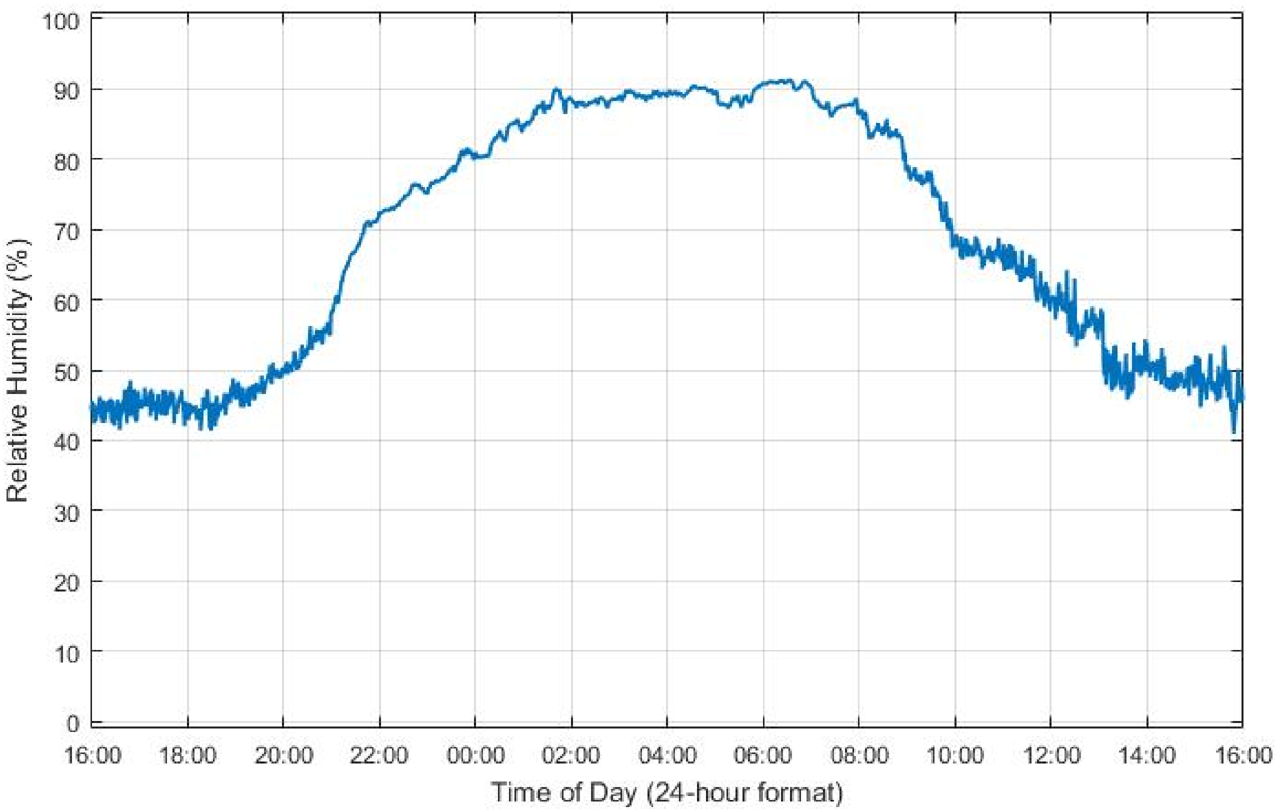
Monitored Wind Speed (July 22 – 23, 2019) at Noise Monitor Location 1



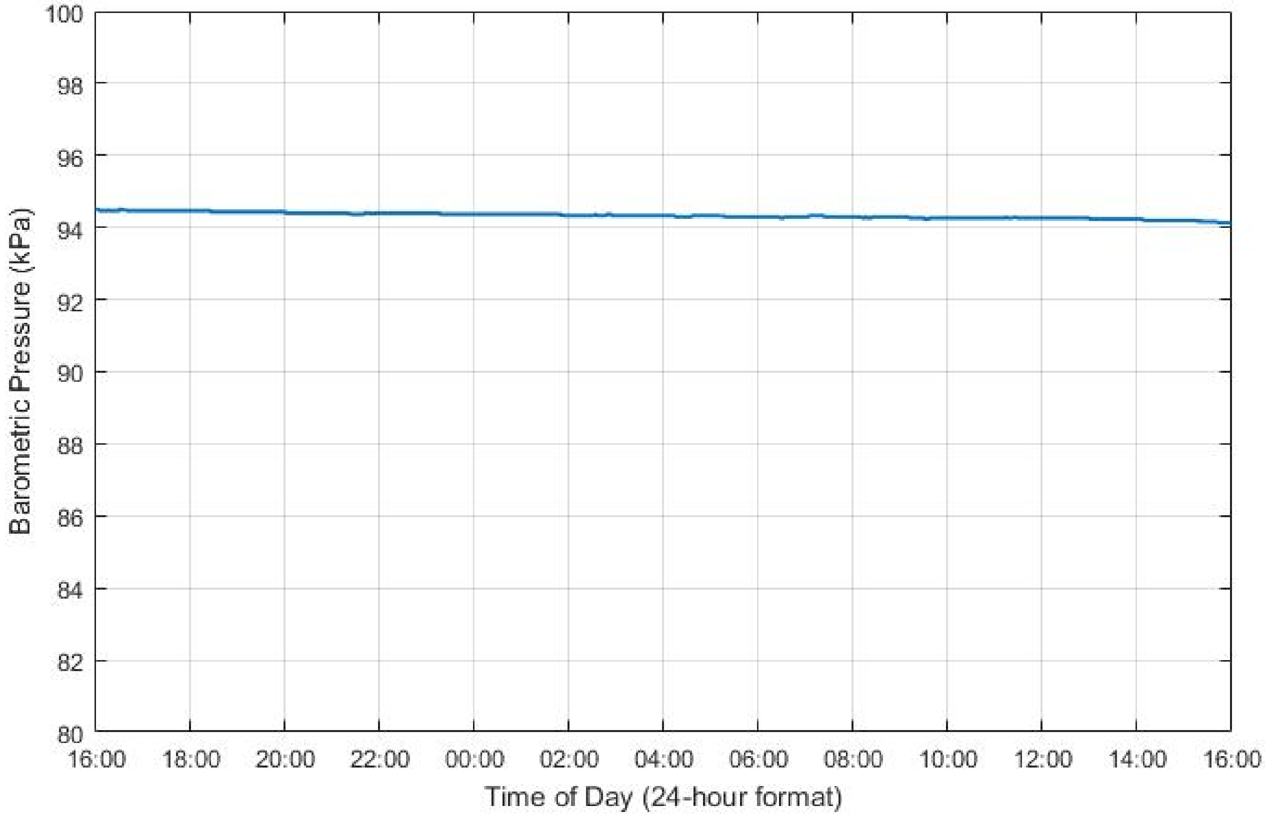
Monitored Wind Direction (July 22 – 23, 2019) at Noise Monitor Location 1



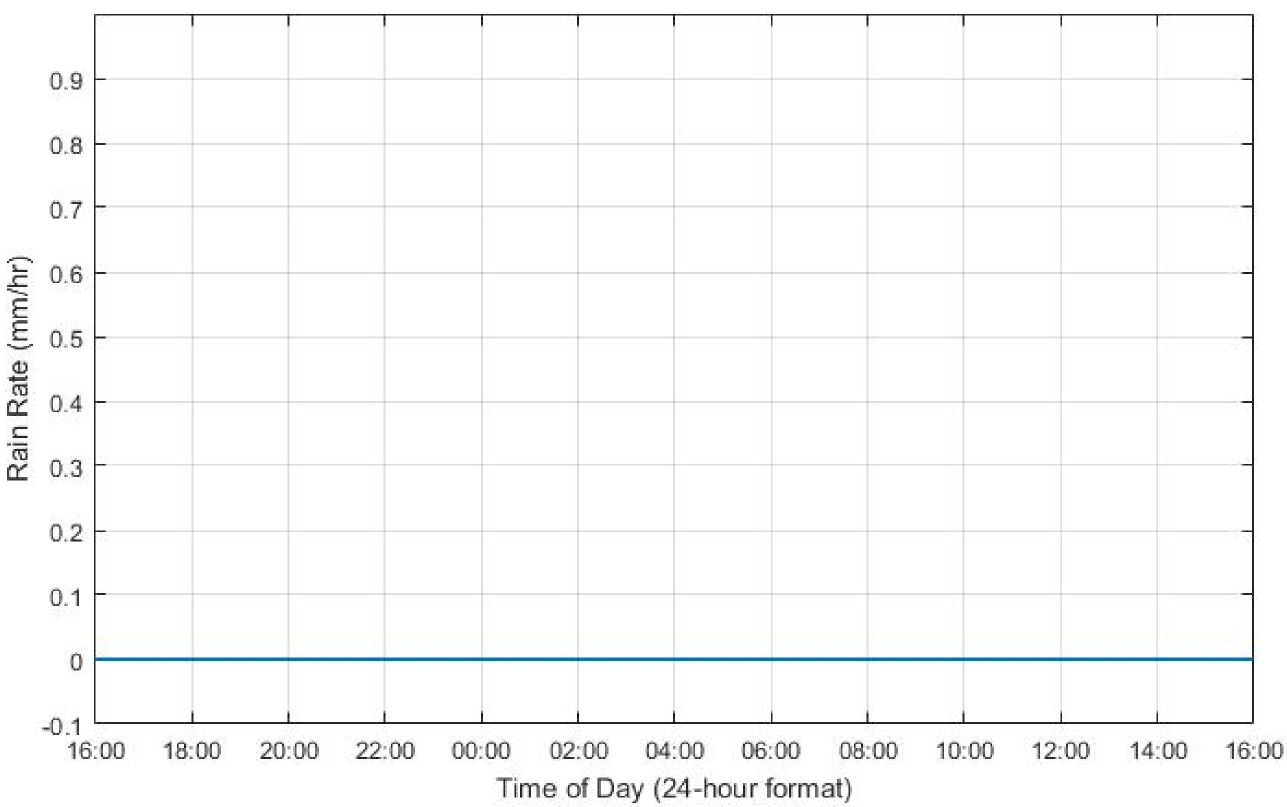
Monitored Temperature (July 22 – 23, 2019) at Noise Monitor Location 1



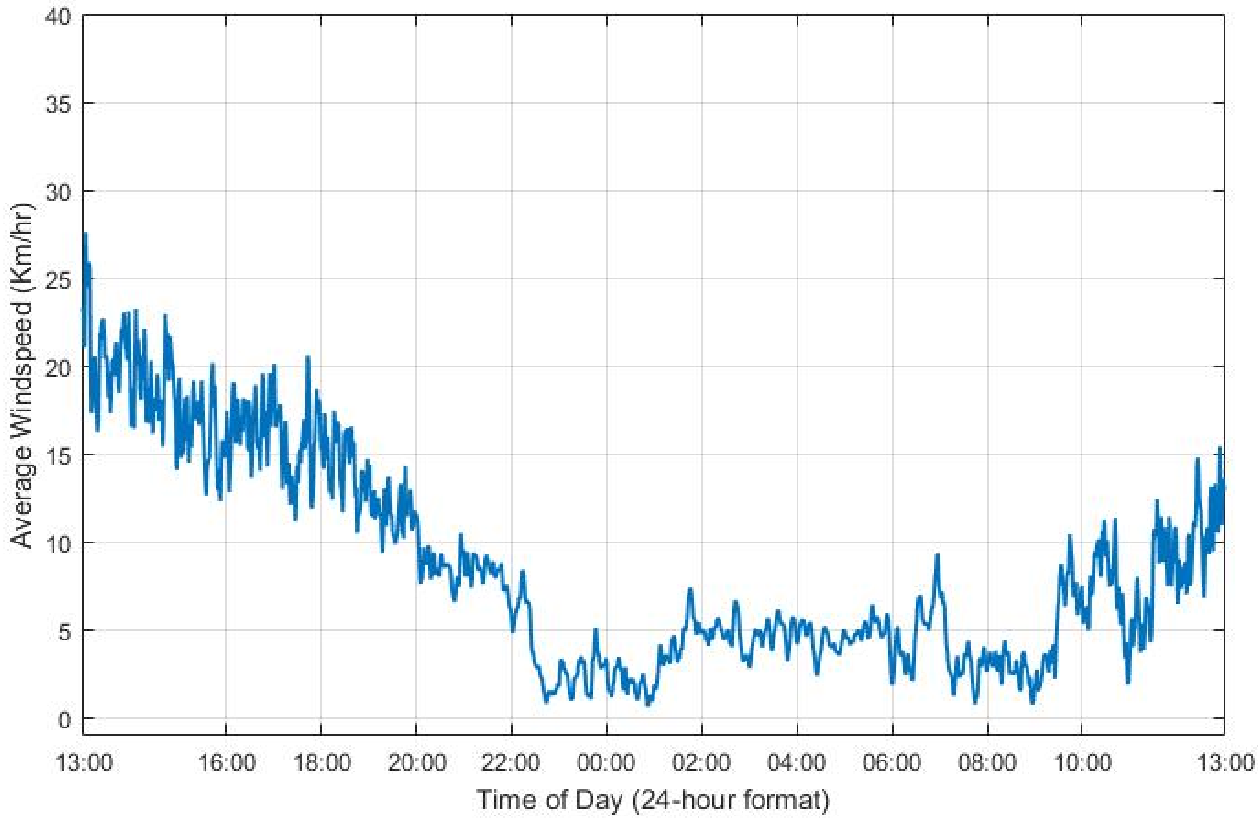
Monitored Humidity (July 22 – 23, 2019) at Noise Monitor Location 1



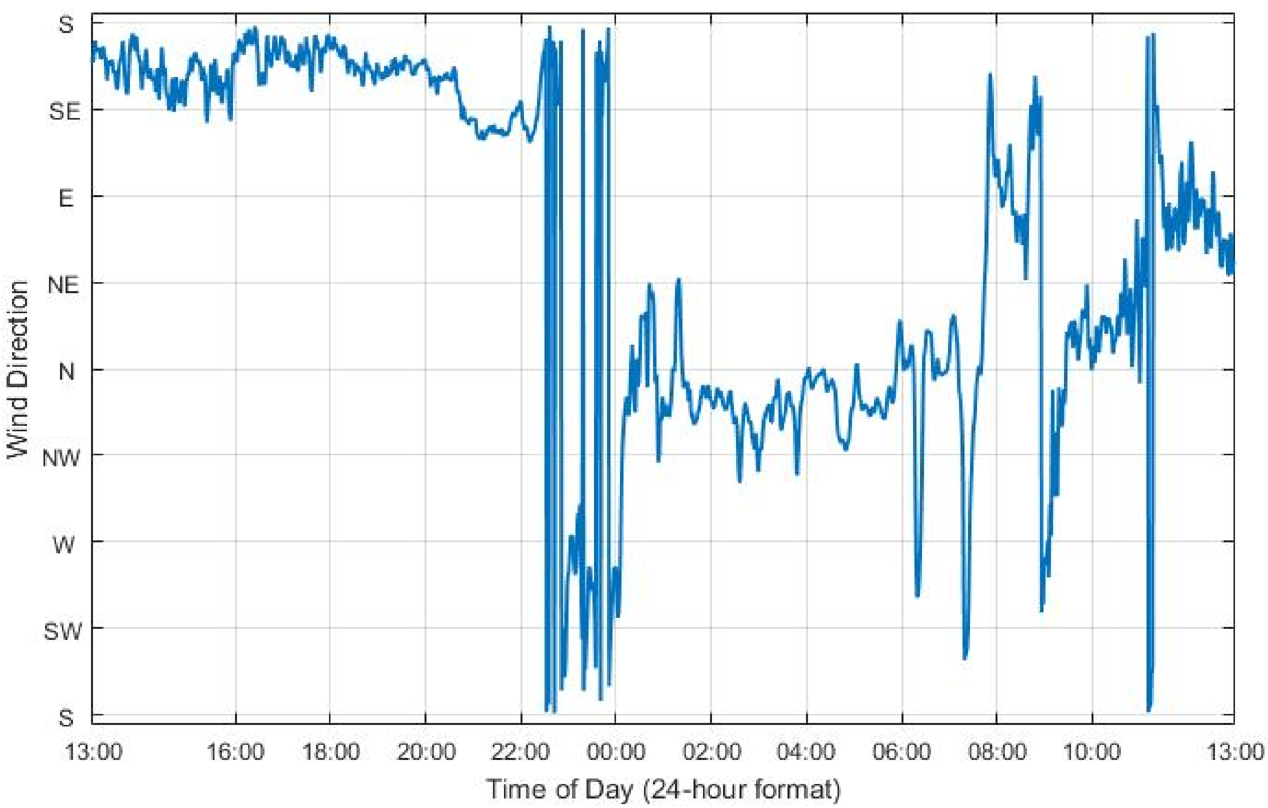
Monitored Barometric Pressure (July 22 – 23, 2019) at Noise Monitor Location 1



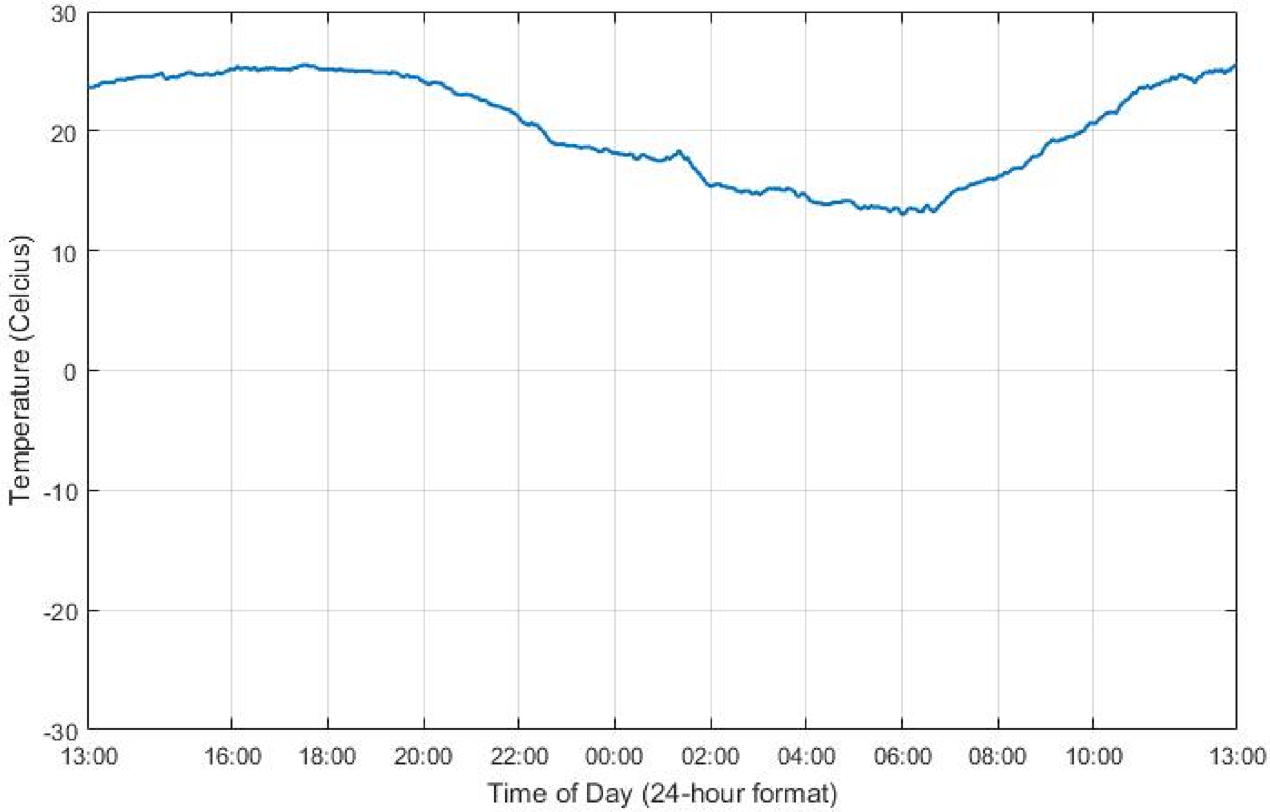
Monitored Rain Rate (July 22 – 23, 2019) at Noise Monitor Location 1



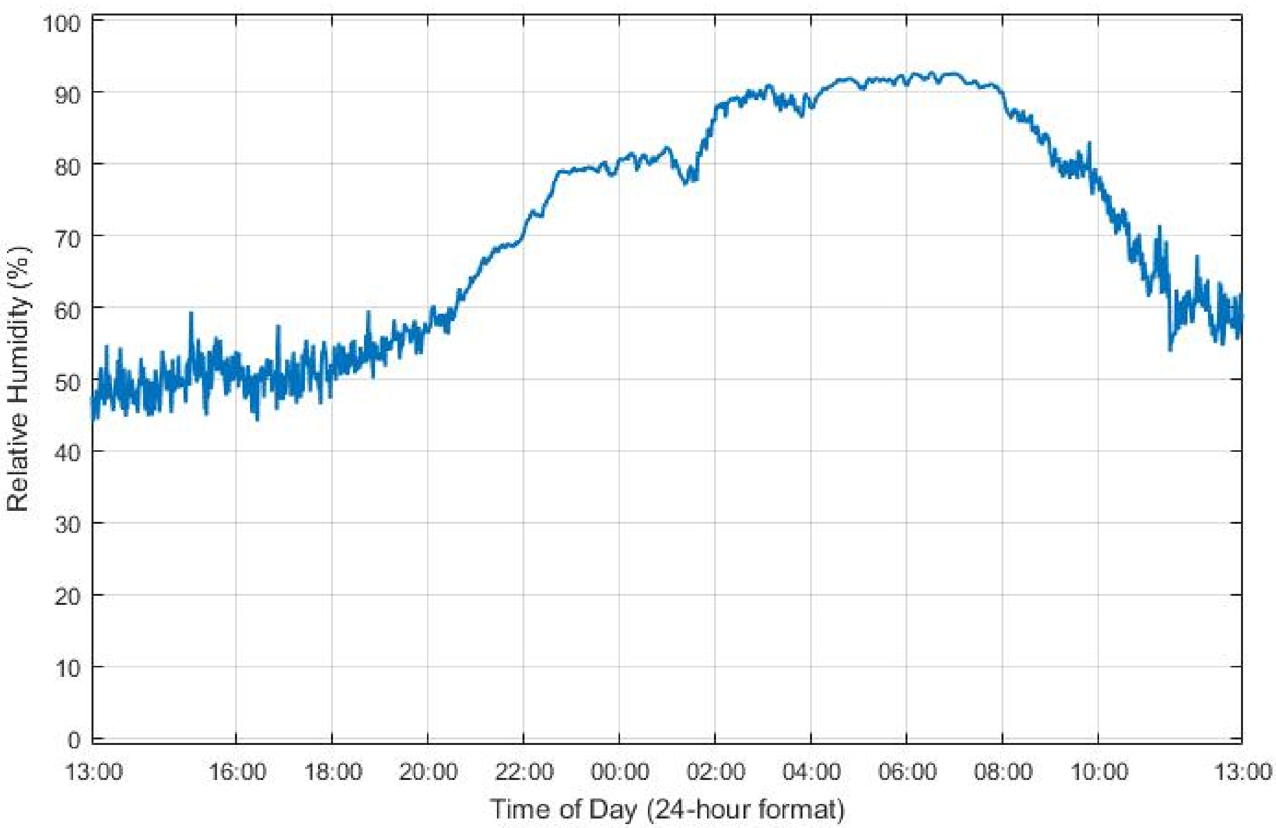
Monitored Wind Speed (July 22 – 23, 2019) at Noise Monitor Location 11



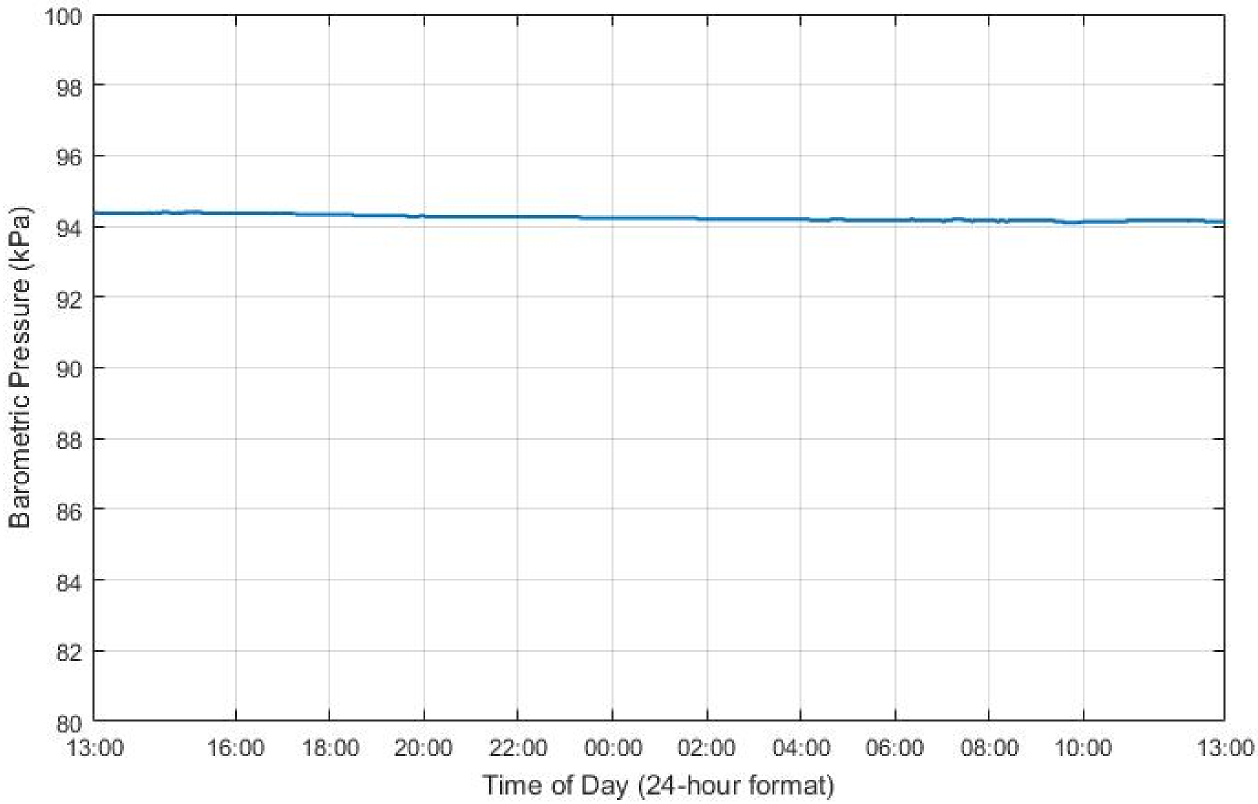
Monitored Wind Direction (July 22 – 23, 2019) at Noise Monitor Location 11



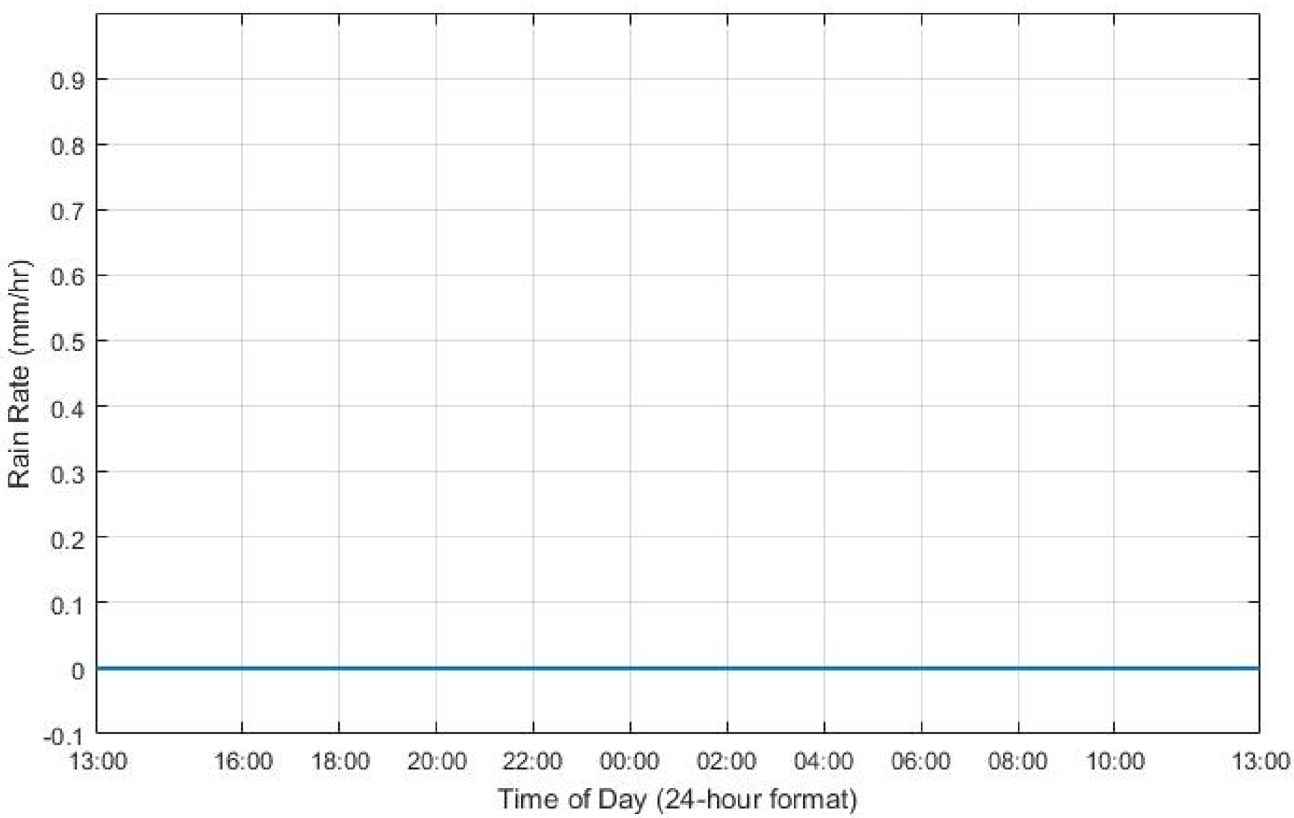
Monitored Temperature (July 22 – 23, 2019) at Noise Monitor Location 11



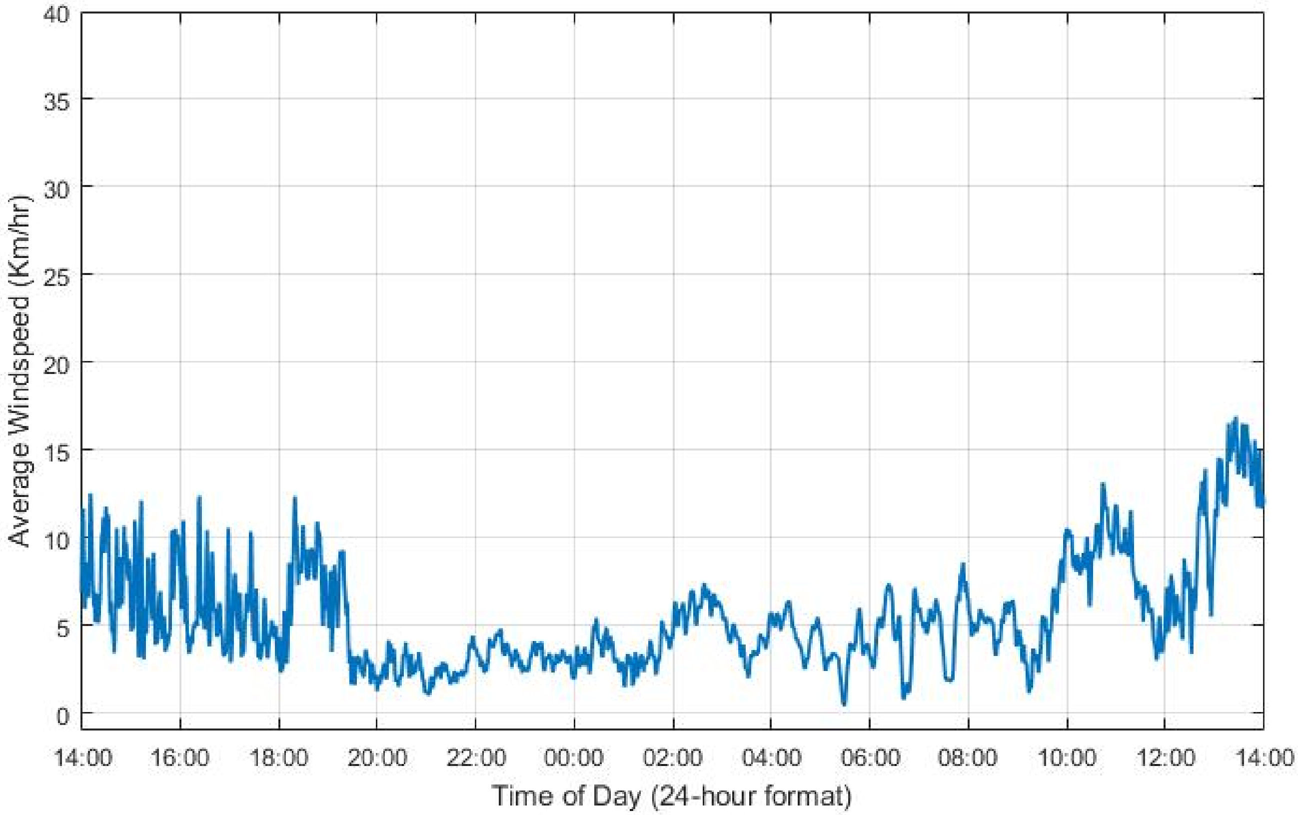
Monitored Humidity (July 22 – 23, 2019) at Noise Monitor Location 11



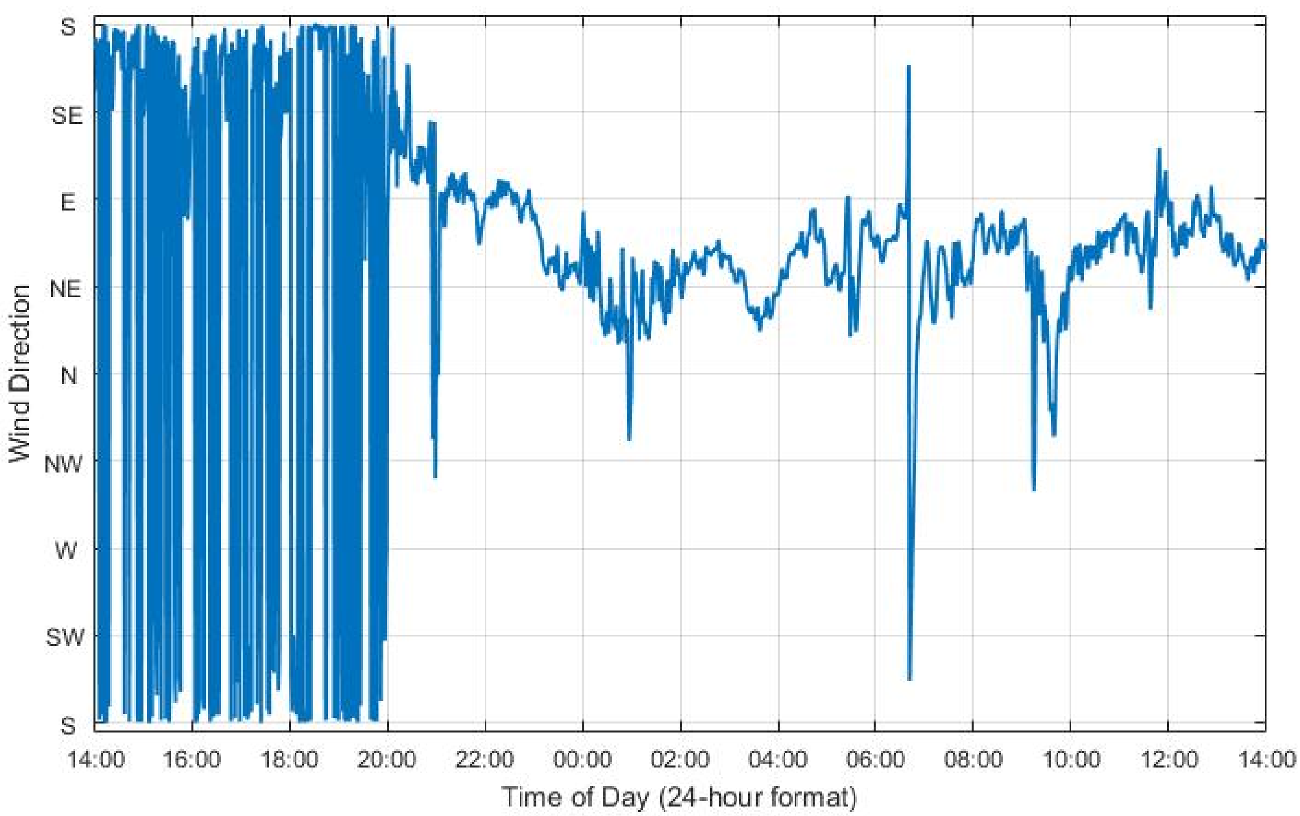
Monitored Barometric Pressure (July 22 – 23, 2019) at Noise Monitor Location 11



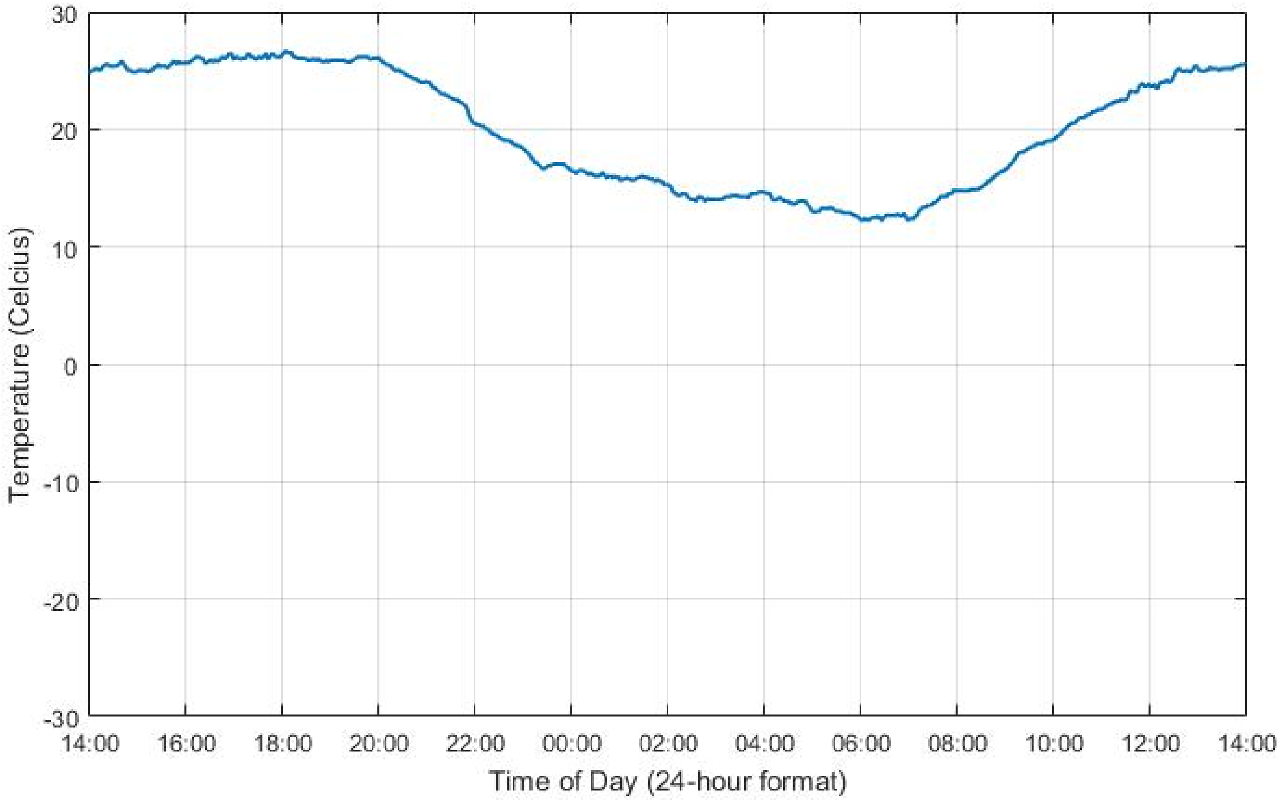
Monitored Rain Rate (July 22 – 23, 2019) at Noise Monitor Location 11



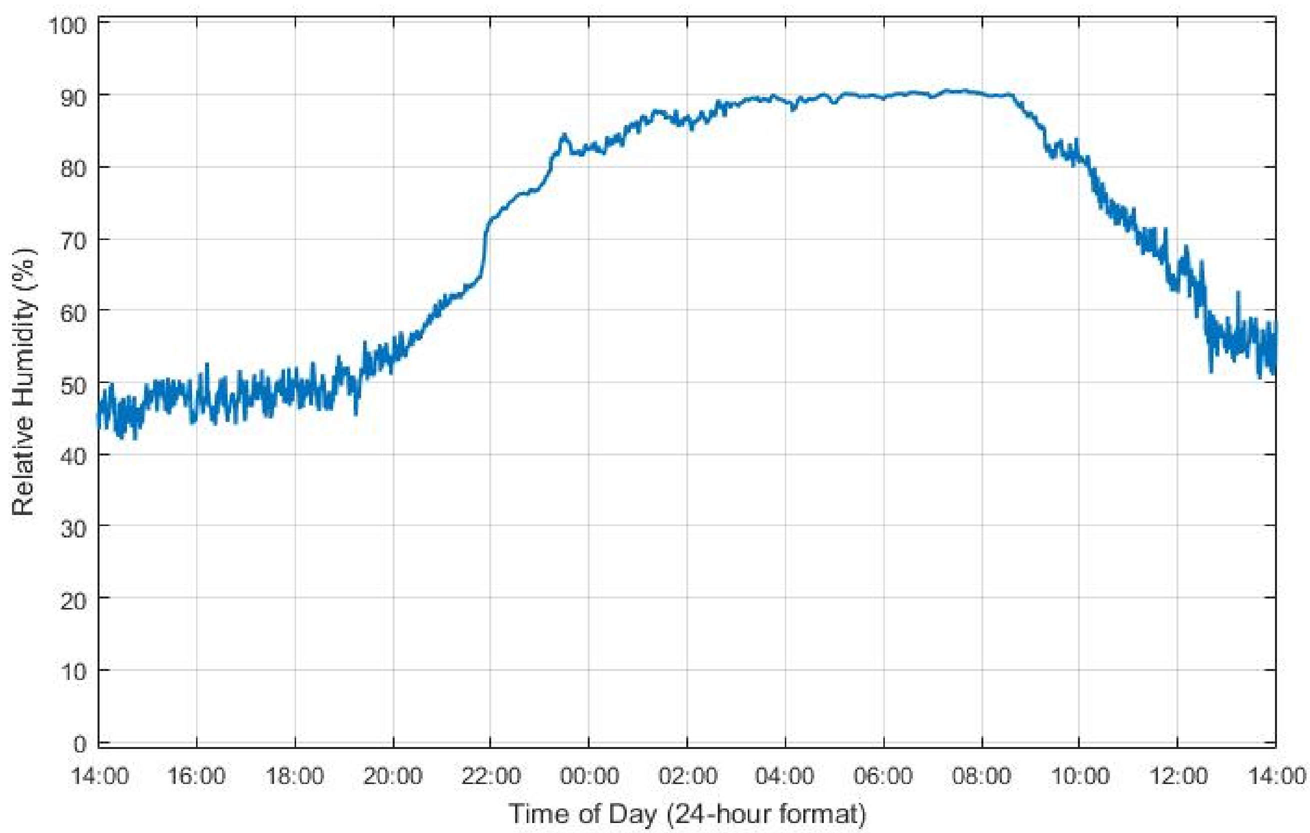
Monitored Wind Speed (July 22 – 23, 2019) at Noise Monitor Location 12



