# NCIA Regional Noise Management Plan (RNMP)

# Annual Report (covering the 2014 Calendar Year)

Prepared for the

Albert Energy Regulator (AER)

And

The Alberta Utilities Commission (AUC)

January 2016

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NCIA Regional Noise Management Plan (RNMP)

Annual Report to the Alberta Energy Regulator (AER)

2015 (covering the calendar year 2014)

# 1 Executive Summary

NCIA completed field validation measurements for the regional noise model in 2014. These results are compared to the updated Regional Noise Model of June 2015 (see Section 3).

A number NCIA member site level noise models were updated or added in 2013 and 2014, mostly due to expansions or changes at these facilities, and those were included in an update to the regional noise model and its outputs beginning in 2014 and ending in June of 2015 (see Section 4.1). The site models that were updated are:

- Dow Chemical Canada – introduced administrative controls to reduce the amount of time that a steam header steam vent in the ethylene cracker operates, thus reducing the noise impact of the Dow Chemical site model.
- Shell Canada Upgrader Expansion – the Environmental Impact Assessment database for the Upgrader expansion plant was replaced with an on-site measured site model and moved from the future regulatory case to the existing regulatory case. Note, not all elements of the model were completed prior to this update and so surrogate values were used for stack noise levels. A future update for this site model is pending (likely in 2017 or early 2018).
- Shell Canada – Chemicals, Refinery and Upgrader model updates were 100% completed. Two projects will have an impact on future noise, namely a Refinery Debottleneck project (2017) and a Quest $CO_2$ capture start-up (2015). These will be captured in a future regional noise model update, likely in 2017.
- Keyera Fort Saskatchewan
    - The product injection pump project described in the 2013 report was completed in 2013. A Noise Impact Assessment completed in the design phase of that project resulted in several modifications to the proposed pump installation, including an acoustically treated building and low noise valves.
    - A brine storage pond was also constructed in 2013, which provides some sound attenuation in the northwest portion of the site.
    - These changes were incorporated into the 2015 NCIA Regional Noise Model update through SLR Consulting.
    - 2014 equipment additions include receipt pumps associated with the Cochin Pipeline reversal project and a de-ethanizer system. It is expected to be operational in the spring of 2015.
    - These changes will result in an updated site model in 2016 at some time and captured in the regional noise model update of 2017.

- Pembina NGL Corporation – Facility underwent some changes that are captured in this regional model update. Additional expansion (RFS II and RFS III) are underway and will result in an updated site noise model in 2016, which will be captured in the regional noise model update of 2017.
- Plains Midstream Canada – Facility underwent an expansion that is now operating.
- Sasol Canada – Environmental Impact Assessment was used to replace Total E&P's information in the previous regional noise model.

## 2 AER Audits of NCIA Member Facilities

- AER conducted an audit of the Dow Site Noise Management Plan in March of 2014.
- AER conducted an audit of the Keyera Site Noise Management Plan in 2014 as well.

## 3 Regional Noise Model Update

A number NCIA member site level noise models were updated or added in 2013 and 2014, mostly due to expansions or changes at these facilities, and those were included in an update to the regional noise model and its outputs beginning in 2014 and ending in June of 2015 (see Section 4.1). The site models that were updated are shown in the tables 1 and 2 below. The site level models that were updated are highlighted in orange in the tables below.

Table 3 below shows those inputs where a basic noise model was used to input to the Regional Noise Model. The site level models that were updated are highlighted in orange in the table below.

A sound level contour difference was generated showing the NCIA 2015 Regional Noise Model minus the NCIA 2012 Regional Noise Model and it is presented in Figure 1 below with some discussion following it.

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

| Company | Plant / Unit | Model Date |
|---|---|---|
| Agrium | Redwater Fertilizer Operations Plant | December 7, 2001 & January 21, 2008 |
| Air Liquide | Cogeneration Unit | June, 1998 |
| Cenovus | Bruderheim 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 |
| Maxim Power Corp. (non NCIA member) | Deerland Peaking Station | July, 2008 |
| North West Redwater Partnership | Sturgeon Refinery (3 units) | November 22, 2007 |
| Pembina Pipeline (formerly Provident Energy) | Redwater Fractionation & Storage Facility | January 17, 2003 |
| Shell Canada | Refinery; Upgrader (base plant and expansion plant); Cogen | September, 2014 |
| Shell Chemicals | Styrene; MEG | March 19, 2009 |
| Sherritt Fort Saskatchewan Integrated Site: | | |
| Agrium | Nitrogen production | January 17, 2003 |
| Corefco | Metal production | February 13, 2006 * |
| Sherritt International | Metal production | February 13, 2006 |
| Oerlikon-Metco (formerly Sultzer-Metco) | Chemical preparation | February 13, 2006 |
| Umicore | Metal products | February 13, 2006 * |
| Smith & Nephew | Surgical appliances | February 13, 2006 * |
| Keyera Fort Saskatchewan | Fractionation and storage | March, 2014 |
| Plains Midstream | Fractionation and storage | March, 2014 |

* integrated into Sherritt model

## Table 2
## Site Noise Models in Regional Noise Model Prepared by Others

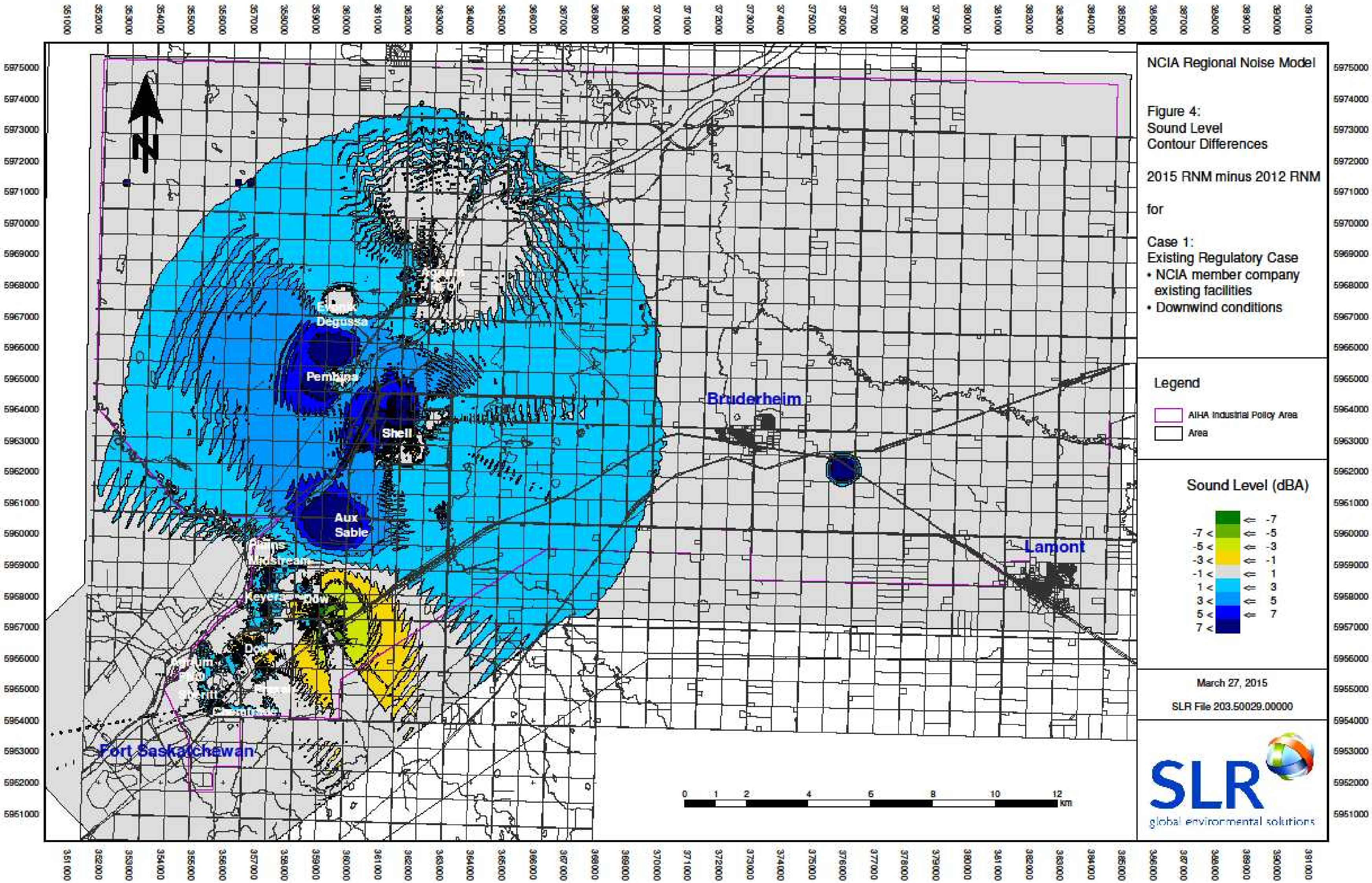
| Company | Plant / Unit | Acoustical Consultant | Model Date |
|---|---|---|---|
| Access Pipelines | Sturgeon Terminal | FFA | July 21, 2010 |
| Value Creation (formerly BA Energy) | Oilsands Upgrader | RWDI | May, 2004 |
| Suncor (formerly Petro Canada) | Fort Hills Sturgeon Upgrader | RWDI | September 3, 2008 |
| Pembina Pipeline | Expansion | Stantec | June 27, 2013 |
| Sasol | Gas to Liquids Plant | Stantec / RWDI | May, 2013 |

## Table 3
## Heartland Plants where Basic Noise Models were Built

| Plant / Unit | Process | Data Provided | Model Data |
|---|---|---|---|
| **NCIA MEMBER COMPANIES** | | | |
| Aux Sable Canada * | Off Gas Plant | Sound Power Levels | September 2, 2010 |
| Aux Sable Canada * | Extraction Plant | Sound Power Levels | September 2, 2010 |
| Plains Midstream (formerly BP Canada Energy) [1] | Fractionation and Storage Complex | Fence line Measurements | March 2, 2010 |
| Evonik Canada Inc. | Hydrogen Peroxide Plant | Fenceline Measurements | June 11, 2010 |
| Keyera Energy | Fractionation and Storage Complex | Fenceline Measurements | March 2, 2011 |
| Chemtrade Logistics (formerly Marsulex Inc.) ** | Central Service Center | Diagnostic Measurements | September 21, 2010 |
| Chemtrade Logistics (formerly Marsulex Inc.) ** | Sulfides Facility | Diagnostic Measurements | September 21, 2010 |
| Praxair Canada Inc. | Air Separation Plant | Fence line Measurements | June 11, 2010 |
| Praxair Canada Inc. | Carbon Dioxide Plant | Fence line Measurements | June 11, 2010 |
| **NON-MEMBER COMPANIES** | | | |
| ATCO Midstream | Liquid Extraction Plant | Sound Power Levels | June 23 2011 |
| Smith & Nephew | Pharmaceuticals | Sound Power Levels | June 23, 2011 |

* based on PWL's delivered by the facility's acoustical specialist
** became Chemtrade after 2012 assessment date
1 2012 database replaced with a detailed database in 2015 model update

**Figure 1: Sound Level Contour Differences**



The 2015 update to the Regional Noise Model contains more data than the previous 2012 model did. This is partly because some of the facilities, which had Basic Noise Models from 2012, updated their databases with more accurate models over the past couple of years. Some of these updates were based upon actual on-site noise measurements. The apparent increase in some of the area sound levels is not because it has gotten louder in the region; it is the availability of more representative data which has led to a more accurate representation.

It is acknowledged that the format of data presentation within Figure 1 is unique. It is SLR's opinion that the data is justifiably correct. An interpretation of the visible effects can be summarized as follows:

- For the Pembina Redwater Fractionation & Storage Facility, the increase in sound levels resulted because the facility underwent an expansion that is now operating.
- For the Shell Scotford Upgrader site, the increase in sound levels resulted because the database for the Upgrader expansion plant was replaced within the Existing Regulatory Case; the former site model included in the 2012 model database was theoretical from the EIA, and the current site model included in the 2015 model updated database was mostly based from on-site noise measurements. Furthermore, the locations of the Upgrader expansion plant's equipment noise sources were moved to their correct locations.
- For the Aux Sable Canada Off Gas Plant and Extraction Plant, the increase in sound levels resulted because the off gas plant was within the Future Regulatory Case in the former 2012 model database, and is now within the Existing Regulatory Case in the current 2015 model updated database.
- For the Cenovus' (formerly Canexus) operations (East of Bruderheim), the increase in sound levels resulted because they were a non-member company within the Model Validation Case of the former 2012 model database, and are now an NCIA member company within the Existing Regulatory Case in the current 2015 model updated database.
- For the Agrium Redwater Fertilizer Operations plant, the region of unchanged sound levels in the vicinity of the plant results from that facility not having increased its noise emission (no noise model update was included for Agrium RFO). As Agrium RFO is still the source of dominant noise in its nearby vicinity, the resultant sound level in the area remains unchanged, and thus the increase in sound levels (indicated by blue shading on the figure) does not predominate the noise environment nearby the facility.
- For the Dow Chemical Canada Light Hydrocarbons site, the decrease in sound levels materialized as a result of Dow advising that administrative controls have been assessed to reduce the amount of time that a steam header steam vent in the ethylene cracker, and thus the model has been updated accordingly.

Furthermore, the light blue shading (representing an increase of between 1 to 3 dBA) covers a large area. If the ambient sound levels were combined with the predicted sound levels, this effect would not be as prevalent.

# 4 2014 Monitoring results for Regional Noise Model

aci Acoustical Consultants Inc. completed sound monitoring surveys near Fort Saskatchewan in Alberta's Industrial Heartland as a means to validate the accuracy of the Regional Noise Model developed for the Northeast Capital Industrial Association (NCIA). A total of eleven (11) 48-hour noise monitoring measurements were conducted in August at 10 locations. Data from June was used for one of the locations. The complete Field Monitoring Report can be found in Appendix 1 of this report. Sampling locations are shown in Table 4 and Figure 2 below.

Measured versus modeled results are shown in Figures 3-5 below. We have taken a different approach to comparing the measured versus modelled results this year as you will note in the figures below. Since this is a new way of presenting this information we have included the 2012 data (Figure 3), the 2013 data (Figure 4) and the 2014 data (Figure 5) which is the current data for this report. These figures show that in general there is good agreement between the modelled range and the measured results.

In each of Figure 3, Figure 4, and Figure 5, the format of presentation shows the measured (monitored) values as **red** diamonds and **dark blue** squares. Furthermore, the format of presentation shows predicted (modeled) ranges as **light blue** bars representing upper and lower values using various conditions explained below.

For each figure, the results of the measured data are compared to the predicted results from the latest Regional Noise Model (RNM) available at the time that the comparison was made. In the case of Figures 3 and 4, the 2012 and 2013 measured results are compared to the predicted results for the 2012 RNM. In Figure 5, the 2014 measured results are compared to the predicted results for the 2015 RNM.

The modeled case used for the predictions is the "Validation Case" which comprises all the available data for both NCIA member and non-member companies that are existing and operating in the region.

The upper and lower limits of the predicted ranges shown in the figures were determined by running the RNM using variations in the meteorological conditions. While best efforts are made to conduct field measurements during ideal meteorological conditions (e.g. stable atmosphere, calm wind, no precipitation), some conditions are difficult to assess and changes can also occur quite rapidly over a fairly short period of time. Changing meteorological conditions can have quite a significant effect on the measured sound level at a given location, as evidenced by some of the variability observed in the measured sound levels from one night to the next at the same location (presuming that source levels from the industrial facilities are constant). For that reason, it was deemed more appropriate to compare the measured sound levels to predicted levels based on a range of meteorological conditions. The conditions used to represent the upper and lower values for the predicted ranges displayed on the figures can be described as follows:

- The lower values represent predictions without any wind and a Pasquill Stability Class 'B', which represents a temperature lapse condition (i.e. decreasing temperature with increasing altitude). The outdoor sound propagation for this condition is acoustically equivalent to a situation having a stable atmosphere and a light to moderate wind (up to 11 km/hr) blowing from the receptor toward the industrial noise sources.

- The upper values represent predictions without any wind and a Pasquill Stability Class 'F', which represents a temperature inversion condition (i.e. increasing temperature with increasing altitude). The outdoor sound propagation for this condition is acoustically equivalent to a situation having a stable atmosphere and a light to moderate wind (up to 11 km/hr) blowing from the industrial noise sources toward the receptor.

Focusing on the 2014 results (Figure 5 below) one will note that Areas 4a and 5 show measured results that are below the modelled results. In other words, the model is over predicting the noise in that area. We now know that the Shell Scotford model is over predicting noise levels somewhat (based on new on-site measurements for the site model) and that will be corrected in the 2017 or 2018 Regional Noise Model update.

For location 6, this is being investigated by Agrium as it suggests that the Agrium Redwater site model may be under predicting noise levels in that area.

For location 10 near the Dow Chemical site, the measured values are below the modelled range and this is being looked at as well. This may be related to the steam vent issue that is discussed in this report, but needs to be confirmed.

**Table 4**
**Monitoring Location Details**

| Location No. | UTM Coordinates (approximate) | | Description |
|---|---|---|---|
| | Easting (m) | Northing (m) | |
| 1 | 354971 | 5954162 | 2 m north of 100 Ave, and 585 m northwest of Highway 15 near Mel Martin's Transfer Facility and approximately 600 m southwest of the Agrium Fort Saskatchewan Facility. |
| 2 | 358261 | 5957223 | 95 m east of 125 Street and 1 km north of Highway 15 Near bend in River Road where it becomes 125 Street, between Dow and Keyera facilities. |
| 3 | 358353 | 5959156 | 6 m east of 125 Street and 220 m north of Petrogas facility. This location was changed from the 2012 noise monitoring location in an effort to better quantify the contributions of the facilities north of the Dow facility. |
| 4 | 361681 | 5961521 | 570 m south of the south fence line of the Shell Scotford site and 1.6 km east of 130 Street; 155 m north of the entrance to the electrical substation to the southwest. |
| 5 | 361777 | 5964711 | 200 m north of Township Road 560A and 5 m east of Range Road 215, at 300 m north of the north fence line of the Shell Scotford facility. |
| 6 | 364322 | 5967894 | 1.0 km north of Township Road 562 and 3 m east of Range Road 213A, 1.6 km East of Agrium Redwater facility. |
| 7 | | | Not measured in 2014 due to construction activities on North West Redwater Partnership site. |
| 8 | 358790 | 5965421 | 1.6 km south of highway 643 and 275 m east of Range Road 221, 15 m north of the north fence line for the Pembina/Williams facility. |
| 9 | 355872 | 5957574 | 5 m southwest of the intersection of Lamoureux Drive & Godbout Avenue, 1.3 km northwest of the Dow facility and 1.4 km west of the Keyera facility. |
| 10 | 355925 | 5955818 | 30 m west of 119 Street and 12 m north of the access road to Agrium Fort Saskatchewan, 750 m northeast of the Agrium facility and 180 m west of the Dow fence line. |
| 11 | 358430 | 5963804 | 3 m northwest of Intersection of Range Road 221 and Township Road 560, 1.7 km southwest of Pembina/Williams facility. |
| 12 | 366660 | 5964360 | Independent control/reference point. It was located 3 m east of Range Road 212 and 785 m north of Township Road 560, 20 m south of the CP rail line and 2.0 km southeast of the Enbridge facility. |

The complete report is included as Appendix 1 of this report.

**Figure 2: NCIA Regional Noise Monitoring Locations (as per Table 4)**

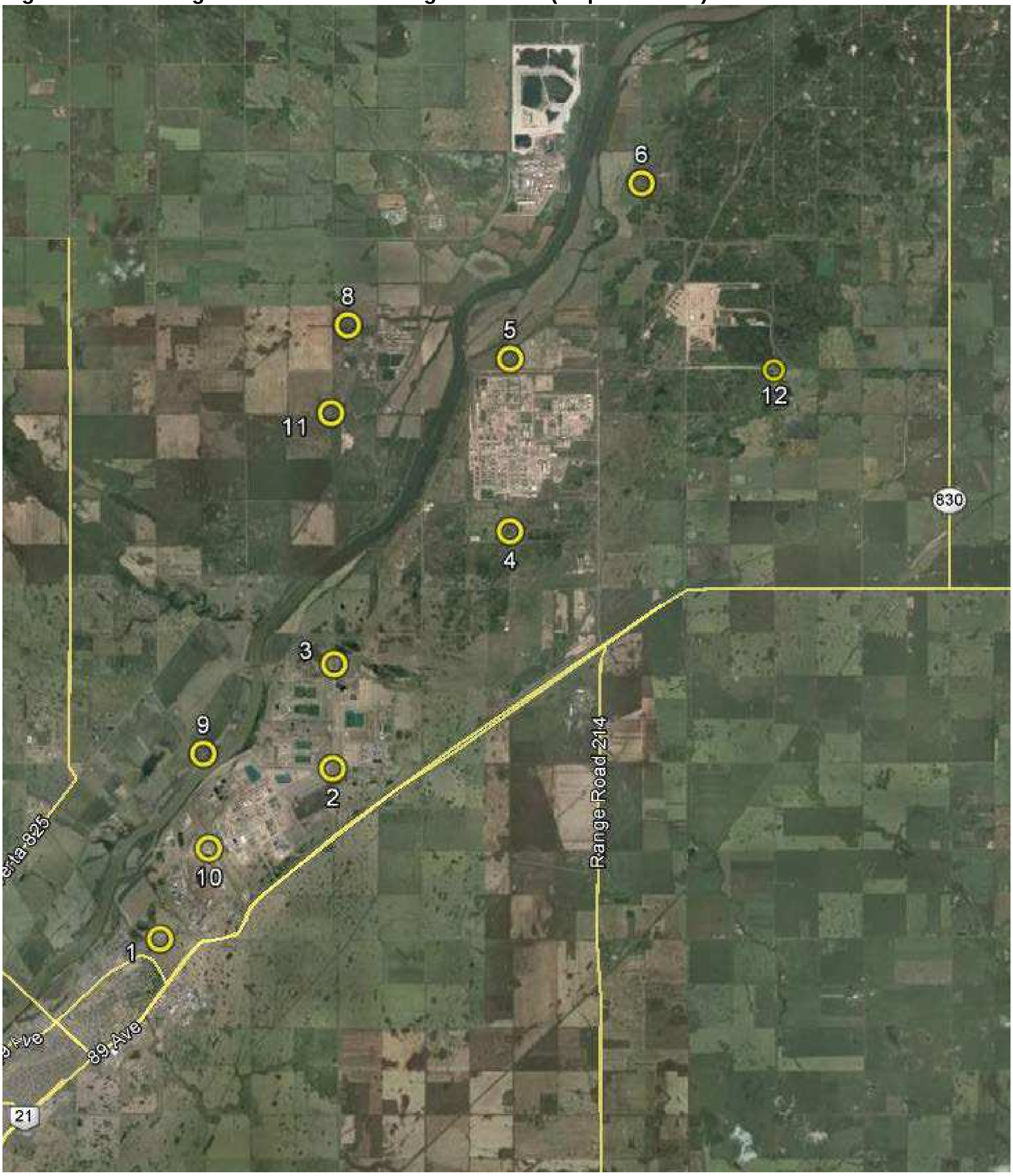


**Figure 3: 2012 Predicted Range versus Measured Sound Levels**

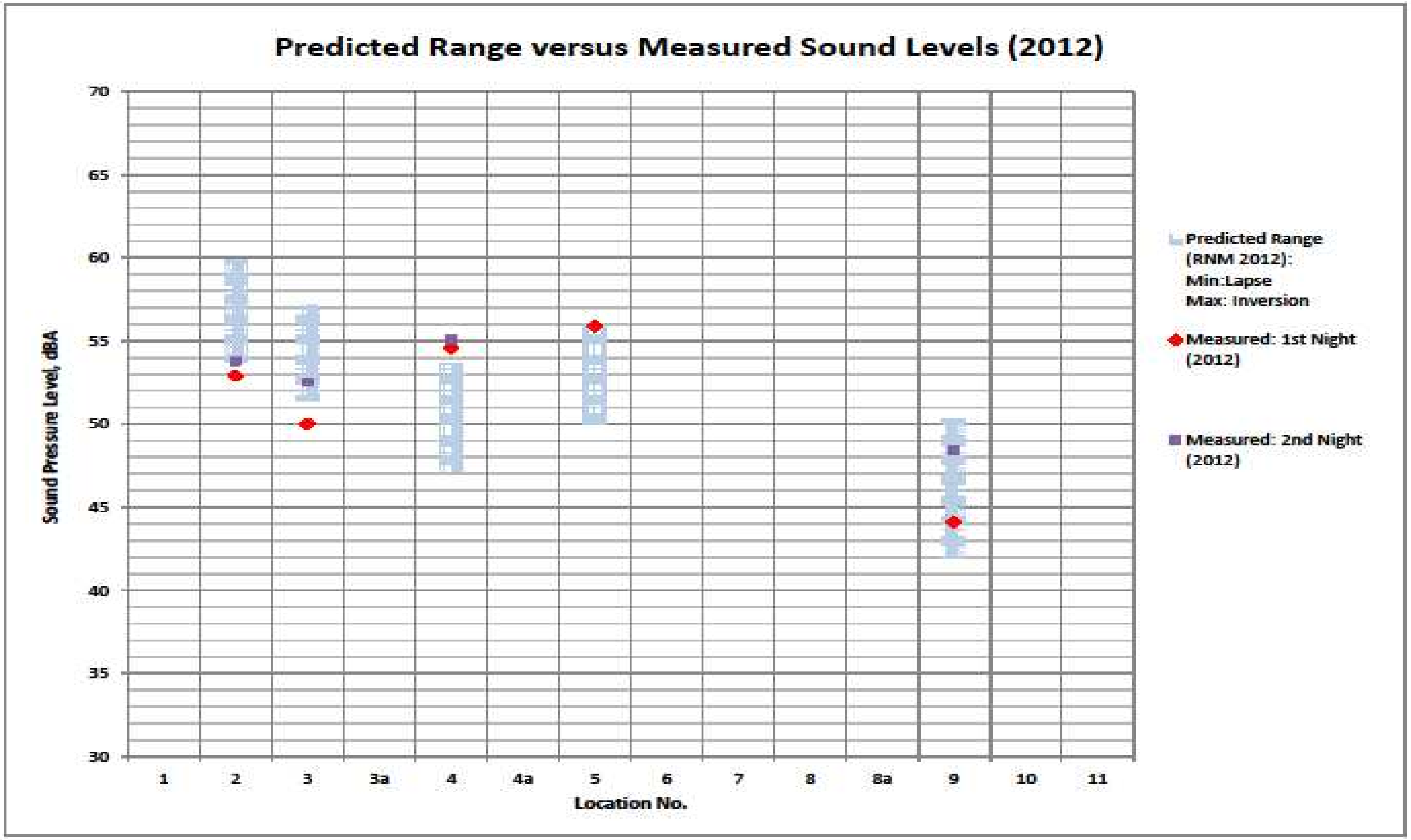


**Figure 4: 2013 Predicted Range versus Measured Sound Levels**

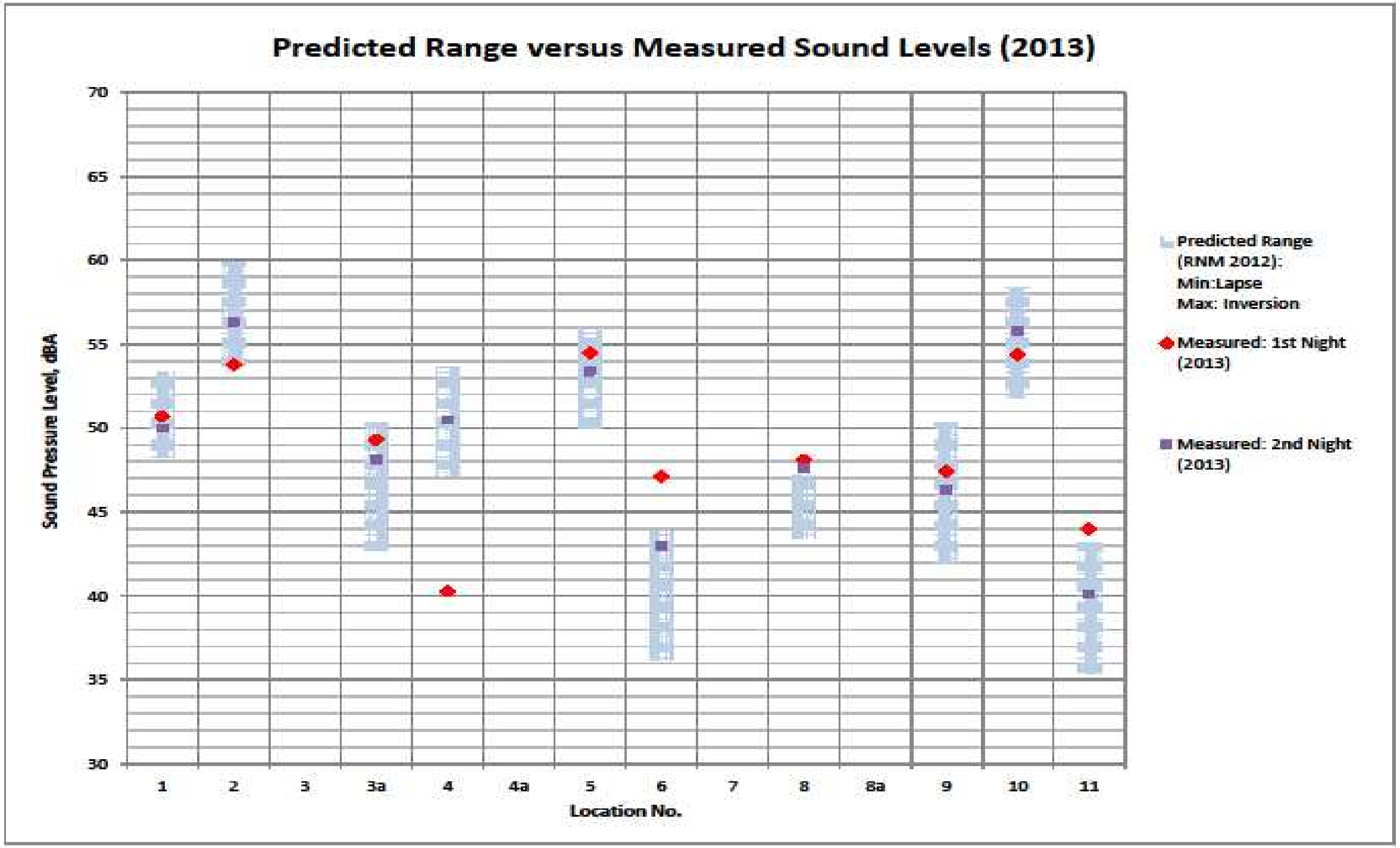
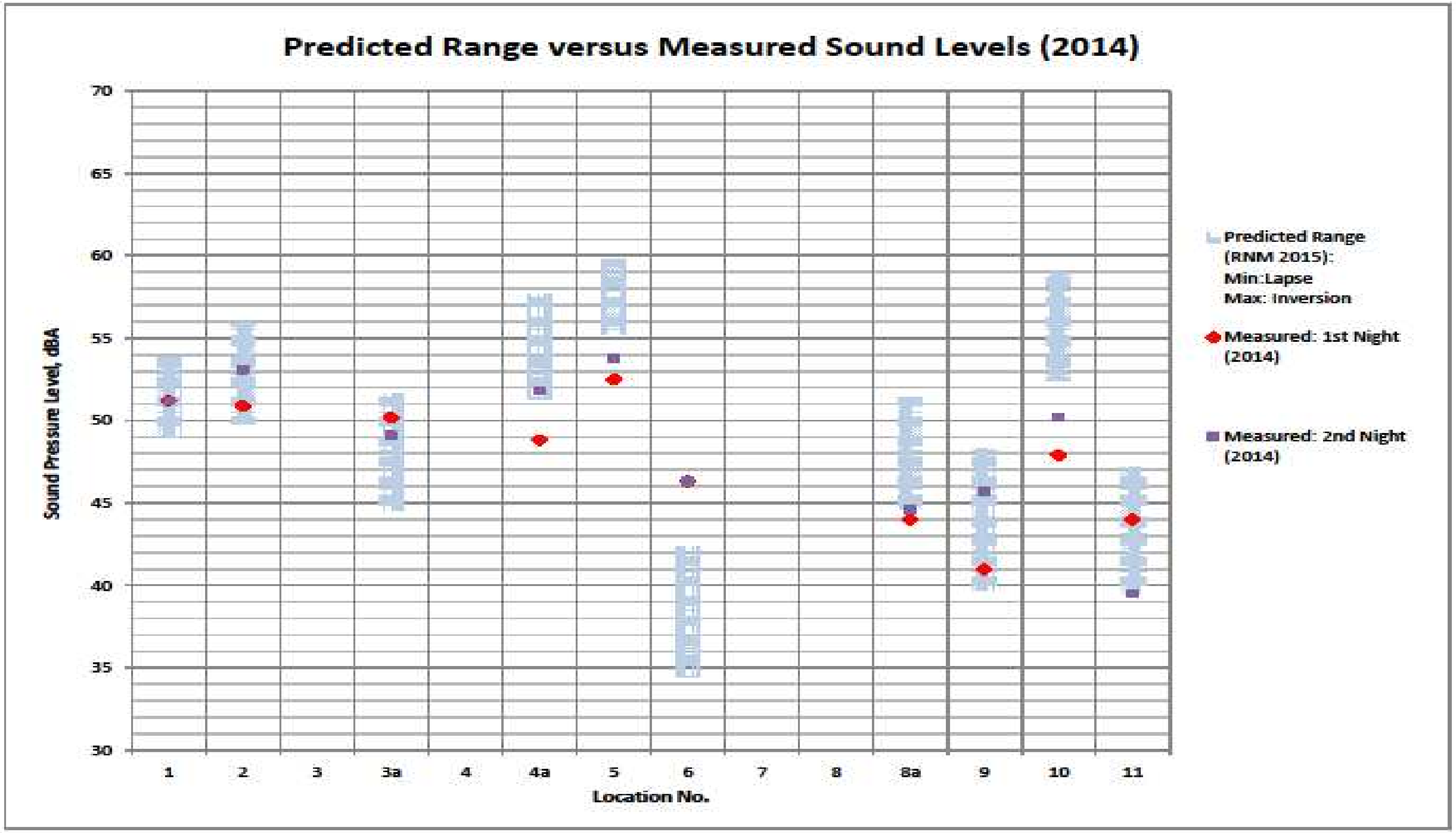


**Figure 5: 2014 Predicted Range versus Measured Sound Levels**



# 5 NCIA Member Compliance

Table 5 summarizes the compliance requirements for NCIA member and non-member companies' vis a vis the NCIA RNMP.

**Table 5**
**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/AESRD |
| Yes | No | Yes | NCIA - RNMP |
| No | No | Yes | Potential NCIA-RNMP |
| No | No | No | Other Regulatory Jurisdictions |

As of this date, Table 6 summarizes the NCIA member companies and their status with respect to Table 3 above.

**Table 6**
**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 2014 (Appendix 3) | Developed a Site Noise Management Plan |
|---|---|---|---|
| **Access Pipeline** | AER regulated under Noise Control Directive 038. | Yes | Not Yet |
| **Agrium Fort Saskatchewan** | Not regulated | Yes | Yes |
| **Agrium Redwater** | Not regulated | Yes | Yes |
| **Air Liquide Canada** | Not regulated | Yes | Partly |
| ATCO Power | Hearland facility not operational. | Yes | Partly |
| **Aux Sable Canada** | Regulated under Section 11 of the OSCA and therefore D-038. | Yes | Yes |

| NCIA Member[1] | AER Regulated Status for Noise Control Directive 038 | Filed an Annual Update with NCIA for 2014 (Appendix 3) | Developed a Site Noise Management Plan |
|---|---|---|---|
| Cenovus | Not regulated | No | Not Yet |
| **Chemtrade West** | Not regulated | Yes | Yes |
| **Dow Chemical Canada** | Regulated under D-038<br>Operator No. 0F05 | Yes | Yes |
| **Enbridge Pipelines** | Is regulated | Yes | Yes |
| **Evonik** | Not regulated | Yes | Partly |
| Fort Hills Energy Partnership | Not operational but will be regulated<br>Operator No. 0XP9 | No | Not Yet |
| **Keyera Corp.** | Regulated under D-038<br>Operator No. A5W1<br>LSD - 02-14-055-22W4<br>Facility No. F-12695 | Yes | Yes |
| **ME Global** | Not regulated | Included with Dow's submission | Yes |
| North West Redwater Partnership | Not operational but will be regulated.<br>LSD - E1/2-18-56-21-W4M | No | Not Yet |
| **Oerlikon Metco (Canada)** | Not regulated | Yes | Yes |
| **Pembina NGL Corporation** | Regulated under D-038 | Yes | Yes |
| **Plains Midstream Canada** | Regulated under D-038<br>Operator No. 60<br>LSD - 14-55-22 W4M<br>Facility No. 12699 | Yes | Yes |
| **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.<br>AER Approval No. 11640. | Yes | Yes |
| **Shell Upgrader** | AER Approval No. 8522 regulated under D-038. | Yes | Yes |
| **Sherritt International** | Not regulated | Yes | Yes |
| Sasol Canada | Not operational but will be regulated | No | Not Yet |

| NCIA Member[1] | AER Regulated Status for Noise Control Directive 038 | Filed an Annual Update with NCIA for 2013 (Appendix 3) | Developed a Site Noise Management Plan |
|---|---|---|---|
| **Umicore Canada** | Not Regulated | Yes | Yes |
| Value Creation | Not operational, but will be regulated. | No | Not Yet |
| Williams Canada Propylene | PDH Not Operational | No | No |

[1] **Bold** type in the above table signifies that these members have operational assets on the ground within Alberta's Industrial Heartland. Non-bold type means these companies are members, but do not have operational assets, at this time, in the region and were therefore not required to complete the annual input form, although some did provide updates on their projects.

# 6 Regional Noise Model

## *6.1 Improvements/Corrective Actions implemented in 2014 (Appendix 2)*

1. Agrium - As stated in the 2013 report, Agrium engaged both SLR and Noise Solutions to proactively provide noise control options for both the compressor / gas turbine (CGT-902) and Utilities Boiler replacement projects respectively. The motive for these assessments is primarily Occupational Hygiene, but it is anticipated that Environmental Noise will also be reduced. Worthy of noting is that implementation of these projects have been rescheduled for 2017 (opposed to 2016).
2. 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. This source was therefore removed from the NCIA Regional Noise Model.

   In March of 2014, 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 of 2015.

   As a follow up to the audit, Dow committed to evaluate whether on-site transportation is a significant cumulative noise source from the Dow site. A review of the 2014 field monitoring conducted by NCIA shows that field monitoring at two of the three locations near the Dow site correlates very well with the model predictions (locations 2 and 9). Field measurements at the third locations were lower than model predictions (location 10). Based on this, the current model adequately predicts noise from the Dow site and on-site transportation is not a significant cumulative noise source. Dow will continue to review field monitoring versus model predictions in the future.

3. For Keyera Corp. changes to the hot oil furnace (HR-15.02) and aerial coolers (HT-16.04/06) in the existing fractionation plant described in the 2013 report were completed in 2014. A Noise Impact Assessment completed in the design phase of the De-Ethanizer project resulted in the completion of burner modifications to the existing hot oil furnace and installation of low noise fans on the aerial coolers to reduce noise emissions. These changes will be incorporated into the 2015 NCIA Regional Noise Model through SLR Consulting.

   2014 equipment additions included receipt pumps associated with the Cochin Pipeline reversal project. The Cochin pumps were operational in the summer of 2014. Construction of a De-ethanizer unit also took place during 2014, with expected commissioning and operation commencing in the spring of 2015. Once the addition is complete there will be a requirement to update the site noise model, which is expected to be completed in 2016.

4. At the Pembina Redwater site, additional equipment was added and the site noise model was updated and incorporated in the 2015 Regional Noise Model update. Additional work is planned for 2015 and 2016 with an updated site noise model planned for some time in 2016.
5. At the Plains Midstream Canada site construction activities continued on with the Phase 1 & 2 Expansion project in 2014. This development began with the final construction of a new facility brine pond, drilling of new storage caverns, installation of associated infrastructure to support the cavern development, relocating and expansion of the truck loading terminal, and earthworks for a new rail loading terminal.

   The expansion has resulted in the site conducting a noise impact assessment which was subsequently used to update the Regional Noise Model in 2014. SLR Consulting conducted the NIA and updated the model with the information.

   The Facility will be continuing on with the Phase 1 & 2 Expansion plans in 2015. This will include the construction of a new facility brine pond, drilling of additional underground storage caverns, final construction of a rail loading terminal, and additional earthworks to facilitate future expansion plans. 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.
6. 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 and is presented in Appendix 2. Additionally, in 2014 an external Noise Survey was conducted at NCIA Validation Location #4 to try to determine the discrepancy between the model results verus actual measurements. This testing was inconclusive. The report is included in Appendix 2.

   The Regional Noise Model was updated with the new site model for the Expansion, however surrogate values were used for the stack noise levels. These will be updated with actual measurements later in 2015. Also in 2014 the Chemicals, Refinery and Upgrader noise models were updated and are included in the 2015 NCIA Regional Noise Model update.

Two projects will have an impact on noise in 2015/2016. Namely a Refinery Debottleneck project (start up in 2017) and the Quest CO2 capture (start up in 2015).

### *6.2 Other Items for Follow-up Based on 2013/2014 Field Measurements*

1. Discrepancy between measured versus predicted sound levels at monitoring location #4 were investigated further in 2014 with inconclusive results. See the aci report in appendix 2. It should be noted that we now understand that the Shell Scotford model is over predicting the noise levels from the site (based on new site level noise measurements) which have resulted in a change in the site model. It will be captured in the next Regional Noise Model update in 2017 or 2018. Consequently, it is likely that the concern expressed in the 2013 report with respect to this location has now been addressed.

### *6.3 Next Steps for 2015*

1. Finalize Regional Noise Model and regenerate output files in both SoundPlan and CadnaA. These files will be available to NCIA member companies at no charge beginning in July of 2015. Non-member companies can use these files for a fee established by NCIA under a confidentiality agreement.
2. Update the Google Earth platform (for new company names and updated site models) and make it publicly available on the NCIA website for calm wind conditions (targeting October of 2015 to complete this activity).

# APPENDIX 1

*2014 Field Validation Monitoring Report*

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2014 Environmental Noise Survey

For The

# Regional Noise Model Annual Field Validation Monitoring

Prepared for:

**Northeast Capital Industrial Association**

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APEGA Permit to Practice #P7735

**aci Project #: 14-020**
**October 28, 2014**

## 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 ten (10) pre-specified locations within the AIH[1]. An additional noise monitoring, spanning two (2) 48-hour periods, was conducted at an 11th monitoring location (determined in 2013 by aci in consultation with the NCIA, and referred to as Location 12) as an independent control/reference point. The noise monitorings were conducted in support of the NCIA's Regional Noise Management Plan. In addition, the results from these noise monitorings will be used to validate the Regional Noise Level Assessment 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 June and August, 2014 by P. Froment, B.Sc., B.Ed. and S. Bilawchuk, M.Sc., P.Eng.

As part of the study, a total of twelve (12) 48-hour noise monitorings were conducted throughout the Alberta's Industrial Heartland. It was found that the isolated $L_{eq}$Night[2] broadband and 1/3 octave band $L_{eq}$ sound levels were similar to those measured in the 2013 Noise Survey. Unlike the 2013 Noise Survey the weather conditions fluctuated more greatly in regards to the wind speed and direction. As a result, there was a greater variance in the noise levels between the two night-time periods for a several of the noise monitoring locations.

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. Lastly, the noise levels from train passages were again prevalent at all locations and tended to dominate the noise climate as they passed through. However, in comparison to the 2013 Noise Survey there were there were a greater number of passages with an increase in average train length throughout the night-time periods.

[1] In 2013, there were 11 locations plus the 12th (control) location. In 2014, only 10 locations were used plus the control location due to construction activity at Location 7.
[2] The term $L_{eq}$ represents the energy equivalent sound level. This is a measure of the equivalent sound level for a specified period of time accounting for fluctuations.

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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 ten (10) pre-specified locations within the AIH[1]. An additional noise monitoring, spanning two (2) 48-hour periods, was conducted at an 11th monitoring location (determined in 2013 by aci in consultation with the NCIA, and referred to as Location 12) as an independent control/reference point. The noise monitorings were conducted in support of the NCIA's Regional Noise Management Plan. In addition, the results from these noise monitorings will be used to validate the Regional Noise Level Assessment 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 June and August, 2014 by P. Froment, B.Sc., B.Ed. and S. Bilawchuk, M.Sc., P.Eng.

## 2.0 Location Description

Alberta's Industrial Heartland (AIH) is located northeast of Edmonton, AB and extends into five different municipalities as shown 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 (with the exception of 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.

[1] In 2013, there were 11 locations plus the 12th (control) location. In 2014, only 10 locations were used plus the control location due to construction activity at Location 7.

## 3.0 Measurement Methods

As part of the study, a total of eleven (11) 48-hour noise monitorings were conducted at 10 locations[1] throughout the AIH, as shown in Figure 2. A noise monitoring was **not** conducted at Noise Monitor Location 7 due to the 24-hour earthworks operations the Northwest Redwater Partnership (NWR) refinery. This noise monitoring location will be reviewed again next year to determine whether future noise monitoring should be conducted at this location. Noise monitor Location 1[2], Location 4[3] and Location 8[4] were placed at new locations relative to their 2013 location, all other the noise monitoring locations were identical to those conducted during the 2013 Noise Survey as outlined in the report, "*Environmental Noise Survey for the Regional Noise Model Annual Field Validation Monitoring*" prepared for the NCIA by aci Acoustical Consultants Inc. on November 13, 2013 (to be referred to as the 2013 Noise Survey).

The noise monitorings were 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[5]. In particular, the chosen noise monitoring periods avoided any major shut-downs or outages that could adversely affect the "typical" noise levels (either louder or quieter) from a given facility. In addition, the monitorings were conducted in summer conditions (i.e. no snow cover) with no precipitation and, if possible, low wind-speeds. Each noise monitoring was accompanied by a 48-hour digital audio recording for more detailed post process analysis. Three local weather monitoring stations were also used throughout all noise monitoring periods[6] to obtain the wind speed, wind direction, temperature, relative humidity, barometric pressure and rain fall data in 1-minute 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, please note that two (2) 48-hour monitorings were conducted at Monitoring Location 12.
[2] Due to construction at the 2013 noise monitoring location the monitor was moved 15 m northeast. (On other side of road.)
[3] Due to potential interference from the large power poles at this location the noise monitor was placed approximately 155 m north of the 2013 noise monitoring location.
[4] Based on conversations with NCIA, Noise Monitor Location 8 was moved slightly to the west to allow for better sight-lines to the Pembina/Williams facility to the south.
[5] This was verified by all of the various company representatives.
[6] Only a single weather monitor was used for the June 16 – 17 and June 25 – 26, 2014 noise monitoring periods, as discussed in Section 4.4.

## 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**

| Monitoring Location | UTM Coordinates[1] (Approximate) | | Start Time | End Time |
|---|---|---|---|---|
| | Easting (m) | Northing (m) | | |
| **1** | 354971 | 5954162 | 8/20/14 14:00 | 8/22/13 14:00 |
| **2** | 358261 | 5957223 | 8/13/14 15:30 | 8/15/14 15:30 |
| **3** | 358353 | 5959156 | 8/13/14 15:15 | 8/15/14 15:15 |
| **4** | 361681 | 5961521 | 6/16/2014 22:00:00<br>6/25/2014 22:00:00 | 6/17/2014 22:00:00<br>6/26/2014 22:00:00 |
| **5** | 361777 | 5964711 | 8/13/14 14:30 | 8/15/14 14:30 |
| **6** | 364322 | 5967894 | 8/13/14 14:00 | 8/15/14 14:00 |
| **7** | N/A for 2014 | | | |
| **8** | 358790 | 5965421 | 8/13/14 13:00 | 8/15/14 13:00 |
| **9** | 355872 | 5957574 | 8/20/14 13:00 | 8/22/14 13:00 |
| **10** | 355925 | 5955818 | 8/20/14 14:00 | 8/22/13 14:00 |
| **11** | 358430 | 5963804 | 8/13/14 13:00 | 8/15/14 13:00 |
| **12** | 366660 | 5964360 | 8/13/14 14:30 | 8/15/14 14:30 |
| **12** | | | 8/20/14 16:00 | 8/22/13 16:00 |

### 4.1. Noise Monitor Location 1

The noise monitor at Location 1 was located approximately 2 m north of 100 Avenue and approximately 585 m northwest of Highway 15 as shown in Figure 2 and Figure 3. This put the noise monitor approximately 20 m northeast of the entrance to Mel Martin's Transfer Facility and approximately 600 m southwest of the Agrium Fort Saskatchewan Facility. This was 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 Agrium Fort Saskatchewan Facility. There was no significant vegetation between the noise monitor and the Agrium facility to the northeast.

[1] The UTM Coordinates have been updated to reflect the modified 2014 noise monitor locations.

### 4.2. Noise Monitor Location 2

The noise monitor at Location 2 was located approximately 95 m east of 125 Street and approximately 1.0 km north of Highway 15 as shown 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 aforementioned facilities.

### 4.3. Noise Monitor Location 3

The noise monitor at Location 3 was located approximately 6 m east of 125 Street and approximately 220 m north of the entrance to the Petrogas entrance as shown in Figure 2 and Figure 5. This put the noise monitor approximately 270 m northwest of the Petrogas facility and approximately 650 m east of the Plains Midstream Facility. At this location, there was no direct line-of-sight to any of the facilities due to the topography of the area. There was no significant vegetation between the noise monitor and the aforementioned facilities.

### 4.4. Noise Monitor Location 4

The noise monitor at Location 4 was located approximately 570 m south of the south fence line of the Shell Scotford site and approximately 1.6 km east of 130 Street as shown in Figure 2 and Figure 6. This put the noise monitor at 155 m north of the entrance to the electrical substation to the southwest. At this location, there was direct line-of-sight to the Shell Scotford site and to the electrical substation to the west. There was no significant vegetation between the noise monitor and the Shell Scotford facility. Note also that a weather monitor was placed approximately 200 m west of this location. A weather monitor was placed approximately 200 m west of this location.

It should be noted that a noise monitoring was conducted at this location on August 20 – 22, 2014. However, due to equipment issues the data could not be downloaded. Therefore, results from a long-term monitoring conducted earlier in the summer for Shell Chemicals Canada Ltd. will be used. As a result, only a single weather station was in place for the two 24-hour monitoring periods at this location.

### 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 shown 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 shown in Figure 1 and Figure 8. This put the noise monitor approximately 1.6 km east of the Agrium Redwater facility and is the northernmost noise monitoring location found within the AIH. Due to favorable topography between the noise monitor and Agrium there was direct line-of-sight to the Agrium site through a small row of deciduous trees across the road. There was no significant vegetation between the noise monitor and the Agrium facility. Note also that a weather monitor was placed at this location, adjacent to the noise monitor.

### 4.7. Noise Monitor Location 7

As previously mentioned a noise monitoring was not conducted at this location due to construction noise nearby.

### 4.8. Noise Monitor Location 8

The noise monitor at Location 8 was located approximately 1.6 km south of Highway 643 (eastbound) and 275 m east of Range Road 221 as shown in Figure 2 and Figure 9. This put the noise monitor approximately 15 m north of the north 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.

### 4.9. 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 shown in Figure 2 and Figure 10. This put the noise monitor approximately 1.3 km northwest of the major structures at the Dow facility and approximately 1.4 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.

### 4.10. 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 Agrium Fort Saskatchewan facility as shown in Figure 2 and Figure 11. This put the noise monitor approximately 750 northeast of the major structures at the Agrium facility and approximately 180 m west of the west fence-line of the Dow facility. There was direct line-of-sight to the Dow facility but not to the Agrium 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.

### 4.11. 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 shown 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). In addition, during the setup and takedown of the noise monitor, there was an internal combustion engine and pump operating that was drawing water from a nearby retention pond. This equipment was approximately 60 m to the south of the noise monitor. There was no significant vegetation between the noise monitor and the aforementioned facilities. Note also that a weather monitor was placed approximately 200 m west of this location.

### 4.12. Noise Monitor Location 12

The noise monitor at Location 12 was the independent control/reference point. It was located approximately 3 m east of Range Road 212 and 785 m north of Township Road 560 as shown in Figure 2 and Figure 13. This put the noise monitor approximately 20 m south of the CP rail line and approximately 2.0 km southeast of the Enbridge facility. At this location, there was direct line-of-sight to the rail line. The noise monitor was bordered on all sides by a combination of dense vegetation and 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, adjacent to the noise monitor.

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

## 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 day-time (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 Monitorings

The results of the eleven (11) 48-hour noise monitorings can be found in Table 2[1] and are presented in Figures 14 – 108. 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[4] 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 thirteen noise monitorings can be found in Appendix IV. In addition, all subjective observations made on-site during each daytime and night-time visit can be found in Appendix VI. Each event that was 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**

| Noise Monitoring Location | 1st Daytime Period | 1st Night-time Period (Non-Isolated) | 1st Night-time Period (Isolated) | 2nd Daytime Period | 2nd Night-time Period (Non-isolated) | 2nd Night-time Period (Isolated) | 3rd Daytime Period |
|---|---|---|---|---|---|---|---|
| | $L_{eq}$Day (dBA) | $L_{eq}$Night (dBA) | | $L_{eq}$Day (dBA) | $L_{eq}$Night (dBA) | | $L_{eq}$Day (dBA) |
| **1** | 62.8 | 59.0 | 51.2 | 62.7 | 57.6 | 51.2 | 61.0 |
| **2** | 68.9 | 67.6 | 50.9 | 70.2 | 66.4 | 53.1 | 70.0 |
| **3** | 53.5 | 52.3 | 50.2 | 54.4 | 51.2 | 49.1 | 55.6 |
| **4** | 47.4 | 49.6 | 48.8 | 59.1 | 51.9 | 51.8 | N/A |
| **5** | 53.2 | 53.1 | 52.5 | 51.6 | 54.2 | 53.8 | 56.0 |
| **6** | 58.3 | 49.2 | 46.3 | 53.8 | 47.8 | 46.3 | 54.9 |
| **7** | N/A for 2014 | | | | | | |
| **8** | 44.4 | 44.3 | 44.0 | 44.3 | 45.1 | 44.6 | 45.1 |
| **9** | 50.4 | 49.3 | 41.0 | 48.9 | 48.6 | 45.7 | 49.2 |
| **10** | 53.6 | 52.0 | 47.9 | 57.8 | 52.9 | 50.2 | 55.8 |
| **11** | 54.0 | 45.7 | 44.0 | 54.2 | 45.1 | 39.5 | 55.3 |
| **12 (Period 1)** | 52.5 | 61.5 | 38.0 | 66.0 | 60.4 | 38.8 | 65.1 |
| **12 (Period 2)** | 55.5 | 62.8 | 31.5 | 65.5 | 66.1 | 31.1 | 60.2 |

[1] The results of each location will be discussed individually.
[2] The data provided in the 15-second $L_{eq}$ traces shows 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] With the exception of R4 in which there were only 2 daytime periods.

### 6.1.1. Noise Monitoring Location 1

The results of the noise monitoring conducted at Location 1 are provided in Table 2 and in Figures 14 - 21 The isolated $L_{eq}$Night values from Table 2 and the traces found in Figures 14 – 17 indicate relatively consistent noise levels throughout & between both night-time periods. In addition, the traces and the $L_{10}$ values in Figures 18 – 19 indicate a high number of short intermittent events (particularly between 05:00 – 07:00) which can be attributed to the local traffic along 100 Avenue. The data was completely removed between 06:00 – 07:00 on August 22, due to the number of vehicle passages (several per minute) during that time period. The 1/3 octave band $L_{eq}$ sound levels are relatively broadband with a decrease in the higher frequencies (2 kHz and above) and an elevated peak in the 25 Hz band. This is consistent with the results of the 2013 Noise Survey in addition to subjective observations made on-site which indicated low frequency noise emanating from the Agrium and Sheritt facilities to the northeast.

### 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 - 29. The isolated $L_{eq}$Night values and the traces found in Figures 22 – 25 indicate relatively consistent noise levels throughout both night-time periods (a difference of 2.2 dBA between both nights). There was however, one significant increase of short duration from approximately 01:15 – 2:00 on August 15, 2014, as shown in Figure 23. Based on subjective observations made on-site during the night-time site visit on August 15, in conjunction with the audio recording and the 1/3 octave band data, the short "spike" in noise level could be attributed to the Dow Station found to the east of the monitor. In addition, as noted within Appendix IV there were several periods in which noise from the rail line to the south was the dominant source. When ignoring the noise contributions from the rail yard to the south the noise at this location was largely from the east-northeast (Dow's primary facility). The 1/3 octave figures indicate relatively broadband noise levels, particularly in the mid-frequency bands, with elevated noise levels in the lower (below 100 Hz) frequency bands. This is consistent with the 2013 Noise Survey.

### 6.1.3. Noise Monitoring Location 3

The results of the noise monitoring conducted at Location 3 are provided in Table 2 and in Figures 30 - 37. The isolated $L_{eq}$Night values and the traces found in Figures 30 – 33 indicate relatively consistent noise levels throughout both night-time periods. In addition there was very little fluctuation in the isolated A-weighted noise levels for both night-time periods. This is also true for the $L_{10}$, $L_{50}$ and $L_{90}$ values in Figures 34 – 35 which indicate very little fluctuation in the noise levels. As indicated in Figures 36 – 37, the 1/3 octave band noise levels are relatively broadband, particularly in the mid-frequency bands with elevated noise levels in the lower (below 100 Hz) and higher frequency bands (8 – 12.5 kHz). This is consistent with the results of the 2013 Noise Survey (particularly for the higher frequency bands) and with subjective observations made on-site which indicated low frequency noise emanating from the south-southeast and high frequency noise from crickets in the nearby fields.

#### 6.1.4. Noise Monitoring Location 4

The results of the noise monitoring conducted at Location 4 are provided in Table 2 and in Figures 38 - 45. The traces found in Figures 38 – 41 indicate relatively consistent noise levels throughout each night-time period. The slight variations between the two night-time periods (3.0 dBA) can likely be attributed to varying meteorological conditions and also to minor operational fluctuations at the Shell Scotford facility. The 1/3 octave band spectral data is consistent between all noise monitoring periods and indicates elevated noise levels in the lower frequency bands that gradually decrease as the frequency increases. As anticipated, and consistent with the 2013 Noise Survey, the Shell Scotford facility is the dominant noise source for this noise monitoring location.

#### 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 46 - 53. The isolated $L_{eq}$Night values and the traces found in Figures 46 – 49 indicate relatively consistent noise levels throughout both night-time periods. This is further confirmed in Figures 50 – 51 where there is very little difference between the $L_{10}$,$L_{50}$ and $L_{90}$ values which indicates that noise levels were relatively steady and are reflective of typical noise levels. The stability of the measured noise levels can be attributed to the proximity of the noise monitor to the Shell Scottford facility which was the most dominant noise source. The 1/3 octave band $L_{eq}$ sound levels indicate elevated noise levels in the lower frequency bands that gradually decrease as the frequency increases. These results are very consistent with the results of the 2013 Noise Survey.

#### 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 54 - 61. The isolated $L_{eq}$Night values and the traces found in Figures 54 – 57 indicate relatively consistent noise levels between both night-time periods (no difference in the $L_{eq}$Night noise levels between both night-time periods). In addition, both night-time periods show a general trend of lower noise levels at 22:00 slowly increasing until the end of the night-time period (07:00). The reason for this trend could not be attributed to the weather conditions during the noise monitoring nor is it consistent with the 2013 Noise Survey. Therefore, the exact cause of the trend found in Figures 54 – 55 is unknown at this time,.

As indicated in the 15-second $L_{eq}$ traces found in Figures 54 – 55 and in the data removal (found in Appendix IV), there is significant road traffic along Range Road 213A. However, during periods with low traffic, the subjective dominant noise source at this location was the Agrium facility to the west. The noise was subjectively broadband across all frequencies which is consistent with the 1/3 octave band $L_{eq}$ traces. This is again consistent with the results from the 2013 Noise Survey.

#### 6.1.7. Noise Monitoring Location 7

As previously mentioned a noise monitoring was not conducted at this location due to the nearby construction activity.

#### 6.1.8. Noise Monitoring Location 8

The results of the noise monitoring conducted at Location 8 are provided in Table 2 and in Figures 62 - 69. The isolated $L_{eq}$Night values and the traces found in Figures 62 – 65 indicate relatively consistent noise levels for each night-time period. In addition there was only a small difference of 0.8 dBA between the two night-time periods. The consistency of the noise climate at this location is further confirmed in Figures 66 – 67 where there is very little difference between the $L_{10}$, $L_{50}$ and $L_{90}$ values which indicates that noise levels were relatively steady and are reflective of typical noise levels. The stability of the measured noise levels can be attributed to the proximity of the noise monitor to the Pembina/Williams facility which was subjectively the most dominant noise source. As indicated in the 1/3 octave band $L_{eq}$ traces, the noise levels are relatively broadband, particularly in the mid-frequency bands with elevated noise levels in the lower frequency bands. When considering the change in location (in comparison to 2013) these results are very consistent with the results of the 2013 Noise Survey.

6.1.9. Noise Monitoring Location 9

The results of the noise monitoring conducted at Location 9 are provided in Table 2 and in Figures 70 - 77. The isolated $L_{eq}$Night values and the traces found in Figures 70 – 73 indicate relatively consistent noise levels throughout both night-time periods. In addition, the relative shape of the 15-second $L_{eq}$ traces are consistent between the two night-time periods. However, the $L_{eq}$Night values differ by 4.7 dBA, which is the largest discrepancy of any of the noise monitoring locations. The difference between the two night-time periods can likely be attributed to the varying weather conditions, as discussed in Section 6.3. During the August 21 night-time period the wind was relatively low and from the west-northwest thus causing crosswind/upwind conditions from the noise monitor to the facilities to the east. During the August 22 night-time period the wind was again relatively low (below 5 km/hr) but it was instead from the east-northeast thus causing downwind conditions from the noise monitor to the facilities to the east. This change in wind direction could account for a difference of 4.7 dBA.

With the exception of vehicle pass-by's and train passages[1] the noise climate was dominated from noise sources originating from the east side of the River. Subjectively, the noise was not emanating from one given direction (i.e. directly east) but instead seemed to span from the southeast to the northeast. The 1/3 octave band $L_{eq}$ sound levels indicate elevated noise levels in the lower frequency bands that gradually decrease as the frequency increases. This is consistent with the results of the 2013 Noise Survey.