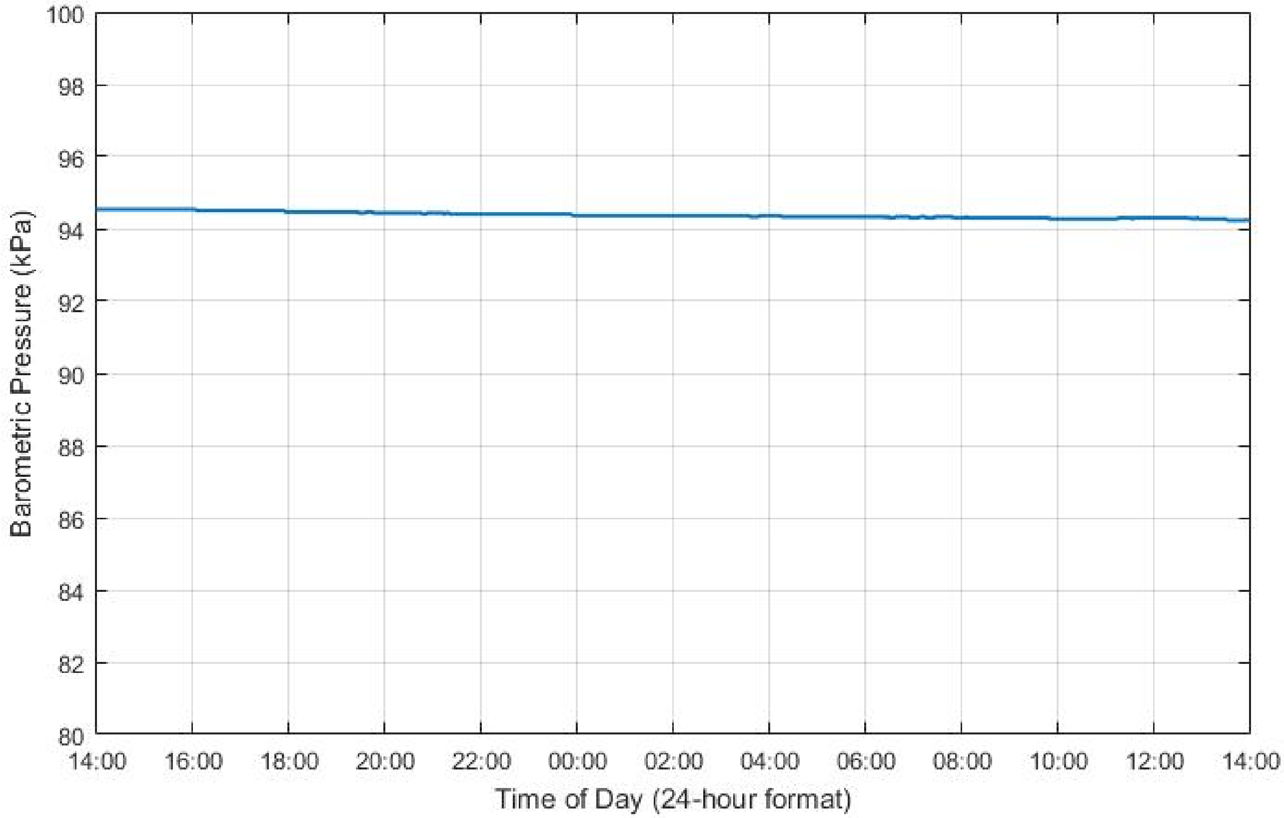
Monitored Wind Direction (July 22 – 23, 2019) at Noise Monitor Location 12



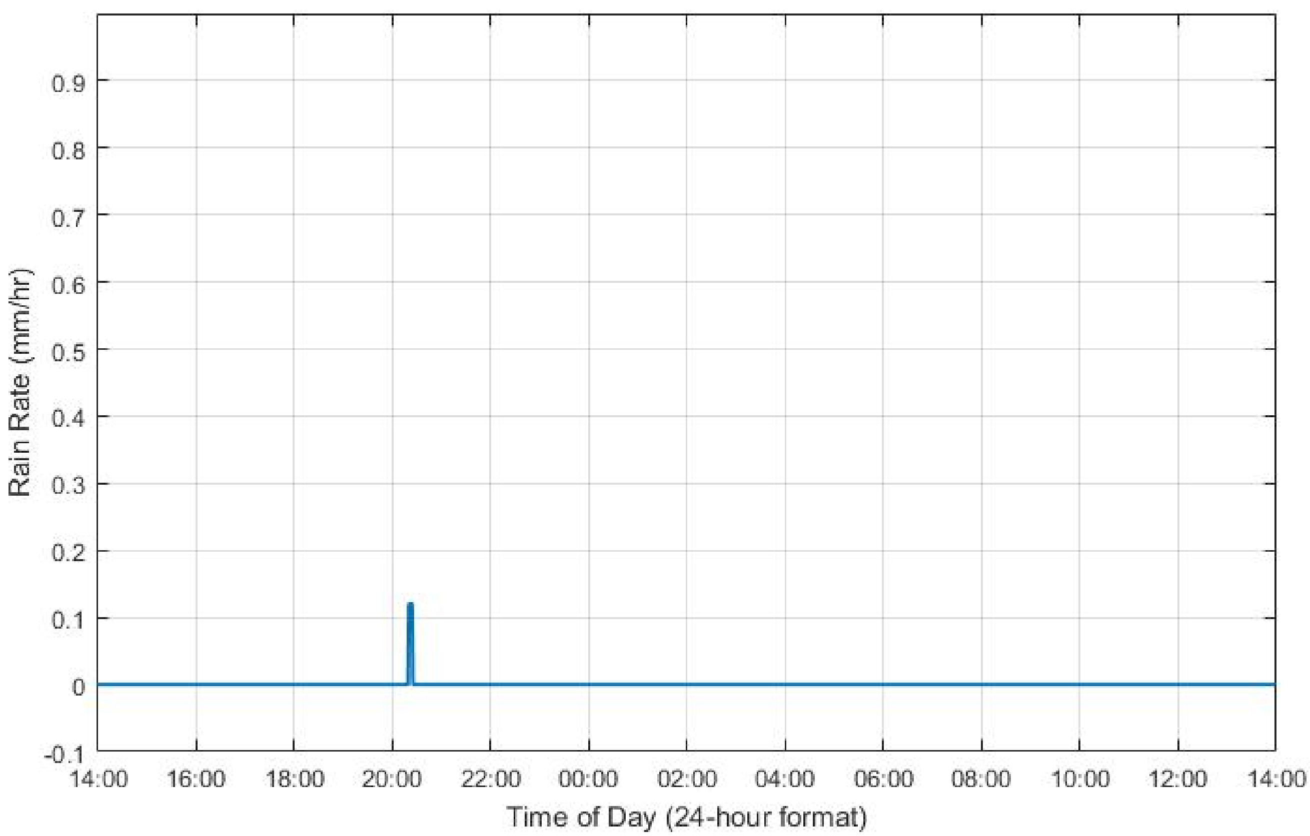
Monitored Temperature (July 22 – 23, 2019) at Noise Monitor Location 12



Monitored Humidity (July 22 – 23, 2019) at Noise Monitor Location 12

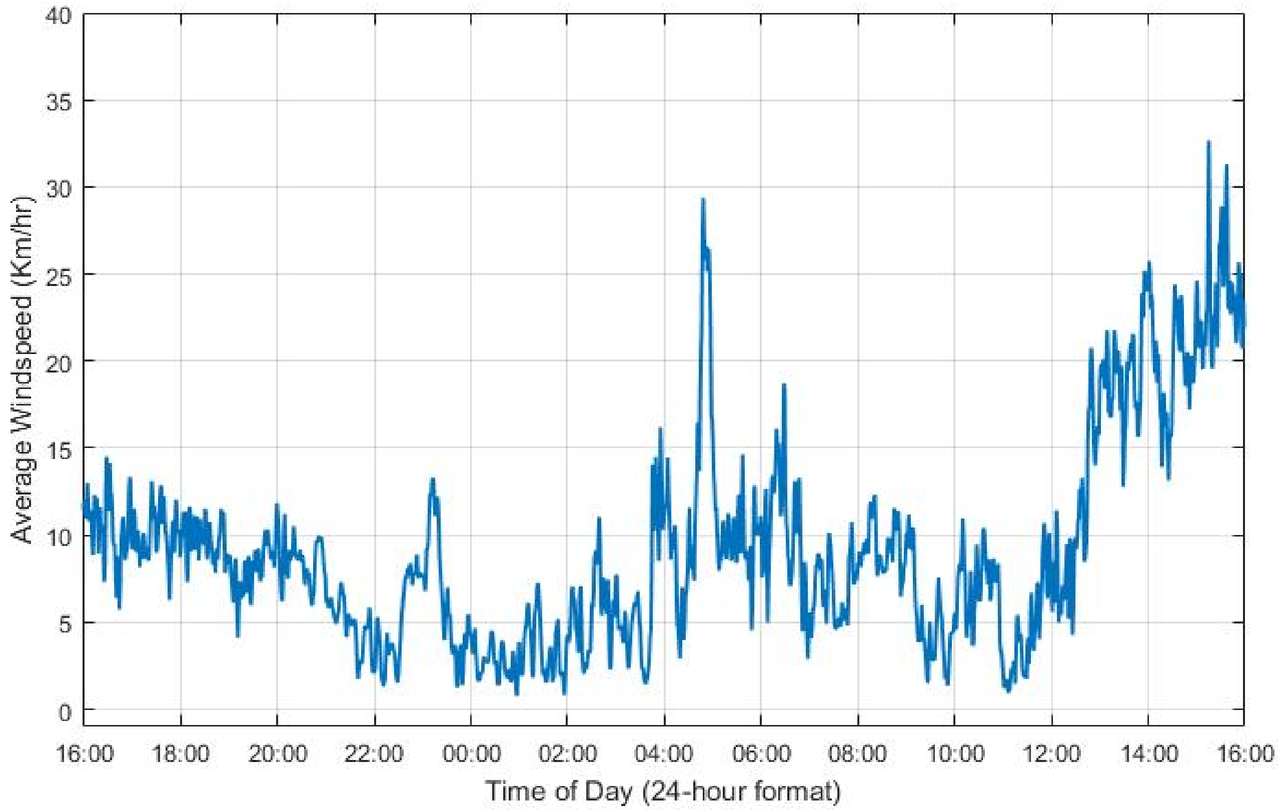


Monitored Barometric Pressure (July 22 – 23, 2019) at Noise Monitor Location 12

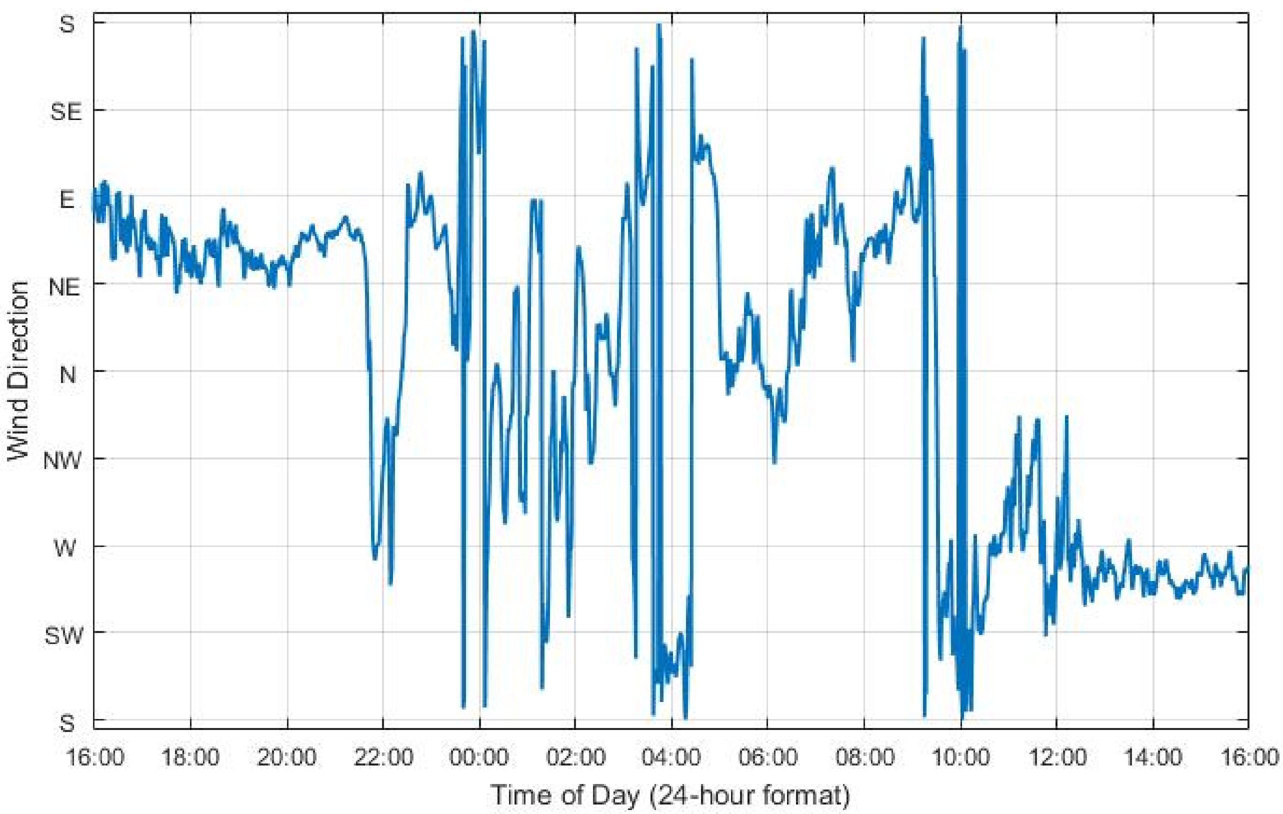


Monitored Rain Rate (July 22 – 23, 2019) at Noise Monitor Location 12

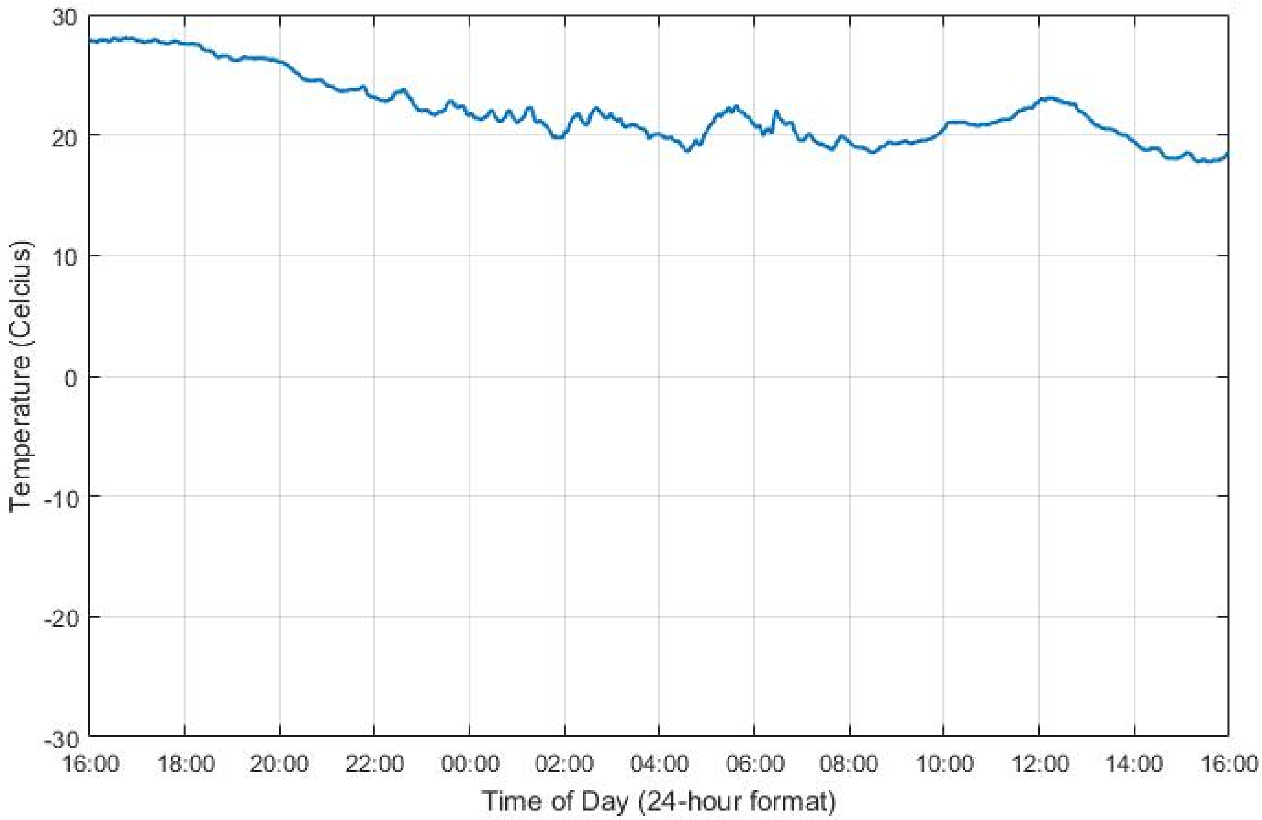
July 23 – 24, 2019 Weather Data



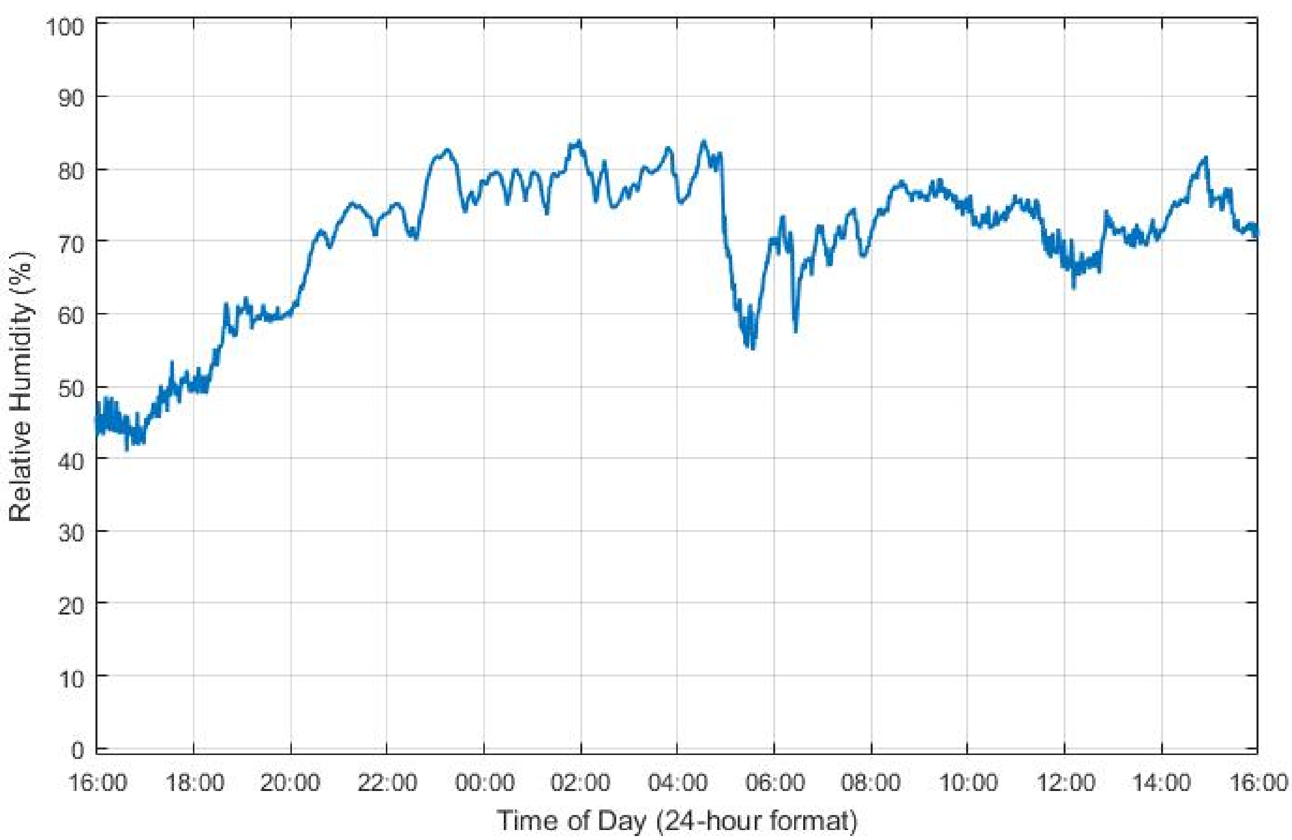
Monitored Wind Speed (July 23 – 24, 2019) at Noise Monitor Location 1



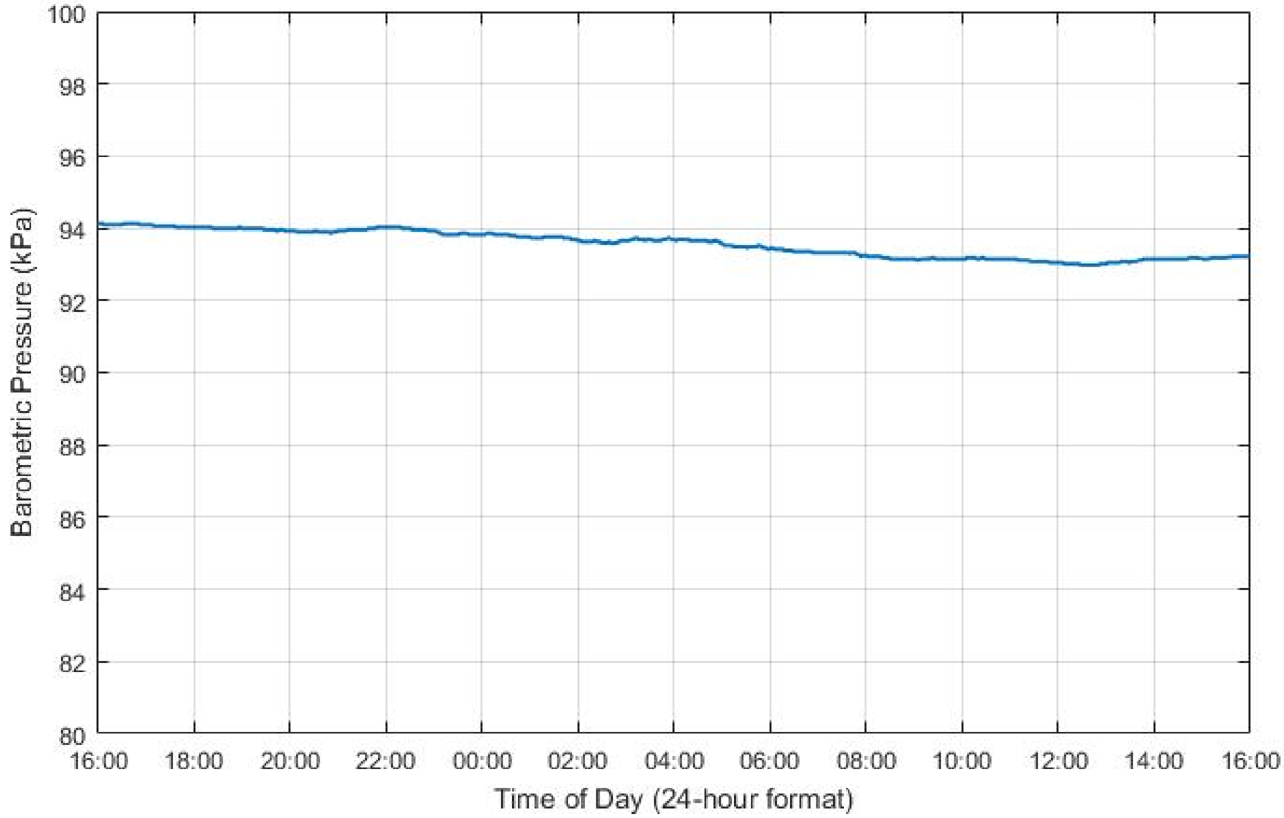
Monitored Wind Direction (July 23 – 24, 2019) at Noise Monitor Location 1



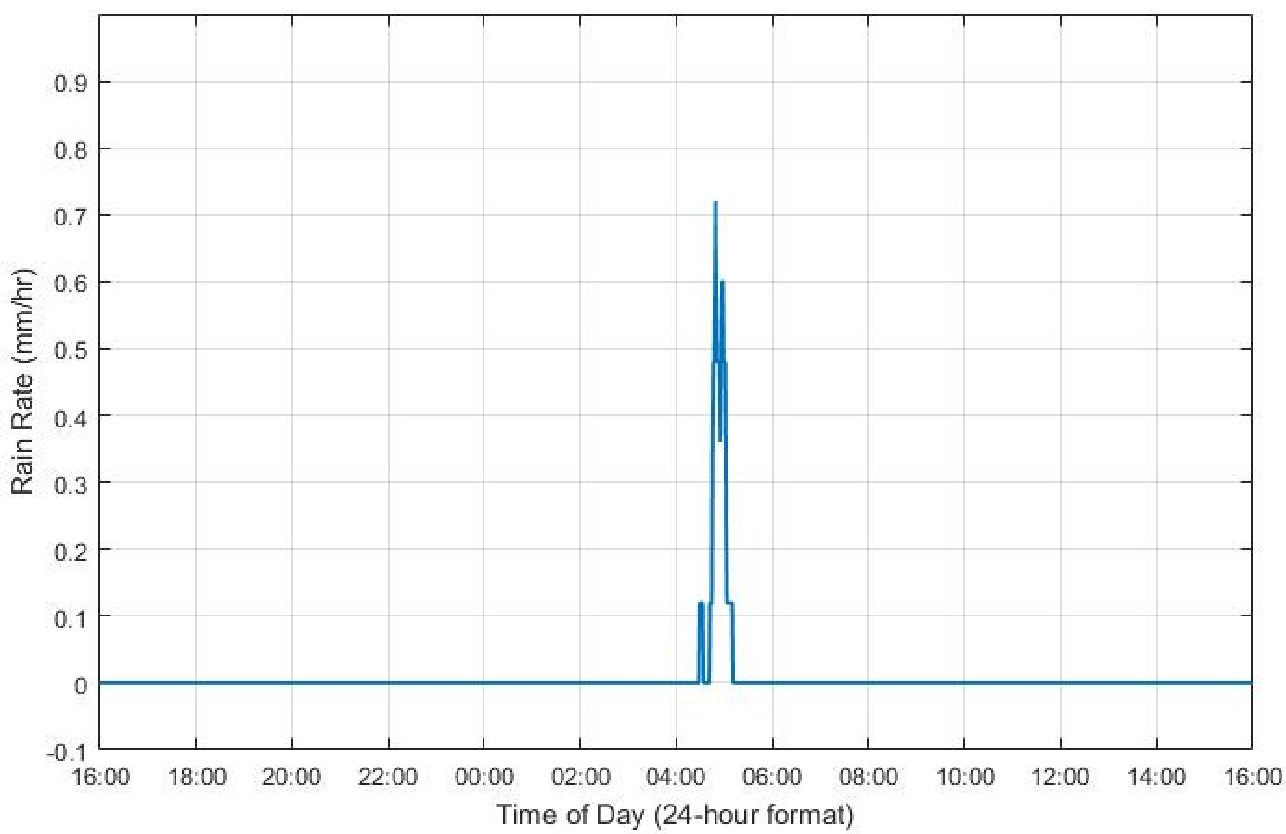
Monitored Temperature (July 23 – 24, 2019) at Noise Monitor Location 1



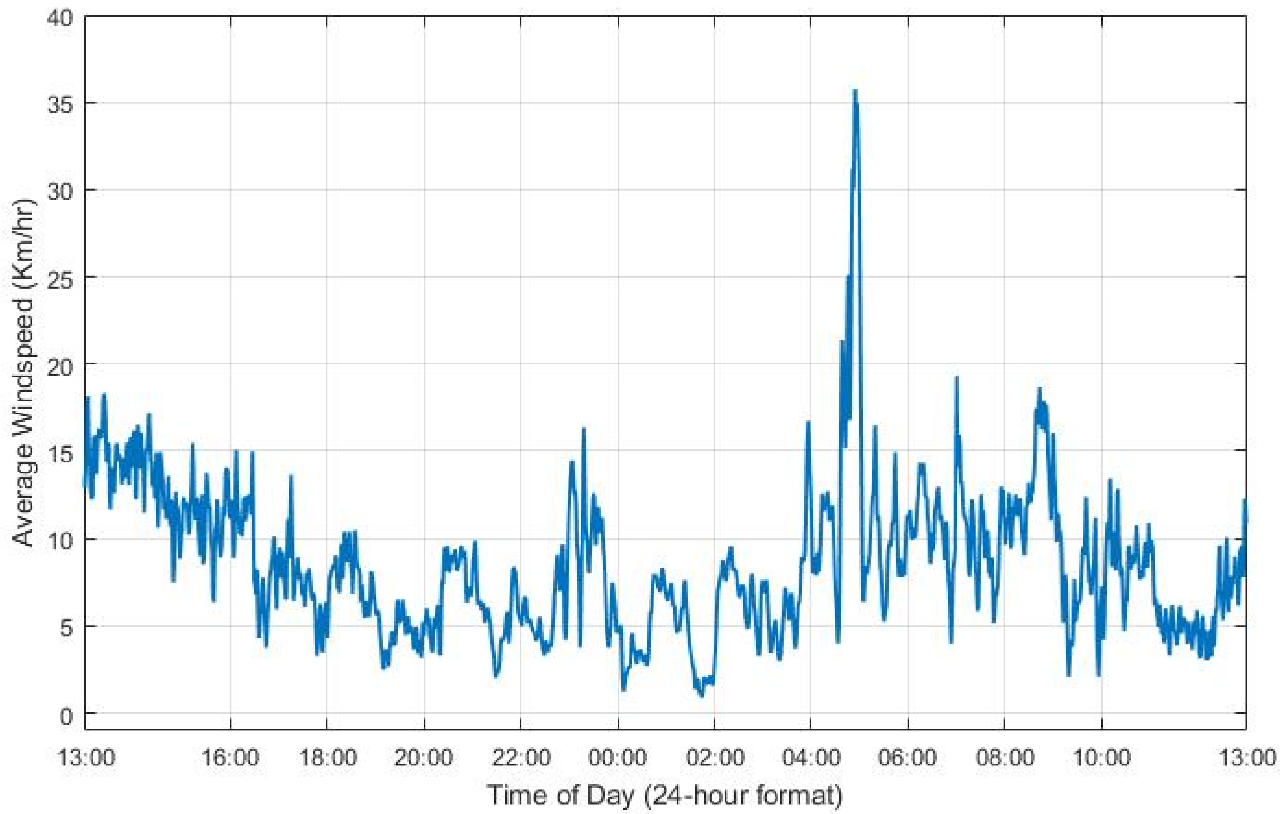
Monitored Humidity (July 23 – 24, 2019) at Noise Monitor Location 1



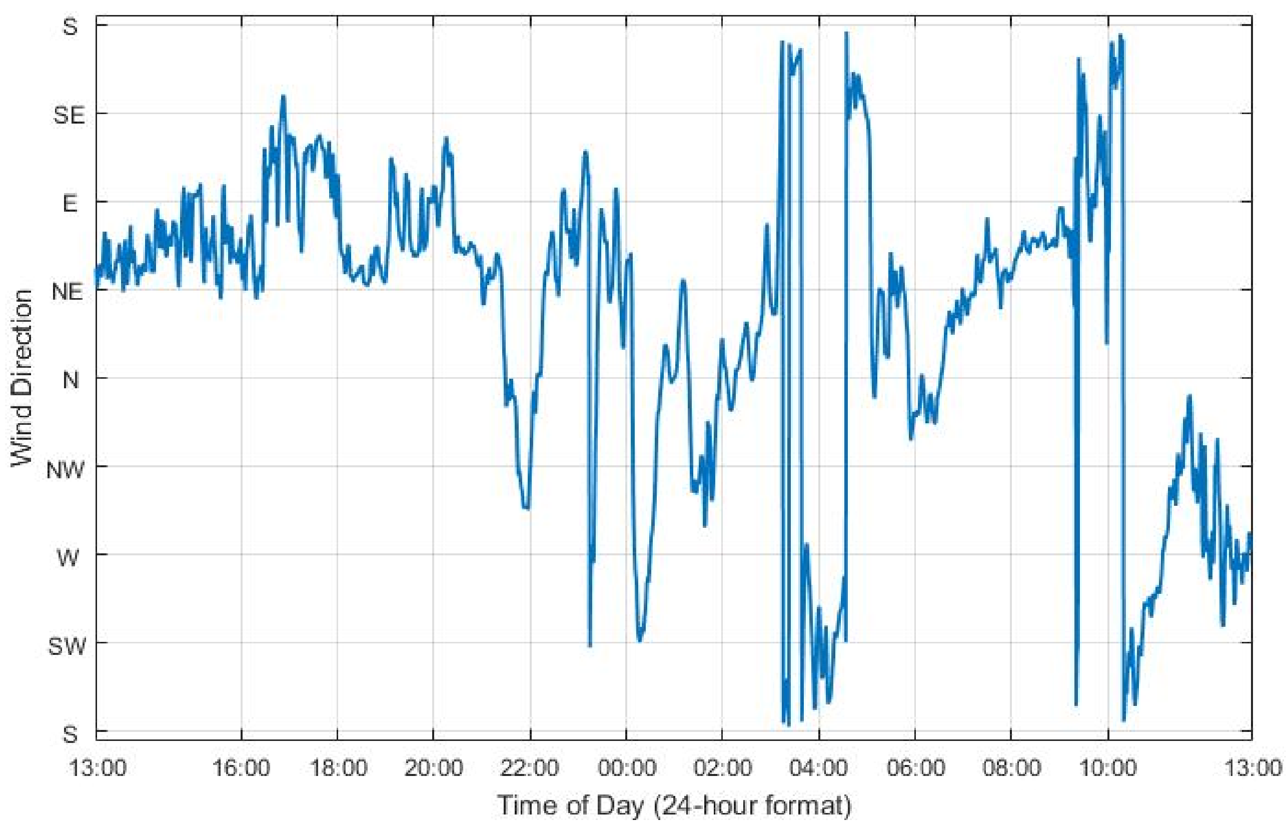
Monitored Barometric Pressure (July 23 – 24, 2019) at Noise Monitor Location 1



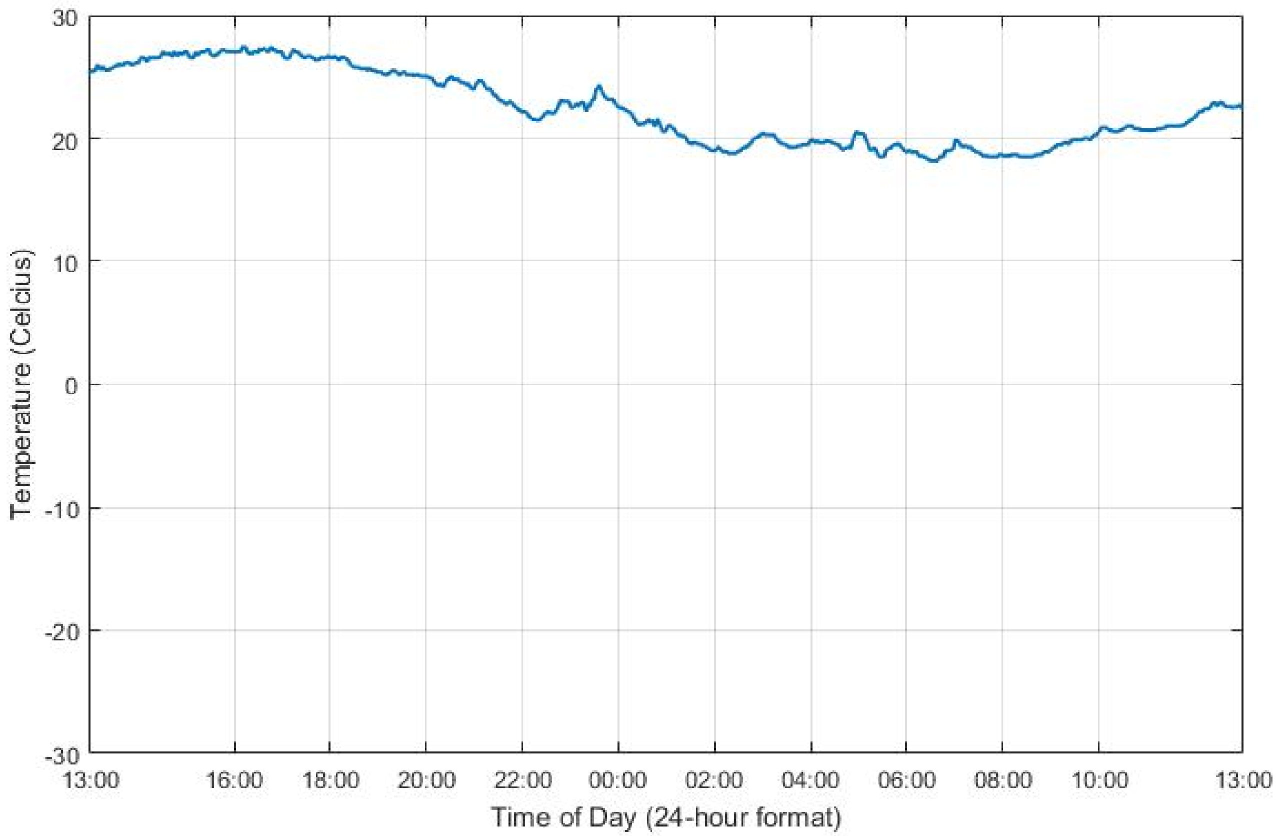
Monitored Rain Rate (July 23 – 24, 2019) at Noise Monitor Location 1



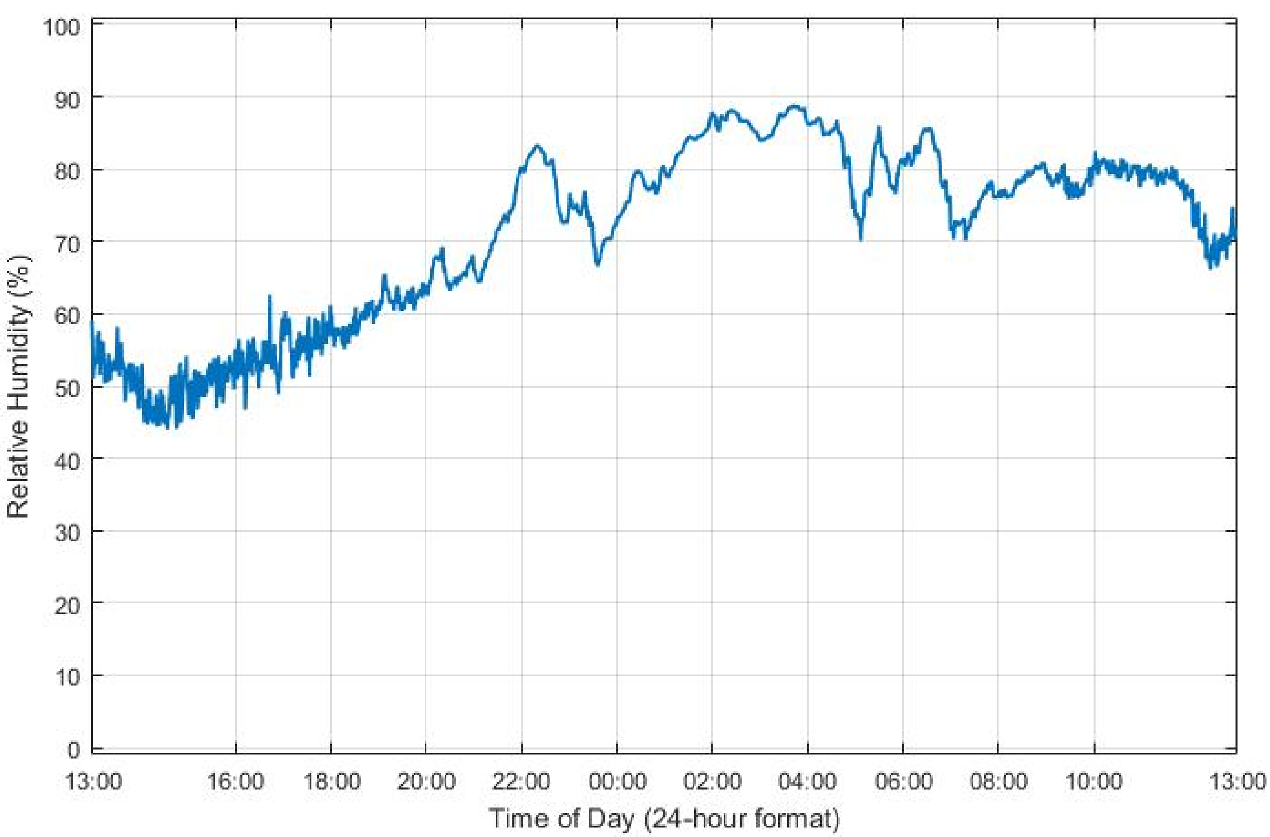
Monitored Wind Speed (July 23 – 24, 2019) at Noise Monitor Location 11



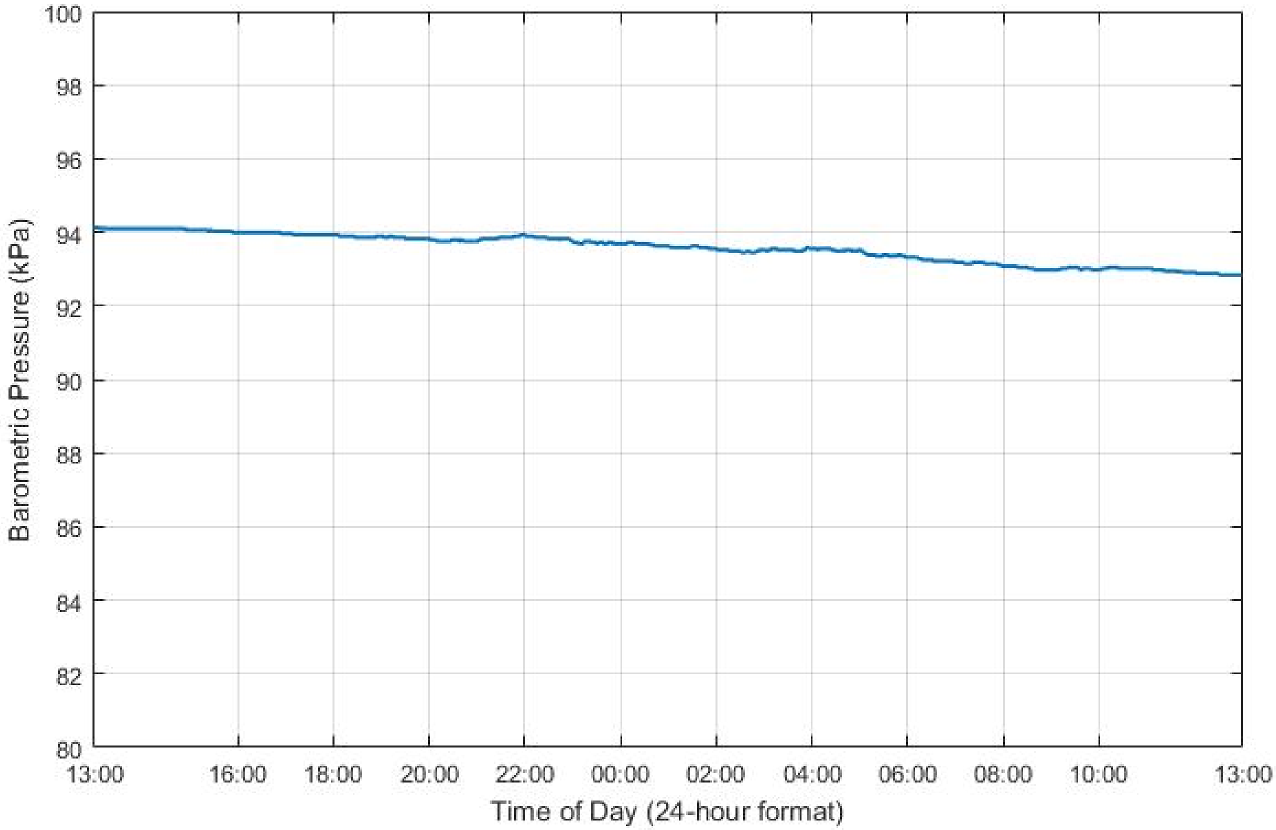
Monitored Wind Direction (July 23 – 24, 2019) at Noise Monitor Location 11



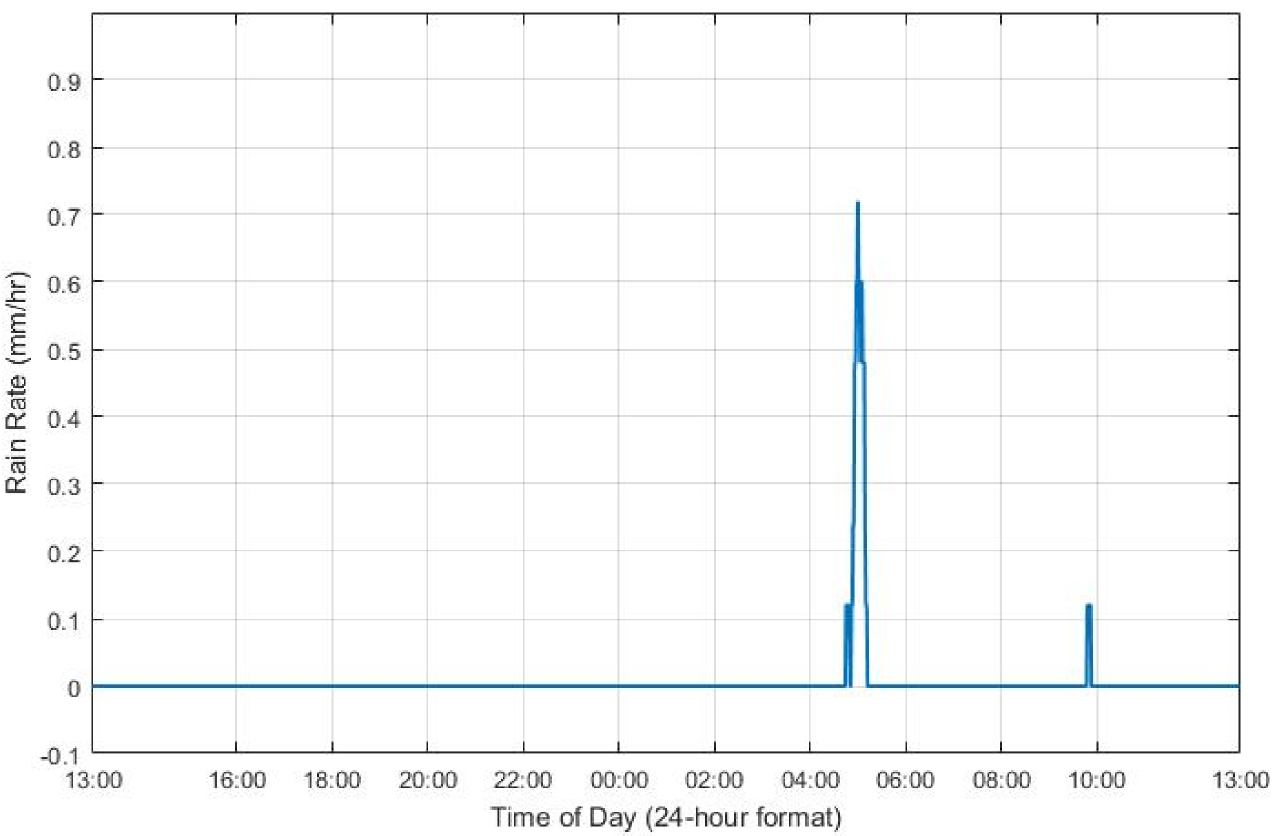
Monitored Temperature (July 23 – 24, 2019) at Noise Monitor Location 11



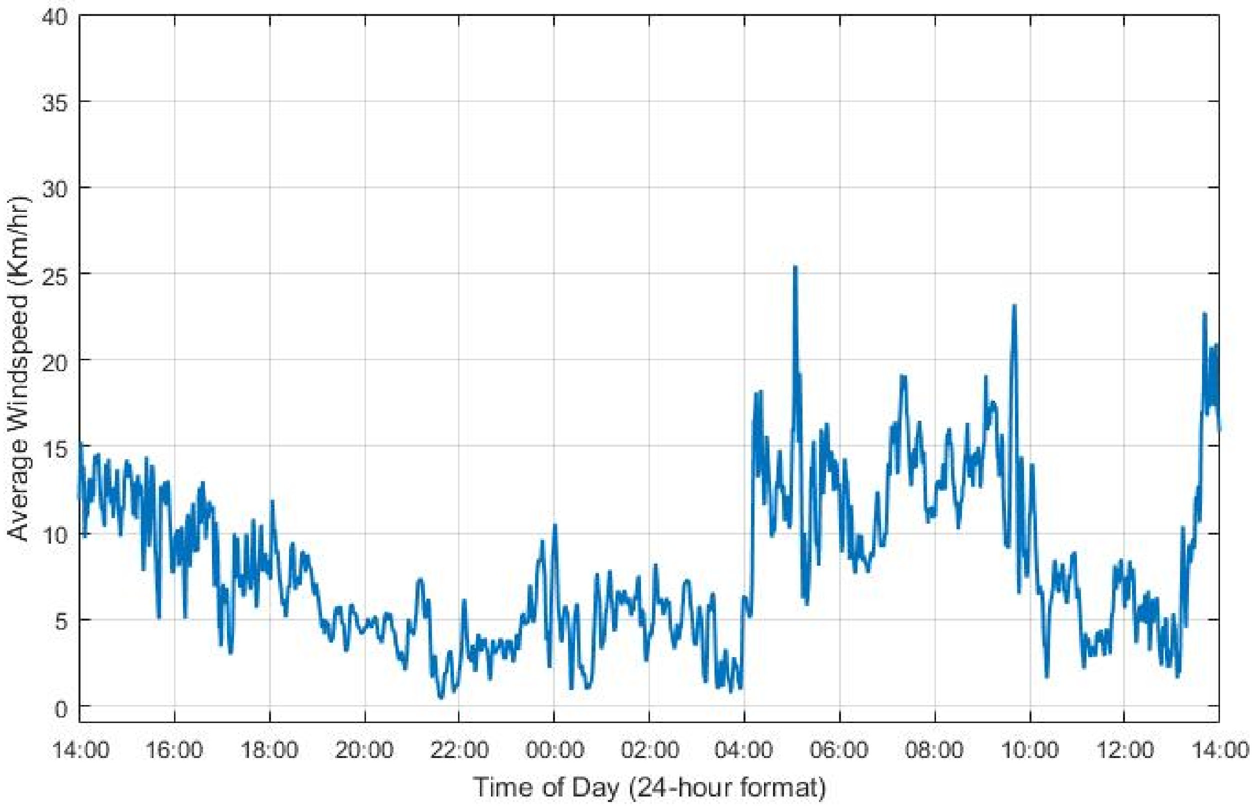
Monitored Humidity (July 23 – 24, 2019) at Noise Monitor Location 11



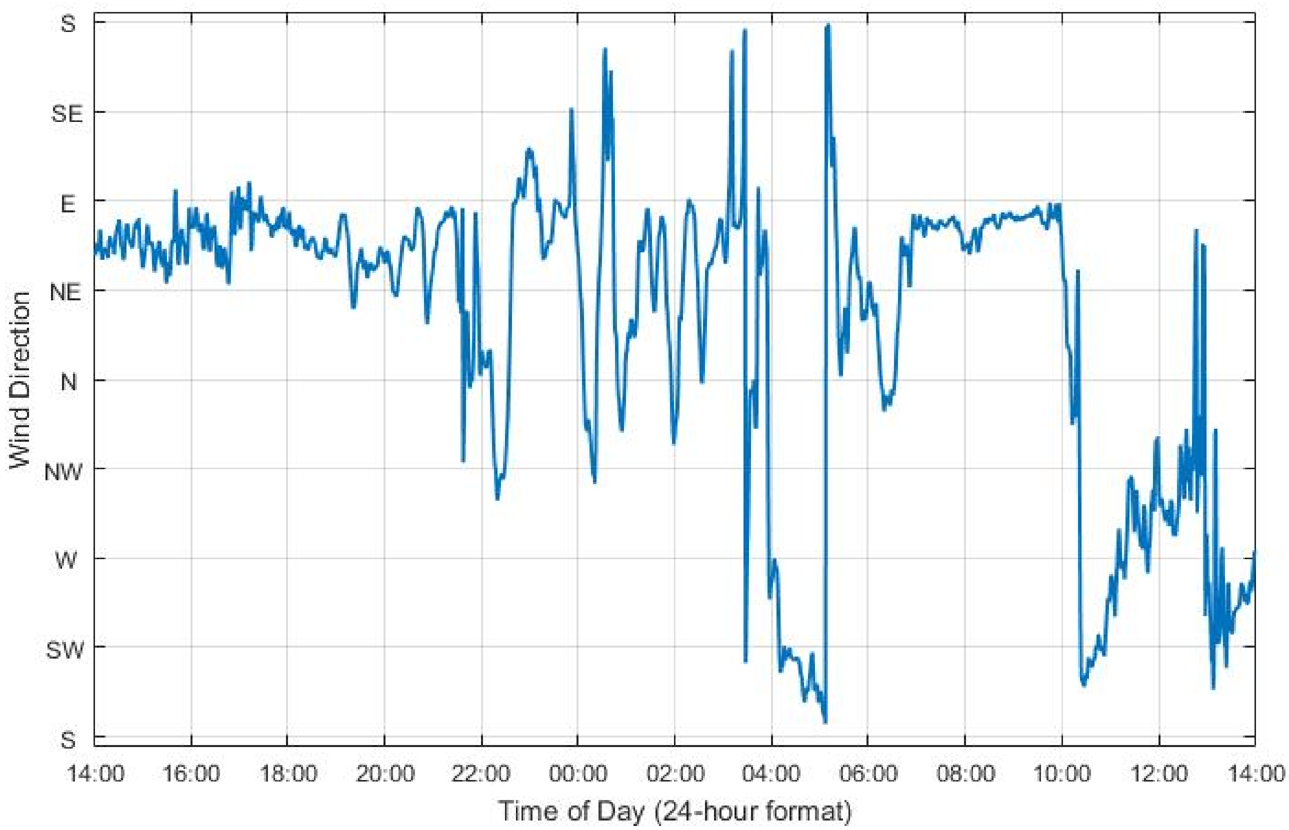
Monitored Barometric Pressure (July 23 – 24, 2019) at Noise Monitor Location 11



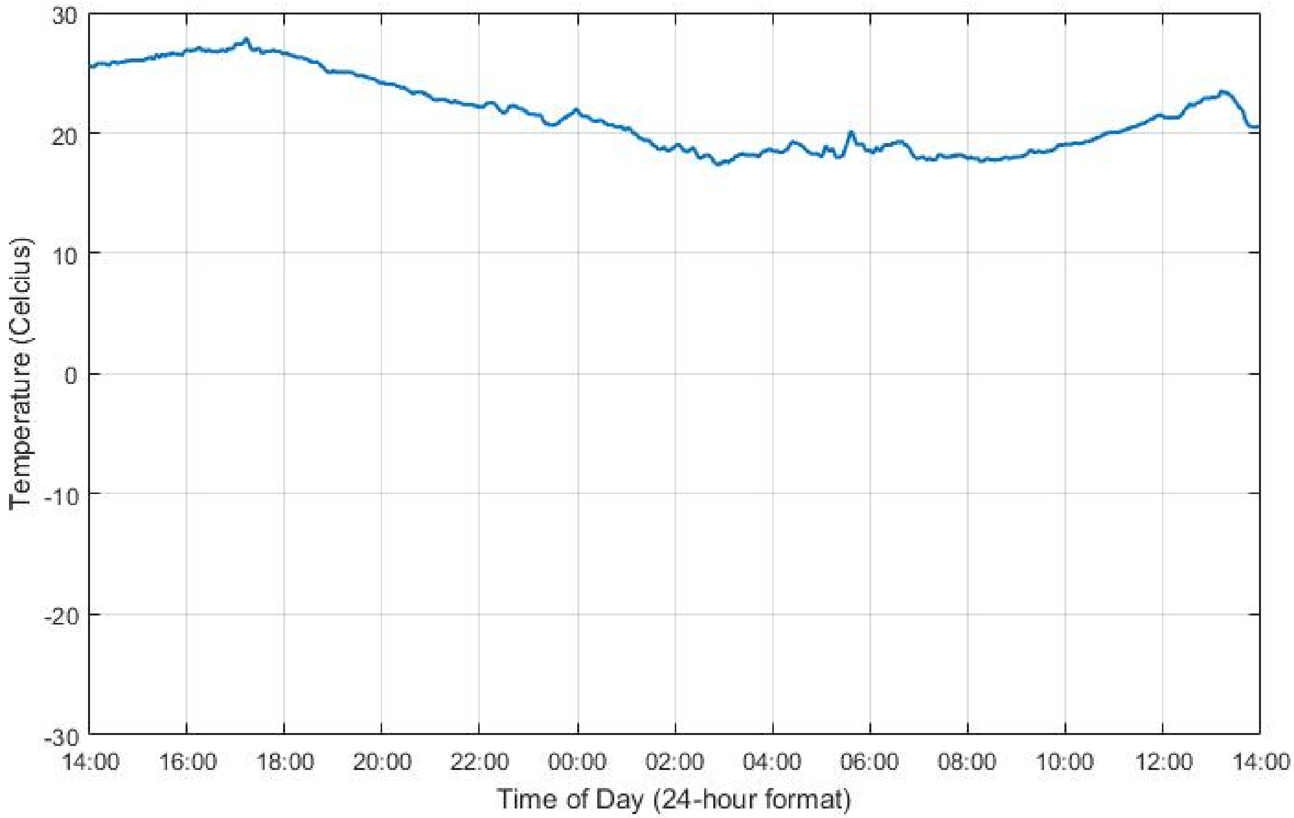
Monitored Rain Rate (July 23 – 24, 2019) at Noise Monitor Location 11



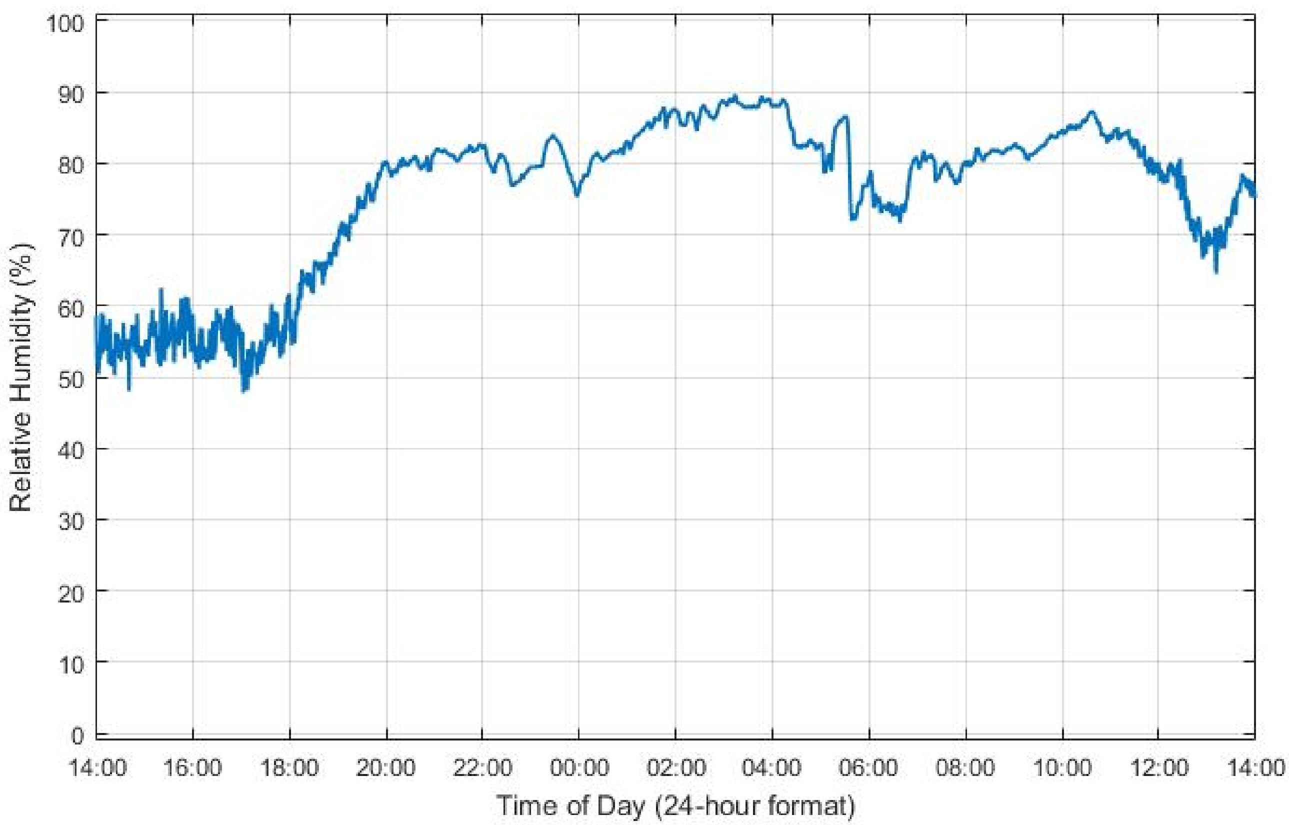
Monitored Wind Speed (July 23 – 24, 2019) at Noise Monitor Location 12



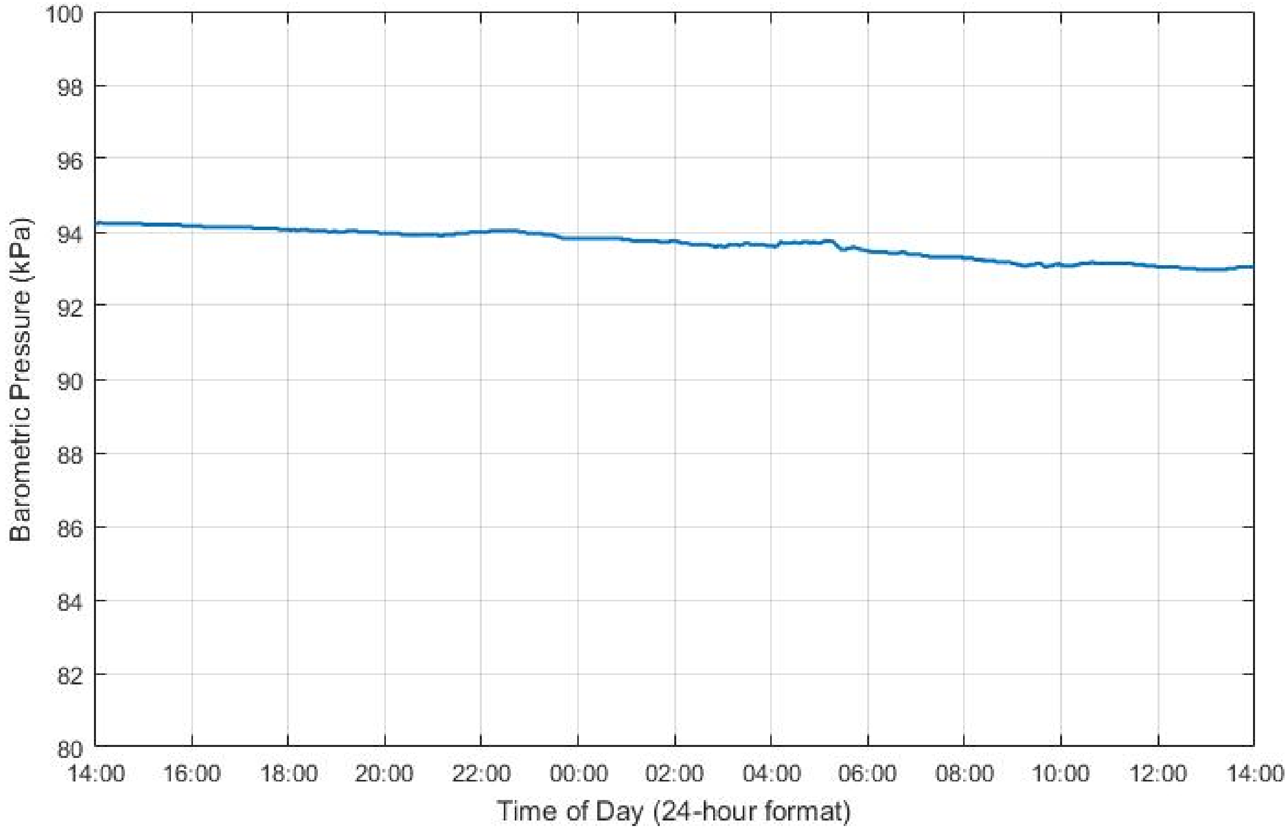
Monitored Wind Direction (July 23 – 24, 2019) at Noise Monitor Location 12



Monitored Temperature (July 23 – 24, 2019) at Noise Monitor Location 12



Monitored Humidity (July 23 – 24, 2019) at Noise Monitor Location 12



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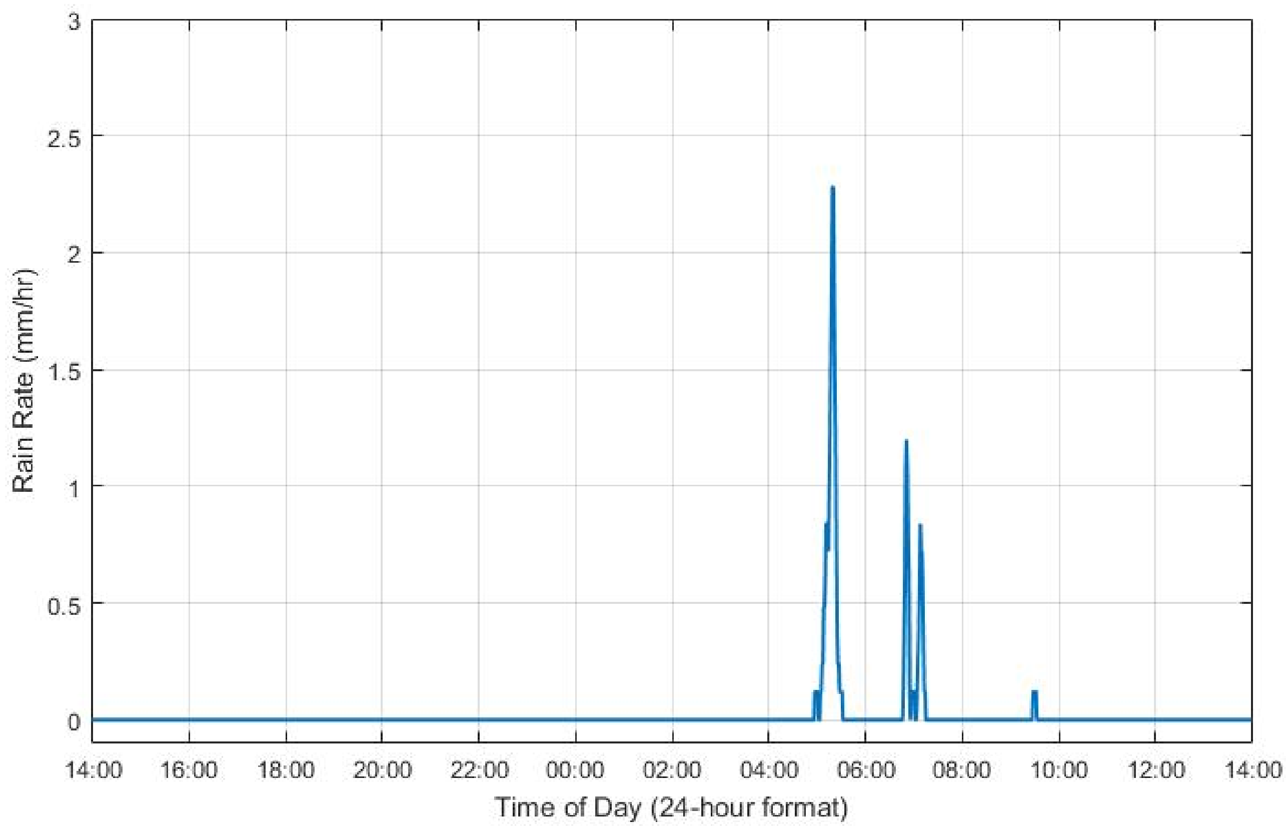
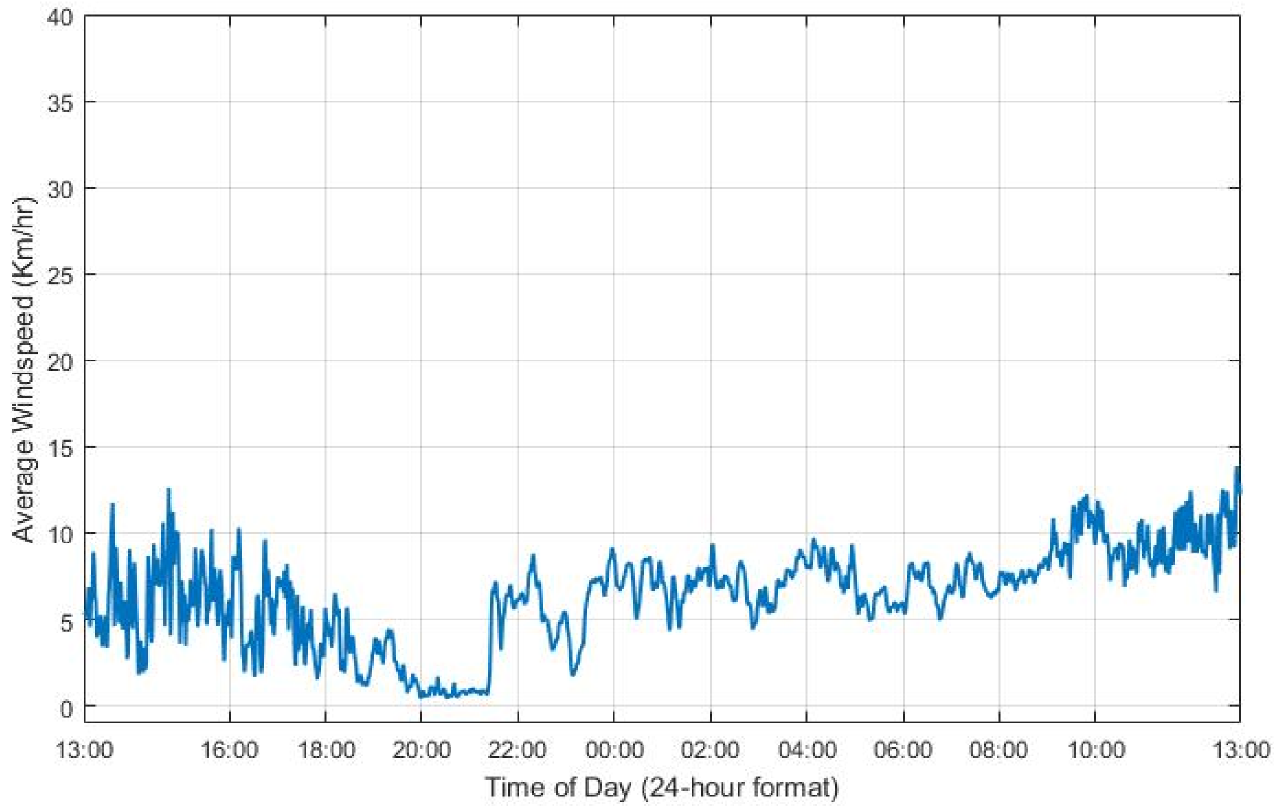


Monitored Rain Rate (July 23 – 24, 2019) at Noise Monitor Location 12

September 18 – 19, 2019 Weather Data



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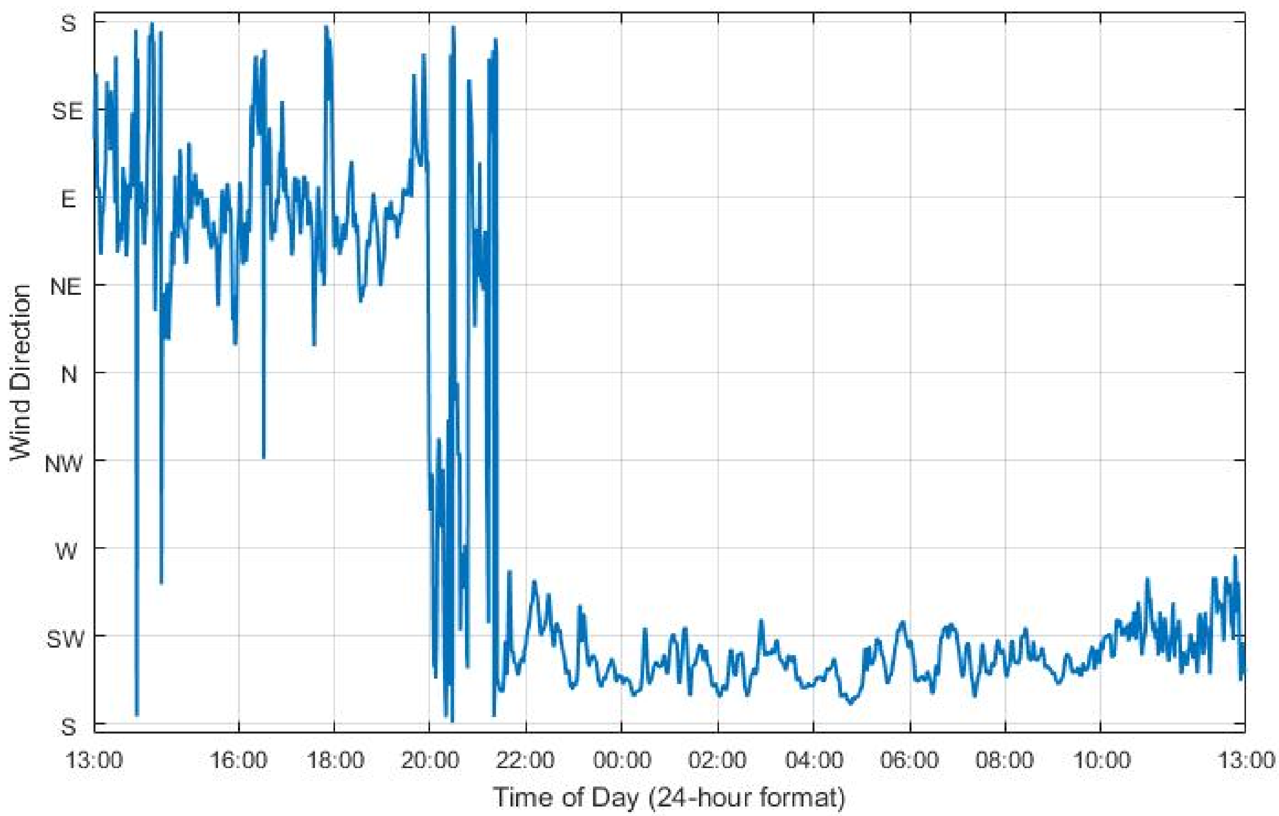

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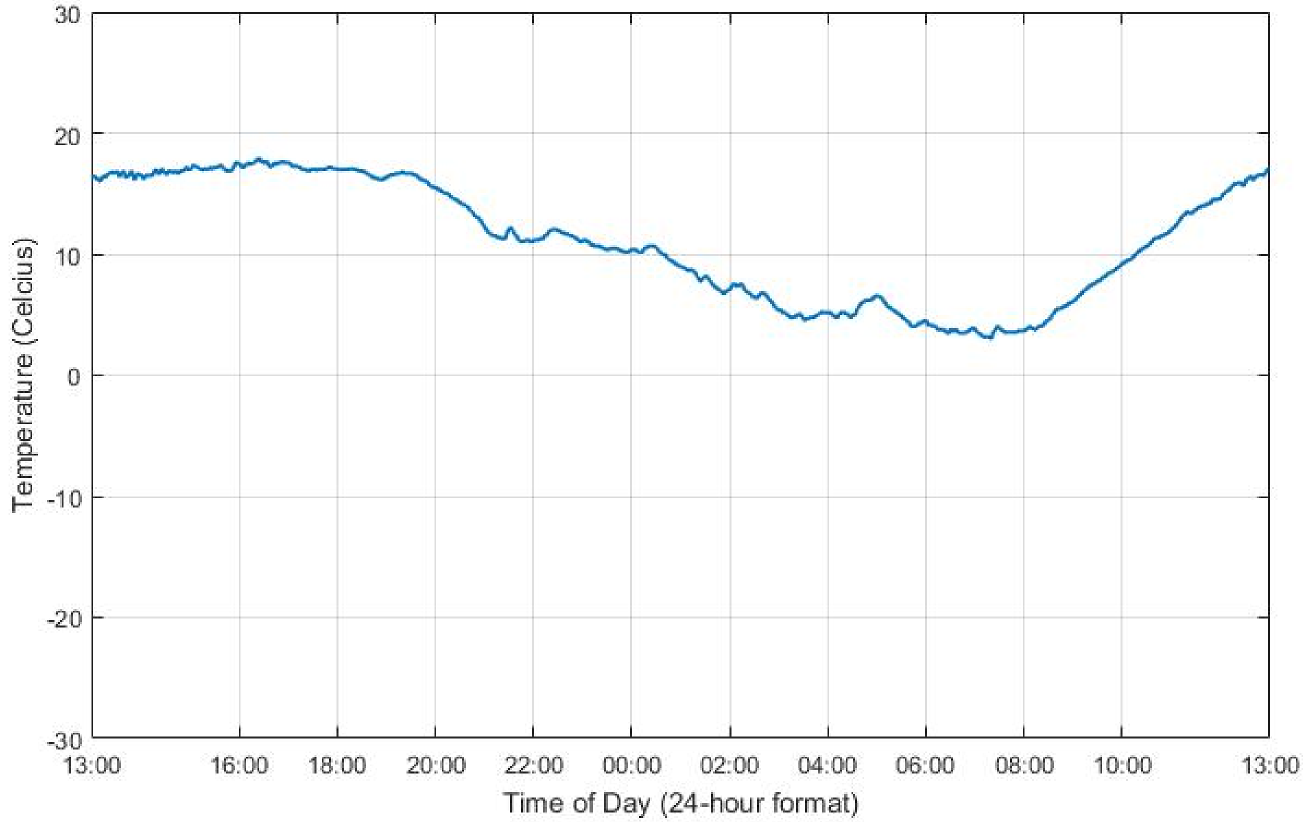
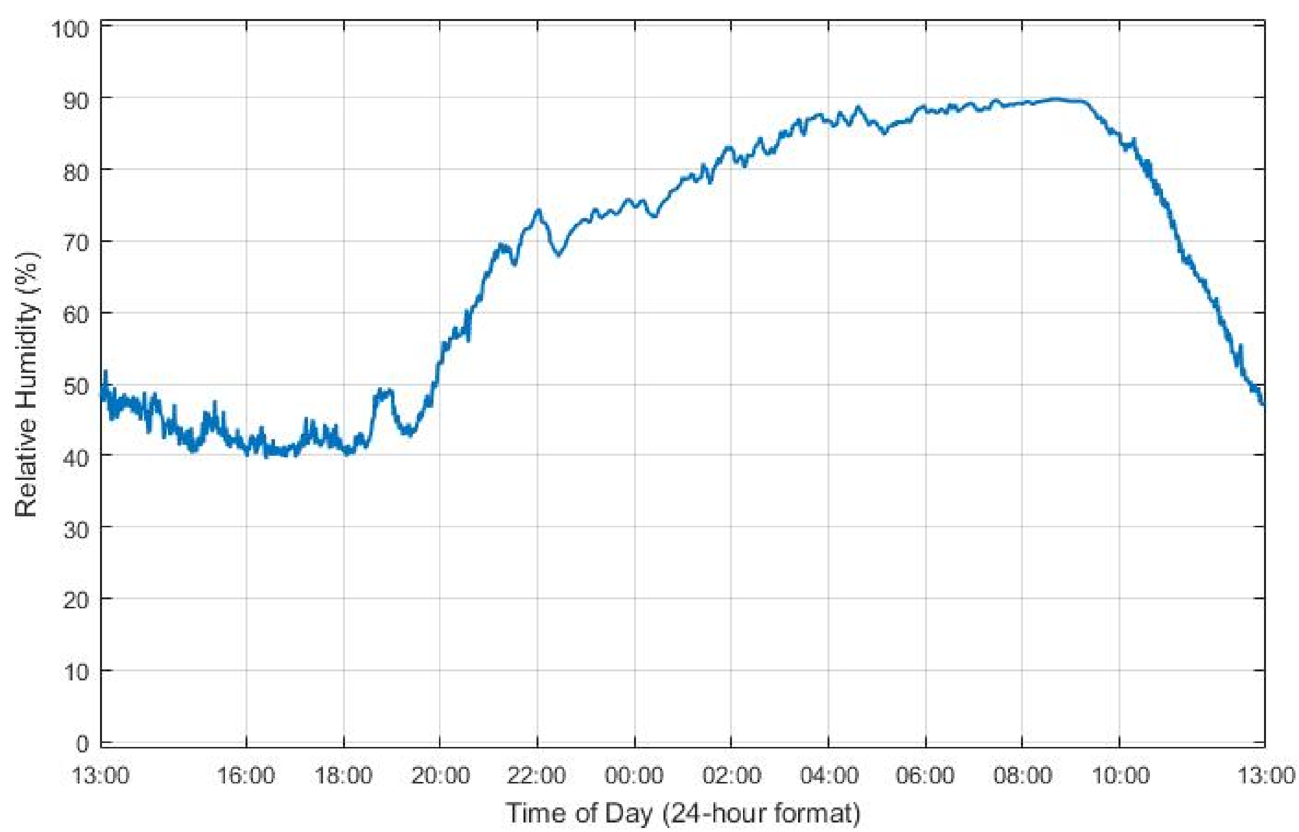


Monitored Temperature (September 18 – 19, 2019) at Noise Monitor Location 6



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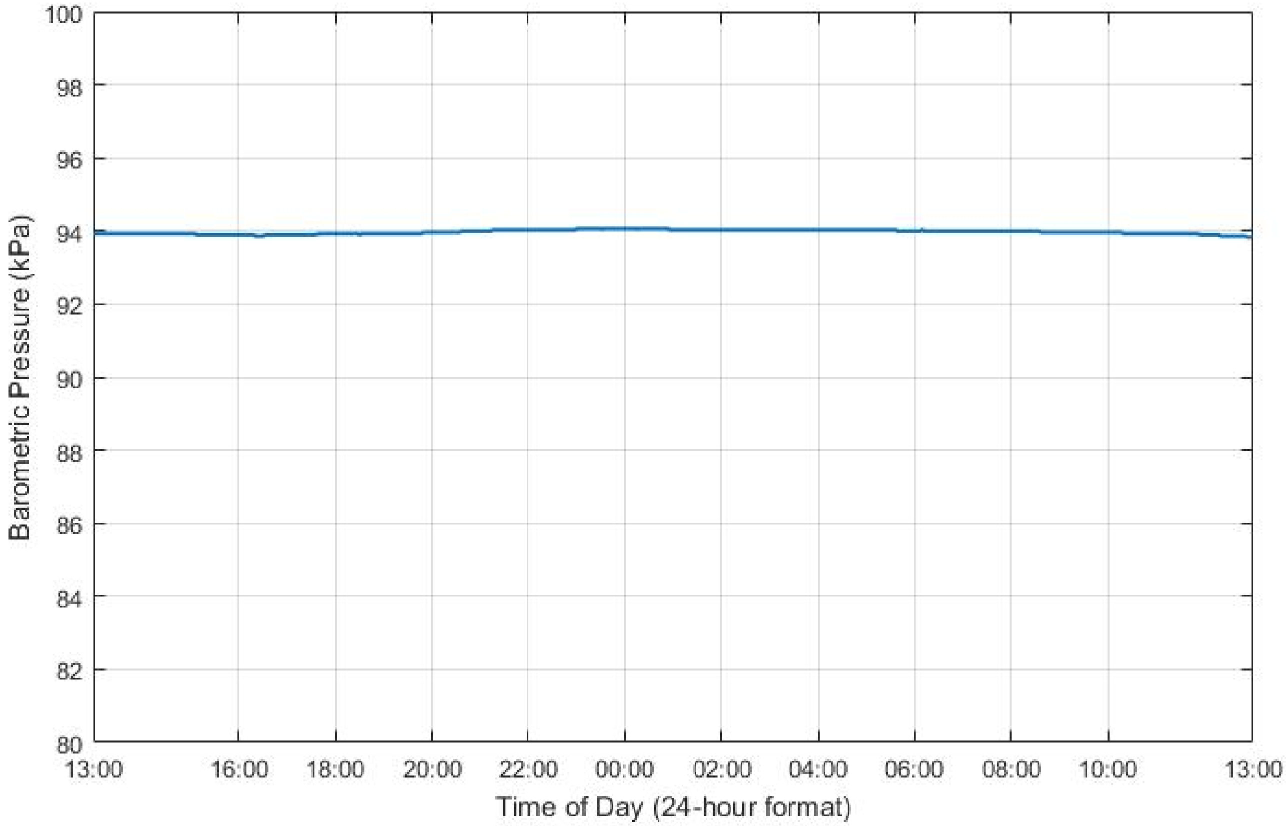

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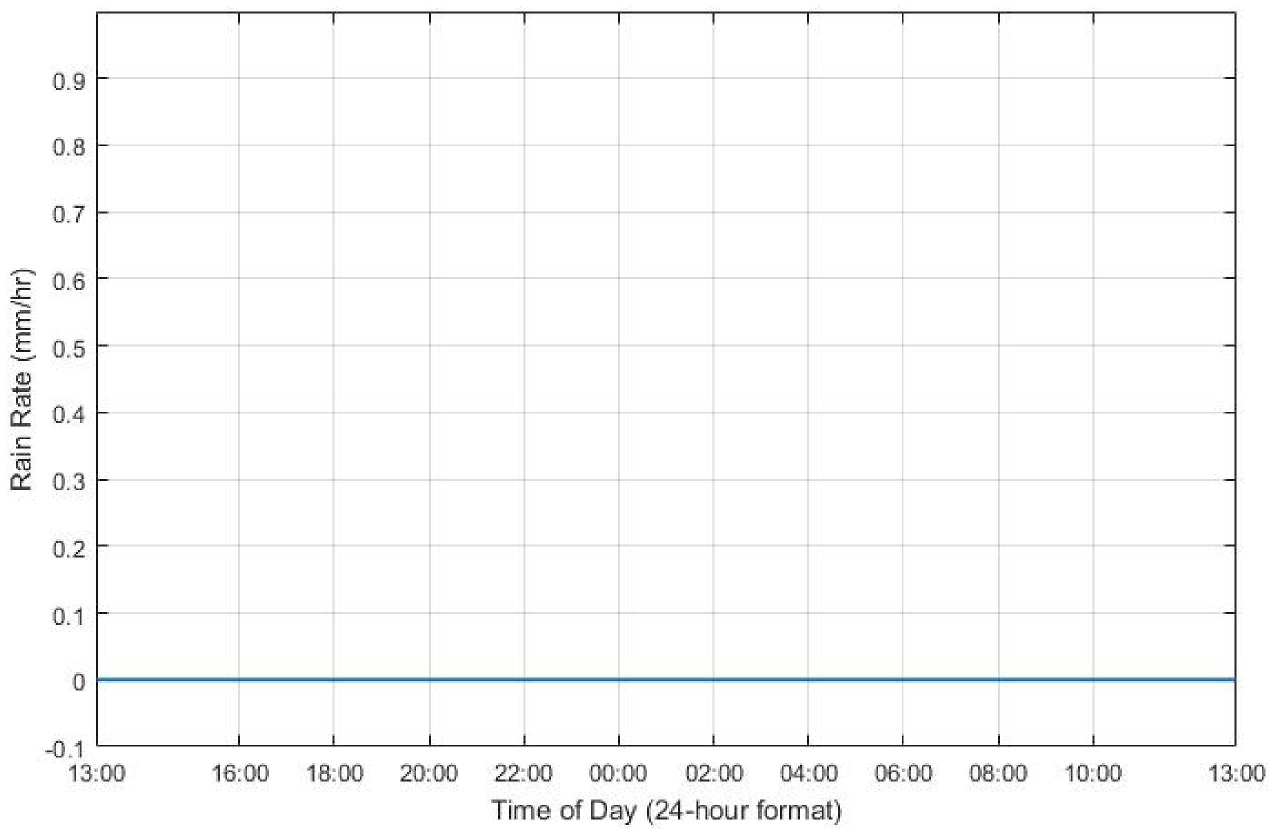