6.1.10. Noise Monitoring Location 10

The results of the noise monitoring conducted at Location 10 are provided in Table 2 and in Figures 78 - 85[2]. The isolated $L_{eq}$Night values and the traces found in Figures 78 – 81 indicate relatively consistent noise levels for the August 21 night-time period and more varying noise levels during the August 22 night-time period. Upon the review of the weather data during the August 22 night-time period it is possible that the variation in the noise levels can be attributed to the varying weather conditions at this location. Despite the varying $L_{eq}$Night values there is very little difference between the

[1] As evidenced in Appendix IV and in the comparison of the measured vs. isolated data in the figures there were a significant amount of train passages during each of the night-time periods.
[2] It should be noted that data from 06:00 – 07:00 for both night-time periods were removed due to very high traffic volumes along 119 Street (several vehicles per minute).

$L_{10}$,$L_{50}$ and $L_{90}$ values which indicates that the noise levels were relatively steady and are reflective of typical noise levels.

Similarly to the 2013 Noise Survey, during all site visits it was noted that not one site dominated the noise climate of the area. Instead noise was distinctly audible from each site and was more prominent when any particular facility was upwind from the noise monitoring location. The 1/3 octave band $L_{eq}$ sound levels indicate elevated noise levels in the lower frequency bands that gradually decrease as the frequency increases with a significant reduction beyond the 5 kHz.

6.1.11. Noise Monitoring Location 11

The results of the noise monitoring conducted at Location 11 are provided in Table 2 and in Figures 86 - 93. The isolated $L_{eq}$Night dBA values from Table 2 and the traces found in Figures 86-89 indicate relatively consistent noise levels throughout both night-time periods with the exception of the time period between approximately 05:30 – 07:00. Review of the weather data for this time period did not indicate any meteorological change to produce the increase in noise level. Therefore it is anticipated that the increase can be attributed to the operations of the Pembina/Williams facility to the northeast. The $L_{10}$ values in Figures 90 – 91 indicate short intermittent events which can be directly attributed to the train whistles near the noise monitor. Subjectively, the noise arriving at this monitoring location (when excluding rail activity) was relatively broadband with the mid/high frequencies coming from the northeast (Pembina/Williams facility) while noise in the lower frequency bands was difficult to localize. The 1/3 octave band $L_{eq}$ sound levels indicate elevated noise levels in the lower frequency bands that gradually decrease as the frequency increases. The contribution of the train and the 1/3 octave band $L_{eq}$ sound levels are consistent with the 2013 Noise Survey.

Lastly, though not relevant to the night-time period, it should be noted that the elevated noise levels during the day-time period can be attributed to the internal combustion engine and pump operating nearby to the south of the noise monitoring location.

6.1.12. Noise Monitoring Location 12

The results of the noise monitoring conducted at Location 12 are provided in Table 2 and in Figures 94 - 108. As previously mentioned, this location was the independent control/reference point. Therefore, the results from this location span two 48-hour monitoring periods. Similarly to the 2013

Noise Survey, there is a significant difference between the non-isolated $L_{eq}$Night noise levels in comparison to the isolated $L_{eq}$Night noise levels for all night-time periods. Again, this can be attributed to the proximity of the noise monitor to the adjacent CP rail line, the number of passages throughout the night-time periods and the length of the train passages.

In comparison to the 2013 Noise Survey, activity along the CP rail line adjacent to this monitoring location has increased significantly (as evidenced in the various figures and in Appendix IV). In the absence of the 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 that gradually decrease as the frequency increases. This is consistent with subjective observations made on-site which indicated low frequency noise coming from the general direction of the Shell Scotford facility (southwest from the noise monitor).

### 6.2. General Subjective Observations for Noise Monitorings

- The isolated $L_{eq}$Night broadband and 1/3 octave band $L_{eq}$ sound levels were similar to those measured in the 2013 Noise Survey.
- The noise arriving at most monitor locations consisted of low frequency components with occasional mid/high frequency components that could be attributed to a nearby facility/facilities.
- Despite the noise being relatively low in frequency, none of the sites indicated any specific low frequency tonal components.
- The noise from train passages were prevalent at all locations and tended to dominate the noise climate as they passed through, particularly when there were train whistles. Based on the isolation analysis, in comparison to the 2013 Noise Survey, there were there were a greater number of passages with an increase in average train length throughout the night-time periods.
- Unlike the 2013 Noise Survey, the weather conditions fluctuated more significantly in regards to the wind speed and direction. As a result, there was a greater variance in the noise levels between the two night-time periods for a several of the noise monitoring locations.

### 6.3. Night-time Weather Conditions

As previously mentioned, 3 local weather monitoring stations were used throughout all noise monitoring periods[1] 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. The wind speeds during the August 20 – 21 night-time period at noise monitor location 6 were in excess of the limits of AER Directive 038. However, upon review of the audio files and the 1/3 octave band $L_{eq}$ sound levels at this location the wind speeds were determined to not affect the noise monitoring results and therefore the results during this noise monitoring period at this location are considered valid. The weather conditions for all other night-time monitoring periods were within acceptable limits as per AER Directive 038. Lastly, there was no precipitation during any night-time periods therefore rain fall data has not been included for any location.

#### 6.3.1. June 16 – 17, 2014

The wind conditions during the night-time period were considered moderate (primarily below 10 km/hr) and from the east and northeast (creating crosswind conditions) throughout. The temperature was consistent at approximately 11°C and the relative humidity ranged from approximately 78% - 92%. The barometric pressure was consistent and relatively flat at approximately 94 kPa.

#### 6.3.2. June 25 – 26, 2014

The wind was relatively calm (approximately 5 km/hr) and from the south at the start of the night-time period (22:00). The wind remained calm throughout the entire night-time period only exceeding 5 km/hr for short durations. The wind direction varied throughout the night-time period but was primarily from the south (i.e. the noise monitor was upwind of the Facility). However due to the low wind speed during the entire night-time period the impact of the wind on the sound propagation is considered negligible. The temperature was relatively consistent and ranged from 9°C to 15°C while the humidity ranged from 78% – 93%. The barometric pressure was consistent and relatively flat at approximately 94 kPa.

[1] With the exception of the June 16 – 17 and June 25 – 26, 2014 noise monitoring periods, as discussed in Section 4.4.

### 6.3.3. August 13 – 14, 2014

The wind was relatively calm (below 5 km/hr) and from the south at each of the weather stations at the start of the night-time period (22:00). The wind remained calm throughout the entire night-time period and, with the exception of the weather monitor at noise monitor location 11, only exceeded 5 km/hr for very short durations. The wind at noise monitor location 11 was also relatively calm throughout the entire night-time period and never exceeded 10 km/hr. The wind direction varied throughout the night-time period though due to the relatively low wind speeds its impact on the sound propagation would be considered minimal. The temperature was relatively consistent at all locations ranging from 15°C to 21°C while the humidity ranged from 80% – 95%. Lastly, the barometric pressure was also very consistent and remained at approximately 94 kPa throughout.

### 6.3.4. August 14 – 15, 2014

The wind was relatively calm (below 5 km/hr) and from the south at each of the weather stations at the start of the night-time period (22:00). The wind remained calm throughout the entire night-time period and, with the exception of the weather monitor at noise monitor location 11, only exceeded 5 km/hr for very short durations. The wind at weather monitor locations 11 was also relatively calm throughout the entire night-time period and never exceeded 10 km/hr. The wind was primarily from the south until approximately 05:00 after which point it shifted from the north/east. The temperature was relatively consistent at all locations ranging from 14°C to 21°C while the humidity ranged from 70% – 95%. Lastly, the barometric pressure was also very consistent and remained at approximately 94 kPa throughout.

### 6.3.5. August 20 – 21, 2014

At the start of the night-time period (22:00) the wind was moderate to calm (below 10 km/hr) at two of the weather station locations (Noise Monitor Location 10 and 12) and from the northwest. The wind was stronger at Noise Monitor Location 4 (approximately 12 km/hr) and from the northwest[1]. The wind speeds remained consistent for the duration of the night-time period and remained primarily from the northwest. In comparison to the other night-time periods the temperature had very little fluctuation and ranged from 9°C to 12 °C at all locations. The humidity was similar to other night-time periods and

[1] The wind speeds were generally higher at this location due to the lack of shielding from the northwest, which was the primary wind direction for this night-time period.

ranged from 76% – 94%. Lastly, the barometric pressure was also very consistent and remained at approximately 94 kPa throughout.

#### 6.3.6. August 21 – 22, 2014

The wind was very calm (below 5 km/hr) and from varying directions at the start of the night-time period (22:00)[1]. The wind remained calm throughout the entire night-time period and, with the exception of the weather monitor at Noise Monitor Location 12, only exceeded 5 km/hr for very short durations. The wind at weather monitor locations 12 was also relatively calm throughout the entire night-time period and only exceeded 10 km/hr for a duration of less than 5 minutes. The wind direction varied throughout the night-time period though due to the relatively low wind speeds its impact on the sound propagation would be considered minimal. The temperature was very consistent at all locations and ranged from 7°C to 10°C while the humidity ranged from 70% – 90%. Lastly, the barometric pressure was also very consistent and remained at approximately 95 kPa throughout.

[1] The varying directions can be attributed to very low wind speeds.

## 7.0 Conclusion

As part of the study, a total of twelve (12) 48-hour noise monitorings were conducted throughout the Alberta's Industrial Heartland. It was found that the isolated $L_{eq}$Night broadband and 1/3 octave band $L_{eq}$ sound levels were similar to those measured in the 2013 Noise Survey. Unlike the 2013 Noise Survey the weather conditions fluctuated more greatly in regards to the wind speed and direction. As a result, there was a greater variance in the noise levels between the two night-time periods for a several of the noise monitoring locations.

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. Lastly, the noise levels from train passages were again prevalent at all locations and tended to dominate the noise climate as they passed through. However, in comparison to the 2013 Noise Survey there were there were a greater number of passages with an increase in average train length throughout the night-time periods.

**8.0 References**


- *Environmental Noise Survey for the Regional Noise Model Annual Field Validation Monitoring,* prepared for the NCIA by aci Acoustical Consultants Inc., November 13, 2013.
- 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.

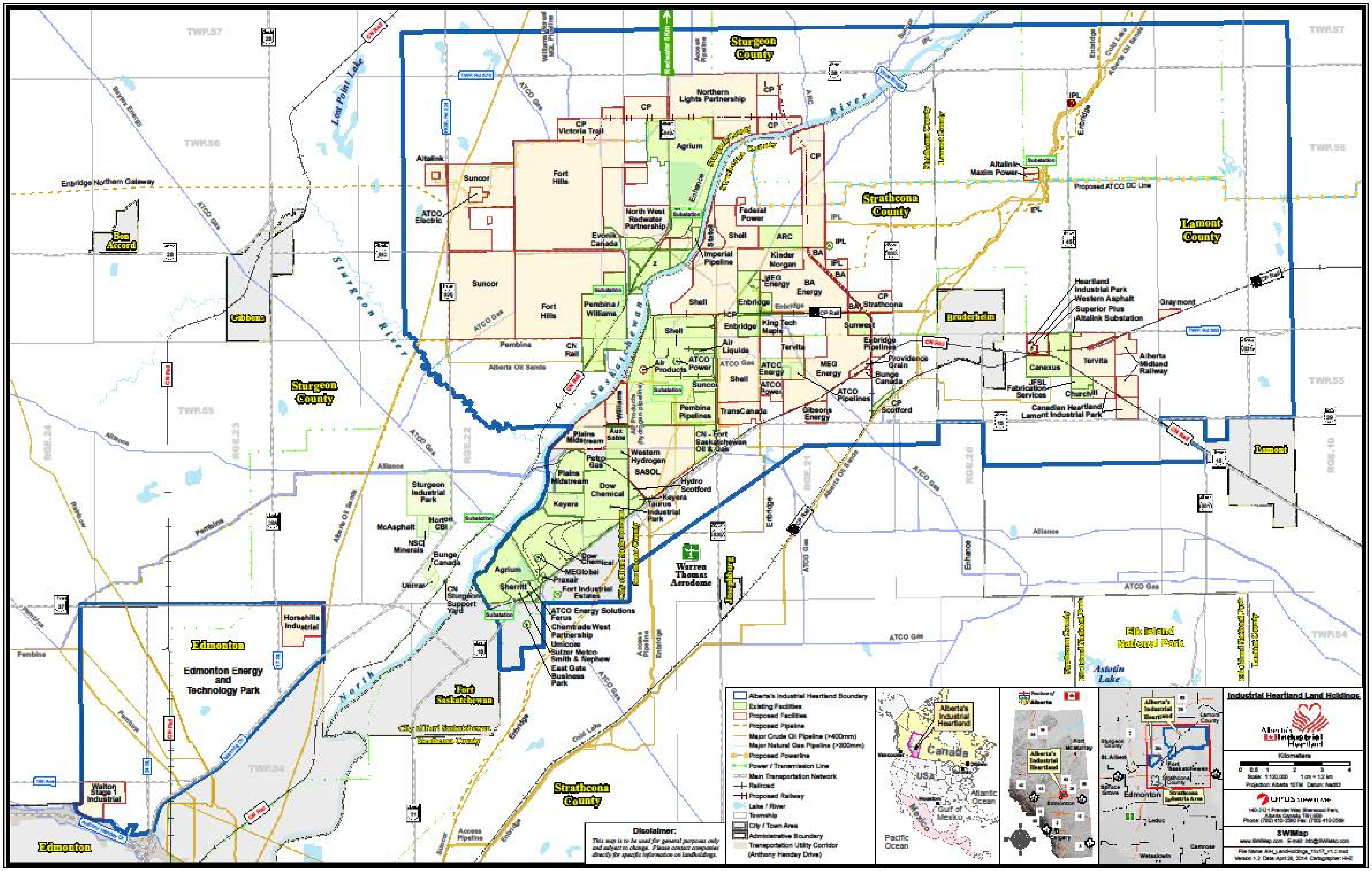

**Figure 1. Study Area**



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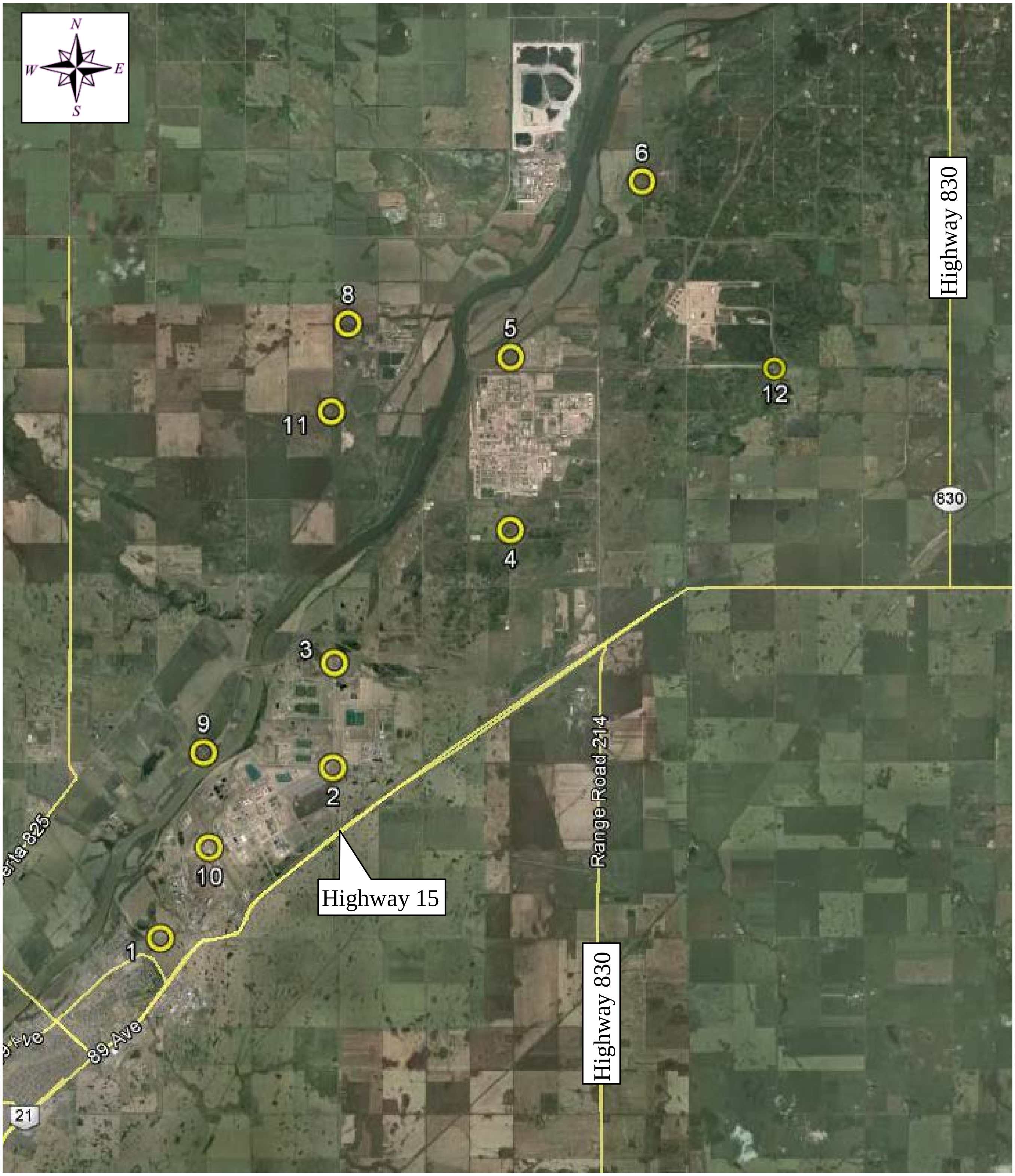


**Figure 2. 2014 Study Area (With Noise Monitoring Locations)[1]**

[1] Note that Location #7 was not included as a noise monitoring was not conducted at this location.

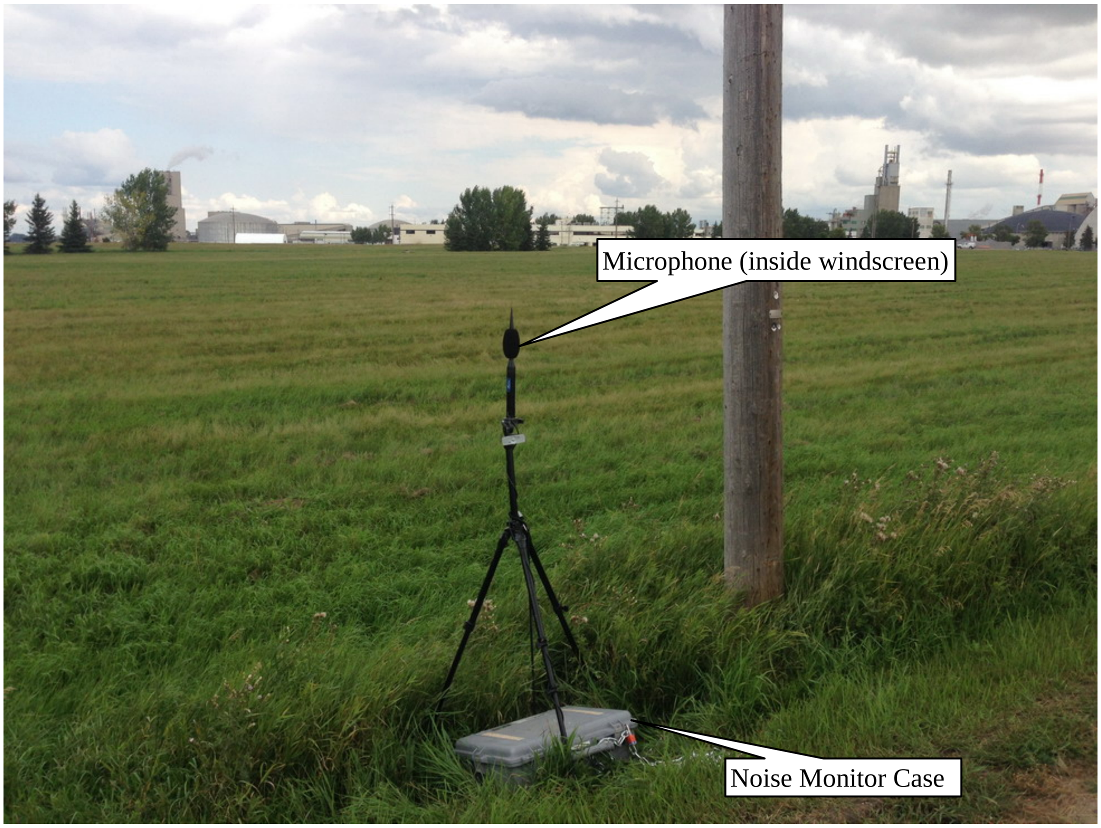


**Figure 3. Noise Monitor #1**

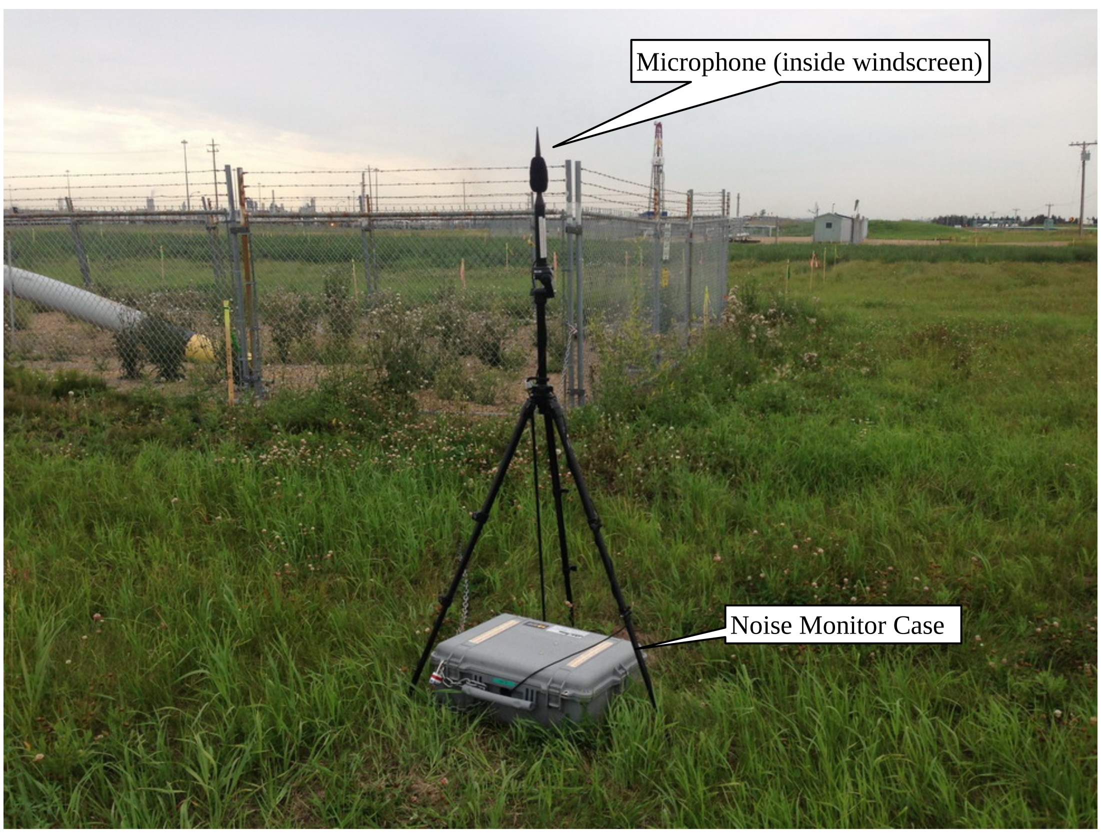


**Figure 4. Noise Monitor #2**

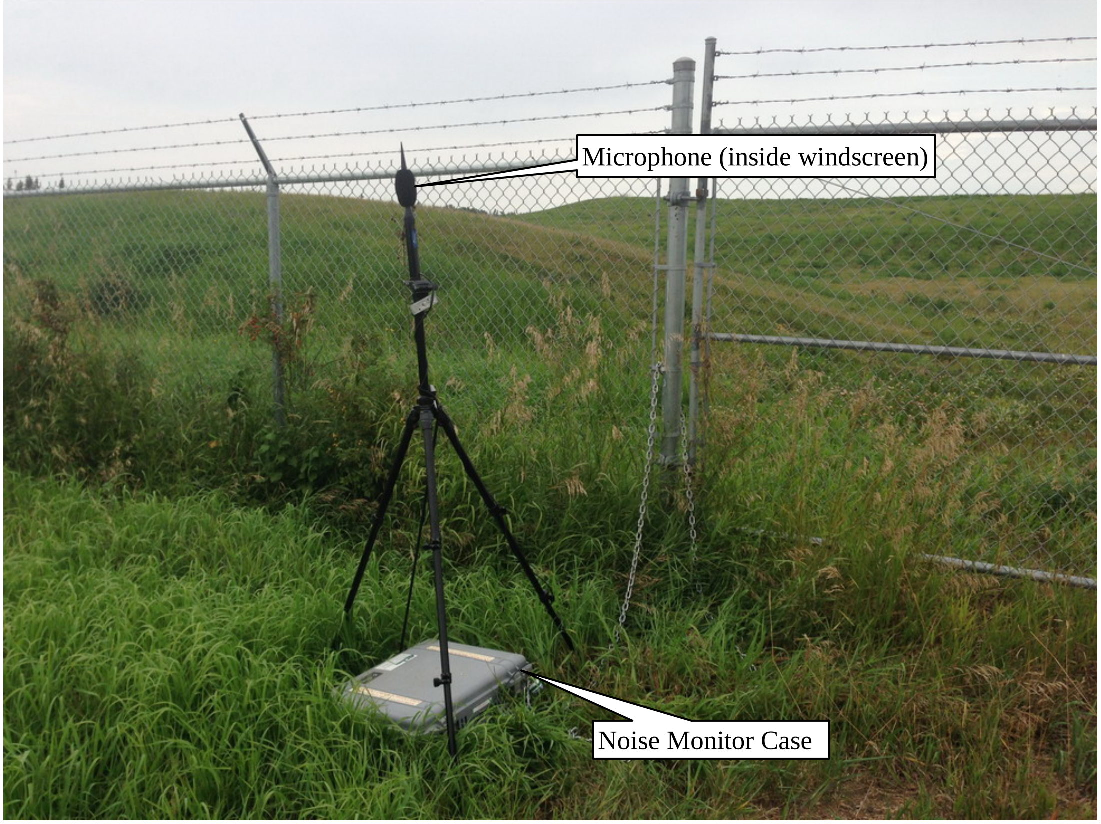


**Figure 5. Noise Monitor #3**

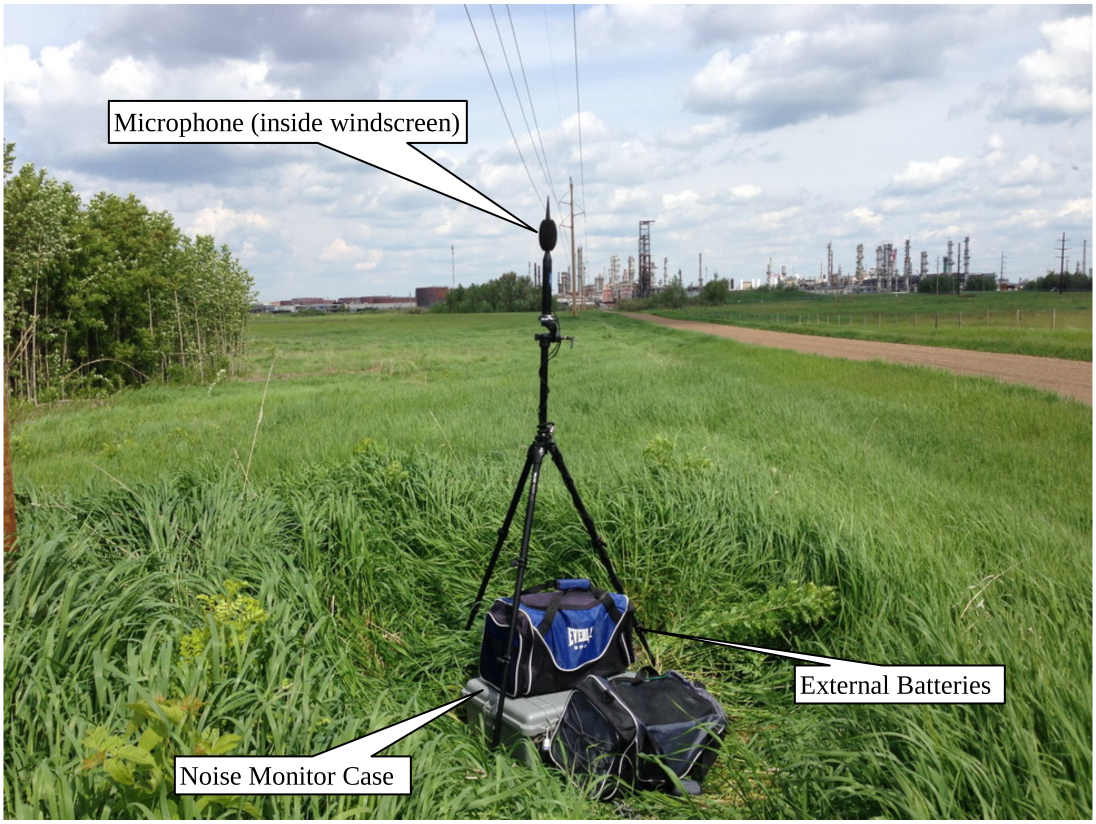


**Figure 6. Noise Monitor #4**

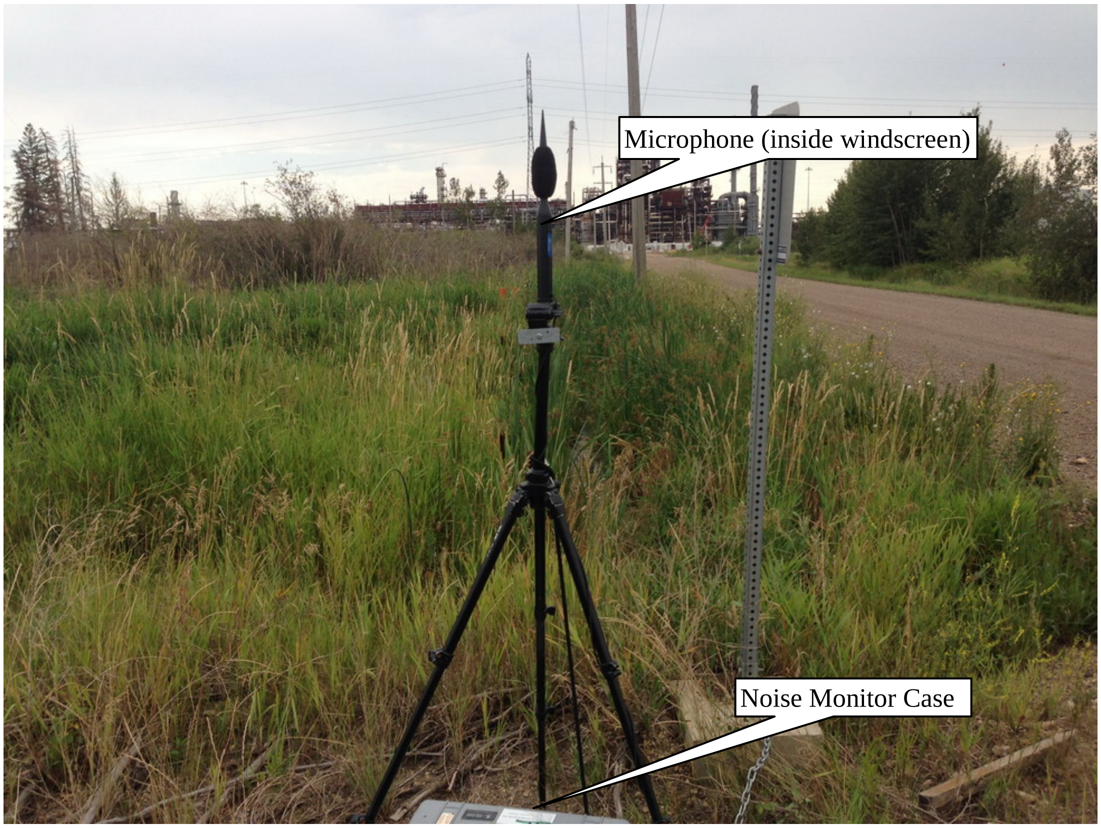


**Figure 7. Noise Monitor #5**

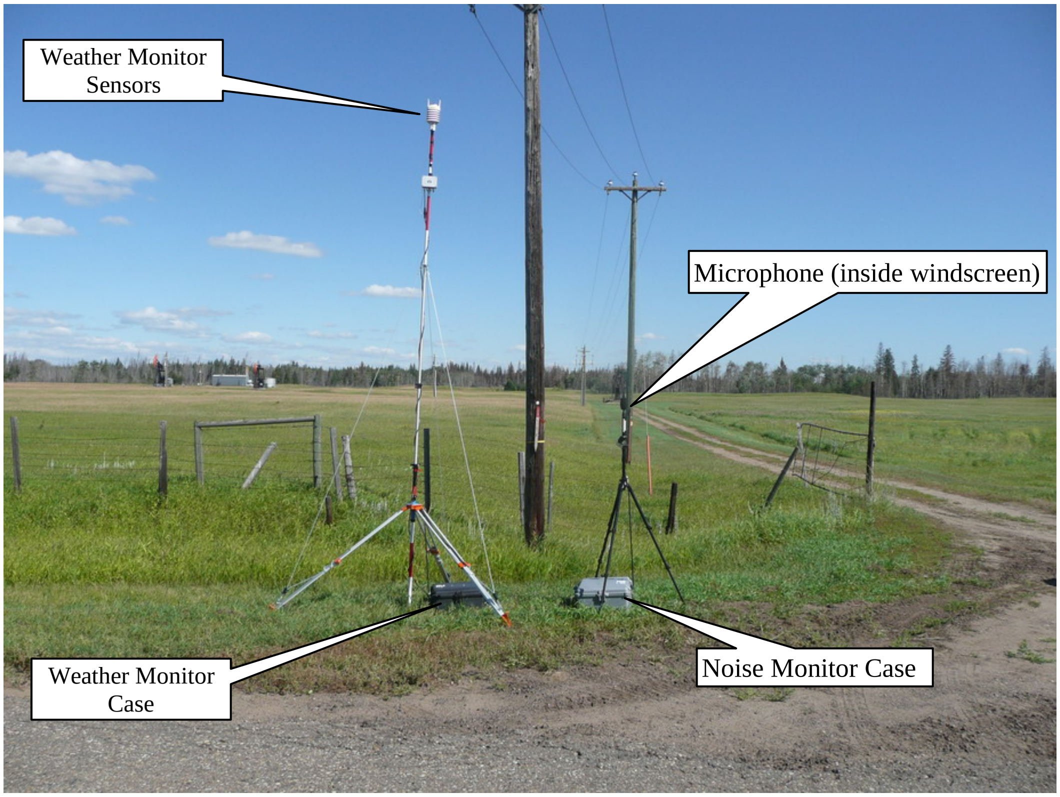


**Figure 8. Noise Monitor #6 (With Weather Monitor)**


**Figure 9. Noise Monitor #8**


**Figure 10. Noise Monitor #9**

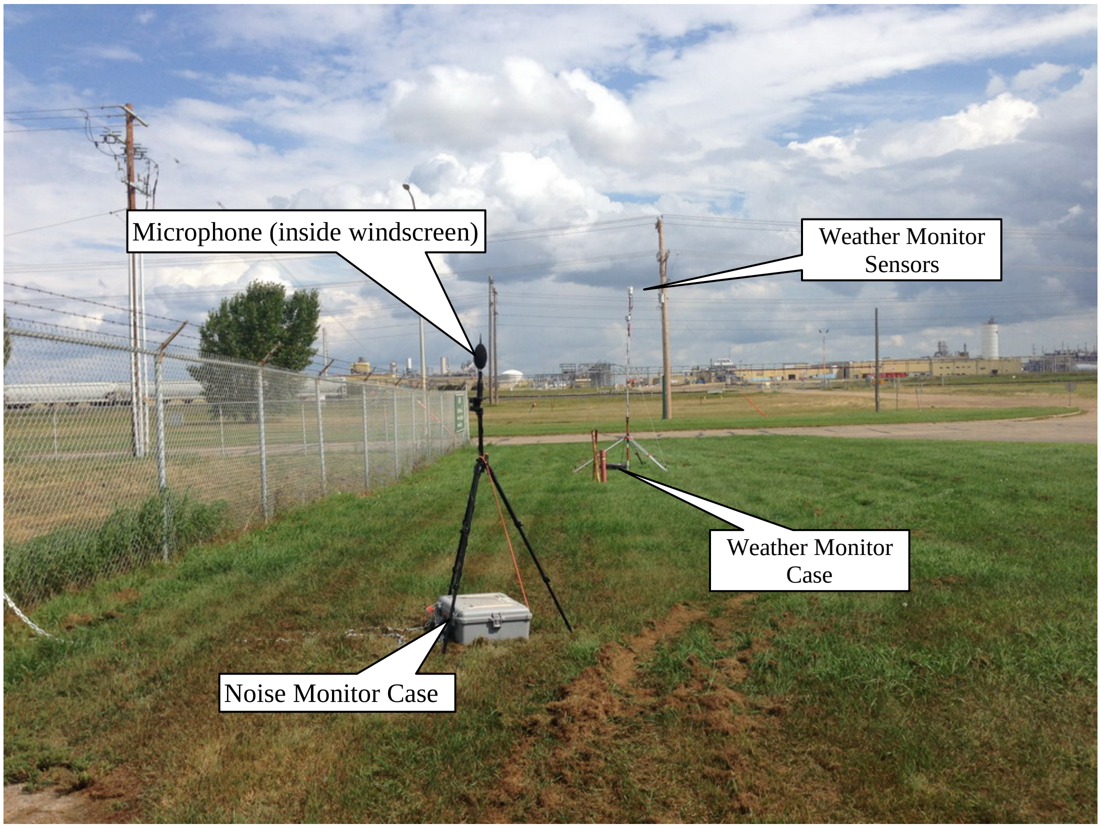


**Figure 11. Noise Monitor #10 (With Weather Monitor)**

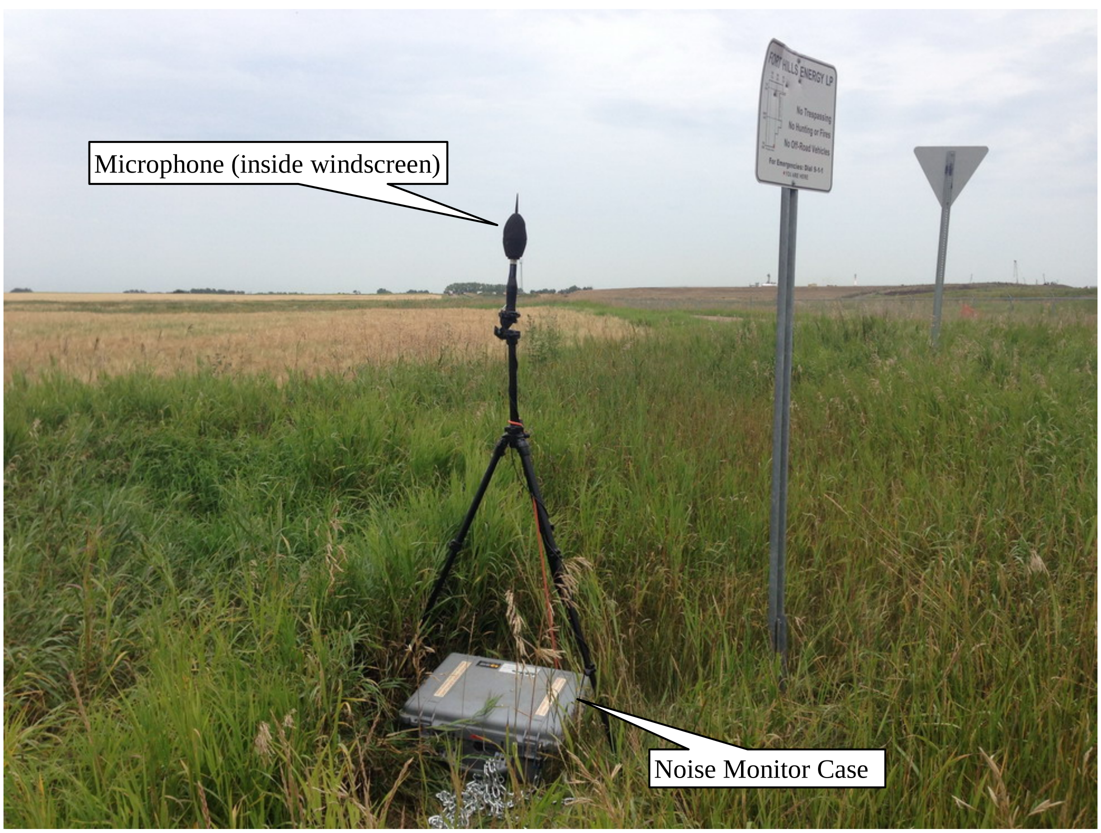


**Figure 12. Noise Monitor #11**

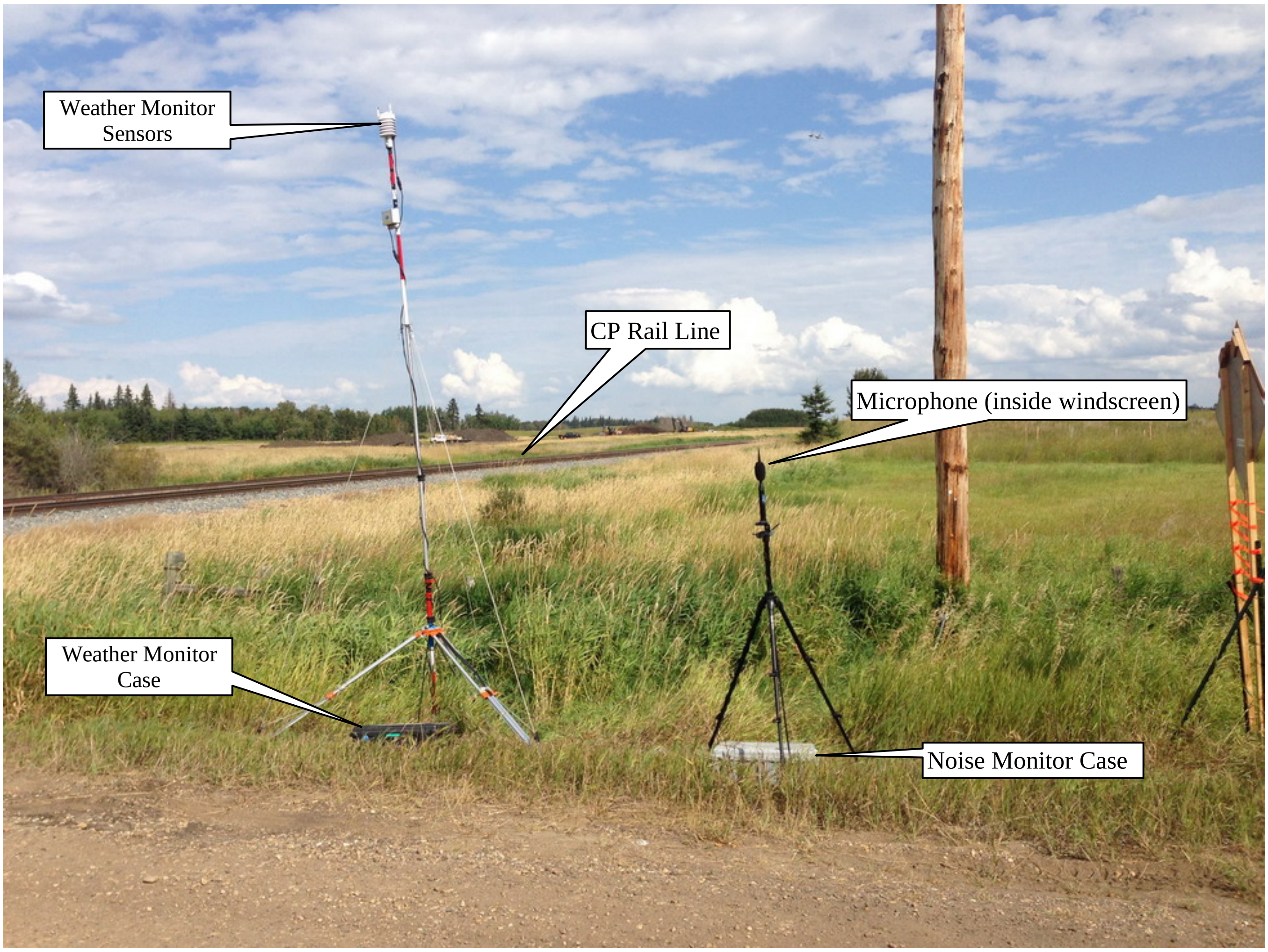


**Figure 13. Noise Monitor #12 (With Weather Monitor)**

Noise Monitor #1

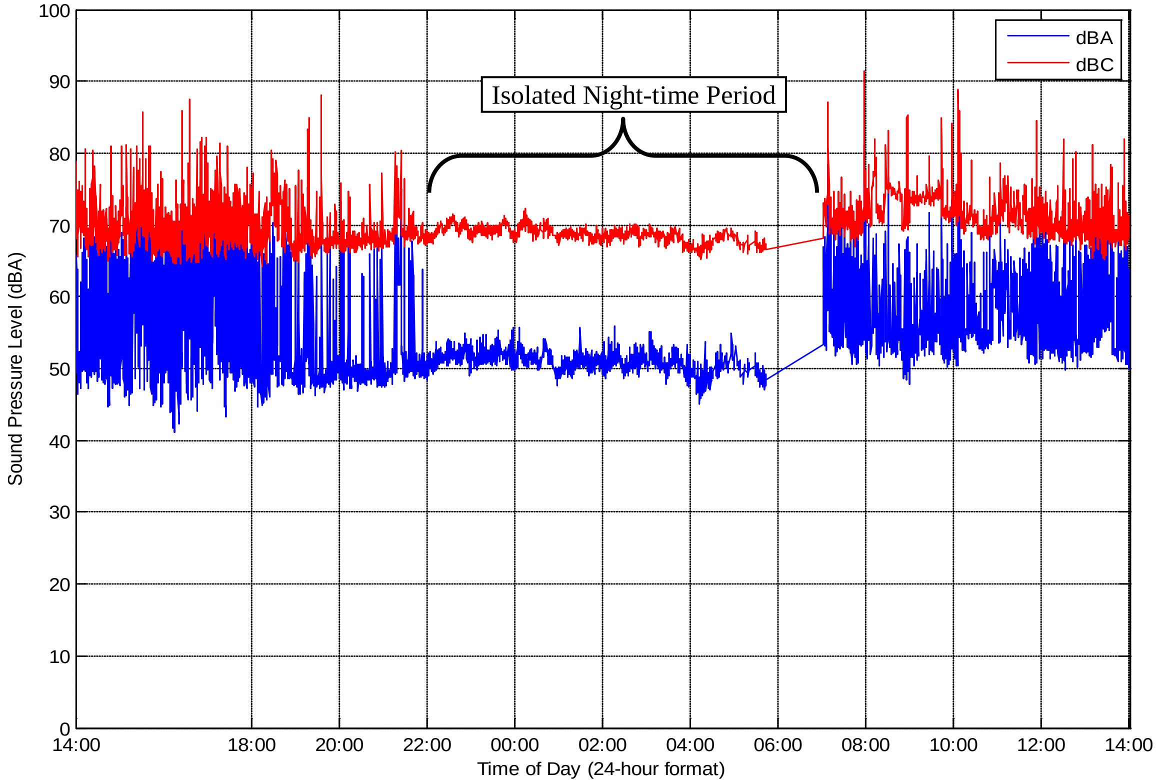


**Figure 14. Noise Monitor #1, 15-Second $L_{eq}$ Sound Levels (August 20 - 21, 2014)**

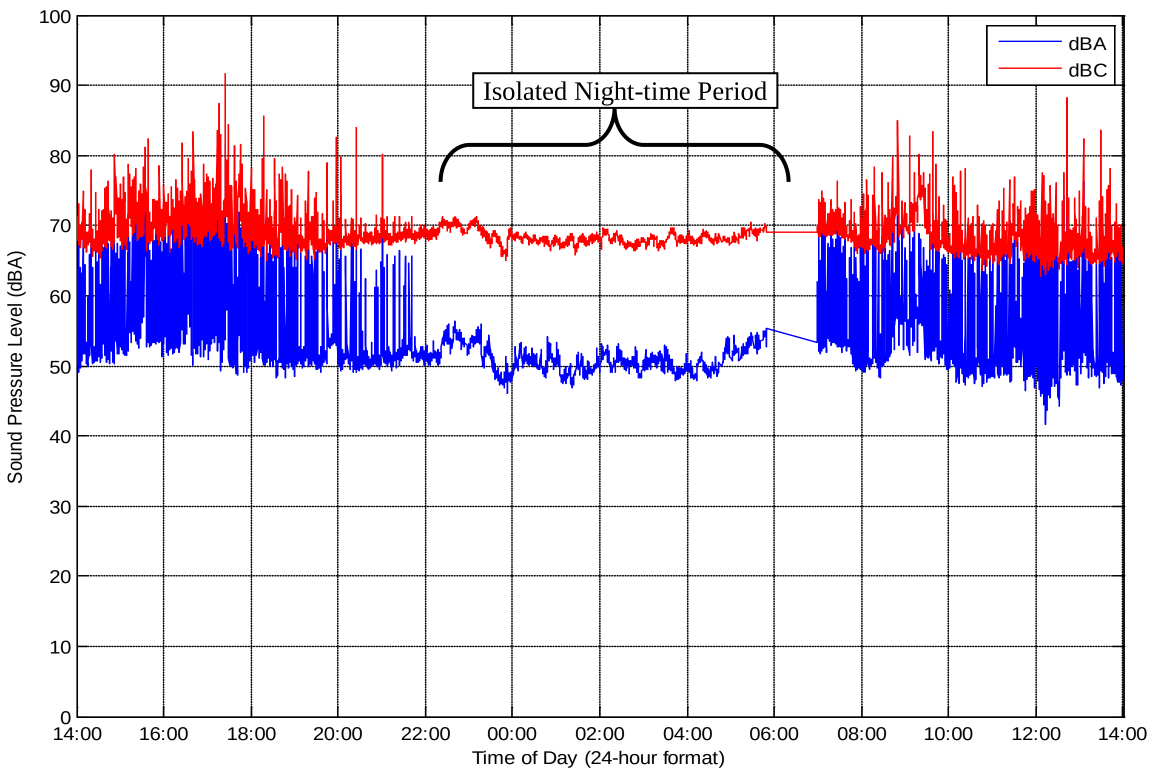


**Figure 15. Noise Monitor #1, 15-Second $L_{eq}$ Sound Levels (August 21 - 22, 2014)**

Noise Monitor #1

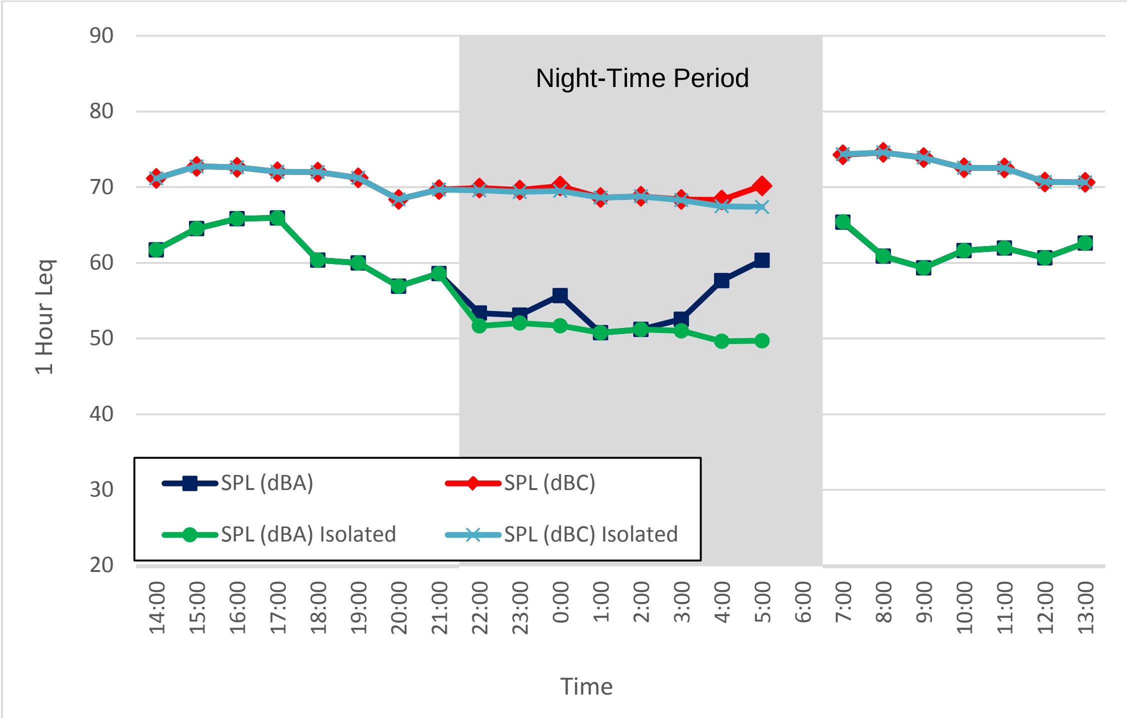


**Figure 16. Noise Monitor #1, 1-Hour $L_{eq}$ Sound Levels (August 20 - 21, 2014)[1]**

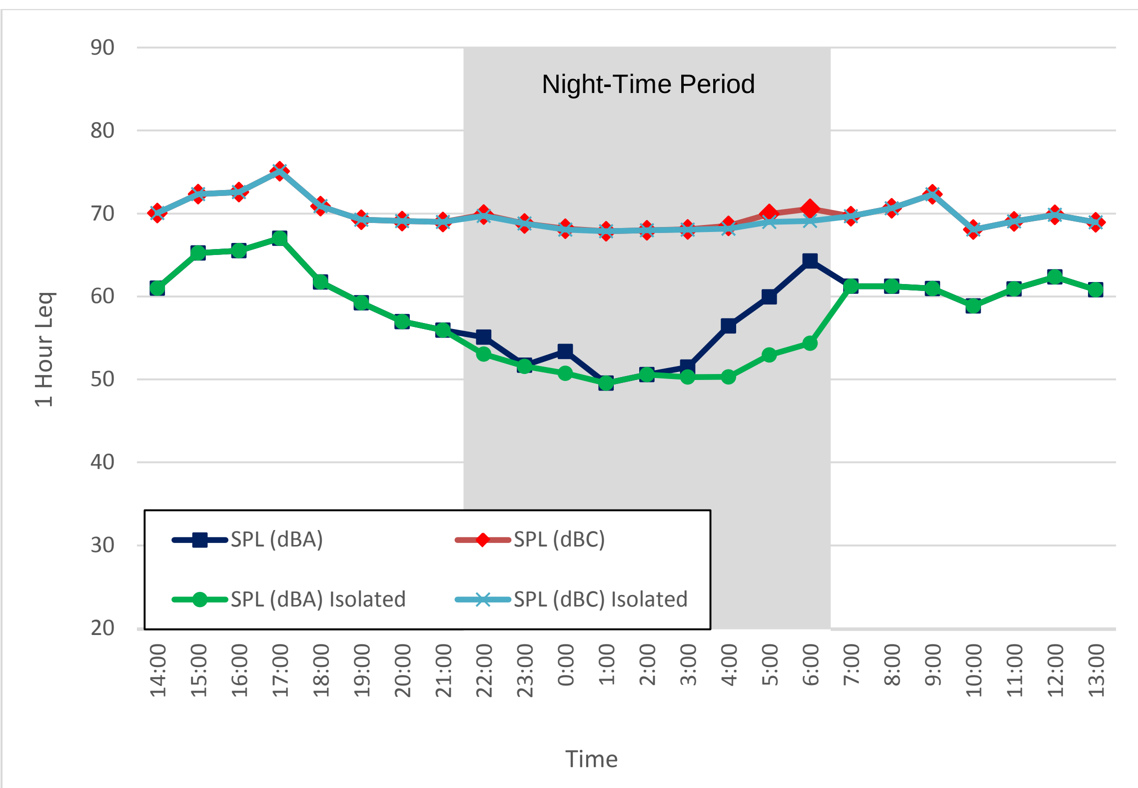


**Figure 17. Noise Monitor #1, 1-Hour $L_{eq}$ Sound Levels (August 21 - 22, 2014)**

[1] Again, it should be noted that data from 06:00 to 07:00 was entirely removed due to traffic along the adjacent road.

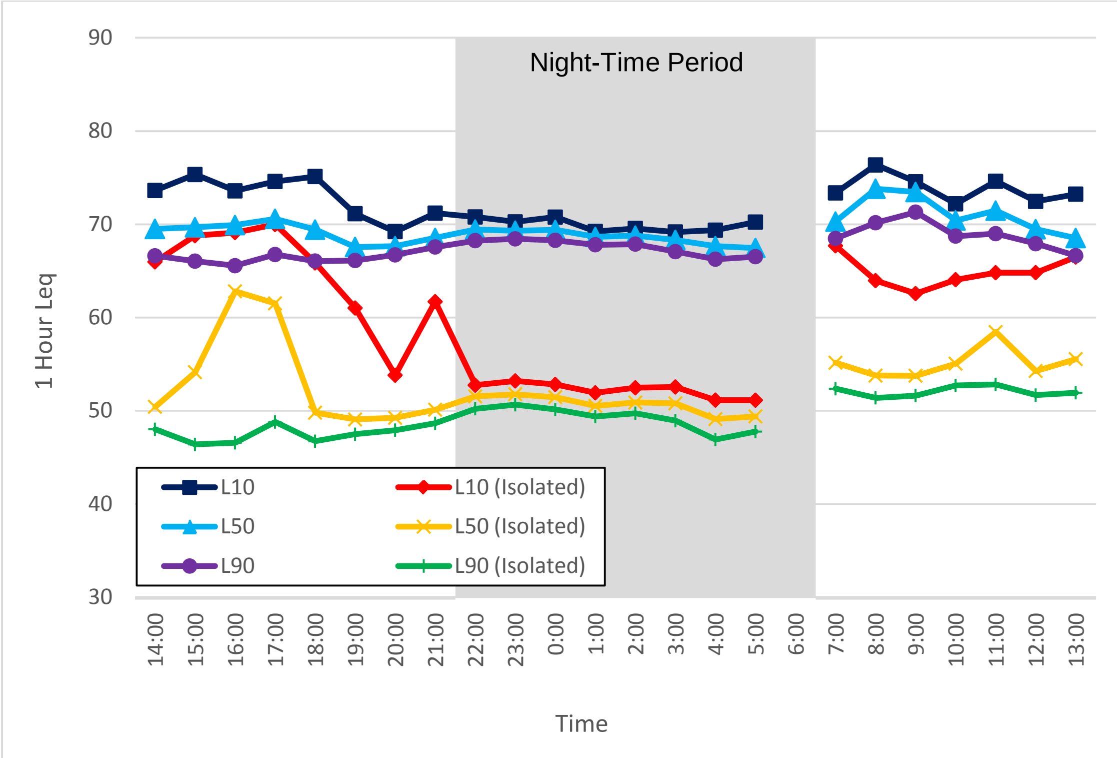


**Figure 18. Noise Monitor #1, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (August 20 - 21, 2014)** [1]

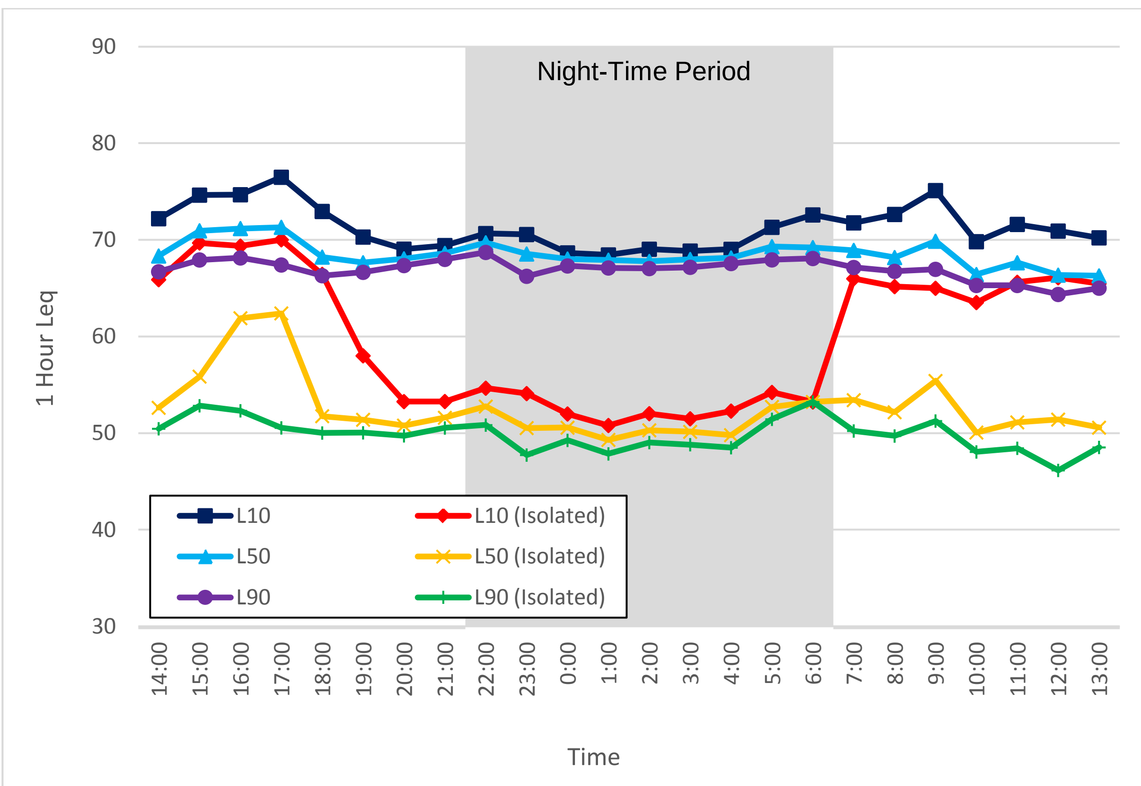


**Figure 19. Noise Monitor #1, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (August 21 - 22, 2014)**

[1] Again, it should be noted that data from 06:00 to 07:00 was entirely removed due to traffic along the adjacent road.