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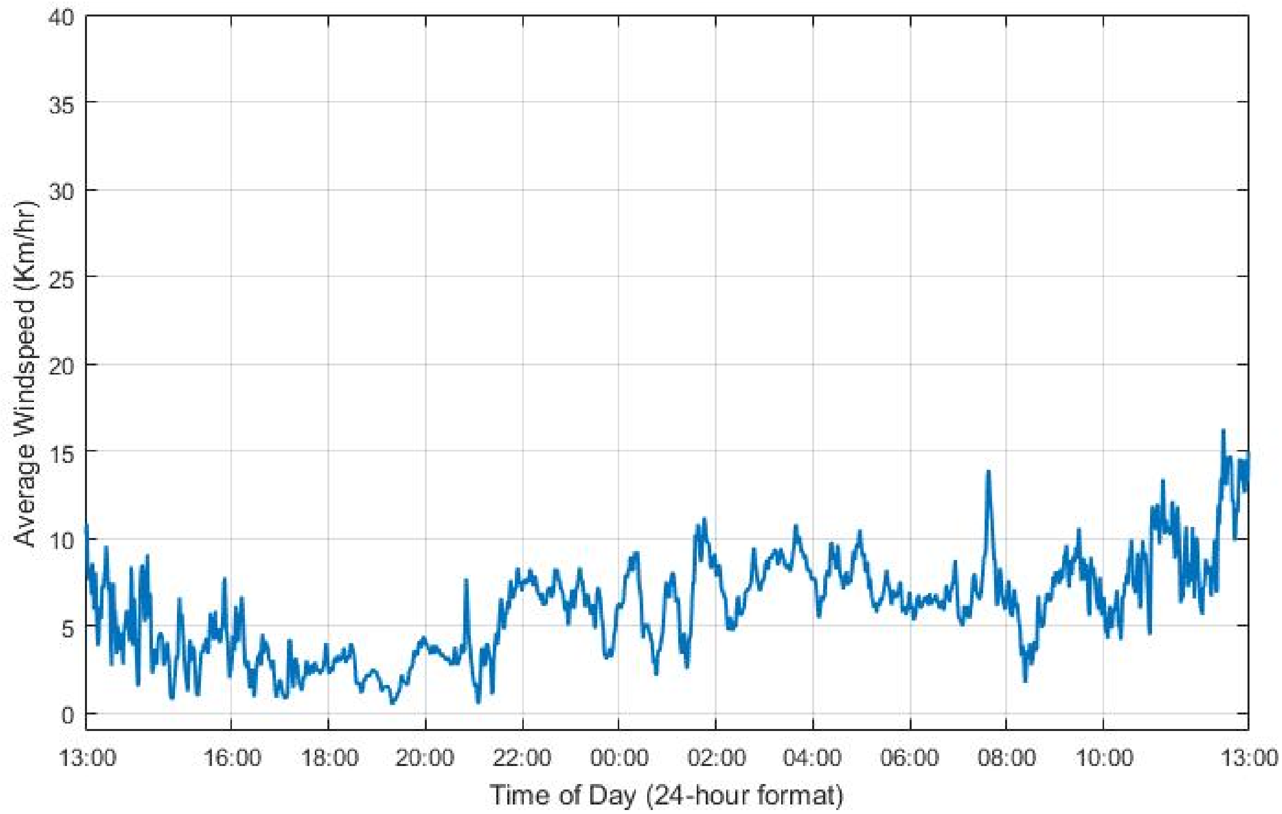
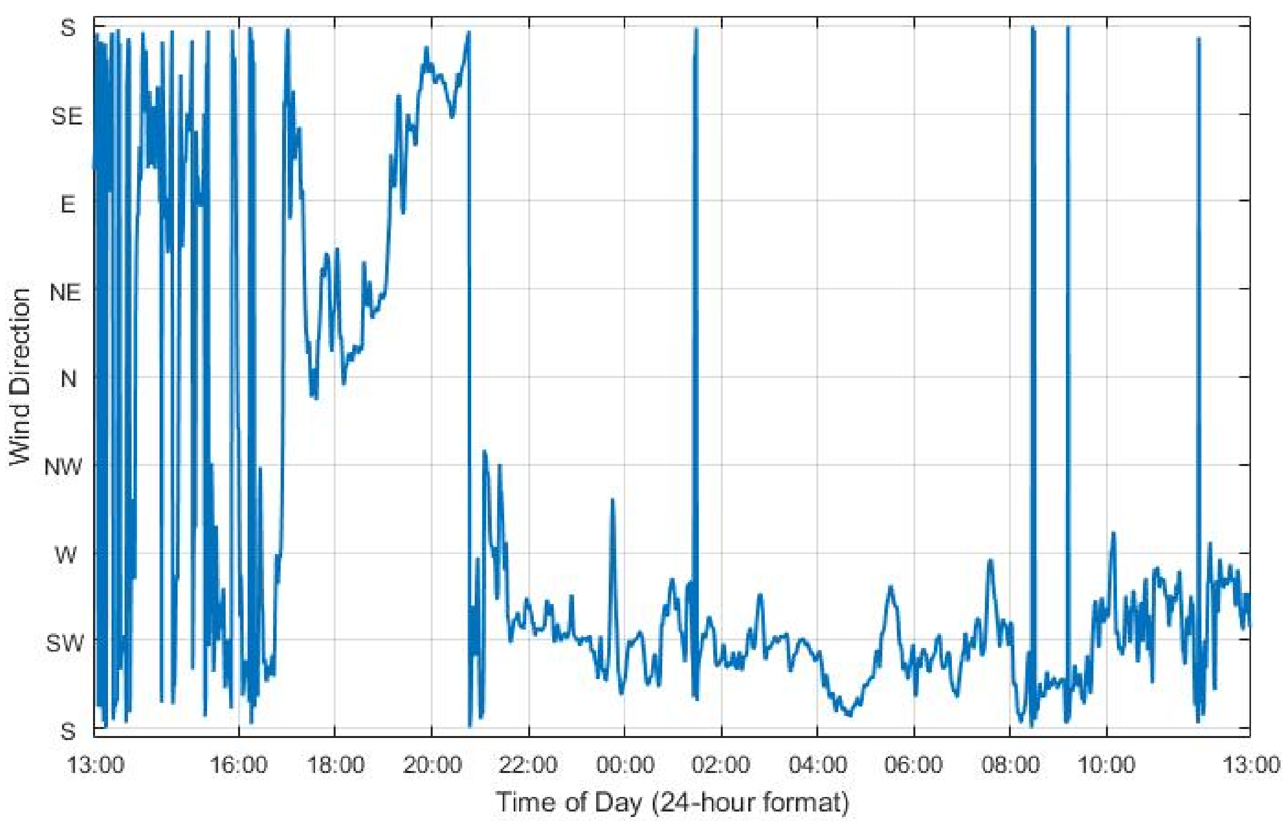


Monitored Wind Speed (September 18 – 19, 2019) at Noise Monitor Location 12



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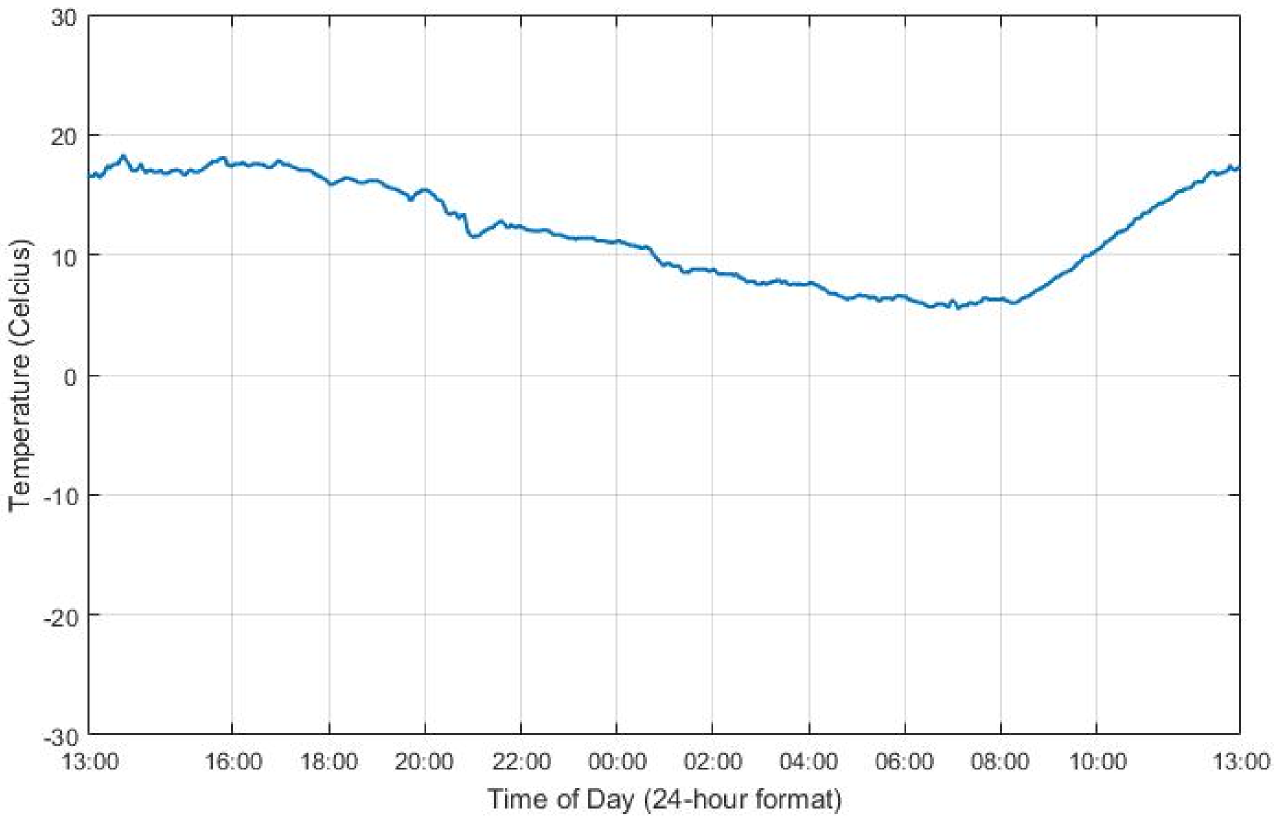

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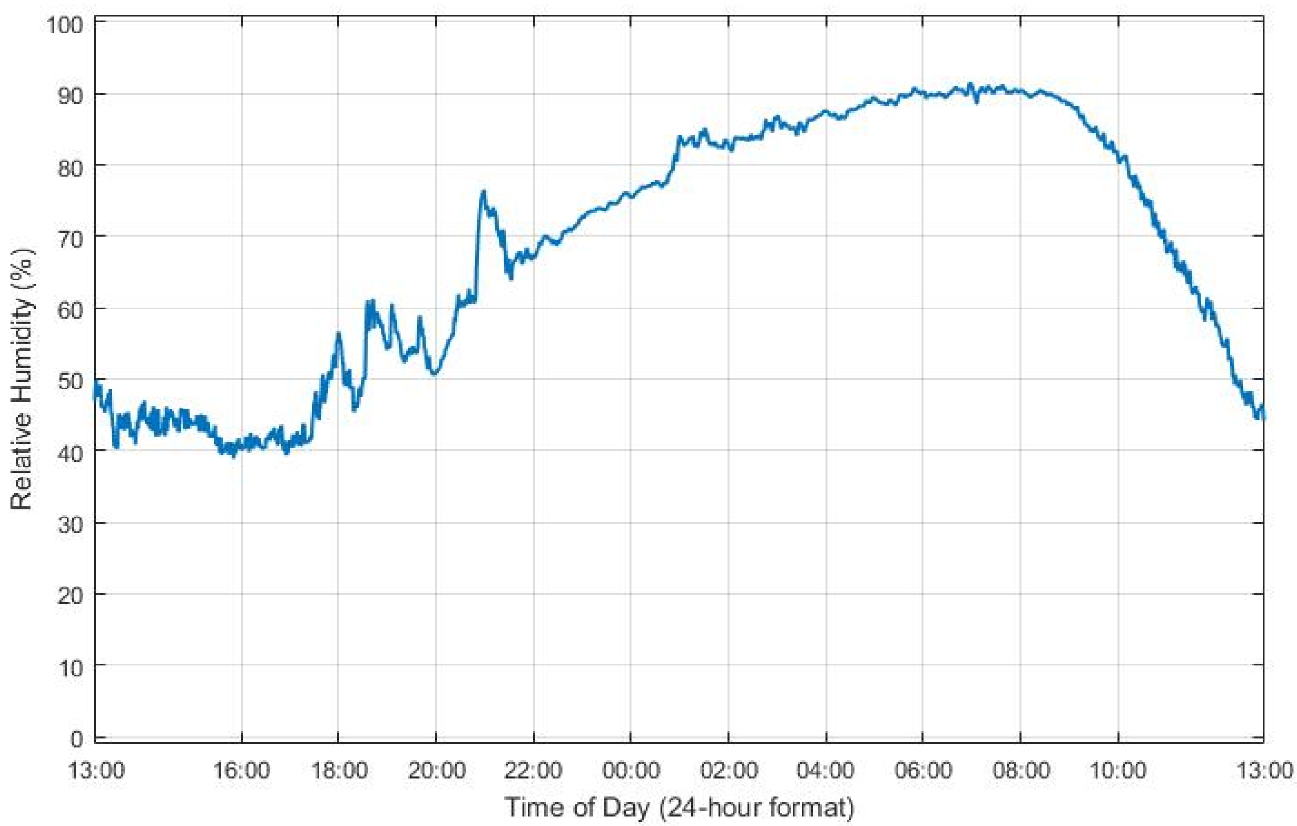

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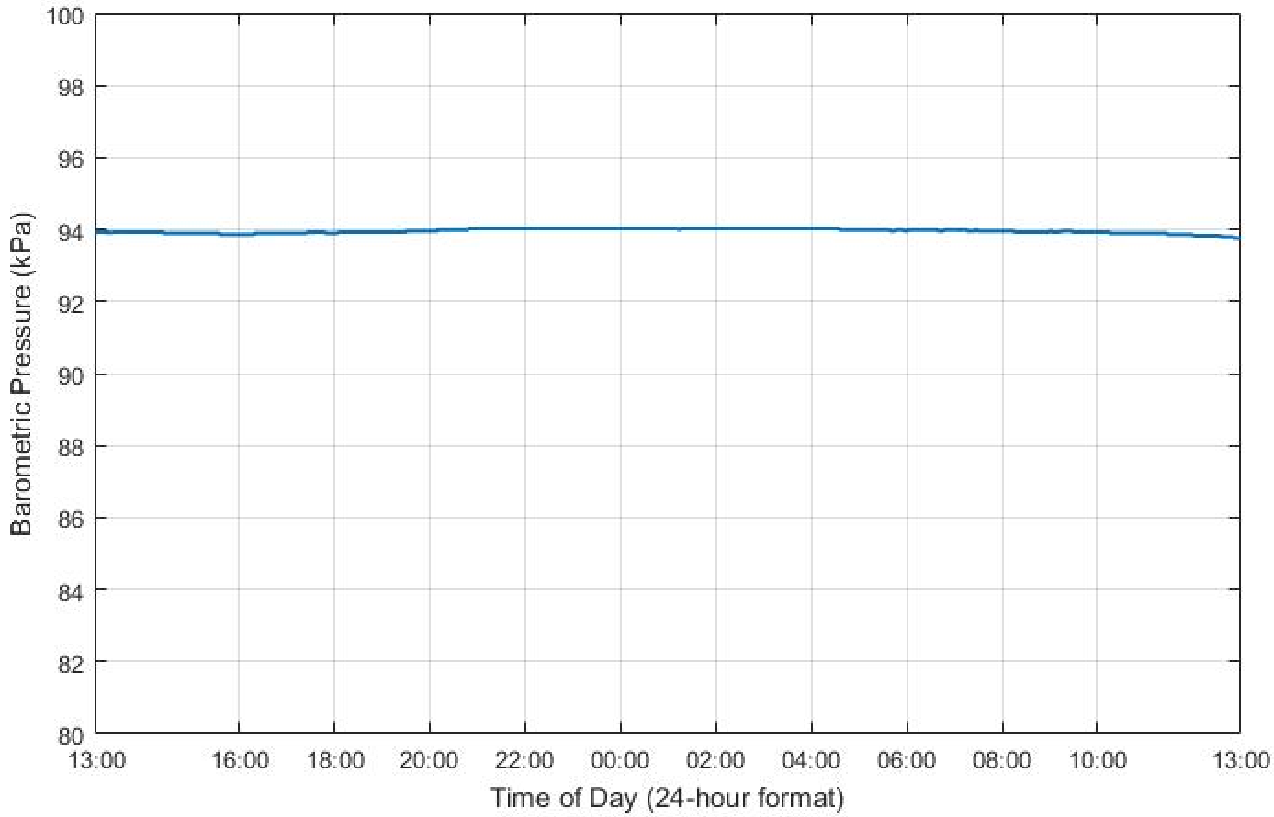

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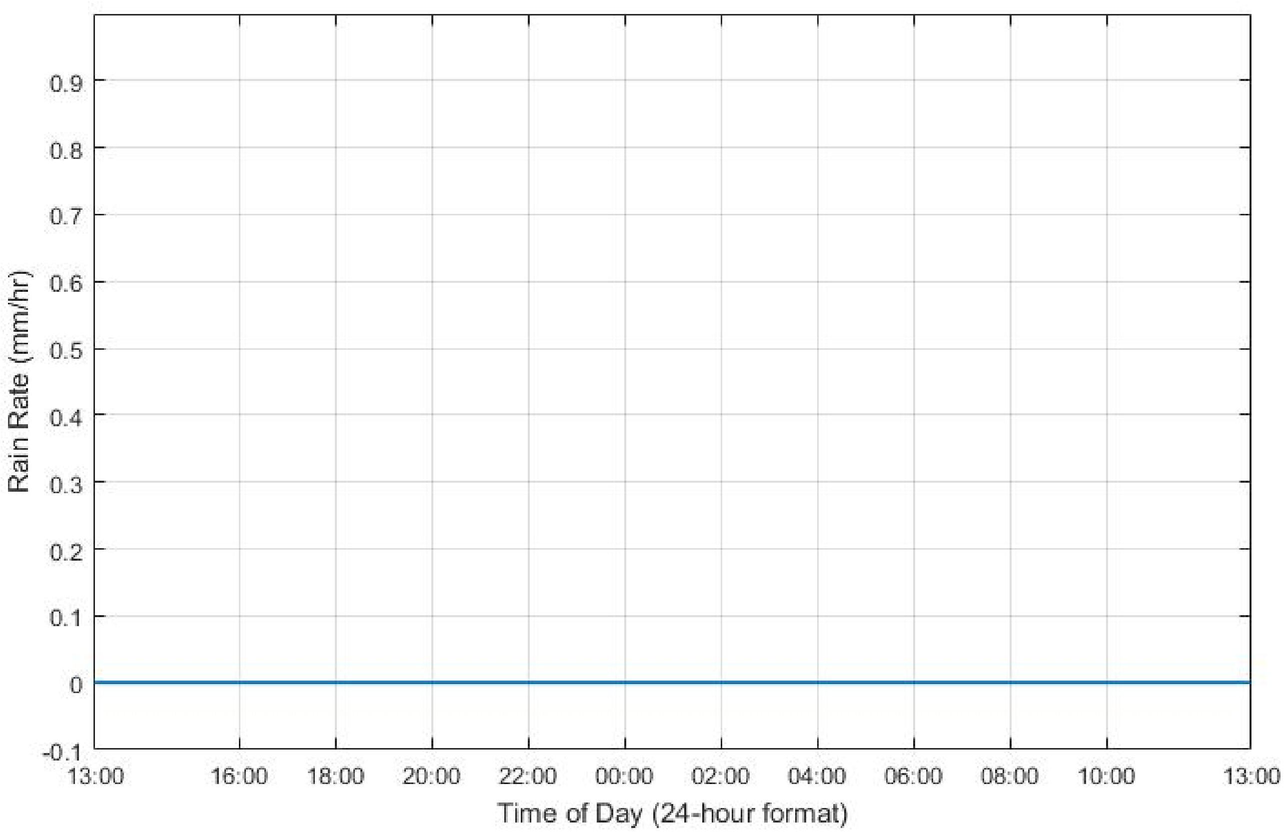
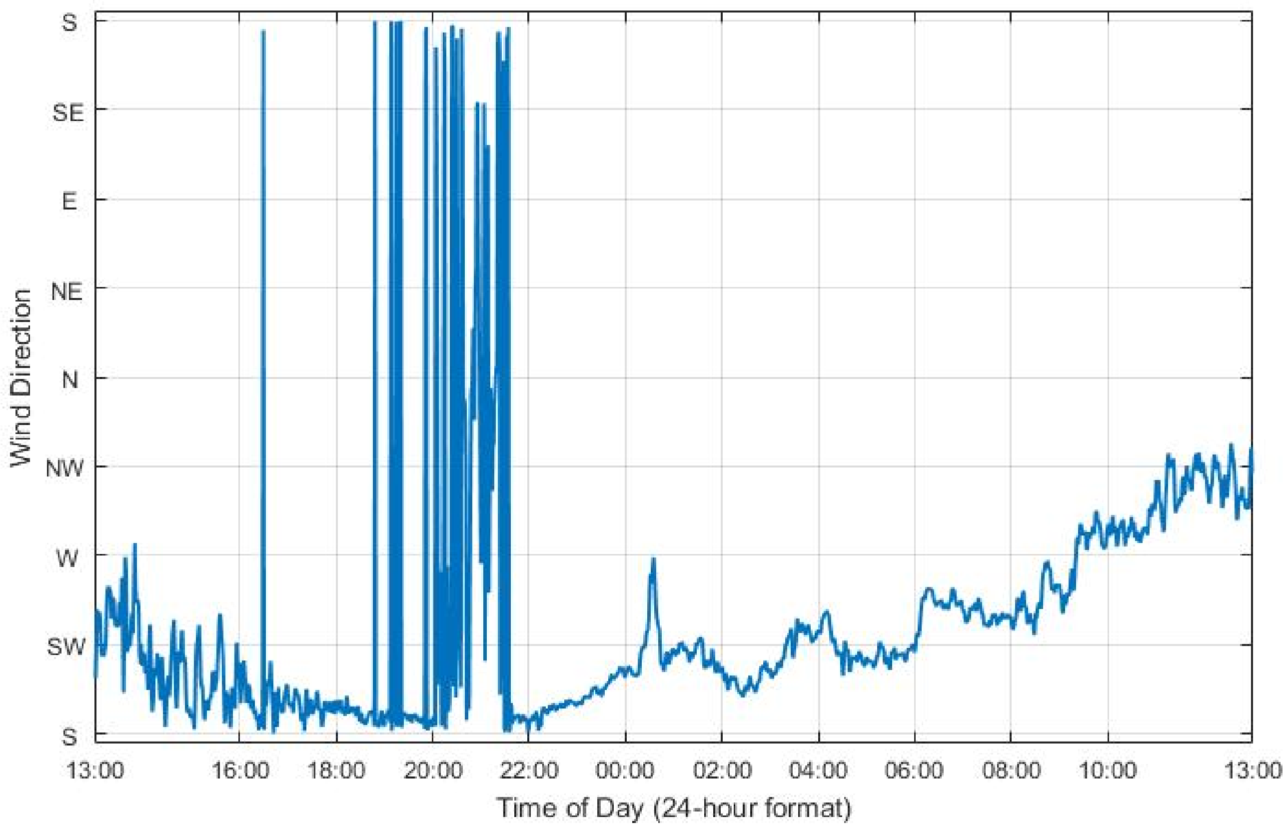
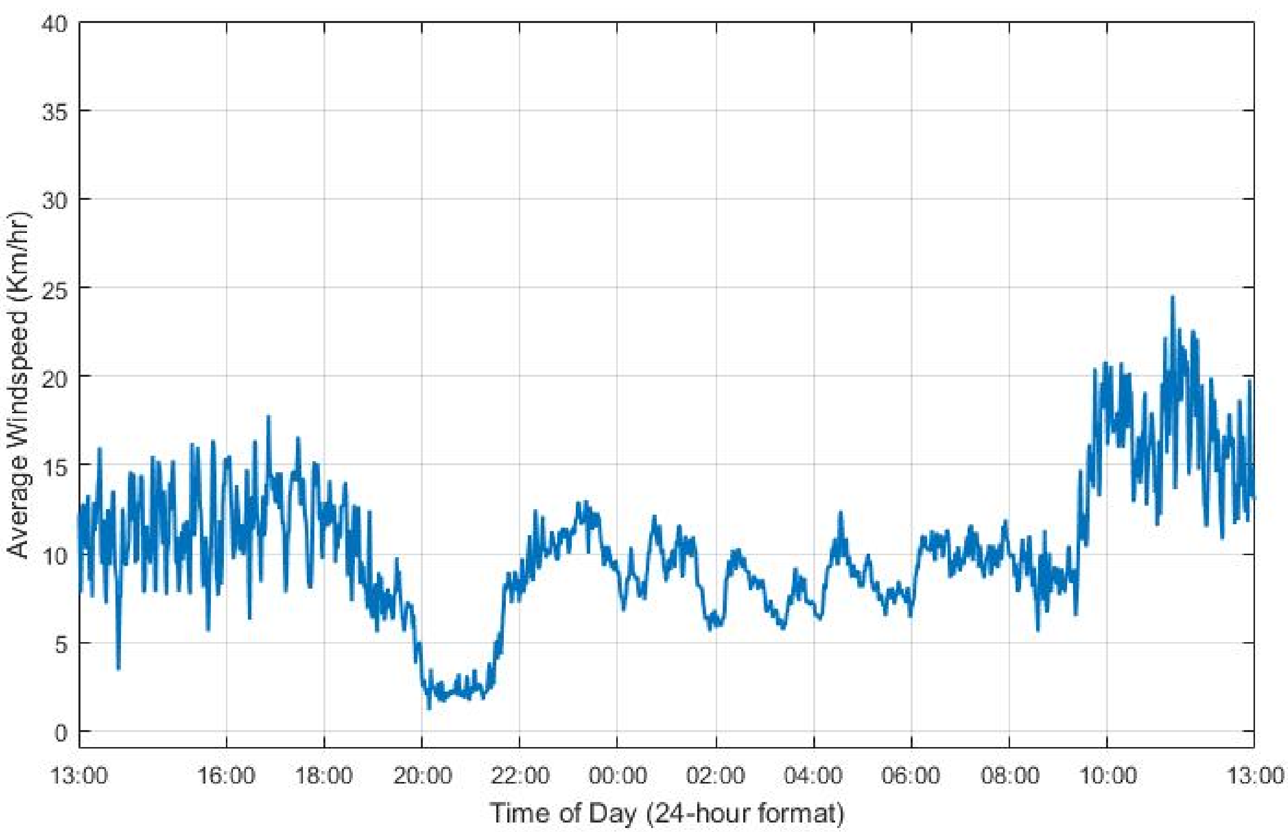


Monitored Rain Rate (September 18 – 19, 2019) at Noise Monitor Location 12

September 19 – 20, 2019 Weather Data



Monitored Wind Speed (September 19 – 20, 2019) at Noise Monitor Location 6



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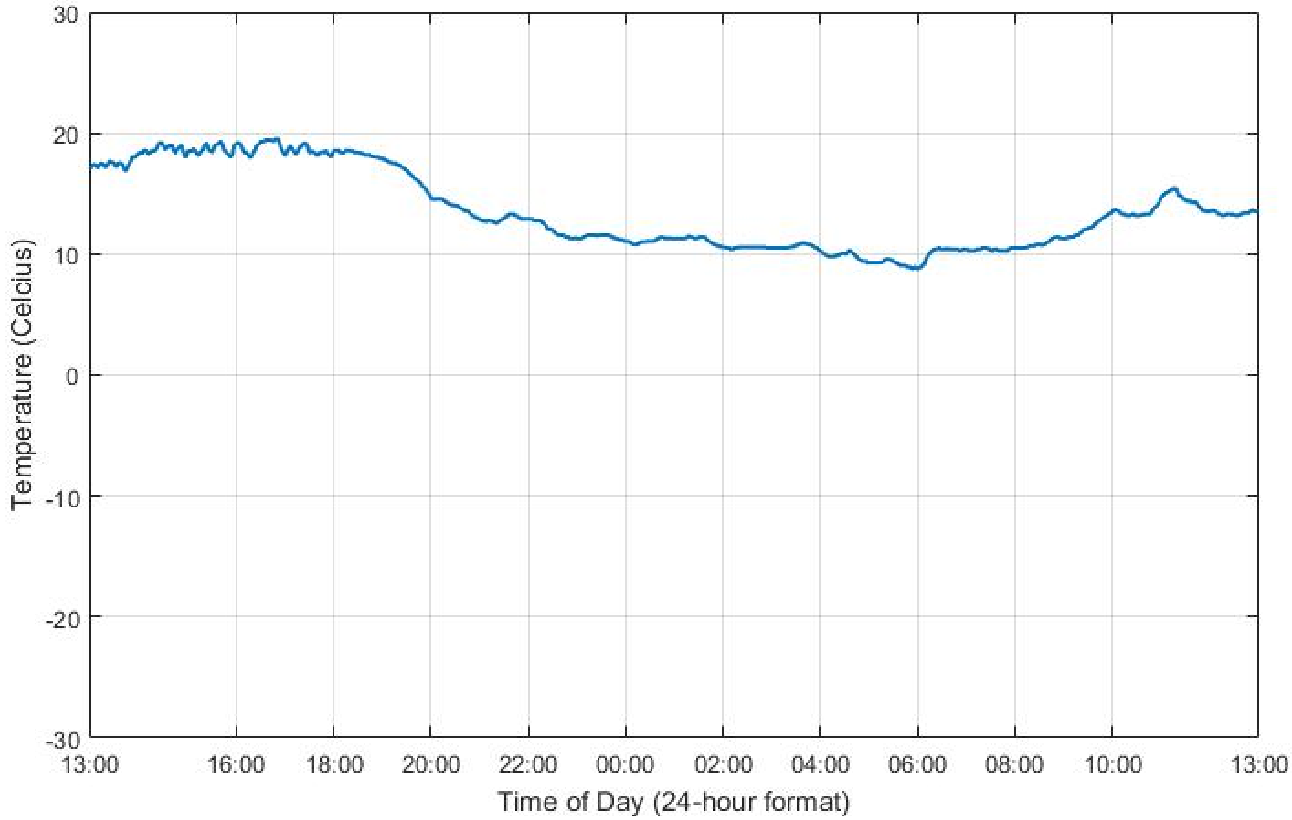
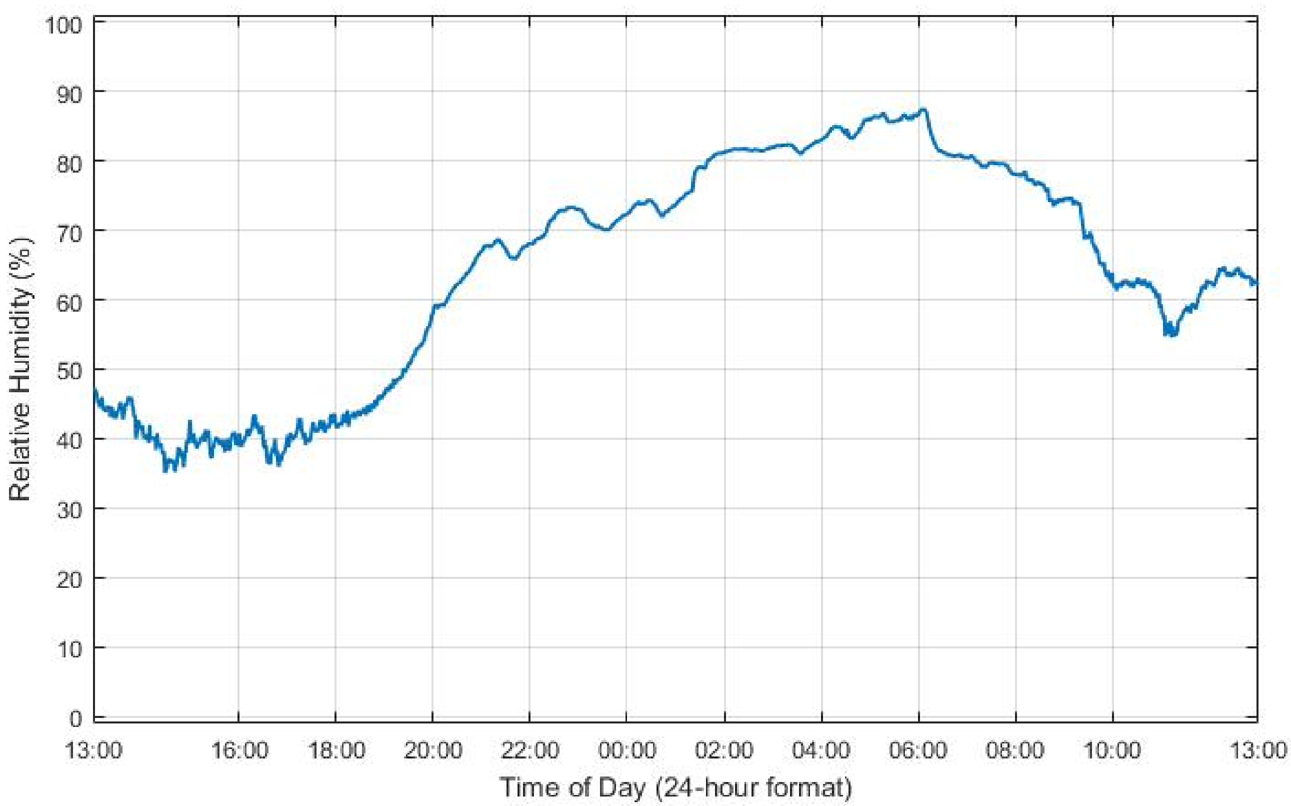
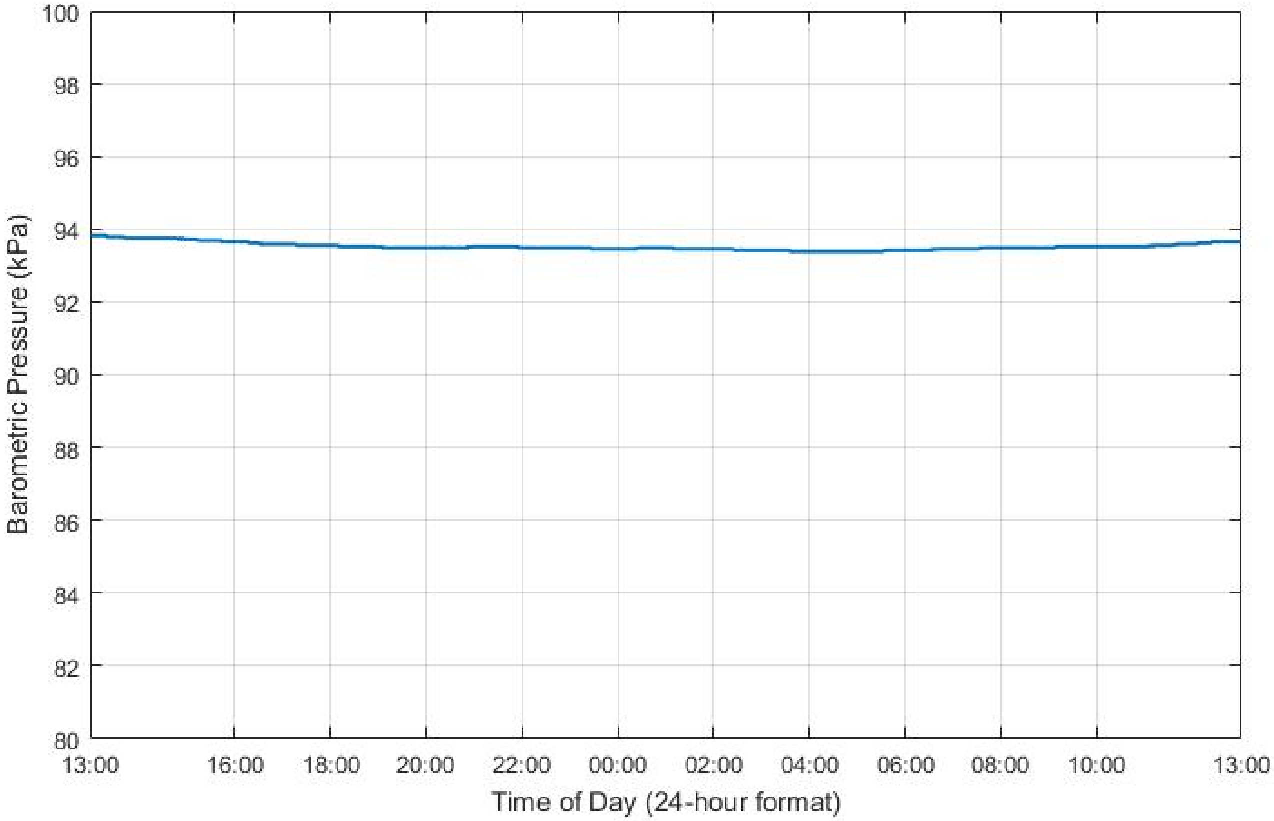


Monitored Temperature (September 19 – 20, 2019) at Noise Monitor Location 6



Monitored Humidity (September 19 – 20, 2019) at Noise Monitor Location 6



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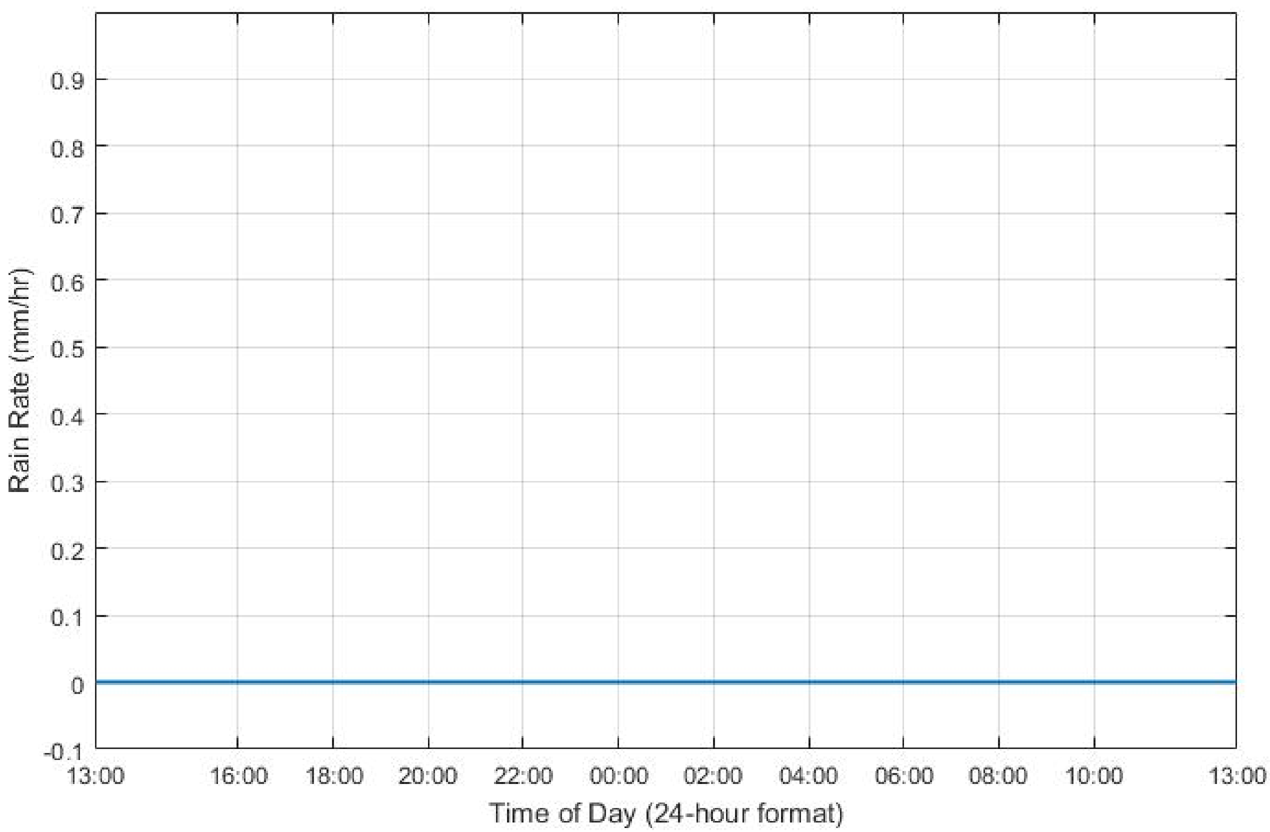

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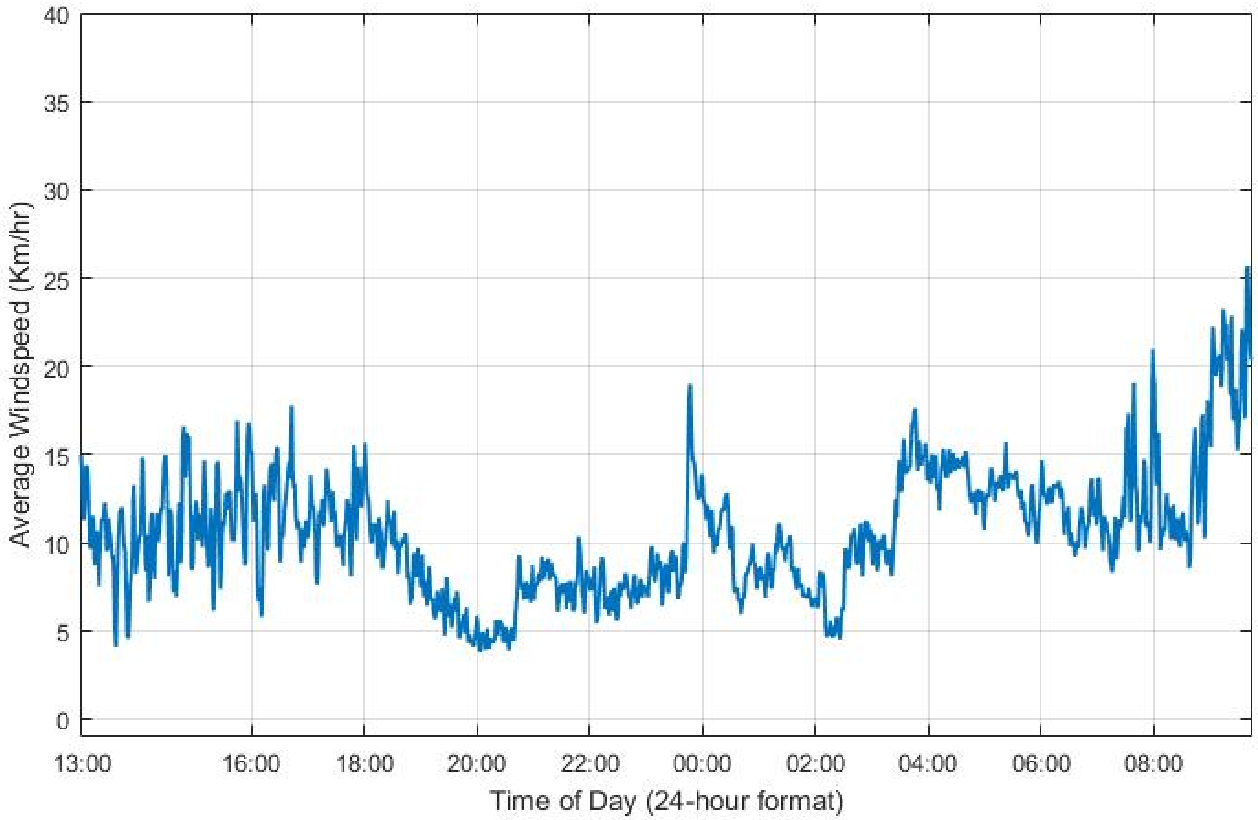

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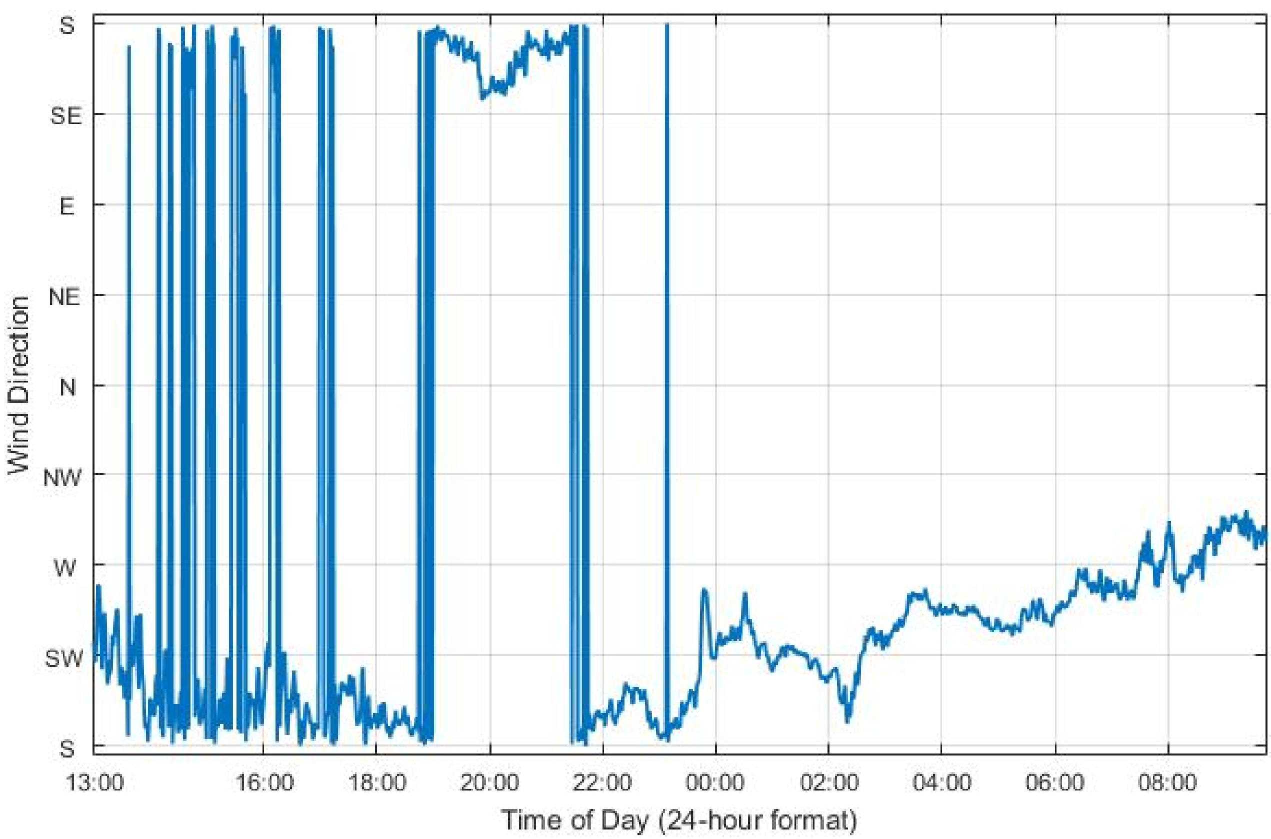
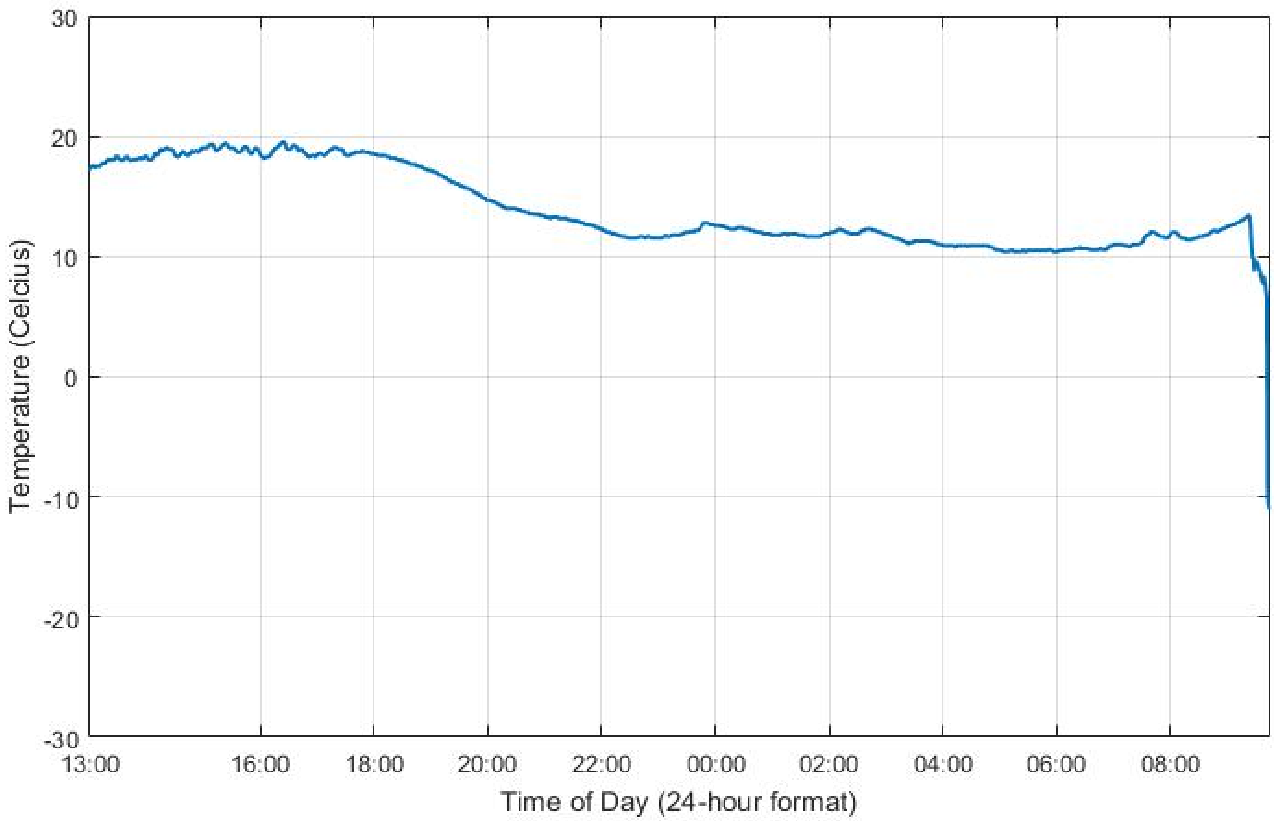
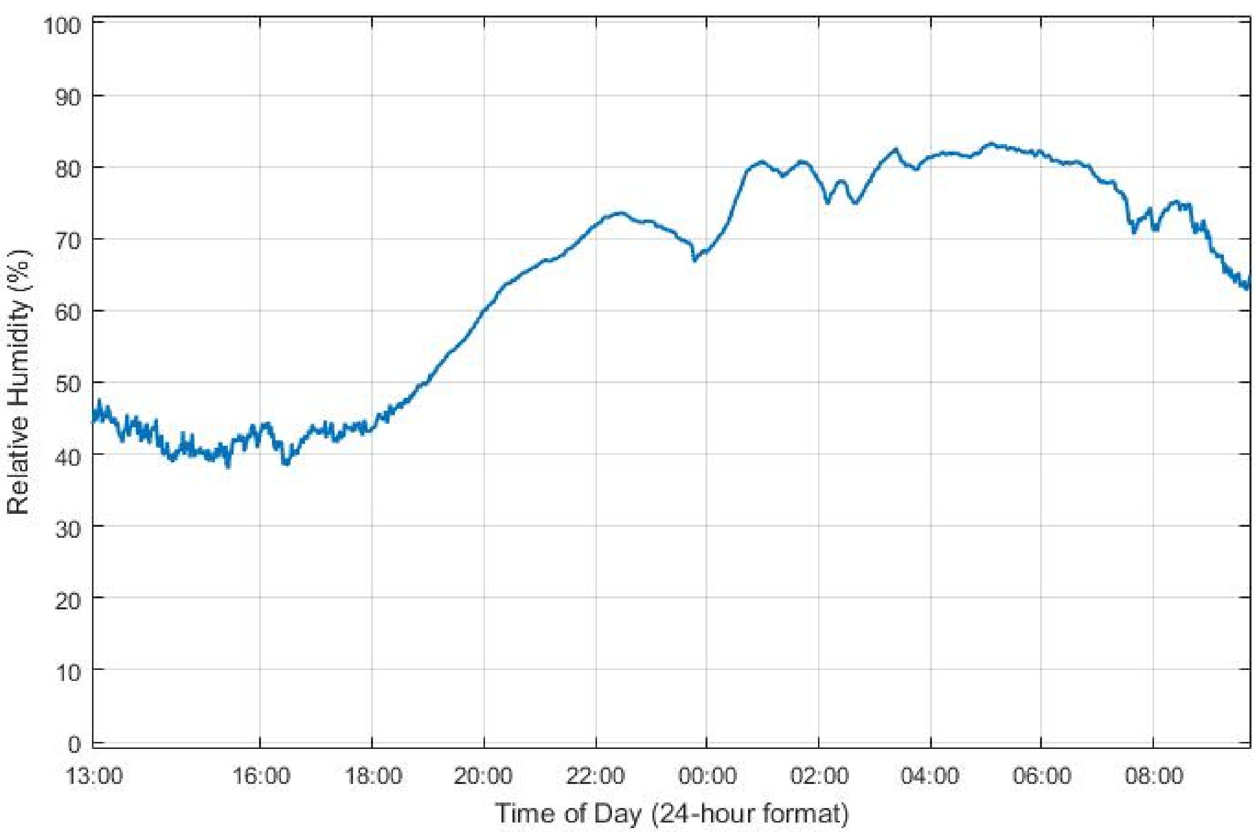


Monitored Wind Direction (September 19 – 20, 2019) at Noise Monitor Location 12



Monitored Temperature (September 19 – 20, 2019) at Noise Monitor Location 12



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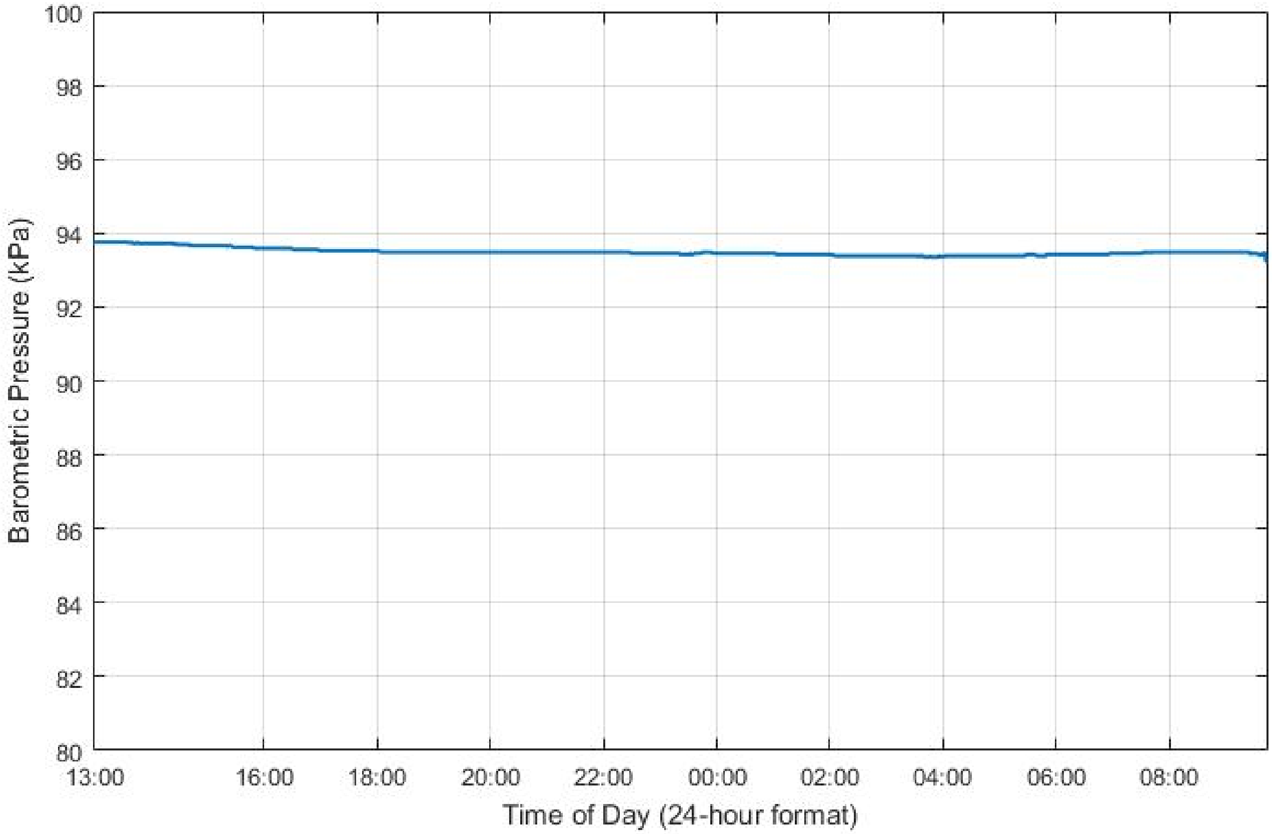
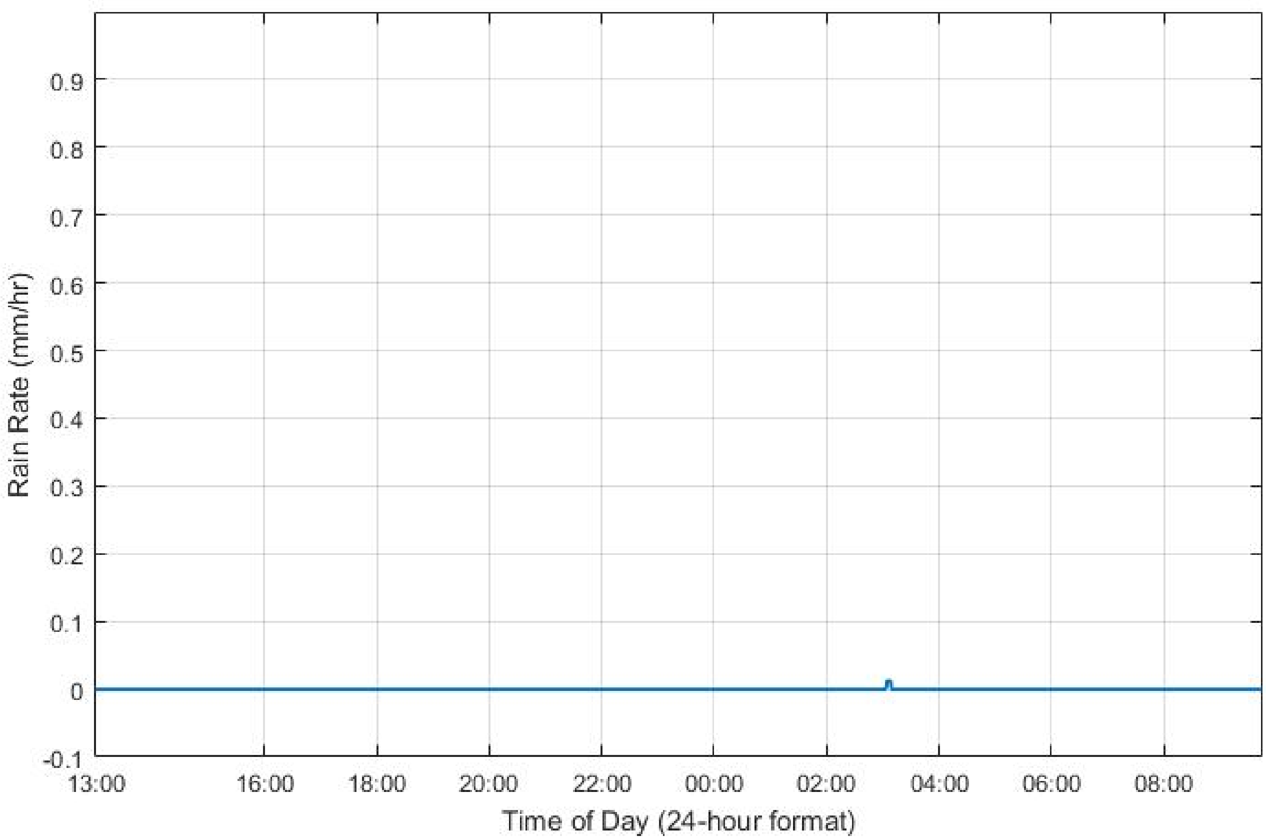
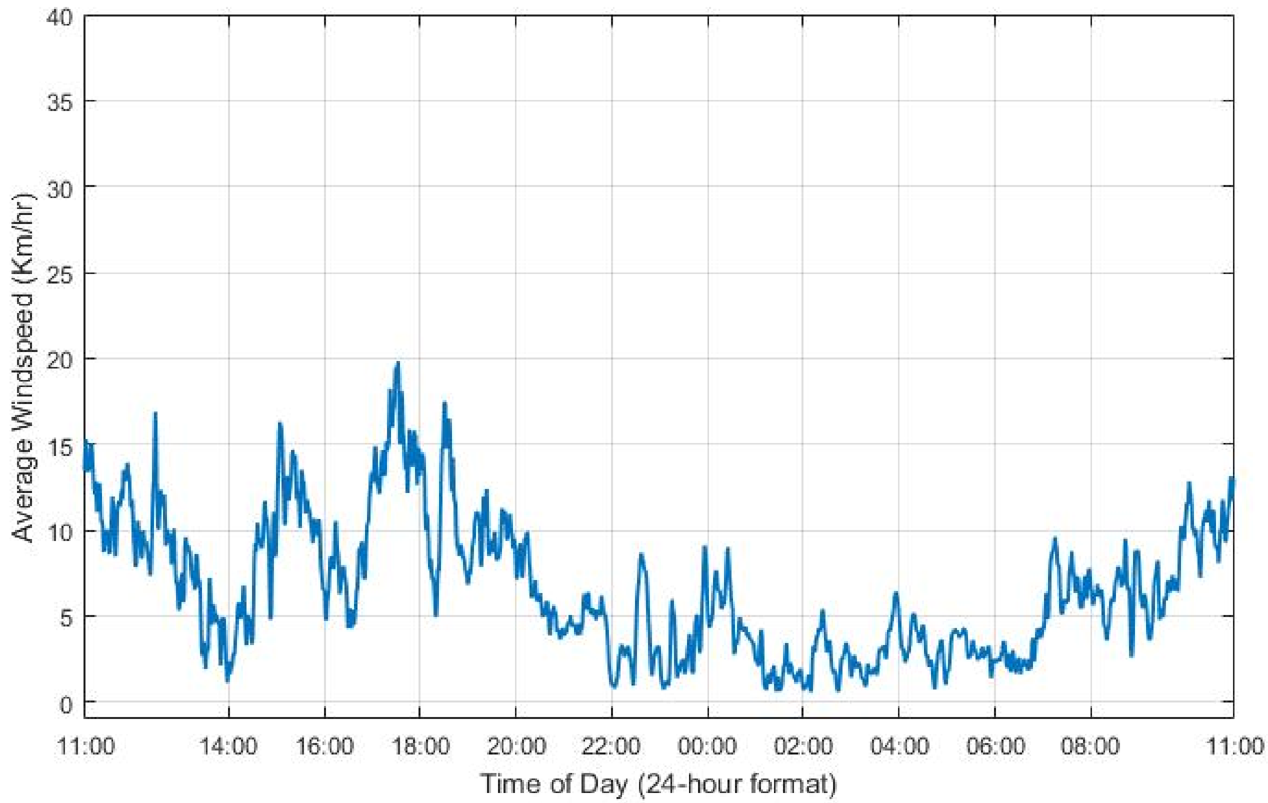


Monitored Barometric Pressure (September 19 – 20, 2019) at Noise Monitor Location 12

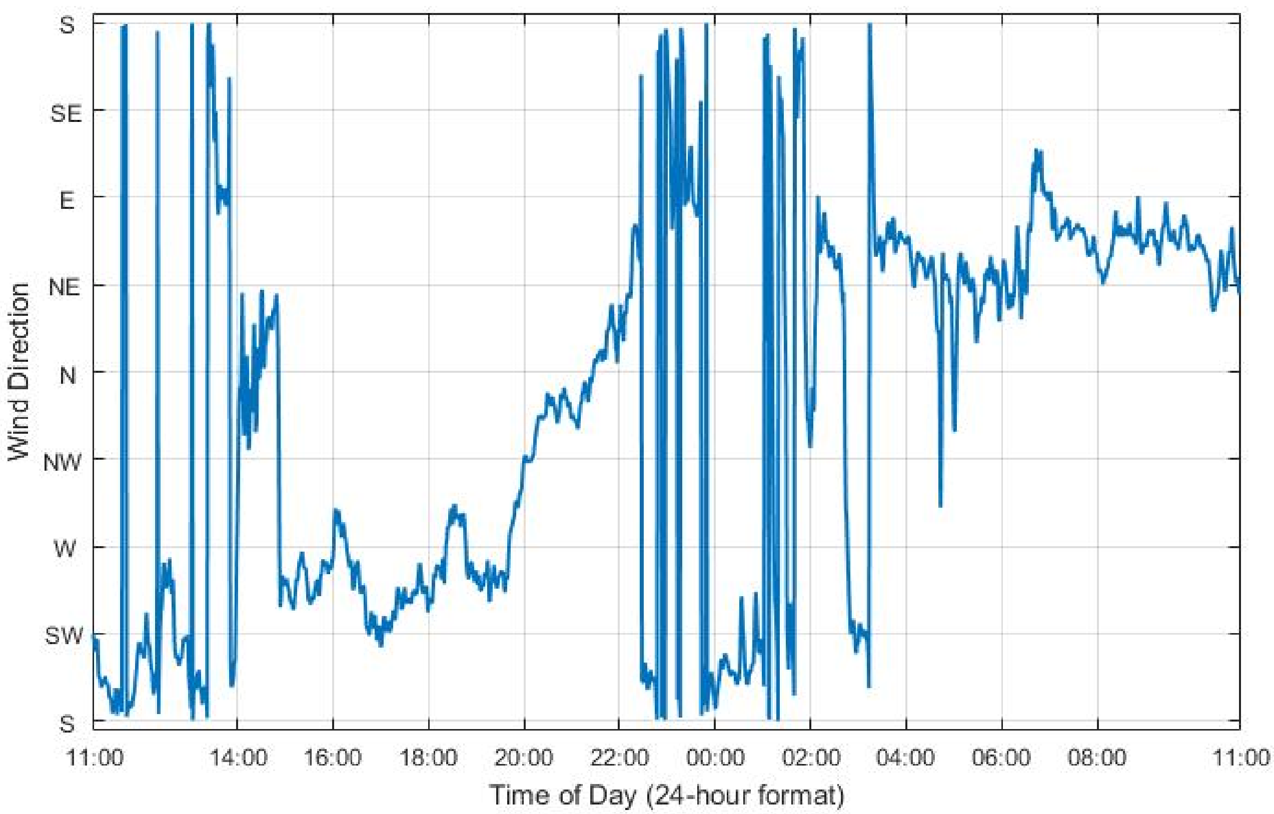


Monitored Rain Rate (September 19 – 20, 2019) at Noise Monitor Location 12

October 21 – 22, 2019 Weather Data



Monitored Wind Speed (October 21 – 22, 2019) at Noise Monitor Location 4



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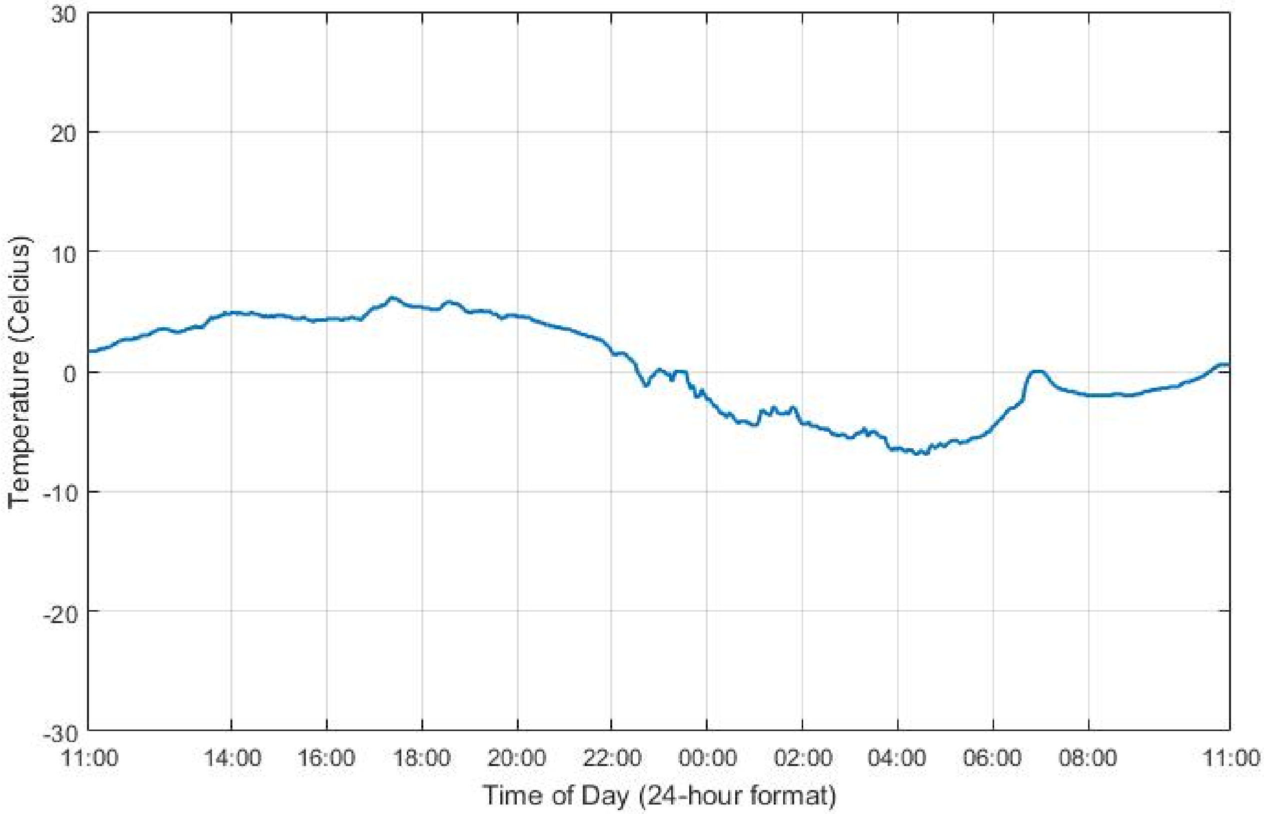
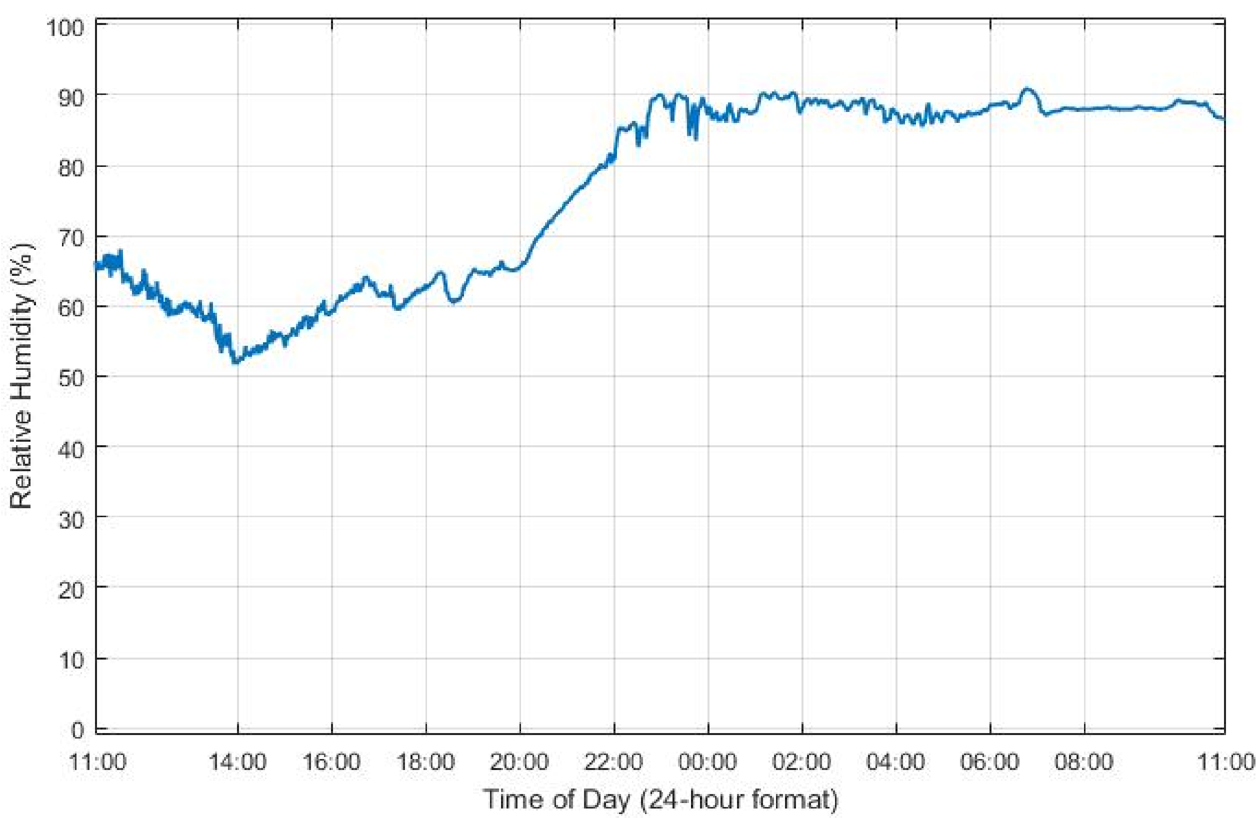


Monitored Temperature (October 21 – 22, 2019) at Noise Monitor Location 4



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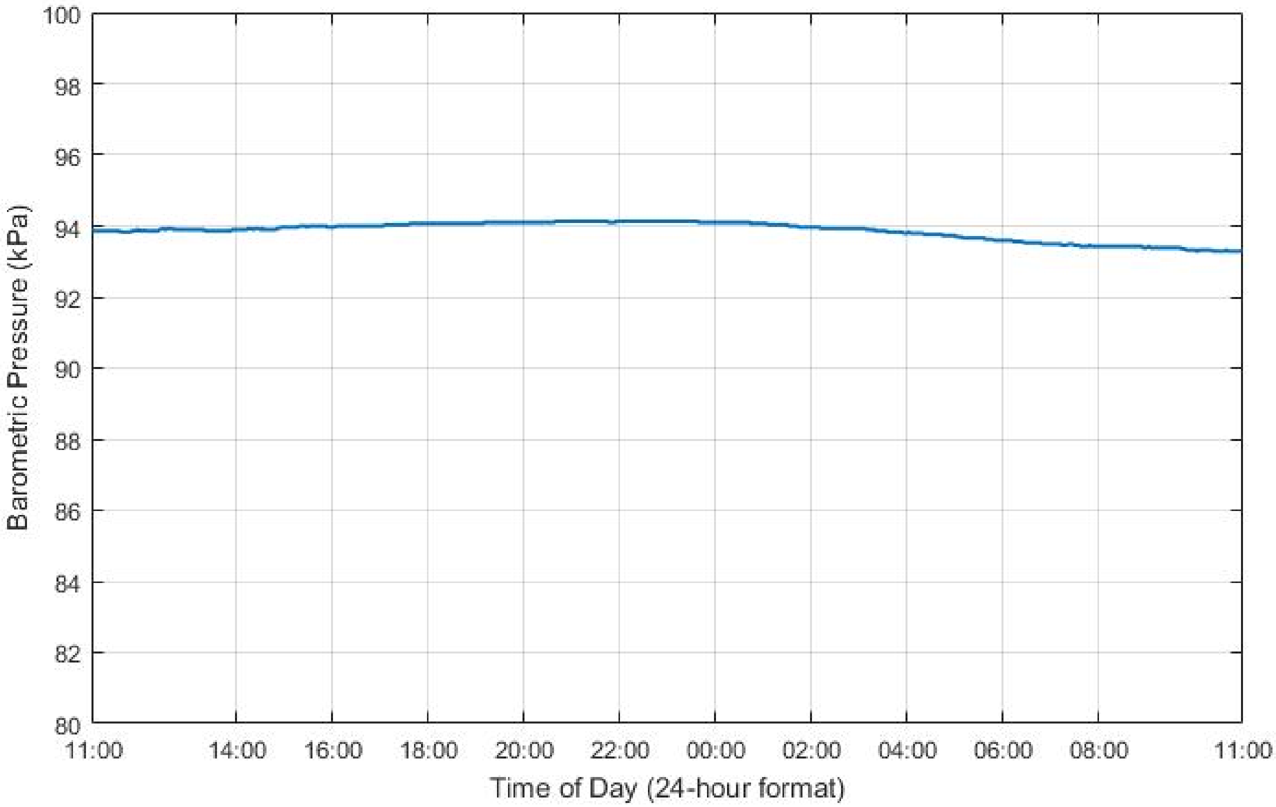
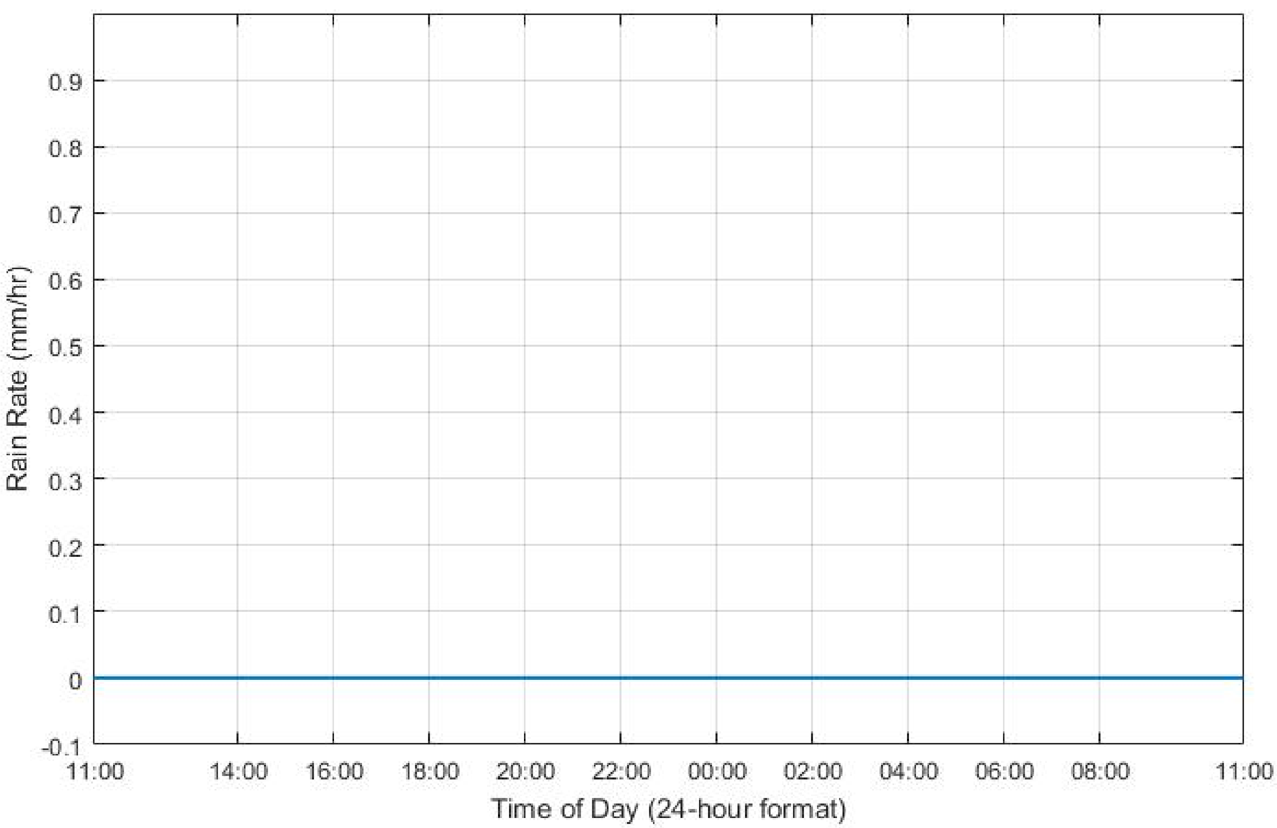


Monitored Barometric Pressure (October 21 – 22, 2019) at Noise Monitor Location 4



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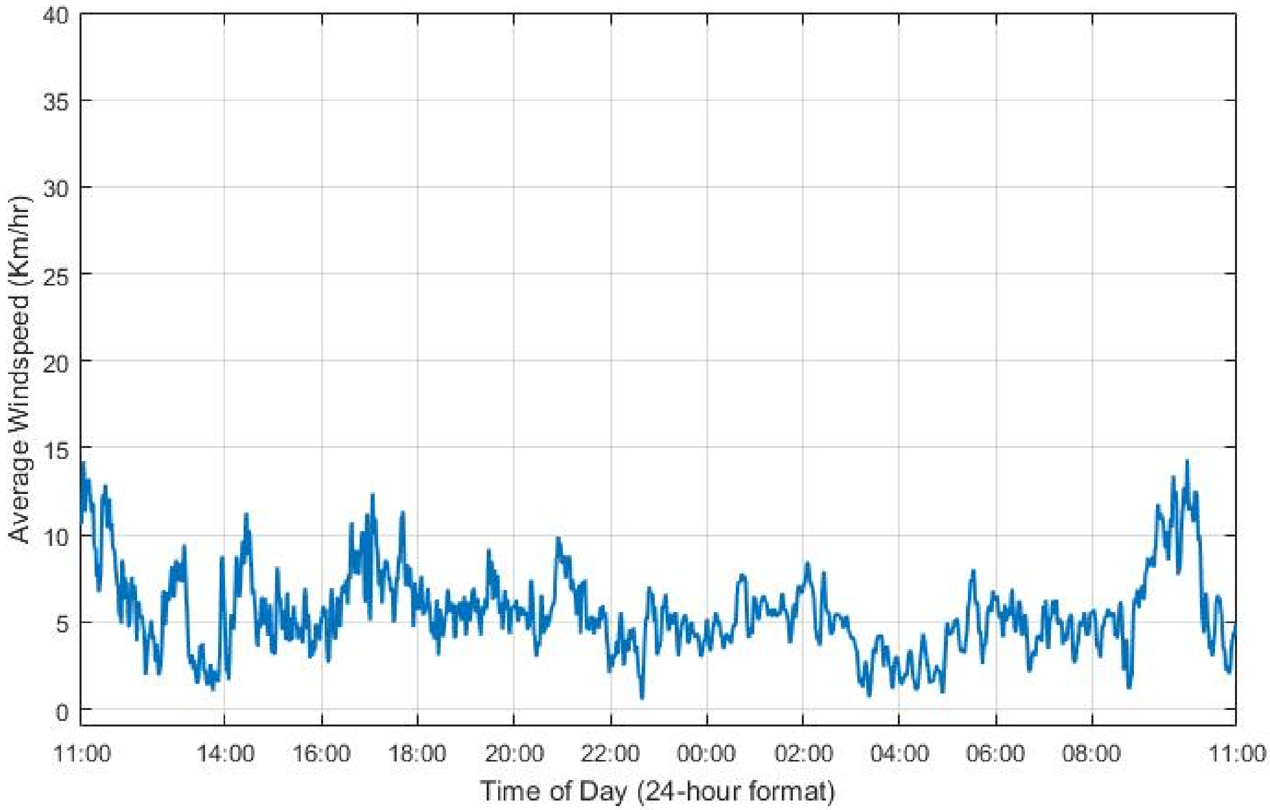
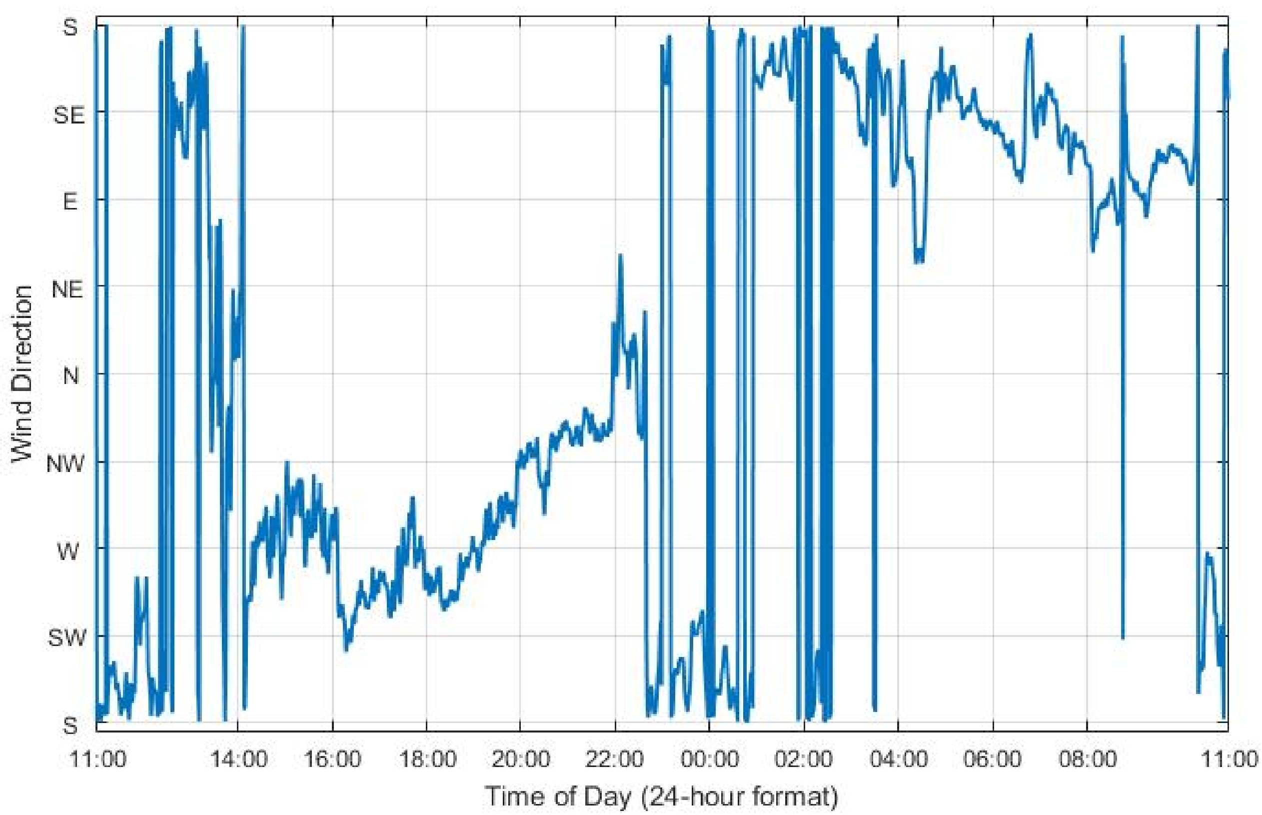
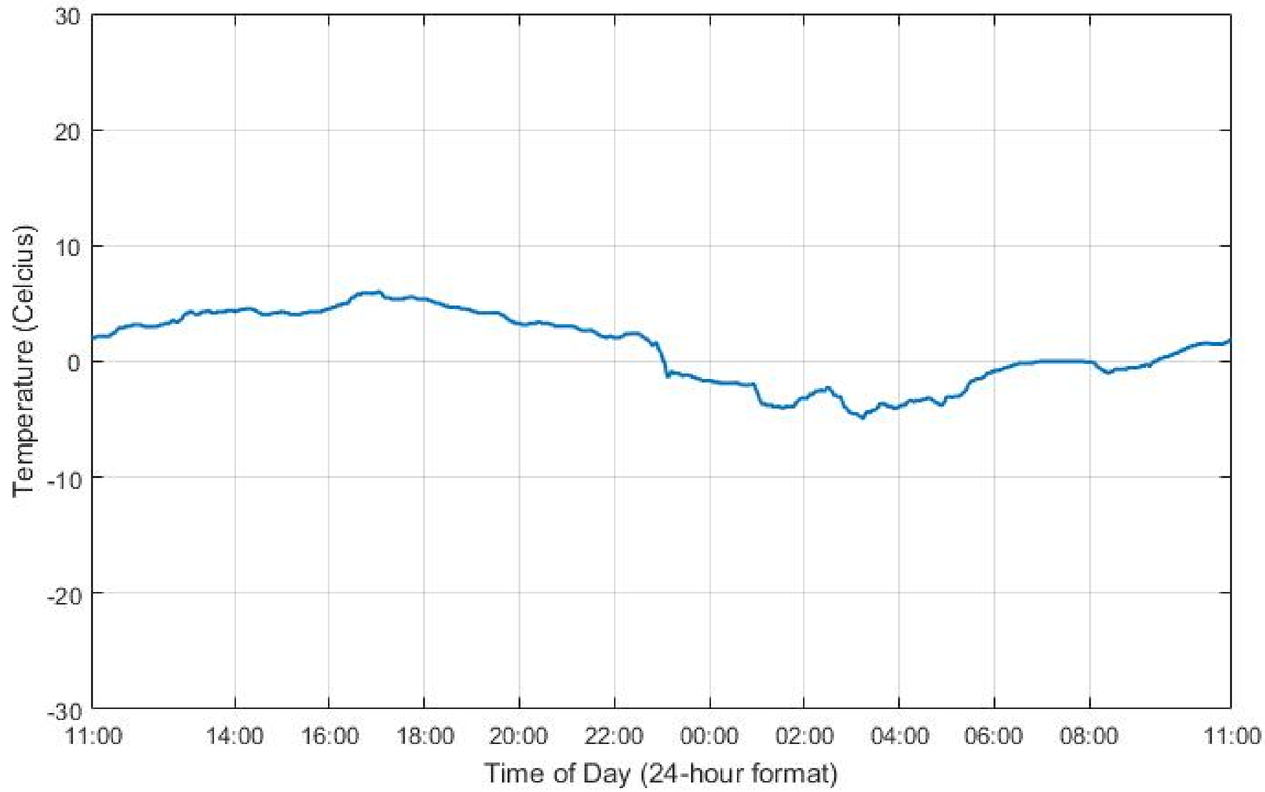