Noise Monitor #1

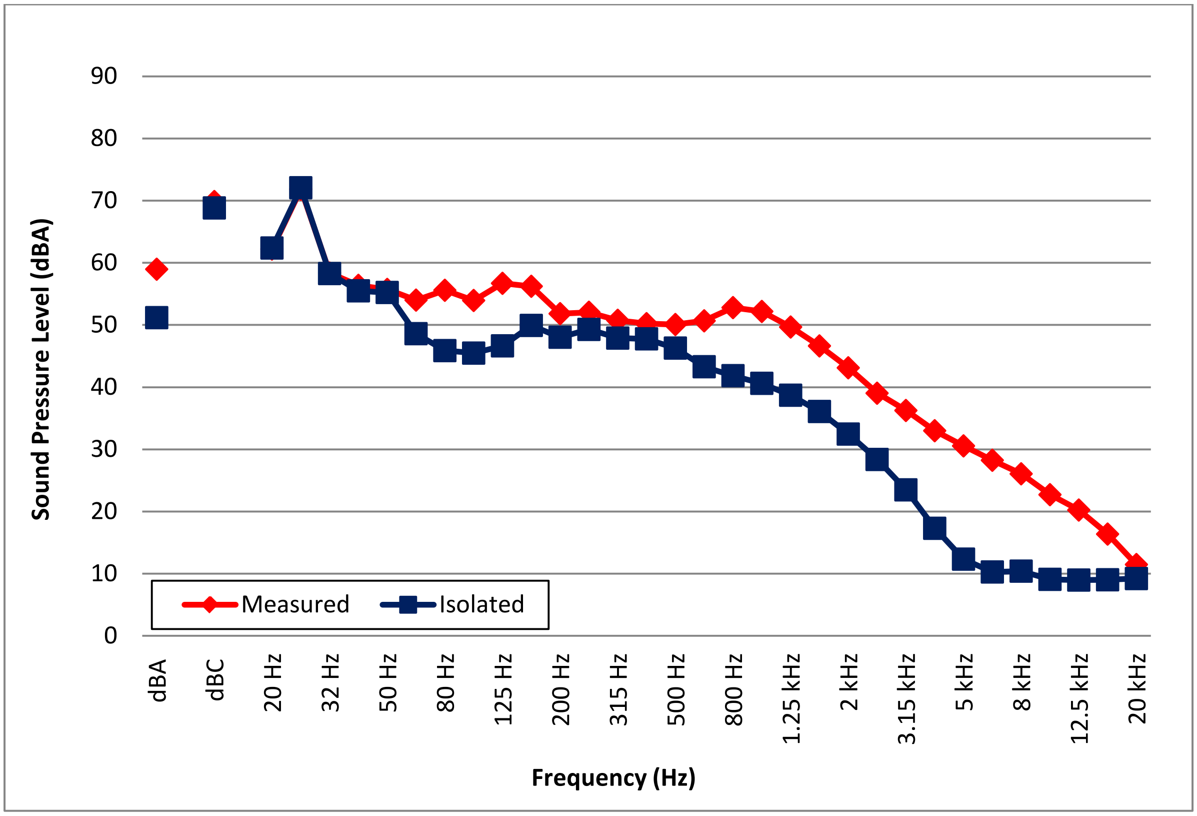


**Figure 20. Noise Monitor #1, 1/3 Octave $L_{eq}$ Sound Levels (August 20 - 21, 2014)**

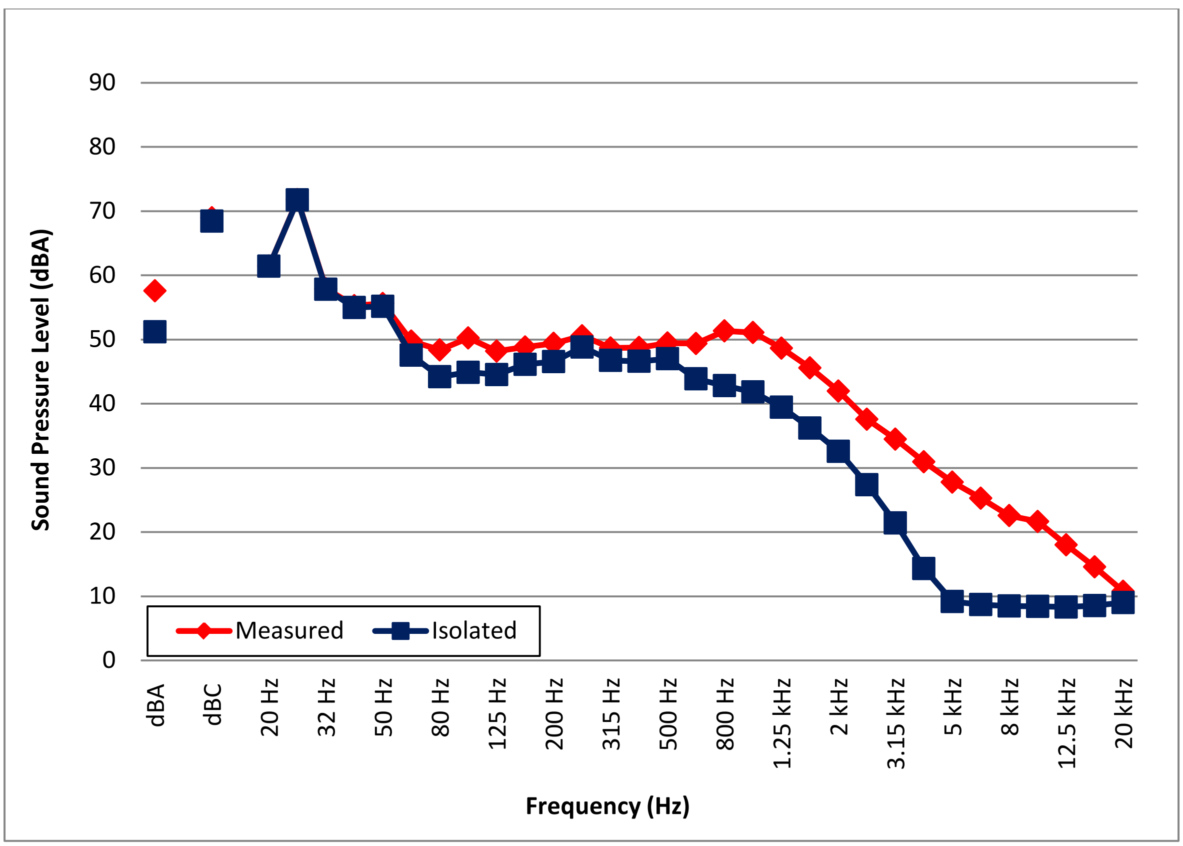


**Figure 21. Noise Monitor #1, 1/3 Octave $L_{eq}$ Sound Levels (August 21 - 22, 2014)**

Noise Monitor #2

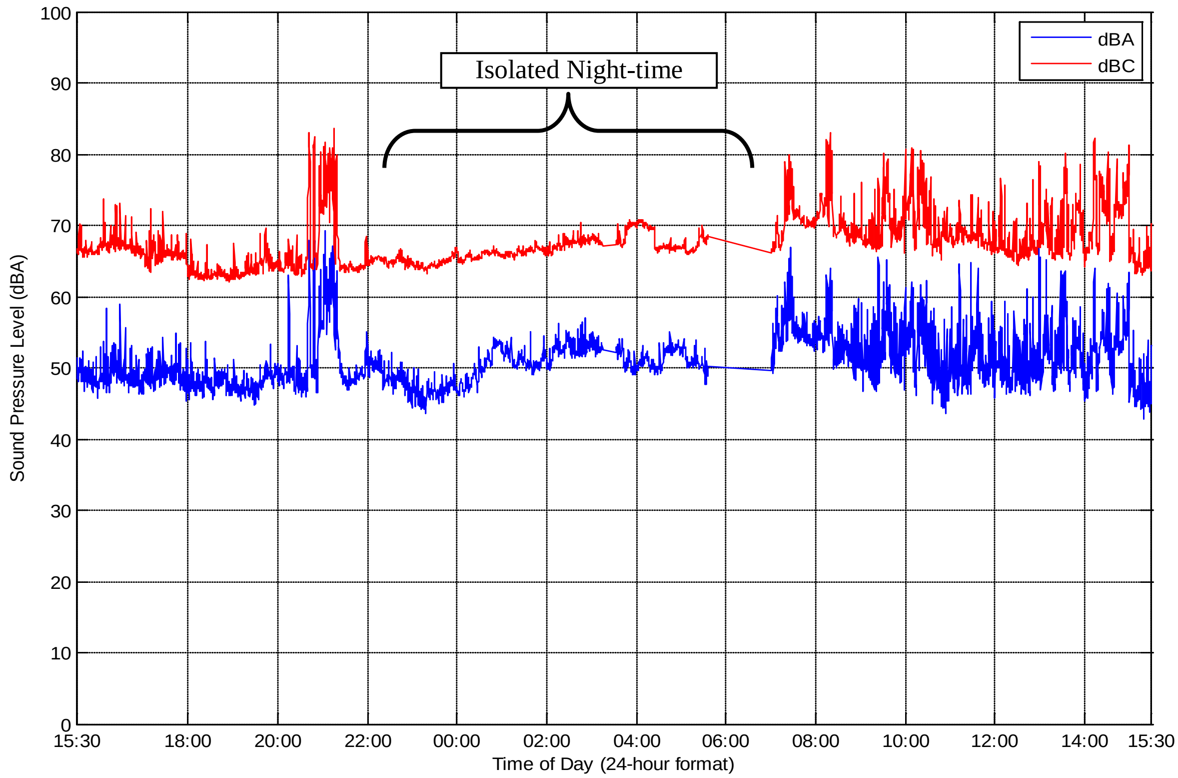


**Figure 22. Noise Monitor #2, 15-Second $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

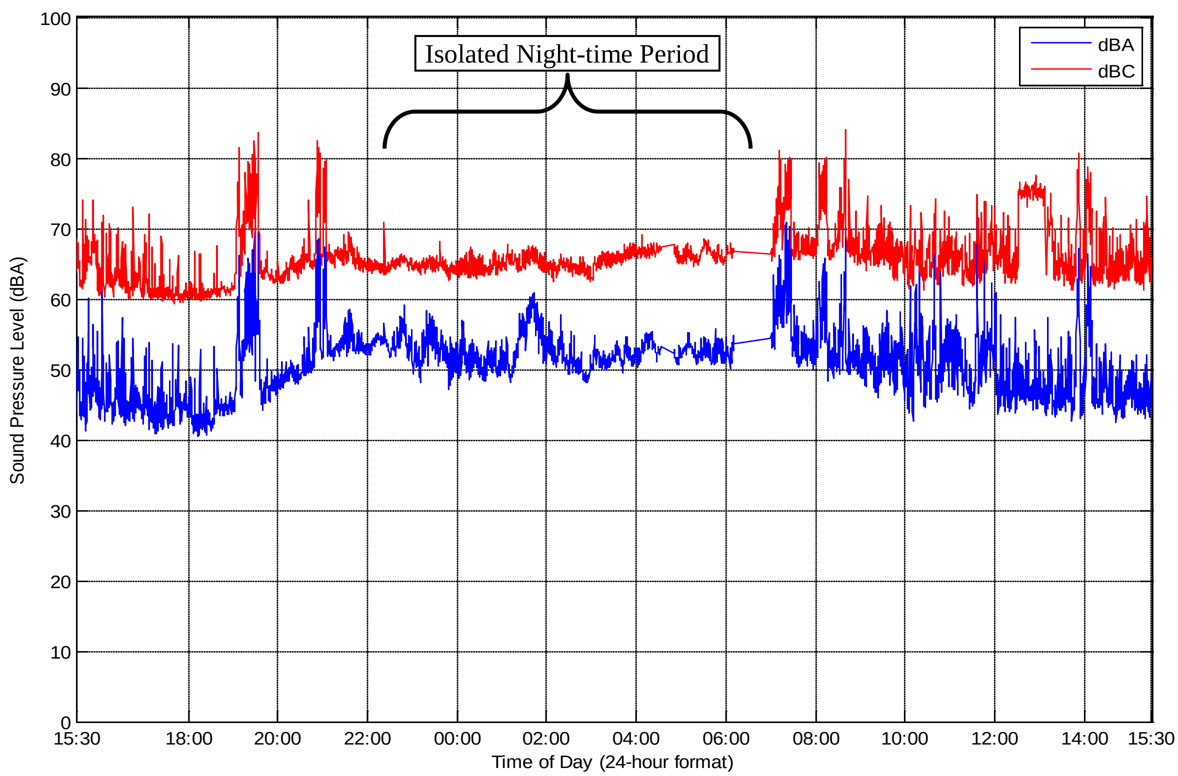


**Figure 23. Noise Monitor #2, 15-Second $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

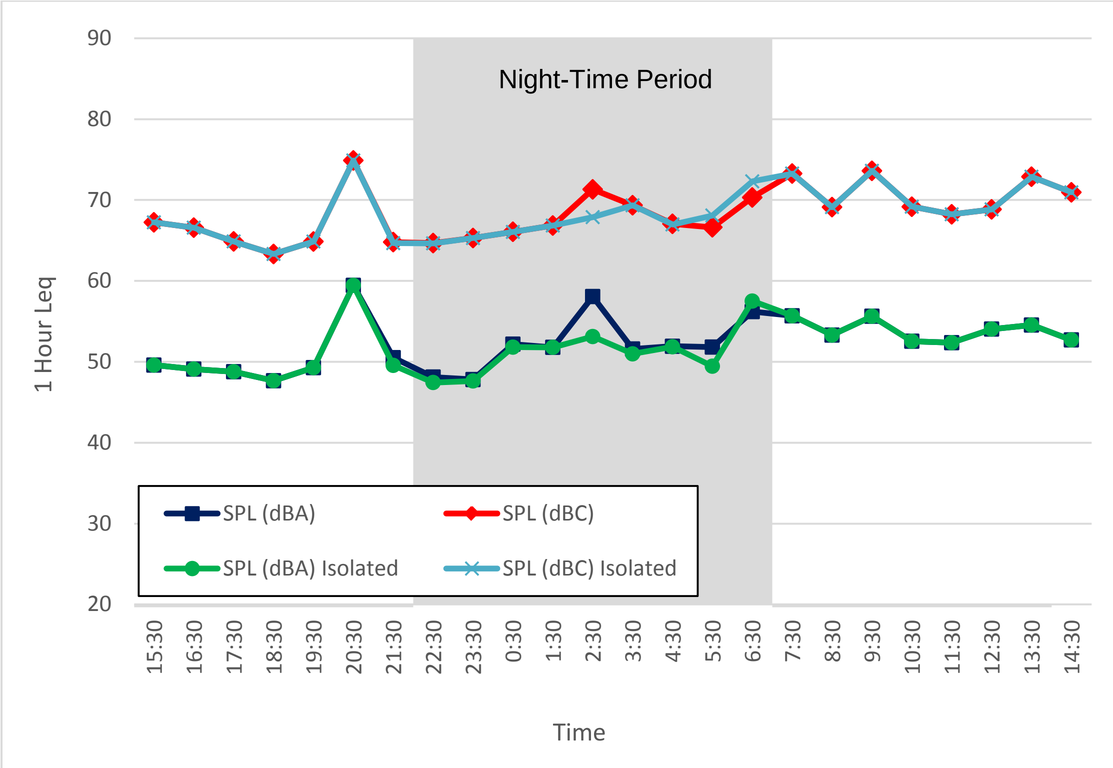


**Figure 24. Noise Monitor #2, 1-Hour $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

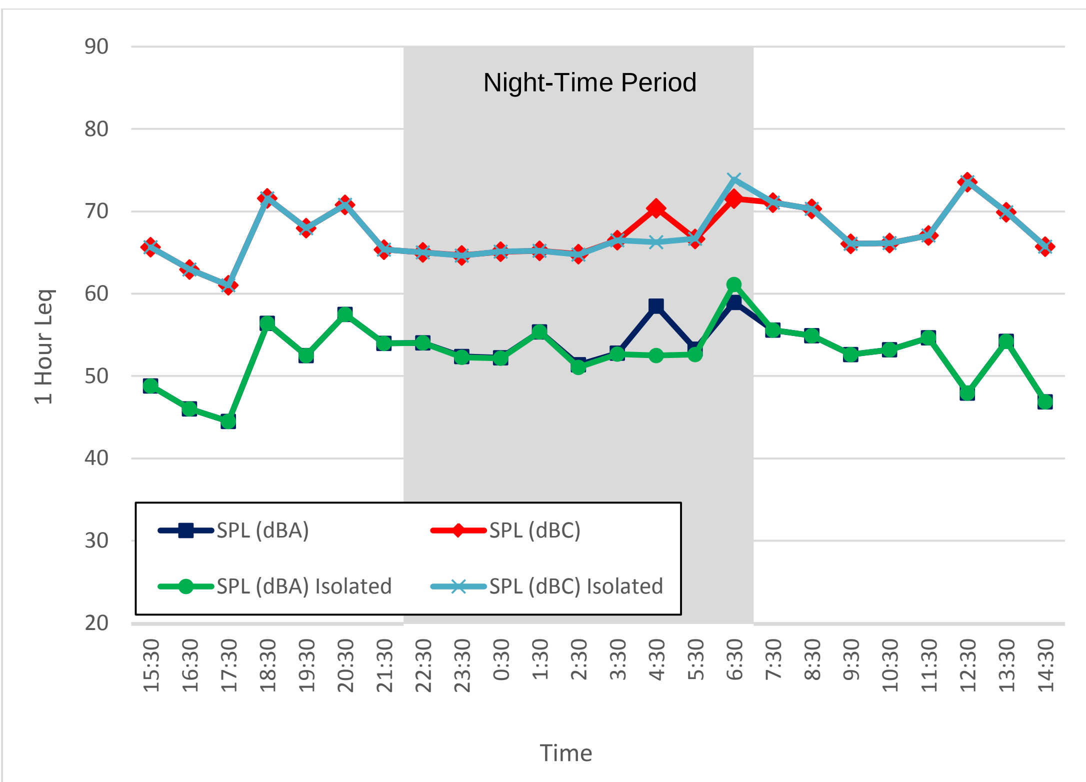


**Figure 25. Noise Monitor #2, 1-Hour $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

Noise Monitor #2

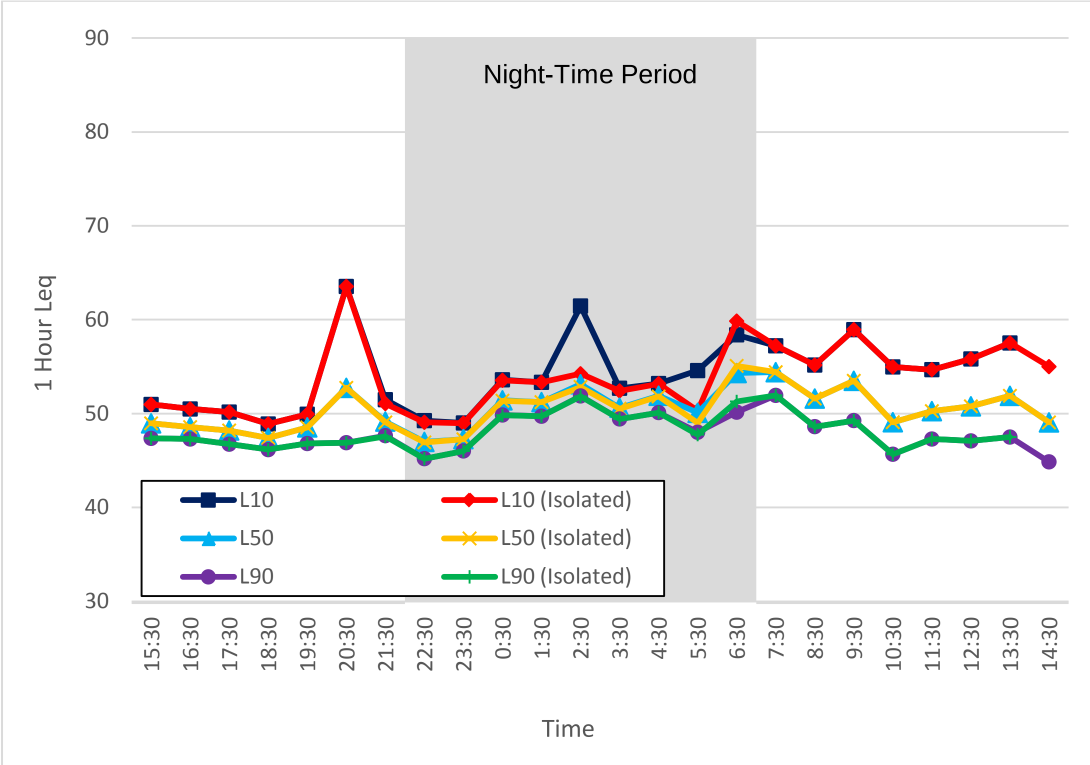


**Figure 26. Noise Monitor #2, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

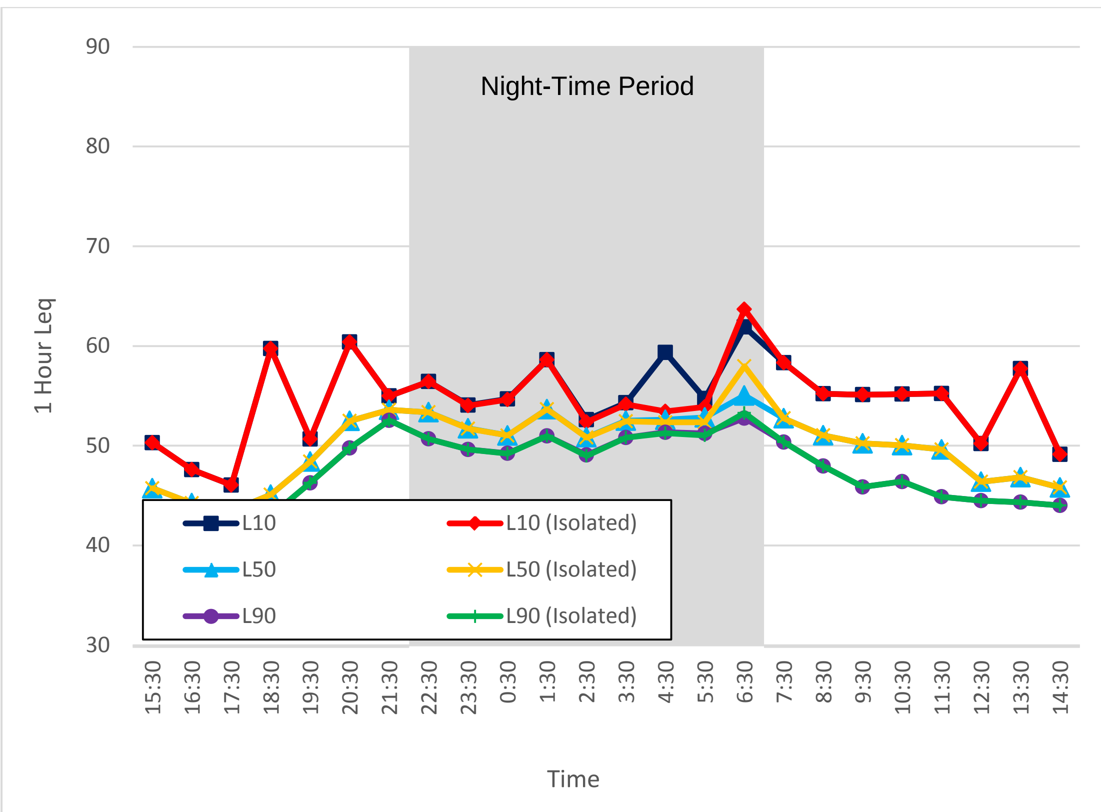


**Figure 27. Noise Monitor #2, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

Noise Monitor #2

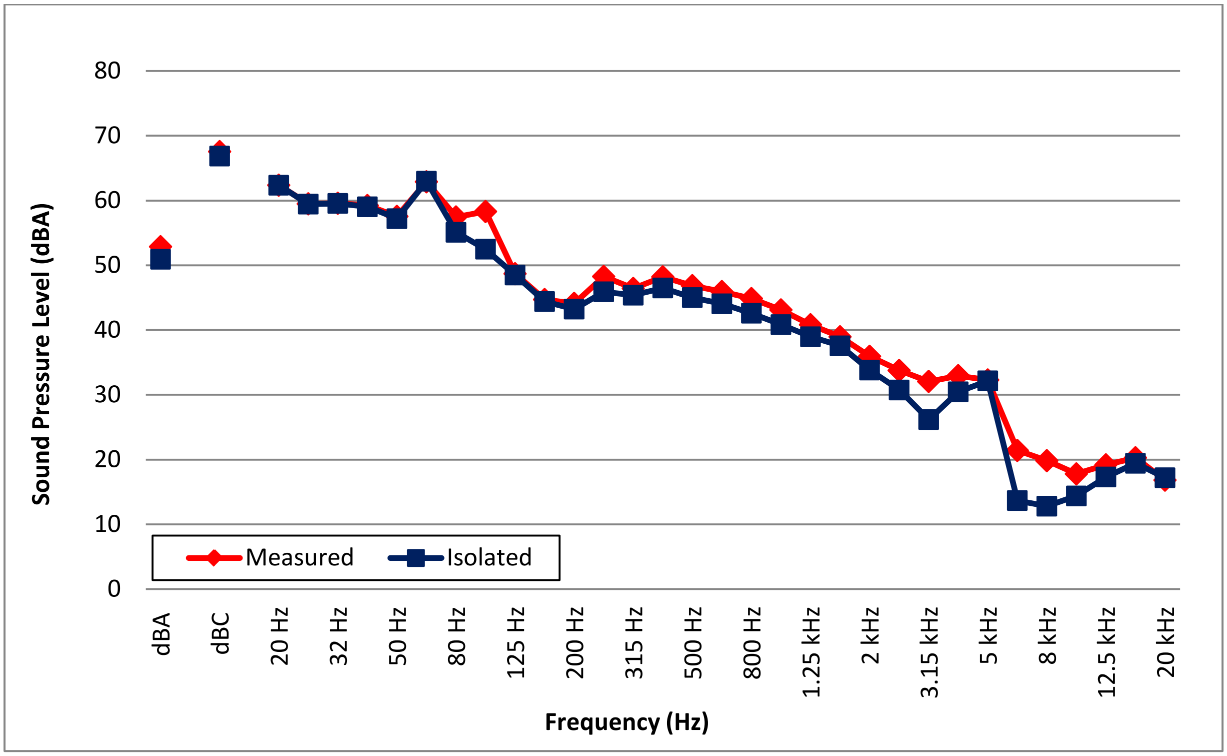


**Figure 28. Noise Monitor #2, 1/3 Octave $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

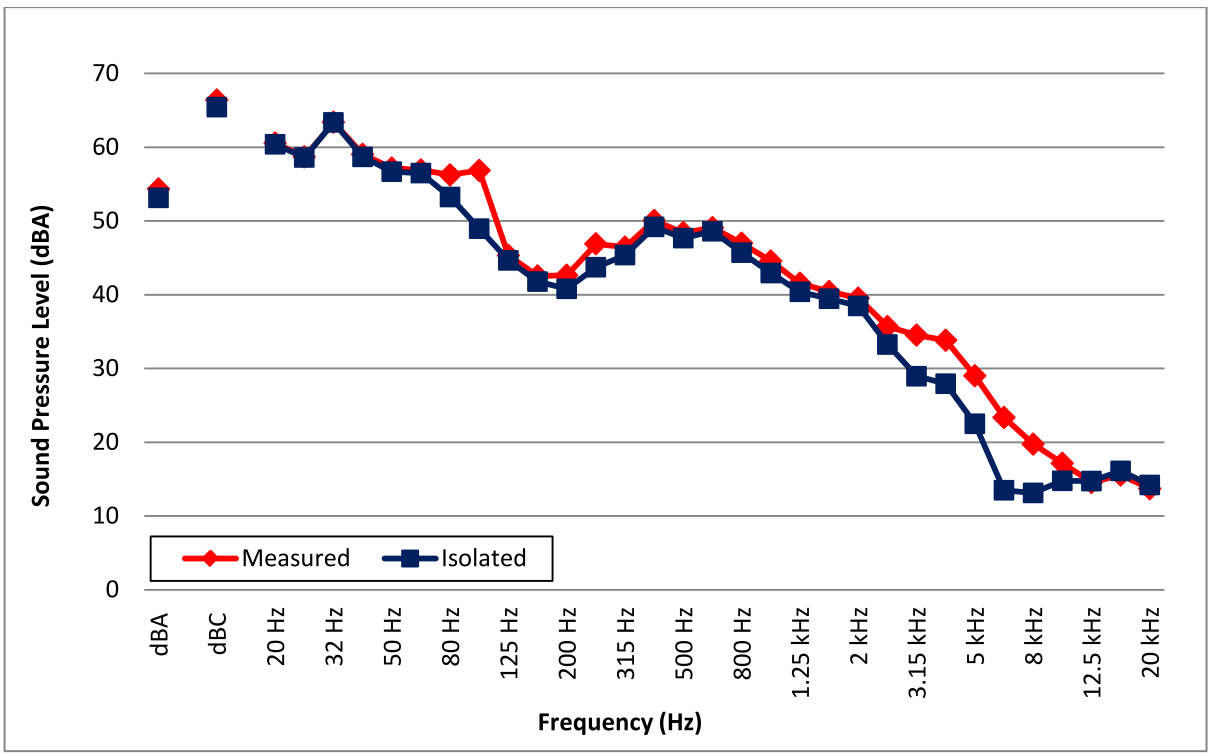


**Figure 29. Noise Monitor #2, 1/3 Octave $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

Noise Monitor #3

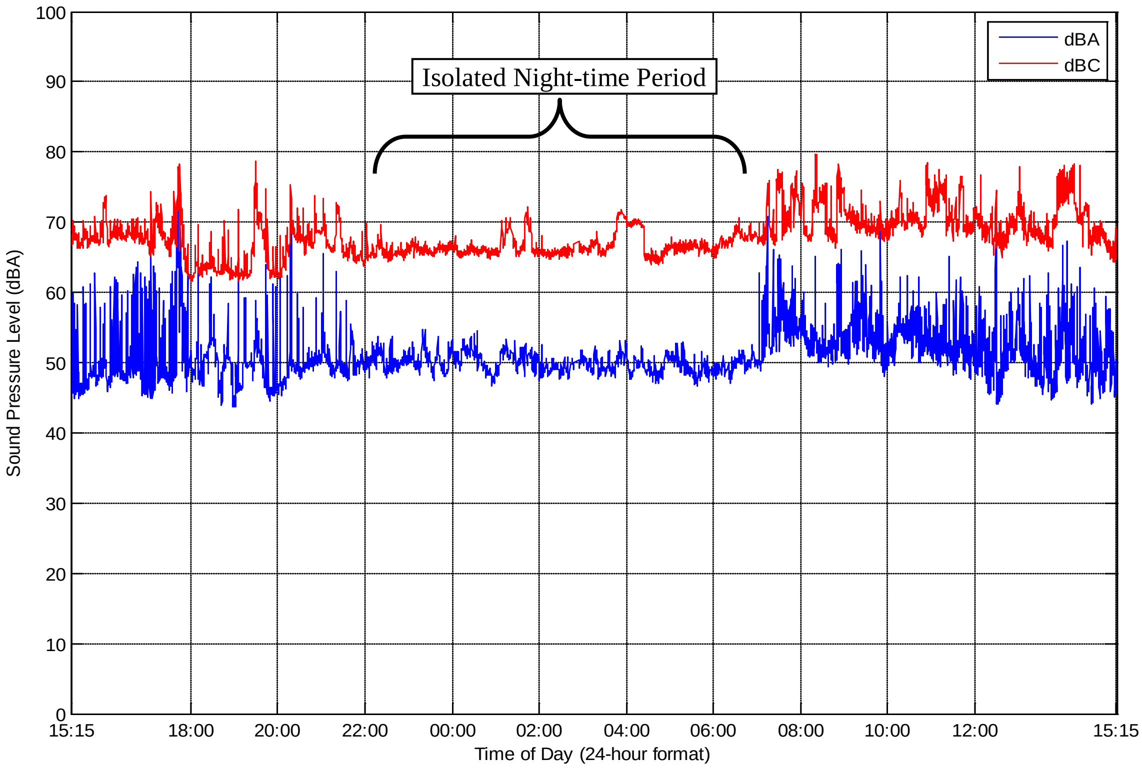


**Figure 30. Noise Monitor #3, 15-Second $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

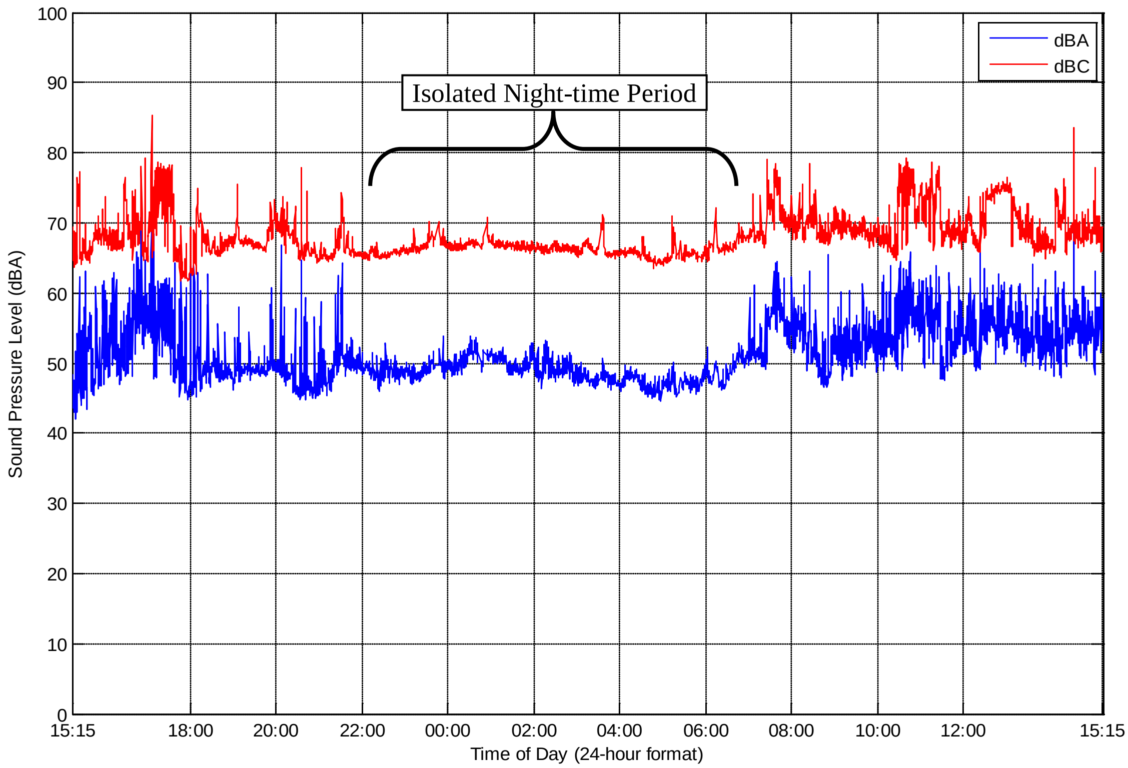


**Figure 31. Noise Monitor #3, 15-Second $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

Noise Monitor #3

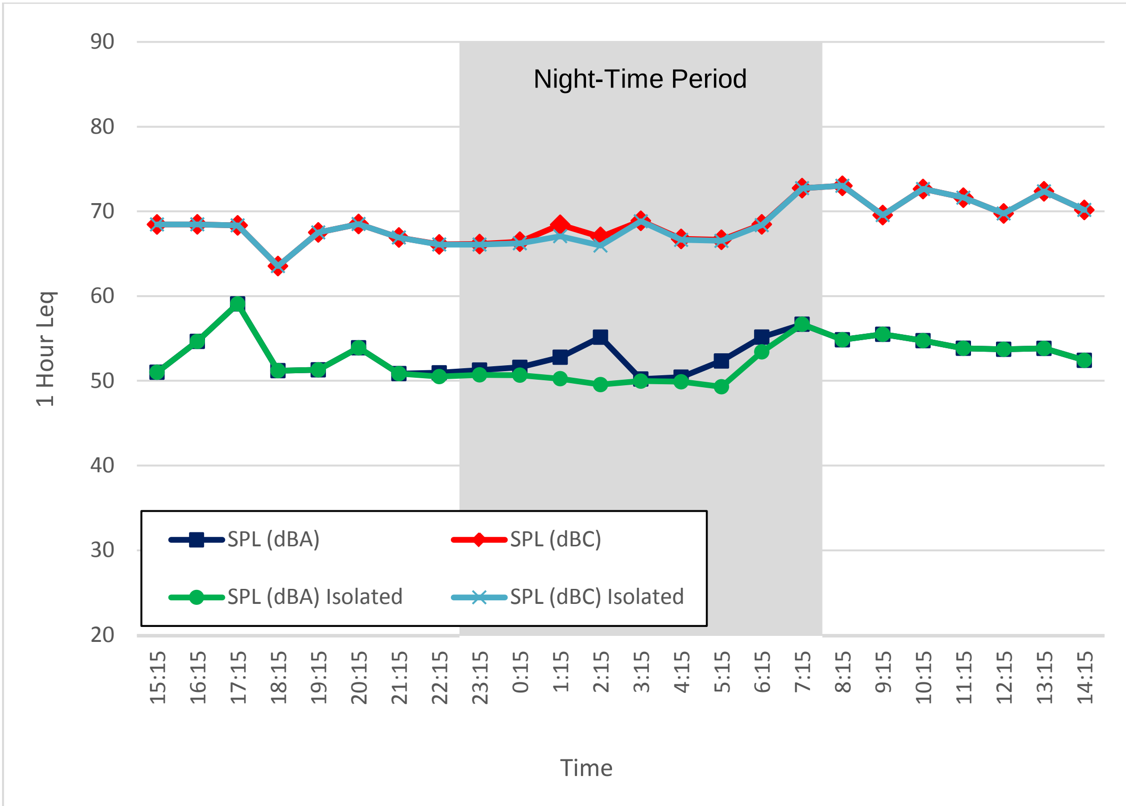


**Figure 32. Noise Monitor #3, 1-Hour $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

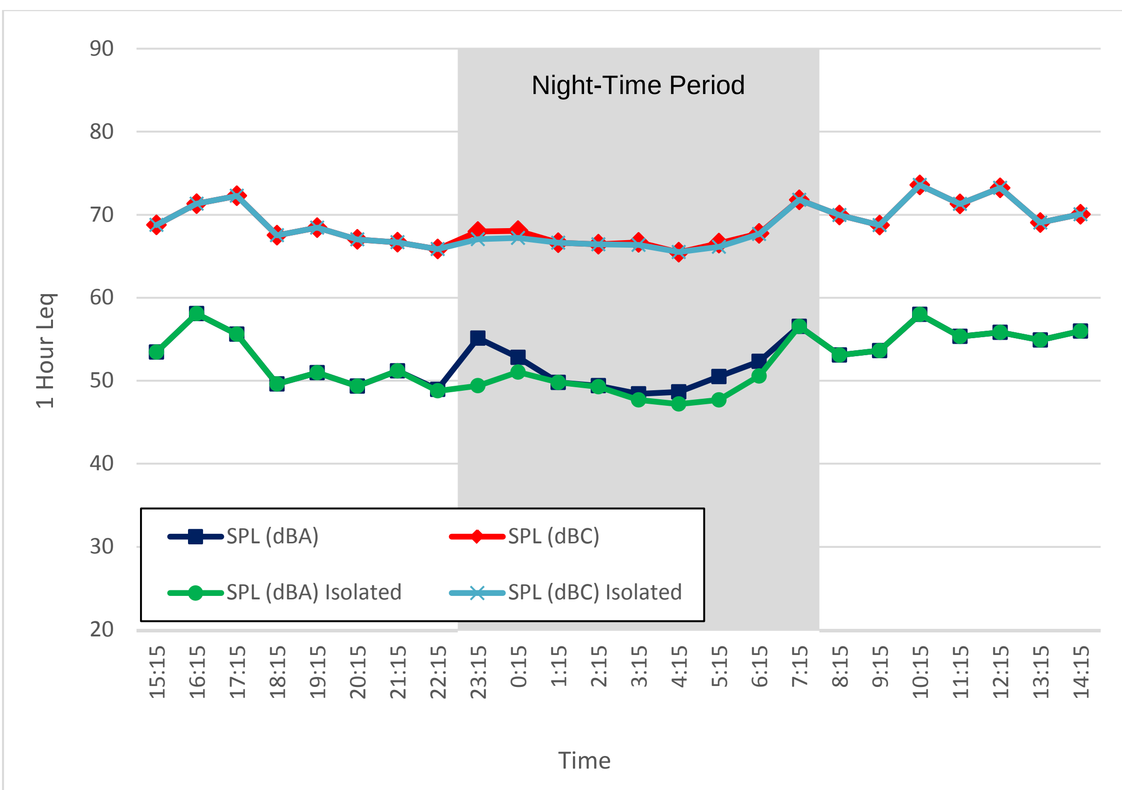


**Figure 33. Noise Monitor #3, 1-Hour $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

Noise Monitor #3

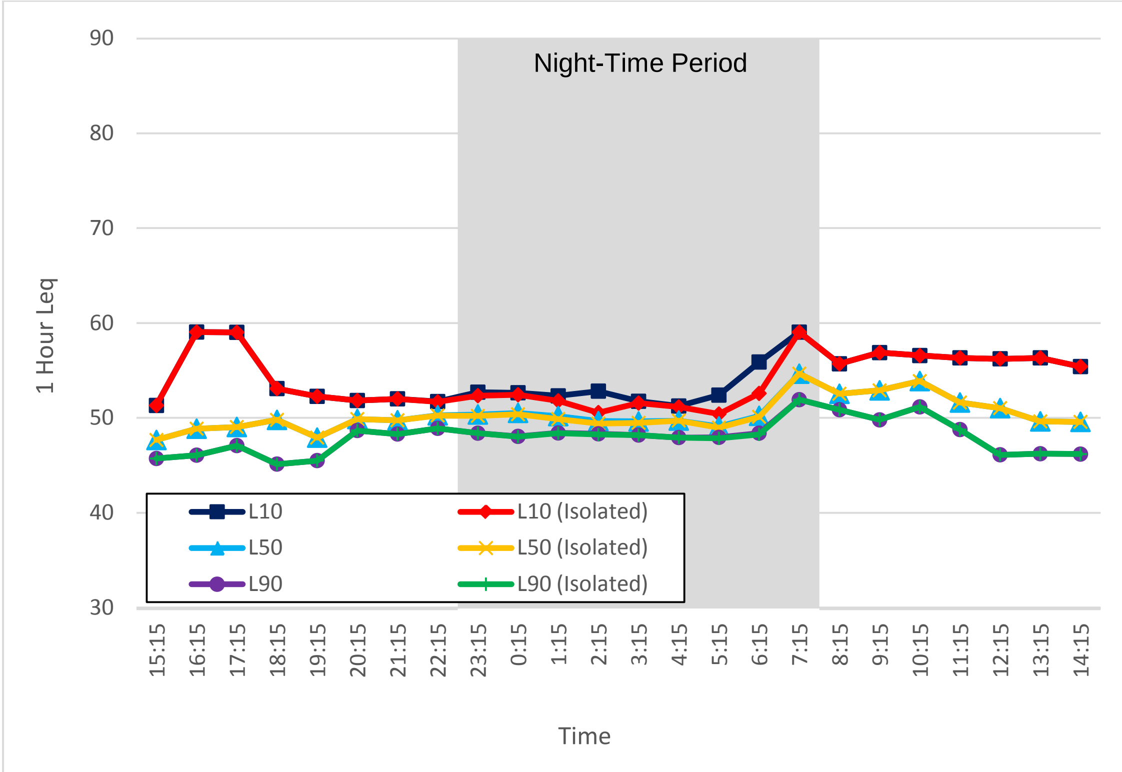


**Figure 34. Noise Monitor #3, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

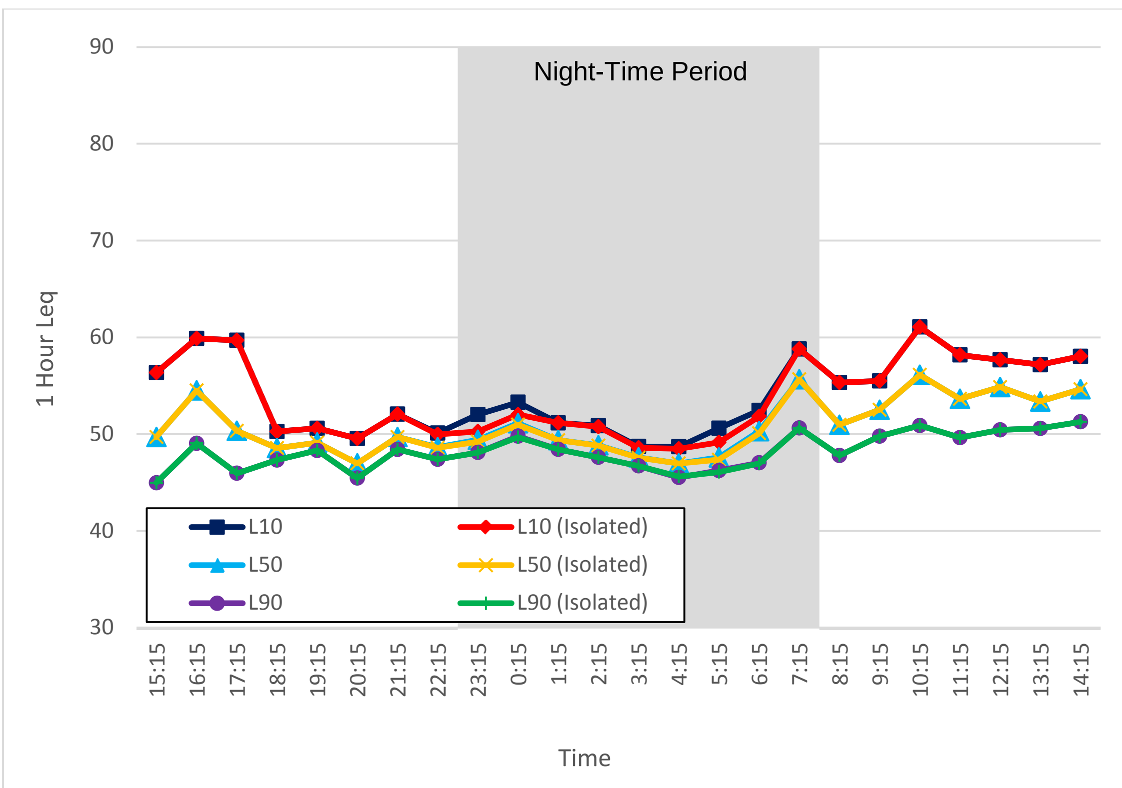


**Figure 35. Noise Monitor #3, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

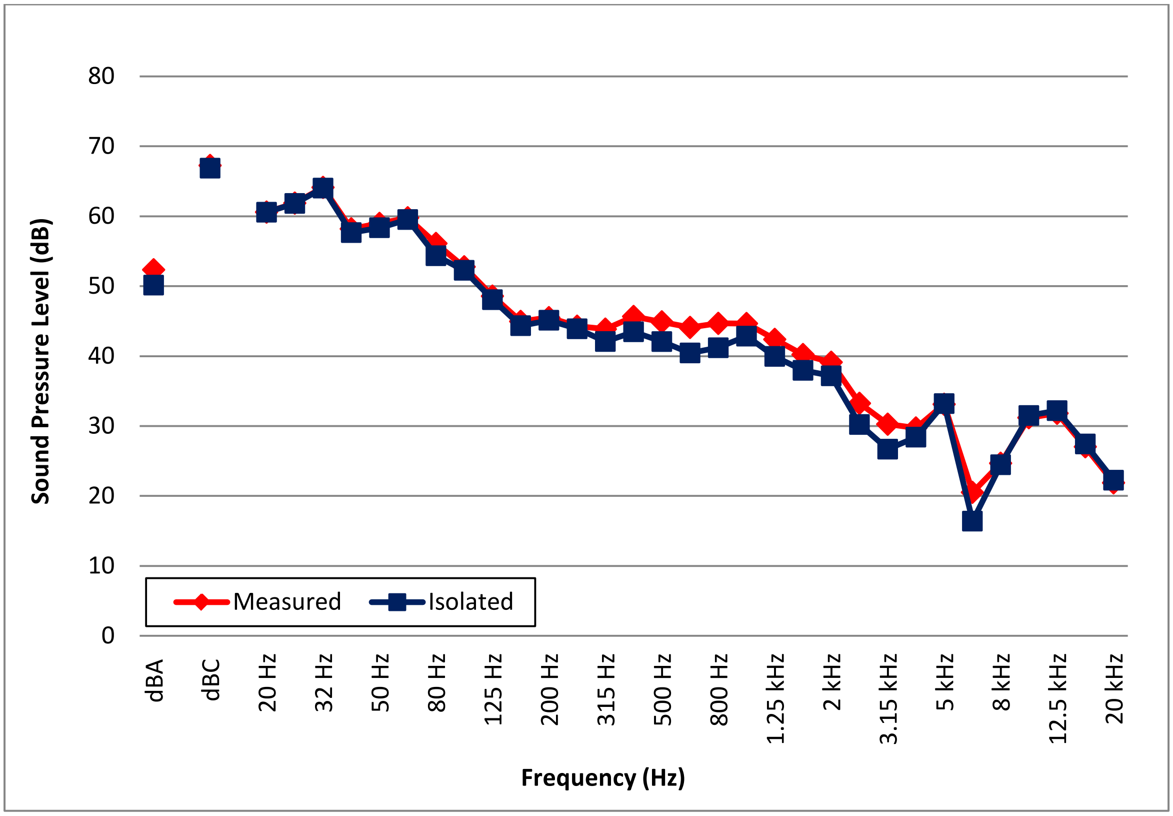


**Figure 36. Noise Monitor #3, 1/3 Octave $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

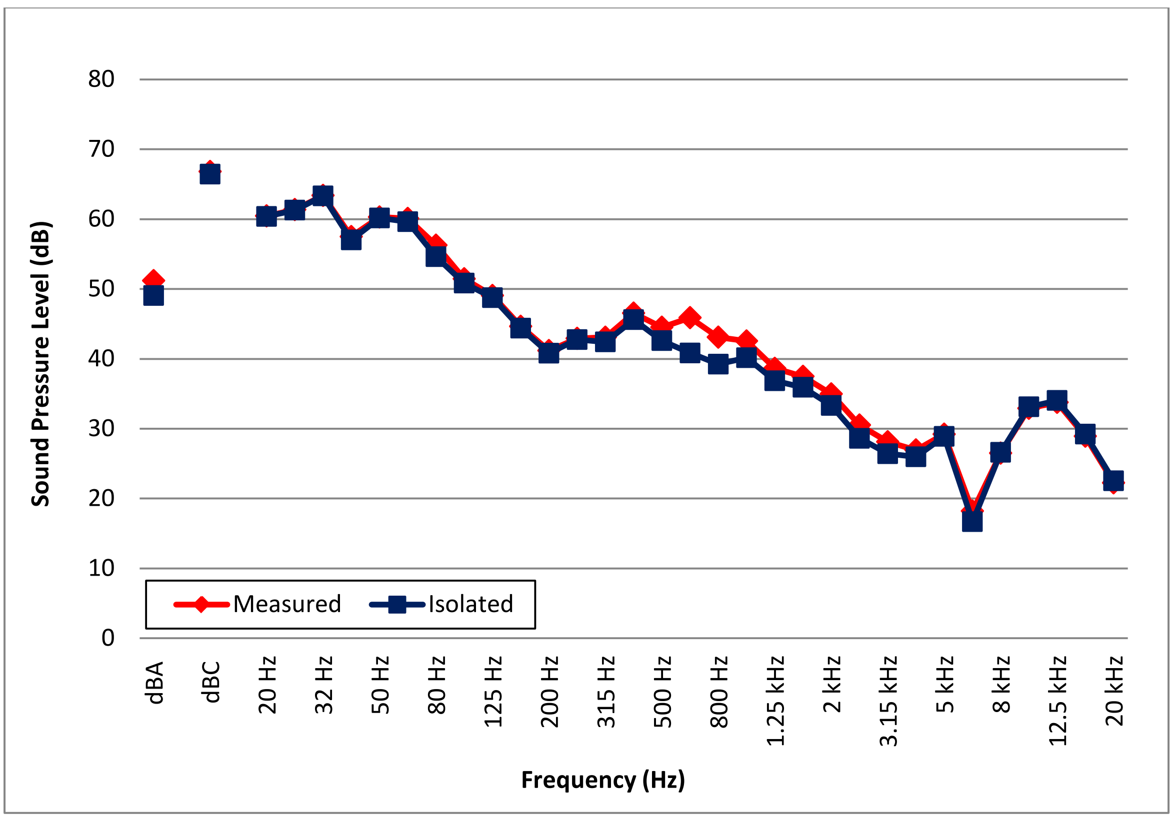


**Figure 37. Noise Monitor #3, 1/3 Octave $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

Noise Monitor #4

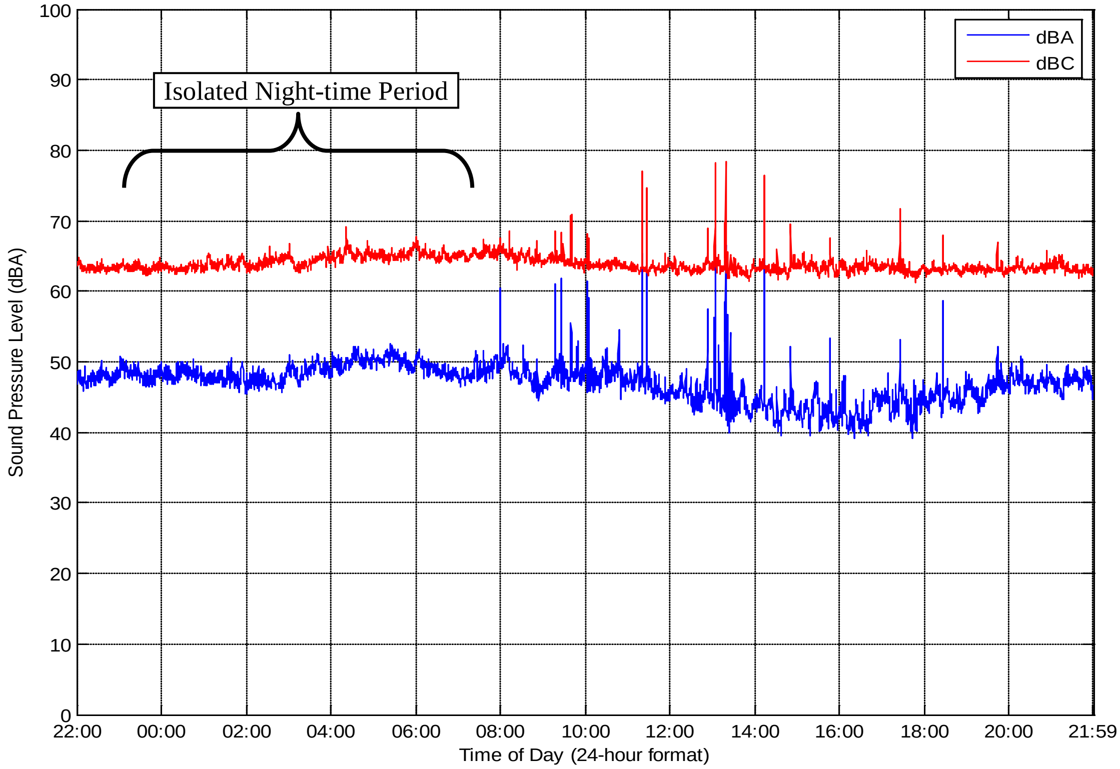


**Figure 38. Noise Monitor #4, 15-Second $L_{eq}$ Sound Levels (June 16 - 17, 2014)**

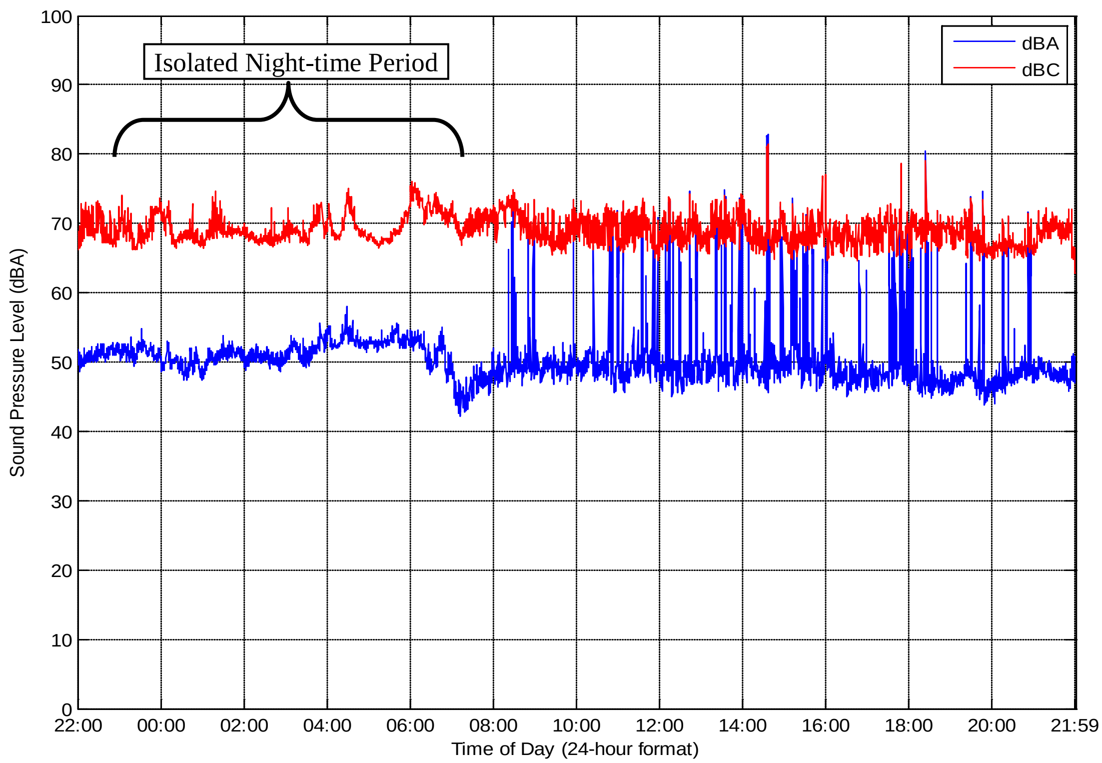


**Figure 39. Noise Monitor #4, 15-Second $L_{eq}$ Sound Levels (June 25 - 26, 2014)**

Noise Monitor #4

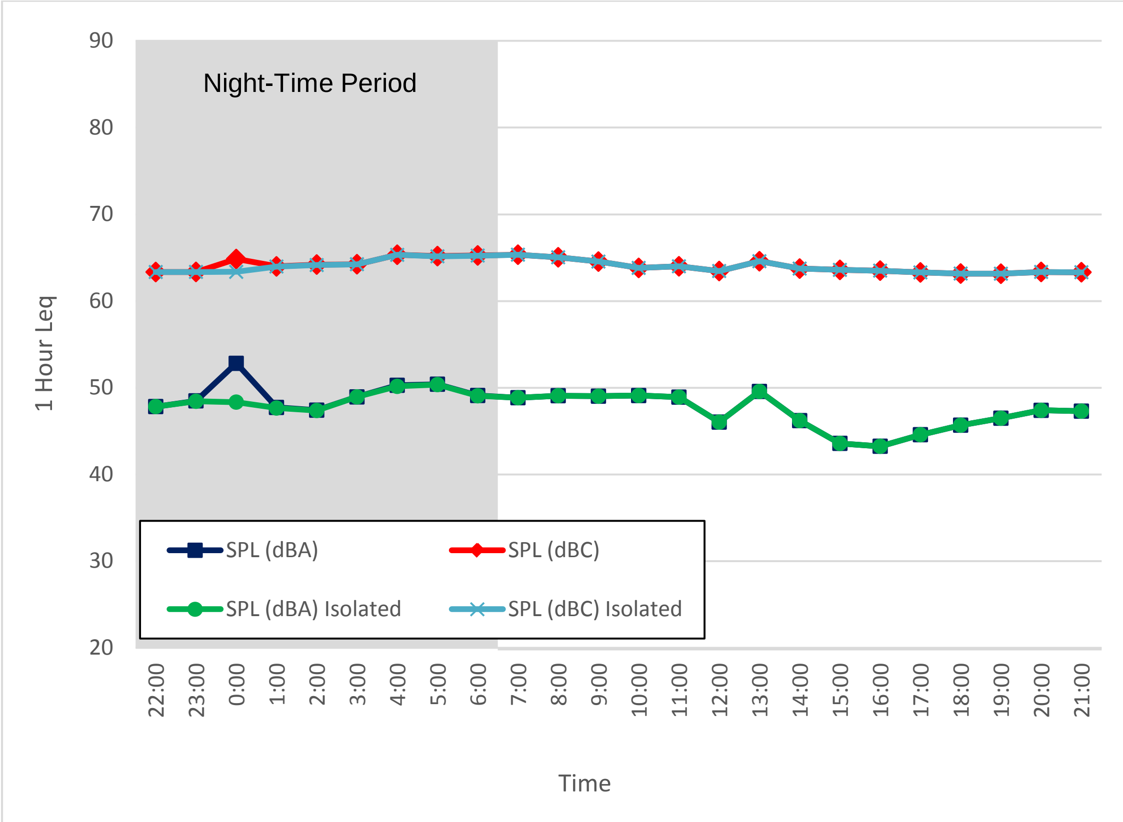


**Figure 40. Noise Monitor #4, 1-Hour $L_{eq}$ Sound Levels (June 16 - 17, 2014)**

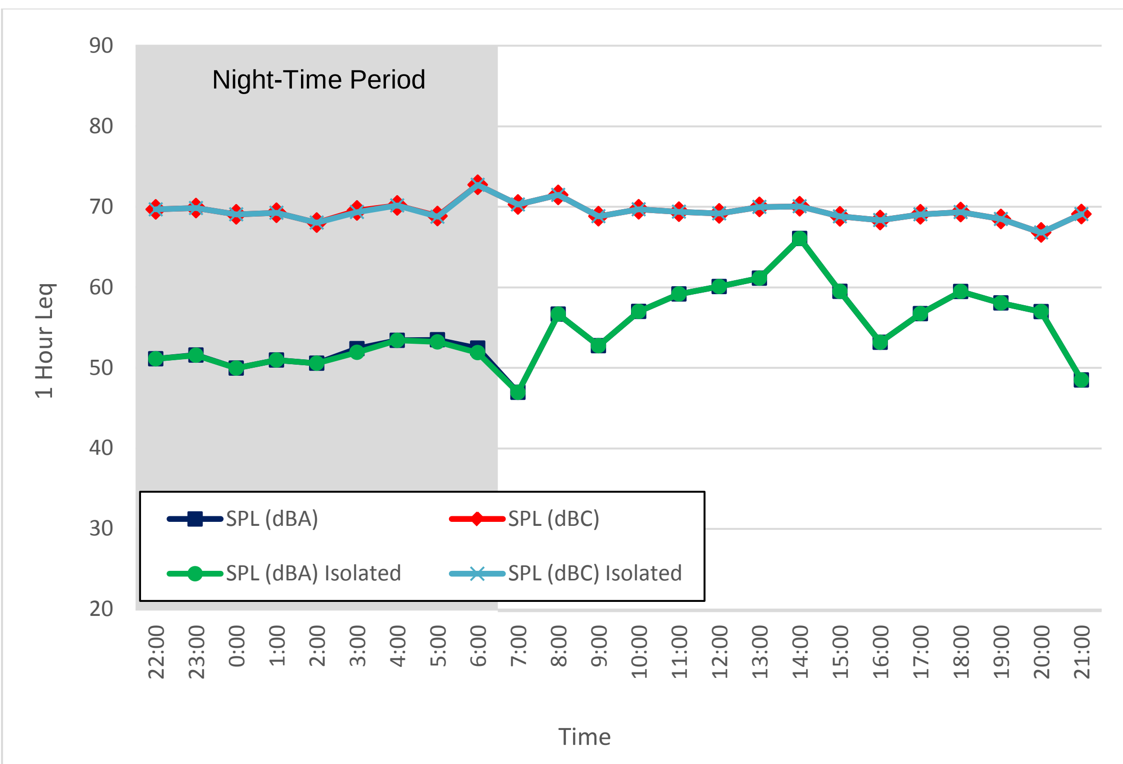


**Figure 41. Noise Monitor #4, 1-Hour $L_{eq}$ Sound Levels (June 25 - 26, 2014)**

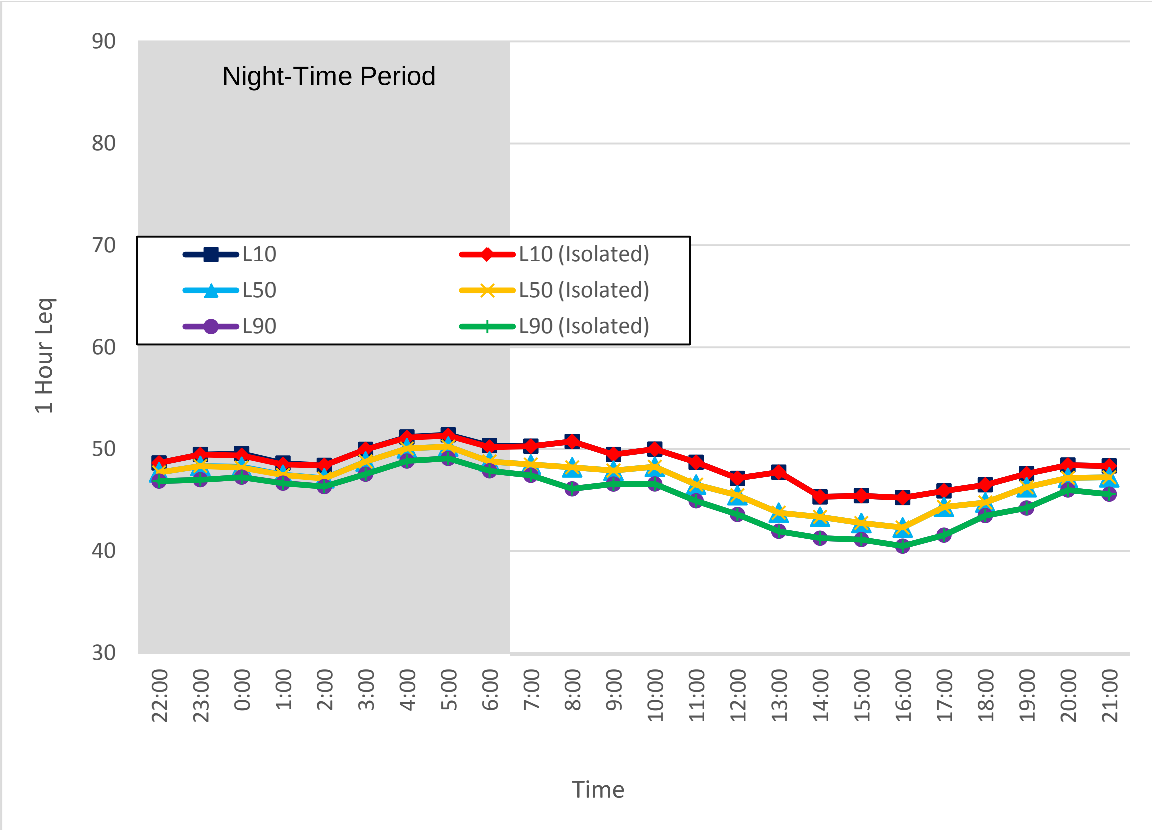