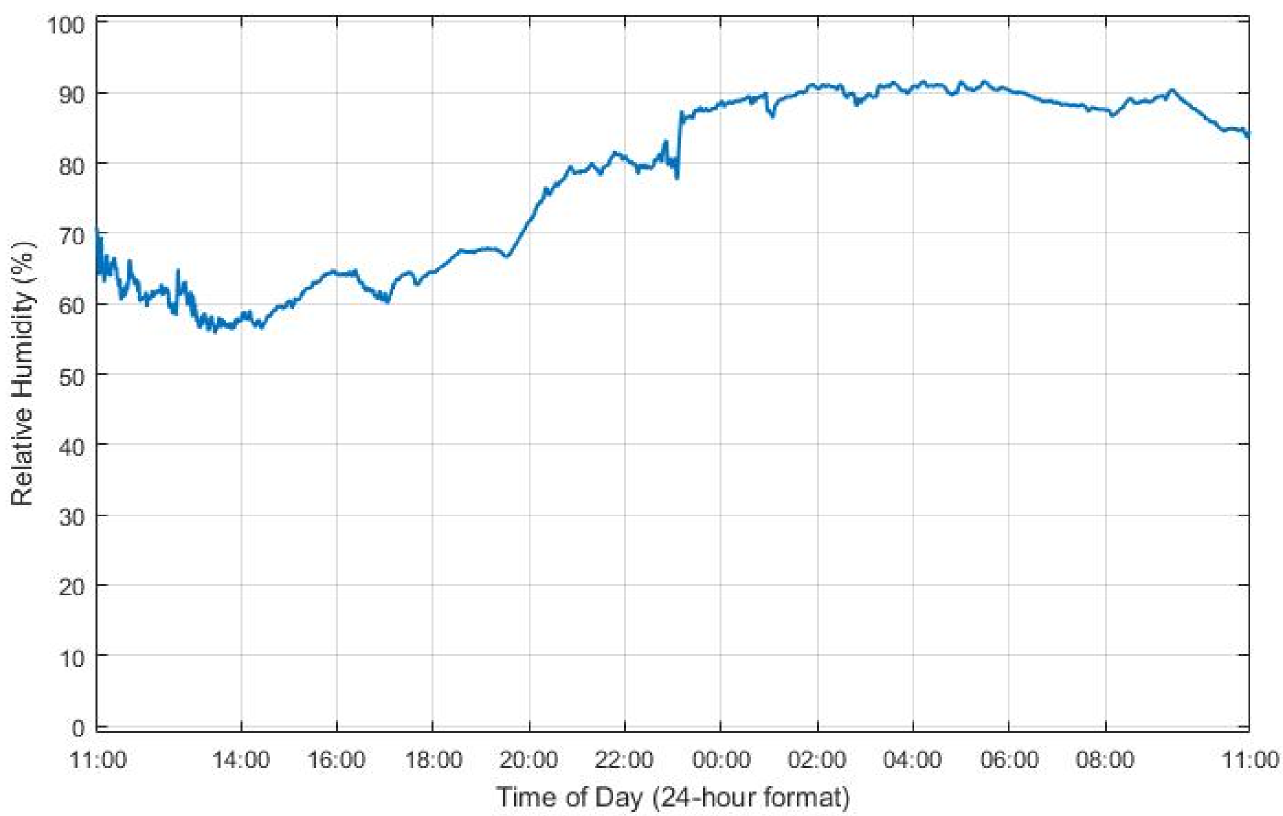
Monitored Wind Speed (October 21 – 22, 2019) at Noise Monitor Location 12



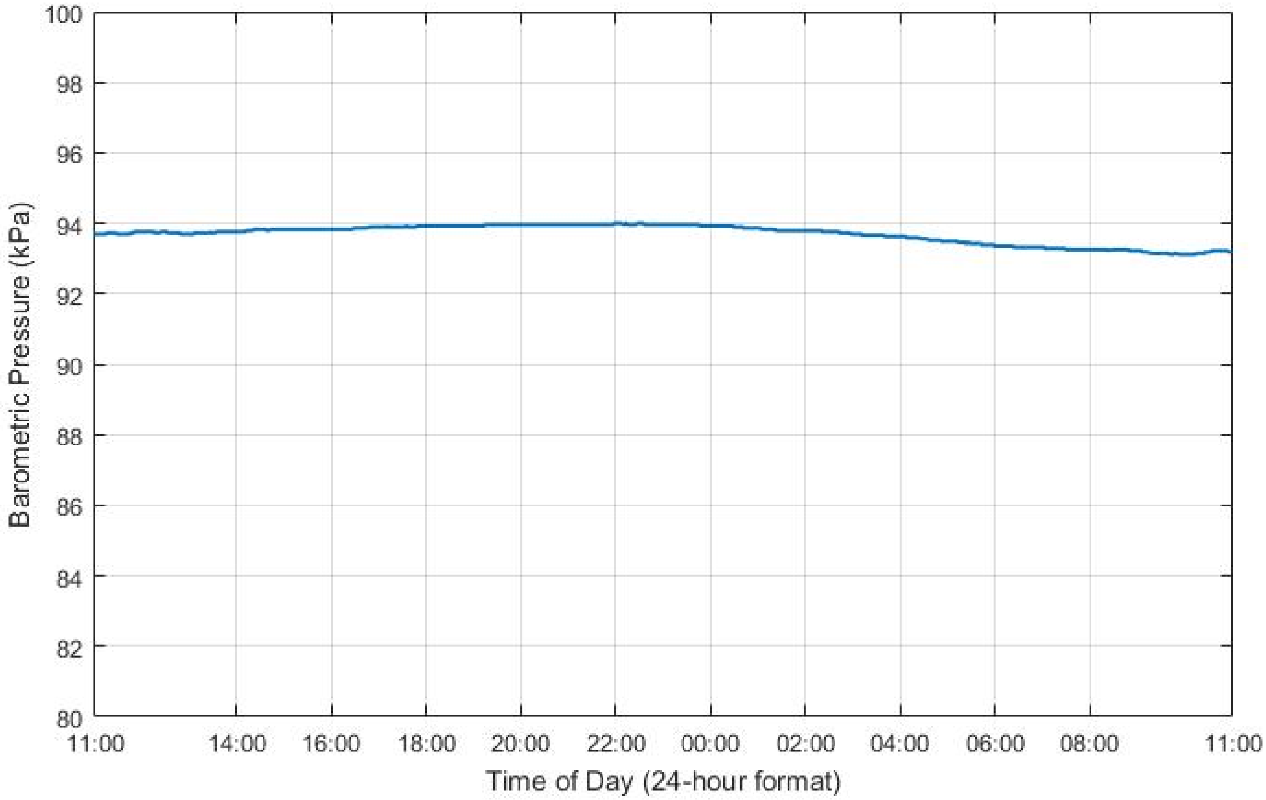
Monitored Wind Direction (October 21 – 22, 2019) at Noise Monitor Location 12



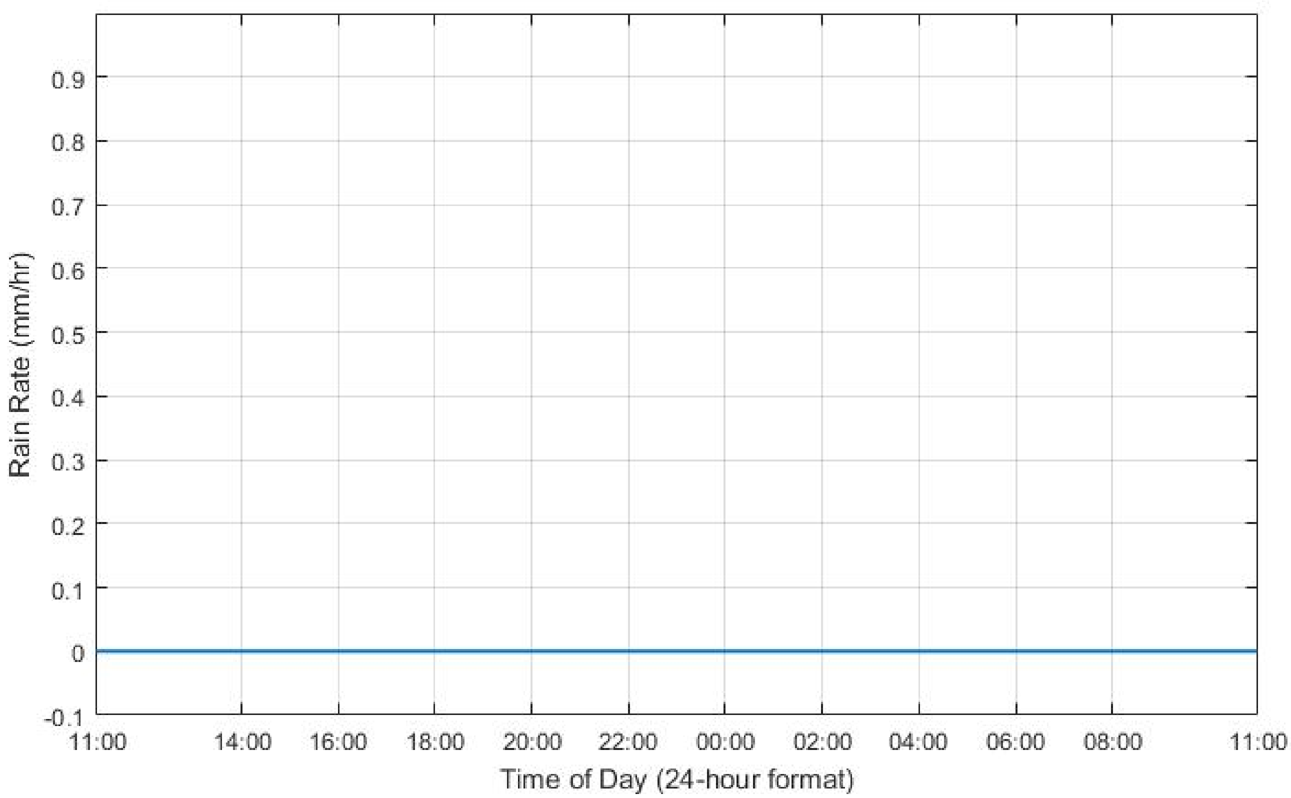
Monitored Temperature (October 21 – 22, 2019) at Noise Monitor Location 12



Monitored Humidity (October 21 – 22, 2019at Noise Monitor Location 12

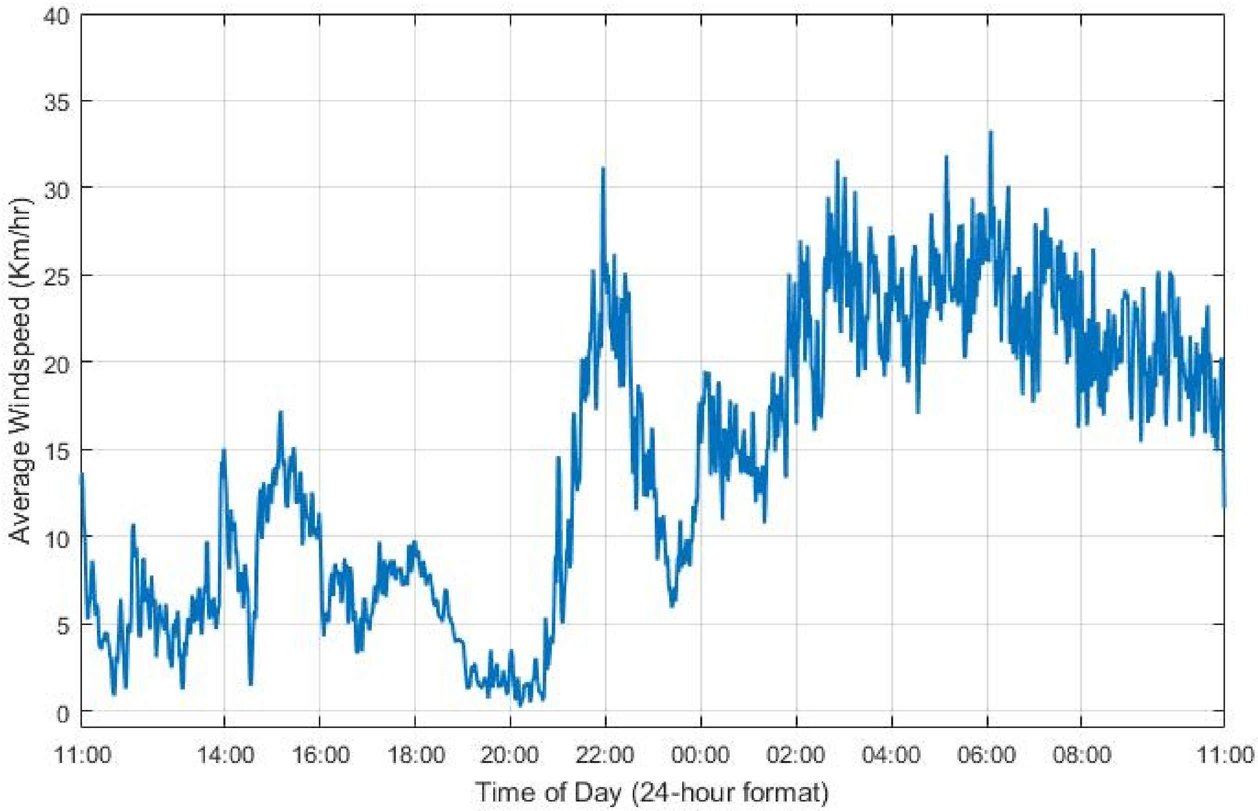


Monitored Barometric Pressure (October 21 – 22, 2019) at Noise Monitor Location 12



Monitored Rain Rate (October 21 – 22, 2019) at Noise Monitor Location 12

October 22 – 23, 2019 Weather Data



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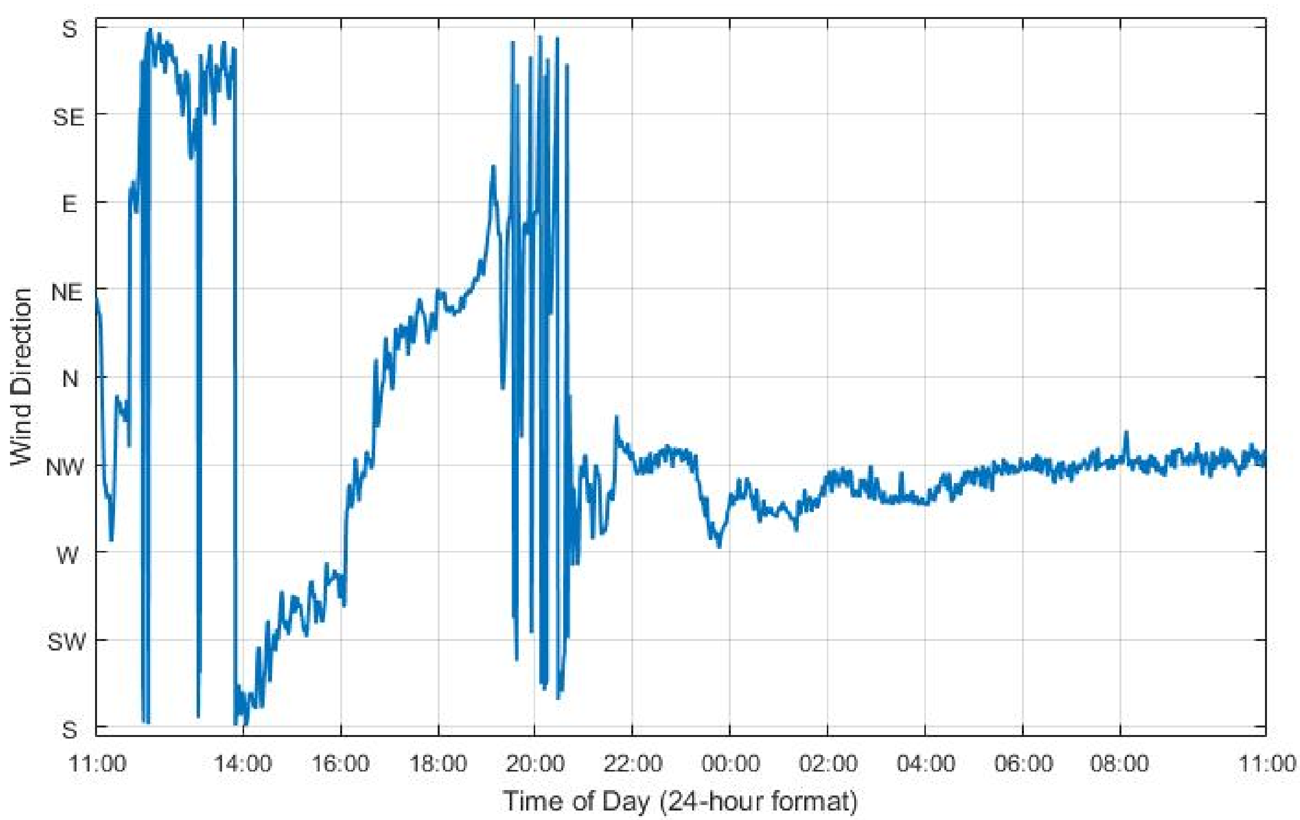

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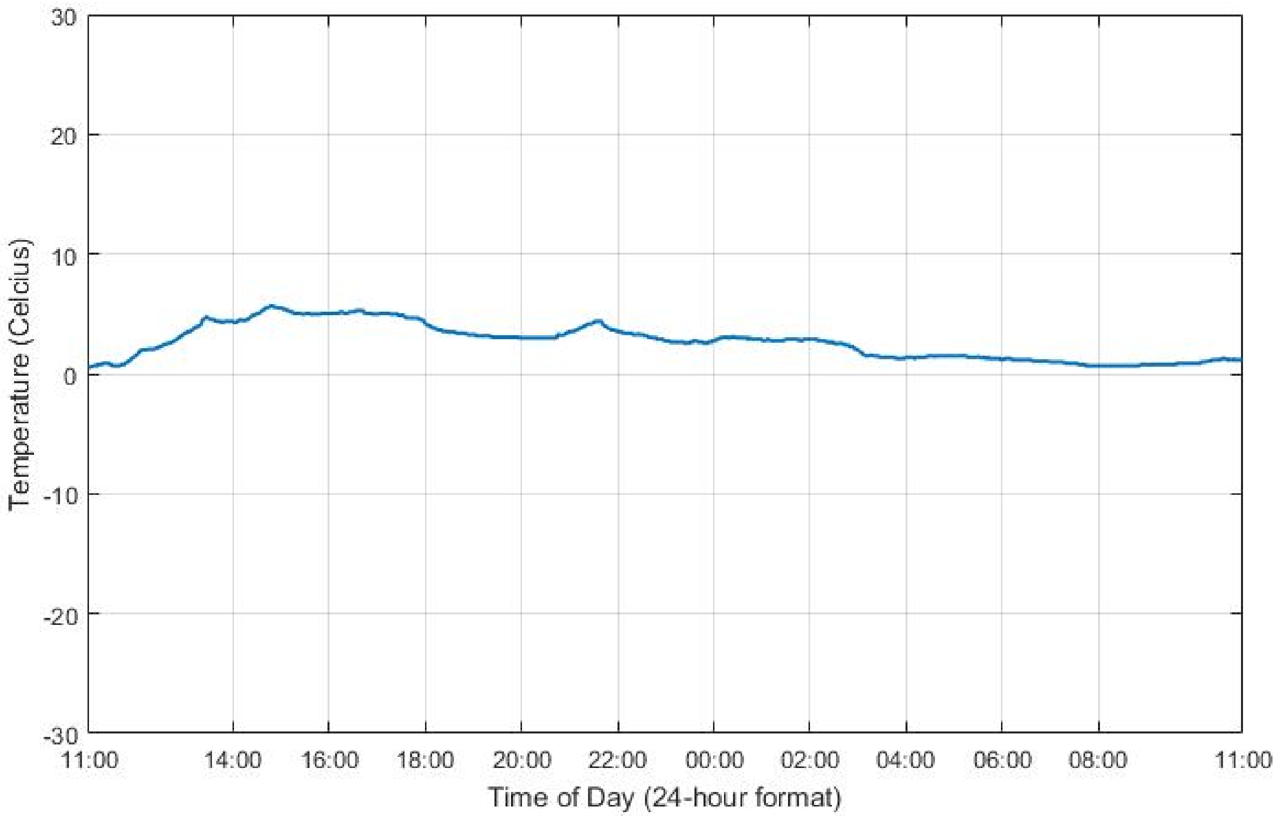
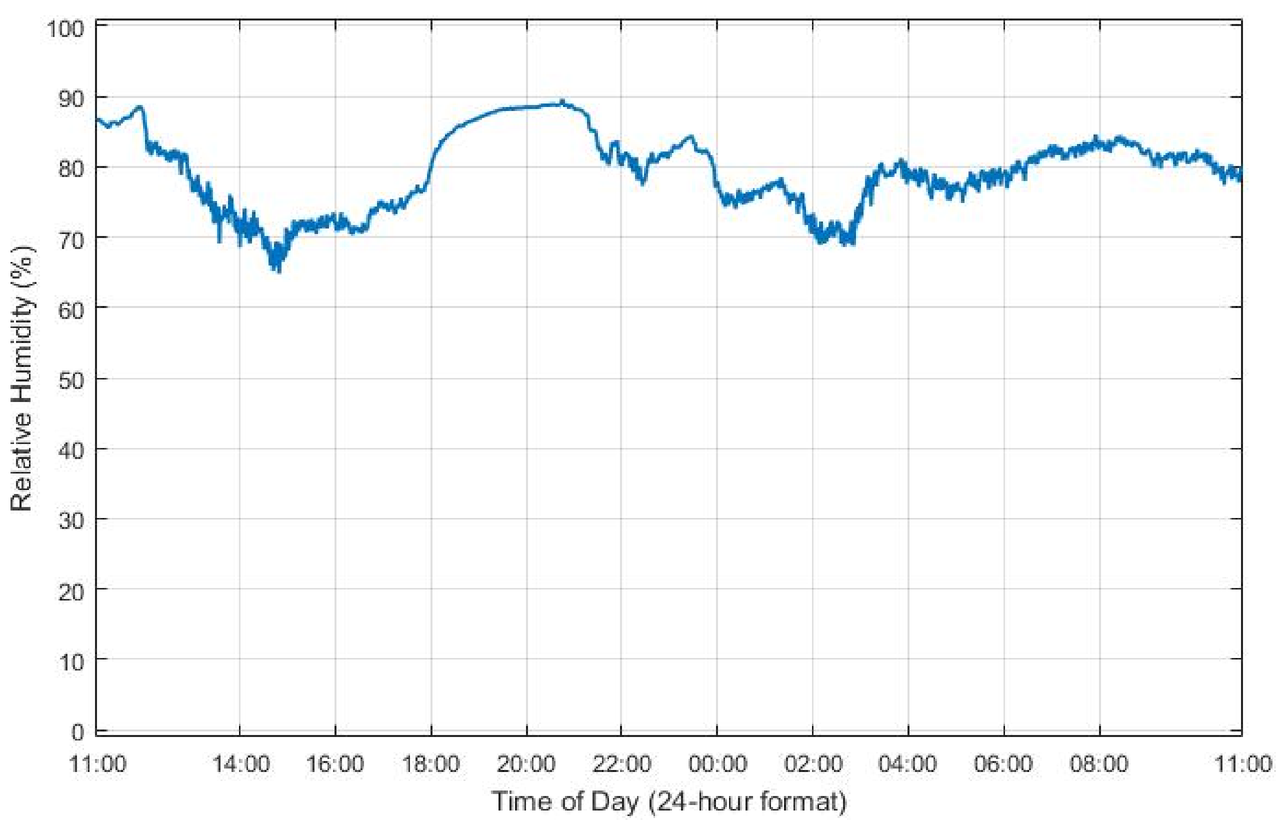
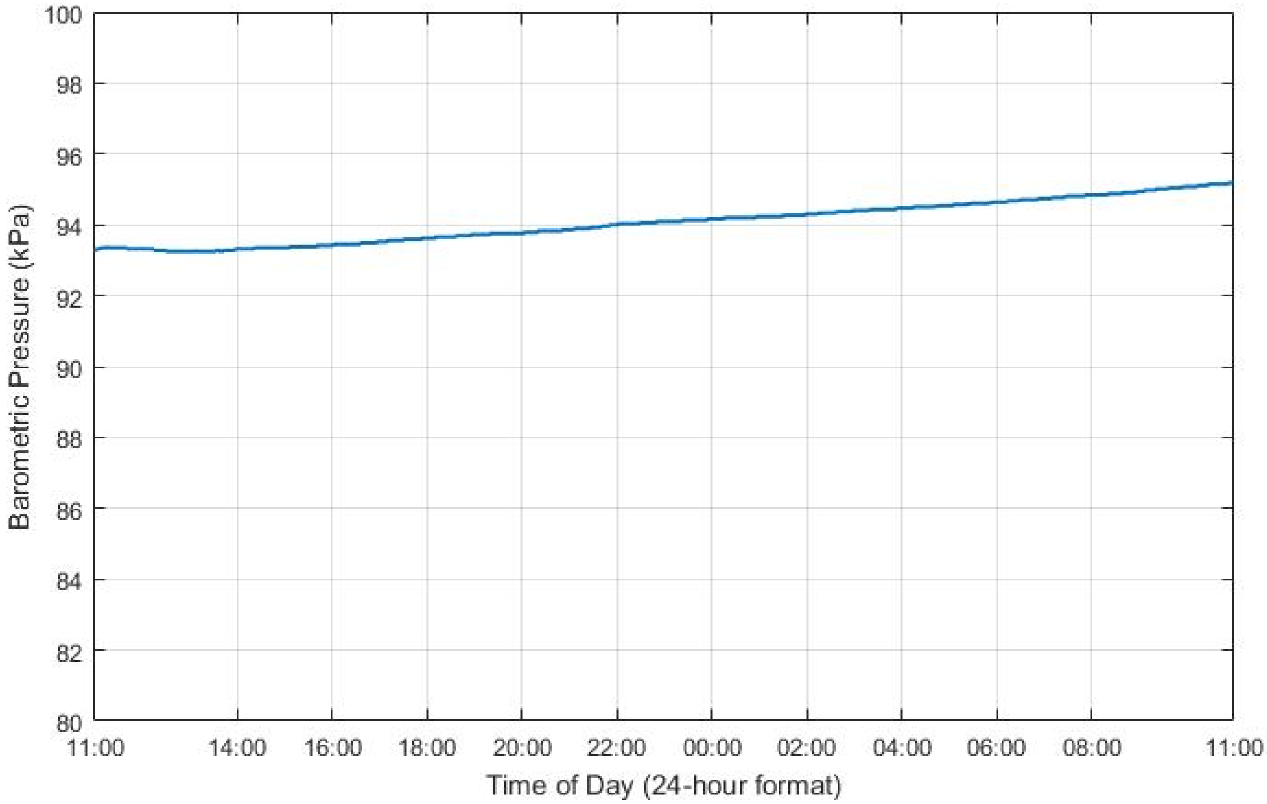


Monitored Temperature (October 22 – 23, 2019) at Noise Monitor Location 4



Monitored Humidity (October 22 – 23, 2019) at Noise Monitor Location 4



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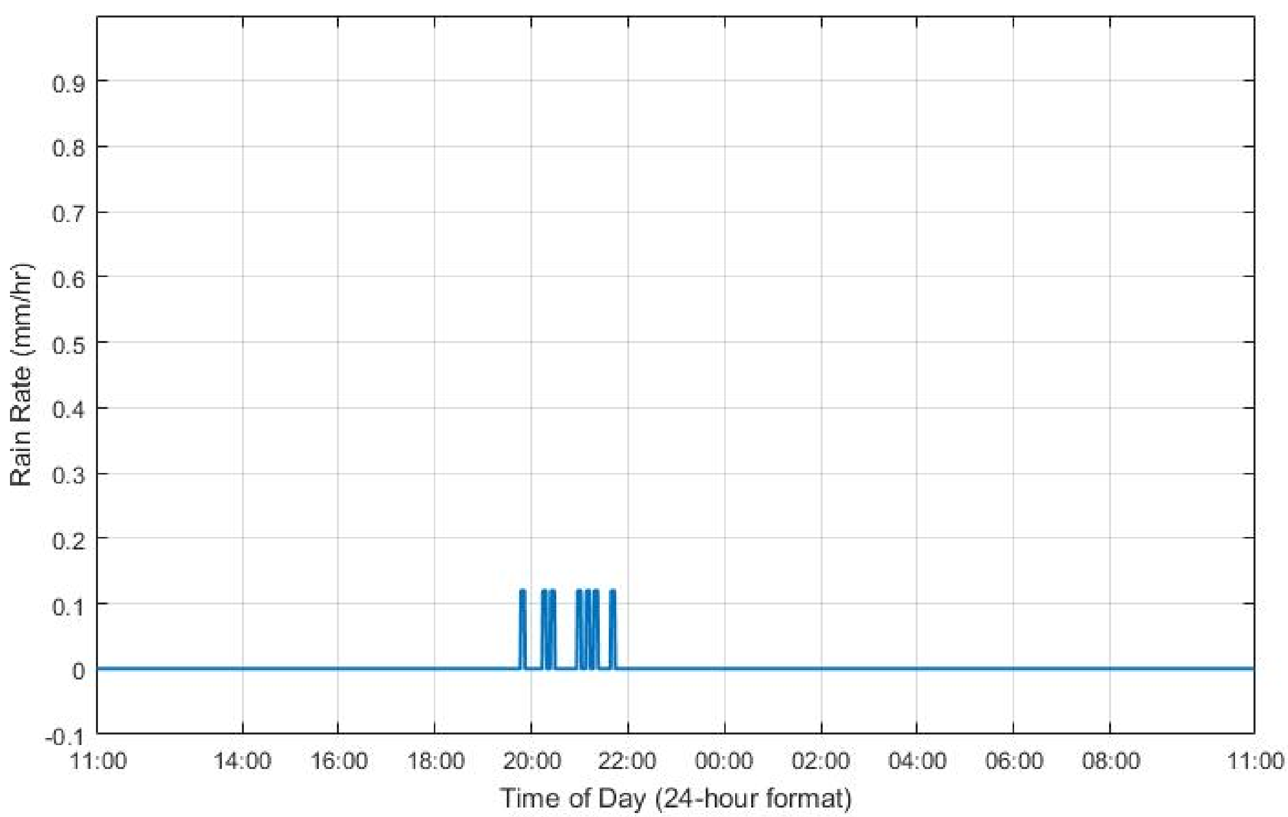
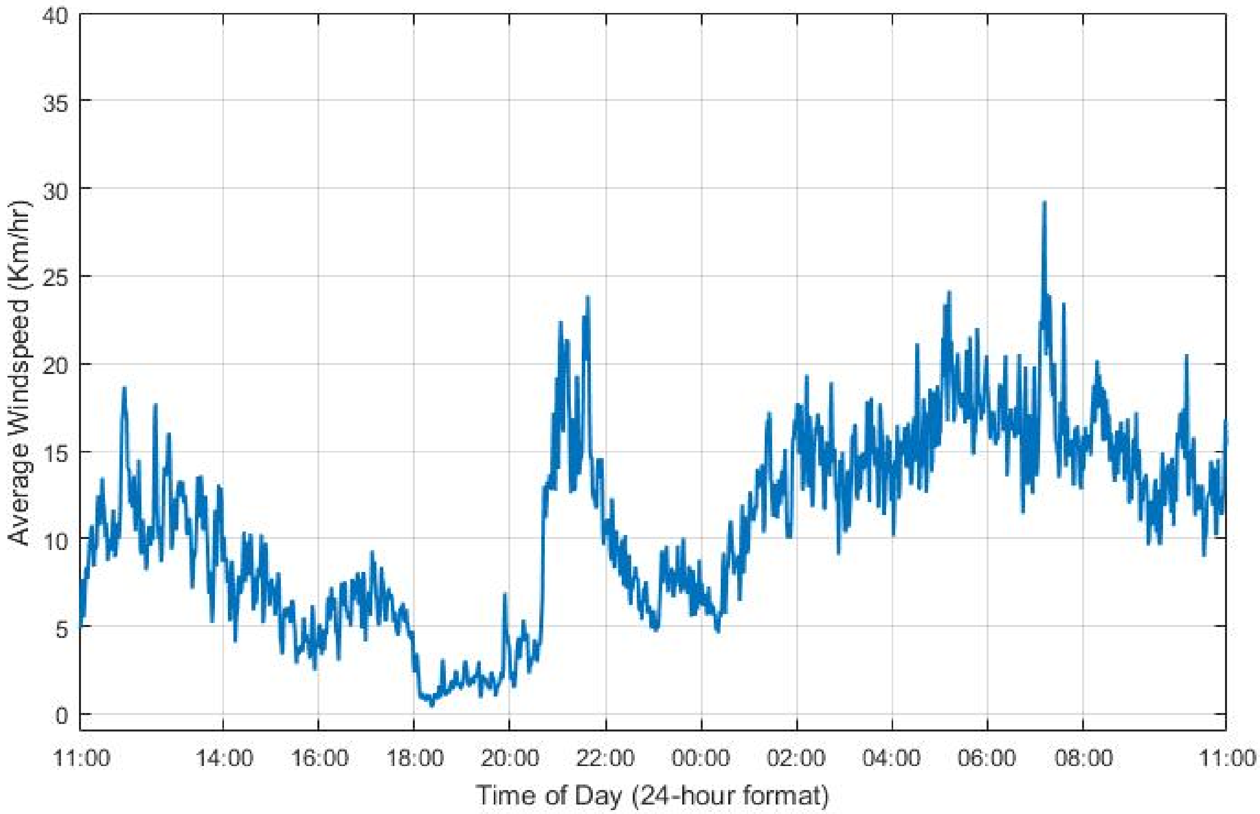
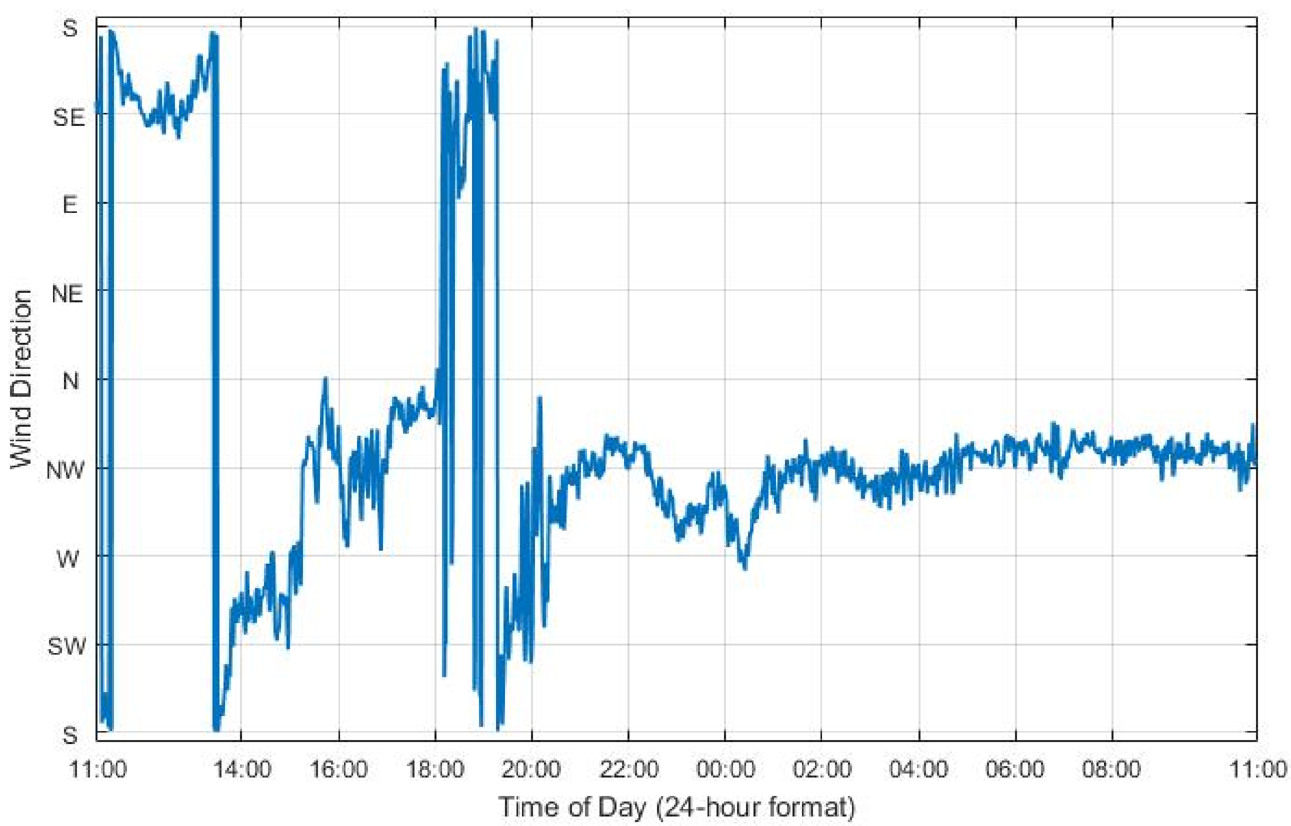


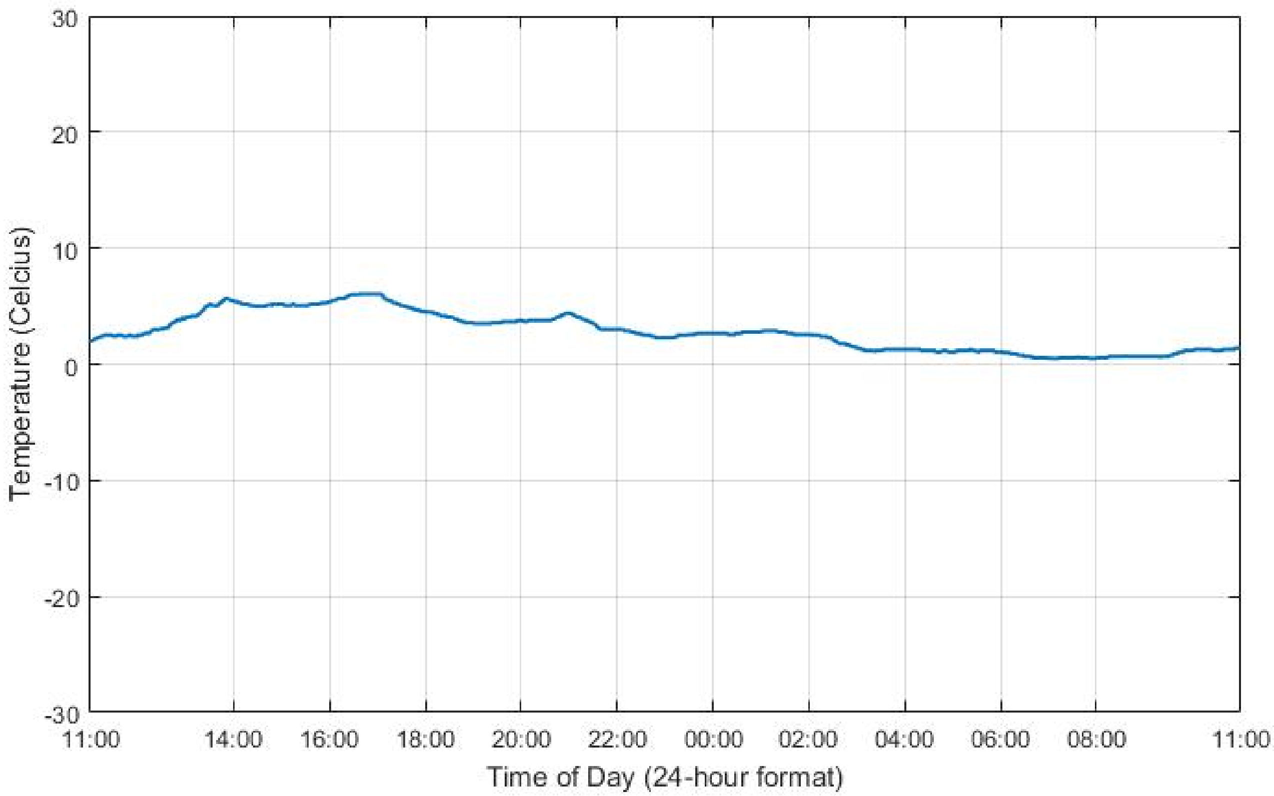
Monitored Rain Rate (October 22 – 23, 2019) at Noise Monitor Location 4



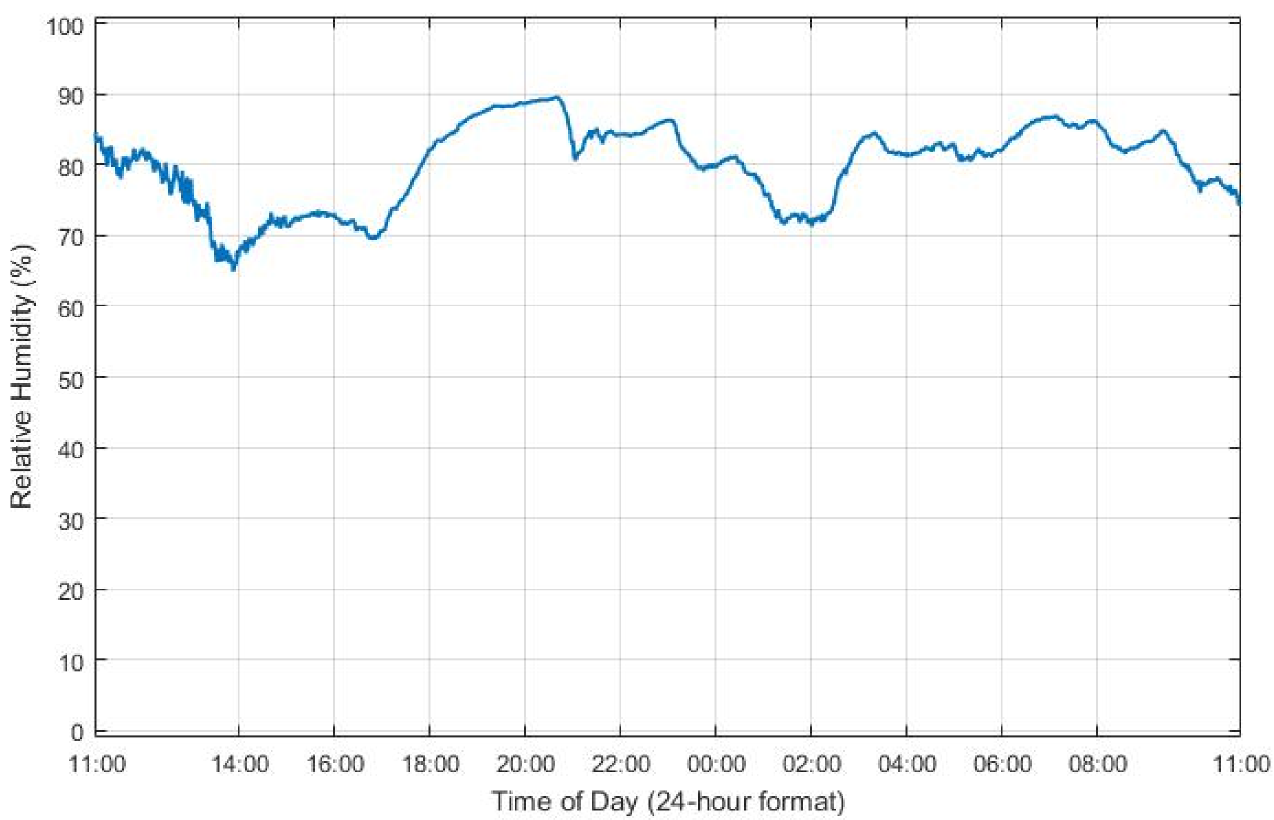
Monitored Wind Speed (October 22 – 23, 2019) at Noise Monitor Location 12



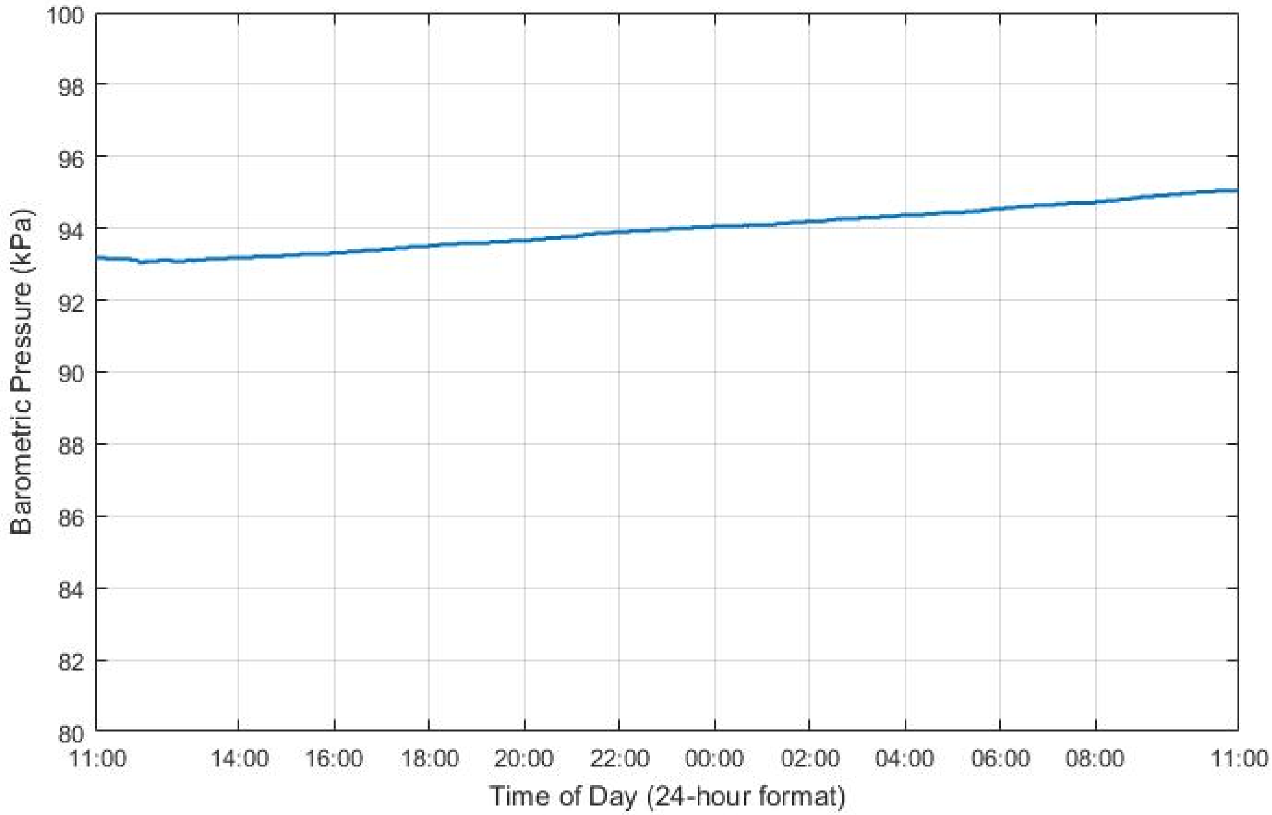
Monitored Wind Direction (October 22 – 23, 2019) at Noise Monitor Location 12



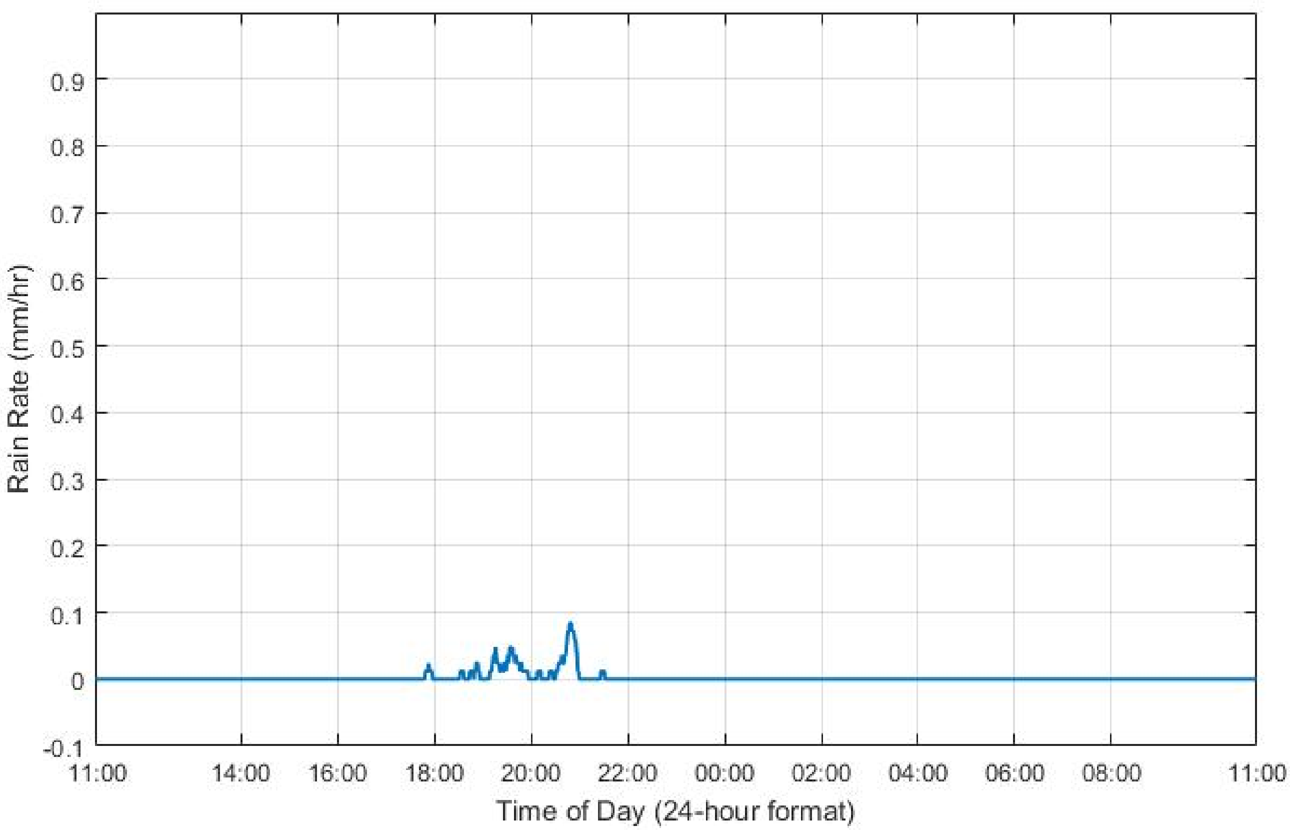
Monitored Temperature (October 22 – 23, 2019) at Noise Monitor Location 12



Monitored Humidity (October 22 – 23, 2019) at Noise Monitor Location 12



Monitored Barometric Pressure (October 22 – 23, 2019) at Noise Monitor Location 12



Monitored Rain Rate (October 22 – 23, 2019) at Noise Monitor Location 12

APPENDIX 3

NCIA Member Company Noise Management Plan Updates for 2019

Air Liquide Canada – Scotford Complex

Note, please provide as much detail as you can for the following, attaching any clarifying or required documents with your submission.

If you have any questions, please call Laurie Danielson @ 780.992.1463

Input Description	Member Site Comments
Confirmation that site has implemented a best management practice to address environmental noise as per NCIA Noise Management Plan Standard 2010-003 issued 3-Sep-10, revised 5-Mar-13, revised 14-Apr-14, revised 31-Mar-16 including the Procedure/Practice/Standard reference. Note, if you have not provided an electronic copy of your site plan to NCIA, please do so.	Signs have been posted to inform of double hearing protection required within plant areas. Annual review of Standard Operating Procedures SFD/CGN-06-101 Hearing Conservation Program to ensure compliance.
Provide a summary of any monitoring (fence line outward completed in 2018. Note, you are not required to conduct any off-site monitoring.	Site Noise survey conducted in July 2013 and provided as attached. No additional equipment/process was added since then.
Disclose any improvements/corrective actions implemented in 2018 or status thereof that would impact the noise level output for your site (either up or down). Did those changes result in a requirement to update your site noise model? If so, have you provided your updated site model to SLR Consulting for incorporation into the NCIA Regional Noise Model as per the process outlined for this purpose?	Continue with Winterization with insulation on critical equipment including outside equipment. No change was made in equipment/process that warrant a new site noise model

Disclose any improvements/projects that are approved for 2019 that would impact the noise level output for your site (either up or down). Will these changes result in a requirement to update your site noise model? If so, when do you anticipate having an updated site model available?	Maintain current program.
Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan in 2018.	A self-audit conducted on the Hearing Protection and Conservative Program. Senior leader in plant reviewed this every 2 years with no findings. Attached is the Hearing Conservation & Protection Program SFD-CGN-06-101 Rev2 Hearing Conserv
Provide a Noise Complaint summary for all noise complaints received in 2018 including any actions taken to address them.	None in 2018

This information is being collected as per the NMP Standard 2010-003 Revised 31-March-2016. All information provided will be disclosed to the AER as part of the required NCIA Annual Reporting on the Regional Noise Management Plan.

Further, the Annual Report will be a public document available on our website once finalized.

This document supersedes the following document(s):

Rev.	Date	Prepared by	Verified by	Approved by	Comments/Changes
0	01 March 2011	Steve Courchesne *Maintenance Manager*	Steve Courchesne *Maintenance Manager*	Abraham Mathew *Plant Manager*	Converted to CGP numbering
1	17 Oct 2013	Josie Doll *Quality & IMS Facilitator*	Robert Harnish *Maintenance Manager*	Terry Fung *Plant Manager*	updated survey maps
2	20 August 2018	Sara Stephens *Quality & IMS Facilitator*	Troy Ayrey *Maintenance Manager*	Terry Fung *Plant Manager*	

This printed procedure/empty form EXPIRES on: 1 November 2019

1. PURPOSE AND SCOPE

The purpose of this Hearing Protection Program is to ascertain that not one of the employees of the Scotford Complex is exposed to noise of such level and duration as to cause possible impairment (permanent or temporary) to his hearing while at this work place.

Scotford Complex Hearing Protection Program is the local application of requirement § 5.3 Hearing Conservation Program, of HSEQ-HEA-002 Hearing Conservation and Protection.

2. RESPONSIBILITIES

Plant Manager

- Investigate practicable options for noise control;
- Prepare, implement, review and update this program annually;
- Supply hearing protection devices;
- Monitor and ensure the wearing of hearing protection in all posted areas;
- Ensure workers attend training;
- Schedule audiometric testing and ensure workers attend audiometric testing;
- Assess new noise sources and arrange for noise measurements if changes in noise Sources.

Employees

- Report noise related concerns to their supervisor;
- Participate in the Hearing Conservation and Protection program;
- Use and care for hearing protection devices where required;
- Participate in the hearing tests;
- Participate in training

Supervisors

- Bring to the attention of the Plant Manager noise related concerns reported to them by their employees;
- Monitor and ensure the wearing of hearing protection in all posted areas.

Quality & IMS Facilitator

- Maintain hearing protection training records

3. NOISE MEASUREMENTS:

Plant Noise Survey

Sound level measurements were taken at a number of locations within the plant both indoors and outdoors.

Attached figures 1 to 4 illustrate the sound levels measured throughout the Scotford Site in the form of color-contoured noise maps. Figure 1 is a noise map of the exterior noise levels on the Scotford Site grounds and Figures 2 to 4 are noise maps of buildings where interior noise levels are displayed.

The highest noise level is inside the ASU building with noise levels registering well above 100 dB(A); the remainder of the buildings and exterior grounds registered noise levels below 100 dB(A). The administration building's interior noise levels are not included in the figures due to the small measurement area making a noise map difficult to produce, however, the noise levels measured inside public areas of the administration building were less than 55 dB(A) on the ground floor (including the maintenance shop) and less than 50 dB(A) on the second floor.

Two isolated interior noise levels are not reported on the noise maps. Those levels are reported as follows: inside the contractor's lunch trailer a noise level of 58 dB(A) was measured and inside the CB/AR MODIN unit a level of 62 dB(A) was measured.

Figure 1
Note that the exterior areas where noise levels are greatest are near the meters/valves underneath the pipe rack north of the scales (96dBA)and near the ASU building's west overhead door (94dBA)

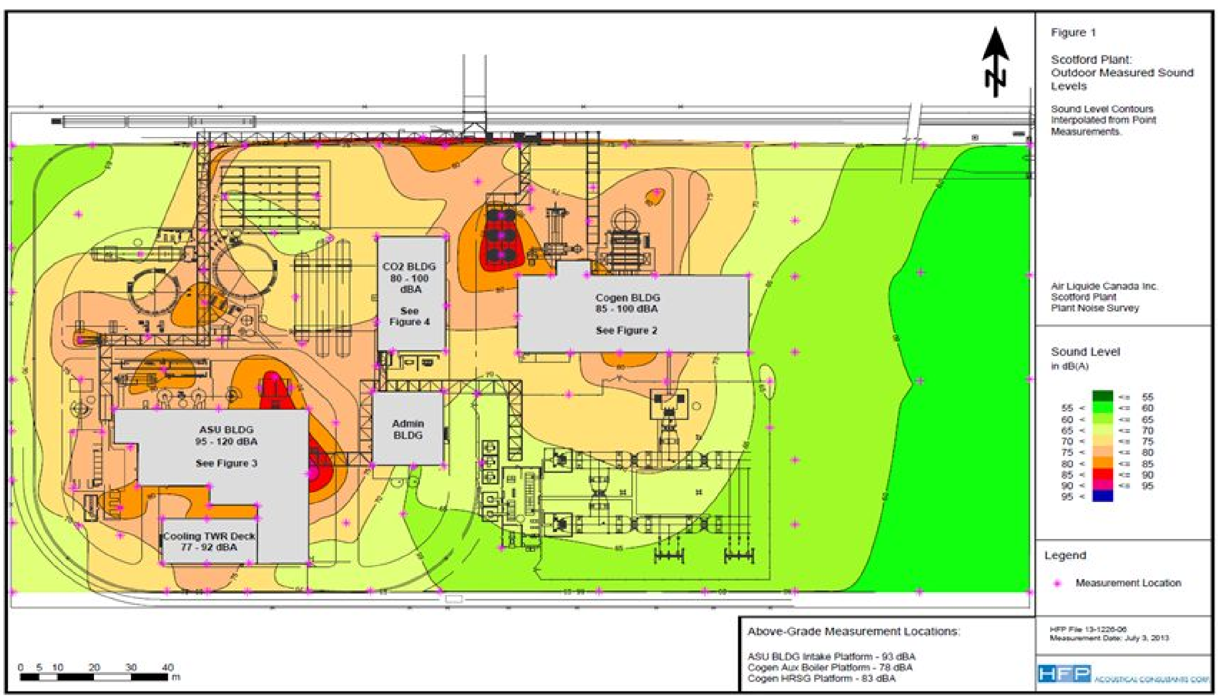


Figure 2

All measurement points located on the expander and the MAC/BAC were taken on the platforms around the equipment. The largest contributor to the overall noise levels measured inside the ASU building is the MAC/BAC. The noise level measured on the east side of the unit was 118 dB(A).

Figure 3

Note that inside the CO2 Plant, the areas where noise levels are greatest are to the north of the NH_3 Compression skid and the CO_2 Compression Skid. Noise levels in those areas were measured at 98 dB(A) and 94 dB(A), respectively

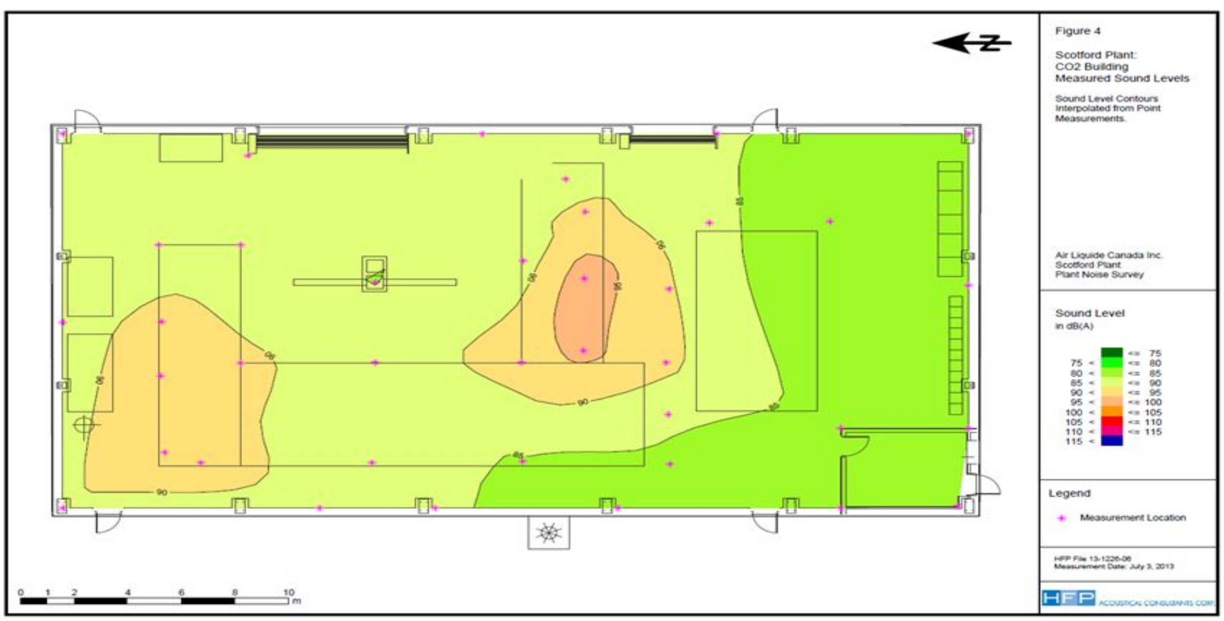
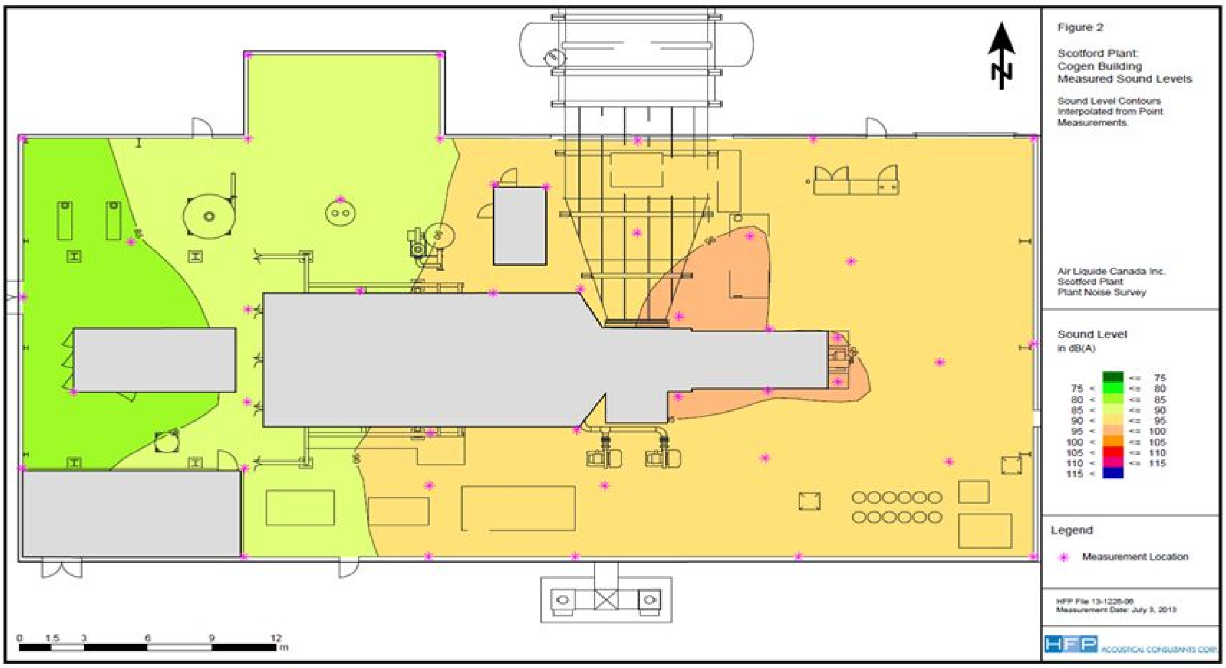


Figure 4

Note that the noise levels inside the COGEN building are greatest near the gas turbine exhaust to the HRSG Stack. The noise levels in that vicinity range from 95 dB(A) to 97 dB(A). The only exception is inside the Gas Valve Mod enclosure where a noise level of 100 dB(A) was measured.



Exposure Level

Exposure level tests have been performed to monitor the exposure of the operators and technicians to noise. The following table describes the exposure level of typical shifts and tasks.

NOISE EXPOSURE OF WORKERS

Scotford site

Job name	Number of workers	Leq dB(A)	Shift duration (hours)	Lex dB(A)	Comments	OK with Regs? (Y/N)	Recommendations
ASU shift (Day & Night)	1	98	24	95	Correction to 12hr shift	N	Grade 3 or Class A HP; Hearing Protection and Prevention Program

Cogen day shift	1	91.8	8	93.3	Correction to 12hr shift	N	Grade 2 or Class B HP; Hearing Protection and Prevention Program
CWP strainer cleaning	2	92.1	1	102.7	Correction to 9hr shift	N	Grade 4 or Class A HP; Hearing Protection and Prevention Program

4. EDUCATION AND TRAINING

All new employees receive information on the effects of noise on hearing, use and maintenance of hearing protection and purpose of the hearing tests during the safety orientation program.

A PowerPoint Presentation on the results of the noise survey, proper use and maintenance of hearing protection and a video on the impact of noise on hearing and hearing testing are reviewed every year with all the employees at risk.

(http://www2.worksafebc.com/Publications/Multimedia/Videos.asp?reportid=34284)

Records of training are recorded by the Quality & IMS Facilitator and kept in the employee's training file.

The audiologist performing audiometric testing will review the selection, care and use of hearing protection with each employee during the audiometric testing.

5. HEARING PROTECTION

Disposable foam earplugs and earmuffs are provided at the plant to the employees and visitors. These hearing protections are available in the Administration building.

The fit and condition of hearing protection is also checked by the audiologist mandated to perform the hearing tests.

Company policy is that hearing protection must be worn by all employees working in a noisy area (which are all posted with warning signs). Because of the high noise level (117 dB(A)), the double hearing protection is mandatory in the ASU building.

6. POSTING OF NOISE HAZARD AREAS

All areas with noise levels greater than 85 dB(A) have been posted with warning signs indicating hearing protection is required (Cogen and CO_2 plant). Double hearing protection signs have been posted on each door of the ASU building. These signs are checked by operation on routine inspections and replaced if necessary.

7. HEARING TESTS

As a result of the noise exposure survey, occupations with noise exposed workers have been identified (see table 1).

Baseline hearing tests are carried out within 70 days on all employees transferred and/or hired into a job where there is potential of exposure to noise levels exceeding 85 dB(A) Lex. Hearing tests are conducted every two years. We are also offering testing to workers that are not exposed to hazardous noise. The schedule for these tests is drawn up by the Plant Manager who ensures all workers attend their tests.

The results of these tests must be given to the employees. In the event copy of a worker's audiometric test is obtained, the Human Resources Department shall keep copy of the audiometric test in the worker's file, as it is medical records. All tests shall be maintained according to confidentiality principles and all applicable laws.

8. ANNUAL PROGRAM REVIEW

Hearing tests participation, statistics, hearing protection use trends and suggestions for improvement are reviewed annually. Any employees with Early Warning Change category receive additional coaching on the use of hearing protection.

In addition, the checklist found in Appendix A of the procedure HSEQ-HEA-002.1 Hearing Conservation and Protection Program Template is used to verify that all necessary program components have been addressed.

The records of the annual review are maintained in Intelex and the information is shared with employees during safety meetings.

Aux Sable Canada:

Note, please provide as much detail as you can for the following, attaching any clarifying or required documents with your submission.

If you have any questions, please call Laurie Danielson @ 780.992.1463

Input Description	Member Site Comments
Confirmation that site has implemented a best management practice to address environmental noise as per NCIA Noise Management Plan Standard 2010-003 issued 3-Sep-10, revised 5-Mar-13, revised 14-Apr-14, revised 31-Mar-16 including the Procedure/Practice/Standard reference. Note, if you have not provided an electronic copy of your site plan to NCIA, please do so.	Aux Sable has implemented a best management practice to address environmental noise and has retained Patching Associates Acoustical Engineering Ltd. to support the program. The program has been designed and is audited to meet NCIA standard 2010-003 31-Mar-16. The Aux Sable plan has been provided to the NCIA.
Provide a summary of any monitoring (fence line outward completed in 2019. Note, you are not required to conduct any off-site monitoring.	There were no noise measurements completed outside the facility fence line in 2019.
Disclose any improvements/corrective actions implemented in 2019 or status thereof that would impact the noise level output for your site (either up or down). Did those changes result in a requirement to update your site noise model? If so, have you provided your updated site model to SLR Consulting for incorporation into the NCIA Regional Noise Model as per the process outlined for this purpose?	There were no changes to the facility in 2019 that would impact the site noise level output of the site. The current noise model for the facility based on 2016 and 2017 measurements was submitted to SLR in June 2018. There is no current requirement to update the noise model.

Disclose any improvements/projects that are approved for 2020 that would impact the noise level output for your site (either up or down). Will these changes result in a requirement to update your site noise model? If so, when do you anticipate having an updated site model available?	There are no improvements or planned projects that will impact the noise levels in 2020.
Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan in 2019.	A sound study was completed in May 2019. This study found that there were no significant changes to the facility and was reviewed by senior site leaders. Full documentation is available on request.
Provide a Noise Complaint summary for all noise complaints received in 2019 including any actions taken to address them.	There was no noise complaints received in 2019.

This information is being collected as per the NMP Standard 2010-003 Revised 31-March-2016. All information provided will be disclosed to the AER as part of the required NCIA Annual Reporting on the Regional Noise Management Plan.

Further, the Annual Report will be a public document available on our website once finalized.

NCIA Northeast Capital Industrial Association	NCIA Standards and Guidelines	Document Number 2010-003	
Noise Management Plan Reporting Requirements as per Section 5.4 of this Standard		Rev. Date 31-March 2016	Rev. 0

CENOVUS ENERGY INC (BRUDERHEIM ENERGY TERMINAL)

Note, please provide as much detail as you can for the following, attaching any clarifying or required documents with your submission.

If you have any questions, please call Laurie Danielson @ 780.992.1463

Input Description	Member Site Comments
Confirmation that site has implemented a best management practice to address environmental noise as per NCIA Noise Management Plan Standard 2010-003 issued 3-Sep-10, revised 5-Mar-13, revised 14-Apr-14, revised 31-Mar-16 including the Procedure/Practice/Standard reference. Note, if you have not provided an electronic copy of your site plan to NCIA, please do so.	Company wide Cenovus manages noise through an internal “Hearing Conservation Practice (see attached)”. The hearing conservation program has the following elements: 1. Worker education and training 2. Facility Noise Survey 3. Personal Exposure assessment 4. Noise control strategies 5. Audiometric testing 6. Annual review of program Roles and responsibilities are clearly defined in the practice as well as training and records management. Given the size of the Brudereheim Energy Terminal we believe the Cenovus internal practice document is sufficient to meet the requirements of the NCIA Standards and Guideline document for a noise management plan.
Provide a summary of any monitoring (fence line outward completed in 2019. Note, you are not required to conduct any off-site monitoring.	In 2019 a noise impact assessment was completed by SLR in response to the licensing (by AER) of an injection building in the Manifest area of the Bruderheim Energy Terminal. The terminal noise model was also updated as part of this program. Predicted sound levels were estimated to be lower than permissible sound levels determined using AER Directive 38.
Disclose any improvements/corrective actions implemented in 2019 or status thereof that would impact the noise level output for your site (either up or down). Did those changes result in a requirement to	No significant changes to operation of the terminal in 2019. As discussed above the noise model was updated as part of the licensing of an injection building at the eastern (Manifest) area of the terminal.

update your site noise model? If so, have you provided your updated site model to SLR Consulting for incorporation into the NCIA Regional Noise Model as per the process outlined for this purpose?	

Disclose any improvements/projects that are approved for 2020 that would impact the noise level output for your site (either up or down). Will these changes result in a requirement to update your site noise model? If so, when do you anticipate having an updated site model available?	Activity at the terminal (rail traffic) is expected to be lower in 2020 than 2019. No updates to site noise model are required.
Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan in 2019.	No audit/self-assessment completed. Site noise survey for operator exposure was completed in May 2019
Provide a Noise Complaint summary for all noise complaints received in 2019 including any actions taken to address them.	No noise complaints received.

This information is being collected as per the NMP Standard 2010-003 Revised 31-March-2016. All information provided will be disclosed to the AER as part of the required NCIA Annual Reporting on the Regional Noise Management Plan.

Further, the Annual Report will be a public document available on our website once finalized.

Hearing Conservation Code of Practice

H&S Discipline	Industrial Hygiene		
Custodian	H&S Programs & Projects		
Program Category	Industrial Hygiene		
Program	Hearing Conservation		
COMS	See COMS Standards		
Document Number	CEN-EHS042		
Version	4.0	**Review Cycle**	3 years
Revised Date	January 16, 2017	**Issued Date**	February 28, 2007

Revision History

Version	Description	Date	Approver
4.0	Updated template, reviewed for regulatory updates (review cycle)	2017-01-17	Manager, Central H&S Services
3.0	Updated practice to align with regulation changes	2013-03-19	Manager, Central H&S Services

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1.0 Purpose

The purpose of the Hearing Conservation Code of Practice (COP) is to set a minimum standard to protect personnel working or visiting Cenovus Worksites from developing noise-induced hearing loss (NIHL).

2.0 Scope

The Hearing Conservation COP applies to all Cenovus worksites and encompasses all Cenovus work activities.

Contractors working on a Cenovus worksite are responsible for developing, implementing and evaluating the effectiveness of their own hearing conservation program that meets or exceeds Cenovus's expectations.

3.0 Noise and NIHL

Noise is unwanted sound. Both preferred sound (e.g. music) and noise can be dangerous to an individual's hearing.

When an individual is exposed to loud noise, the ear's sensitivity level decreases as a measure of protection – this is known as a threshold shift. In general there are two types of shifts that may occur:

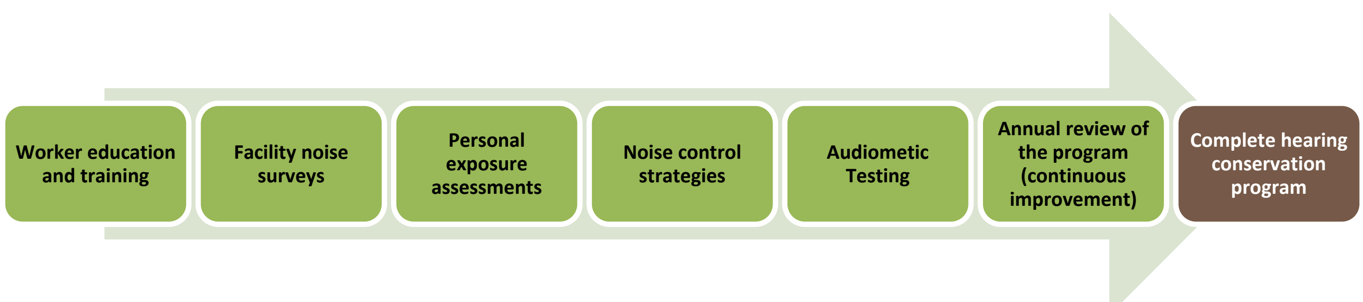
- Temporary Threshold Shift – hearing sensitivity is temporarily reduced after sudden exposure to high level of noise. Temporary hearing loss typically lasts up to 24-hours but may last a couple of weeks.
- Permanent Threshold Shift – hearing sensitivity is reduced permanently due to irreversible damage to specialized cells in the ear. This is typically a result of chronic exposure to loud noise. NIHL is an example of permanent threshold shift that occurs over time.

An individual's risk of developing NIHL increases as the intensity (i.e. sound pressure level), duration and frequency of exposure increase.

4.0 Hearing Conservation Program

Alberta and Saskatchewan OH&S legislation stipulates that employers establish a hearing conservation program at worksites where workers are exposed to excess noise (85 dBA L_{EX}). The conservation program must include the following components:

Figure 1: Components of hearing conservation program



4.1 Worker Education and Training

Cenovus employees who are or may be exposed to noise are required to complete the Hearing Conservation eLearning on LMS. In the course, employees will be educated on:

- Noise sources at their worksite;
- Health effects of exposure to noise;
- How to manage noise exposures;
- How to select, wear, and care for hearing protection devices; and
- Requirements to participate in audiometric testing.

4.2 Facility Noise Survey

A facility noise survey must be conducted by a competent person using equipment in accordance with regulatory requirements.

Facility noise survey must be conducted routinely as determined by Occupational Health, or when one of the following occurs:

- New work sites or buildings have been commissioned
- Significant physical alterations, renovations, or repairs to an existing work area (e.g. deviation from design) have been made
- New work processes or changes to existing work processes have been introduced
- Additional equipment has been introduced into the work area
- Noise complaint

4.3 Personal Exposure Assessment

In accordance with *Cenovus Industrial Hygiene Management Practice*, workers identified to work in a noisy work environment will be placed in a noise hazard similar exposure group (SEG), and noise exposure assessments will be conducted for the SEG by a competent person. The results of exposure assessments will help determine whether audiometric testing is required.

4.4 Noise Control Strategies

Cenovus will take reasonably practicable measures to reduce workers exposure to noise at Cenovus worksites by implementing control strategies in the following order:

1. Elimination of Noise
2. Engineering Controls
3. Administrative Controls
4. Personal Protective Equipment

In some cases, a combination of these control strategies may be required.

4.4.1 Elimination of Noise

Design, construct, and purchase new equipment and/or work areas where continuous noise levels generated is as low as reasonably practicable.

4.4.2 Engineering Controls

If elimination of noise is not reasonably practicable. Engineering controls should be considered to reduce noise generation. Examples of engineering controls include installation of mufflers, noise dampening devices, and/or enclosing noise-generating equipment.

4.4.3 Administrative Controls

Administrative controls refer to mitigation strategies that reduce a worker's exposure by imposed rules and procedures, such as the implementation of a preventative maintenance program, limiting time spent in a noisy environment, and the posting of noise signage.

Noise signage shall be posted at all access points to buildings and/or work areas where noise levels are elevated as below:

Warning Signage & Hearing Protection Requirements	**Occupational Noise Levels**	
	Alberta	Saskatchewan*
"Hearing Protection Required for Entry" (or equivalent)	≥ 85 dBA	≥ 80 dBA
"Double Hearing Protection Required for Entry" (or equivalent)	≥105 dBA	≥ 105 dBA

*In Saskatchewan, the warning signage must also include the range of noise levels measured (e.g. 87 – 93 dBA).

Unprotected personnel (i.e. without hearing protection devices) shall not be exposed to a maximum noise level exceeding 115 dBA at any time.

4.4.4 Personal Protective Equipment

Hearing protection should be used in conjunction with engineering and administrative controls. At Cenovus worksites, workers must only use CSA Class A hearing protection devices.

For illustration, the proper way of wear soft foam earplugs is shown in Appendix A.

In buildings and/or work areas with posted noise warning signage and hearing protection requirements or where noise levels are suspected to be high, hearing protection must be worn even if exposure is brief. If one need to raise one's voice to be heard at arm's length, the noise levels in the area is likely exceeded 85 dBA.

4.5 Audiometric Testing

It is a legislated requirement that a worker who is or may be noise-exposed be evaluated through a standardized test (audiometric test) to track the health of the workers hearing.

Audiometric testing must be performed by a qualified audiometric at the schedule below:

- Initial baseline as soon as possible but no later than 6 months of employment
- Follow-up testing within 12 months of the baseline testing
- At least every 2 years after the follow-up testing

Cenovus Occupational Health & Wellness (OH&W) will maintain audiometric testing records for Cenovus employees. The test results are considered medical records and will remain confidential and be retained at a minimum 10 years. Employees can request audiometric testing results through OH&W if required.

The impacted worker will be notified if an abnormal shift in hearing has occurred. A physician will review the results and recommend a Workers Compensation Board (WCB) claim be submitted.

4.6 Annual Review of Program

The Hearing Conservation Program will be reviewed on an annual basis to determine program effectiveness and ensure the information remains accurate and reflects industry best practices.

5.0 Roles and Responsibilities

The following responsibilities apply to this practice:

Table 1: Roles and Responsibilities

Role	Description
Cenovus Leadership	• Commission, develop, review, and approve a COP for Hearing Conservation • Ensure all practices will be reviewed and updated on a three-year cycle or more frequently as required
Asset Team and Site Leadership	• Ensure that all facilities under their control comply with the requirements of this COP and associated procedures. • Provide resources for facility design, construction, and maintenance that minimizes the generation of elevated noise levels • Ensure training is provided to Cenovus employee

Role	Description
	potentially exposed to noise • Keep records of employee training in the Learning Management System (LMS)
Cenovus Supervisors	• Communicate noise control practices and procedures to affected workers • Ensure that the appropriate PPE is available • Ensure that employees use PPE when required • Respond to worker questions directly or by seeking additional feedback from H&S personnel • Provide feedback to the asset team and corporate management concerning the value and effectiveness of this COP and all associated procedures • Ensuring that workers have been oriented to the hazards of noise and the controls that are in place. The Learning Management System (LMS) or other suitable means to track competency may be used for this purpose • Ensuring that contractors engaged to do work on Cenovus's behalf have practices to manage noise exposures that the contractor's employees may encounter while working on Cenovus worksites • Applying the COP to worksites under their control and establishing the necessary competencies for those who may be engaged to support the development and implementation of the COP requirements
Cenovus Workers	• Familiarize themselves with this COP and all associated procedures • Being aware of the noise sources in the work area and adhering to the controls that are in place to protect their health and safety • Apply recommended practices and procedures, including PPE • Seek clarification concerning any practice or procedure through their immediate Supervisor • Reporting to their Supervisor concerns and/or unusual conditions which may occur during the work, and stopping the work if necessary

Role	Description
Contractors	• Review any practices and procedures provided to them by Cenovus. • Apply information from practices and procedures as minimum work standards as appropriate to their work situation. • Seek clarification concerning any Cenovus practice or procedure through their immediate Supervisor. • Implement their own hearing conservation program.
Operations Health & Safety	• Assist the asset team in complying with this COP and all associated procedures. • Respond to questions or concerns relating to the interpretation of this COP and all associated procedures. • Provide assistance to the asset team regarding appropriate noise surveys.
Occupational Health & Wellness	• Conduct facility noise surveys and personal noise exposure assessments • Coordinate audiometric testing • Coordinate submission of WCB claims • Review and provide continuous improvement on the COP.

6.0 Training and Competency

Competency describes the knowledge and skills required to successfully perform the technical aspects of a job. A worker must be able to demonstrate competency in safely performing work tasks or using equipment.

6.1 Training

It is expected that all personnel involved in this process will have training and the appropriate competency to perform their roles. Cenovus expectations related to this process are outlined in H&S Training Matrix.

6.2 Competency Verification

Competency will be validated through formal, theory-based evaluations and practical skill demonstration. All theory-based training requires a written knowledge check (e.g. test, quiz, exam) that will be reviewed and assessed by a competent instructor.

Practical skill assessments of task completion and equipment use must be conducted by a competent supervisor or mentor.

Workers may be required to attended additional training sessions or complete further on-the-job training if performance deficiencies are identified through formal assessments.

All written evaluations and practical skill assessments must be documented and retained in the worker's personnel file. Records may be maintained in hard copy or electronically.

7.0 Records Management

All records created within this program are considered critical and require permanent retention.

8.0 Quality Assurance

8.1 Performance Measurement

Compliance with this practice and program effectiveness shall be assessed through program assessments and internal audits, or other measurement criteria as specified in the COMS Assurance Standard. Measurement can also be accomplished through the tracking of appropriate Key Performance Indicators (KPI).

Business functions or departments impacted by this practice must include compliance and program effectiveness verifications in their business assurance program. Performance will be monitored and reported within the responsible departments at least every three years.

Central Health and Safety Services will review Cenovus-wide program KPIs at a minimum every three years in conjunction with program review and update activities.

8.2 Management of Change

Proposed changes to this practice can be directed to H&S Programs and Projects.

8.3 Practice Verification

The document owner will complete and document reviews of this practice, as follows:

- At minimum once every three years
- If there is a significant regulation or industry best practice change that indicates the need for review
- If an incident investigation indicates the causes were related to unclear or inadequate written instructions described within this practice

If frequent and multiple variances are required due to operational needs, the reason(s) will be investigated and the document owner will determine if there is a business need to update the practice.

If submitted MOC requests indicate gaps or significant improvement opportunities, the document owner will determine if there is a business need to update the practice.

9.0 References

The following definitions and acronyms are specific to this document:

Table 2: Terms and Definitions

Term	Definition
Noise induced hearing loss (NIHL)	Hearing loss due to unsafe exposure to loud sounds
85 dBA L_{ex}	Alberta's and Saskatchewan's daily exposure limit to noise. It is the level of a worker's total exposure averaged over the entire workday and adjusted to an equivalent eight (8) hour exposure.
Similar Exposure Group	A Similar Exposure Group (SEG) is a group of workers who experience similar exposures to environmental hazards.
Double Hearing Protection	The practice of donning two CSA Class A hearing protection devices at the same time. Typically, this consists of earplugs and ear muffs.
Audiometry	A medical exam to test a person's ability to hear sounds.

Table 3: Acronyms, Initialisms and Abbreviations

Term	In Full
COP	Code of Practice
KPI	Key Performance Indicator
LMS	Learning Management System
SEG	Similar Exposure Group
OH&W	Occupational Health & Wellness

10.0 References

10.1 Internal Documents

The following Cenovus documents support this practice:

Table 4: Internal Document References

Document Type or Number	Document Title
Policy	Corporate Responsibility Policy
Framework	Cenovus Operations Management System (COMS)
Policy	Enterprise Risk Management Policy
Web	Cenovus Risk Matrix

Appendix A: How to wear soft foam earplugs

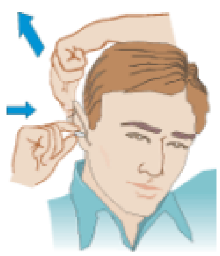
Mining Safety and Health Content

NIOSH National Institute for Occupational Safety and Health

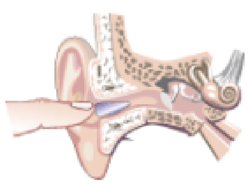
How To Wear Soft Foam Earplugs

To get the best protection from your soft foam earplugs, remember to **roll**, **pull**, and **hold** when putting them in. Use clean hands to keep from getting dirt and germs into your ears!

1. Roll the earplug up into a small, thin "snake" with your fingers. You can use one or both hands.



2. Pull the top of your ear up and back with your opposite hand to straighten out your ear canal. The rolled-up earplug should slide right in.



3. Hold the earplug in with your finger. Count to 20 or 30 out loud while waiting for the plug to expand and fill the ear canal. Your voice will sound muffled when the plug has made a good seal.

Check the fit when you're all done. Most of the foam body of the earplug should be within the ear canal. Try cupping your hands tightly over your ears. If sounds are much more muffled with your hands in place, the earplug may not be sealing properly. Take the earplug out and try again.

http://www.cdc.gov/niosh/mining/topics/hearingloss/earplug.htm

<table>
<tr><td rowspan="1">NCIA Northeast Capital Industrial Association</td><td>NCIA Standards and Guidelines</td><td colspan="2">Document Number
2010-003</td></tr>
<tr><td colspan="2">Noise Management Plan Reporting Requirements as per Section 5.4 of this Standard</td><td>Rev. Date
31-March 2016</td><td>Rev.
0</td></tr>
</table>

Insert your Company Name here: Chemtrade - 2019

Note, please provide as much detail as you can for the following, attaching any clarifying or required documents with your submission.

If you have any questions, please call Laurie Danielson @ 780.992.1463

Input Description	Member Site Comments
Confirmation that site has implemented a best management practice to address environmental noise as per NCIA Noise Management Plan Standard 2010-003 issued 3-Sep-10, revised 5-Mar-13, revised 14-Apr-14, revised 31-Mar-16 including the Procedure/Practice/Standard reference. Note, if you have not provided an electronic copy of your site plan to NCIA, please do so.	All equipment that produce noise above 85db are placed in buildings to reduce noise and to provide a safe working area.
Provide a summary of any monitoring (fence line outward completed in 2019. Note, you are not required to conduct any off-site monitoring.	No monitoring was done at the site level
Disclose any improvements/corrective actions implemented in 2019 or status thereof that would impact the noise level output for your site (either up or down). Did those changes result in a requirement to update your site noise model? If so, have you provided your updated site model to SLR Consulting for incorporation into the NCIA Regional Noise Model as per the process outlined for this purpose?	No changers were implemented

Disclose any improvements/projects that are approved for 2020 that would impact the noise level output for your site (either up or down). Will these changes result in a requirement to update your site noise model? If so, when do you anticipate having an updated site model available?	No major improvements were made or equipment purchased that would have an impact.
Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan in 2019.	Routine internal audits are carried.
Provide a Noise Complaint summary for all noise complaints received in 2019 including any actions taken to address them.	No complaints were received.

This information is being collected as per the NMP Standard 2010-003 Revised 31-March-2016. All information provided will be disclosed to the AER as part of the required NCIA Annual Reporting on the Regional Noise Management Plan.

Further, the Annual Report will be a public document available on our website once finalized.

July 13, 2020

Northeast Capital Industrial Association
Laurie Danielson, Executive Director
#204, 9902 - 102 Street
Fort Saskatchewan, AB T8L 2C3

Dear Dr. Danielson,

Subject: 2019 Noise Management Annual Report
Dow Chemical Canada ULC (Dow) Fort Saskatchewan Site

Please find attached Dow Chemical Canada ULC (Dow) input into the NCIA Regional Noise Management Plan report to the Alberta Energy Regulator (AER) for the Dow Fort Saskatchewan Industrial Site. MEGlobal Canada ULC (MEGlobal) operates a production facility within the Dow Site and is included in this submission.

Please call Marcella deJong at 780 - 992 - 8529 or myself at 780 - 992 - 4148 if you require any further information or clarification.

Yours truly,

Stephen Tong, P. Eng.
Responsible Care Director
Dow Alberta Operations

Copy: Andrew Maile, Responsible Care Leader MEGlobal Canada ULC

Dow Fort Saskatchewan Site

2019 Noise Management Annual Report

Prepared for Northeast Capital Industrial Association (NCIA)

This report provides Dow and MEGlobal's 2019 input to the NCIA Regional Noise Management Plan report to be submitted to the AER. Based on AER licensed assets on the Fort Saskatchewan Site, Dow is required to follow AER Noise Directive 38 and provide input into the NCIA report. The Dow power plant is governed by the Alberta utilities Commission Rule 012: Noise Control. MEGlobal participates in the Noise Management Plan and provides this information on a voluntary basis.