**Figure 42. Noise Monitor #4, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (June 16 - 17, 2014)**

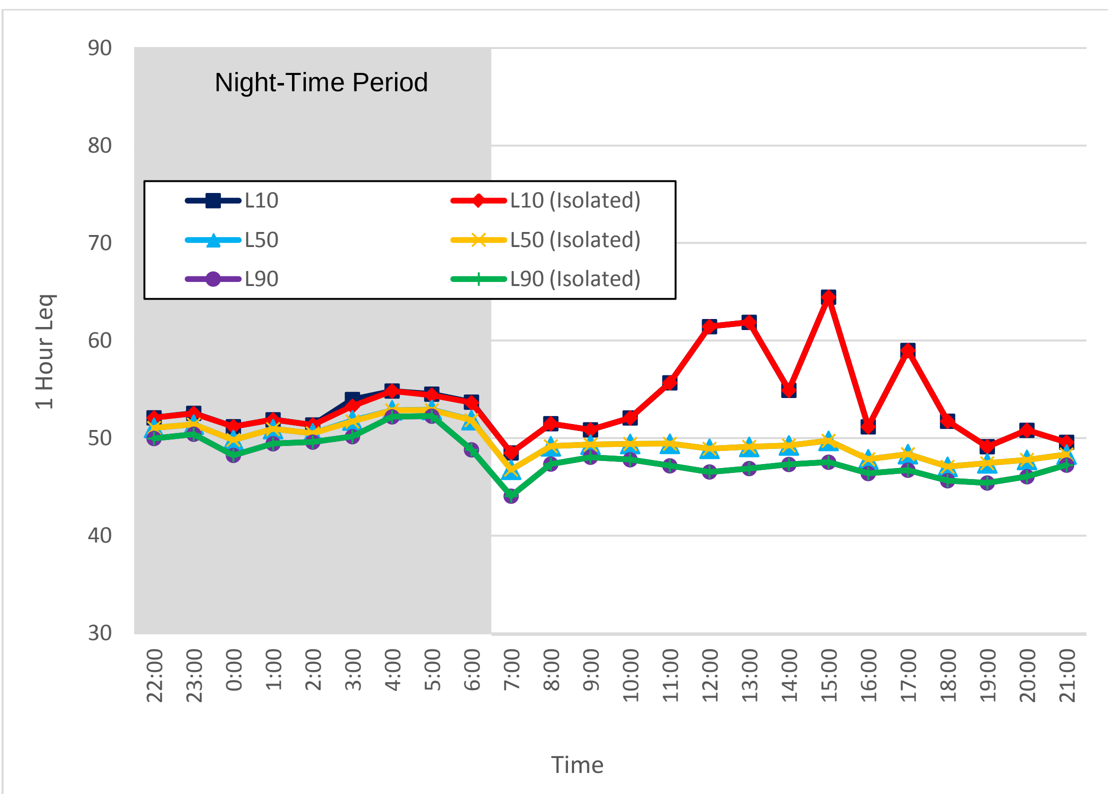


**Figure 43. Noise Monitor #4, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (June 25 - 26, 2014)**

Noise Monitor #4

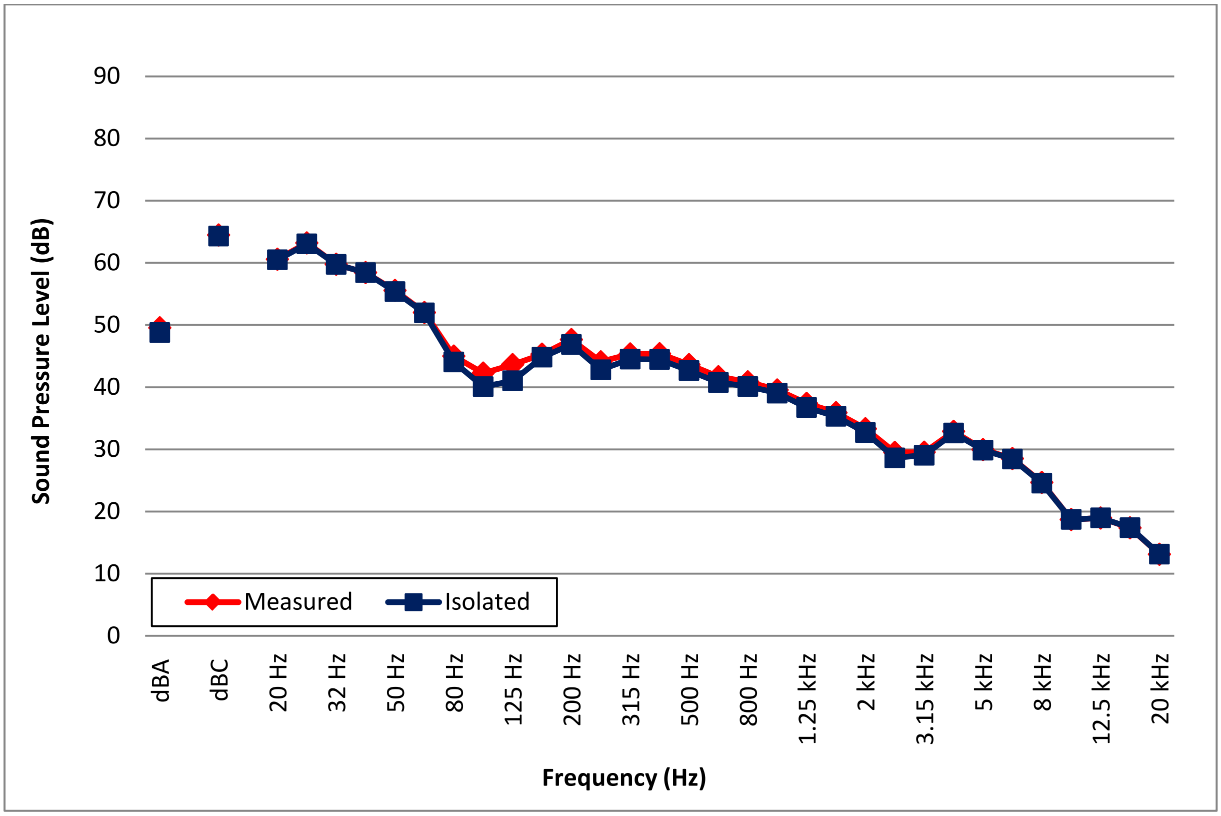


**Figure 44. Noise Monitor #4, 1/3 Octave $L_{eq}$ Sound Levels (June 16 - 17, 2014)**

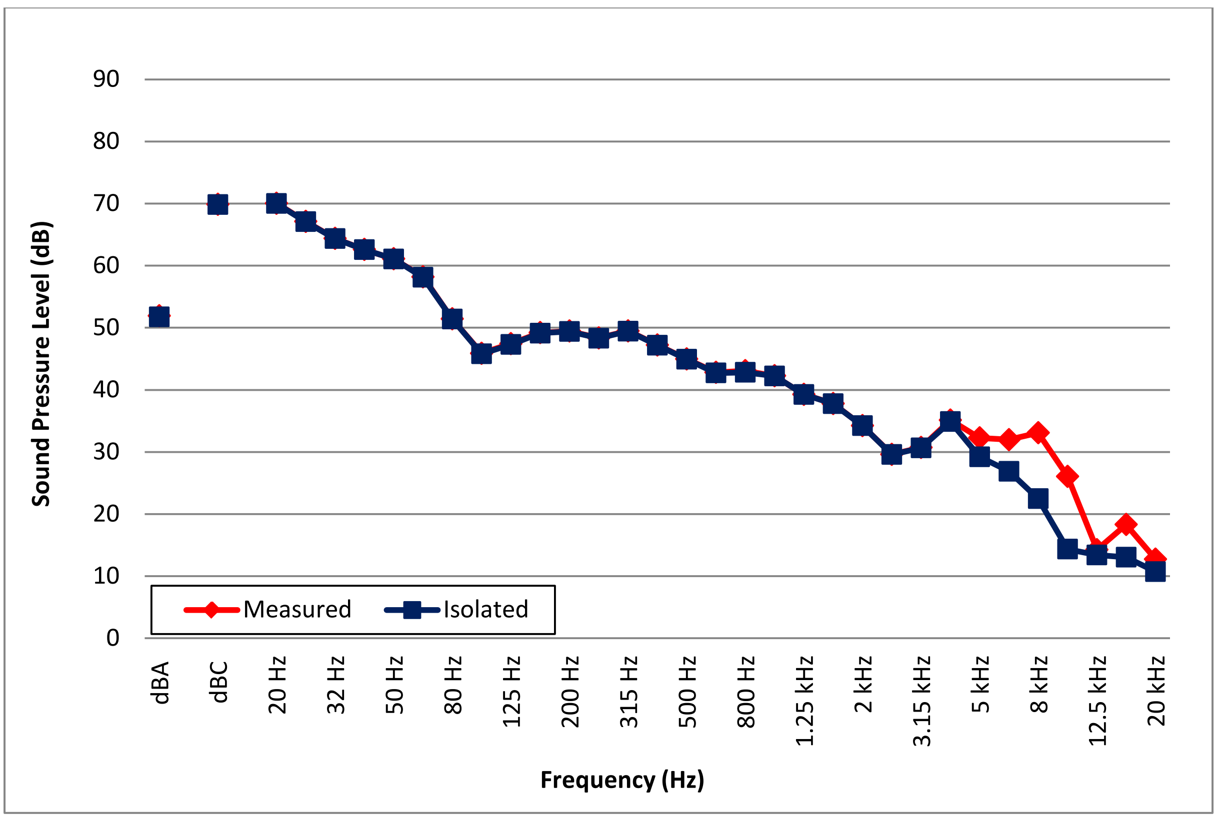


**Figure 45. Noise Monitor #4, 1/3 Octave $L_{eq}$ Sound Levels (June 25 - 26, 2014)**

Noise Monitor #5

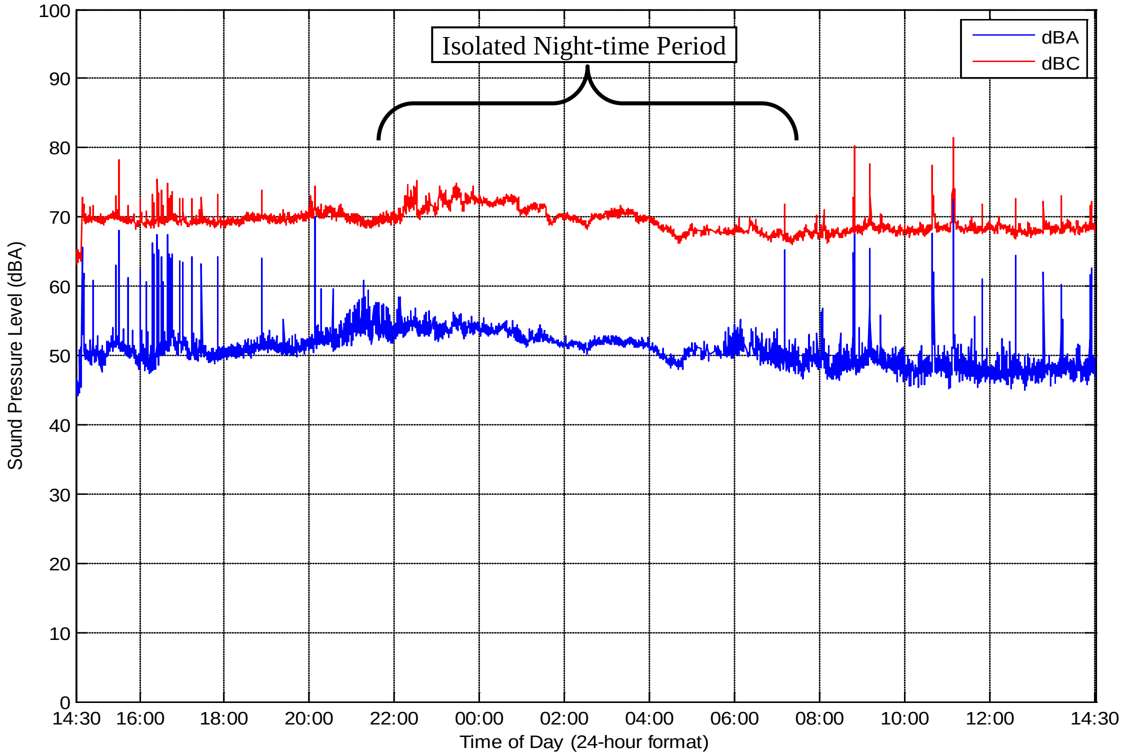


**Figure 46. Noise Monitor #5, 15-Second $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

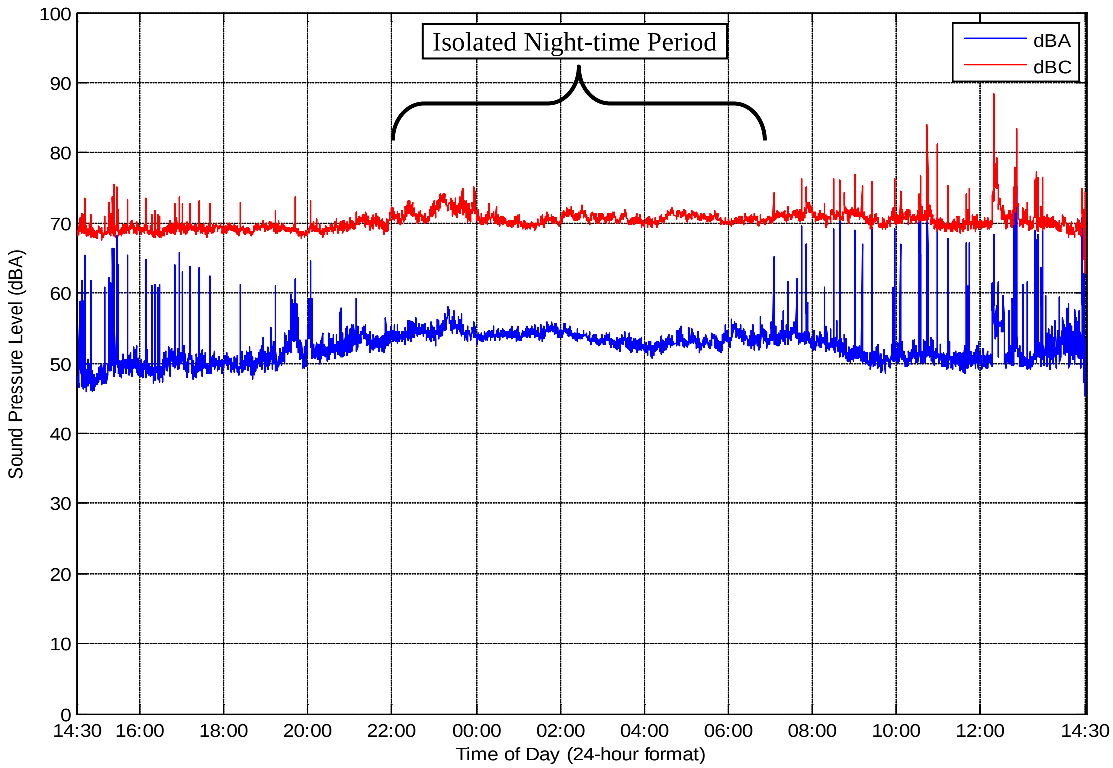


**Figure 47. Noise Monitor #5, 15-Second $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

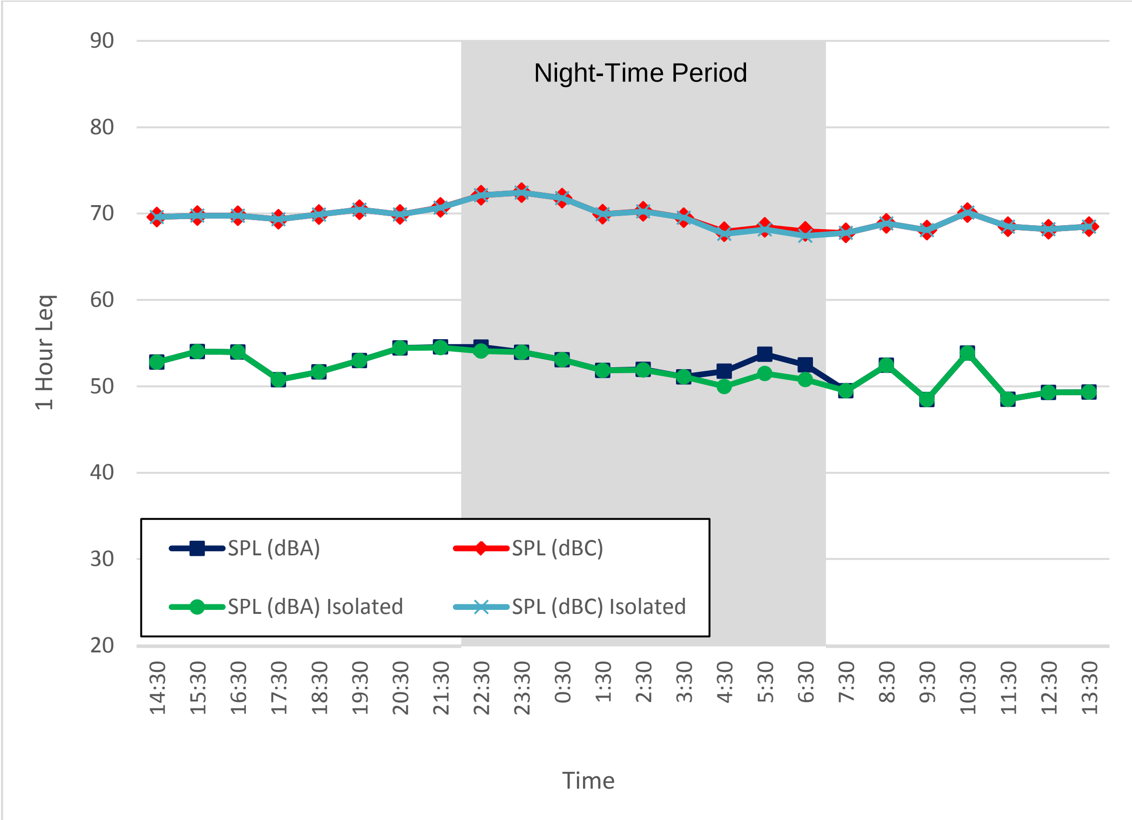


**Figure 48. Noise Monitor #5, 1-Hour $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

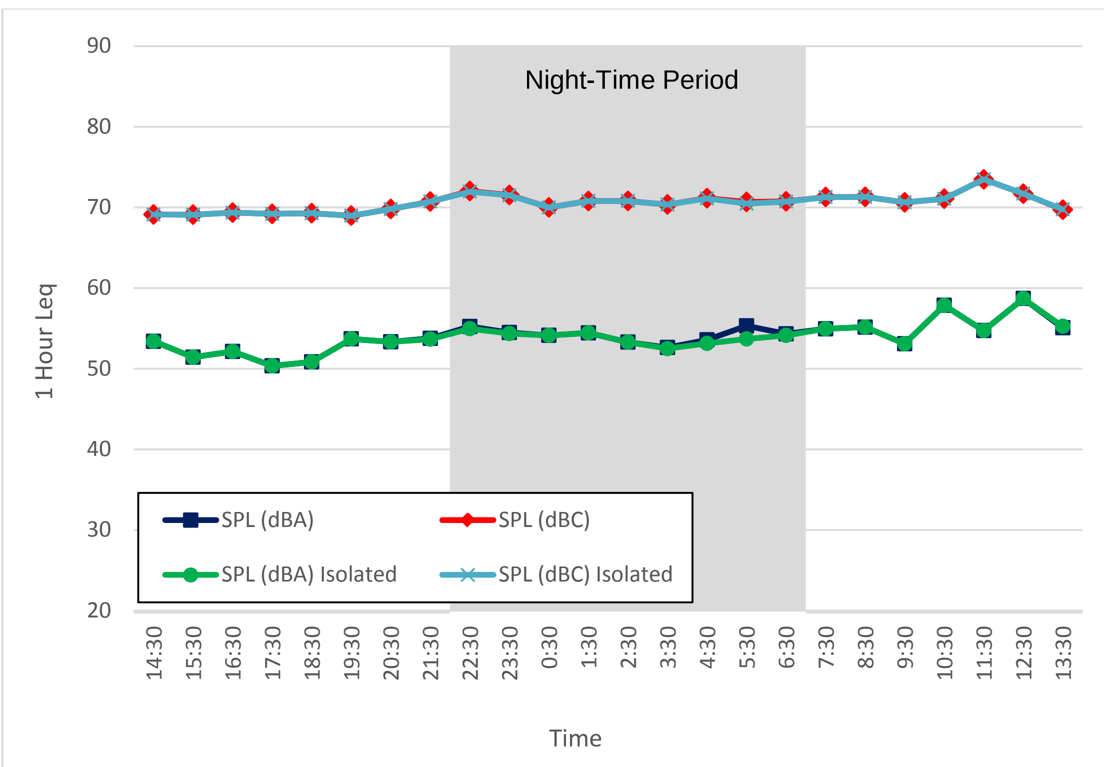


**Figure 49. Noise Monitor #5, 1-Hour $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

Noise Monitor #5

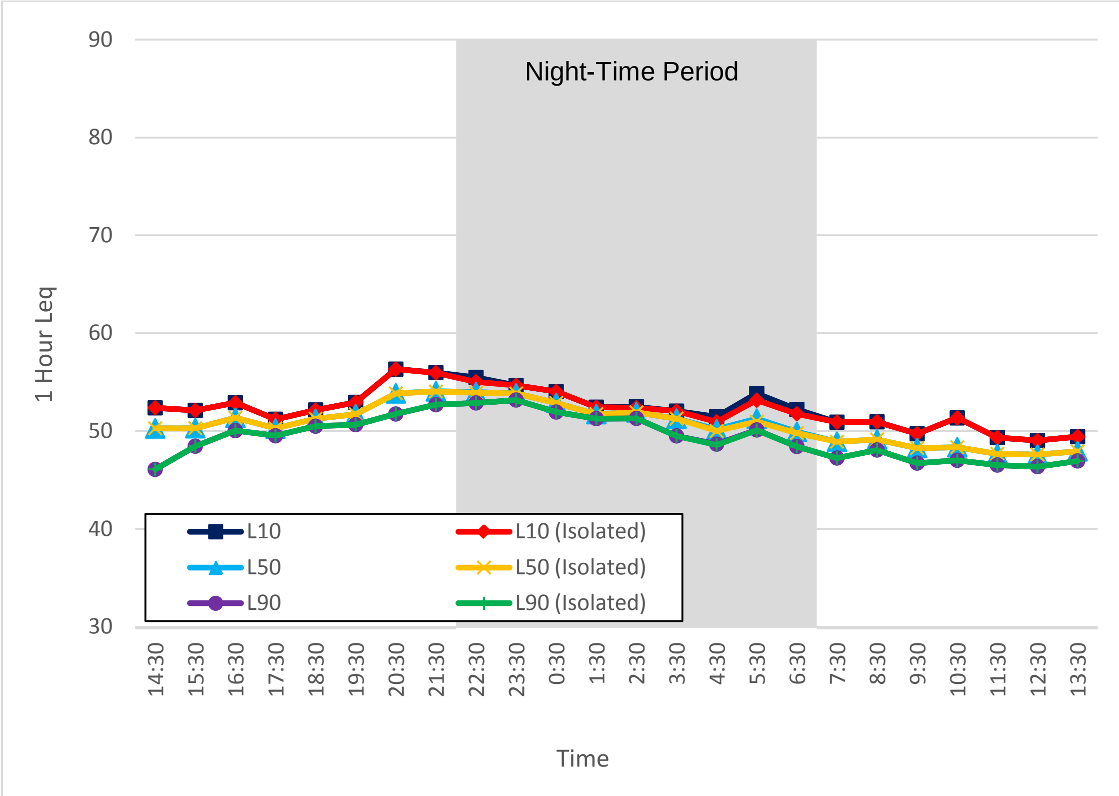


**Figure 50. Noise Monitor #5, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

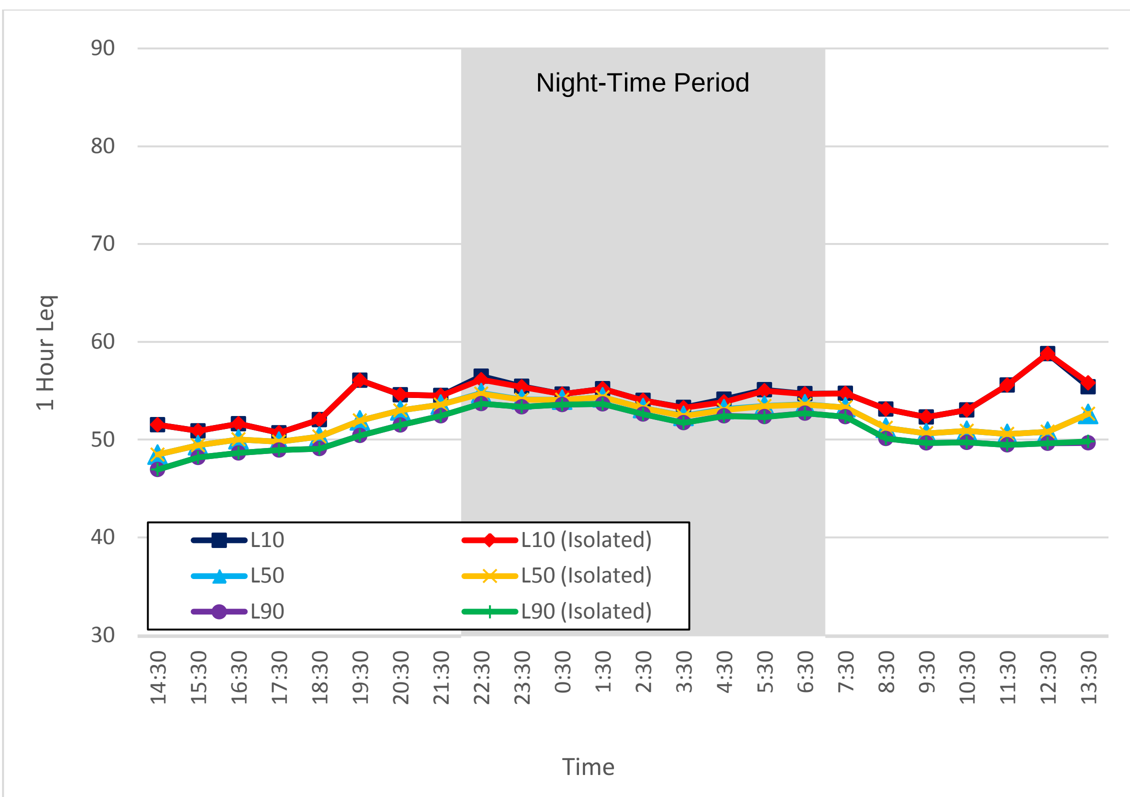


**Figure 51. Noise Monitor #5, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

Noise Monitor #5

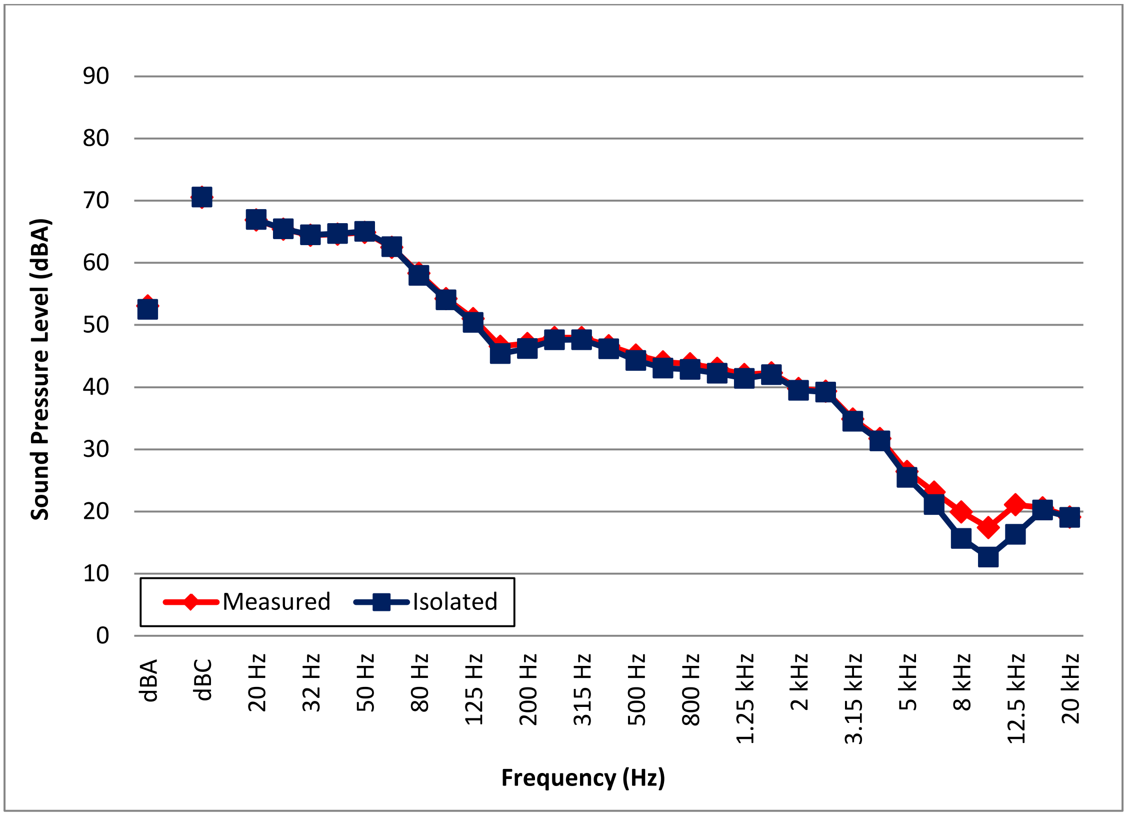


**Figure 52. Noise Monitor #5, 1/3 Octave $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

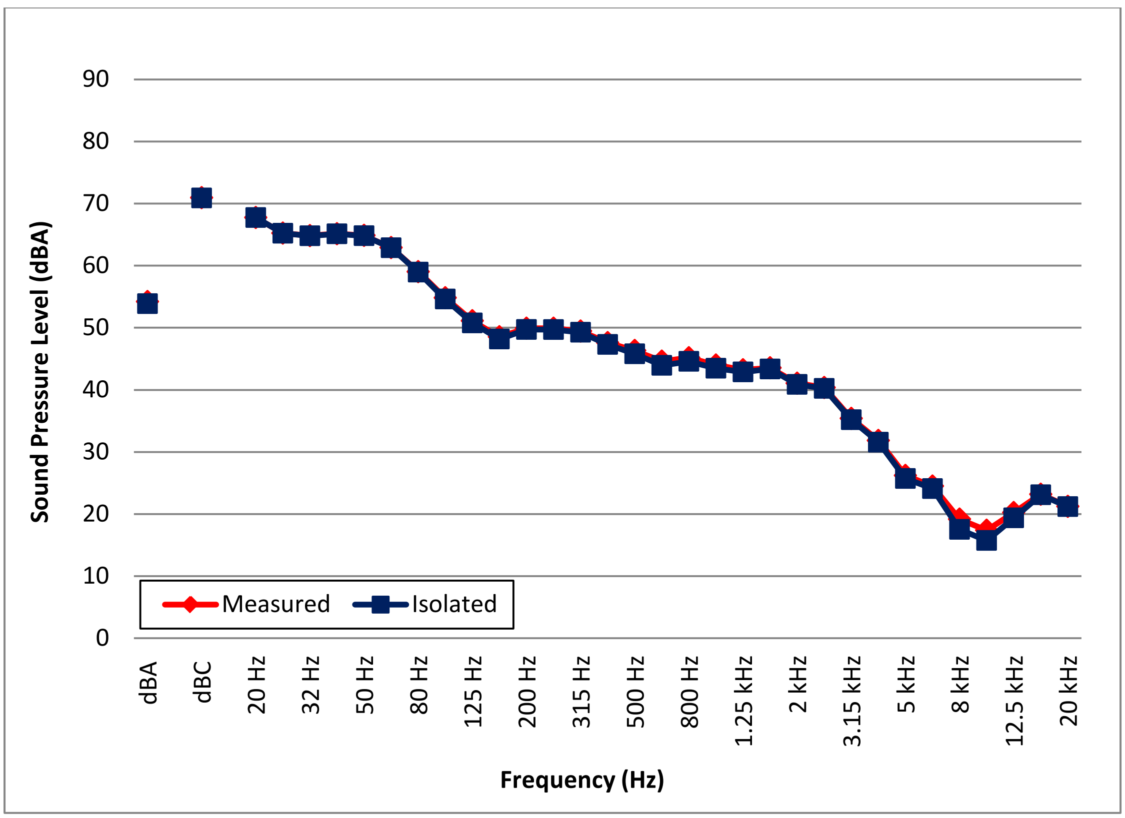


**Figure 53. Noise Monitor #5, 1/3 Octave $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

Noise Monitor #6

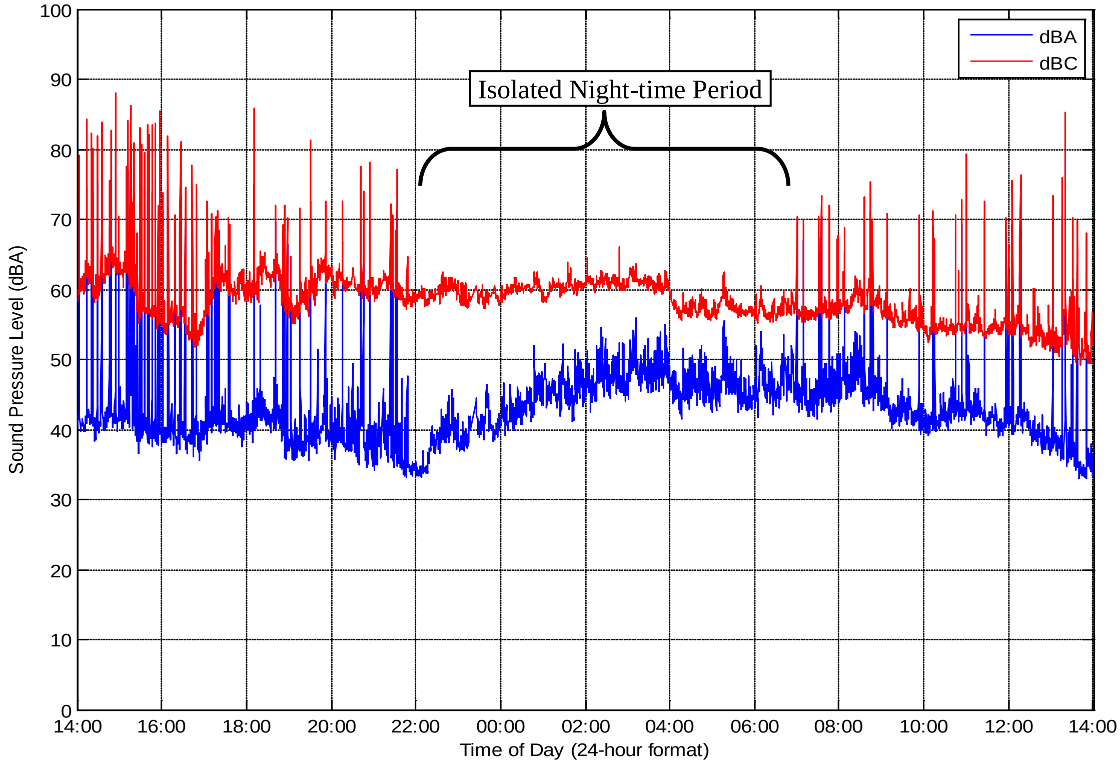


**Figure 54. Noise Monitor #6, 15-Second $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

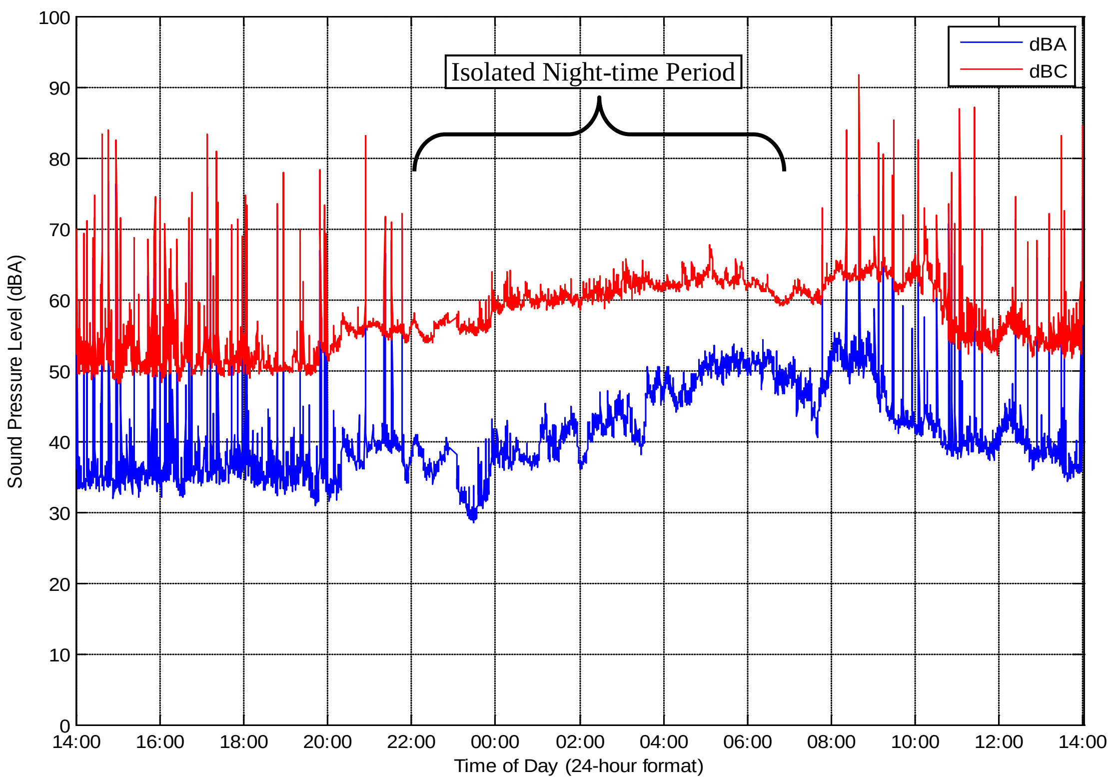


**Figure 55. Noise Monitor #6, 15-Second $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

Noise Monitor #6

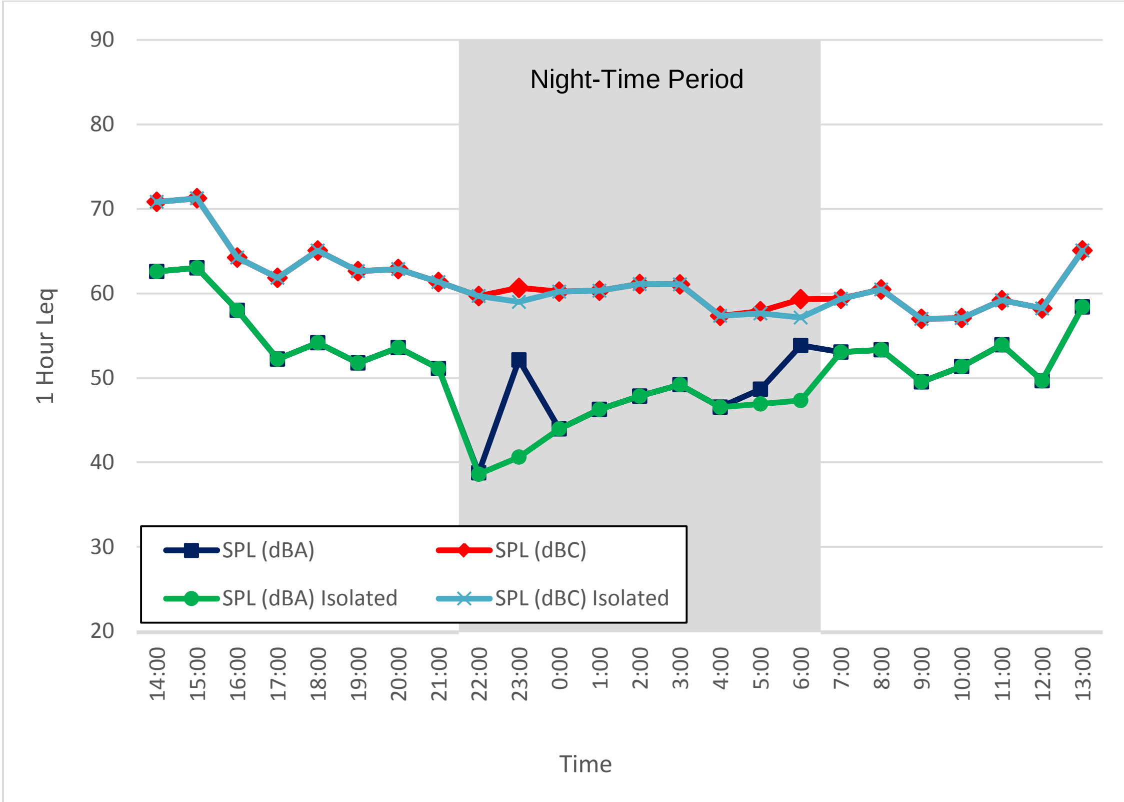


**Figure 56. Noise Monitor #6, 1-Hour $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

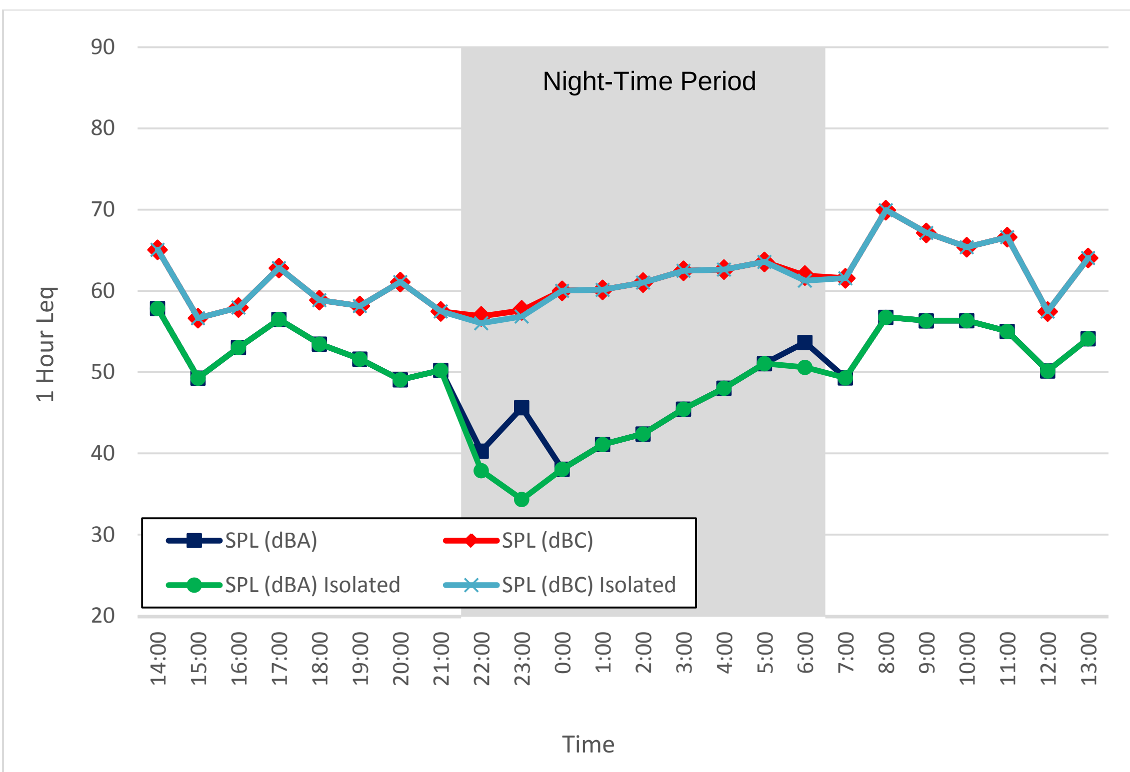


**Figure 57. Noise Monitor #6, 1-Hour $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

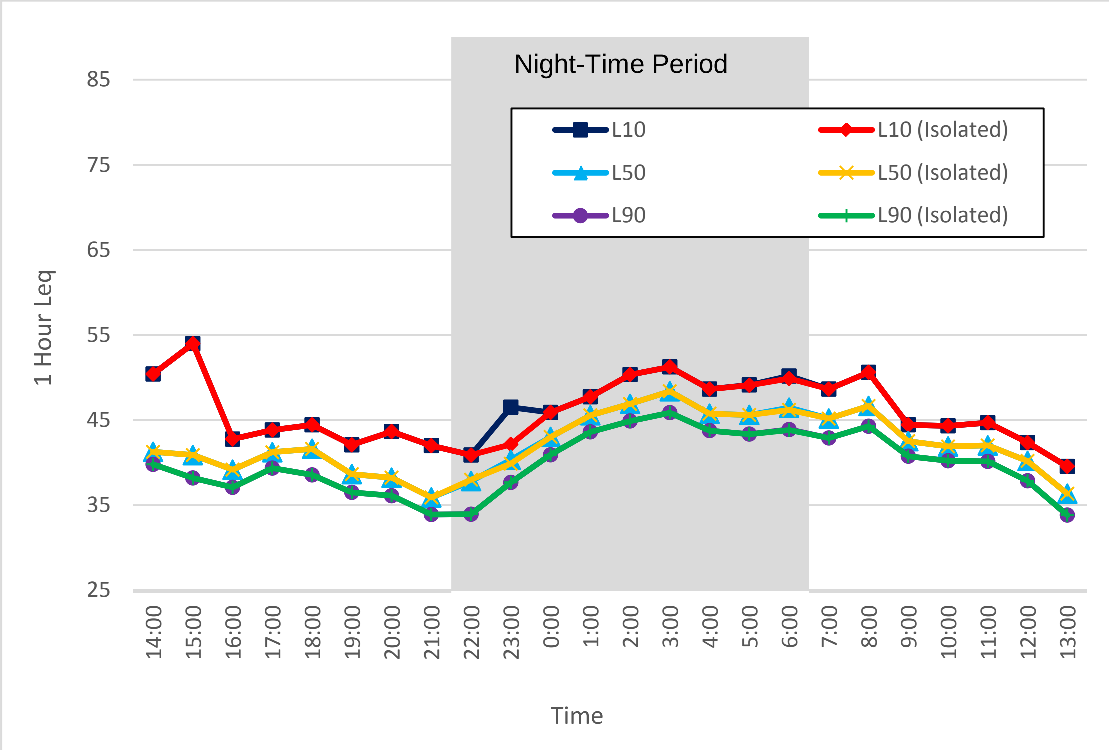


**Figure 58. Noise Monitor #6, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

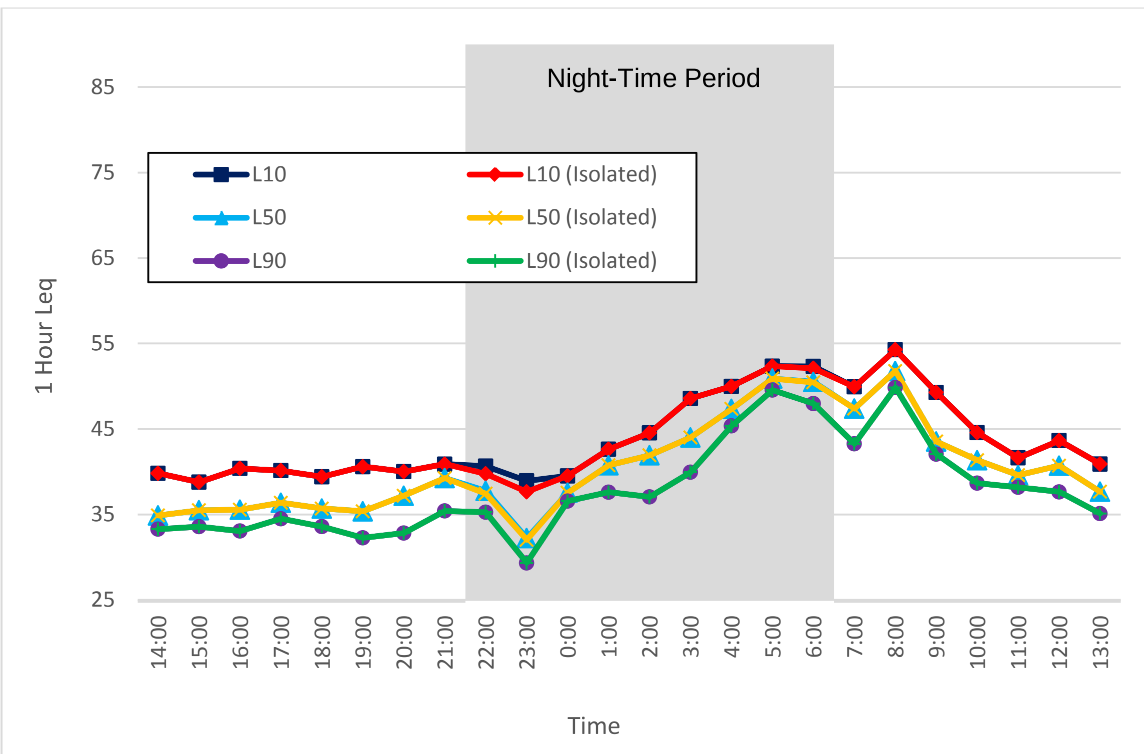


**Figure 59. Noise Monitor #6, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

Noise Monitor #6

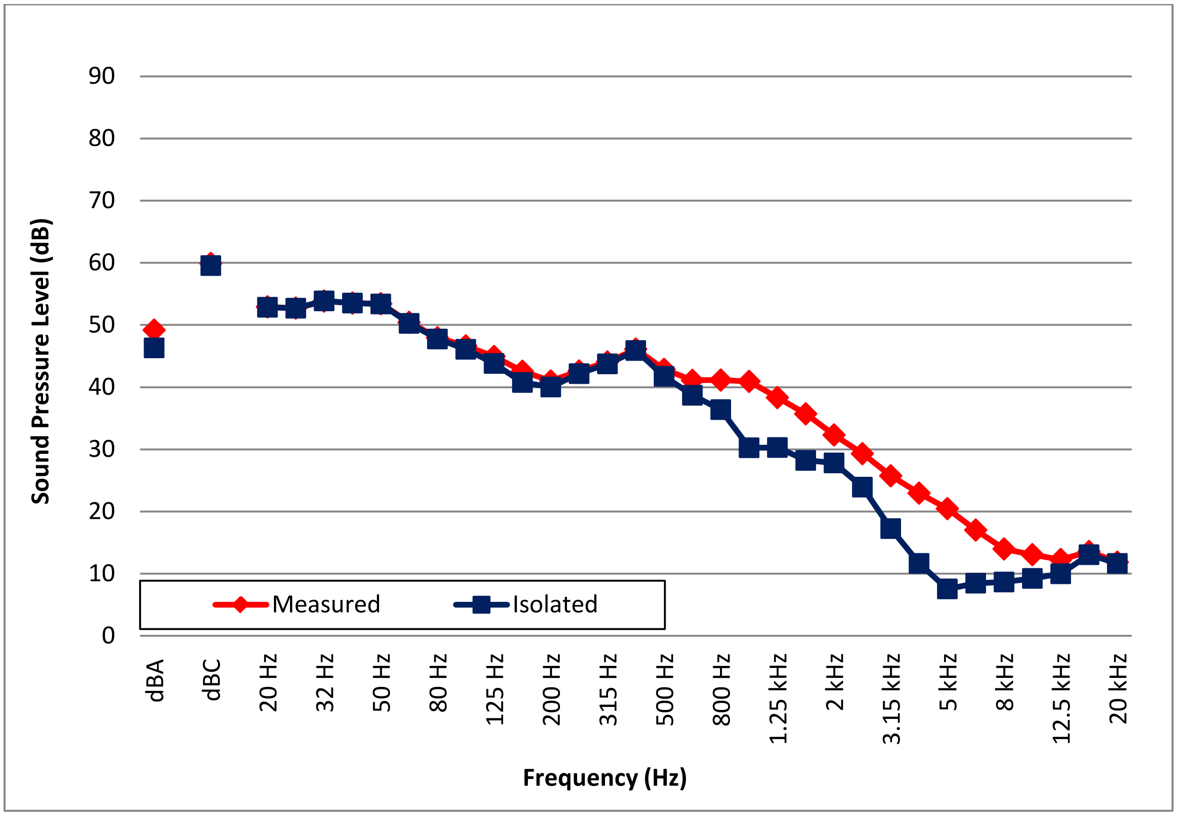


**Figure 60. Noise Monitor #6, 1/3 Octave $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

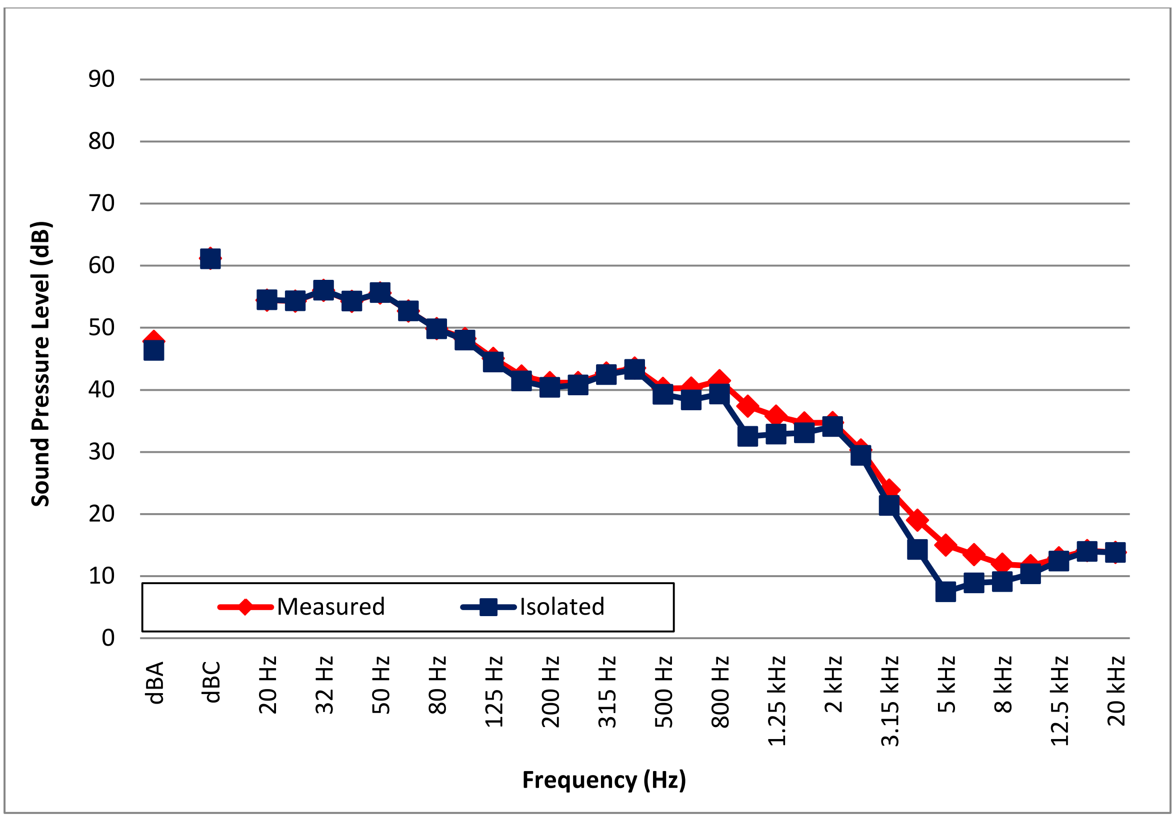


**Figure 61. Noise Monitor #6, 1/3 Octave $L_{eq}$ Sound Levels (August 14 – 15, 2014)**

Noise Monitor #8

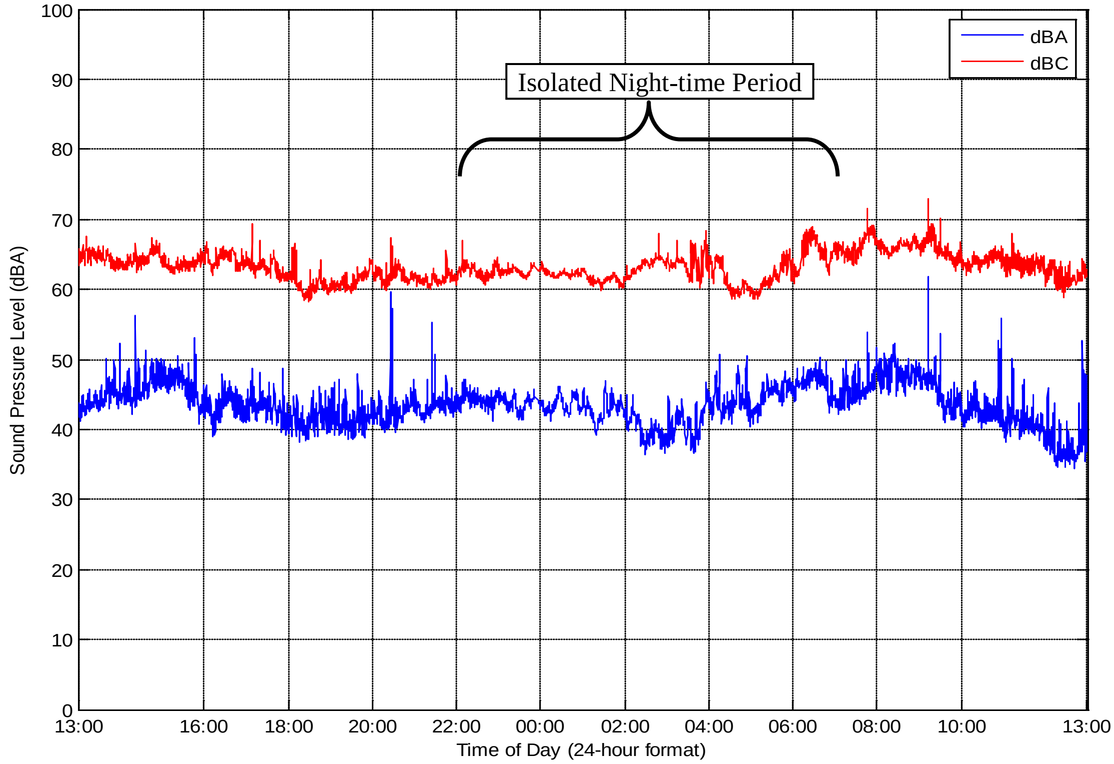


**Figure 62. Noise Monitor #8, 15-Second $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

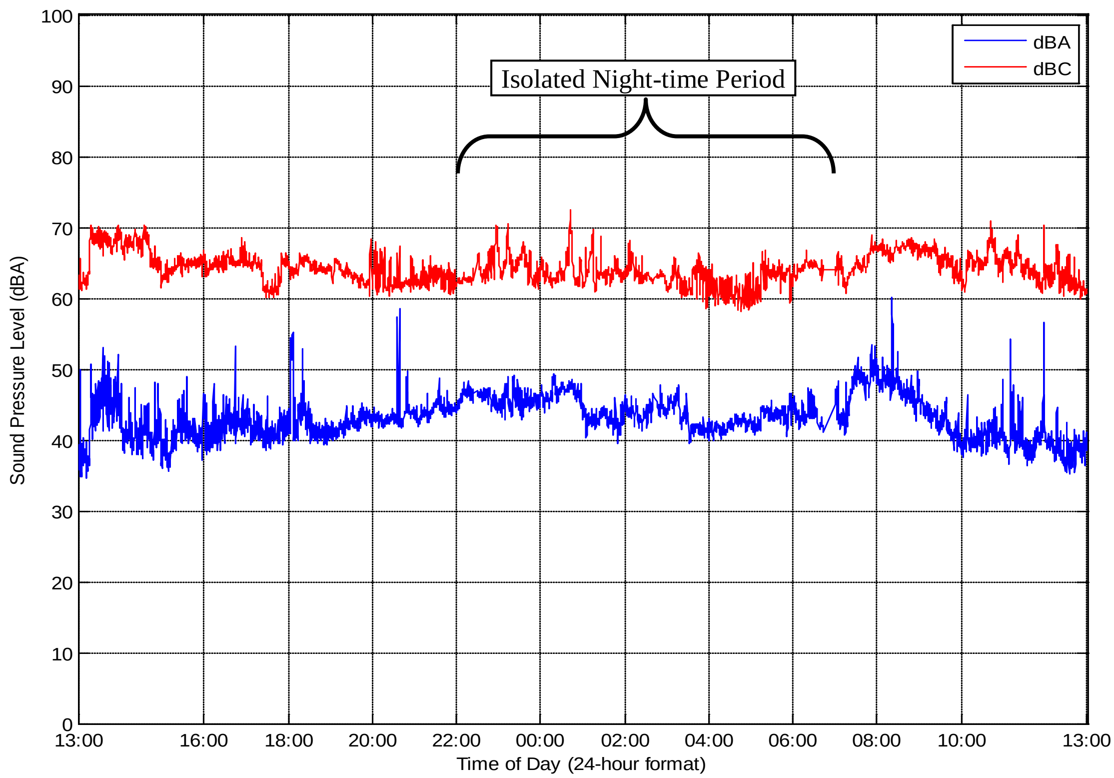


**Figure 63. Noise Monitor #8, 15-Second $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

Noise Monitor #8