Input Description	Dow and MEGlobal Comments
Confirmation that site has implemented a best management practice to address environmental noise as per NCIA Noise Management Plan Standard 2010-003 issued 3-Sep-10, revised 5-Mar-13, revised 14-Apr-14, revised 31-Mar-16 including the Procedure/Practice/Standard reference.	A Noise Management Plan was developed by Dow and MEGlobal for submission to NCIA for inclusion in the 2011 NCIA report to the AER. A copy of the most recent version is included with this report. Noise management is done on a site wide basis without separation of which facilities are required to follow AER Directive 38 and AUC Rule 012.
Attach results of any monitoring (fenceline outward) completed in 2019. *Note, you are not required to conduct any off-site monitoring.*	No noise monitoring (fenceline outward) was completed in 2019. The site noise model was updated in 2014 for all sources (other than on-site transportation) within the Dow Fort Saskatchewan Site, including MEGlobal. Recent updates to the Dow site model have been incorporated into the NCIA regional noise model.
Disclose any improvements/corrective actions implemented in 2019 or status thereof that would impact the noise level output for your site (either up or down). *Did those changes result in a requirement to update your site noise model?* *If so, have you provided your updated site model to SLR Consulting for incorporation into the NCIA Regional Noise Model as per the process outlined for this purpose?*	Changes were made to a Dow site steam turbine in 2012 which has resulted in significantly less venting of a seasonally operated steam vent during the summer season. Since the spring 2012 turnaround, we have seen a significant decrease in the number of days that this steam vent has been open. However, the intensity of the venting remains similar to prior to the turnaround. This source was removed from the NCIA regional noise model during the most recent update but remains in the Dow site model as part of a worst case.
Disclose any improvements/projects that are approved for 2020 that would impact the noise level output for your site (either up or down). *Will these changes result in a requirement to update your site noise model?* *If so, when do you anticipate having an updated site model available?*	In 2020, Dow will continue track the frequency of time that the steam vent is operated as well as the valve position to ensure that the frequency remains reduced from pre-2012 turnaround and will plan for field monitoring only if the intensity of the sound when the vent is operating changes over time.

Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan in 2019.	The noise management plan falls within the Pollution Prevention section of Dow and MEGlobal's Operating Discipline Management System (ODMS). A site management system review was most recently conducted in December 2019 by the site leader. No actions or gaps were identified related to the Noise Management Plan. In March 2014, the AER conducted an audit of the Dow Site Noise Management Plan. Dow participated fully in the audit and provided all requested information to the AER auditor including, most recently, an updated source order ranking for each residence near the Dow site in January 2015. No additional self-assessments were completed in 2019.
Provide a Noise Complaint summary for all noise complaints received in 2019 including any actions taken to address them.	There were no noise complaints in 2019 related to Dow or MEGlobal operations at the site.

Dow Fort Saskatchewan Site Noise Management Plan

Policy

The Dow Chemical Canada ULC Fort Saskatchewan site follows the Operating Discipline Management System (ODMS) of the Dow Chemical Company to manage environmental noise and hearing conservation.

MEGlobal Canada ULC (MEGlobal) Operations on the Dow Fort Saskatchewan Site follows the EQUATE Chemical Company ODMS and is included in this Noise Management Plan.

Scope

This document is created to define how the Dow Chemical Canada ULC Fort Saskatchewan site complies with the ODMS requirements concerning Noise Minimization and Hearing Conservation outlined in:

- Section E (noise minimization to meet community expectations and applicable government requirements) of 06.07 L1 Pollution Prevention
- Section C14 (employee hearing conservation) of 06.05 L1 Employee Health and Safety
- Section A2 (all equipment must be designed to control noise levels) of 06.03 EH&S Engineering Design and Control

Purpose

This document summarizes how the Dow Fort Saskatchewan Site meets the Northeast Capital Industrial Association (NCIA) requirement for a Noise Management Plan including identification, evaluation and control of noise impacts at this site.

This Noise Management Plan meets the requirements of NCIA Standard and Guideline #2010-003, as amended.

Based on AER licensed assets on the Fort Saskatchewan Site, Dow is required to follow AER Noise Directive 38 and provide input into the NCIA report. The Dow power plant is governed by the Alberta Utilities Commission Rule 012: Noise Control.

Goals / Objectives

Dow and MEGlobal, as Responsible Care® Companies will:

- Minimize, to the extent possible, noise levels impacting on the environment including minimizing nighttime and low frequency noise
- Maintain a noise monitoring program to reduce the likelihood of noise impacts on the environment
- Assign employees to manage the site noise monitoring, mitigation and continuous improvement.
- Ensure employees associated with noise sources are aware of the impact on the environment and the processes in place to control
- Design new and modified equipment to minimize noise.

Training Requirements

Workers are educated on noise through:

- All workers receive initial and three year recurring Environmental Training (Instructor led or online), which includes environmental noise.
- Noise exposed workers receive training on hearing conservation.
- Personnel conducting noise monitoring receive training from the Industrial Hygiene specialists.
- Personnel delivering unit industrial hygiene programs receive training on these programs.
- Training is tracked in a corporate web based system.

Abatement Strategies	New facilities and modifications to existing facilities are designed and built to control noise levels. Engineering controls are addressed through the Management of Change process and ODMS 06.03 EH&S Design and Control. All projects are reviewed by EH&S regulatory personnel opposite the Alberta Operations Project Regulatory Review Checklist, which includes noise abatement and models. The Dow Management of Change system includes a similar review for changes to site facilities.
Onsite / Offsite Monitoring Requirements	Dow and MEGlobal follow ODMS and AER regulatory requirements for noise monitoring on site. Offsite noise monitoring is addressed through the NCIA regional noise model. Dow has a current Noise Model prepared by SLR Consulting Ltd. which includes all significant site sources within the fenceline other than on-site transportation sources. The site noise model is updated if equipment is added or removed from the site that would significantly impact noise levels. The regional noise model is validated periodically by NCIA. If any discrepancies are noted during NCIA field validation related to the Dow site, Dow will work toward resolving the discrepancy and may validate the Dow noise model with field measurements if required. Dow responds to external noise complaints appropriately, including monitoring if necessary. Dispatch Noise Complaint Procedure EH&S On-Call Noise Complaint Logsheet Individual production units do their own noise surveys at least every five years, or when equipment is added, modified or removed. The onsite noise monitoring program is managed as per in ODMS 06.05.C14 Personal noise dosimetry is done periodically on a frequency depending on exposure.
Site Noise Sources	Site noise sources are detailed in the site Noise Model and included in the NCIA regional noise model. In addition, each unit has an area noise map.
Audit / Self Assessment Requirements	Intensive EH&S ODMS based integrated audits are conducted at 3 to 5 year frequencies for all site units/departments and include ODMS elements related to noise and hearing conservation. Periodic self-assessments are conducted by unit/department ODMS element owners and results are reviewed with leaders at unit and department management system reviews. Results of unit, department and site self-assessments are reviewed by the Site Leader at the annual site management system review. These self-assessments include environmental noise and hearing conservation. The hearing conservation program is designed to minimize job induced hearing loss and meets the Alberta OH&S Code as well as Dow corporate requirements for a noise exposure and control program. This program is reviewed annually. This Noise Management Plan is reviewed once per year by the Responsible Care Leader.

Reporting Requirements	Annual reports will be generated for the NCIA. This report will include the following information for the calendar year: • Confirmation that the site has implemented a Noise Management Program and that it has been reviewed/updated as required. • Results of any monitoring / assessments (fenceline outward) • Improvements/Corrective Actions implemented • Improvement / projects that have resulted in changed noise levels on the site • Audit/Self-Assessment evaluation • Information on any external noise complaints received and actions taken
Ownership	The AER Regulatory Specialist manages the Noise Management Program and reports to NCIA as required.

Revision History

Approval

Approved by — Date: January 2012

Carol Moen (Dow Responsible Care Leader)

Pravind Ramdial (MEGlobal Responsible Care Leader)

Review History

The following documents the review history for this file.

Date	Reviewed By	Position
April 2013	Mike Dziarmaga	Dow Responsible Care Leader
May 2014	Mike Dziarmaga	Dow Responsible Care Leader
August 2015	Mike Dziarmaga	Dow Responsible Care Leader
June 2016	Mike Dziarmaga	Dow Responsible Care Leader
June 2017	Jacint Domenech	Dow Responsible Care Leader
October 2018	Jacint Domenech	Dow Responsible Care Leader
October 2019	Jacint Domenech	Dow Responsible Care Leader
July 2020	Stephen Tong	Dow Responsible Care Leader

Revision History

The following information documents at least the last 3 changes to this document, with all the changes listed for the last 6 months.

Date	Revised By	Changes
January 2012	Marcella deJong	New document.
April 2013	Marcella deJong	Updated Reporting Requirements to match with updated NCIA NMP Standard dated 5-Mar-13.
May 2014	Marcella deJong	Updated with clarifications suggested during AER audit of the Noise Management Plan and to meet the current NCIA standard revised in April 2014.
May 2016	Marcella deJong	Updated MEGlobal Canada Inc. to MEGlobal Canada ULC. Updated HFP to SLR.
June 2017	Marcella deJong	Replaced “MyLearning” with “online”.
October 2018	Marcella deJong	Updated Broken Links
July 2020	Marcella deJong	Updated Broken Links

Enbridge Pipeline (Athabasca) Inc.

Note, please provide as much detail as you can for the following, attaching any clarifying or required documents with your submission.

If you have any questions, please call Laurie Danielson @ 780.992.1463

Input Description	Member Site Comments
Confirmation that site has implemented a best management practice to address environmental noise as per NCIA Noise Management Plan Standard 2010-003 issued 3-Sep-10, revised 5-Mar-13, revised 14-Apr-14, revised 31-Mar-16 including the Procedure/Practice/Standard reference. Note, if you have not provided an electronic copy of your site plan to NCIA, please do so.	Enbridge has implemented a best management practice to address environmental noise as per NCIA Noise Management Plan.
Provide a summary of any monitoring (fence line outward completed in 2019. Note, you are not required to conduct any off-site monitoring.	No offsite monitoring was conducted in 2019.
Disclose any improvements/corrective actions implemented in 2019 or status thereof that would impact the noise level output for your site (either up or down). Did those changes result in a requirement to update your site noise model? If so, have you provided your updated site model to SLR Consulting for incorporation into the NCIA Regional Noise Model as per the process outlined for this purpose?	No improvement/corrective actions were implemented in 2019 that would impact the noise level output.

Disclose any improvements/projects that are approved for 2020 that would impact the noise level output for your site (either up or down). Will these changes result in a requirement to update your site noise model? If so, when do you anticipate having an updated site model available?	No improvements/projects were approved for 2020 that would impact the noise level output
Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan in 2019.	No audit/self-assessment evaluation was completed in 2019
Provide a Noise Complaint summary for all noise complaints received in 2019 including any actions taken to address them.	No noise complaints were received in 2019

This information is being collected as per the NMP Standard 2010-003 Revised 31-March-2016. All information provided will be disclosed to the AER as part of the required NCIA Annual Reporting on the Regional Noise Management Plan.

Further, the Annual Report will be a public document available on our website once finalized.

Evonik Canada Inc.:

Note, please provide as much detail as you can for the following, attaching any clarifying or required documents with your submission.

If you have any questions, please call Laurie Danielson @ 780.992.1463

Input Description	**Member Site Comments**
Confirmation that site has implemented a best management practice to address environmental noise as per NCIA Noise Management Plan Standard 2010-003 issued 3-Sep-10, revised 5-Mar-13, revised 14-Apr-14, revised 31-Mar-16 including the Procedure/Practice/Standard reference. Note, if you have not provided an electronic copy of your site plan to NCIA, please do so.	Confirmed. Relevant Evonik site policy was provided in 2014 and has remained unchanged since then.
Provide a summary of any monitoring (fence line outward completed in 2019. Note, you are not required to conduct any off-site monitoring.	No monitoring or assessment required or carried out in 2018.
Disclose any improvements/corrective actions implemented in 2019 or status thereof that would impact the noise level output for your site (either up or down). Did those changes result in a requirement to update your site noise model? If so, have you provided your updated site model to SLR Consulting for incorporation into the NCIA Regional Noise Model as per the process outlined for this purpose?	None to disclose at this time.

Disclose any improvements/projects that are approved for 2020 that would impact the noise level output for your site (either up or down). Will these changes result in a requirement to update your site noise model? If so, when do you anticipate having an updated site model available?	None to disclose at this time.
Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan in 2019.	2016 assessment and evaluation conducted by Evonik ESHQ/OH experts. Suitable report excerpt available upon request.
Provide a Noise Complaint summary for all noise complaints received in 2019 including any actions taken to address them.	No complaints.

This information is being collected as per the NMP Standard 2010-003 Revised 31-March-2016. All information provided will be disclosed to the AER as part of the required NCIA Annual Reporting on the Regional Noise Management Plan.

Further, the Annual Report will be a public document available on our website once finalized.

NCIA Northeast Capital Industrial Association	**NCIA Standards and Guidelines**	Document Number **2010-003**
Noise Management Plan Reporting Requirements as per Section 5.4 of this Standard	Rev. Date **31-March 2016**	Rev. **0**

Insert your Company Name here: Keyera Energy Ltd. 2019

Note, please provide as much detail as you can for the following, attaching any clarifying or required documents with your submission.

If you have any questions, please call Laurie Danielson @ 780.992.1463

Input Description	Member Site Comments
Confirmation that site has implemented a best management practice to address environmental noise as per NCIA Noise Management Plan Standard 2010-003 issued 3-Sep-10, revised 5-Mar-13, revised 14-Apr-14, revised 31-Mar-16 including the Procedure/Practice/Standard reference. Note, if you have not provided an electronic copy of your site plan to NCIA, please do so.	Keyera has implemented a best management practice to address environmental noise as per standard 2010-003. Keyera has provided an electronic copy of the site plan to NCIA.
Provide a summary of any monitoring (fence line outward completed in 2019. Note, you are not required to conduct any off-site monitoring.	No monitoring was completed outside the fence line in 2019.
Disclose any improvements/corrective actions implemented in 2019 or status thereof that would impact the noise level output for your site (either up or down). Did those changes result in a requirement to update your site noise model? If so, have you provided your updated site model to SLR Consulting for incorporation into the NCIA Regional Noise Model as per the process outlined for this purpose?	Keyera has completed the installation of two additional C5+ injection pumps. These pumps were installed within a building that was designed to mitigate noise impact. At present there has been no update to the site noise model.

Disclose any improvements/projects that are approved for 2020 that would impact the noise level output for your site (either up or down). Will these changes result in a requirement to update your site noise model? If so, when do you anticipate having an updated site model available?	Replacement of the Hot Oil Heater in Frac 1 will be completed in 2020, which will reduce the overall site noise level when the new heater is commissioned in Q2 2020. Engineering and regulatory groups will determine following replacement if an updated noise model will be required. If so, an pupdated model will be provided to NCIA in late 2020/early 2021.
Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan in 2019.	None completed in 2019.
Provide a Noise Complaint summary for all noise complaints received in 2019 including any actions taken to address them.	There were no noise complaints received for 2019 for this site.

This information is being collected as per the NMP Standard 2010-003 Revised 31-March-2016. All information provided will be disclosed to the AER as part of the required NCIA Annual Reporting on the Regional Noise Management Plan.

Further, the Annual Report will be a public document available on our website once finalized.

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Access Pipeline o/a Wolf Midstream (Stonefell Terminal – Operating on Behalf of MEG Energy)

Note, please provide as much detail as you can for the following, attaching any clarifying or required documents with your submission.

If you have any questions, please call Laurie Danielson @ 780.992.1463

Input Description	Member Site Comments
Confirmation that site has implemented a best management practice to address environmental noise as per NCIA Noise Management Plan Standard 2010-003 issued 3-Sep-10, revised 5-Mar-13, revised 14-Apr-14, revised 31-Mar-16 including the Procedure/Practice/Standard reference. Note, if you have not provided an electronic copy of your site plan to NCIA, please do so.	Access abides by AER’s Directive 38. We participate in industrial noise monitoring.
Provide a summary of any monitoring (fence line outward completed in 2017. Note, you are not required to conduct any off-site monitoring.	A noise monitoring was not conducted in 2019.
Disclose any improvements/corrective actions implemented in 2017 or status thereof that would impact the noise level output for your site (either up or down). Did those changes result in a requirement to update your site noise model? If so, have you provided your updated site model to SLR Consulting for incorporation into the NCIA Regional Noise Model as per the process outlined for this purpose?	N/A

Disclose any improvements/projects that are approved for 2018 that would impact the noise level output for your site (either up or down). Will these changes result in a requirement to update your site noise model? If so, when do you anticipate having an updated site model available?	There were no anticipated projects or improvement for 2019 that may have impacted noise levels.
Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan in 2017.	None.
Provide a Noise Complaint summary for all noise complaints received in 2017 including any actions taken to address them.	Access Pipeline did not receive any noise complaints for the 2019 year.

This information is being collected as per the NMP Standard 2010-003 Revised 31-March-2016. All information provided will be disclosed to the AER as part of the required NCIA Annual Reporting on the Regional Noise Management Plan.

Further, the Annual Report will be a public document available on our website once finalized.

Nutrien Redwater:

Note, please provide as much detail as you can for the following, attaching any clarifying or required documents with your submission.

If you have any questions, please call Laurie Danielson @ 780.992.1463

Input Description	Member Site Comments
Confirmation that site has implemented a best management practice to address environmental noise as per NCIA Noise Management Plan Standard 2010-003 issued 3-Sep-10, revised 5-Mar-13, revised 14-Apr-14, revised 31-Mar-16 including the Procedure/Practice/Standard reference. Note, if you have not provided an electronic copy of your site plan to NCIA, please do so.	Nutrien has a Noise Management Plan. The plan consists of the following documents: • ESP 3.07.01 Noise Management Overview • ESP 3.07.02 Noise Management Program • ESP 3.07.03 Noise Source List • ESP 3.07.04 Monitoring Program
Provide a summary of any monitoring (fence line outward completed in 2018. Note, you are not required to conduct any off-site monitoring.	There was no offsite monitoring completed in 2019 for the Redwater or the Fort Saskatchewan facilities.
Disclose any improvements/corrective actions implemented in 2018 or status thereof that would impact the noise level output for your site (either up or down). Did those changes result in a requirement to update your site noise model? If so, have you provided your updated site model to SLR Consulting for incorporation into the NCIA Regional Noise Model as per the process outlined for this purpose?	<u>Redwater Facility</u> The phosphoric acid unit was permanently shut down in April of 2019. The Sulphuric Acid #2 Unit was permanently shut down in October of 2019. Boiler #2 was replaced in 2019. There were no improvements or corrective actions implemented in 2019. <u>Fort Saskatchewan facility</u> There were no improvements or corrective actions implemented in 2019 at the Fort Saskatchewan site.

Disclose any improvements/projects that are approved for 2020 that would impact the noise level output for your site (either up or down). Will these changes result in a requirement to update your site noise model? If so, when do you anticipate having an updated site model available?	Redwater Approved projects have been deferred. In terms of the 30# Steam Vents identified in the Noise Model Update, Noise Curtains are now scheduled to be installed in 2020. As stated in the 2013-2015 reports, Redwater engaged both SLR and Noise Solutions to proactively provide noise control options for both the compressor / gas turbine (CGT-902) and Utilities Boiler #2 replacement projects respectively. These assessments are primarily Occupational Hygiene, but it is anticipated that Environmental Noise will also be reduced. The Boiler #2 replacement project took place in 2019, with CGT-902 being deferred to 2021. Fort Saskatchewan No improvement/projects planned for 2020.
Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan in 2019.	The Noise Management Plan, program and associated documents were not reviewed in 2019.
Provide a Noise Complaint summary for all noise complaints received in 2019 including any actions taken to address them.	There were no external noise complaints for the Redwater or Fort Saskatchewan facilities in 2019.

This information is being collected as per the NMP Standard 2010-003 Revised 31-March-2016. All information provided will be disclosed to the AER as part of the required NCIA Annual Reporting on the Regional Noise Management Plan.

Further, the Annual Report will be a public document available on our website once finalized.

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Insert your Company Name here:

Note, please provide as much detail as you can for the following, attaching any clarifying or required documents with your submission.

If you have any questions, please call Laurie Danielson @ 780.992.1463

Input Description	**Member Site Comments**
Confirmation that site has implemented a best management practice to address environmental noise as per NCIA Noise Management Plan Standard 2010-003 issued 3-Sep-10, revised 5-Mar-13, revised 14-Apr-14, revised 31-Mar-16 including the Procedure/Practice/Standard reference. Note, if you have not provided an electronic copy of your site plan to NCIA, please do so.	Yes and a copy was provided
Provide a summary of any monitoring (fence line outward completed in 2019. Note, you are not required to conduct any off-site monitoring.	No outside. There was a noise map of the interior of the production area
Disclose any improvements/corrective actions implemented in 2019 or status thereof that would impact the noise level output for your site (either up or down). Did those changes result in a requirement to update your site noise model? If so, have you provided your updated site model to SLR Consulting for incorporation into the NCIA Regional Noise Model as per the process outlined for this purpose?	None completed No N/A

Disclose any improvements/projects that are approved for 2020 that would impact the noise level output for your site (either up or down). Will these changes result in a requirement to update your site noise model? If so, when do you anticipate having an updated site model available?	None N/A N/A
Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan in 2019.	No audit/self-assessments
Provide a Noise Complaint summary for all noise complaints received in 2019 including any actions taken to address them.	No noise complaints received

This information is being collected as per the NMP Standard 2010-003 Revised 31-March-2016. All information provided will be disclosed to the AER as part of the required NCIA Annual Reporting on the Regional Noise Management Plan.

Further, the Annual Report will be a public document available on our website once finalized.

Pembina NGL Corporation – Redwater Facilities

Note, please provide as much detail as you can for the following, attaching any clarifying or required documents with your submission.

If you have any questions, please call Laurie Danielson @ 780.992.1463

Input Description	Member Site Comments
Confirmation that site has implemented a best management practice to address environmental noise as per NCIA Noise Management Plan Standard 2010-003 issued 3-Sep-10, revised 5-Mar-13, revised 14-Apr-14, revised 31-Mar-16 including the Procedure/Practice/Standard reference. Note, if you have not provided an electronic copy of your site plan to NCIA, please do so.	Pembina Redwater facilities have a Noise Management Program, which includes implementation of Best Management Practices to address environmental noise as per the NCIA Noise Management Plan.
Provide a summary of any monitoring (fence line outward completed in 2019. Note, you are not required to conduct any off-site monitoring.	No fence line outward monitoring conducted in 2019.
Disclose any improvements/corrective actions implemented in 2019 or status thereof that would impact the noise level output for your site (either up or down). Did those changes result in a requirement to update your site noise model? If so, have you provided your updated site model to SLR Consulting for incorporation into the NCIA Regional Noise Model as per the process outlined for this purpose?	RFS II/III Cogen commenced operations in April 2019. This did not create any significant impacts to the noise level output for the facility. Actual measurements for the Cogen unit were completed in 2019 by SLR to update the site noise model with measured data instead of theoretical values. SLR has the updated Redwater site model for incorporation into the RNM.

Disclose any improvements/projects that are approved for 2020 that would impact the noise level output for your site (either up or down). Will these changes result in a requirement to update your site noise model? If so, when do you anticipate having an updated site model available?	No changes anticipated for 2020.
Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan in 2019.	None completed
Provide a Noise Complaint summary for all noise complaints received in 2019 including any actions taken to address them.	No complaints received

This information is being collected as per the NMP Standard 2010-003 Revised 31-March-2016. All information provided will be disclosed to the AER as part of the required NCIA Annual Reporting on the Regional Noise Management Plan.

Further, the Annual Report will be a public document available on our website once finalized.

Plains Midstream Canada:

Note, please provide as much detail as you can for the following, attaching any clarifying or required documents with your submission.

If you have any questions, please call Laurie Danielson @ 780.992.1463

Input Description	Member Site Comments
Confirmation that site has implemented a best management practice to address environmental noise as per NCIA Noise Management Plan Standard 2010-003 issued 3-Sep-10, revised 5-Mar-13, revised 14-Apr-14, revised 31-Mar-16 including the Procedure/Practice/Standard reference. Note, if you have not provided an electronic copy of your site plan to NCIA, please do so.	The Facility has an Environmental Noise Management Practice. The practice is part of PMC's Operational Management System (FSK-P-36-00-12).
Provide a summary of any monitoring (fence line outward completed in 2019. Note, you are not required to conduct any off-site monitoring.	No monitoring/assessments were completed in 2019.
Disclose any improvements/corrective actions implemented in 2019 or status thereof that would impact the noise level output for your site (either up or down). Did those changes result in a requirement to update your site noise model? If so, have you provided your updated site model to SLR Consulting for incorporation into the NCIA Regional Noise Model as per the process outlined for this purpose?	No improvements/corrective actions implemented in 2019 that would impact the noise level output from the Facility.

Disclose any improvements/projects that are approved for 2020 that would impact the noise level output for your site (either up or down). Will these changes result in a requirement to update your site noise model? If so, when do you anticipate having an updated site model available?	The Facility will be installing new pumps to support cavern storage activities. These activities may result in changes that require the facility to update the Regional Noise Model. This will be evaluated as we proceed with expansion activities. An update, if required, will be conducted in conjunction with the next regional noise model update.
Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan in 2019.	No audits or self-assessment evaluations were completed in 2019.
Provide a Noise Complaint summary for all noise complaints received in 2019 including any actions taken to address them.	No noise complaints were received by the Facility in 2019.

This information is being collected as per the NMP Standard 2010-003 Revised 31-March-2016. All information provided will be disclosed to the AER as part of the required NCIA Annual Reporting on the Regional Noise Management Plan.

Further, the Annual Report will be a public document available on our website once finalized.

NCIA Northeast Capital Industrial Association	**NCIA Standards and Guidelines**	**Document Number** **2010-003**	
Noise Management Plan Reporting Requirements as per Section 5.4 of this Standard		**Rev. Date** **31-March 2016**	**Rev.** **0**

Shell Scotford Site

Note, please provide as much detail as you can for the following, attaching any clarifying or required documents with your submission.

If you have any questions, please call Laurie Danielson @ 780.992.1463

Input Description	**Member Site Comments**
Confirmation that site has implemented a best management practice to address environmental noise as per NCIA Noise Management Plan Standard 2010-003 issued 3-Sep-10, revised 5-Mar-13, revised 14-Apr-14, revised 31-Mar-16 including the Procedure/Practice/Standard reference. Note, if you have not provided an electronic copy of your site plan to NCIA, please do so.	In 2014, Shell Scotford amalgamated individual (Refinery, Chemicals, and Upgrader) Site NMPs into one document. It is called the Shell Scotford Site Noise Management Plan (SUG.HSSE.ENV.AIR.NOIS.M.002). Document attached. SUG.HSSE.ENV.NOIS .M.002_Site_Noise_M
Provide a summary of any monitoring (fence line outward completed in 2019. Note, you are not required to conduct any off-site monitoring.	
Disclose any improvements/corrective actions implemented in 2019 or status thereof that would impact the noise level output for your site (either up or down). Did those changes result in a requirement to update your site noise model? If so, have you provided your updated site model to SLR Consulting for incorporation into the NCIA Regional Noise Model as per the process outlined for this purpose?	No improvements/corrective actions implemented in 2019

Disclose any improvements/projects that are approved for 2020 that would impact the noise level output for your site (either up or down). Will these changes result in a requirement to update your site noise model? If so, when do you anticipate having an updated site model available?	No improvements/projects approved for 2020 that would impact the noise level output for the site
Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan in 2019.	No audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for Scotford site noise management plan in 2019.
Provide a Noise Complaint summary for all noise complaints received in 2019 including any actions taken to address them.	No noise complaints received in 2019.

This information is being collected as per the NMP Standard 2010-003 Revised 31-March-2016. All information provided will be disclosed to the AER as part of the required NCIA Annual Reporting on the Regional Noise Management Plan.

Further, the Annual Report will be a public document available on our website once finalized.

Shell Scotford Site Noise Management Plan

Document Review and Approval		
Reviewed By		
Elaine Rippon		
Maurice Ouellet		
Wendy Konsorada		
Michael Frigge		
Achim Schempp		
APPROVED BY	**DATE**	**SIGNATURE**

Version 3

27-November-2018

Scotford Upgrader	**Area: Noise Monitoring**	Document Number: SUG.HSSE.ENV.AIR.NOIS.M.002
	Title: Shell Scotford Site Noise Management Plan	Rev No: 2 Date: Nov 27-18
Document Owner: Environment Manager	Document Focal: Noise Focal	

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<tr><td>Title: Shell Scotford Site Noise Management Plan</td><td>Rev No: 2

Date: Nov 27-18</td></tr>
<tr><td colspan="2">Document Owner: Environment Manager</td><td>Document Focal: Noise Focal</td></tr>
</table>

1 POLICY

Royal Dutch Shell's Commitment and Policy on Health, Security, Safety, the Environment and Social Performance demonstrates commitment for reducing environmental and social impacts resulting from our operations. For Shell Scotford, noise is actively managed by instituting controls, and measures up front when designing or changing parts of the process that generate noise, and by also measuring and monitoring to ensure controls are effective. This Site Noise Management Plan is part of the Scotford's ongoing commitment to the environment, our neighbours, and social performance. The Scotford Leadership Teams are committed to controlling noise and support the contents of this Site Noise Management Plan.

2 NOISE MANAGEMENT PROGRAM

2.1 Goals and Objectives

2.1.1 Regulatory Compliance

Noise is regulated by the Alberta Energy and Resources Conservation Board (ERCB), Directive 038, "Noise Control Directive – User Guide" and applies to all facilities where the ERCB has issued a permit to operate. Section 5.1 of the Noise Control Directive states,

> "A facility is in compliance if a CSL (comprehensive sound level) survey conducted at representative conditions has results equal to or lower than the established PSL (permissible sound level), taking into consideration any LFN (low frequency noise). Alternatively, if the ERCB agrees that a CSL survey is not practical, a detailed Noise Management Plan (NMP) approved by the ERCB may be used."

The Industrial Heartland is considered an area where a CSL survey is not practical due to the large industrial base in a relatively small area. As such, all NCIA (Northeast Capital Industrial Association) member companies in the Industrial Heartland are mandated to participate in the Regional Noise Management Plan developed by the NCIA. The RNMP is designed with the intent of minimizing, to the extent practical, the noise levels impacting on the environment from member companies and their associated industrial facilities. The RNMP ensures that NCIA member companies adopt best practices and principles in noise management and that each member company will implement a Site NMP (noise management plan) independently. Each NMP must include:

- identification of noise sources,
- assessment of current noise mitigation programs,
- performance effectiveness of noise control devices,
- methods of noise measurement,
- best practices programs, and
- continuous improvement programs

Compliance with D-38 is to be demonstrated through conformance with the RNMP on the basis of due diligence for noise control (taking all reasonable steps to reduce a given impact). Key expectations with respect to compliance are as follows:

1. Conformance with individual facility programs – implementing best practices in monitoring, abatement, self audit, annual reporting and other program details.
2. Complaint Resolution – partnership with regulator to determine adequate resources to manage complaints to a "workable resolution".
3. Readiness for potential management system (Site NMP) audit – similar to other regulated activities under current monitoring and enforcement rules.
4. Participation in development and maintenance of a Regional Noise Model – the model provides a baseline for industrial noise and allows for an empirical assessment of potential problem area and sources.
5. Tracking noise management initiatives and providing an annual status to NCIA to facilitate a comprehensive annual report to the ERCB.

Companies that do not demonstrate conformance with the plan would default to Permissible Sound Level (PSL) compliance under Directive 038.

2.1.2 Noise Control Objectives

Shell recognizes that it is not practical or possible to eliminate all sources of noise. However, it is expected that wherever possible, noise control practices and mitigation will be in place to minimize noise, for example, maintaining a noise standard when procuring new equipment or taking into consideration possible noise impacts when instituting plant process changes. It also includes how Shell operates including employing the use of silencers and mufflers, or simply keeping doors on buildings closed.

Shell takes a proactive approach for activities that could have an environmental impact such as noise. When planning work that could generate excessive noise, such as boiler blow downs or flaring for example, it is important to assess the community impact and communicate with stakeholders as required. It is also Shell's approach to avoid practices that create excessive noise during evening hours and weekends whenever possible.

If despite proactive measures a resident expresses concern that they are impacted by plant operation, Shell will immediately initiate a complaint protocol and work in collaboration with the resident to attain resolution.

2.1.3 Continuous Improvement and Best Practices

For Shell, continuous improvement from a noise perspective means to examine noise sources to discover and eliminate problems. Examination of noise sources is accomplished through Industrial Hygiene (IH) noise surveys, noise modelling, and offsite noise surveys. When any of these tools identifies a potential unacceptable noise level, mitigation plans are implemented.

Shell educates and trains their staff on the Noise Management Plan during Operations Compliance Training.

Shell stays current by attending the bi-annual noise conference (hosted by the Alberta Acoustics & Noise Association) and having active representation on the NCIA Noise Best Practices Sub-committee. In the way Shell will be aware of the latest technology and advancements in the noise field and institute best practices accordingly.

2.1.4 Facility Communication Strategies

Where noise has been identified as a potential issue with the community, Shell will notify stakeholders in advance of the activity by utilizing the NRCAER line.

If a noise concern is received from a stakeholder, then SDP11021 Public Concern Response Practice is activated and followed and the

SUG.HSSE.ENV.NOIS.P.001 Noise Sampling Practice is initiated and followed. All relevant information is entered in the SDF11021 Public Concern Form and the SUG.HSSE.ENV.NOIS.TO.001 Fenceline Noise Monitoring Form along with an incident report being entered into FIM (Fountain Incident Management).

2.2 Roles and Responsibilities

Department or Title	**Roles**
Community Affairs	• Notification to neighbours for planned activities. • Reactive communications to neighbours concern. • Monitor operations response to public concern.
Shift Supervisor or Designate	• Initiate investigation for public concern for operating units • Perform fence-line noise surveys. • If required follow-up with concern in off-hours (PA during normal hours).
Environment Department	• Support to Operations for investigation of noise concern, conducting fence-line noise surveys & regulatory notifications. • Data analysis and external noise surveys. • Maintain site noise model.
Industrial Hygiene	• Primary support for onsite noise monitoring.
Security	• Initial contact for public concern.

2.3 Monitoring and Measuring

2.3.1 Fenceline Monitoring

When a public concern is received and the SDP 11021 Public Concern Response Practice is activated, as stated in 2.1.4, or activities on site create the need to monitor noise levels, fenceline noise measurements are conducted.

Fenceline measurements are conducted as per SUG.HSSE.ENV.NOIS.P.001 Noise Sampling Practice and results are recorded on SUG.HSSE.ENV.NOIS.TO.001 Fenceline Noise Monitoring Form.

If the need arises for any other type of noise monitoring, a request can be submitted through SUG.HSSE.ENV.NOIS.TO.002 Request for Non-Routine Noise Sampling.

2.3.2 Industrial Hygiene (IH) Surveys

IH Surveys are done on a request basis, or at a minimum a unit noise survey is conducted every 4 years. All results and reports are stored in Livelink.

Shell is regulated under the Alberta OH&S Code and participates in the Hearing Conversation Program set forth in the code. IH is responsible to ensure that workers get noise dosimeter testing done every 2 years as part of this program.

2.3.3 Noise Modelling

A detailed noise model was developed for the Shell Scotford Upgrader in 2006 and can be viewed here 2006 Noise Model. The model identifies all noise sources within the base Upgrader.

The Upgrader Expansion started operations in June 2011. It is Shell's intent to update the original 2006 Model to include the Expansion facilities, and to identify any changes to the existing Base plant, by the end of 2014.

2.3.4 Routine Monitoring

There is currently no routine monitoring being done at Shell Scotford, due to the fact there has not been a residence complaint since 2004 and the results of the 2005 Noise Model demonstrated satisfactory offsite noise levels.

An offsite noise survey of the Shell facilities will be completed in 2014 to determine the offsite CSL's post Expansion project start up.

The results of this survey along with the information obtained from the upcoming model will determine what, if any, routine monitoring will be conducted.

2.4 Noise Control

Proactively ensuring mitigative measures and controls are considered in order to minimize the impact of noise when implementing facility design changes or purchasing new equipment is a key principle of noise control. When implementing a change at Shell Scotford, whether it's new equipment or a modification to existing equipment, the MOC (Management of Change) process must be followed. For the Upgrader, Shell's definition of a plant change can be found in SUG.CON.MOC.C.001 Definition of Plant Change. For Manufacturing, changes that do not require following the MOC process are listed in SCM-MOC-SP-01 Changes Not Requiring Management of Change (MOC).

The Management of Change Quality Assurance Manual describes the work process for all managed changes within the Shell Scotford Upgrader. The SCM-MOC-PR-01 Management of Change (MOC) Procedure describes the work process for all managed changes within Shell Scotford Manufacturing. Any change that may increase noise as per SUG.CON.MOC.G.001 Environmental Guideline for Noise Producing Equipment.needs to be reviewed and signed off by both the Environment department and Industrial Hygiene as per SUG.CON.MOC.C.003 Discipline Review Parties Matrix for the Upgrader, and the SCM-MOC-G-06 Discipline Reviewer Matrix for Manufacturing

3 AUDIT/SELF ASSESSMENT

Noise is included in the scope of ongoing ISO 14001 audits and the HSSE MS internal audits under social performance. Audit findings are recorded in Fountain Assurance Management (FAM) with related action items assigned to individuals. Audit findings are reviewed by Upgrader Leadership Team.

An internal audit specific to the Site NMP against the NCIA Standards and Guidelines will be done every 3 years.

Audit results and findings will be included in the annual summary to NCIA to be included in the NCIA Annual Noise Report to ERCB.

4 REPORTING

All routine sampling results, non-routine sampling results, monitoring surveys, and modelling results are stored in Shell's Livelink and/or Sharepoint system.

Shell has the responsibility to provide input into the Annual Regional Noise Management Plan report, which is submitted to the ERCB by NCIA. Information to be provided is as follows:

- Confirmation that site has implemented a best management practice to address environmental noise as per NCIA Noise Management Plan Standard 2010-001 issued 3-Sep-10.
- Procedure/Practice/Standard reference (i.e. SOP-AG-RW-200-002)
- Results of any monitoring/assessments (fenceline outward) completed in the reporting year.
- Improvements implemented for the reporting year.
- Changes that have resulted in increased noise levels on your site for the year reporting on.

- Noise Complaints received and follow up actions taken to address them.

- Planned improvements to noise management practice, noise abatement work or noise model work for the upcoming year.

Insert your Company Name here: Sherritt International Corporation

Note, please provide as much detail as you can for the following, attaching any clarifying or required documents with your submission.

If you have any questions, please call Laurie Danielson @ 780.992.1463

Input Description	Member Site Comments
Confirmation that site has implemented a best management practice to address environmental noise as per NCIA Noise Management Plan Standard 2010-003 issued 3-Sep-10, revised 5-Mar-13, revised 14-Apr-14, revised 31-Mar-16 including the Procedure/Practice/Standard reference. Note, if you have not provided an electronic copy of your site plan to NCIA, please do so.	The Site has implemented the referenced standard and developed a Code of Practice (FSSMP001-021) which has been previously submitted to NCIA. There were no updates made to the Code of Practice in 2019.
Provide a summary of any monitoring (fence line outward completed in 2019. Note, you are not required to conduct any off-site monitoring.	Fence line monitoring was completed in 2019 by SLR Consulting (Canada) Ltd. The five measurement locations used were the same as the ones used in previous surveys. The results for the 2019 survey are generally lower than the 2011 values. The 2013 survey results are generally consistent with the measurement results from the 2019 survey. At this time, it is believed that an updated Site model is not required as a result of the 2019 survey.
Disclose any improvements/corrective actions implemented in 2019 or status thereof that would impact the noise level output for your site (either up or down). Did those changes result in a requirement to update your site noise model? If so, have you provided your updated site model to SLR Consulting for incorporation into the NCIA Regional Noise Model as per the process outlined for this purpose?	None in 2019. The Site noise model does not require updating at this time.

Disclose any improvements/projects that are approved for 2020 that would impact the noise level output for your site (either up or down). Will these changes result in a requirement to update your site noise model? If so, when do you anticipate having an updated site model available?	None in 2020. The Site noise model does not require updating at this time.
Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan.	In 2019, there were 8 noise assessments completed at the Site. There were no significant changes; therefore, the Site noise model does not require updating at this time.
Provide a Noise Complaint summary for all noise complaints received in 2019 including any actions taken to address them.	No noise complaints were received in 2019.

This information is being collected as per the NMP Standard 2010-003 Revised 31-March-2016. All information provided will be disclosed to the AER as part of the required NCIA Annual Reporting on the Regional Noise Management Plan.

Further, the Annual Report will be a public document available on our website once finalized.

Umicore Cana

Note, please provide as much detail as you can for the following, attaching any clarifying or required documents with your submission.

If you have any questions, please call Laurie Danielson @ 780.992.1463

Input Description	Member Site Comments
Confirmation that site has implemented a best management practice to address environmental noise as per NCIA Noise Management Plan Standard 2010-003 issued 3-Sep-10, revised 5-Mar-13, revised 14-Apr-14, revised 31-Mar-16 including the Procedure/Practice/Standard reference. Note, if you have not provided an electronic copy of your site plan to NCIA, please do so.	Code of Practice (COP-323-7) Noise Exposure Management Plan included in the Umicore Canada Inc. Management System. Reference to 'environmental noise' included in the Umicore Canada Inc. Air Quality Management Program (COP-319-2)
Provide a summary of any monitoring (fence line outward completed in 2019. Note, you are not required to conduct any off-site monitoring.	Not applicable – noise monitoring conducted inside the plant from an industrial hygiene perspective.
Disclose any improvements/corrective actions implemented in 2019 or status thereof that would impact the noise level output for your site (either up or down). Did those changes result in a requirement to update your site noise model? If so, have you provided your updated site model to SLR Consulting for incorporation into the NCIA Regional Noise Model as per the process outlined for this purpose?	Management of Change (MOC) program includes elements to identify potential changes/ impacts with respect to noise exposure. There were no projects in 2019 that impacted noise exposures up or down.

Disclose any improvements/projects that are approved for 2020 that would impact the noise level output for your site (either up or down). Will these changes result in a requirement to update your site noise model? If so, when do you anticipate having an updated site model available?	Many of the projects approved for 2020 will not have any effect on the noise level. All circuits for the most part are located inside of Umicore proper buildings and maintain a rating of approximately 81 - 83 db. No requirement to update site noise model.
Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan in 2019.	Not applicable – noise monitoring conducted inside the plant from an industrial hygiene perspective
Provide a Noise Complaint summary for all noise complaints received in 2019 including any actions taken to address them.	No complaints received in 2019.

This information is being collected as per the NMP Standard 2010-003 Revised 31-March-2016. All information provided will be disclosed to the AER as part of the required NCIA Annual Reporting on the Regional Noise Management Plan.

Further, the Annual Report will be a public document available on our website once finalized.

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2010-003</td></tr>
<tr><td colspan="2">Noise Management Plan Reporting Requirements as per Section 5.4 of this Standard</td><td>Rev. Date
31-March 2016</td><td>Rev.
0</td></tr>
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Access Pipeline o/a Wolf Midstream (Sturgeon Terminal)

Note, please provide as much detail as you can for the following, attaching any clarifying or required documents with your submission.

If you have any questions, please call Laurie Danielson @ 780.992.1463

Input Description	Member Site Comments
Confirmation that site has implemented a best management practice to address environmental noise as per NCIA Noise Management Plan Standard 2010-003 issued 3-Sep-10, revised 5-Mar-13, revised 14-Apr-14, revised 31-Mar-16 including the Procedure/Practice/Standard reference. Note, if you have not provided an electronic copy of your site plan to NCIA, please do so.	Access abides by AER's Directive 38. We participate in industrial noise monitoring.
Provide a summary of any monitoring (fence line outward completed in 2018. Note, you are not required to conduct any off-site monitoring.	A noise monitoring was not conducted in 2019.
Disclose any improvements/corrective actions implemented in 2018 or status thereof that would impact the noise level output for your site (either up or down). Did those changes result in a requirement to update your site noise model? If so, have you provided your updated site model to SLR Consulting for incorporation into the NCIA Regional Noise Model as per the process outlined for this purpose?	N/A

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Disclose any improvements/projects that are approved for 2018 that would impact the noise level output for your site (either up or down). Will these changes result in a requirement to update your site noise model? If so, when do you anticipate having an updated site model available?	There were no anticipated projects or improvement for 2019 that may have impacted noise levels.
Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan in 2018.	None.
Provide a Noise Complaint summary for all noise complaints received in 2018 including any actions taken to address them.	Wolf Midstream did not receive any noise complaints for the 2019 year.

This information is being collected as per the NMP Standard 2010-003 Revised 31-March-2016. All information provided will be disclosed to the AER as part of the required NCIA Annual Reporting on the Regional Noise Management Plan.

Further, the Annual Report will be a public document available on our website once finalized.