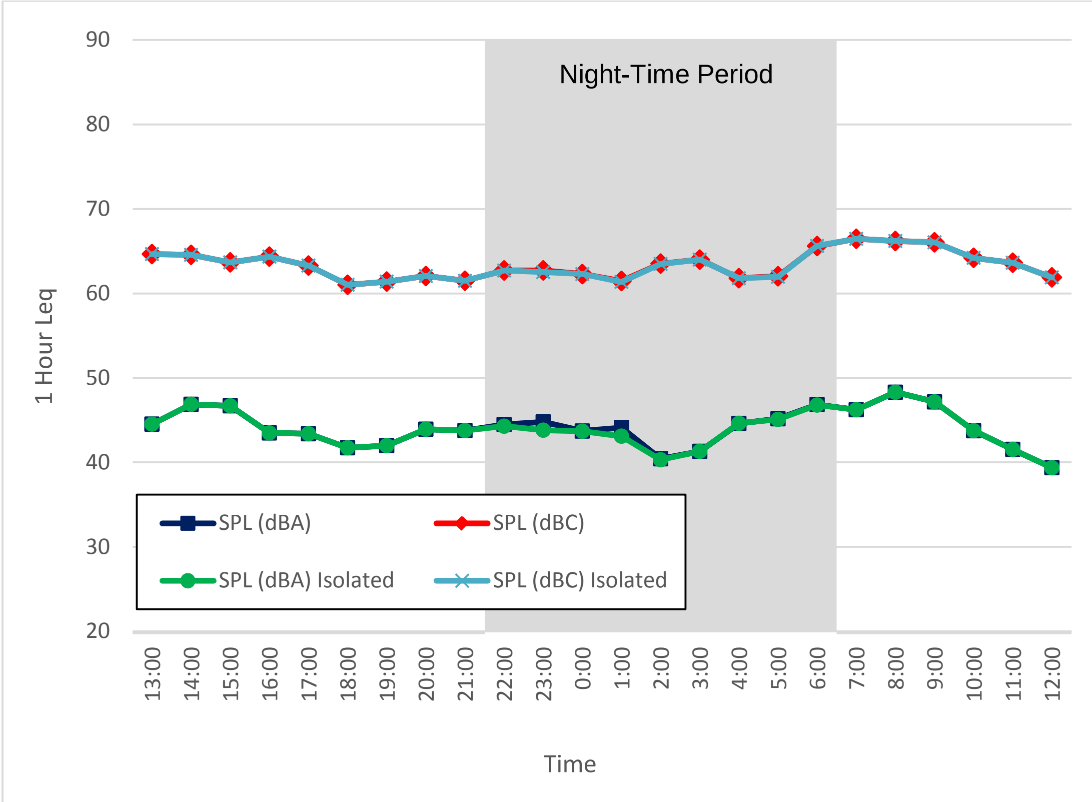


**Figure 64. Noise Monitor #8, 1-Hour $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

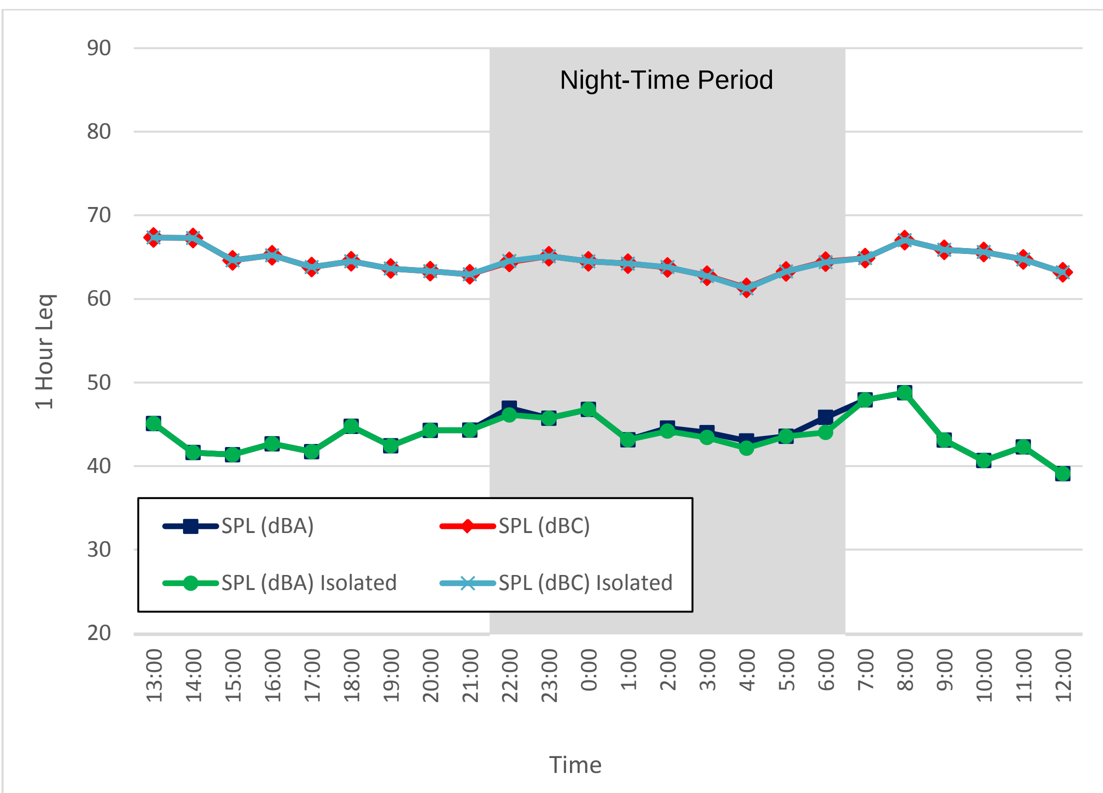


**Figure 65. Noise Monitor #8, 1-Hour $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

Monitor #8

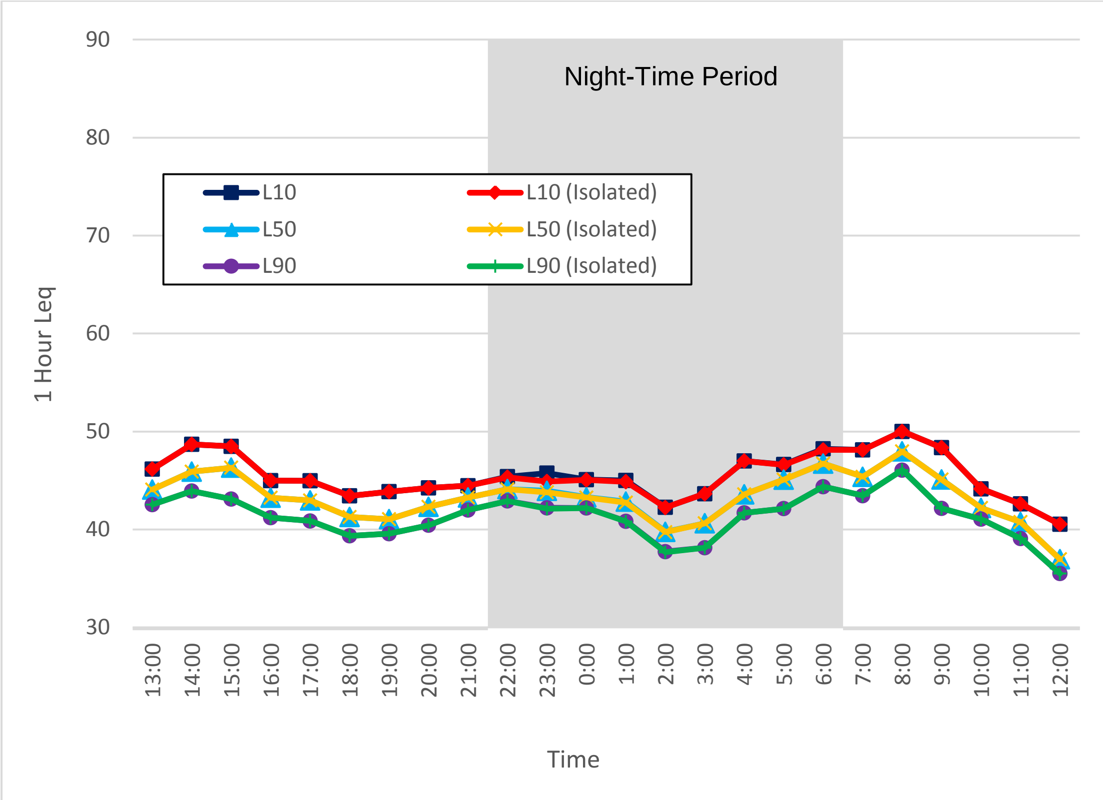


**Figure 66. Noise Monitor #8, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

Noise

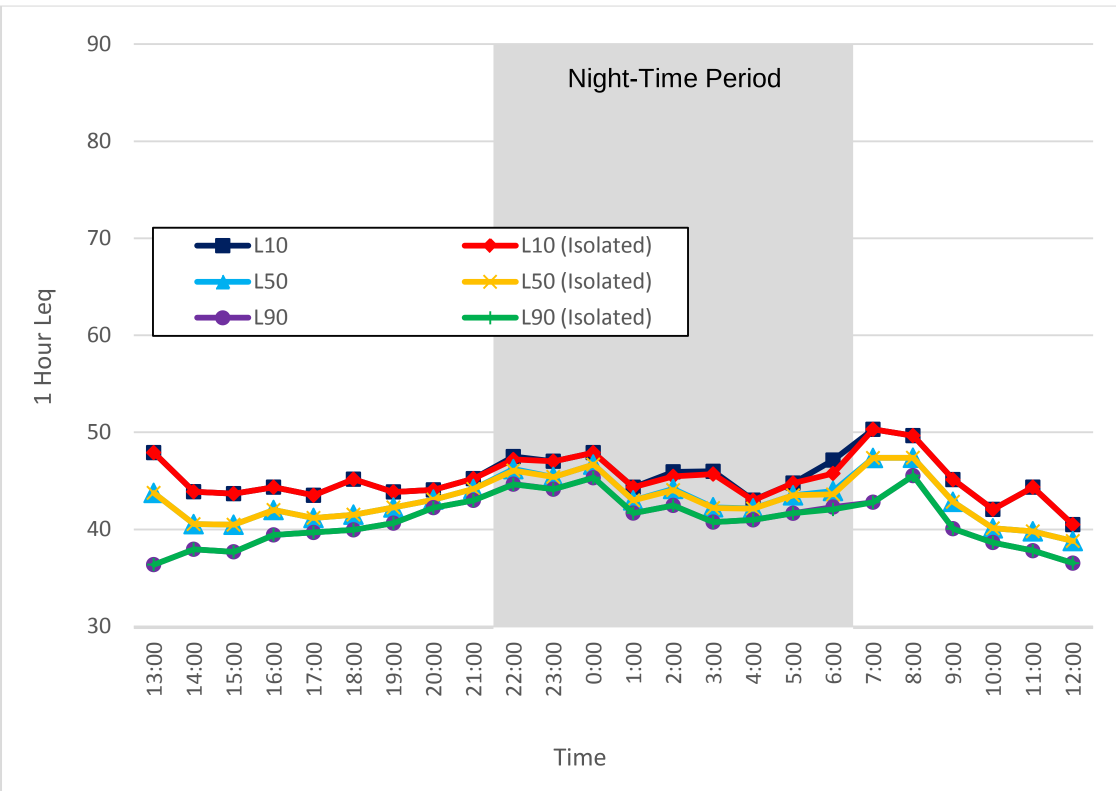


**Figure 67. Noise Monitor #8, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

Noise Monitor #8

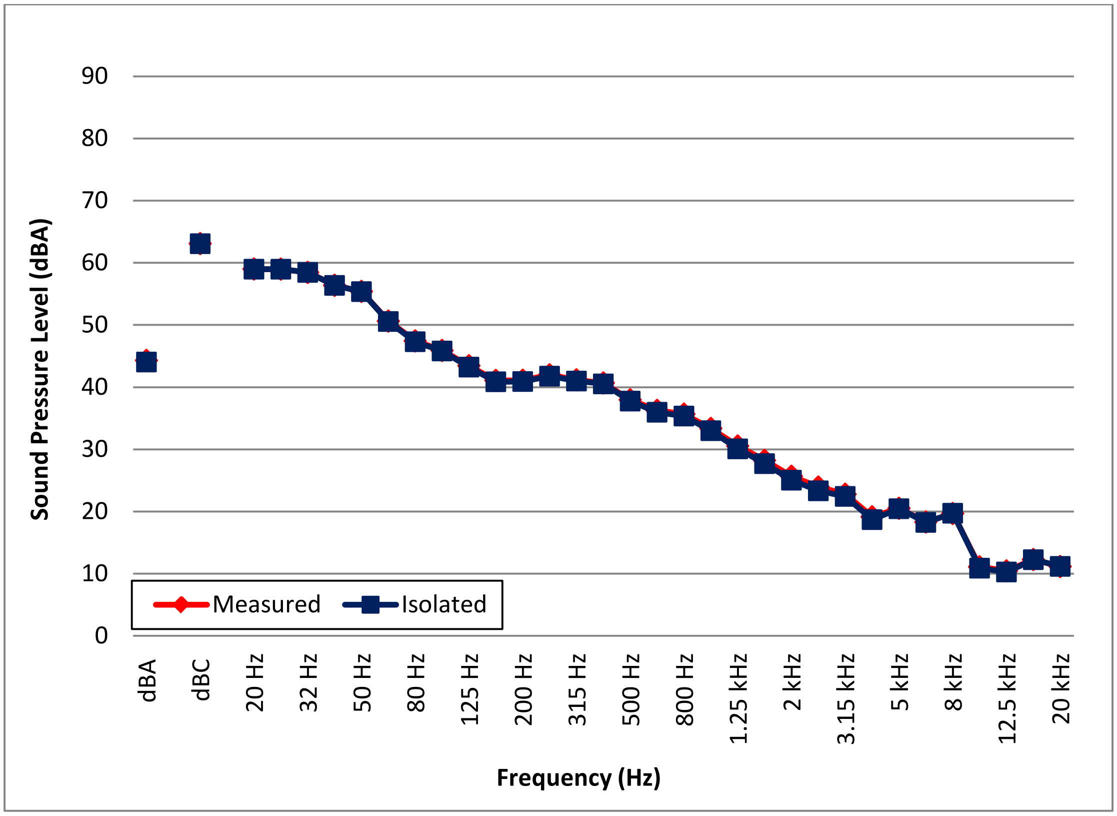


**Figure 68. Noise Monitor #8, 1/3 Octave $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

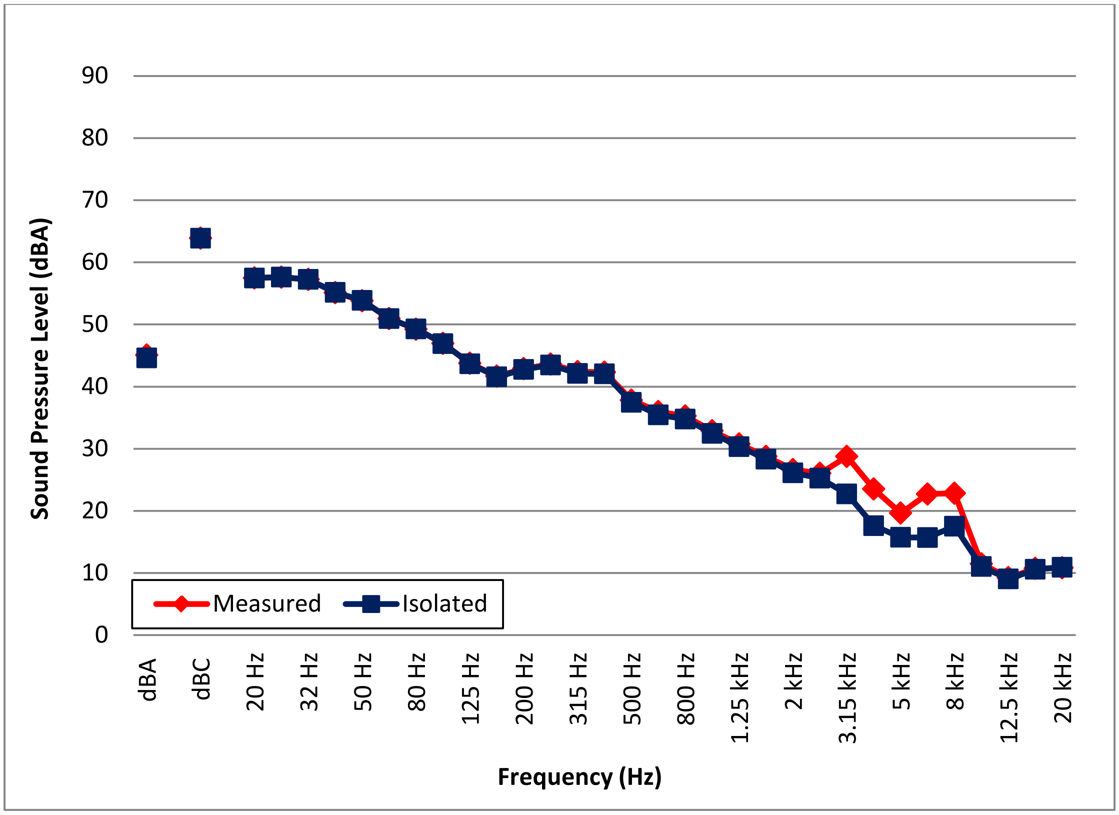


**Figure 69. Noise Monitor #8, 1/3 Octave $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

Noise Monitor #9

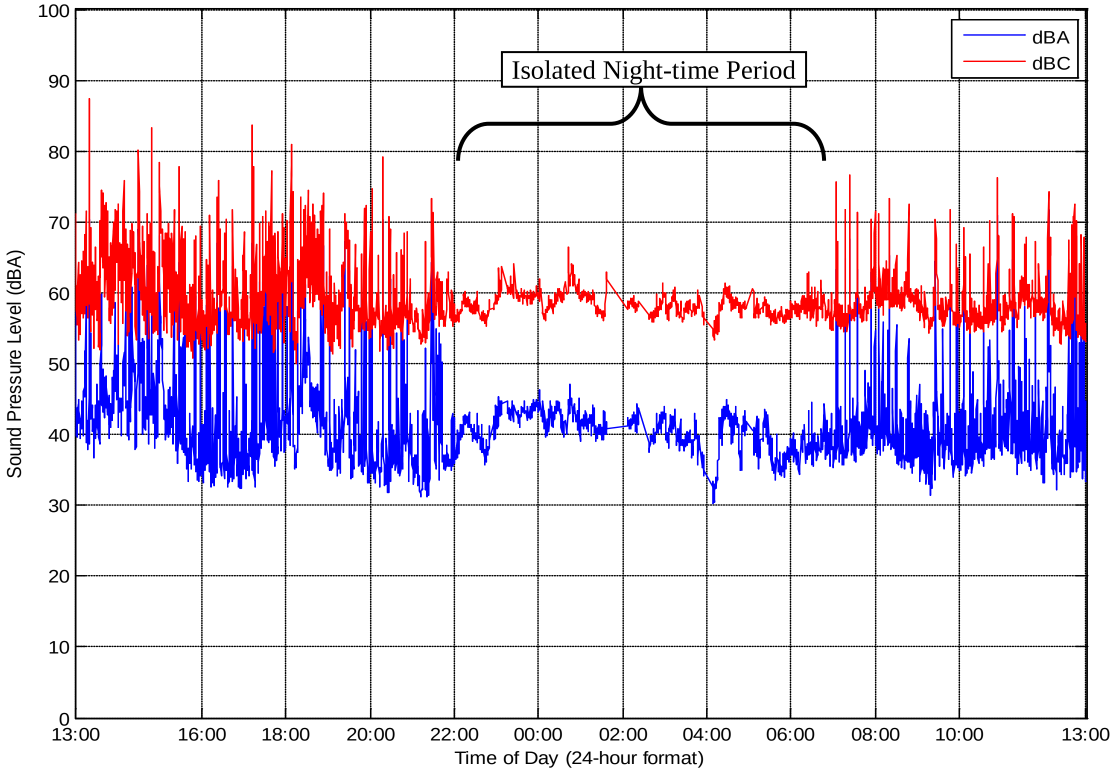


**Figure 70. Noise Monitor #9, 15-Second $L_{eq}$ Sound Levels (August 20 - 21, 2014)**

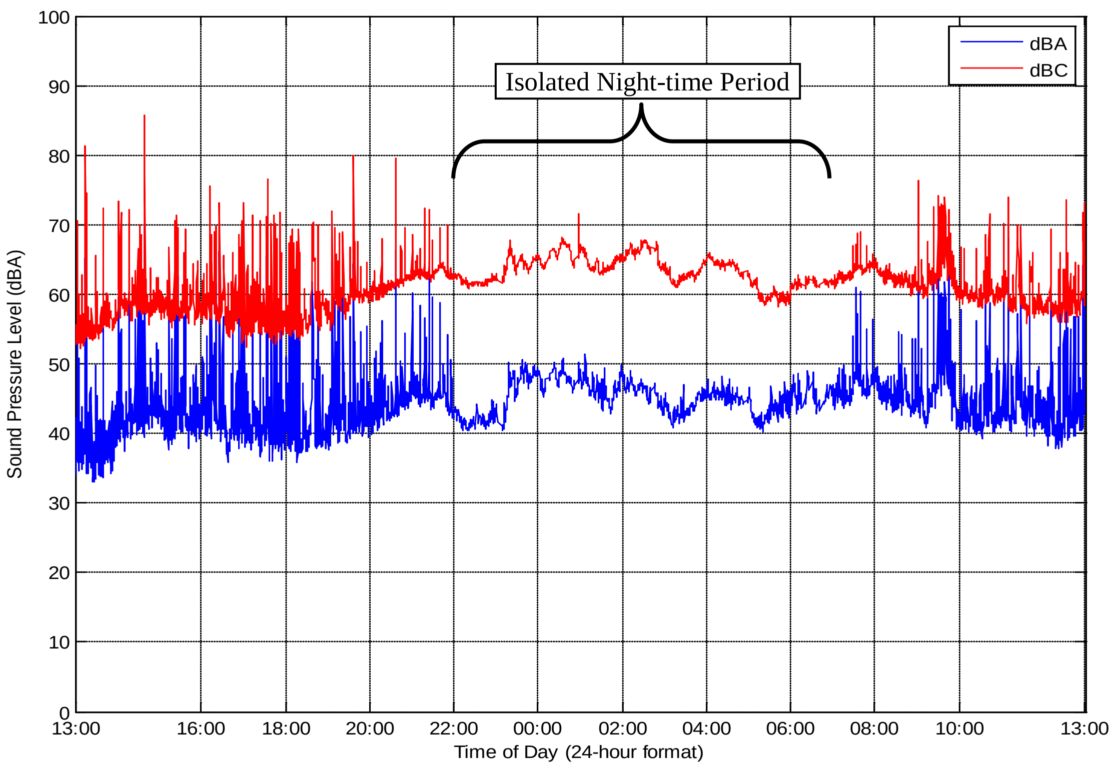


**Figure 71. Noise Monitor #9, 15-Second $L_{eq}$ Sound Levels (August 21 - 22, 2014)**

Noise Monitor #9

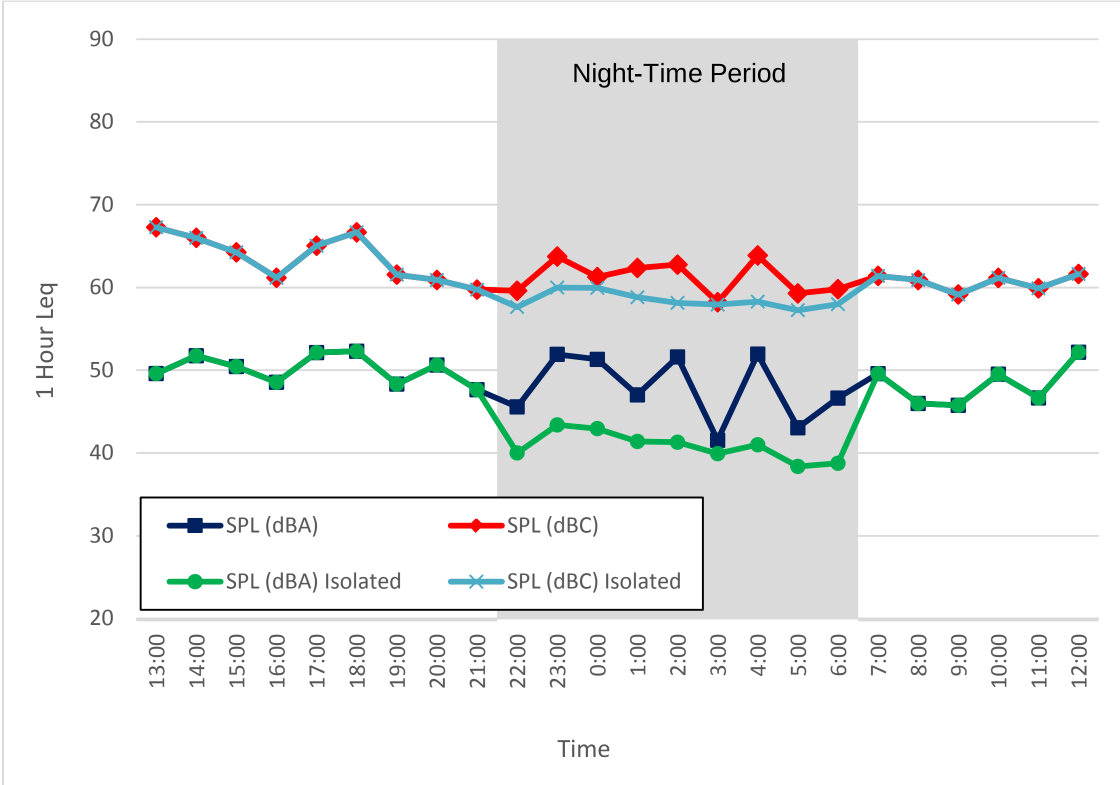


**Figure 72. Noise Monitor #9, 1-Hour $L_{eq}$ Sound Levels (August 20 - 21, 2014)**

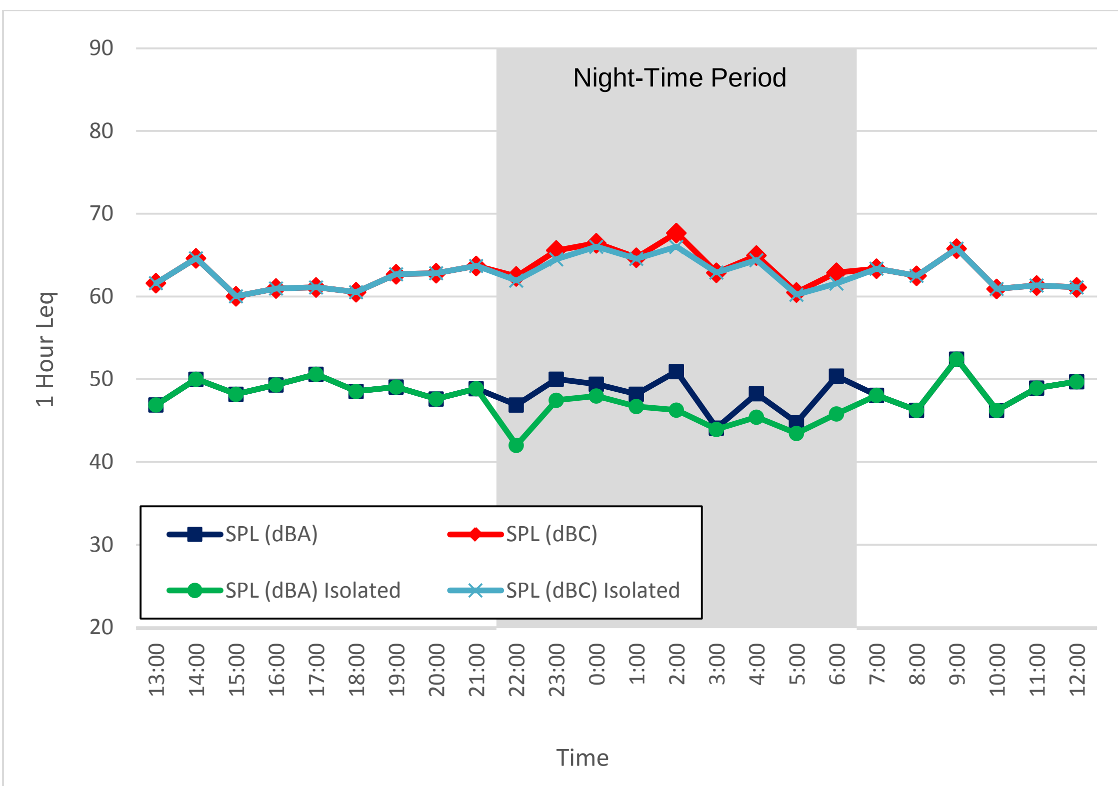


**Figure 73. Noise Monitor #9, 1-Hour $L_{eq}$ Sound Levels (August 21 - 22, 2014)**

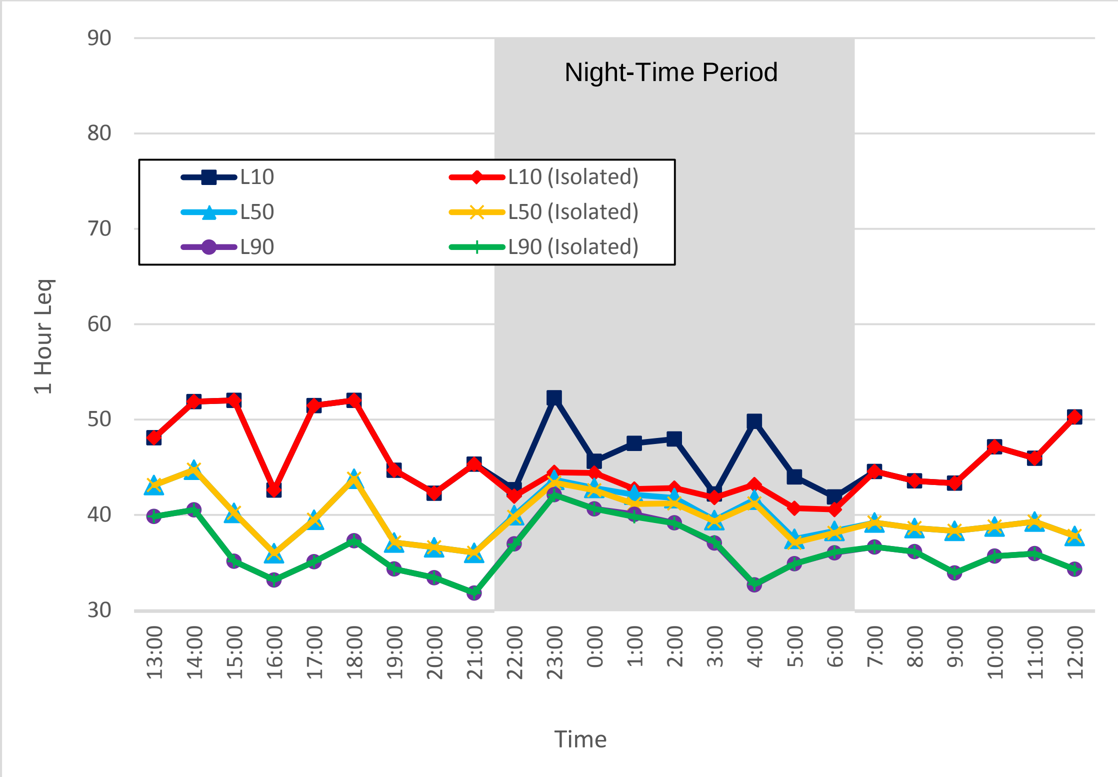


**Figure 74. Noise Monitor #9, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (August 20 - 21, 2014)**

Noise Monitor #9

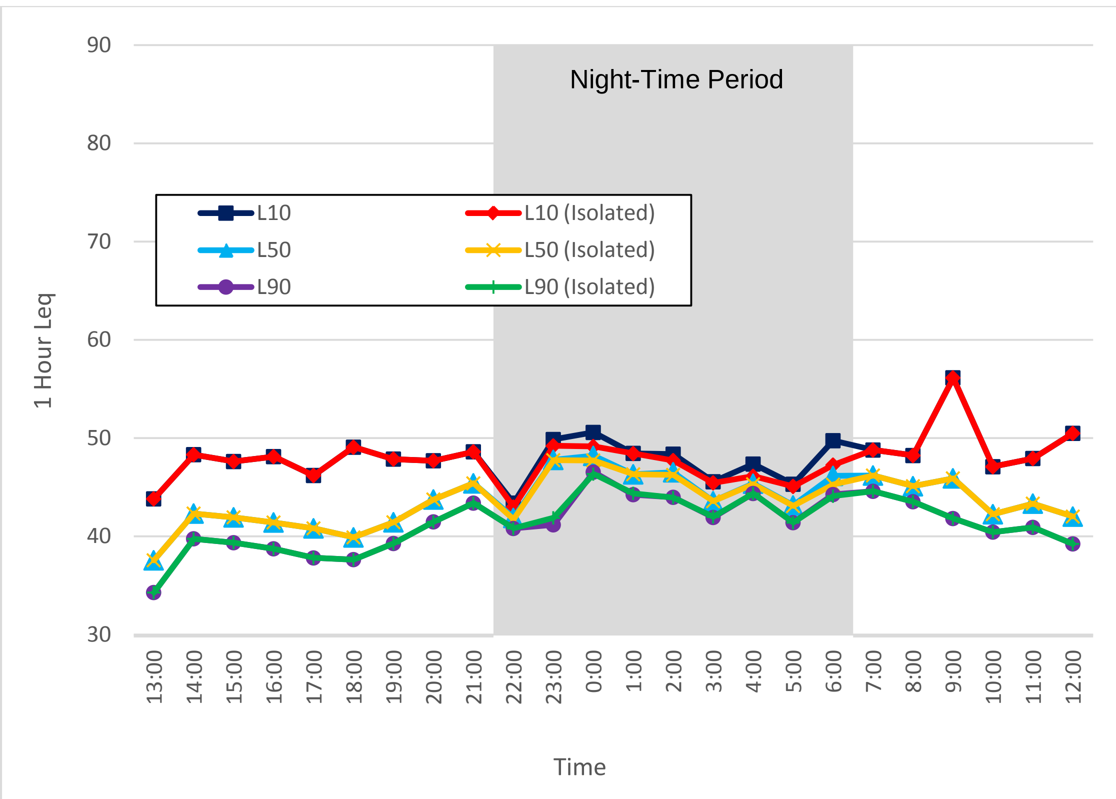


**Figure 75. Noise Monitor #9, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (August 21 - 22, 2014)**

Noise Monitor #9

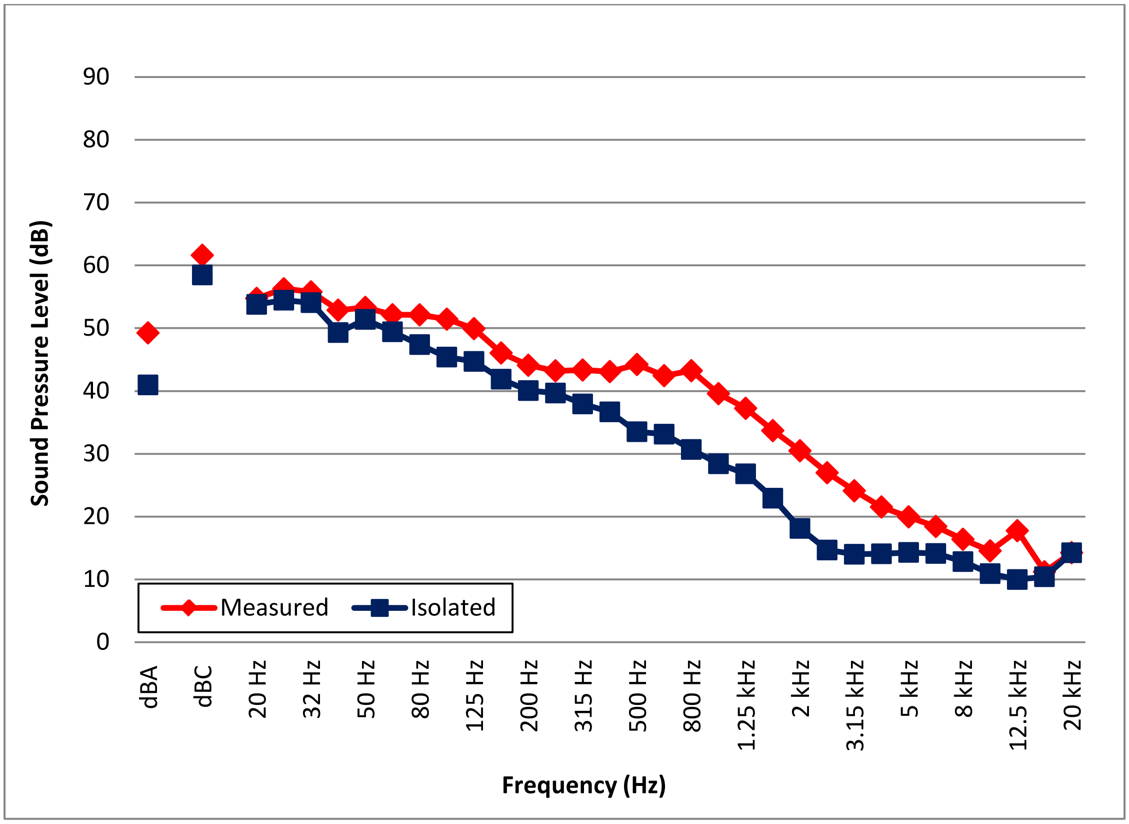


**Figure 76. Noise Monitor #9, 1/3 Octave $L_{eq}$ Sound Levels (August 20 - 21, 2014)**

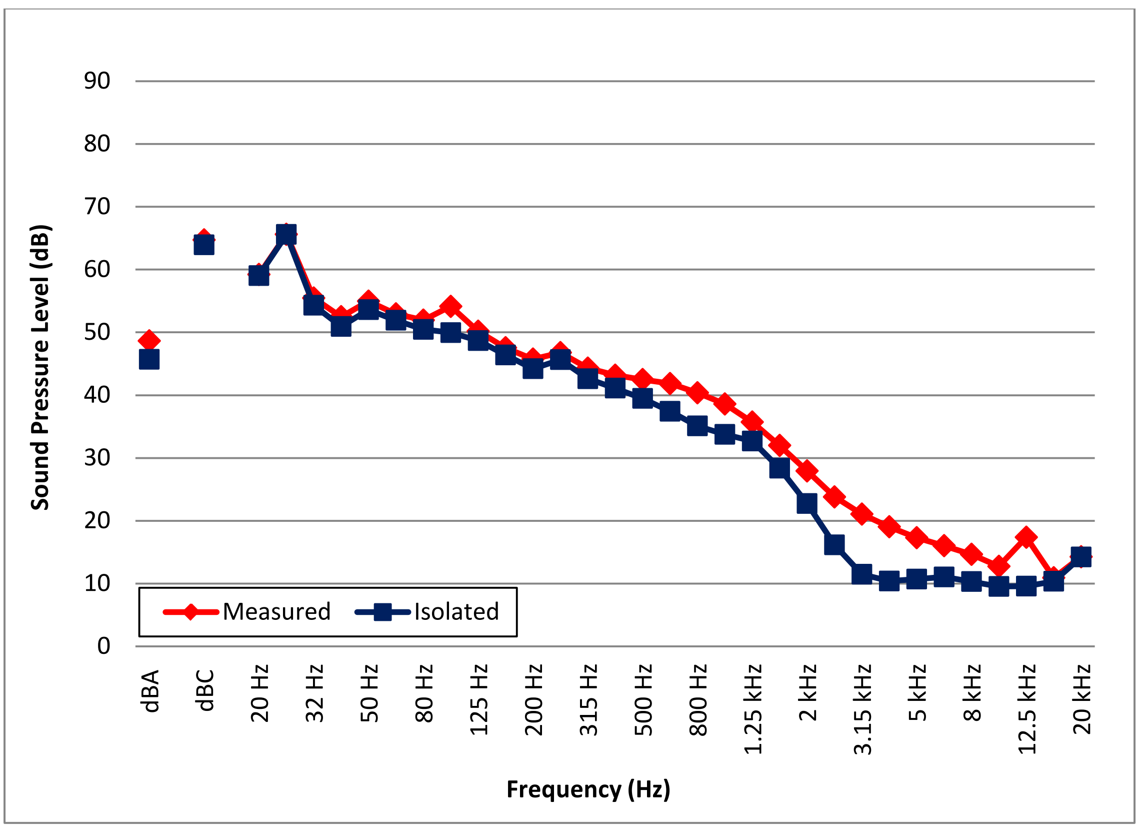


**Figure 77. Noise Monitor #9, 1/3 Octave $L_{eq}$ Sound Levels (August 21 - 22, 2014)**

Noise Monitor #10

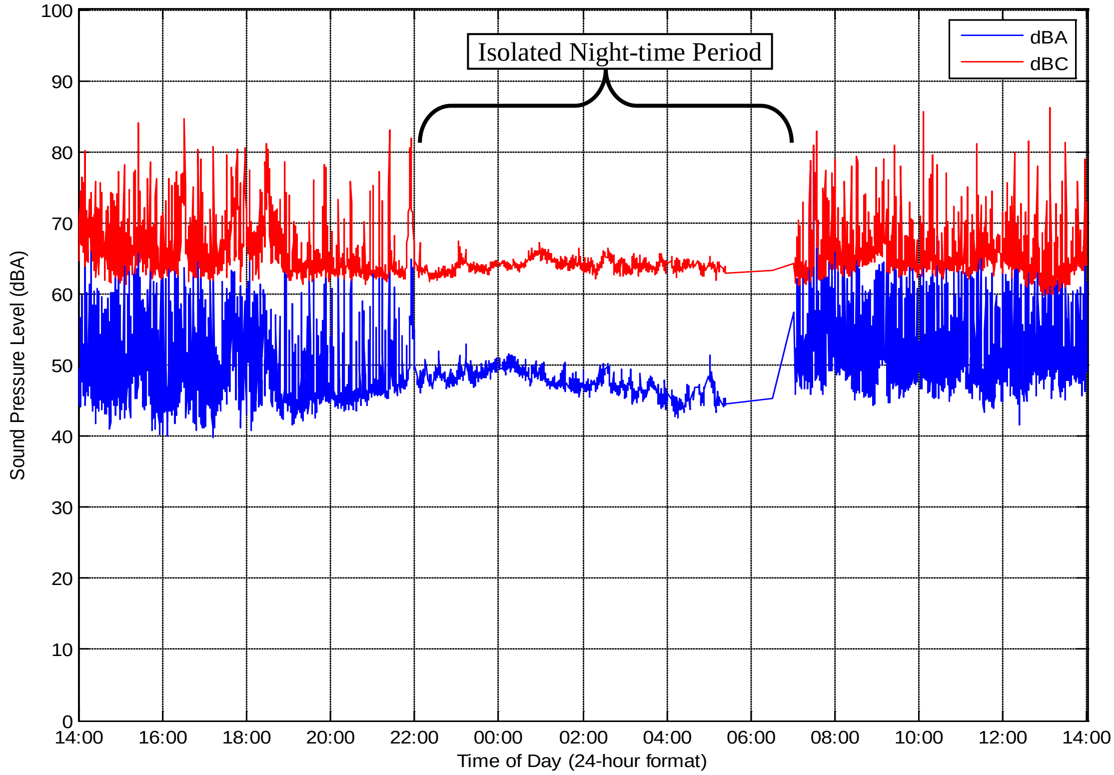


**Figure 78. Noise Monitor #10, 15-Second $L_{eq}$ Sound Levels (August 20 - 21, 2014)**

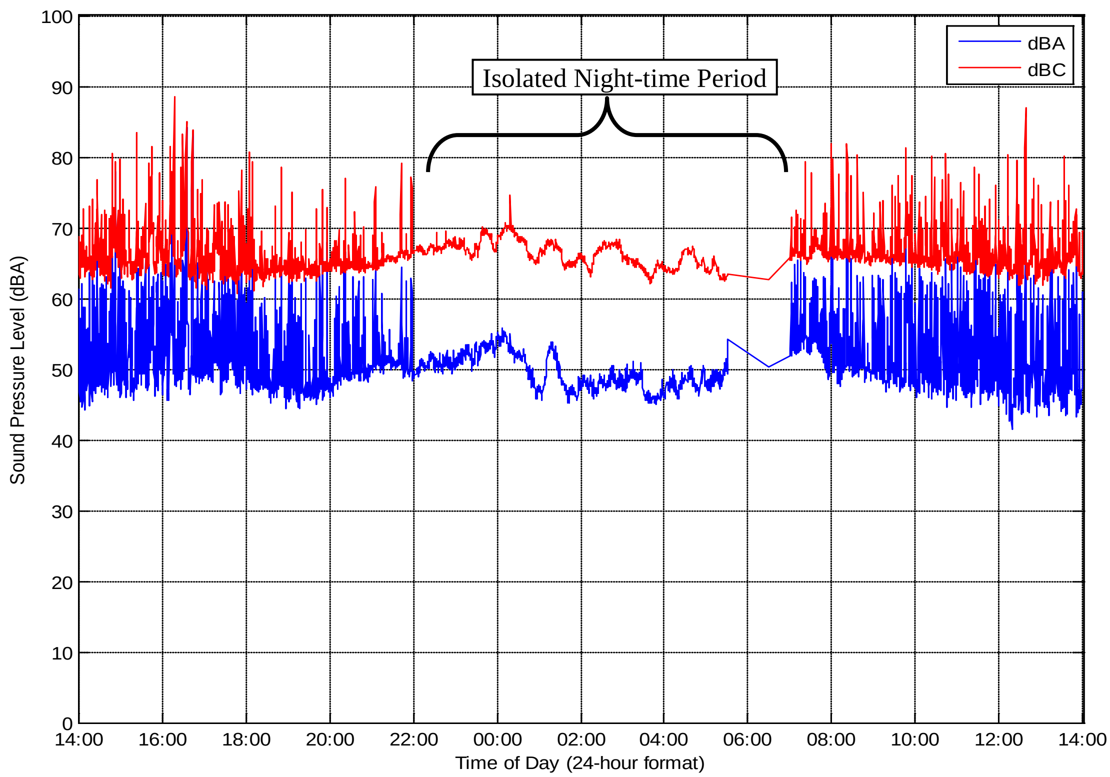


**Figure 79. Noise Monitor #10, 15-Second $L_{eq}$ Sound Levels (August 21 - 22, 2014)**

Noise Monitor #10

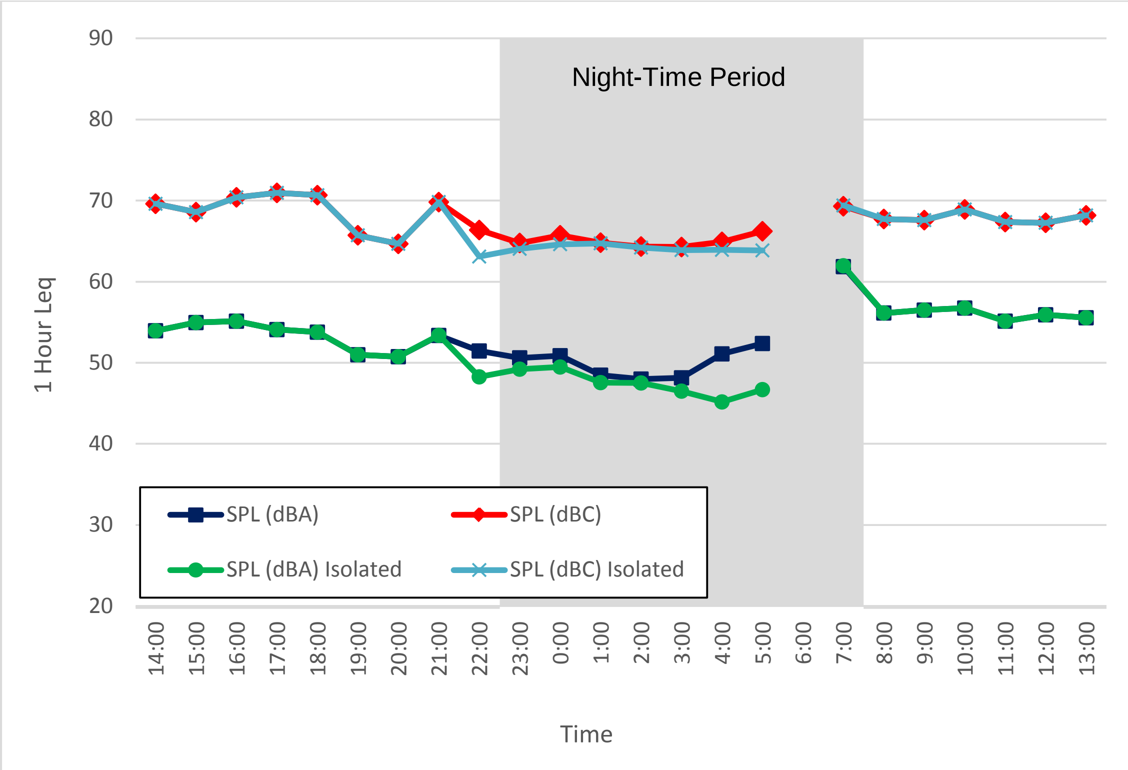


**Figure 80. Noise Monitor #10, 1-Hour $L_{eq}$ Sound Levels (August 20 - 21, 2014)** [1]

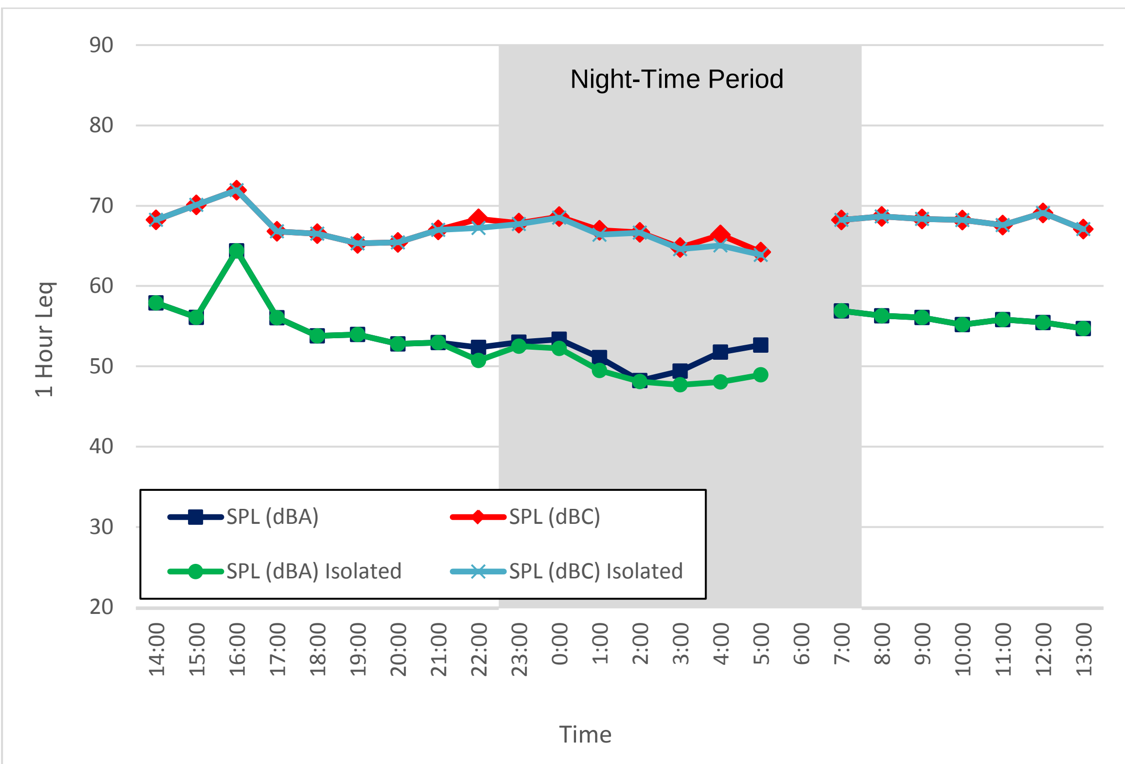


**Figure 81. Noise Monitor #10, 1-Hour $L_{eq}$ Sound Levels (August 21 - 22, 2014)** [1]

[1] Again, it should be noted that data from 06:00 to 07:00 was entirely removed due to traffic along the adjacent road.

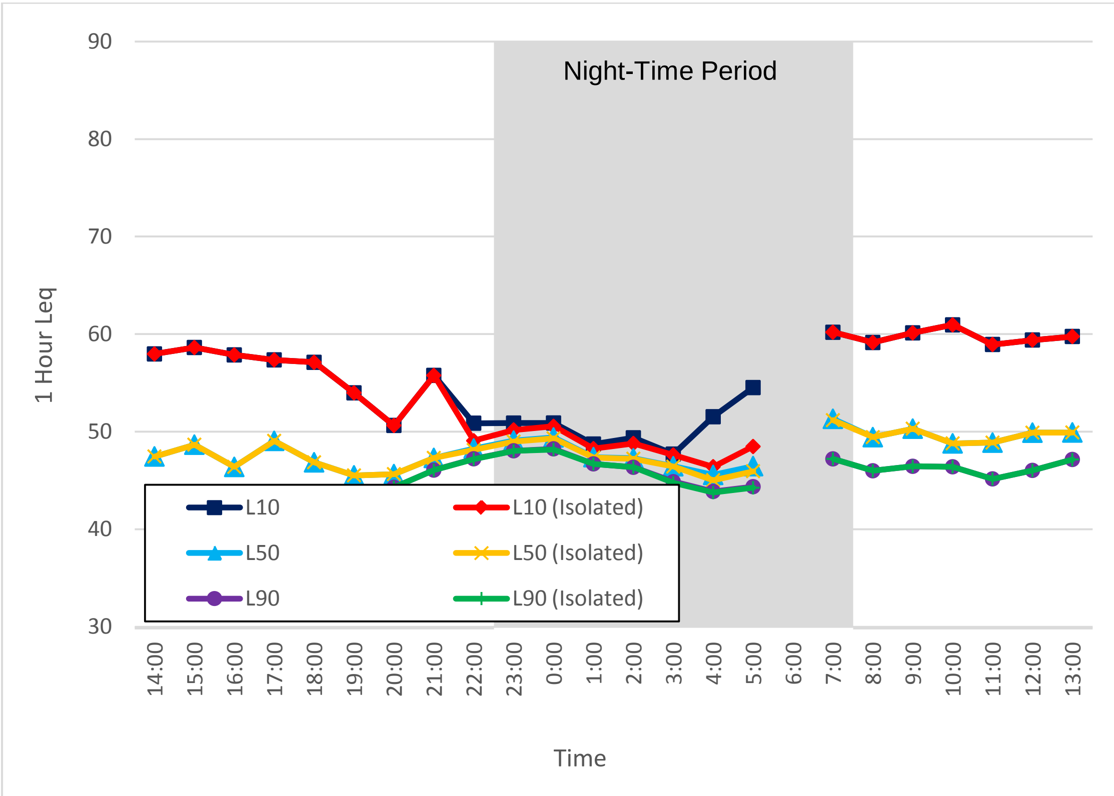


**Figure 82. Noise Monitor #10, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (August 20 - 21, 2014)** [1]

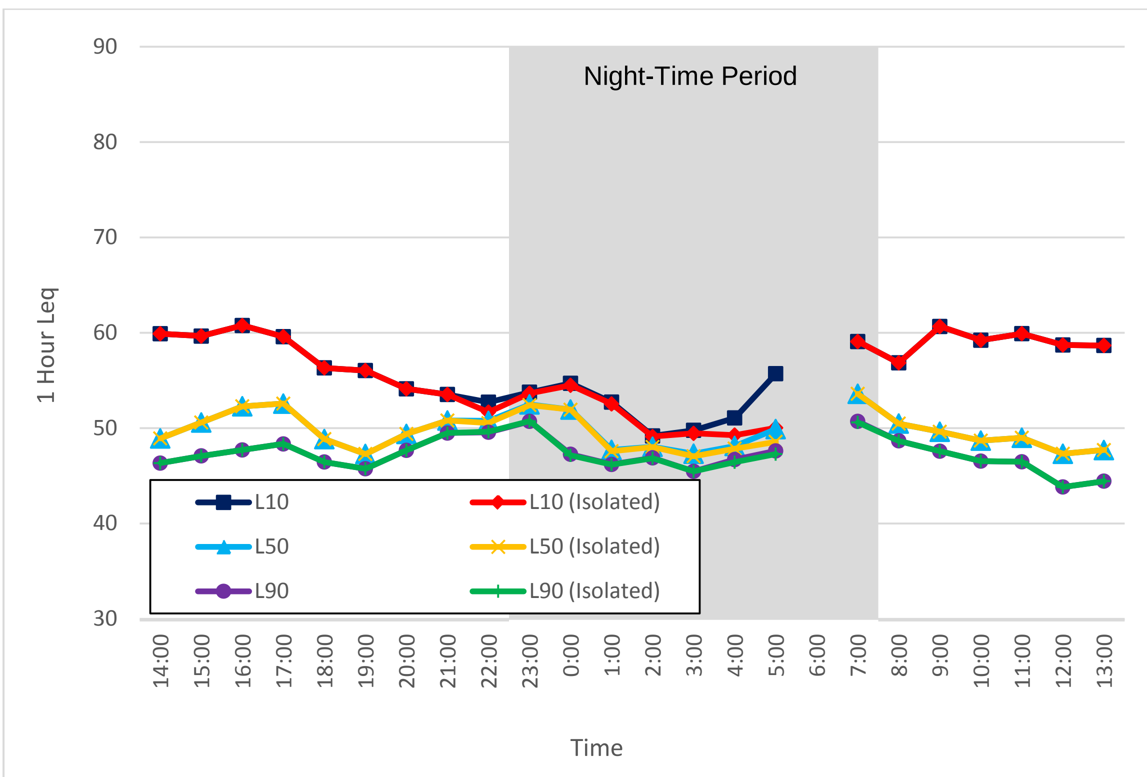


**Figure 83. Noise Monitor #10, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (August 21 - 22, 2014)** [1]

[1] Again, it should be noted that data from 06:00 to 07:00 was entirely removed due to traffic along the adjacent road.

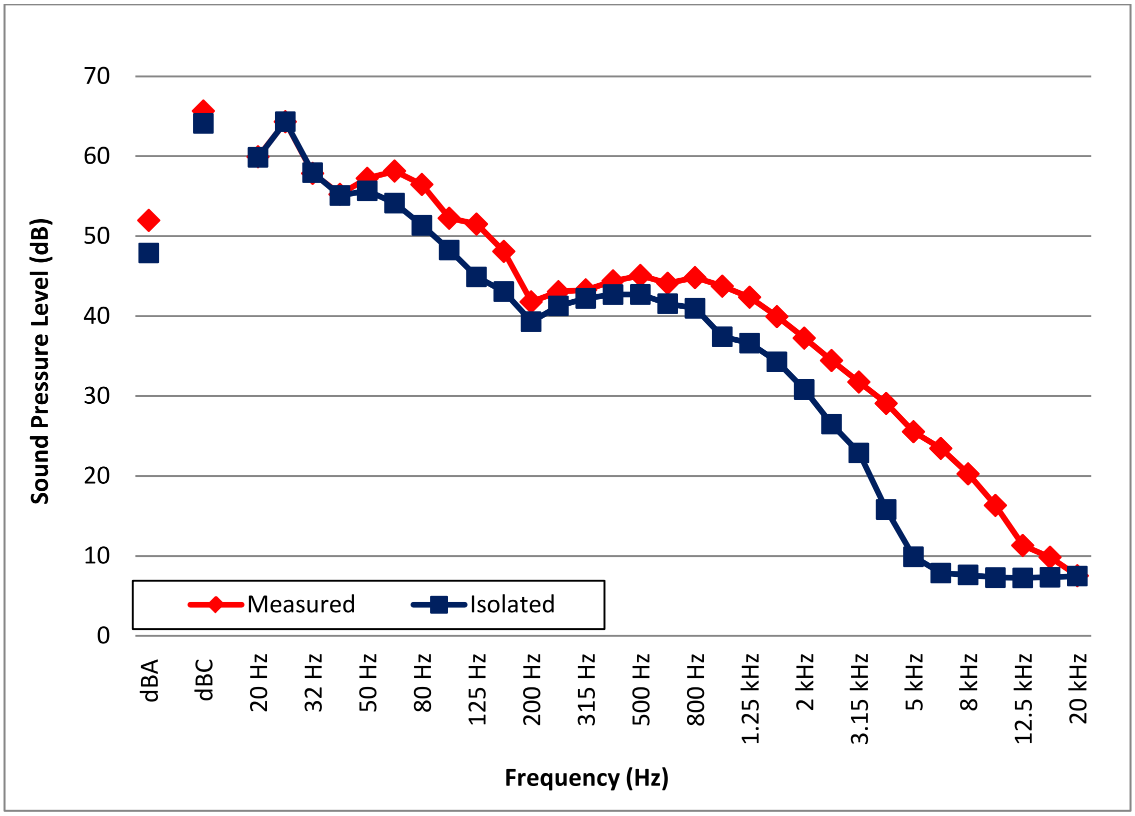


**Figure 84. Noise Monitor #10, 1/3 Octave $L_{eq}$ Sound Levels (August 20 - 21, 2014)**

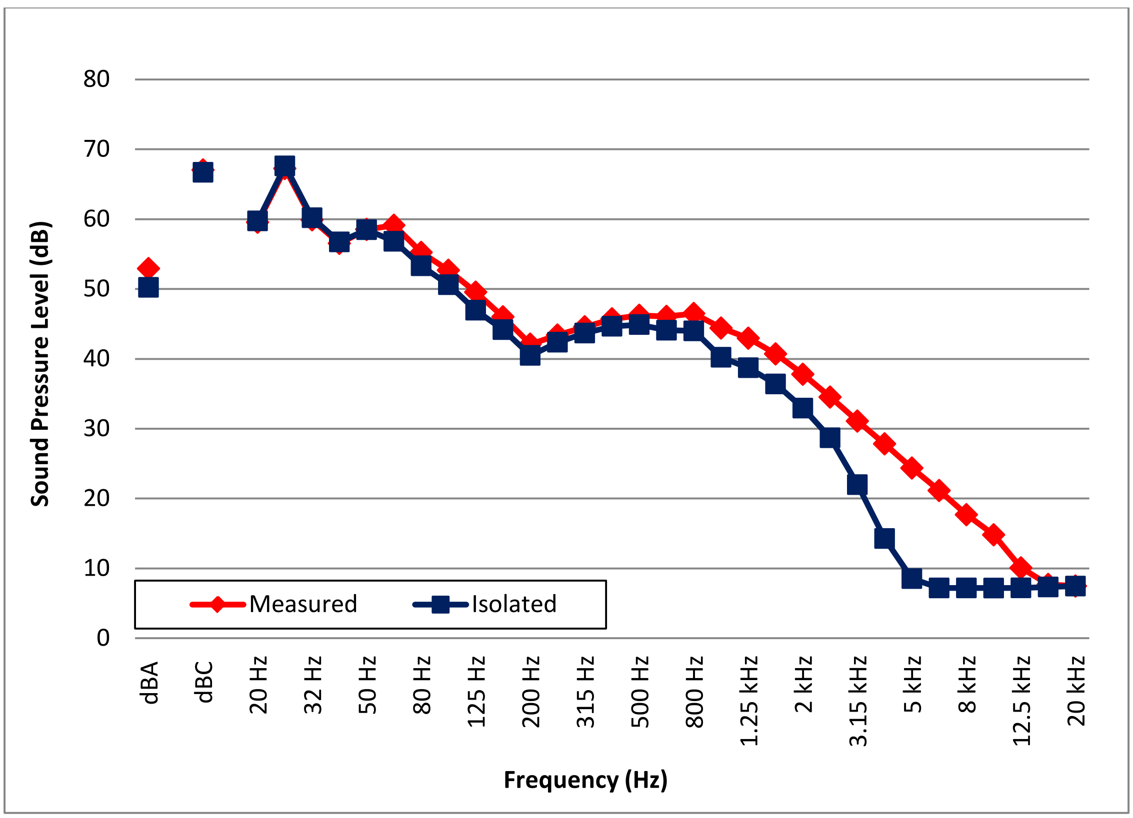


**Figure 85. Noise Monitor #10, 1/3 Octave $L_{eq}$ Sound Levels (August 21 - 22, 2014)**

Noise Monitor #11

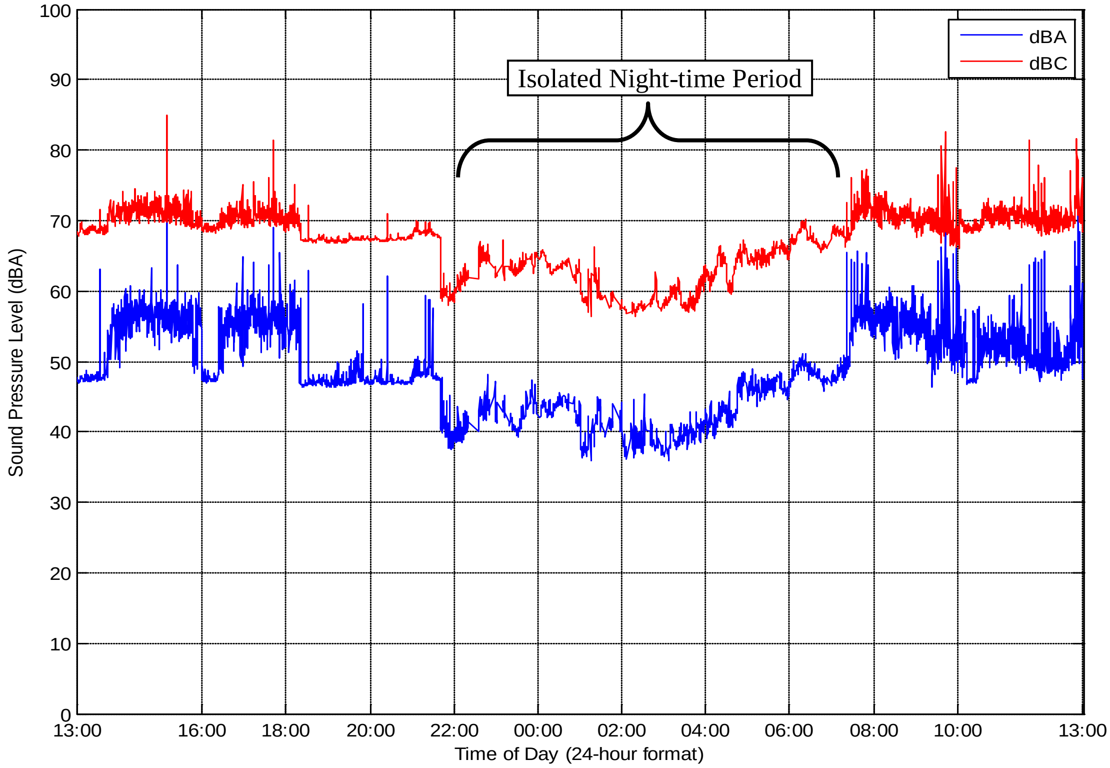


**Figure 86. Noise Monitor #11, 15-Second $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

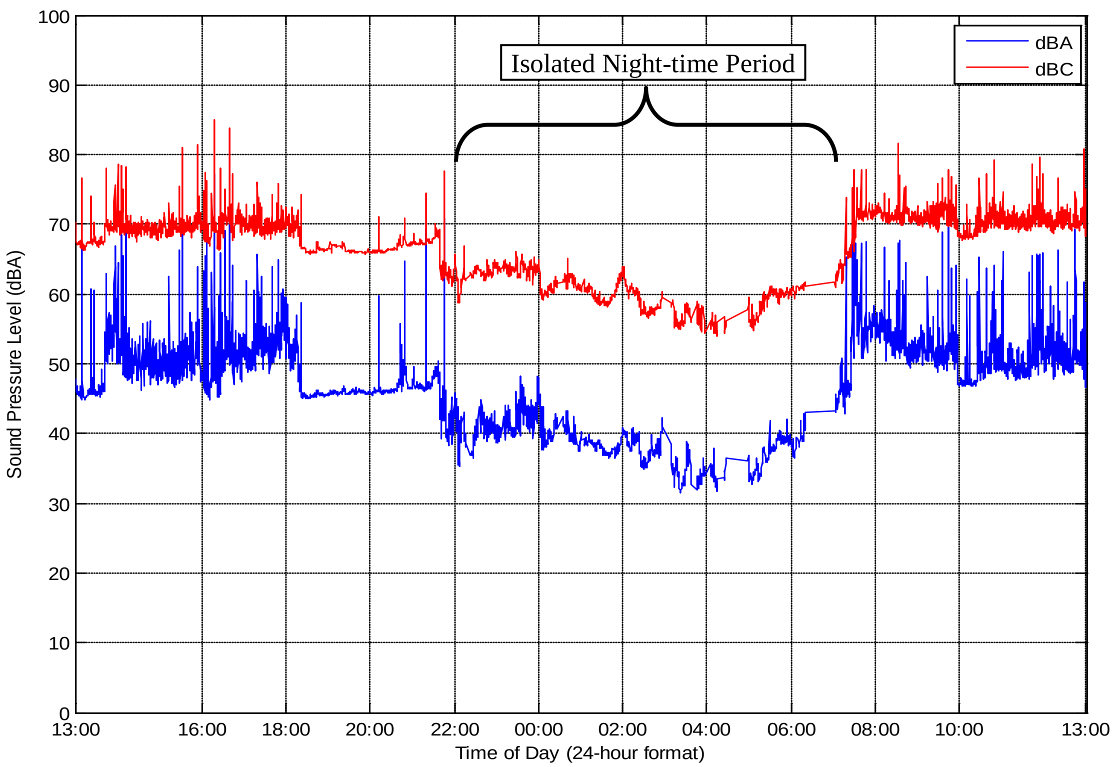


**Figure 87. Noise Monitor #11, 15-Second $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

Noise Monitor #11

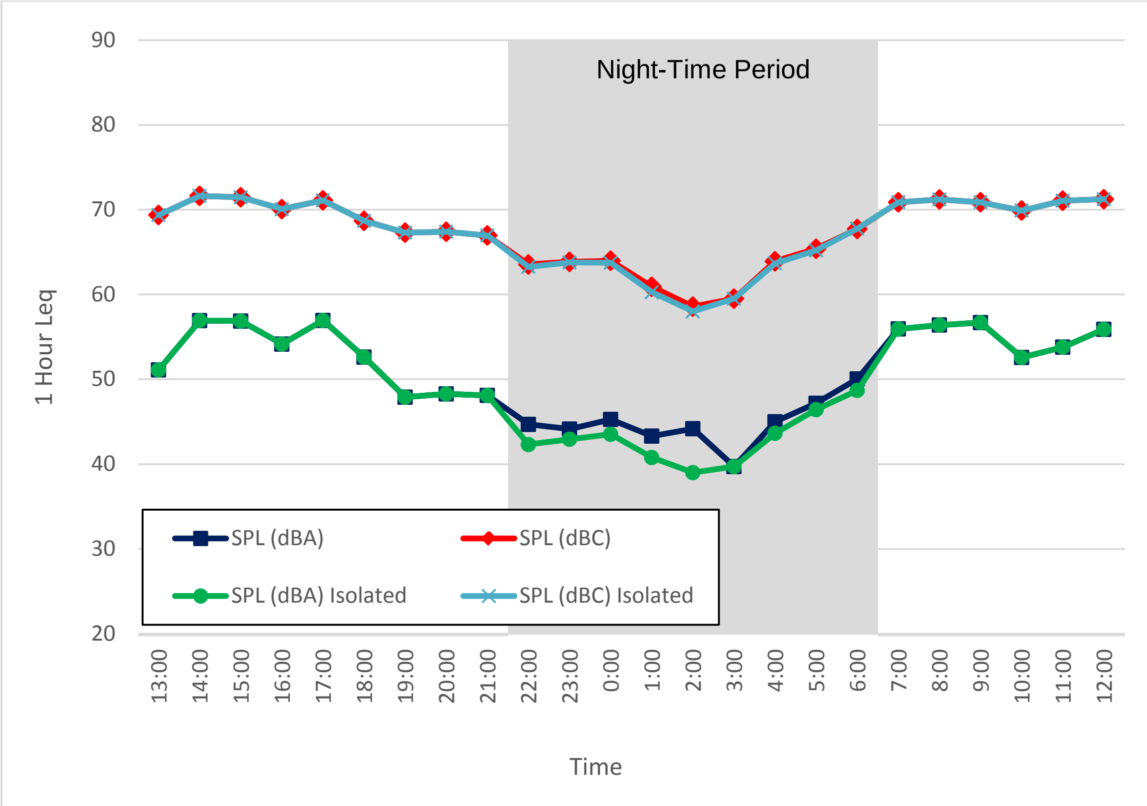


**Figure 88. Noise Monitor #11, 1-Hour $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

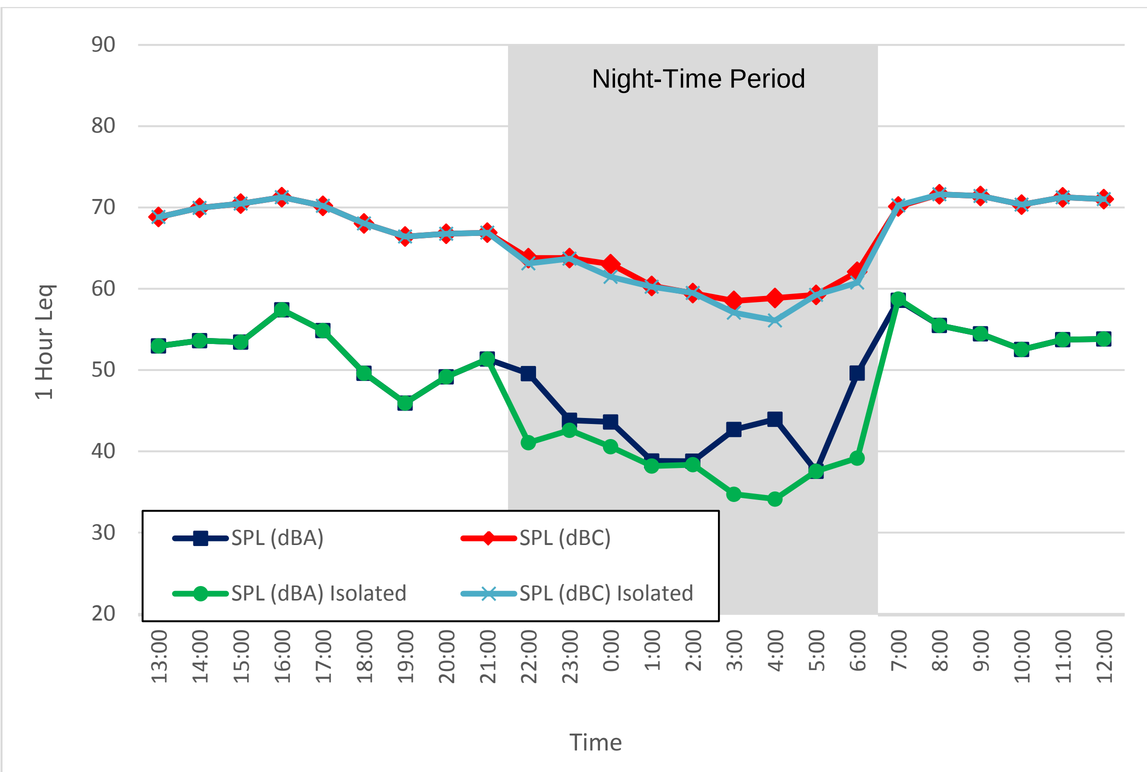


**Figure 89. Noise Monitor #11, 1-Hour $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

Noise Monitor #11

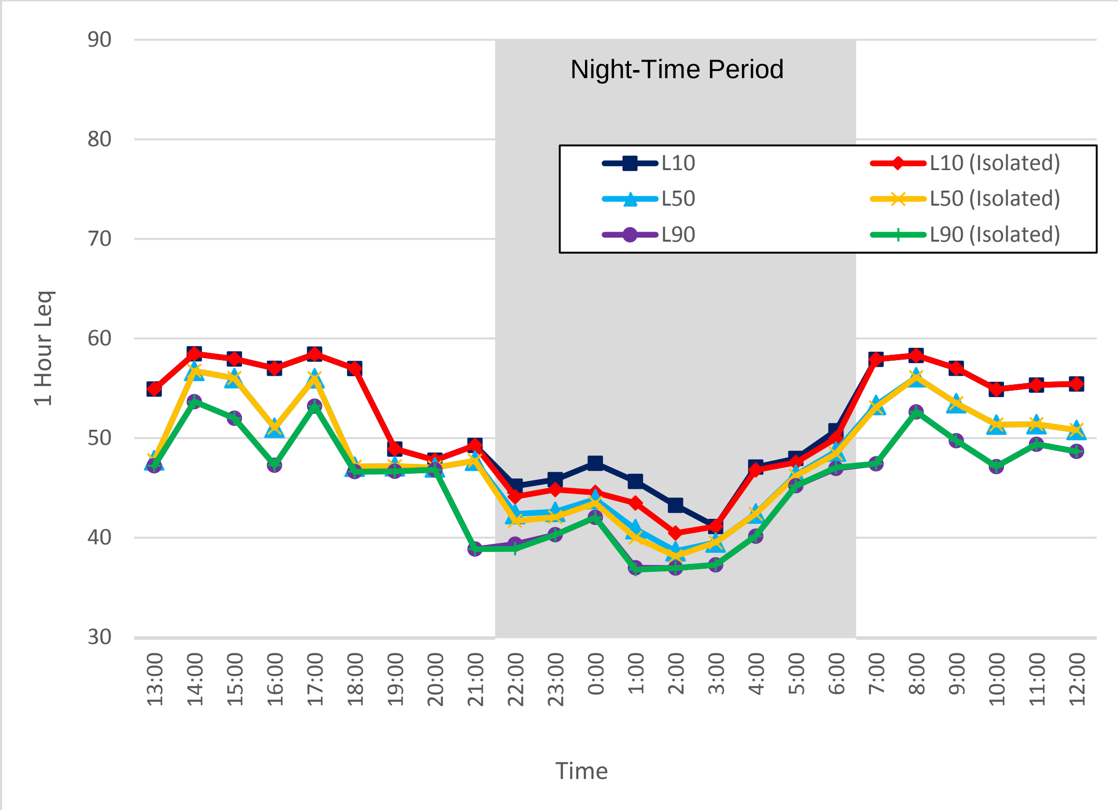


**Figure 90. Noise Monitor #11, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

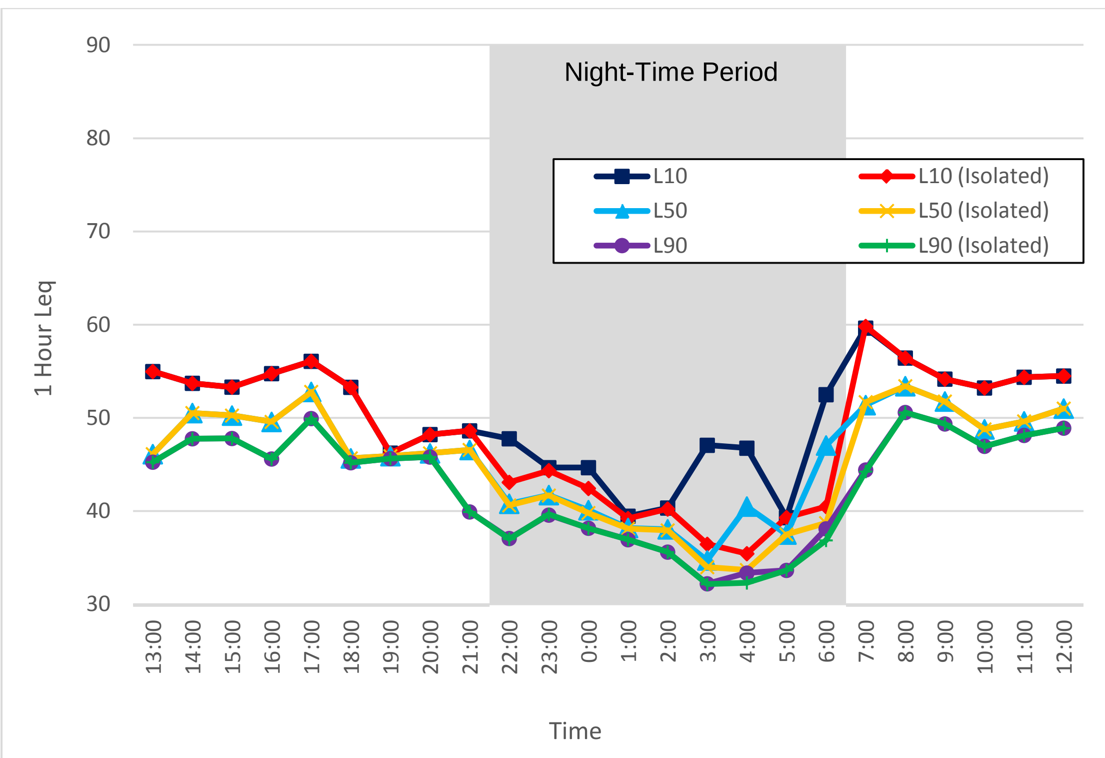


**Figure 91. Noise Monitor #11, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

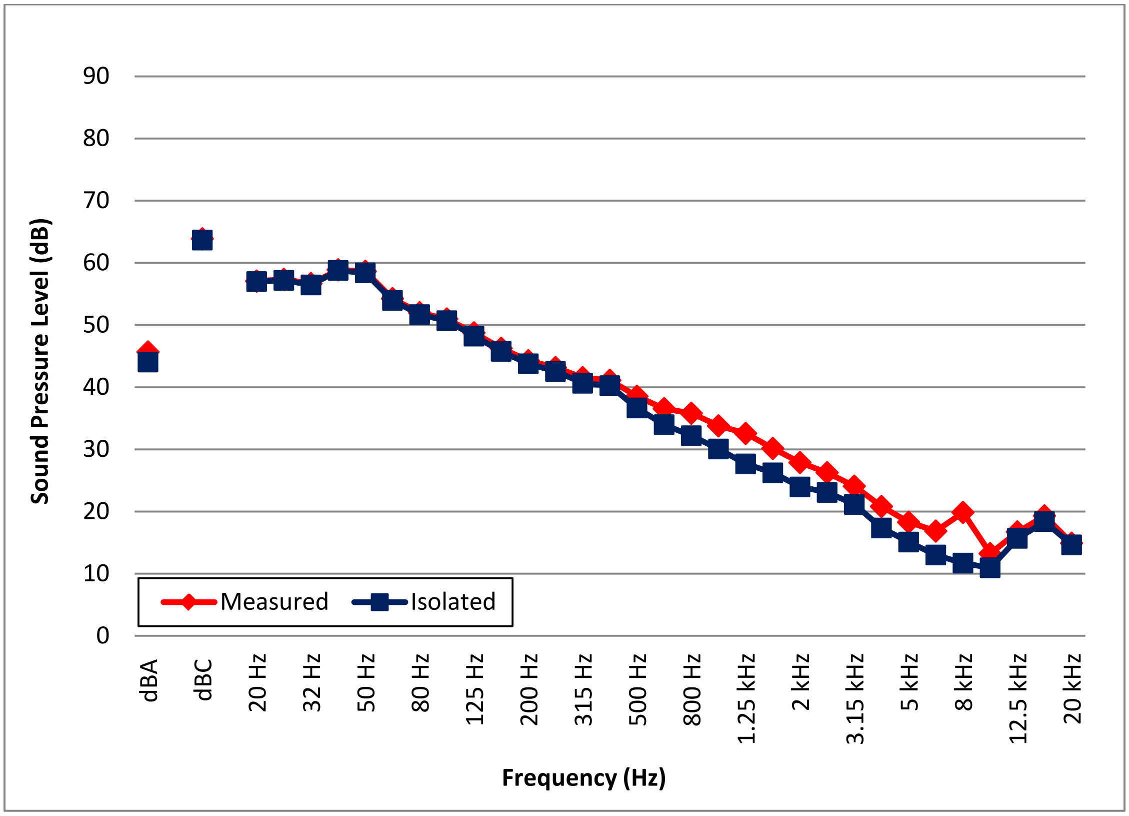


**Figure 92. Noise Monitor #11, 1/3 Octave $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

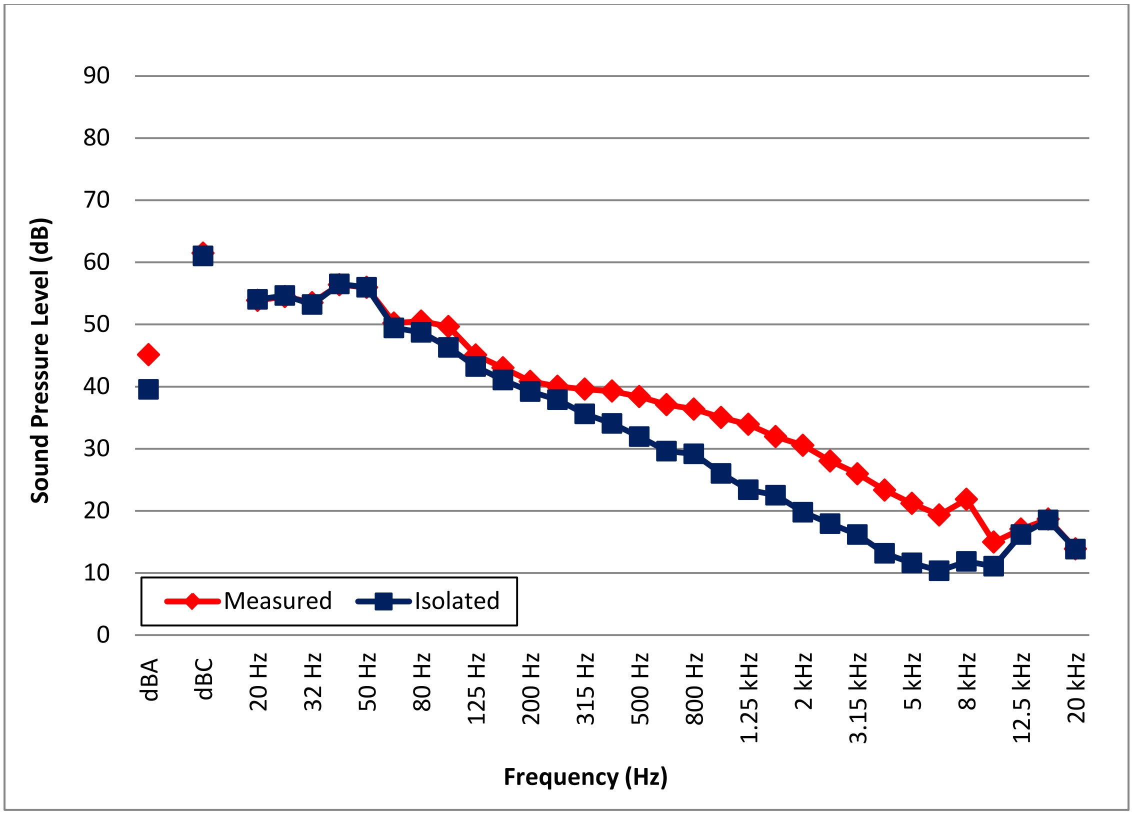


**Figure 93. Noise Monitor #11, 1/3 Octave $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

Noise Monitor #12

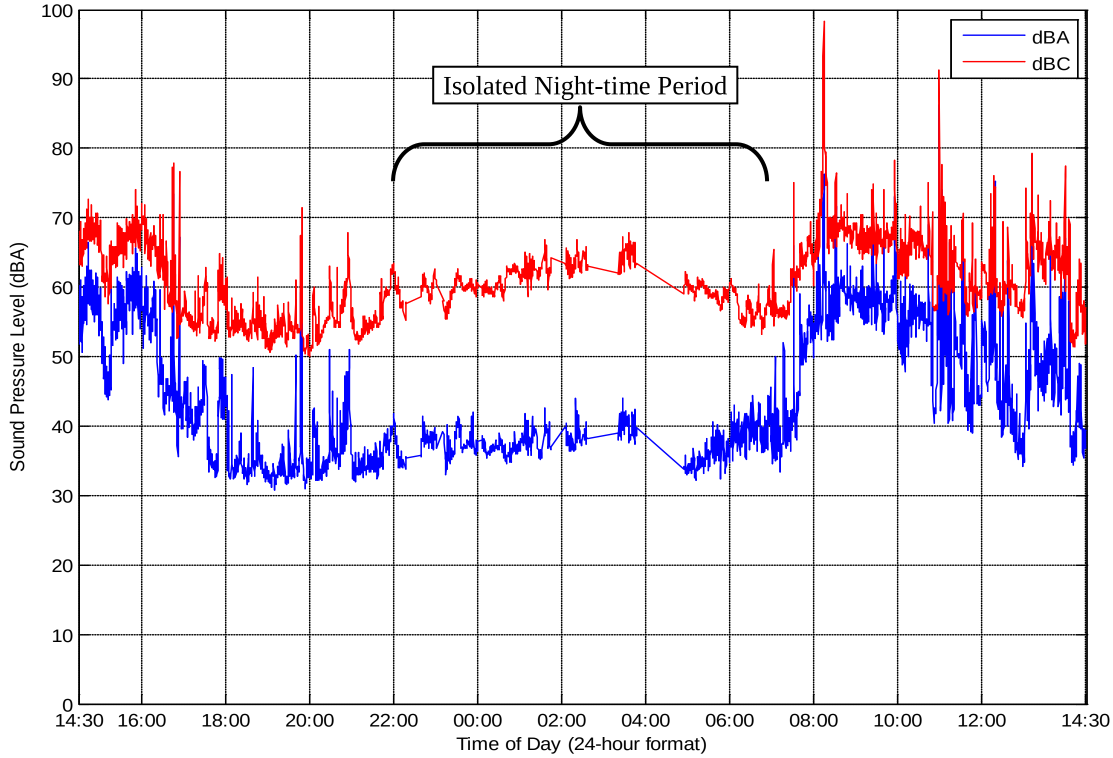


**Figure 94. Noise Monitor #12, 15-Second $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

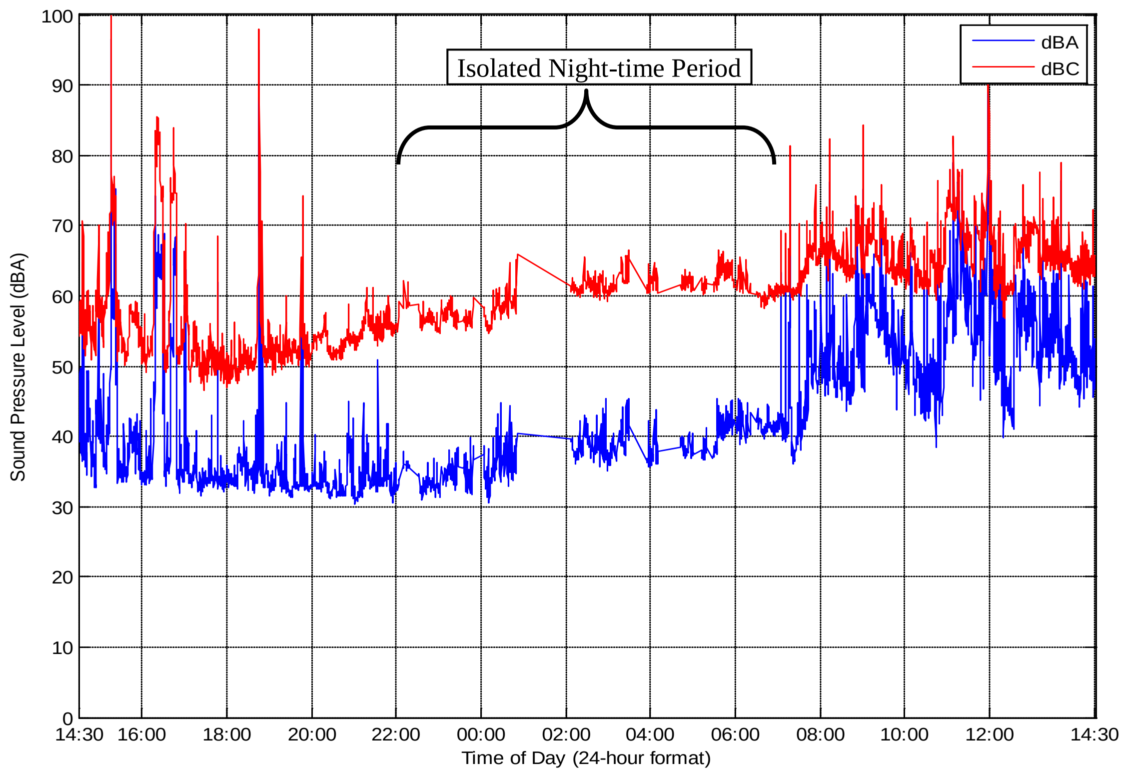


**Figure 95. Noise Monitor #12, 15-Second $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

Noise Monitor #12

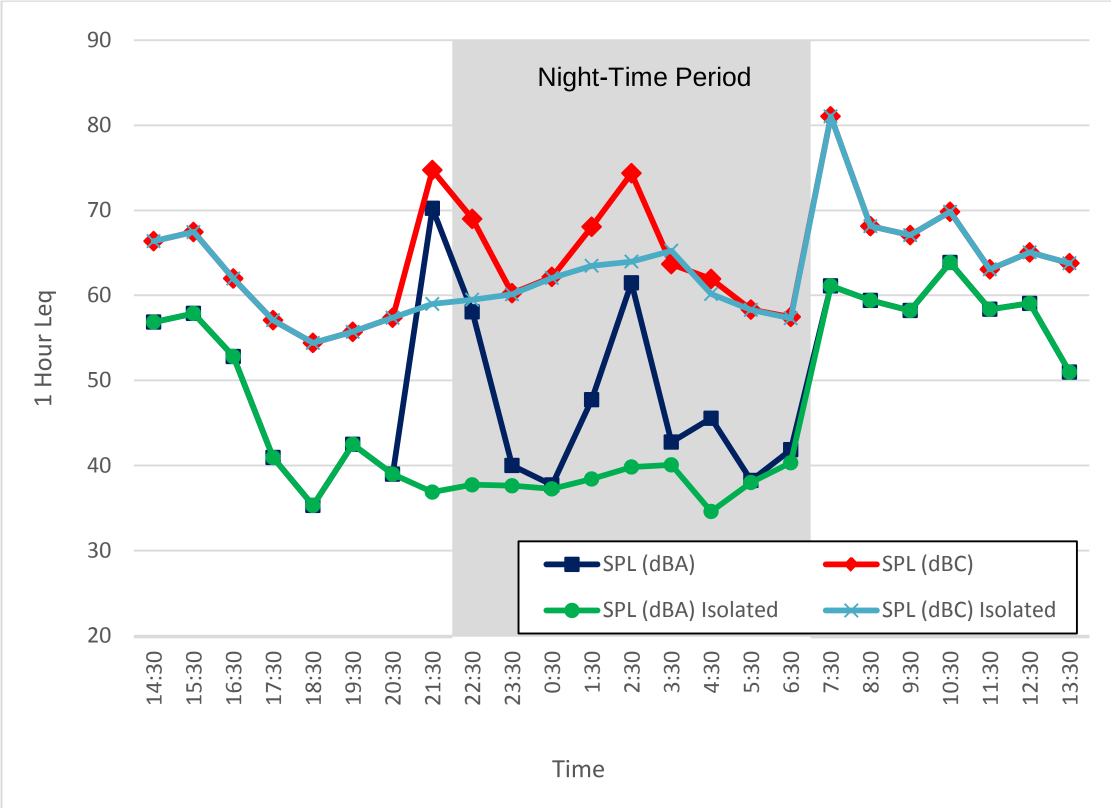


**Figure 96. Noise Monitor #12, 1-Hour $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

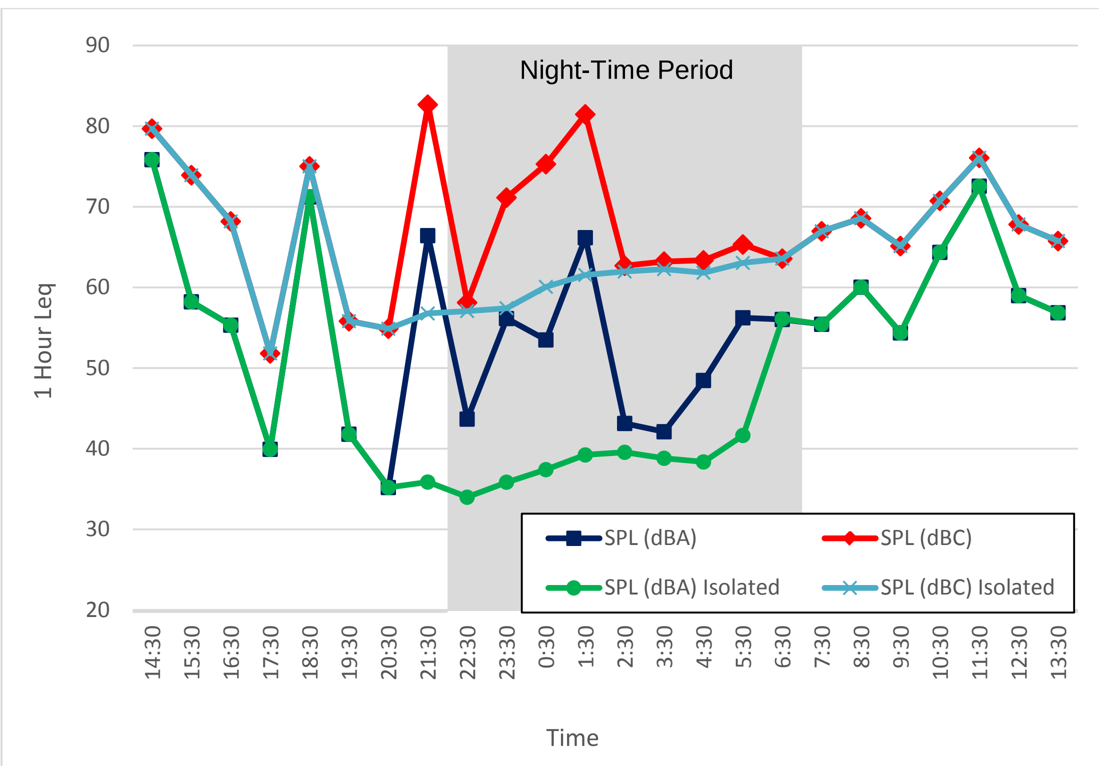


**Figure 97. Noise Monitor #12, 1-Hour $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

Noise Monitor #12

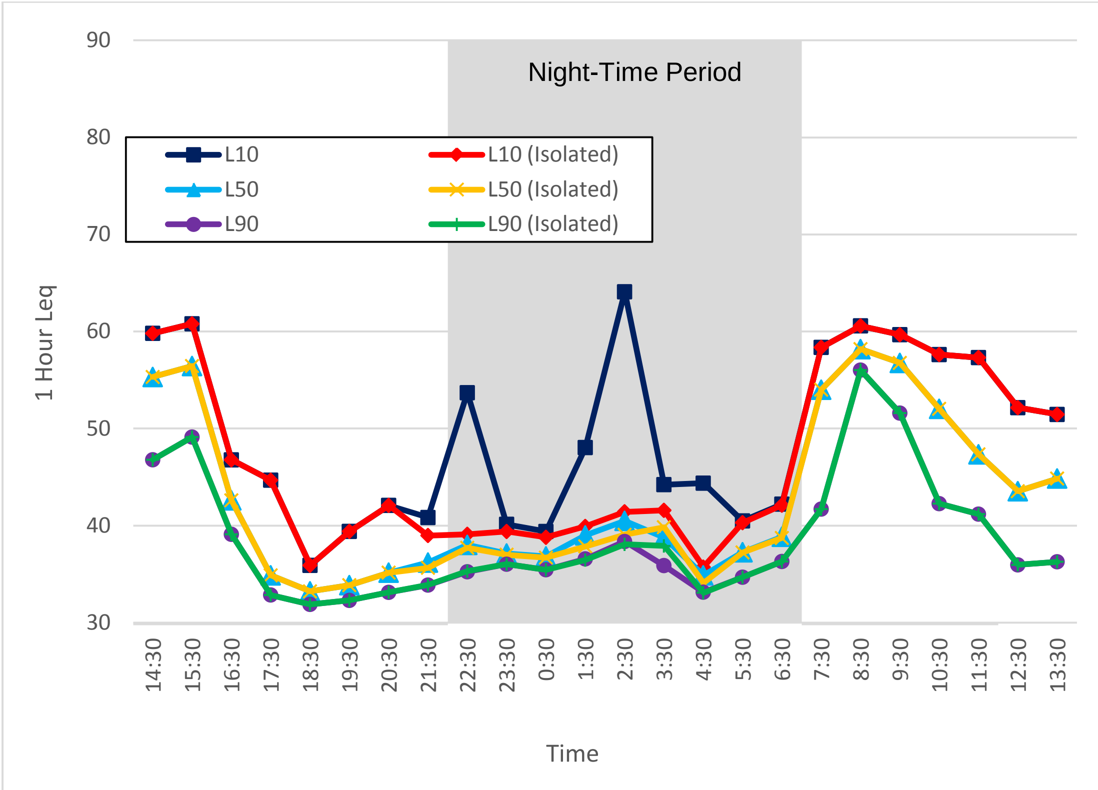


**Figure 98. Noise Monitor #12, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

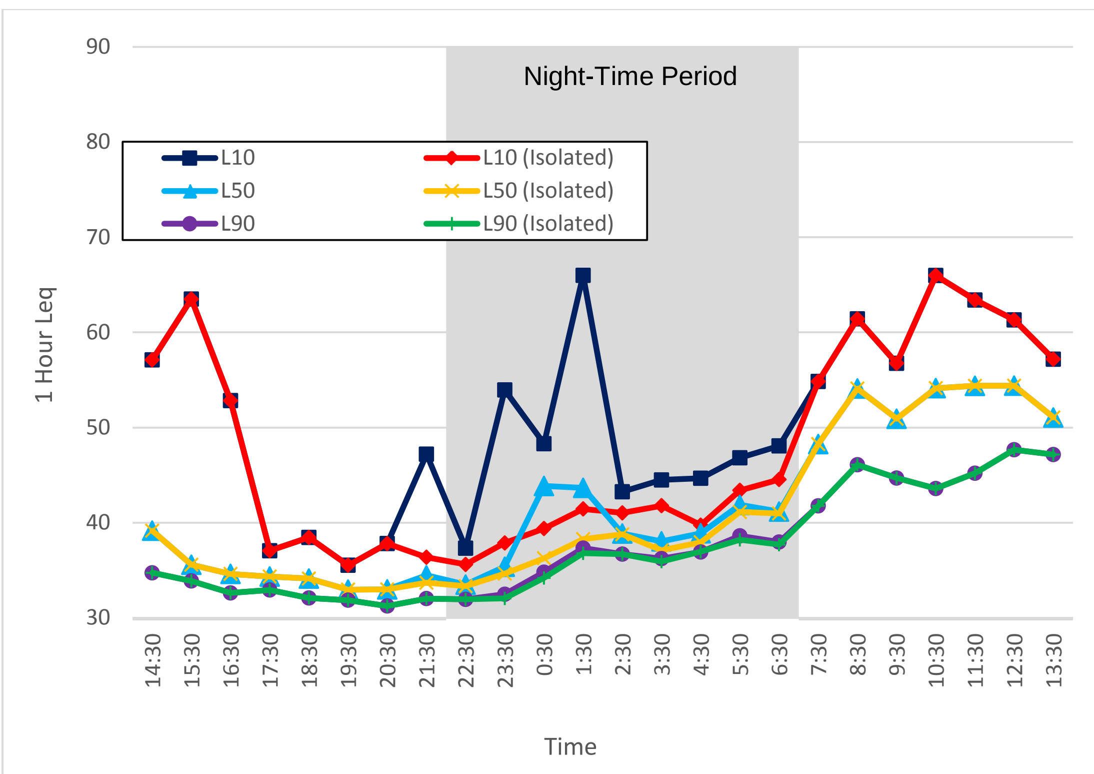


**Figure 99. Noise Monitor #12, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

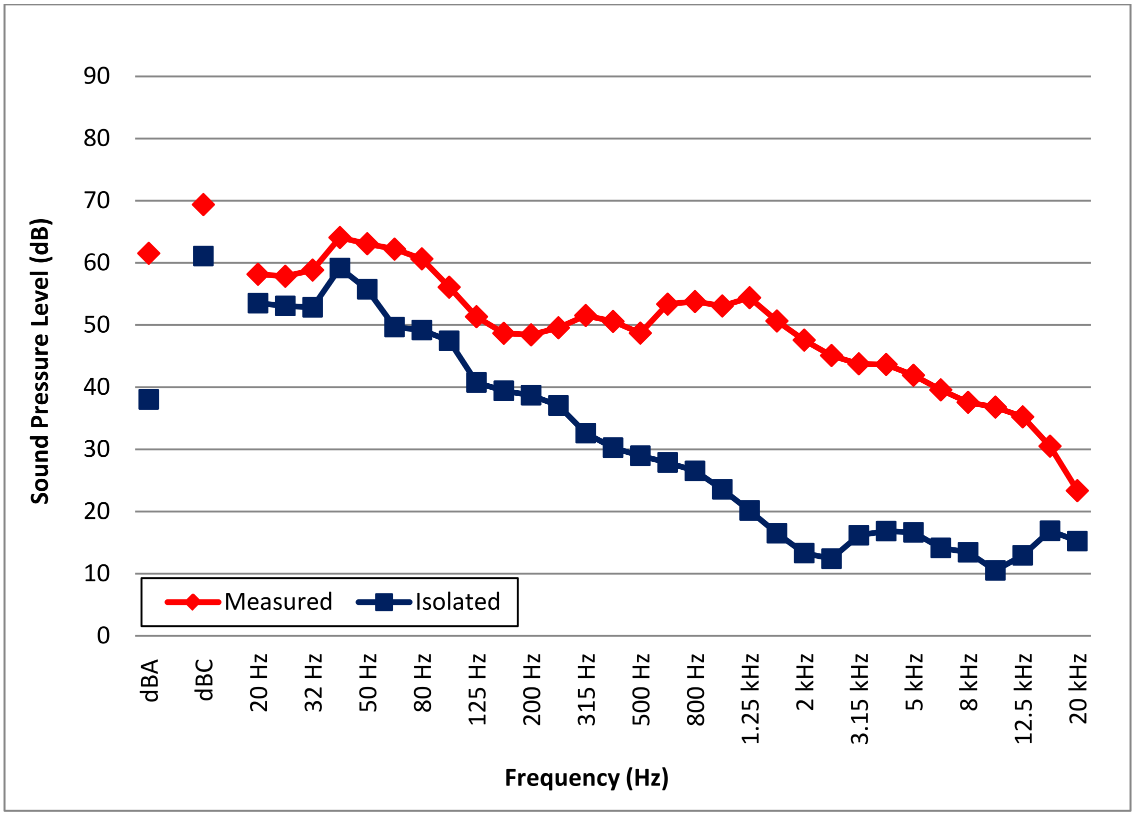


**Figure 100. Noise Monitor #12, 1/3 Octave $L_{eq}$ Sound Levels (August 13 - 14, 2014)**

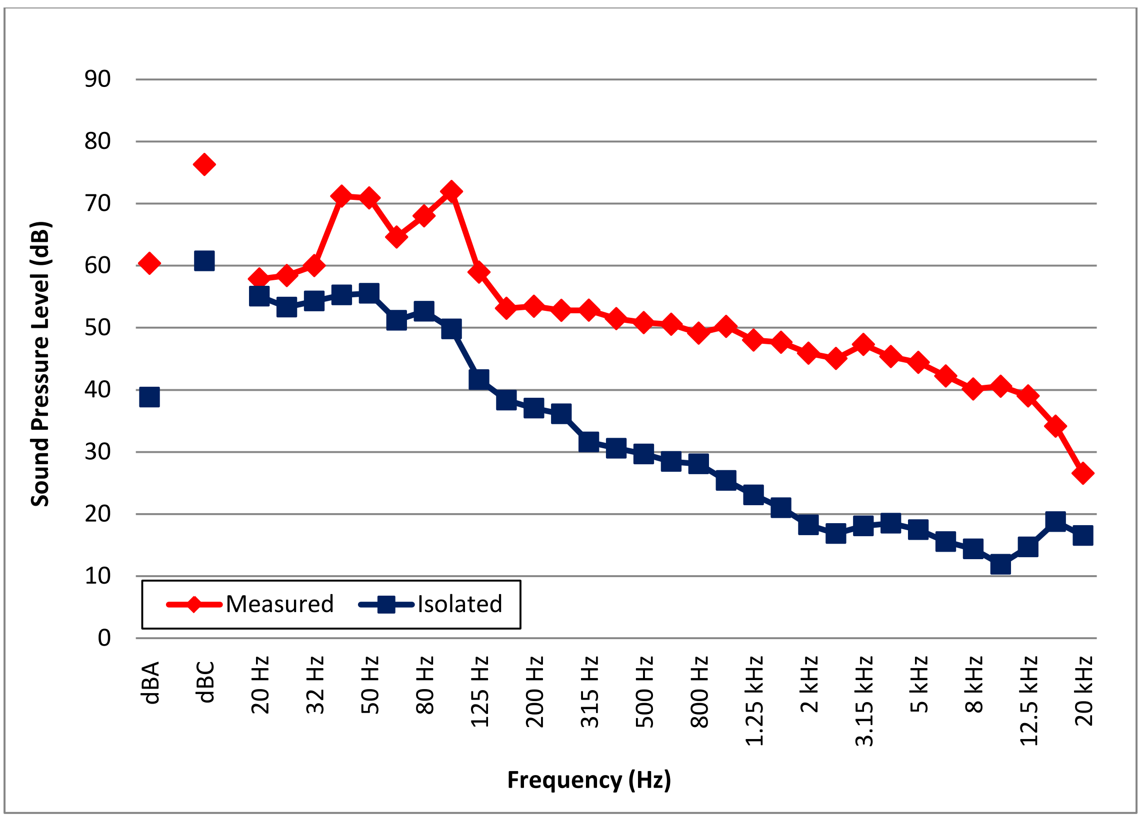


**Figure 100. Noise Monitor #12, 1/3 Octave $L_{eq}$ Sound Levels (August 14 - 15, 2014)**

Noise Monitor #12

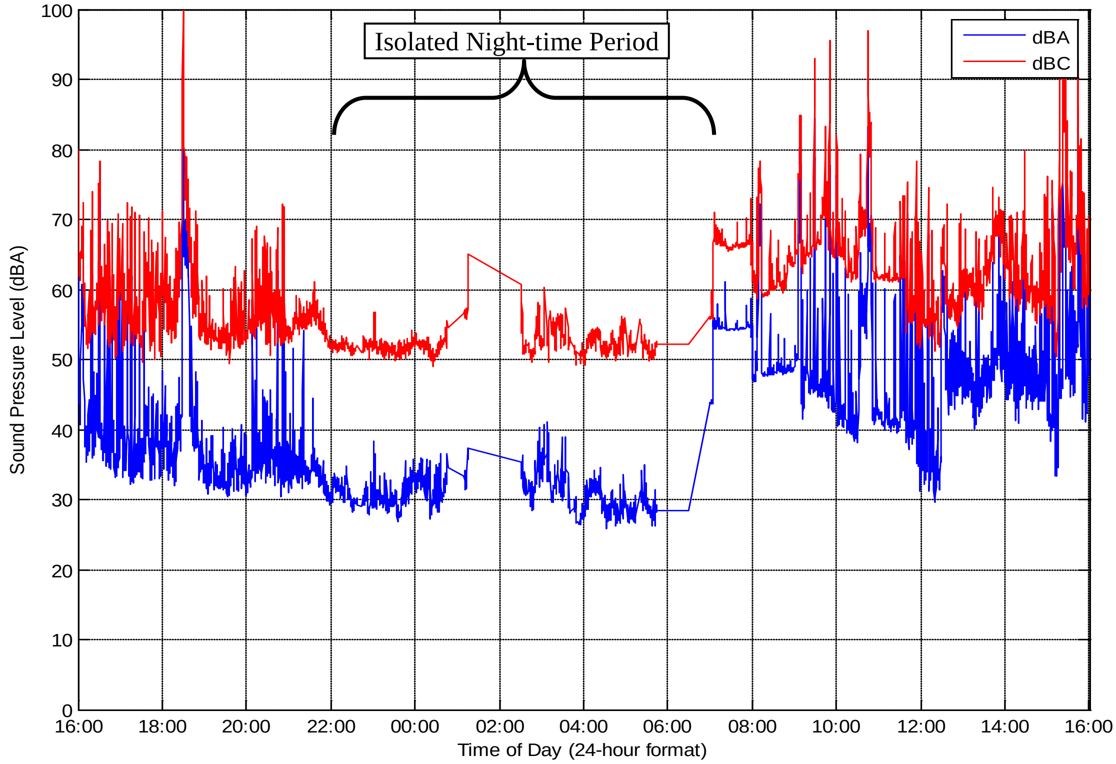


**Figure 101. Noise Monitor #12, 15-Second $L_{eq}$ Sound Levels (August 20 - 21, 2014)**

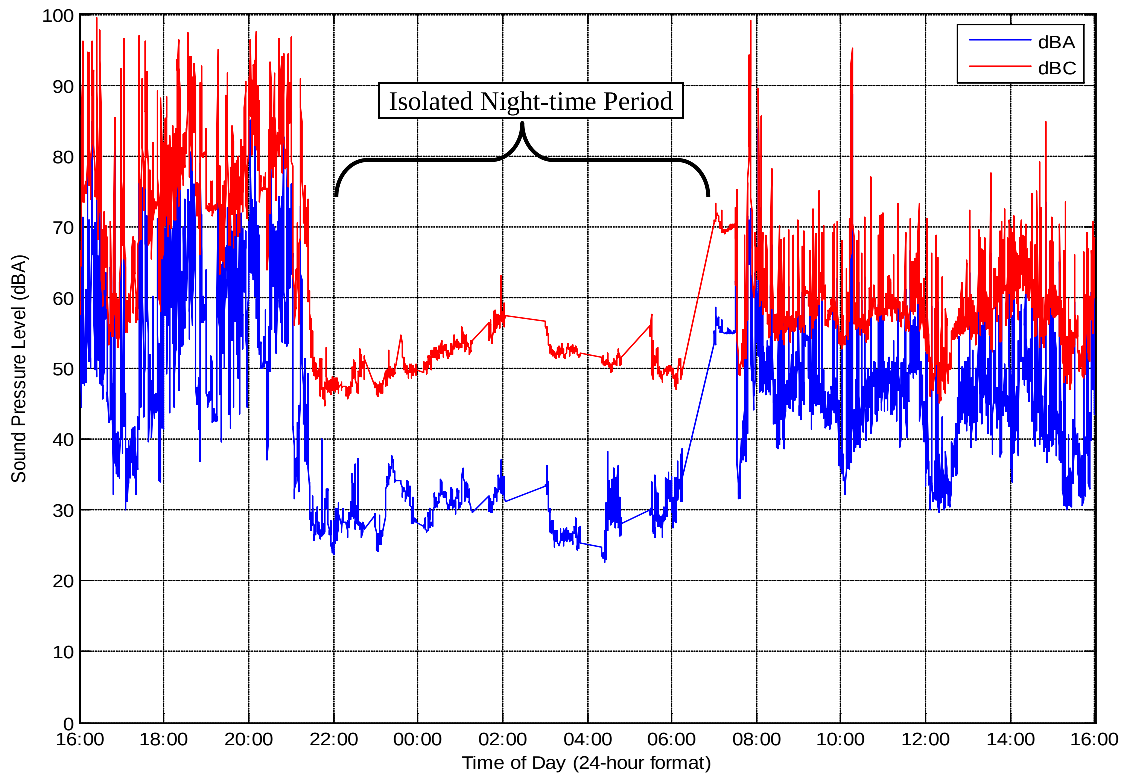


**Figure 102. Noise Monitor #12, 15-Second $L_{eq}$ Sound Levels (August 21 - 22, 2014)**

Noise Monitor #12

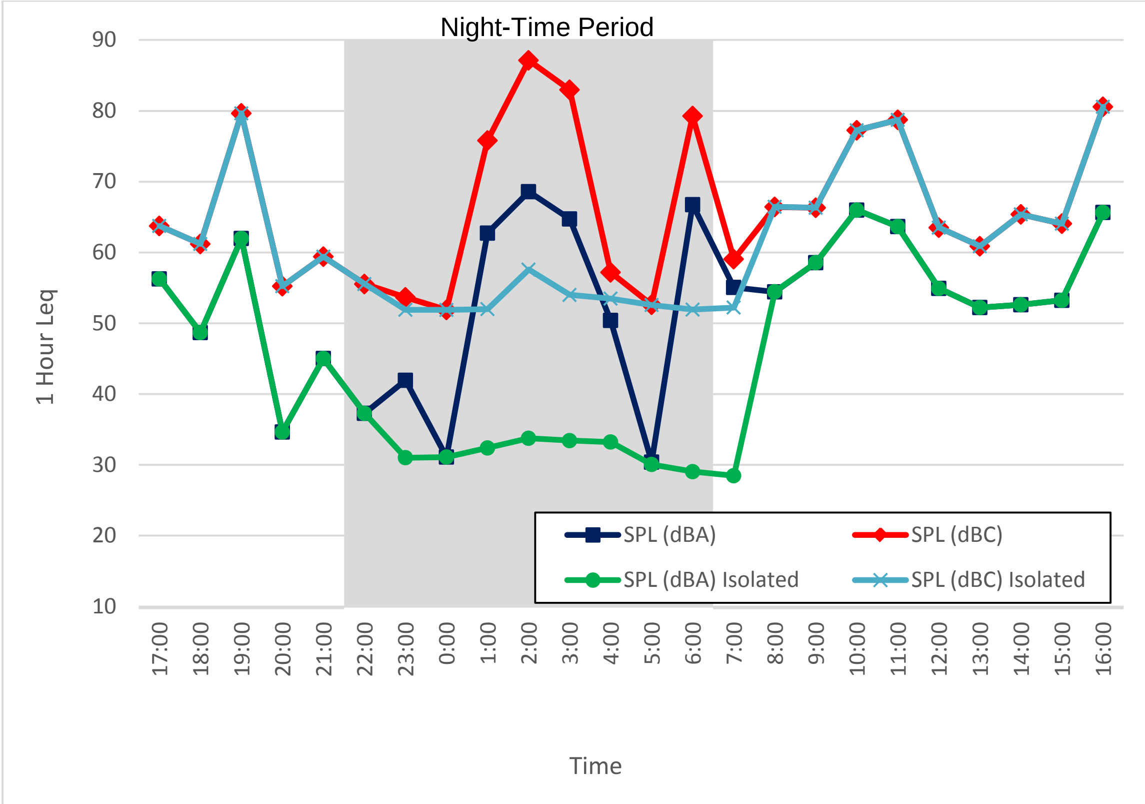


**Figure 103. Noise Monitor #12, 1-Hour $L_{eq}$ Sound Levels (August 20 - 21, 2014)**

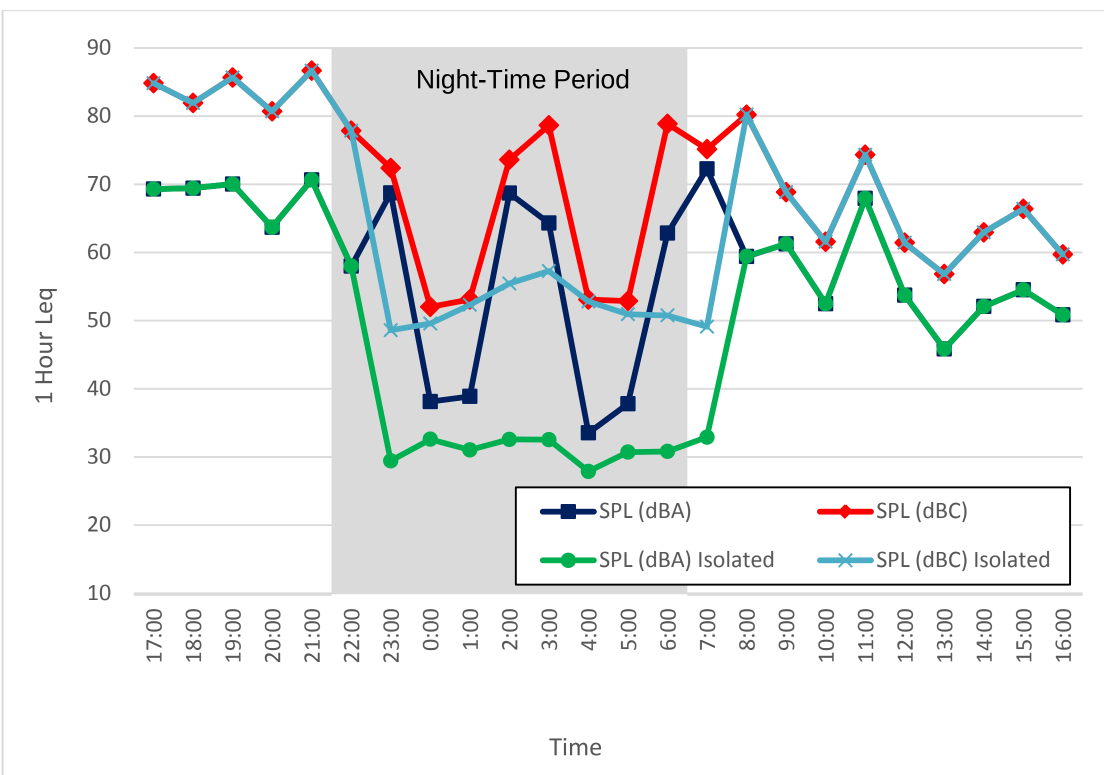


**Figure 104. Noise Monitor #12, 1-Hour $L_{eq}$ Sound Levels (August 21 - 22, 2014)**

Noise Monitor #12

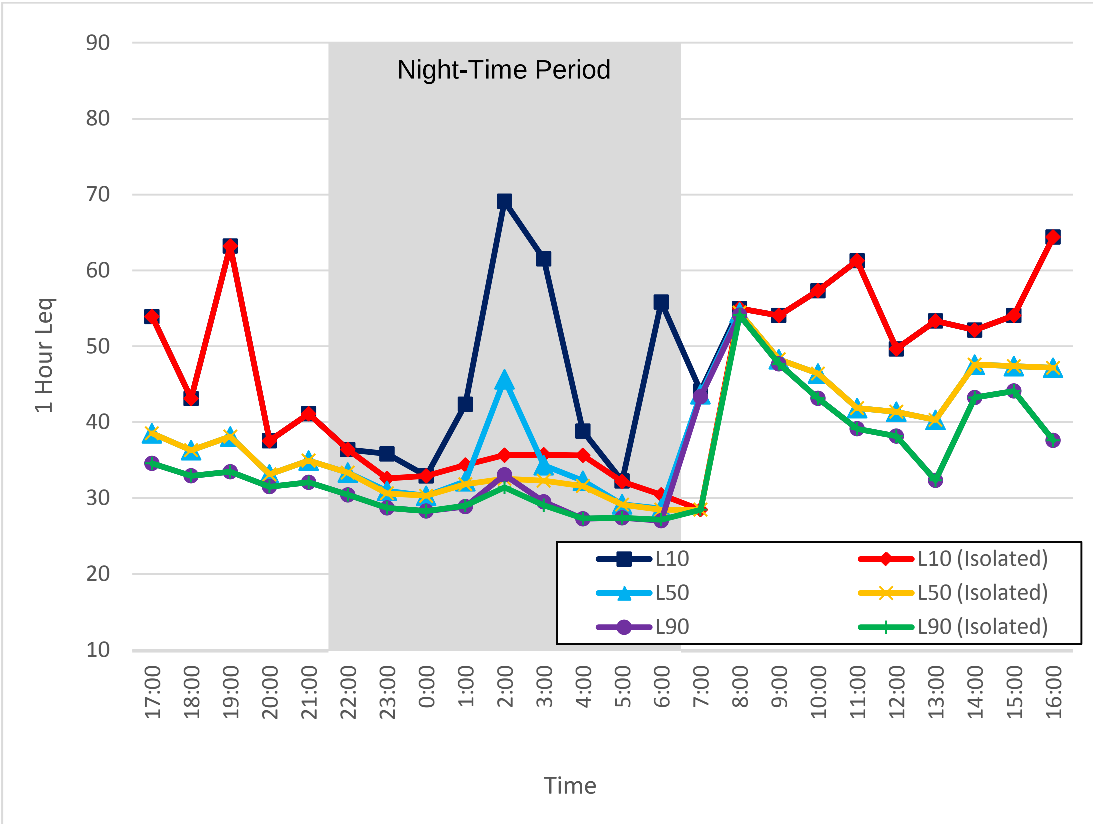


**Figure 105. Noise Monitor #12, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (August 20 - 21, 2014)**

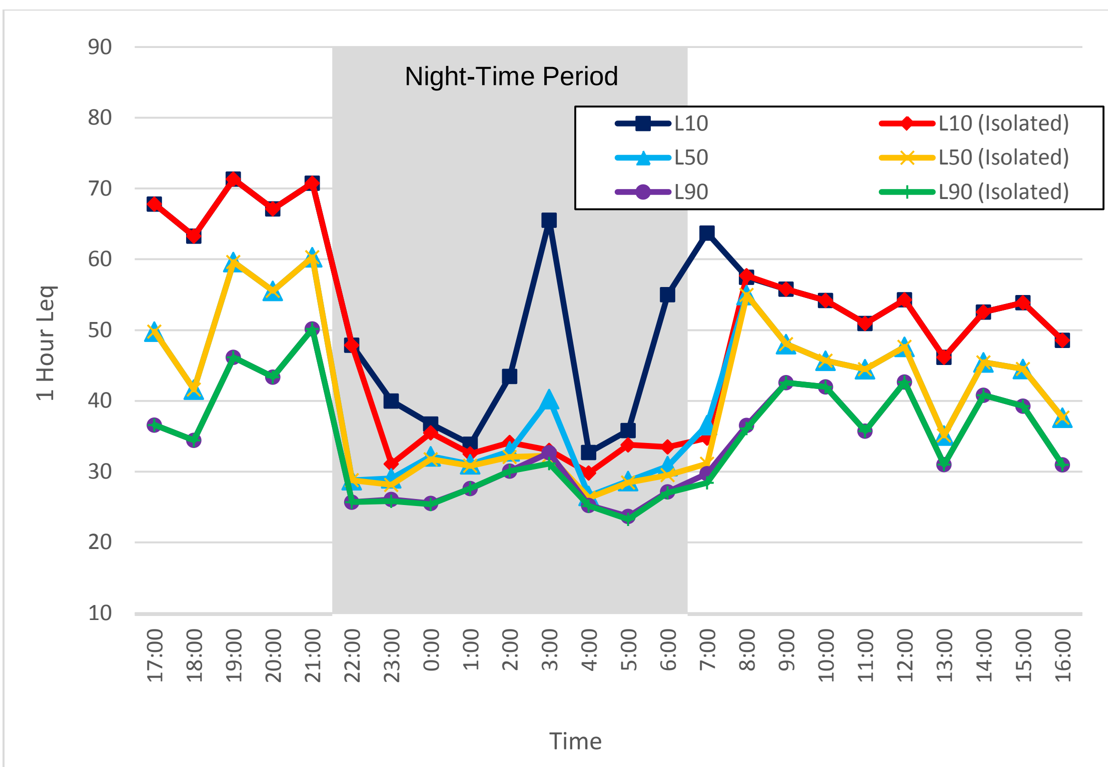


**Figure 106. Noise Monitor #12, 1-Hour $L_{10}$, $L_{50}$, $L_{90}$ $L_{eq}$ Sound Levels (August 21 - 22, 2014)**

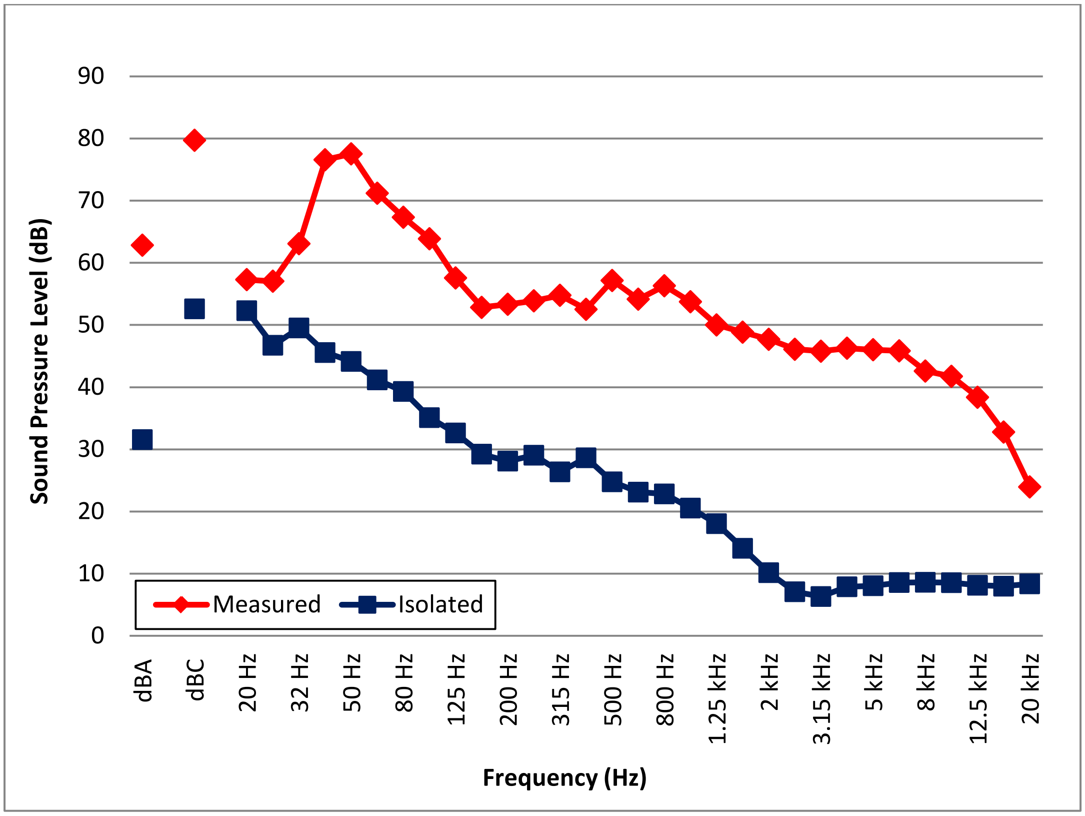


**Figure 107. Noise Monitor #12, 1/3 Octave $L_{eq}$ Sound Levels (August 20 - 21, 2014)**

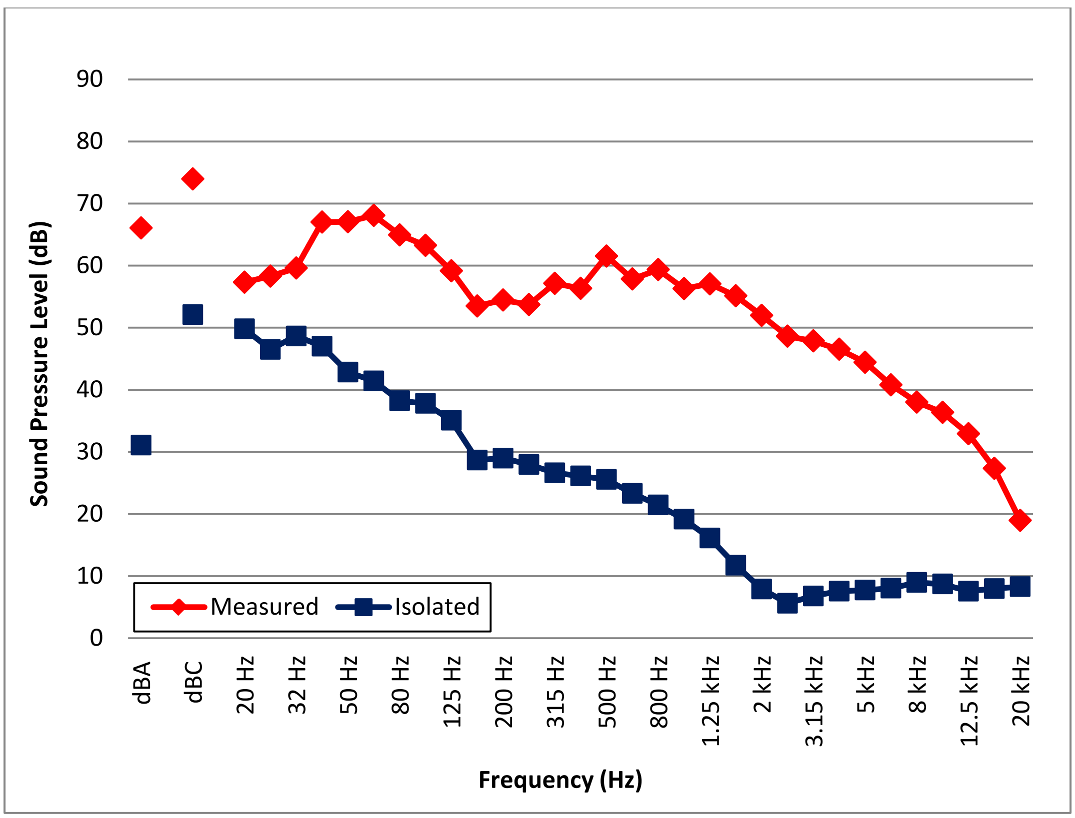


**Figure 108. Noise Monitor #12, 1/3 Octave $L_{eq}$ Sound Levels (August 21 - 22, 2014)**

# Appendix I MEASUREMENT EQUIPMENT USED

**Noise Monitors**

The environmental noise monitoring equipment used consisted of Brüel and Kjær Type 2250/2270 Precision Integrating Sound Level Meters enclosed in environmental cases with a tripods, weather protective microphone hoods, and (in some cases) external batteries. The systems 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 meters conform 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 meters, pre-amplifiers and microphones were certified on December 11, 2012 / October 2, 2012 / October 2, 2012 / October 2, 2012 / October 1, 2012 / April 30, 2014 / April 30, 2014 and the calibrator (type B&K 4231) was certified on November 07, 2013 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 3.3 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 | August 20, 2014 | 13:40 | Pre | 93.9 dBA | B&K 4231 | 2656414 |
| Monitor #1 | August 22, 2014 | 14:35 | Post | 93.8 dBA | B&K 4231 | 2656414 |
| | | | | | | |
| Monitor #2 | August 13, 2014 | 13:30 | Pre | 93.9 dBA | B&K 4231 | 2656414 |
| Monitor #2 | August 15, 2014 | 15:35 | Post | 93.9 dBA | B&K 4231 | 2656414 |
| | | | | | | |
| Monitor #3 | August 13, 2014 | 15:15 | Pre | 93.9 dBA | B&K 4231 | 2656414 |
| Monitor #3 | August 15, 2014 | 15:25 | Post | 93.9 dBA | B&K 4231 | 2656414 |
| | | | | | | |
| Monitor #4 | June 12, 2014 | 13:50 | Pre | 93.9 dBA | B&K 4231 | 2575493 |
| Monitor #4 | July 9, 2014 | 14:30 | Post | 93.8 dBA | B&K 4231 | 2575493 |
| | | | | | | |
| Monitor #5 | August 13, 2014 | 13:40 | Pre | 93.9 dBA | B&K 4231 | 2656414 |
| Monitor #5 | August 15, 2014 | 14:30 | Post | 93.8 dBA | B&K 4231 | 2656414 |
| | | | | | | |
| Monitor #6 | August 13, 2014 | 13:25 | Pre | 93.9 dBA | B&K 4231 | 2656414 |
| Monitor #6 | August 15, 2014 | 14:20 | Post | 93.9 dBA | B&K 4231 | 2656414 |
| | | | | | | |
| Monitor #8 | August 13, 2014 | 12:25 | Pre | 93.9 dBA | B&K 4231 | 2656414 |
| Monitor #8 | August 15, 2014 | 13:35 | Post | 93.9 dBA | B&K 4231 | 2656414 |
| | | | | | | |
| Monitor #9 | August 20, 2014 | 12:30 | Pre | 93.9 dBA | B&K 4231 | 2656414 |
| Monitor #9 | August 22, 2014 | 14:05 | Post | 94.0 dBA | B&K 4231 | 2656414 |
| | | | | | | |
| Monitor #10 | August 20, 2014 | 13:20 | Pre | 93.9 dBA | B&K 4231 | 2656414 |
| Monitor #10 | August 22, 2014 | 15:00 | Post | 93.8 dBA | B&K 4231 | 2656414 |
| | | | | | | |
| Monitor #11 | August 13, 2014 | 12:15 | Pre | 93.9 dBA | B&K 4231 | 2656414 |
| Monitor #11 | August 15, 2014 | 13:25 | Post | 93.9 dBA | B&K 4231 | 2656414 |
| | | | | | | |
| Monitor #12a | August 13, 2014 | 14:15 | Pre | 93.9 dBA | B&K 4231 | 2656414 |
| Monitor #12a | August 15, 2014 | 14:50 | Post | 93.8 dBA | B&K 4231 | 2656414 |
| | | | | | | |
| Monitor #12b | August 20, 2014 | 15:25 | Pre | 93.9 dBA | B&K 4231 | 2656414 |
| Monitor #12b | August 22, 2014 | 16:10 | Post | 93.9 dBA | B&K 4231 | 2656414 |

## B&K 2270 Unit #2 Calibration Certificates

# MANUFACTURER'S CERTIFICATE OF CONFORMANCE

We certify that Brüel & Kjær **-2270--D00-** Serial No. **3002718** 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 9001:2008 assuring that all test data is retained on file and is available for inspection upon request.

Nærum 11-dec-2012

Torben Bjørn
Vice President, Operations

Please note that this document is not a calibration certificate.
For information on our calibration services please contact your nearest Brüel & Kjær office.

HEADQUARTERS: Brüel & Kjær Sound & Vibration Measurement A/S · DK-2850 Nærum · Denmark
Telephone: +45 7741 2000 · Fax: +45 4580 1405 · www.bksv.com · info@bksv.com
Local representatives and service organisations worldwide

Brüel & Kjær

---

Brüel & Kjær

**Prepolarized Free-field 1/2" Microphone Type 4189**

Calibration Chart

Serial No: 2850742

| | | |
|---|---|---|
| Open-circuit Sensitivity*, $S_0$: | -26.0 | dB re 1V/Pa |
| Equivalent to: | 50.4 | mV/Pa |
| Uncertainty, 95 % confidence level | 0.2 | dB |
| Capacitance: | 13.4 | 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:**
99.7 kPa 22 °C 47 % RH

**Procedure:** 704215 **Date:** 26. Nov. 2012 **Signature:**

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



acoustical consultants inc

## 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 and APLAC signatory)

NVLAP®
NVLAP Lab Code: 200625-0

# Calibration Certificate No.27282

| | | | | |
|---|---|---|---|---|
| *Instrument:* | **Sound Level Meter** | *Date Calibrated:* **10/2/2012** *Cal Due:* | | |
| *Model:* | **2270** | *Status:* | **Received** | **Sent** |
| *Manufacturer:* | **Brüel and Kjær** | *In tolerance:* | **X** | **X** |
| *Serial number:* | **2644639** | *Out of tolerance:* | | |
| *Tested with:* | **Microphone 4189 s/n 2643219**<br>**Preamplifier ZC0032 s/n 8255** | *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 / -6376** | | | |

**Tested in accordance with the following procedures and standards:**
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/22/2012
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<br>Cal. Lab / Accreditation | Cal. Due |
|---|---|---|---|---|---|
| 483B-Norsonic | SME Cal Unit | 25747 | Jul 2, 2012 | Scantek, Inc./ NVLAP | Jul 2, 2013 |
| DS-360-SRS | Function Generator | 61646 | Nov 16, 2011 | ACR Env./ A2LA | Nov 16, 2013 |
| 34401A-Agilent Technologies | Digital Voltmeter | MY41022043 | Dec 9, 2011 | ACR Env. / A2LA | Dec 9, 2012 |
| DPI 141-Druck | Pressure Indicator | 790/00-04 | Dec 13, 2010 | ACR Env./ A2LA | Dec 13, 2012 |
| HMP233-Vaisala Oyj | Humidity & Temp. | V3820001 | Sep 6, 2012 | ACR Env./ A2LA | Mar 6, 2014 |
| PC Program 1019 Norsonic | Calibration software | v.5.2 | Validated Mar 2011 | Scantek, Inc. | - |
| 1251-Norsonic | Calibrator | 30878 | Dec 13, 2011 | Scantek, Inc./ NVLAP | Dec 13, 2012 |

**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 (%) |
|---|---|---|
| 24 °C | 100.067 kPa | 49.4 %RH |

| **Calibrated by:** | Valentin Buzduga | **Authorized signatory:** | Mariana Buzduga |
|---|---|---|---|
| Signature | [signature] | Signature | [signature] |
| Date | 10/02/2012 | Date | 10/02/2012 |

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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 and APLAC signatory)

NVLAP®
NVLAP Lab Code: 200625-0

# Calibration Certificate No.27283

*Instrument:* **Microphone**
*Model:* **4189**
*Manufacturer:* **Brüel & Kjær**
*Serial number:* **2643219**
*Composed of:*

*Date Calibrated:* **10/1/2012** *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.**
*Tel/Fax:* **780-414-6373 / -6376**
*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. 11/30/2010

**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 | 25747 | Jul 2, 2012 | Scantek, Inc./ NVLAP | Jul 2, 2013 |
| DS-360-SRS | Function Generator | 61646 | Nov 16, 2011 | ACR Env./ A2LA | Nov 16, 2013 |
| 34401A-Agilent Technologies | Digital Voltmeter | MY41022043 | Dec 9, 2011 | ACR Env. / A2LA | Dec 9, 2012 |
| DPI 141-Druck | Pressure Indicator | 790/00-04 | Dec 13, 2010 | ACR Env./ A2LA | Dec 13, 2012 |
| HMP233-Vaisala Oyj | Humidity & Temp. Transmitter | V3820001 | Sep 6, 2012 | ACR Env./ A2LA | Mar 6, 2014 |
| PC Program 1017 Norsonic | Calibration software | v.5.2 | Validated Mar 2011 | Scantek, Inc. | - |
| 1253-Norsonic | Calibrator | 28326 | Dec 13, 2011 | Scantek, Inc./ NVLAP | Dec 13, 2012 |
| 1203-Norsonic | Preamplifier | 14059 | Jan 3, 2012 | Scantek, Inc./ NVLAP | Jan 3, 2013 |
| 4180-Brüel&Kjær | Microphone | 2246115 | Nov 21, 2011 | NPL-UK / UKAS | Nov 21, 2013 |

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

| **Calibrated by:** | Valentin Buzduga | **Authorized signatory:** | Mariana Buzduga |
|---|---|---|---|
| Signature | [signature] | Signature | [signature] |
| Date | 10/02/2012 | Date | 10/2/2012 |

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## B&K 2250 Unit #5 SLM Calibration Certificate

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

NVLAP®
NVLAP Lab Code: 200625-0

# Calibration Certificate No.27284

*Instrument:* **Sound Level Meter**
*Model:* **2250**
*Manufacturer:* **Brüel and Kjær**
*Serial number:* **2722894**
*Tested with:* **Microphone 4189 s/n 2719777**
**Preamplifier ZC0032 s/n 13895**
*Type (class):* **1**
*Customer:* **ACI Acoustical Consultants Inc.**
*Tel/Fax:* **780-414-6373 / -6376**

*Date Calibrated:* **10/2/2012** *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. 6/22/2012
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 | 25747 | Jul 2, 2012 | Scantek, Inc./ NVLAP | Jul 2, 2013 |
| DS-360-SRS | Function Generator | 61646 | Nov 16, 2011 | ACR Env./ A2LA | Nov 16, 2013 |
| 34401A-Agilent Technologies | Digital Voltmeter | MY41022043 | Dec 9, 2011 | ACR Env. / A2LA | Dec 9, 2012 |
| DPI 141-Druck | Pressure Indicator | 790/00-04 | Dec 13, 2010 | ACR Env./ A2LA | Dec 13, 2012 |
| HMP233-Vaisala Oyj | Humidity & Temp. | V3820001 | Sep 6, 2012 | ACR Env./ A2LA | Mar 6, 2014 |
| PC Program 1019 Norsonic | Calibration software | v.5.2 | Validated Mar 2011 | Scantek, Inc. | - |
| 1251-Norsonic | Calibrator | 30878 | Dec 13, 2011 | Scantek, Inc./ NVLAP | Dec 13, 2012 |

**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 (%) |
|---|---|---|
| 24.7 °C | 100.019 kPa | 48.6 %RH |

| **Calibrated by:** | Valentin Buzduga | **Authorized signatory:** | Mariana Buzduga |
|---|---|---|---|
| Signature | [signature] | Signature | [signature] |
| Date | 10/02/2012 | Date | 10/2/2012 |

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**B&K 2250 Unit #5 Microphone Calibration Certificate**

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

NVLAP®
NVLAP Lab Code: 200625-0

# Calibration Certificate No.27285

| | | | | |
|---|---|---|---|---|
| *Instrument:* | **Microphone** | *Date Calibrated:* **10/1/2012** *Cal Due:* | | |
| *Model:* | **4189** | *Status:* | **Received** | **Sent** |
| *Manufacturer:* | **Brüel & Kjær** | *In tolerance:* | X | X |
| *Serial number:* | **2719777** | *Out of tolerance:* | | |
| *Composed of:* | | *See comments:* | | |
| | | *Contains non-accredited tests:* __Yes _X_ No | | |
| *Customer:* | **ACI Acoustical Consultants Inc.** | *Address:* | **5031 - 210 Street, Edmonton** | |
| *Tel/Fax:* | **780-414-6373 / -6376** | | **Alberta, CANADA T6M 0A8** | |

**Tested in accordance with the following procedures and standards:**
Calibration of Measurement Microphones, Scantek, Inc., Rev. 11/30/2010

**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 | 25747 | Jul 2, 2012 | Scantek, Inc./ NVLAP | Jul 2, 2013 |
| DS-360-SRS | Function Generator | 61646 | Nov 16, 2011 | ACR Env./ A2LA | Nov 16, 2013 |
| 34401A-Agilent Technologies | Digital Voltmeter | MY41022043 | Dec 9, 2011 | ACR Env. / A2LA | Dec 9, 2012 |
| DPI 141-Druck | Pressure Indicator | 790/00-04 | Dec 13, 2010 | ACR Env./ A2LA | Dec 13, 2012 |
| HMP233-Vaisala Oyj | Humidity & Temp. Transmitter | V3820001 | Sep 6, 2012 | ACR Env./ A2LA | Mar 6, 2014 |
| PC Program 1017 Norsonic | Calibration software | v.5.2 | Validated Mar 2011 | Scantek, Inc. | - |
| 1253-Norsonic | Calibrator | 28326 | Dec 13, 2011 | Scantek, Inc./ NVLAP | Dec 13, 2012 |
| 1203-Norsonic | Preamplifier | 14059 | Jan 3, 2012 | Scantek, Inc./ NVLAP | Jan 3, 2013 |
| 4180-Brüel&Kjær | Microphone | 2246115 | Nov 21, 2011 | NPL-UK / UKAS | Nov 21, 2013 |

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

| **Calibrated by:** | Valentin Buzduga | **Authorized signatory:** | Mariana Buzduga |
|---|---|---|---|
| Signature | [signature] | Signature | [signature] |
| Date | 10/01/2012 | Date | 10/2/2012 |


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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 and APLAC signatory)

NVLAP®

NVLAP Lab Code: 200625-0

# Calibration Certificate No.27286

*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**

*Date Calibrated:* **10/2/2012** *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

*Customer:* **ACI Acoustical Consultants Inc.**
*Tel/Fax:* **780-414-6373 / -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. 6/22/2012
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 | 25747 | Jul 2, 2012 | Scantek, Inc./ NVLAP | Jul 2, 2013 |
| DS-360-SRS | Function Generator | 61646 | Nov 16, 2011 | ACR Env./ A2LA | Nov 16, 2013 |
| 34401A-Agilent Technologies | Digital Voltmeter | MY41022043 | Dec 9, 2011 | ACR Env. / A2LA | Dec 9, 2012 |
| DPI 141-Druck | Pressure Indicator | 790/00-04 | Dec 13, 2010 | ACR Env./ A2LA | Dec 13, 2012 |
| HMP233-Vaisala Oyj | Humidity & Temp. | V3820001 | Sep 6, 2012 | ACR Env./ A2LA | Mar 6, 2014 |
| PC Program 1019 Norsonic | Calibration software | v.5.2 | Validated Mar 2011 | Scantek, Inc. | - |
| 1251-Norsonic | Calibrator | 30878 | Dec 13, 2011 | Scantek, Inc./ NVLAP | Dec 13, 2012 |

**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 (%) |
|---|---|---|
| 23.2 °C | 99.991 kPa | 51.9 %RH |

| **Calibrated by:** | Valentin Buzduga | **Authorized signatory:** | Mariana Buzduga |
|---|---|---|---|
| Signature | [signature] | Signature | [signature] |
| Date | 10/02/2012 | Date | 10/2/2012 |


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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 and APLAC signatory)

NVLAP®
NVLAP Lab Code: 200625-0

# Calibration Certificate No.27287

| | | | | | |
|---|---|---|---|---|---|
| *Instrument:* | **Microphone** | *Date Calibrated:* **10/1/2012** | *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** | | |
| *Tel/Fax:* | **780-414-6373 / -6376** | | **Alberta, CANADA T6M 0A8** | | |

**Tested in accordance with the following procedures and standards:**
Calibration of Measurement Microphones, Scantek, Inc., Rev. 11/30/2010

**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 | 25747 | Jul 2, 2012 | Scantek, Inc./ NVLAP | Jul 2, 2013 |
| DS-360-SRS | Function Generator | 61646 | Nov 16, 2011 | ACR Env./ A2LA | Nov 16, 2013 |
| 34401A-Agilent Technologies | Digital Voltmeter | MY41022043 | Dec 9, 2011 | ACR Env. / A2LA | Dec 9, 2012 |
| DPI 141-Druck | Pressure Indicator | 790/00-04 | Dec 13, 2010 | ACR Env./ A2LA | Dec 13, 2012 |
| HMP233-Vaisala Oyj | Humidity & Temp. Transmitter | V3820001 | Sep 6, 2012 | ACR Env./ A2LA | Mar 6, 2014 |
| PC Program 1017 Norsonic | Calibration software | v.5.2 | Validated Mar 2011 | Scantek, Inc. | - |
| 1253-Norsonic | Calibrator | 28326 | Dec 13, 2011 | Scantek, Inc./ NVLAP | Dec 13, 2012 |
| 1203-Norsonic | Preamplifier | 14059 | Jan 3, 2012 | Scantek, Inc./ NVLAP | Jan 3, 2013 |
| 4180-Brüel&Kjær | Microphone | 2246115 | Nov 21, 2011 | NPL-UK / UKAS | Nov 21, 2013 |

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

| Calibrated by: | Valentin Buzduga | Authorized signatory: | Mariana Buzduga |
|---|---|---|---|
| Signature | [signature] | Signature | [signature] |
| Date | 10/01/2012 | Date | 10/2/2012 |


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**B&K 2250 Unit #7 SLM Calibration Certificate**

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

NVLAP®
NVLAP Lab Code: 200625-0

# Calibration Certificate No.27288

| | | | | |
|---|---|---|---|---|
| *Instrument:* | **Sound Level Meter** | *Date Calibrated:* **10/1/2012** *Cal Due:* | | |
| *Model:* | **2250** | *Status:* | **Received** | **Sent** |
| *Manufacturer:* | **Brüel and Kjær** | *In tolerance:* | **X** | **X** |
| *Serial number:* | **2722859** | *Out of tolerance:* | | |
| *Tested with:* | **Microphone 4189 s/n 2710791** | *See comments:* | | |
| | **Preamplifier ZC0032 s/n 13398** | *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** | | |
| *Tel/Fax:* | **780-414-6373 / -6376** | **Alberta, CANADA T6M 0A8** | | |

**Tested in accordance with the following procedures and standards:**
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/22/2012
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 | 25747 | Jul 2, 2012 | Scantek, Inc./ NVLAP | Jul 2, 2013 |
| DS-360-SRS | Function Generator | 61646 | Nov 16, 2011 | ACR Env./ A2LA | Nov 16, 2013 |
| 34401A-Agilent Technologies | Digital Voltmeter | MY41022043 | Dec 9, 2011 | ACR Env. / A2LA | Dec 9, 2012 |
| DPI 141-Druck | Pressure Indicator | 790/00-04 | Dec 13, 2010 | ACR Env./ A2LA | Dec 13, 2012 |
| HMP233-Vaisala Oyj | Humidity & Temp. | V3820001 | Sep 6, 2012 | ACR Env./ A2LA | Mar 6, 2014 |
| PC Program 1019 Norsonic | Calibration software | v.5.2 | Validated Mar 2011 | Scantek, Inc. | - |
| 1251-Norsonic | Calibrator | 30878 | Dec 13, 2011 | Scantek, Inc./ NVLAP | Dec 13, 2012 |

**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 (%) |
|---|---|---|
| 22.7 °C | 100.02 kPa | 47.4 %RH |

| **Calibrated by:** | Valentin Buzduga | **Authorized signatory:** | Mariana Buzduga |
|---|---|---|---|
| Signature | [signature] | Signature | [signature] |
| Date | 10/01/2012 | Date | 10/2/2012 |


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## B&K 2250 Unit #7 Microphone Calibration Certificate

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

NVLAP®
NVLAP Lab Code: 200625-0

# Calibration Certificate No.27289

*Instrument:* **Microphone**
*Model:* **4189**
*Manufacturer:* **Brüel & Kjær**
*Serial number:* **2710791**
*Composed of:*

*Date Calibrated:* **10/1/2012** *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.**
*Tel/Fax:* **780-414-6373 / -6376**
*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. 11/30/2010

**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 | 25747 | Jul 2, 2012 | Scantek, Inc./ NVLAP | Jul 2, 2013 |
| DS-360-SRS | Function Generator | 61646 | Nov 16, 2011 | ACR Env./ A2LA | Nov 16, 2013 |
| 34401A-Agilent Technologies | Digital Voltmeter | MY41022043 | Dec 9, 2011 | ACR Env. / A2LA | Dec 9, 2012 |
| DPI 141-Druck | Pressure Indicator | 790/00-04 | Dec 13, 2010 | ACR Env./ A2LA | Dec 13, 2012 |
| HMP233-Vaisala Oyj | Humidity & Temp. Transmitter | V3820001 | Sep 6, 2012 | ACR Env./ A2LA | Mar 6, 2014 |
| PC Program 1017 Norsonic | Calibration software | v.5.2 | Validated Mar 2011 | Scantek, Inc. | - |
| 1253-Norsonic | Calibrator | 28326 | Dec 13, 2011 | Scantek, Inc./ NVLAP | Dec 13, 2012 |
| 1203-Norsonic | Preamplifier | 14059 | Jan 3, 2012 | Scantek, Inc./ NVLAP | Jan 3, 2013 |
| 4180-Brüel&Kjær | Microphone | 2246115 | Nov 21, 2011 | NPL-UK / UKAS | Nov 21, 2013 |

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

| Calibrated by: | Valentin Buzduga | Authorized signatory: | Mariana Buzduga |
|---|---|---|---|
| Signature | [signature] | Signature | [signature] |
| Date | 10/01/2012 | Date | 10/2/2012 |


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**B&K 2250 Unit #8 SLM Calibration Certificate**

# MANUFACTURER'S CERTIFICATE OF CONFORMANCE

We certify that Brüel & Kjær **-2250--D00-** Serial No. **3005978** 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 9001:2008 assuring that all test data is retained on file and is available for inspection upon request.

Nærum 30-apr-2014

Torben Bjørn
Vice President, Operations

Please note that this document is not a calibration certificate.
For information on our calibration services please contact your nearest Brüel & Kjær office.

HEADQUARTERS: Brüel & Kjær Sound & Vibration Measurement A/S · DK-2850 Nærum · Denmark
Telephone: +45 7741 2000 · Fax: +45 4580 1405 · www.bksv.com · info@bksv.com
Local representatives and service organisations worldwide

Brüel & Kjær

**Prepolarized Free-field 1/2" Microphone Type 4189**

Bruel & Kjær

**Calibration Chart**

| | | |
|---|---|---|
| Serial No: | 2851039 | |
| Open-circuit Sensitivity*, $S_0$: | -25.8 | dB re 1V/Pa |
| Equivalent to: | 51.6 | mV/Pa |
| Uncertainty, 95 % confidence level | 0.2 | dB |
| Capacitance: | 13.7 | 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:**
102.5 kPa 23 °C 46 % RH

**Procedure:** 704215 **Date:** 10. Dec. 2013 **Signature:** BLK

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



acoustical consultants inc

**B&K 2250 Unit #9 SLM Calibration Certificate**

# MANUFACTURER'S CERTIFICATE OF CONFORMANCE

We certify that Brüel & Kjær **-2250--D00-** Serial No. **3006198** 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 9001:2008 assuring that all test data is retained on file and is available for inspection upon request.

Nærum 30-apr-2014

Torben Bjørn
Vice President, Operations

Please note that this document is not a calibration certificate.
For information on our calibration services please contact your nearest Brüel & Kjær office.

HEADQUARTERS: Brüel & Kjær Sound & Vibration Measurement A/S · DK-2850 Nærum · Denmark
Telephone: +45 7741 2000 · Fax: +45 4580 1405 · www.bksv.com · info@bksv.com
Local representatives and service organisations worldwide

Brüel & Kjær

**Prepolarized Free-field 1/2" Microphone Type 4189**

Brüel & Kjær — **Calibration Chart**

**Serial No:** 2906926

| | | |
|---|---|---|
| **Open-circuit Sensitivity*, $S_0$:** | *-25.7* | dB re 1V/Pa |
| Equivalent to: | *52.0* | mV/Pa |
| Uncertainty, 95 % confidence level | 0.2 | dB |
| **Capacitance:** | *12.7* | 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:**
99.2 kPa 23 °C 50 % RH

**Procedure:** 704215 **Date:** 10. Feb. 2014 **Signature:** BUC

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

## B&K 4231 Calibrator Calibration Certificate

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

NVLAP®
NVLAP Lab Code: 200625-0

# Calibration Certificate No.30005

| | | | | | |
|---|---|---|---|---|---|
| *Instrument:* | **Acoustical Calibrator** | *Date Calibrated:* **11/7/2013** *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, Edmonton** |
| *Tel/Fax:* | **780-414-6373 / -6376** | | **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 | 25747 | Jul 2, 2013 | Scantek, Inc./ NVLAP | Jul 2, 2014 |
| DS-360-SRS | Function Generator | 61646 | Nov 20, 2012 | ACR Env./ A2LA | Nov 20, 2014 |
| 34401A-Agilent Technologies | Digital Voltmeter | MY41022043 | Nov 20, 2012 | ACR Env. / A2LA | Nov 20, 2013 |
| DPI 141-Druck | Pressure Indicator | 790/00-04 | Nov 21, 2012 | ACR Env./ A2LA | Nov 21, 2014 |
| HMP233-Vaisala Oyj | Humidity & Temp. Transmitter | V3820001 | Sep 6, 2012 | ACR Env./ A2LA | Mar 6, 2014 |
| 8903A-HP | Audio Analyzer | 2514A05691 | Dec 1, 2010 | ACR Env./ A2LA | Dec 1, 2013 |
| PC Program 1018 Norsonic | Calibration software | v.5.2 | Validated March 2011 | Scantek, Inc. | - |
| 4134-Brüel&Kjær | Microphone | 906763 | Nov 23, 2011 | NPL-UK / UKAS | Nov 23, 2013 |
| 1203-Norsonic | Preamplifier | 14059 | Jan 4, 2013 | Scantek, Inc./ NVLAP | Jan 4, 2014 |

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

| Calibrated by: | Valentin Buzduga | Authorized signatory: | Mariana Buzduga |
|---|---|---|---|
| Signature | [signature] | Signature | [signature] |
| Date | 11/07/2013 | Date | 11/7/2013 |


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Page 1 of 2

# Appendix II THE ASSESSMENT OF ENVIRONMENTAL NOISE (GENERAL)

## Sound Pressure Level

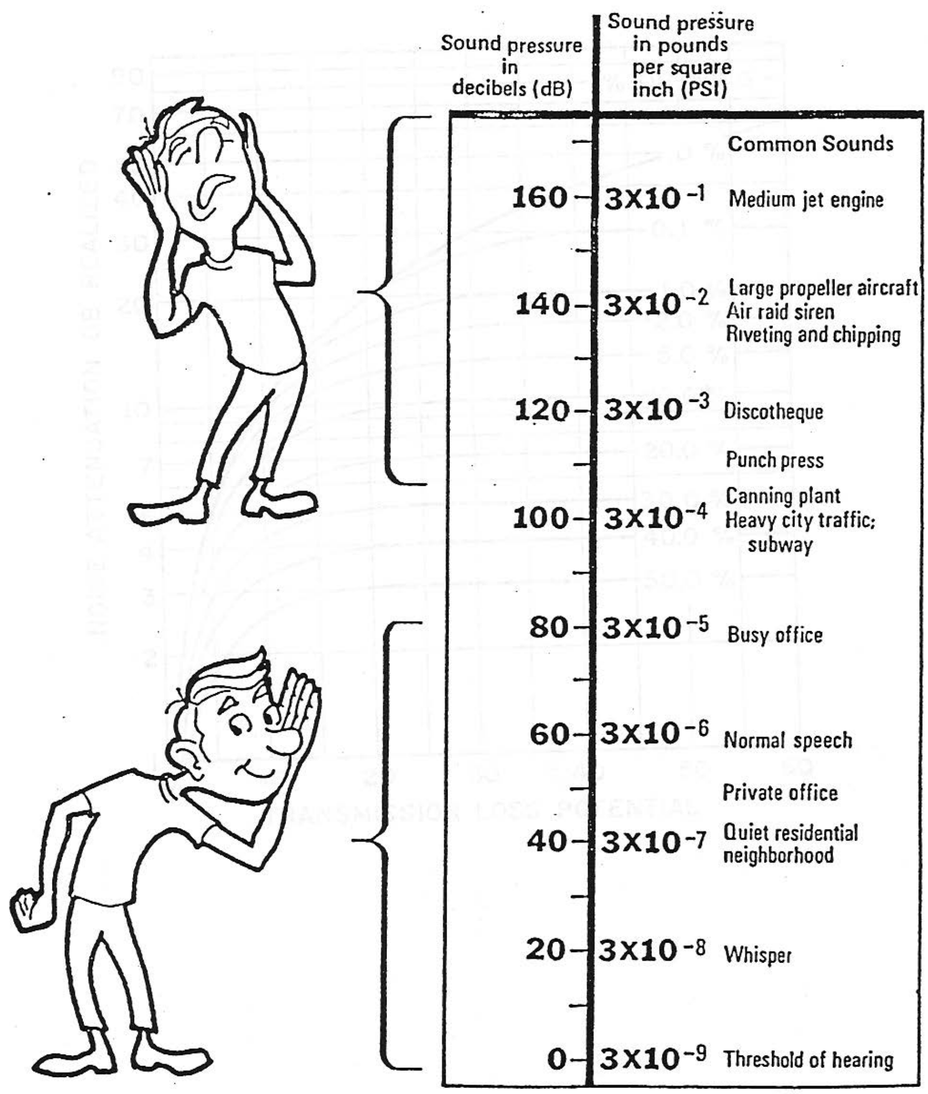
Sound pressure is initially measured in Pascal's (Pa). Humans can hear several orders of magnitude in sound pressure levels, so a more convenient scale is used. This scale is known as the decibel (dB) scale, named after Alexander Graham Bell (telephone guy). It is a base 10 logarithmic scale. When we 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 ($P_{ref} = 2\text{x}10^{-5}$ 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!


Sound pressure in decibels (dB)
Sound pressure in pounds per square inch (PSI)
Common Sounds
160 3X10-1 Medium jet engine
140 3X10-2 Large propeller aircraft
Air raid siren
Riveting and chipping
120 3X10-3 Discotheque
Punch press
Canning plant
100 3X10-4 Heavy city traffic; subway
80 3X10-5 Busy office
60 3X10-6 Normal speech
Private office
40 3X10-7 Quiet residential neighborhood
20 3X10-8 Whisper
0 3X10-9 Threshold of hearing

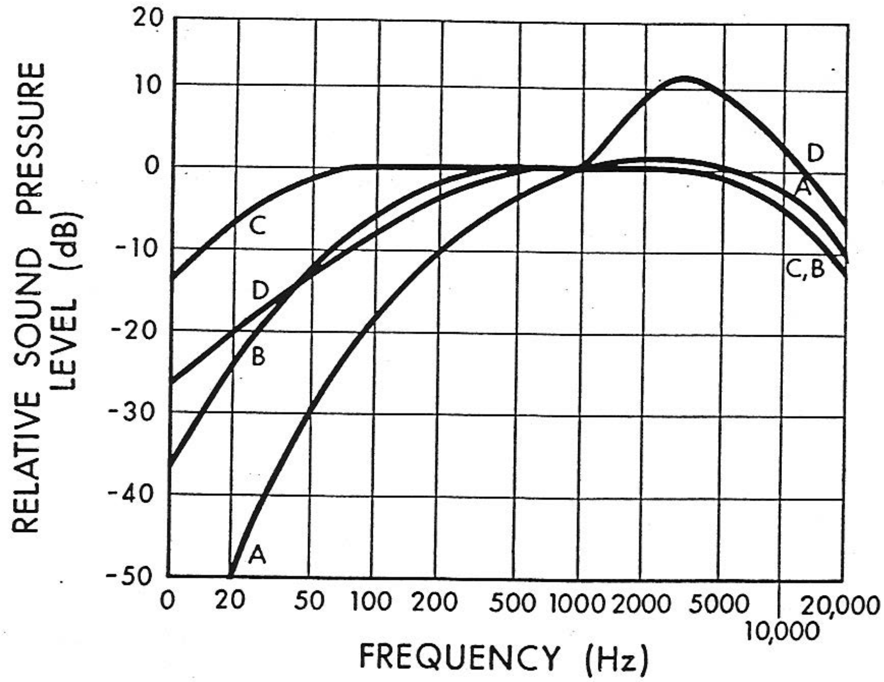
## Frequency

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 | **31.5** | 44 | 22.4 | **25** | 28.2 |
| | | | 28.2 | **31.5** | 35.5 |
| | | | 35.5 | **40** | 44.7 |
| 44 | **63** | 88 | 44.7 | **50** | 56.2 |
| | | | 56.2 | **63** | 70.8 |
| | | | 70.8 | **80** | 89.1 |
| 88 | **125** | 177 | 89.1 | **100** | 112 |
| | | | 112 | **125** | 141 |
| | | | 141 | **160** | 178 |
| 177 | **250** | 355 | 178 | **200** | 224 |
| | | | 224 | **250** | 282 |
| | | | 282 | **315** | 355 |
| 355 | **500** | 710 | 355 | **400** | 447 |
| | | | 447 | **500** | 562 |
| | | | 562 | **630** | 708 |
| 710 | **1000** | 1420 | 708 | **800** | 891 |
| | | | 891 | **1000** | 1122 |
| | | | 1122 | **1250** | 1413 |
| 1420 | **2000** | 2840 | 1413 | **1600** | 1778 |
| | | | 1778 | **2000** | 2239 |
| | | | 2239 | **2500** | 2818 |
| 2840 | **4000** | 5680 | 2818 | **3150** | 3548 |
| | | | 3548 | **4000** | 4467 |
| | | | 4467 | **5000** | 5623 |
| 5680 | **8000** | 11360 | 5623 | **6300** | 7079 |
| | | | 7079 | **8000** | 8913 |
| | | | 8913 | **10000** | 11220 |
| 11360 | **16000** | 22720 | 11220 | **12500** | 14130 |
| | | | 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.

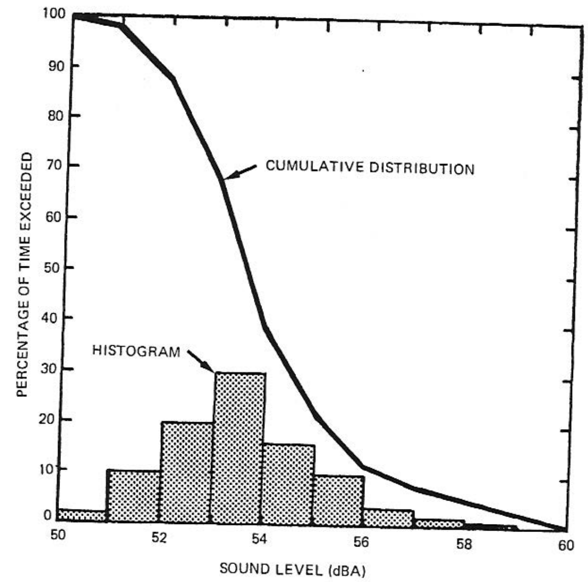



Figure 16.6 Statistically processed community noise showing histogram and cumulative distribution of A weighted sound levels.

*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

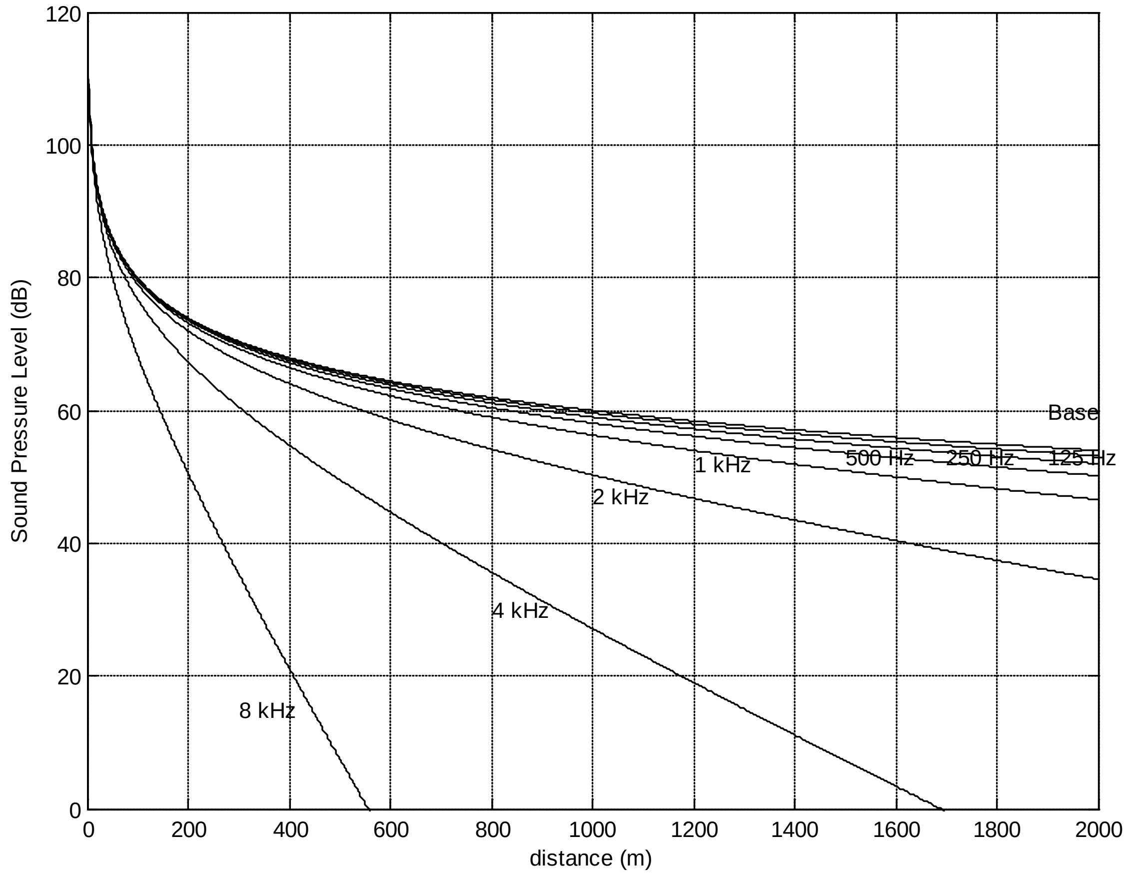
As sound transmits through a medium, there is an attenuation (or dissipation of acoustic energy) which can be attributed to three mechanisms:

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 10°C 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.

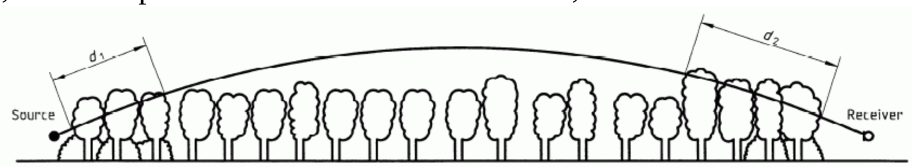
Topography
- One of the most important factors in sound propagation.
- Can provide a natural barrier between source and receiver (i.e. if berm or hill in between).
- Can provide a natural amplifier between source and receiver (i.e. large valley in between or hard reflective surface in between).
- Must 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 |
| | Attenuation, dB: | | | | | | | |
| $10 \leq d_f \leq 20$ | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 3 |
| | Attenuation, dB/m: | | | | | | | |
| $20 \leq d_f \leq 200$ | 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 |
|---|---|---|---|
| 8/20/14 22:12 | 8/20/14 22:13 | 1 | Loud Vehicle Passby |
| 8/20/14 22:23 | 8/20/14 22:24 | 1 | Loud Vehicle Passby |
| 8/20/14 22:48 | 8/20/14 22:49 | 1 | Loud Vehicle Passby |
| 8/20/14 22:52 | 8/20/14 22:53 | 1 | Loud Vehicle Passby |
| 8/20/14 23:02 | 8/20/14 23:03 | 1 | Loud Vehicle Passby |
| 8/20/14 23:23 | 8/20/14 23:23 | 1 | Loud Vehicle Passby |
| 8/21/14 00:16 | 8/21/14 00:16 | 1 | Loud Vehicle Passby |
| 8/21/14 00:20 | 8/21/14 00:21 | 1 | Loud Vehicle Passby |
| 8/21/14 00:33 | 8/21/14 00:33 | 1 | Loud Vehicle Passby |
| 8/21/14 00:36 | 8/21/14 00:38 | 3 | Loud Vehicle Passby |
| 8/21/14 00:53 | 8/21/14 00:55 | 2 | Loud Vehicle Passby |
| 8/21/14 00:55 | 8/21/14 00:56 | 1 | Loud Vehicle Passby |
| 8/21/14 03:01 | 8/21/14 03:02 | 1 | Loud Vehicle Passby |
| 8/21/14 03:23 | 8/21/14 03:24 | 1 | Loud Vehicle Passby |
| 8/21/14 03:41 | 8/21/14 03:42 | 1 | Loud Vehicle Passby |
| 8/21/14 04:05 | 8/21/14 04:05 | 1 | Loud Vehicle Passby |
| 8/21/14 04:06 | 8/21/14 04:07 | 1 | Loud Vehicle Passby |
| 8/21/14 04:08 | 8/21/14 04:09 | 1 | Loud Vehicle Passby |
| 8/21/14 04:18 | 8/21/14 04:18 | 0 | Loud Vehicle Passby |
| 8/21/14 04:20 | 8/21/14 04:21 | 1 | Loud Vehicle Passby |
| 8/21/14 04:30 | 8/21/14 04:31 | 1 | Loud Vehicle Passby |
| 8/21/14 04:32 | 8/21/14 04:34 | 2 | Loud Vehicle Passby |
| 8/21/14 04:35 | 8/21/14 04:36 | 1 | Loud Vehicle Passby |
| 8/21/14 04:39 | 8/21/14 04:39 | 0 | Loud Vehicle Passby |
| 8/21/14 04:42 | 8/21/14 04:43 | 1 | Loud Vehicle Passby |
| 8/21/14 04:45 | 8/21/14 04:46 | 1 | Loud Vehicle Passby |
| 8/21/14 04:47 | 8/21/14 04:48 | 2 | Loud Vehicle Passby |
| 8/21/14 04:50 | 8/21/14 04:50 | 1 | Loud Vehicle Passby |
| 8/21/14 04:52 | 8/21/14 04:56 | 4 | Loud Vehicle Passby |
| 8/21/14 04:58 | 8/21/14 05:00 | 2 | Loud Vehicle Passby |
| 8/21/14 05:02 | 8/21/14 05:02 | 1 | Loud Vehicle Passby |
| 8/21/14 05:02 | 8/21/14 05:03 | 1 | Loud Vehicle Passby |
| 8/21/14 05:04 | 8/21/14 05:05 | 1 | Loud Vehicle Passby |
| 8/21/14 05:06 | 8/21/14 05:07 | 1 | Loud Vehicle Passby |
| 8/21/14 05:09 | 8/21/14 05:12 | 3 | Loud Vehicle Passby |
| 8/21/14 05:14 | 8/21/14 05:18 | 4 | Several Vehicle Passby's |
| 8/21/14 05:21 | 8/21/14 05:28 | 8 | Several Vehicle Passby's |
| 8/21/14 05:34 | 8/21/14 05:34 | 1 | Several Vehicle Passby's |
| 8/21/14 05:38 | 8/21/14 05:39 | 1 | Several Vehicle Passby's |

**Data Removal Noise Monitoring Location #1 Cont.**

| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 8/21/14 05:43 | 8/21/14 07:01 | 78 | Morning Rush (Several Vehicles per minute) |
| 8/21/14 22:09 | 8/21/14 22:09 | 1 | Loud Vehicle Passby |
| 8/21/14 22:21 | 8/21/14 22:22 | 1 | Loud Vehicle Passby |
| 8/21/14 22:23 | 8/21/14 22:23 | 1 | Loud Vehicle Passby |
| 8/21/14 22:24 | 8/21/14 22:25 | 1 | Loud Vehicle Passby |
| 8/21/14 22:39 | 8/21/14 22:39 | 0 | Motorcycle in distant |
| 8/21/14 22:46 | 8/21/14 22:47 | 1 | Loud Vehicle Passby |
| 8/21/14 22:51 | 8/21/14 22:52 | 1 | Loud Vehicle Passby |
| 8/21/14 22:54 | 8/21/14 22:56 | 2 | Loud Vehicle Passby |
| 8/21/14 23:38 | 8/21/14 23:39 | 0 | Loud Vehicle Passby |
| 8/22/14 00:12 | 8/22/14 00:13 | 1 | Loud Vehicle Passby |
| 8/22/14 00:15 | 8/22/14 00:16 | 1 | Loud Vehicle Passby |
| 8/22/14 00:52 | 8/22/14 00:52 | 0 | Loud Vehicle Passby |
| 8/22/14 00:53 | 8/22/14 00:53 | 1 | Loud Vehicle Passby |
| 8/22/14 03:07 | 8/22/14 03:08 | 1 | Loud Vehicle Passby |
| 8/22/14 03:16 | 8/22/14 03:16 | 1 | Loud Vehicle Passby |
| 8/22/14 04:10 | 8/22/14 04:11 | 1 | Loud Vehicle Passby |
| 8/22/14 04:16 | 8/22/14 04:17 | 1 | Loud Vehicle Passby |
| 8/22/14 04:19 | 8/22/14 04:19 | 1 | Loud Vehicle Passby |
| 8/22/14 04:23 | 8/22/14 04:24 | 1 | Loud Vehicle Passby |
| 8/22/14 04:31 | 8/22/14 04:31 | 1 | Loud Vehicle Passby |
| 8/22/14 04:35 | 8/22/14 04:35 | 1 | Loud Vehicle Passby |
| 8/22/14 04:39 | 8/22/14 04:40 | 1 | Loud Vehicle Passby |
| 8/22/14 04:44 | 8/22/14 04:47 | 4 | Loud Vehicle Passby |
| 8/22/14 04:48 | 8/22/14 04:48 | 0 | Loud Vehicle Passby |
| 8/22/14 04:48 | 8/22/14 04:49 | 1 | Loud Vehicle Passby |
| 8/22/14 04:52 | 8/22/14 04:53 | 1 | Loud Vehicle Passby |
| 8/22/14 04:59 | 8/22/14 05:02 | 3 | Loud Vehicle Passby |
| 8/22/14 05:06 | 8/22/14 05:06 | 1 | Loud Vehicle Passby |
| 8/22/14 05:08 | 8/22/14 05:10 | 2 | Loud Vehicle Passby |
| 8/22/14 05:12 | 8/22/14 05:14 | 2 | Loud Vehicle Passby |
| 8/22/14 05:18 | 8/22/14 05:19 | 1 | Loud Vehicle Passby |
| 8/22/14 05:23 | 8/22/14 05:24 | 1 | Loud Vehicle Passby |
| 8/22/14 05:25 | 8/22/14 05:26 | 1 | Loud Vehicle Passby |
| 8/22/14 05:29 | 8/22/14 05:30 | 1 | Loud Vehicle Passby |
| 8/22/14 05:32 | 8/22/14 05:33 | 1 | Loud Vehicle Passby |
| 8/22/14 05:38 | 8/22/14 05:39 | 1 | Loud Vehicle Passby |
| 8/22/14 05:41 | 8/22/14 05:44 | 3 | Loud Vehicle Passby |
| 8/22/14 05:45 | 8/22/14 05:46 | 1 | Loud Vehicle Passby |
| 8/22/14 05:47 | 8/22/14 05:48 | 1 | Loud Vehicle Passby |

## Data Removal Noise Monitoring Location #1 Cont.

| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 8/22/14 05:49 | 8/22/14 06:59 | 70 | Morning Rush (Several Vehicles per Minute) |
| | **Total Night #1** | **131** | |
| | **Total Night #2** | **109** | |
| | **Total Data** | **240** | |

## Data Removal Noise Monitoring Location #2

| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 8/13/14 22:15 | 8/13/14 22:15 | 1 | Loud Vehicle Passby |
| 8/13/14 22:23 | 8/13/14 22:24 | 1 | Loud Vehicle Passby |
| 8/13/14 22:24 | 8/13/14 22:26 | 2 | Loud Vehicle Passby |
| 8/13/14 22:29 | 8/13/14 22:30 | 1 | Check on Monitor |
| 8/13/14 23:16 | 8/13/14 23:16 | 1 | Loud Vehicle Passby |
| 8/13/14 23:42 | 8/13/14 23:42 | 1 | Loud Vehicle Passby |
| 8/13/14 23:56 | 8/13/14 23:57 | 0 | Loud Vehicle Passby |
| 8/14/14 01:12 | 8/14/14 01:13 | 2 | Train Passby |
| 8/14/14 01:17 | 8/14/14 01:18 | 1 | Train Passby |
| 8/14/14 03:14 | 8/14/14 03:32 | 18 | Rail Activity |
| 8/14/14 05:25 | 8/14/14 05:26 | 1 | Loud Vehicle Passby |
| 8/14/14 05:29 | 8/14/14 05:30 | 1 | Loud Vehicle Passby |
| 8/14/14 05:36 | 8/14/14 07:00 | 84 | (Morning Rush) Several Vehicles Per Minute |
| 8/14/14 23:37 | 8/14/14 23:37 | 0 | Train Whistle |
| 8/15/14 00:38 | 8/15/14 00:39 | 1 | Loud Vehicle Passby |
| 8/15/14 00:59 | 8/15/14 00:59 | 0 | Train Whistle |
| 8/15/14 02:40 | 8/15/14 02:40 | 1 | Loud Vehicle Passby |
| 8/15/14 02:59 | 8/15/14 03:00 | 1 | Loud Vehicle Passby |
| 8/15/14 03:09 | 8/15/14 03:09 | 0 | Train Whistle |
| 8/15/14 03:15 | 8/15/14 03:15 | 1 | Loud Vehicle Passby |
| 8/15/14 03:17 | 8/15/14 03:18 | 1 | Loud Vehicle Passby |
| 8/15/14 04:19 | 8/15/14 04:20 | 1 | Horn |
| 8/15/14 04:24 | 8/15/14 04:24 | 1 | Horn |
| 8/15/14 04:33 | 8/15/14 04:50 | 17 | Rail Activity |
| 8/15/14 04:58 | 8/15/14 04:59 | 1 | Train Whistle |
| 8/15/14 05:27 | 8/15/14 05:28 | 1 | Loud Vehicle Passby |
| 8/15/14 05:39 | 8/15/14 05:40 | 1 | Loud Vehicle Passby |
| 8/15/14 05:40 | 8/15/14 05:41 | 1 | Loud Vehicle Passby |
| 8/15/14 05:57 | 8/15/14 05:57 | 1 | Loud Vehicle Passby |
| 8/15/14 06:03 | 8/15/14 06:05 | 2 | Loud Vehicle Passby |
| 8/15/14 06:10 | 8/15/14 07:00 | 49 | (Morning Rush) Several Vehicles Per Minute |
| | **Total Night #1** | **115** | |
| | **Total Night #2** | **81** | |
| | **Total Data** | **196** | |

## Data Removal Noise Monitoring Location #3

| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 8/13/14 22:31 | 8/13/14 22:31 | 1 | Loud Vehicle Passby |
| 8/13/14 22:39 | 8/13/14 22:40 | 1 | Loud Vehicle Passby |
| 8/13/14 23:17 | 8/13/14 23:18 | 1 | Loud Vehicle Passby |
| 8/14/14 00:00 | 8/14/14 00:01 | 1 | Loud Vehicle Passby |
| 8/14/14 00:03 | 8/14/14 00:04 | 1 | Loud Vehicle Passby |
| 8/14/14 00:10 | 8/14/14 00:10 | 1 | Loud Vehicle Passby |
| 8/14/14 01:04 | 8/14/14 01:04 | 0 | Aircraft Flyover |
| 8/14/14 01:06 | 8/14/14 01:07 | 1 | Train Passby |
| 8/14/14 01:12 | 8/14/14 01:13 | 1 | Train Passby |
| 8/14/14 01:17 | 8/14/14 01:18 | 1 | Train Passby |
| 8/14/14 01:21 | 8/14/14 01:23 | 2 | Train Passby |
| 8/14/14 01:30 | 8/14/14 01:31 | 1 | Train Passby |
| 8/14/14 01:41 | 8/14/14 01:43 | 2 | Train Passby |
| 8/14/14 01:44 | 8/14/14 01:46 | 2 | Train Passby |
| 8/14/14 02:37 | 8/14/14 02:38 | 1 | Train Passby |
| 8/14/14 02:42 | 8/14/14 02:44 | 2 | Train Passby |
| 8/14/14 02:45 | 8/14/14 02:46 | 1 | Loud Vehicle Passby |
| 8/14/14 02:47 | 8/14/14 02:55 | 8 | Train Passby |
| 8/14/14 03:19 | 8/14/14 03:20 | 1 | Train Passby |
| 8/14/14 03:31 | 8/14/14 03:32 | 1 | Train Passby |
| 8/14/14 03:36 | 8/14/14 03:37 | 1 | Train Passby |
| 8/14/14 03:53 | 8/14/14 03:55 | 2 | Train Passby |
| 8/14/14 04:46 | 8/14/14 04:47 | 1 | Loud Vehicle Passby |
| 8/14/14 05:24 | 8/14/14 05:25 | 1 | Loud Vehicle Passby |
| 8/14/14 05:29 | 8/14/14 05:30 | 1 | Loud Vehicle Passby |
| 8/14/14 05:31 | 8/14/14 05:32 | 1 | Loud Vehicle Passby |
| 8/14/14 05:37 | 8/14/14 05:39 | 1 | Loud Vehicle Passby |
| 8/14/14 05:40 | 8/14/14 05:41 | 1 | Loud Vehicle Passby |
| 8/14/14 05:45 | 8/14/14 05:46 | 1 | Loud Vehicle Passby |
| 8/14/14 05:55 | 8/14/14 05:56 | 2 | Loud Vehicle Passby |
| 8/14/14 05:59 | 8/14/14 06:00 | 1 | Loud Vehicle Passby |
| 8/14/14 06:05 | 8/14/14 06:05 | 1 | Loud Vehicle Passby |
| 8/14/14 06:07 | 8/14/14 06:10 | 3 | Loud Vehicle Passby |
| 8/14/14 06:14 | 8/14/14 06:15 | 1 | Loud Vehicle Passby |
| 8/14/14 06:18 | 8/14/14 06:19 | 1 | Loud Vehicle Passby |
| 8/14/14 06:19 | 8/14/14 06:20 | 1 | Loud Vehicle Passby |
| 8/14/14 06:26 | 8/14/14 06:26 | 1 | Loud Vehicle Passby |
| 8/14/14 06:31 | 8/14/14 06:32 | 1 | Loud Vehicle Passby |
| 8/14/14 06:41 | 8/14/14 06:42 | 1 | Loud Vehicle Passby |
| 8/14/14 06:45 | 8/14/14 06:46 | 1 | Loud Vehicle Passby |

## Data Removal Noise Monitoring Location #3 Cont.

| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 8/14/14 06:47 | 8/14/14 06:48 | 1 | Loud Vehicle Passby |
| 8/14/14 06:52 | 8/14/14 06:53 | 1 | Loud Vehicle Passby |
| 8/14/14 06:54 | 8/14/14 06:56 | 2 | Loud Vehicle Passby |
| 8/14/14 06:58 | 8/14/14 06:59 | 1 | Loud Vehicle Passby |
| 8/14/14 07:00 | 8/14/14 07:00 | 1 | Loud Vehicle Passby |
| 8/14/14 22:43 | 8/14/14 22:44 | 1 | Loud Vehicle Passby |
| 8/14/14 23:37 | 8/14/14 23:38 | 1 | Train Passby |
| 8/14/14 23:41 | 8/14/14 23:47 | 6 | Train Passby |
| 8/15/14 00:41 | 8/15/14 00:46 | 4 | Train Passby |
| 8/15/14 00:49 | 8/15/14 00:54 | 4 | Train Passby |
| 8/15/14 00:59 | 8/15/14 01:00 | 2 | Train Passby |
| 8/15/14 02:36 | 8/15/14 02:38 | 2 | Train Passby |
| 8/15/14 03:09 | 8/15/14 03:10 | 1 | Train Passby |
| 8/15/14 03:30 | 8/15/14 03:33 | 3 | Train Passby |
| 8/15/14 04:45 | 8/15/14 04:46 | 1 | Train Passby |
| 8/15/14 04:50 | 8/15/14 04:52 | 2 | Train Passby |
| 8/15/14 04:57 | 8/15/14 04:59 | 2 | Train Passby |
| 8/15/14 05:20 | 8/15/14 05:21 | 2 | Train Passby |
| 8/15/14 05:24 | 8/15/14 05:26 | 2 | Loud Vehicle Passby |
| 8/15/14 05:33 | 8/15/14 05:34 | 1 | Loud Vehicle Passby |
| 8/15/14 05:45 | 8/15/14 05:45 | 1 | Loud Vehicle Passby |
| 8/15/14 05:50 | 8/15/14 05:52 | 2 | Train Passby |
| 8/15/14 05:52 | 8/15/14 05:53 | 1 | Loud Vehicle Passby |
| 8/15/14 05:55 | 8/15/14 05:57 | 1 | Loud Vehicle Passby |
| 8/15/14 06:05 | 8/15/14 06:06 | 1 | Loud Vehicle Passby |
| 8/15/14 06:09 | 8/15/14 06:10 | 1 | Loud Vehicle Passby |
| 8/15/14 06:12 | 8/15/14 06:13 | 1 | Loud Vehicle Passby |
| 8/15/14 06:14 | 8/15/14 06:16 | 2 | Train Passby |
| 8/15/14 06:17 | 8/15/14 06:18 | 1 | Loud Vehicle Passby |
| 8/15/14 06:20 | 8/15/14 06:21 | 1 | Loud Vehicle Passby |
| 8/15/14 06:36 | 8/15/14 06:37 | 1 | Loud Vehicle Passby |
| 8/15/14 06:43 | 8/15/14 06:44 | 2 | Loud Vehicle Passby |
| 8/15/14 06:47 | 8/15/14 06:48 | 1 | Loud Vehicle Passby |
| 8/15/14 06:54 | 8/15/14 06:55 | 1 | Loud Vehicle Passby |
| 8/15/14 06:57 | 8/15/14 06:58 | 1 | Loud Vehicle Passby |
| | **Total Night #1** | **55** | |
| | **Total Night #2** | **53** | |
| | **Total Data** | **109** | |

## Data Removal Noise Monitoring Location #4

| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 6/16/14 23:29 | 6/16/14 23:30 | 1 | Train Whistle |
| 6/17/14 00:23 | 6/17/14 00:25 | 1 | Whistle from other equipment |
| 6/17/14 00:32 | 6/17/14 00:33 | 1 | Train Whistle |
| 6/17/14 00:53 | 6/17/14 00:55 | 2 | Helicopter |
| 6/17/14 01:54 | 6/17/14 01:55 | 1 | Train Whistle |
| 6/17/14 02:43 | 6/17/14 02:44 | 1 | Aircraft Flyover |
| 6/17/14 04:17 | 6/17/14 04:20 | 2 | Train Passby |
| 6/17/14 04:25 | 6/17/14 04:26 | 1 | Train Passby |
| 6/17/14 05:23 | 6/17/14 05:23 | 0 | Train Whistle |
| 6/17/14 05:59 | 6/17/14 06:00 | 1 | Excessive Bird Noise |
| 6/25/14 23:23 | 6/25/14 23:23 | 0 | Aircraft Flyover |
| 6/26/14 03:51 | 6/26/14 03:55 | 4 | Train Passby |
| 6/26/14 05:56 | 6/26/14 05:58 | 2 | Train Passby |
| 6/26/14 06:16 | 6/26/14 06:17 | 1 | Train Passby |
| 6/26/14 06:32 | 6/26/14 06:34 | 1 | Train Passby |
| | **Total Night #1** | **13** | |
| | **Total Night #2** | **8** | |
| | **Total Data** | **21** | |

## Data Removal Noise Monitoring Location #5

| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 8/13/14 22:24 | 8/13/14 22:25 | 1 | Loud Vehicle Passby |
| 8/13/14 22:50 | 8/13/14 22:52 | 2 | Check on monitor |
| 8/13/14 22:52 | 8/13/14 22:55 | 3 | Check on monitor |
| 8/14/14 02:45 | 8/14/14 02:46 | 1 | Loud Vehicle Passby |
| 8/14/14 02:53 | 8/14/14 02:54 | 1 | Loud Vehicle Passby |
| 8/14/14 05:07 | 8/14/14 05:13 | 6 | Loud Vehicle Passby |
| 8/14/14 05:22 | 8/14/14 05:22 | 1 | Loud Vehicle Passby |
| 8/14/14 05:25 | 8/14/14 05:26 | 1 | Loud Vehicle Passby |
| 8/14/14 05:26 | 8/14/14 05:28 | 2 | Loud Vehicle Passby |
| 8/14/14 05:28 | 8/14/14 05:32 | 3 | Loud Vehicle Passby |
| 8/14/14 05:32 | 8/14/14 05:35 | 2 | Loud Vehicle Passby |
| 8/14/14 05:41 | 8/14/14 05:44 | 3 | Loud Vehicle Passby |
| 8/14/14 06:13 | 8/14/14 06:18 | 4 | Loud Vehicle Passby |
| 8/14/14 06:19 | 8/14/14 06:21 | 2 | Loud Vehicle Passby |
| 8/14/14 06:24 | 8/14/14 06:25 | 1 | Loud Vehicle Passby |
| 8/14/14 06:34 | 8/14/14 06:35 | 1 | Loud Vehicle Passby |
| 8/14/14 06:40 | 8/14/14 06:41 | 1 | Loud Vehicle Passby |
| 8/14/14 06:42 | 8/14/14 06:43 | 1 | Loud Vehicle Passby |
| 8/14/14 06:48 | 8/14/14 06:49 | 1 | Loud Vehicle Passby |
| 8/14/14 06:53 | 8/14/14 06:54 | 1 | Loud Vehicle Passby |
| 8/14/14 22:12 | 8/14/14 22:13 | 1 | Loud Vehicle Passby |
| 8/14/14 23:18 | 8/14/14 23:19 | 1 | Loud Vehicle Passby |
| 8/14/14 23:21 | 8/14/14 23:22 | 1 | Loud Vehicle Passby |
| 8/14/14 23:45 | 8/14/14 23:46 | 1 | Loud Vehicle Passby |
| 8/15/14 03:34 | 8/15/14 03:36 | 1 | Loud Vehicle Passby |
| 8/15/14 04:42 | 8/15/14 04:44 | 3 | Train Passby |
| 8/15/14 05:24 | 8/15/14 05:24 | 1 | Loud Vehicle Passby |
| 8/15/14 05:28 | 8/15/14 05:29 | 1 | Loud Vehicle Passby |
| 8/15/14 05:37 | 8/15/14 05:37 | 1 | Loud Vehicle Passby |
| 8/15/14 05:45 | 8/15/14 05:46 | 1 | Loud Vehicle Passby |
| 8/15/14 05:51 | 8/15/14 05:51 | 1 | Loud Vehicle Passby |
| 8/15/14 05:52 | 8/15/14 05:52 | 1 | Loud Vehicle Passby |
| 8/15/14 06:26 | 8/15/14 06:27 | 1 | Loud Vehicle Passby |
| 8/15/14 06:47 | 8/15/14 06:47 | 1 | Loud Vehicle Passby |
| 8/15/14 06:57 | 8/15/14 06:57 | 1 | Loud Vehicle Passby |
| | **Total Night #1** | **39** | |
| | **Total Night #2** | **17** | |
| | **Total Data** | **56** | |

# Data Removal Noise Monitoring Location #6

| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 8/13/14 22:28 | 8/13/14 22:30 | 2 | Coyotes Howling |
| 8/13/14 23:17 | 8/13/14 23:25 | 8 | Site Visit |
| 8/13/14 23:45 | 8/13/14 23:47 | 2 | Vehicle Honking Horn |
| 8/13/14 23:48 | 8/13/14 23:49 | 2 | Loud Vehicle Passby |
| 8/14/14 05:49 | 8/14/14 05:49 | 1 | Loud Vehicle Passby |
| 8/14/14 06:23 | 8/14/14 06:25 | 2 | Loud Vehicle Passby |
| 8/14/14 06:27 | 8/14/14 06:29 | 1 | Loud Vehicle Passby |
| 8/14/14 06:42 | 8/14/14 06:44 | 2 | Loud Vehicle Passby |
| 8/14/14 06:55 | 8/14/14 06:56 | 1 | Loud Vehicle Passby |
| 8/14/14 06:59 | 8/14/14 06:59 | 0 | Loud Vehicle Passby |
| 8/14/14 07:00 | 8/14/14 07:00 | 0 | Loud Vehicle Passby |
| 8/14/14 22:53 | 8/14/14 23:00 | 7 | Site Visit |
| 8/14/14 23:00 | 8/14/14 23:03 | 3 | Site Visit |
| 8/14/14 23:41 | 8/14/14 23:43 | 2 | Loud Vehicle Passby |
| 8/15/14 06:28 | 8/15/14 06:29 | 1 | Loud Vehicle Passby |
| 8/15/14 06:35 | 8/15/14 06:36 | 1 | Loud Vehicle Passby |
| 8/15/14 06:44 | 8/15/14 06:45 | 1 | Loud Vehicle Passby |
| 8/15/14 06:50 | 8/15/14 06:51 | 1 | Loud Vehicle Passby |
| | **Total Night #1** | **20** | |
| | **Total Night #2** | **16** | |
| | **Total Data** | **37** | |

## Data Removal Noise Monitoring Location #8

| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 8/13/14 22:22 | 8/13/14 22:23 | 1 | Train Passby |
| 8/13/14 22:31 | 8/13/14 22:32 | 1 | Train Passby |
| 8/13/14 23:46 | 8/13/14 23:48 | 2 | Abnormal Machine noise |
| 8/13/14 23:51 | 8/13/14 23:57 | 6 | Monitor Check |
| 8/14/14 00:32 | 8/14/14 00:32 | 0 | Train Passby |
| 8/14/14 01:43 | 8/14/14 01:46 | 2 | Loud Vehicle Passby |
| 8/14/14 02:35 | 8/14/14 02:35 | 0 | Train Passby |
| 8/14/14 02:45 | 8/14/14 02:46 | 1 | Train Passby |
| 8/14/14 04:20 | 8/14/14 04:20 | 0 | Aircraft Flyover |
| 8/14/14 05:53 | 8/14/14 05:53 | 1 | Excessive Bird Noise |
| 8/14/14 06:44 | 8/14/14 06:45 | 1 | Loud Vehicle Passby |
| 8/14/14 22:12 | 8/14/14 22:12 | 1 | Train Passby |
| 8/14/14 22:24 | 8/14/14 22:30 | 5 | Check on monitor |
| 8/14/14 22:35 | 8/14/14 22:35 | 1 | Train Passby |
| 8/15/14 02:41 | 8/15/14 02:45 | 4 | Train Passby |
| 8/15/14 03:03 | 8/15/14 03:04 | 1 | Train Passby |
| 8/15/14 03:10 | 8/15/14 03:11 | 1 | Train Passby |
| 8/15/14 03:30 | 8/15/14 03:31 | 1 | Train Passby |
| 8/15/14 03:35 | 8/15/14 03:35 | 1 | Train Passby |
| 8/15/14 04:10 | 8/15/14 04:11 | 1 | Loud Vehicle Passby |
| 8/15/14 04:12 | 8/15/14 04:12 | 1 | Loud Vehicle Passby |
| 8/15/14 06:35 | 8/15/14 06:37 | 3 | Excessive Bird Noise |
| 8/15/14 06:43 | 8/15/14 06:59 | 16 | Excessive Bird Noise |
| 8/15/14 06:59 | 8/15/14 06:59 | 0 | Excessive Bird Noise |
| | **Total Night #1** | **16** | |
| | **Total Night #2** | **35** | |
| | **Total Data** | **51** | |

# Data Removal Noise Monitoring Location #9

| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 8/20/14 22:17 | 8/20/14 22:18 | 1 | Loud Vehicle Passby |
| 8/20/14 22:36 | 8/20/14 22:36 | 0 | Train Passby |
| 8/20/14 22:50 | 8/20/14 22:55 | 5 | Train Passby |
| 8/20/14 22:58 | 8/20/14 22:58 | 1 | Train Passby |
| 8/20/14 23:03 | 8/20/14 23:04 | 2 | Train Passby |
| 8/20/14 23:08 | 8/20/14 23:15 | 7 | Train Passby |
| 8/20/14 23:17 | 8/20/14 23:17 | 0 | Train Passby |
| 8/20/14 23:18 | 8/20/14 23:18 | 0 | Train Passby |
| 8/20/14 23:21 | 8/20/14 23:22 | 1 | Train Passby |
| 8/20/14 23:24 | 8/20/14 23:29 | 5 | Train Passby |
| 8/20/14 23:41 | 8/20/14 23:42 | 2 | Monitor Check |
| 8/20/14 23:45 | 8/20/14 23:46 | 1 | Monitor Check |
| 8/20/14 23:55 | 8/20/14 23:56 | 1 | Train Passby |
| 8/20/14 23:57 | 8/20/14 23:58 | 1 | Train Passby |
| 8/20/14 23:59 | 8/21/14 00:00 | 1 | Train Passby |
| 8/21/14 00:02 | 8/21/14 00:03 | 1 | Train Passby |
| 8/21/14 00:04 | 8/21/14 00:05 | 1 | Train Passby |
| 8/21/14 00:36 | 8/21/14 00:38 | 2 | Train Passby |
| 8/21/14 00:39 | 8/21/14 00:41 | 2 | Train Passby |
| 8/21/14 00:46 | 8/21/14 00:48 | 2 | Train Passby |
| 8/21/14 00:52 | 8/21/14 00:53 | 1 | Train Passby |
| 8/21/14 01:00 | 8/21/14 01:02 | 1 | Train Passby |
| 8/21/14 01:34 | 8/21/14 01:35 | 1 | Train Passby |
| 8/21/14 01:37 | 8/21/14 01:40 | 4 | Train Passby |
| 8/21/14 01:40 | 8/21/14 01:46 | 6 | Train Passby |
| 8/21/14 01:46 | 8/21/14 01:50 | 4 | Train Passby |
| 8/21/14 01:51 | 8/21/14 02:01 | 11 | Train Passby |
| 8/21/14 02:02 | 8/21/14 02:06 | 4 | Train Passby |
| 8/21/14 02:23 | 8/21/14 02:37 | 14 | Train Passby |
| 8/21/14 03:47 | 8/21/14 03:48 | 1 | Train Passby |
| 8/21/14 03:49 | 8/21/14 03:53 | 3 | Train Passby |
| 8/21/14 03:56 | 8/21/14 03:58 | 2 | Train Passby |
| 8/21/14 03:59 | 8/21/14 04:07 | 8 | Train Passby |
| 8/21/14 04:49 | 8/21/14 04:50 | 1 | Loud Vehicle Passby |
| 8/21/14 04:56 | 8/21/14 05:05 | 10 | Loud Vehicle Passby |
| 8/21/14 05:16 | 8/21/14 05:19 | 3 | Train Passby |
| 8/21/14 05:24 | 8/21/14 05:25 | 1 | Loud Vehicle Passby |
| 8/21/14 05:46 | 8/21/14 05:48 | 2 | Train Passby |
| 8/21/14 06:02 | 8/21/14 06:03 | 1 | Loud Vehicle Passby |
| 8/21/14 06:12 | 8/21/14 06:14 | 2 | Loud Vehicle Passby |

## Data Removal Noise Monitoring Location #9 Cont.

| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 8/21/14 06:15 | 8/21/14 06:15 | 1 | Loud Vehicle Passby |
| 8/21/14 06:16 | 8/21/14 06:16 | 1 | Loud Vehicle Passby |
| 8/21/14 06:18 | 8/21/14 06:20 | 2 | Loud Vehicle Passby |
| 8/21/14 06:39 | 8/21/14 06:40 | 2 | Train Passby |
| 8/21/14 22:01 | 8/21/14 22:02 | 1 | Train Passby |
| 8/21/14 22:24 | 8/21/14 22:25 | 1 | Train Passby |
| 8/21/14 22:30 | 8/21/14 22:32 | 2 | Train Passby |
| 8/21/14 22:36 | 8/21/14 22:37 | 2 | Train Passby |
| 8/21/14 22:43 | 8/21/14 22:44 | 1 | Loud Vehicle Passby |
| 8/21/14 23:02 | 8/21/14 23:08 | 6 | Monitor Check |
| 8/21/14 23:21 | 8/21/14 23:22 | 2 | Loud Vehicle Passby |
| 8/21/14 23:31 | 8/21/14 23:34 | 3 | Loud Vehicle Passby |
| 8/21/14 23:48 | 8/21/14 23:50 | 2 | Loud Vehicle Passby |
| 8/22/14 00:11 | 8/22/14 00:15 | 5 | Train Passby |
| 8/22/14 00:17 | 8/22/14 00:20 | 3 | Train Passby |
| 8/22/14 00:21 | 8/22/14 00:22 | 1 | Train Passby |
| 8/22/14 00:32 | 8/22/14 00:33 | 1 | Train Passby |
| 8/22/14 00:38 | 8/22/14 00:39 | 1 | Train Passby |
| 8/22/14 00:52 | 8/22/14 00:57 | 5 | Train Passby |
| 8/22/14 01:01 | 8/22/14 01:01 | 1 | Loud Vehicle Passby |
| 8/22/14 01:26 | 8/22/14 01:27 | 1 | Loud Vehicle Passby |
| 8/22/14 02:26 | 8/22/14 02:27 | 0 | Train Passby |
| 8/22/14 02:30 | 8/22/14 02:31 | 1 | Train Passby |
| 8/22/14 02:33 | 8/22/14 02:34 | 1 | Train Passby |
| 8/22/14 02:38 | 8/22/14 02:38 | 1 | Train Passby |
| 8/22/14 02:41 | 8/22/14 02:46 | 5 | Train Passby |
| 8/22/14 03:08 | 8/22/14 03:11 | 2 | Train Passby |
| 8/22/14 04:48 | 8/22/14 04:49 | 1 | Train Passby |
| 8/22/14 04:52 | 8/22/14 04:58 | 6 | Train Passby |
| 8/22/14 05:13 | 8/22/14 05:14 | 1 | Train Passby |
| 8/22/14 05:22 | 8/22/14 05:23 | 1 | Train Passby |
| 8/22/14 05:52 | 8/22/14 05:53 | 1 | Loud Vehicle Passby |
| 8/22/14 05:55 | 8/22/14 05:56 | 1 | Loud Vehicle Passby |
| 8/22/14 06:04 | 8/22/14 06:05 | 1 | Train Passby |
| 8/22/14 06:16 | 8/22/14 06:16 | 1 | Train Passby |
| 8/22/14 06:17 | 8/22/14 06:20 | 3 | Train Passby |
| 8/22/14 06:22 | 8/22/14 06:23 | 1 | Loud Vehicle Passby |
| 8/22/14 06:26 | 8/22/14 06:27 | 1 | Train Passby |
| 8/22/14 06:27 | 8/22/14 06:28 | 1 | Loud Vehicle Passby |
| 8/22/14 06:28 | 8/22/14 06:31 | 3 | Loud Vehicle Passby |

## Data Removal Noise Monitoring Location #9 Cont.

| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 8/22/14 06:37 | 8/22/14 06:40 | 3 | Loud Vehicle Passby |
| 8/22/14 06:40 | 8/22/14 06:47 | 7 | Loud Vehicle Passby |
| 8/22/14 06:49 | 8/22/14 06:51 | 2 | Train Passby |
| 8/22/14 06:54 | 8/22/14 06:56 | 3 | Loud Vehicle Passby |
| | **Total Night #1** | **21** | |
| | **Total Night #2** | **28** | |
| | **Total Data** | **49** | |

## Data Removal Noise Monitoring Location #10

| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 8/20/14 21:31 | 8/20/14 21:31 | 0 | Aircraft Flyover |
| 8/20/14 22:00 | 8/20/14 22:01 | 1 | Train Passby |
| 8/20/14 22:02 | 8/20/14 22:03 | 2 | Train Passby |
| 8/20/14 22:14 | 8/20/14 22:15 | 1 | Loud Vehicle Passby |
| 8/20/14 22:16 | 8/20/14 22:18 | 2 | Train Passby |
| 8/20/14 22:18 | 8/20/14 22:19 | 1 | Loud Vehicle Passby |
| 8/20/14 22:26 | 8/20/14 22:26 | 1 | Loud Vehicle Passby |
| 8/20/14 22:44 | 8/20/14 22:45 | 1 | Loud Vehicle Passby |
| 8/20/14 22:48 | 8/20/14 22:48 | 1 | Loud Vehicle Passby |
| 8/20/14 22:59 | 8/20/14 22:59 | 1 | Loud Vehicle Passby |
| 8/20/14 23:06 | 8/20/14 23:07 | 1 | Loud Vehicle Passby |
| 8/20/14 23:11 | 8/20/14 23:12 | 1 | Loud Vehicle Passby |
| 8/20/14 23:14 | 8/20/14 23:15 | 1 | Monitor Check |
| 8/20/14 23:29 | 8/20/14 23:29 | 0 | Loud Vehicle Passby |
| 8/20/14 23:30 | 8/20/14 23:30 | 0 | Loud Vehicle Passby |
| 8/20/14 23:31 | 8/20/14 23:32 | 1 | Loud Vehicle Passby |
| 8/20/14 23:47 | 8/20/14 23:47 | 0 | Loud Vehicle Passby |
| 8/20/14 23:58 | 8/21/14 00:00 | 2 | Loud Vehicle Passby |
| 8/21/14 00:02 | 8/21/14 00:05 | 3 | Loud Vehicle Passby |
| 8/21/14 00:19 | 8/21/14 00:19 | 1 | Loud Vehicle Passby |
| 8/21/14 00:39 | 8/21/14 00:41 | 2 | Loud Vehicle Passby |
| 8/21/14 00:49 | 8/21/14 00:50 | 0 | Train Passby |
| 8/21/14 00:58 | 8/21/14 00:59 | 1 | Loud Vehicle Passby |
| 8/21/14 01:09 | 8/21/14 01:10 | 1 | Loud Vehicle Passby |
| 8/21/14 01:17 | 8/21/14 01:18 | 1 | Loud Vehicle Passby |
| 8/21/14 01:37 | 8/21/14 01:38 | 2 | Loud Vehicle Passby |
| 8/21/14 01:59 | 8/21/14 01:59 | 1 | Loud Vehicle Passby |
| 8/21/14 02:32 | 8/21/14 02:35 | 3 | Train Passby |
| 8/21/14 03:22 | 8/21/14 03:24 | 1 | Loud Vehicle Passby |
| 8/21/14 03:51 | 8/21/14 03:52 | 1 | Loud Vehicle Passby |
| 8/21/14 03:55 | 8/21/14 03:55 | 1 | Loud Vehicle Passby |
| 8/21/14 04:00 | 8/21/14 04:02 | 2 | Loud Vehicle Passby |
| 8/21/14 04:02 | 8/21/14 04:06 | 4 | Train Passby |
| 8/21/14 04:15 | 8/21/14 04:17 | 1 | Loud Vehicle Passby |
| 8/21/14 04:23 | 8/21/14 04:23 | 1 | Train Passby |
| 8/21/14 04:25 | 8/21/14 04:26 | 1 | Loud Vehicle Passby |
| 8/21/14 04:32 | 8/21/14 04:33 | 1 | Loud Vehicle Passby |
| 8/21/14 04:34 | 8/21/14 04:37 | 3 | Loud Vehicle Passby |
| 8/21/14 04:39 | 8/21/14 04:45 | 6 | Loud Vehicle Passby |
| 8/21/14 04:54 | 8/21/14 04:59 | 5 | Train Passby |

## Data Removal Noise Monitoring Location #10 Cont.

| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 8/21/14 05:10 | 8/21/14 05:11 | 1 | Loud Vehicle Passby |
| 8/21/14 05:15 | 8/21/14 05:21 | 6 | Loud Vehicle Passby |
| 8/21/14 05:24 | 8/21/14 07:01 | 98 | (Morning Rush) Several Vehicles Per Minute |
| 8/21/14 22:02 | 8/21/14 22:05 | 3 | Loud Vehicle Passby |
| 8/21/14 22:12 | 8/21/14 22:13 | 1 | Loud Vehicle Passby |
| 8/21/14 22:17 | 8/21/14 22:18 | 1 | Loud Vehicle Passby |
| 8/21/14 22:19 | 8/21/14 22:20 | 1 | Loud Vehicle Passby |
| 8/21/14 22:25 | 8/21/14 22:27 | 2 | Loud Vehicle Passby |
| 8/21/14 22:33 | 8/21/14 22:34 | 1 | Loud Vehicle Passby |
| 8/21/14 22:38 | 8/21/14 22:38 | 0 | Loud Vehicle Passby |
| 8/21/14 22:41 | 8/21/14 22:41 | 1 | Loud Vehicle Passby |
| 8/21/14 22:43 | 8/21/14 22:43 | 1 | Loud Vehicle Passby |
| 8/21/14 22:48 | 8/21/14 22:49 | 1 | Monitor Check |
| 8/21/14 22:56 | 8/21/14 22:57 | 1 | Loud Vehicle Passby |
| 8/21/14 23:02 | 8/21/14 23:03 | 2 | Loud Vehicle Passby |
| 8/21/14 23:26 | 8/21/14 23:26 | 1 | Loud Vehicle Passby |
| 8/21/14 23:30 | 8/21/14 23:31 | 1 | Loud Vehicle Passby |
| 8/21/14 23:39 | 8/21/14 23:40 | 1 | Loud Vehicle Passby |
| 8/22/14 00:11 | 8/22/14 00:12 | 1 | Train Passby |
| 8/22/14 00:19 | 8/22/14 00:20 | 0 | Loud Vehicle Passby |
| 8/22/14 00:32 | 8/22/14 00:33 | 1 | Loud Vehicle Passby |
| 8/22/14 00:38 | 8/22/14 00:39 | 1 | Loud Vehicle Passby |
| 8/22/14 00:51 | 8/22/14 00:53 | 2 | Loud Vehicle Passby |
| 8/22/14 01:01 | 8/22/14 01:02 | 1 | Loud Vehicle Passby |
| 8/22/14 01:08 | 8/22/14 01:09 | 1 | Train Passby |
| 8/22/14 01:17 | 8/22/14 01:18 | 1 | Loud Vehicle Passby |
| 8/22/14 01:34 | 8/22/14 01:35 | 1 | Loud Vehicle Passby |
| 8/22/14 02:33 | 8/22/14 02:34 | 1 | Train Passby |
| 8/22/14 02:38 | 8/22/14 02:39 | 1 | Train Passby |
| 8/22/14 03:01 | 8/22/14 03:01 | 1 | Train Passby |
| 8/22/14 03:07 | 8/22/14 03:08 | 1 | Loud Vehicle Passby |
| 8/22/14 03:11 | 8/22/14 03:12 | 1 | Loud Vehicle Passby |
| 8/22/14 03:24 | 8/22/14 03:24 | 1 | Train Passby |
| 8/22/14 03:34 | 8/22/14 03:34 | 1 | Train Passby |
| 8/22/14 03:43 | 8/22/14 03:44 | 1 | Loud Vehicle Passby |
| 8/22/14 03:51 | 8/22/14 03:52 | 1 | Loud Vehicle Passby |
| 8/22/14 03:55 | 8/22/14 03:56 | 1 | Loud Vehicle Passby |
| 8/22/14 04:02 | 8/22/14 04:03 | 1 | Loud Vehicle Passby |
| 8/22/14 04:15 | 8/22/14 04:16 | 1 | Loud Vehicle Passby |
| 8/22/14 04:17 | 8/22/14 04:18 | 1 | Loud Vehicle Passby |

## Data Removal Noise Monitoring Location #10 Cont.

| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 8/22/14 04:21 | 8/22/14 04:22 | 1 | Loud Vehicle Passby |
| 8/22/14 04:25 | 8/22/14 04:25 | 0 | Loud Vehicle Passby |
| 8/22/14 04:28 | 8/22/14 04:28 | 1 | Loud Vehicle Passby |
| 8/22/14 04:29 | 8/22/14 04:32 | 3 | Loud Vehicle Passby |
| 8/22/14 04:33 | 8/22/14 04:34 | 1 | Loud Vehicle Passby |
| 8/22/14 04:35 | 8/22/14 04:35 | 1 | Loud Vehicle Passby |
| 8/22/14 04:37 | 8/22/14 04:38 | 1 | Loud Vehicle Passby |
| 8/22/14 04:39 | 8/22/14 04:40 | 1 | Loud Vehicle Passby |
| 8/22/14 04:45 | 8/22/14 04:46 | 1 | Loud Vehicle Passby |
| 8/22/14 04:50 | 8/22/14 04:52 | 2 | Loud Vehicle Passby |
| 8/22/14 04:54 | 8/22/14 04:55 | 1 | Loud Vehicle Passby |
| 8/22/14 05:00 | 8/22/14 05:00 | 1 | Loud Vehicle Passby |
| 8/22/14 05:12 | 8/22/14 05:13 | 1 | Loud Vehicle Passby |
| 8/22/14 05:13 | 8/22/14 05:14 | 1 | Loud Vehicle Passby |
| 8/22/14 05:19 | 8/22/14 05:20 | 1 | Loud Vehicle Passby |
| 8/22/14 05:21 | 8/22/14 05:21 | 1 | Loud Vehicle Passby |
| 8/22/14 05:23 | 8/22/14 05:24 | 1 | Loud Vehicle Passby |
| 8/22/14 05:29 | 8/22/14 05:29 | 1 | Loud Vehicle Passby |
| 8/22/14 05:31 | 8/22/14 07:00 | 89 | Morning Rush (Several Vehicles per Minute) |
| | **Total Night #1** | **171** | |
| | **Total Night #2** | **148** | |
| | **Total Data** | **319** | |

## Data Removal Noise Monitoring Location #11

| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 8/13/14 22:20 | 8/13/14 22:35 | 14 | Train Passby |
| 8/13/14 22:51 | 8/13/14 22:57 | 6 | Train Passby |
| 8/13/14 23:02 | 8/13/14 23:09 | 7 | Train Passby |
| 8/13/14 23:13 | 8/13/14 23:19 | 6 | Loud Vehicle Passby |
| 8/13/14 23:45 | 8/13/14 23:48 | 3 | Train Passby |
| 8/13/14 23:58 | 8/14/14 00:02 | 5 | Monitor Check |
| 8/14/14 00:31 | 8/14/14 00:32 | 1 | Train Passby |
| 8/14/14 00:35 | 8/14/14 00:37 | 2 | Train Passby |
| 8/14/14 00:43 | 8/14/14 00:51 | 8 | Train Passby |
| 8/14/14 01:31 | 8/14/14 01:35 | 5 | Train Passby |
| 8/14/14 01:36 | 8/14/14 01:41 | 5 | Train Passby |
| 8/14/14 01:48 | 8/14/14 01:50 | 2 | Loud Vehicle Passby |
| 8/14/14 01:50 | 8/14/14 01:55 | 6 | Train Passby |
| 8/14/14 01:56 | 8/14/14 01:57 | 2 | Train Passby |
| 8/14/14 02:02 | 8/14/14 02:03 | 2 | Train Passby |
| 8/14/14 02:07 | 8/14/14 02:13 | 6 | Train Passby |
| 8/14/14 02:34 | 8/14/14 02:40 | 6 | Train Passby |
| 8/14/14 02:45 | 8/14/14 02:47 | 3 | Train Passby |
| 8/14/14 02:52 | 8/14/14 02:55 | 3 | Train Passby |
| 8/14/14 04:57 | 8/14/14 04:59 | 2 | Loud Vehicle Passby |
| 8/14/14 05:32 | 8/14/14 05:33 | 1 | Loud Vehicle Passby |
| 8/14/14 05:40 | 8/14/14 05:41 | 1 | Loud Vehicle Passby |
| 8/14/14 05:42 | 8/14/14 05:45 | 3 | Loud Vehicle Passby |
| 8/14/14 05:56 | 8/14/14 05:57 | 1 | Loud Vehicle Passby |
| 8/14/14 06:02 | 8/14/14 06:03 | 1 | Loud Vehicle Passby |
| 8/14/14 06:09 | 8/14/14 06:10 | 1 | Loud Vehicle Passby |
| 8/14/14 06:28 | 8/14/14 06:29 | 1 | Loud Vehicle Passby |
| 8/14/14 06:30 | 8/14/14 06:31 | 1 | Loud Vehicle Passby |
| 8/14/14 06:36 | 8/14/14 06:37 | 1 | Loud Vehicle Passby |
| 8/14/14 06:39 | 8/14/14 06:39 | 1 | Loud Vehicle Passby |
| 8/14/14 06:43 | 8/14/14 06:44 | 1 | Loud Vehicle Passby |
| 8/14/14 06:45 | 8/14/14 06:46 | 1 | Loud Vehicle Passby |
| 8/14/14 06:46 | 8/14/14 06:47 | 1 | Loud Vehicle Passby |
| 8/14/14 06:51 | 8/14/14 06:53 | 2 | Loud Vehicle Passby |
| 8/14/14 06:53 | 8/14/14 06:54 | 1 | Loud Vehicle Passby |
| 8/14/14 06:54 | 8/14/14 07:00 | 5 | Loud Vehicle Passby |
| 8/14/14 22:11 | 8/14/14 22:13 | 2 | Loud Vehicle Passby |
| 8/14/14 22:16 | 8/14/14 22:23 | 7 | Monitor Check |
| 8/14/14 22:25 | 8/14/14 22:26 | 1 | Train Passby |
| 8/14/14 22:34 | 8/14/14 22:36 | 2 | Train Passby |

## Data Removal Noise Monitoring Location #11 Cont.

| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 8/14/14 22:39 | 8/14/14 22:39 | 1 | Train Passby |
| 8/14/14 23:07 | 8/14/14 23:10 | 3 | Train Passby |
| 8/15/14 00:27 | 8/15/14 00:35 | 8 | Train Passby |
| 8/15/14 00:53 | 8/15/14 00:55 | 2 | Train Passby |
| 8/15/14 01:01 | 8/15/14 01:04 | 3 | Train Passby |
| 8/15/14 01:44 | 8/15/14 01:46 | 2 | Loud Vehicle Passby |
| 8/15/14 02:57 | 8/15/14 03:08 | 12 | Train Passby |
| 8/15/14 03:35 | 8/15/14 03:35 | 1 | Train Passby |
| 8/15/14 03:37 | 8/15/14 03:45 | 8 | Train Passby |
| 8/15/14 03:57 | 8/15/14 04:05 | 8 | Train Passby |
| 8/15/14 04:15 | 8/15/14 04:16 | 2 | Loud Vehicle Passby |
| 8/15/14 04:17 | 8/15/14 04:23 | 7 | Train Passby |
| 8/15/14 04:26 | 8/15/14 04:58 | 32 | Train Passby |
| 8/15/14 06:06 | 8/15/14 06:07 | 1 | Loud Vehicle Passby |
| 8/15/14 06:08 | 8/15/14 06:10 | 2 | Loud Vehicle Passby |
| 8/15/14 06:20 | 8/15/14 07:02 | 42 | Non-typical Activities |
| | **Total Night #1** | **117** | |
| | **Total Night #2** | **146** | |
| | **Total Data** | **263** | |

## Data Removal Noise Monitoring Location #12 (First Monitoring Period)

| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 8/13/14 22:14 | 8/13/14 22:16 | 3 | Train Passby |
| 8/13/14 22:19 | 8/13/14 22:38 | 20 | Train Passby |
| 8/13/14 23:01 | 8/13/14 23:10 | 10 | Train Passby |
| 8/13/14 23:55 | 8/13/14 23:56 | 1 | Train Passby |
| 8/14/14 00:00 | 8/14/14 00:05 | 5 | Monitor Check |
| 8/14/14 00:25 | 8/14/14 00:26 | 1 | Coyotes |
| 8/14/14 01:04 | 8/14/14 01:06 | 2 | Train Passby |
| 8/14/14 01:22 | 8/14/14 01:24 | 2 | Train Passby |
| 8/14/14 01:32 | 8/14/14 01:35 | 3 | Train Passby |
| 8/14/14 01:45 | 8/14/14 01:50 | 5 | Train Passby |
| 8/14/14 01:50 | 8/14/14 02:05 | 15 | Train Passby |
| 8/14/14 02:30 | 8/14/14 02:31 | 2 | Train Passby |
| 8/14/14 02:37 | 8/14/14 03:20 | 43 | Train Passby |
| 8/14/14 03:21 | 8/14/14 03:22 | 1 | Train Passby |
| 8/14/14 03:30 | 8/14/14 03:31 | 1 | Train Passby |
| 8/14/14 03:47 | 8/14/14 04:55 | 68 | Train Stationed Nearby (Shunting, etc) |
| 8/14/14 05:17 | 8/14/14 05:18 | 0 | Train Passby |
| 8/14/14 05:27 | 8/14/14 05:27 | 0 | Train Passby |
| 8/14/14 05:34 | 8/14/14 05:35 | 1 | Train Passby |
| 8/14/14 06:11 | 8/14/14 06:12 | 1 | Loud Vehicle Passby |
| 8/14/14 06:36 | 8/14/14 06:37 | 1 | Loud Vehicle Passby |
| 8/14/14 22:01 | 8/14/14 22:02 | 1 | Train Passby |
| 8/14/14 22:04 | 8/14/14 22:09 | 5 | Train Passby |
| 8/14/14 22:11 | 8/14/14 22:13 | 2 | Train Passby |
| 8/14/14 22:16 | 8/14/14 22:17 | 0 | Train Passby |
| 8/14/14 22:18 | 8/14/14 22:32 | 14 | Train Passby |
| 8/14/14 23:02 | 8/14/14 23:03 | 1 | Train Passby |
| 8/14/14 23:22 | 8/14/14 23:22 | 1 | Monitor Check |
| 8/14/14 23:27 | 8/14/14 23:35 | 8 | Monitor Check |
| 8/14/14 23:47 | 8/14/14 23:48 | 2 | Train Passby |
| 8/14/14 23:50 | 8/15/14 00:04 | 14 | Train Passby |
| 8/15/14 00:14 | 8/15/14 00:15 | 1 | Trains Stationed Nearby |
| 8/15/14 00:24 | 8/15/14 00:25 | 0 | Trains Stationed Nearby |
| 8/15/14 00:31 | 8/15/14 00:32 | 1 | Loud Vehicle Passby |
| 8/15/14 00:36 | 8/15/14 00:37 | 1 | Loud Vehicle Passby |
| 8/15/14 00:51 | 8/15/14 00:53 | 3 | Train Passby |
| 8/15/14 00:54 | 8/15/14 02:07 | 74 | Trains Stationed Nearby (Long Time) |
| 8/15/14 03:09 | 8/15/14 03:10 | 1 | Trains Stationed Nearby |
| 8/15/14 03:11 | 8/15/14 03:16 | 5 | Trains Stationed Nearby |
| 8/15/14 03:30 | 8/15/14 03:54 | 24 | Rail Activity |

**Data Removal Noise Monitoring Location #12 (First Monitoring Period) Cont.**

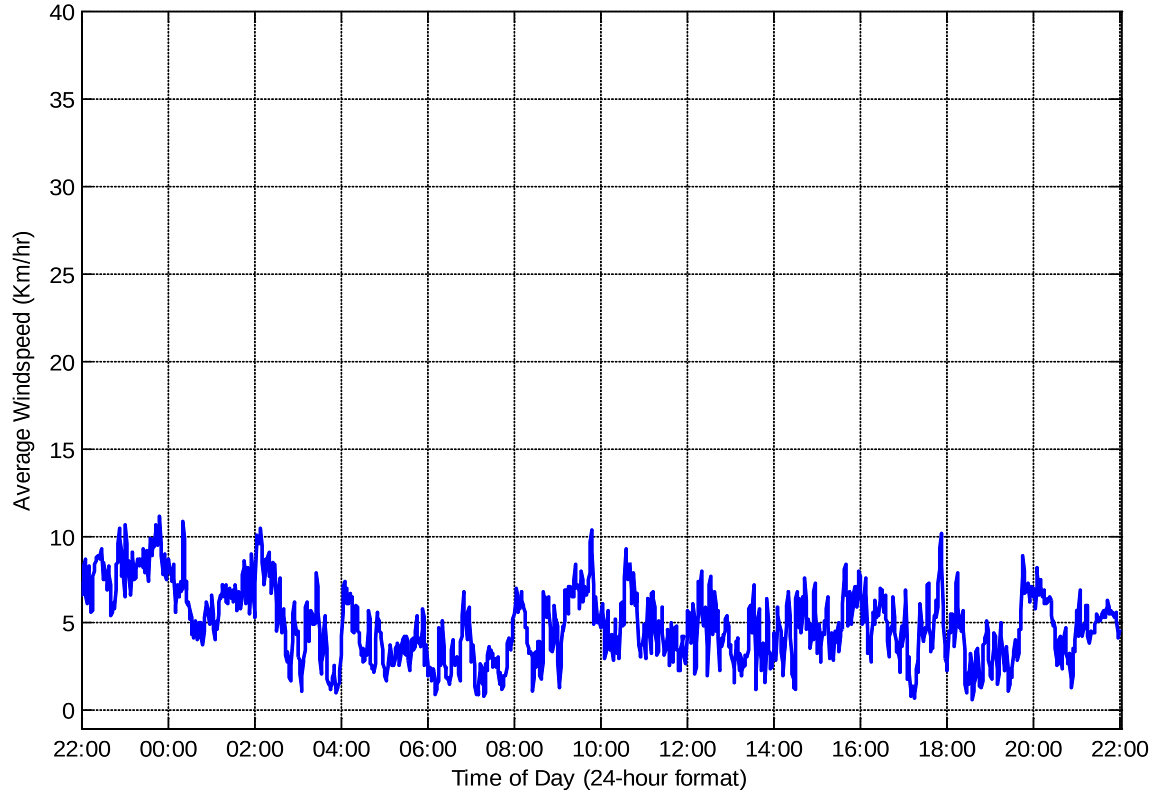
| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 8/15/14 04:00 | 8/15/14 04:01 | 1 | Rail Activity |
| 8/15/14 04:02 | 8/15/14 04:03 | 0 | Rail Activity |
| 8/15/14 04:09 | 8/15/14 04:10 | 1 | Rail Activity |
| 8/15/14 04:11 | 8/15/14 04:43 | 32 | Rail Activity |
| 8/15/14 04:55 | 8/15/14 04:57 | 2 | Rail Activity |
| 8/15/14 05:01 | 8/15/14 05:13 | 12 | Rail Activity |
| 8/15/14 05:20 | 8/15/14 05:28 | 8 | Rail Activity |
| 8/15/14 05:47 | 8/15/14 05:49 | 2 | Rail Activity |
| 8/15/14 05:57 | 8/15/14 06:02 | 4 | Loud Vehicle Passby |
| 8/15/14 06:11 | 8/15/14 06:14 | 4 | Loud Vehicle Passby |
| 8/15/14 06:19 | 8/15/14 06:21 | 2 | Train Passby |
| 8/15/14 06:22 | 8/15/14 06:30 | 8 | Loud Vehicle Passby |
| 8/15/14 06:33 | 8/15/14 06:35 | 3 | Loud Vehicle Passby |
| 8/15/14 06:43 | 8/15/14 06:45 | 2 | Loud Vehicle Passby |
| 8/15/14 06:50 | 8/15/14 06:51 | 1 | Loud Vehicle Passby |
| | **Total Night #1** | **186** | |
| | **Total Night #2** | **241** | |
| | **Total Data** | **427** | |

## Data Removal Noise Monitoring Location #12 (Second Monitoring Period)

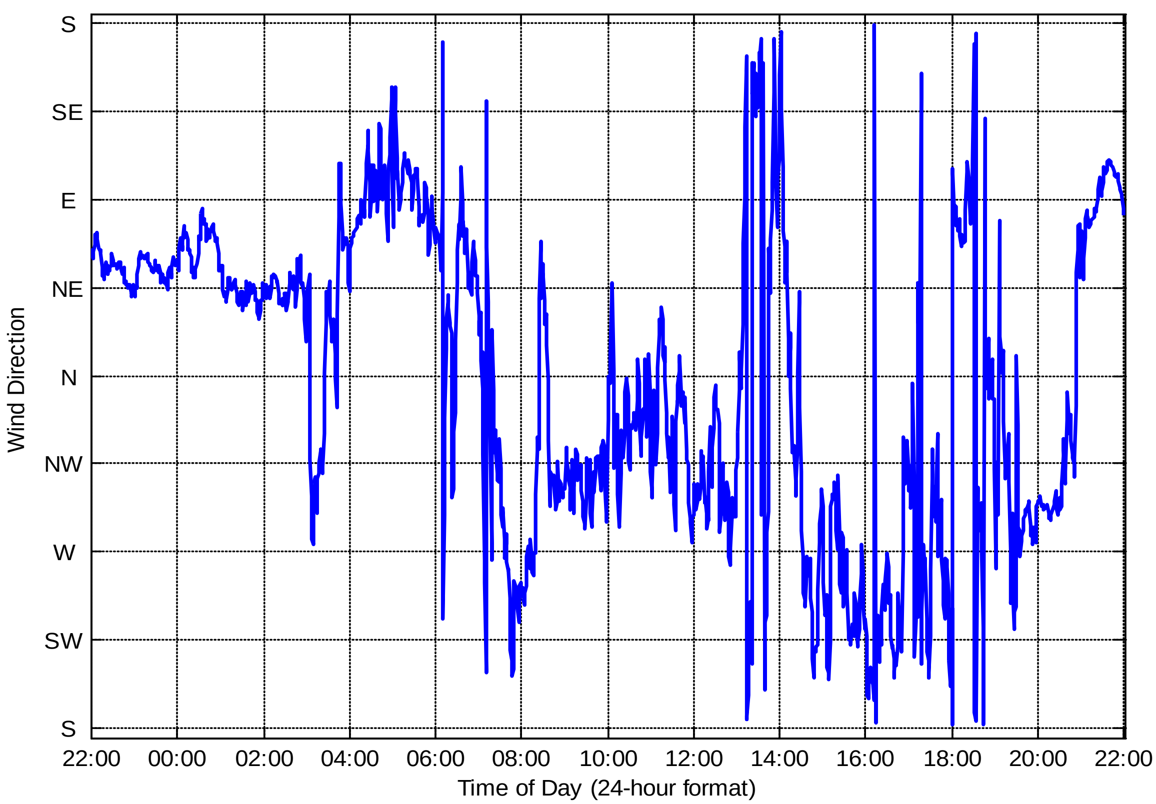
| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 8/20/14 22:34 | 8/20/14 22:36 | 2 | Aircraft Flyover |
| 8/20/14 22:37 | 8/20/14 22:44 | 7 | Monitor Check |
| 8/21/14 00:38 | 8/21/14 00:40 | 2 | Train Passby |
| 8/21/14 00:46 | 8/21/14 00:47 | 1 | Train Passby |
| 8/21/14 00:47 | 8/21/14 00:48 | 1 | Train Passby |
| 8/21/14 00:49 | 8/21/14 01:09 | 21 | Train Passby |
| 8/21/14 01:15 | 8/21/14 02:31 | 76 | Rail Activity Nearby (Long Time Period) |
| 8/21/14 02:39 | 8/21/14 02:41 | 2 | Train Passby |
| 8/21/14 02:52 | 8/21/14 02:53 | 1 | Train Whistle |
| 8/21/14 03:04 | 8/21/14 03:07 | 3 | Train Passby |
| 8/21/14 03:12 | 8/21/14 03:14 | 3 | Train Passby |
| 8/21/14 03:23 | 8/21/14 03:24 | 2 | Train Passby |
| 8/21/14 03:35 | 8/21/14 03:37 | 2 | Train Passby |
| 8/21/14 03:40 | 8/21/14 03:46 | 6 | Train Passby |
| 8/21/14 03:50 | 8/21/14 03:54 | 3 | Aircraft Flyover |
| 8/21/14 04:20 | 8/21/14 04:21 | 1 | Aircraft Flyover |
| 8/21/14 04:59 | 8/21/14 05:01 | 3 | Train Passby |
| 8/21/14 05:14 | 8/21/14 05:20 | 6 | Train Passby |
| 8/21/14 05:44 | 8/21/14 07:00 | 76 | Train Stationed by Monitor |
| 8/21/14 22:07 | 8/21/14 22:11 | 4 | Monitor Check |
| 8/21/14 22:13 | 8/21/14 22:18 | 5 | Monitor Check |
| 8/21/14 22:41 | 8/21/14 22:43 | 2 | Train Passby |
| 8/21/14 22:44 | 8/21/14 22:59 | 15 | Train Passby |
| 8/21/14 23:11 | 8/21/14 23:13 | 3 | Aircraft Flyover |
| 8/21/14 23:29 | 8/21/14 23:36 | 7 | Train Passby |
| 8/21/14 23:54 | 8/21/14 23:56 | 2 | Loud Vehicle Passby |
| 8/21/14 23:57 | 8/22/14 00:07 | 10 | Train Passby |
| 8/22/14 01:16 | 8/22/14 01:40 | 23 | Train Passby |
| 8/22/14 02:04 | 8/22/14 03:01 | 57 | Train Passby |
| 8/22/14 03:50 | 8/22/14 04:20 | 31 | Train Passby |
| 8/22/14 04:49 | 8/22/14 05:29 | 40 | Train Passby |
| 8/22/14 06:09 | 8/22/14 06:11 | 2 | Loud Vehicle Passby |
| 8/22/14 06:16 | 8/22/14 07:00 | 44 | Train Passby |
| | **Total Night #1** | **219** | |
| | **Total Night #2** | **247** | |
| | **Total Data** | **466** | |

# Appendix V WEATHER DATA

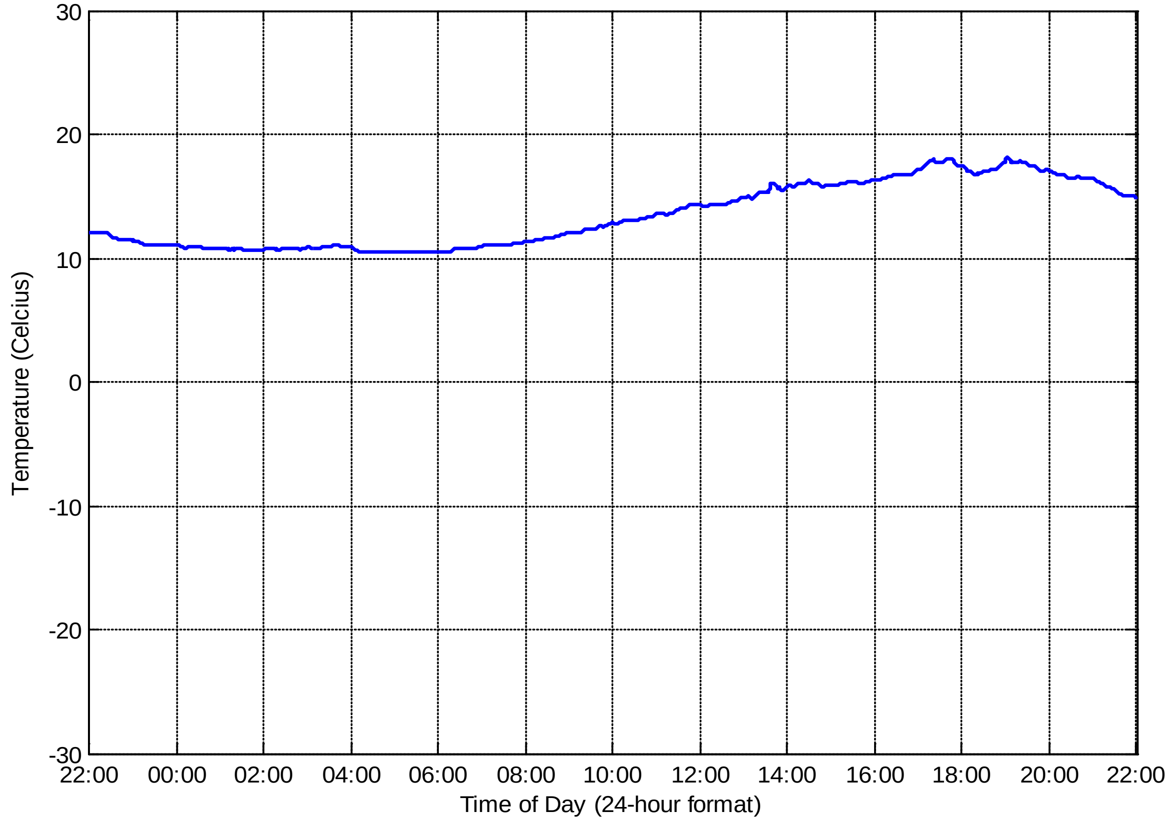
## June 16 – 17, 2014 Weather Data



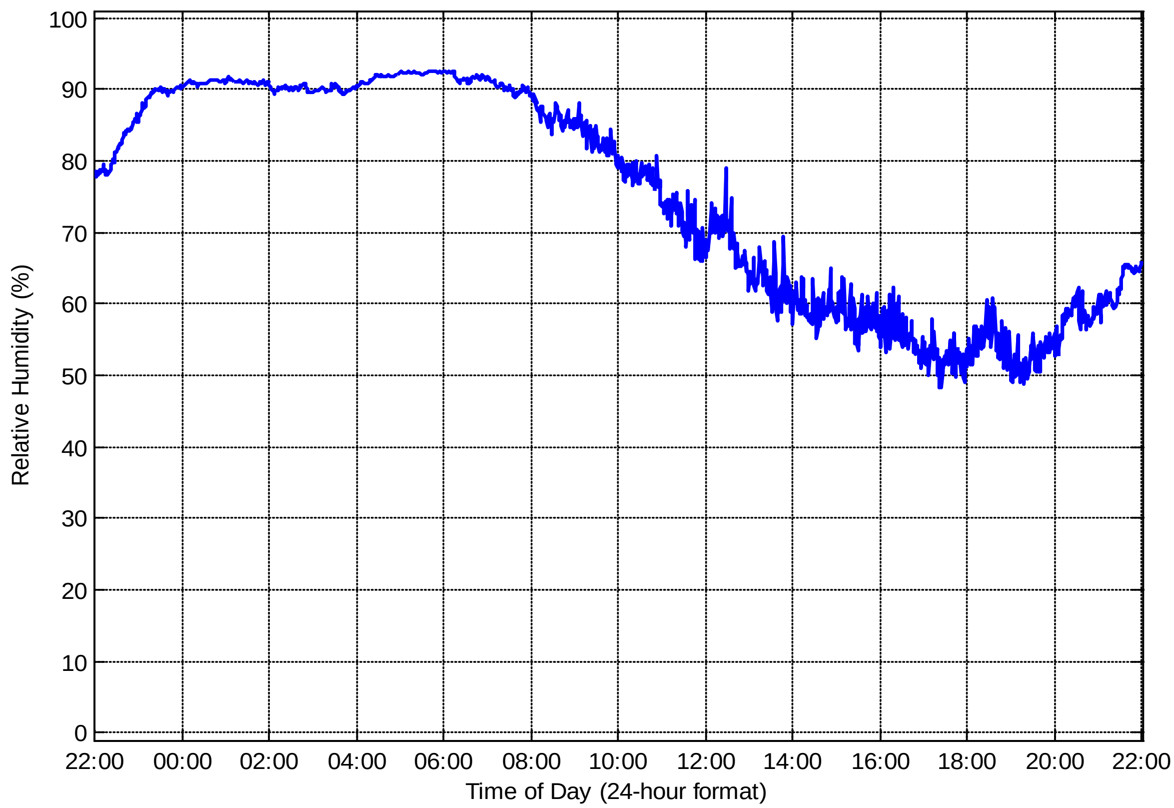

**Monitored Wind Speed (June 16 – June 17, 2014) at Noise Monitor Location 4**



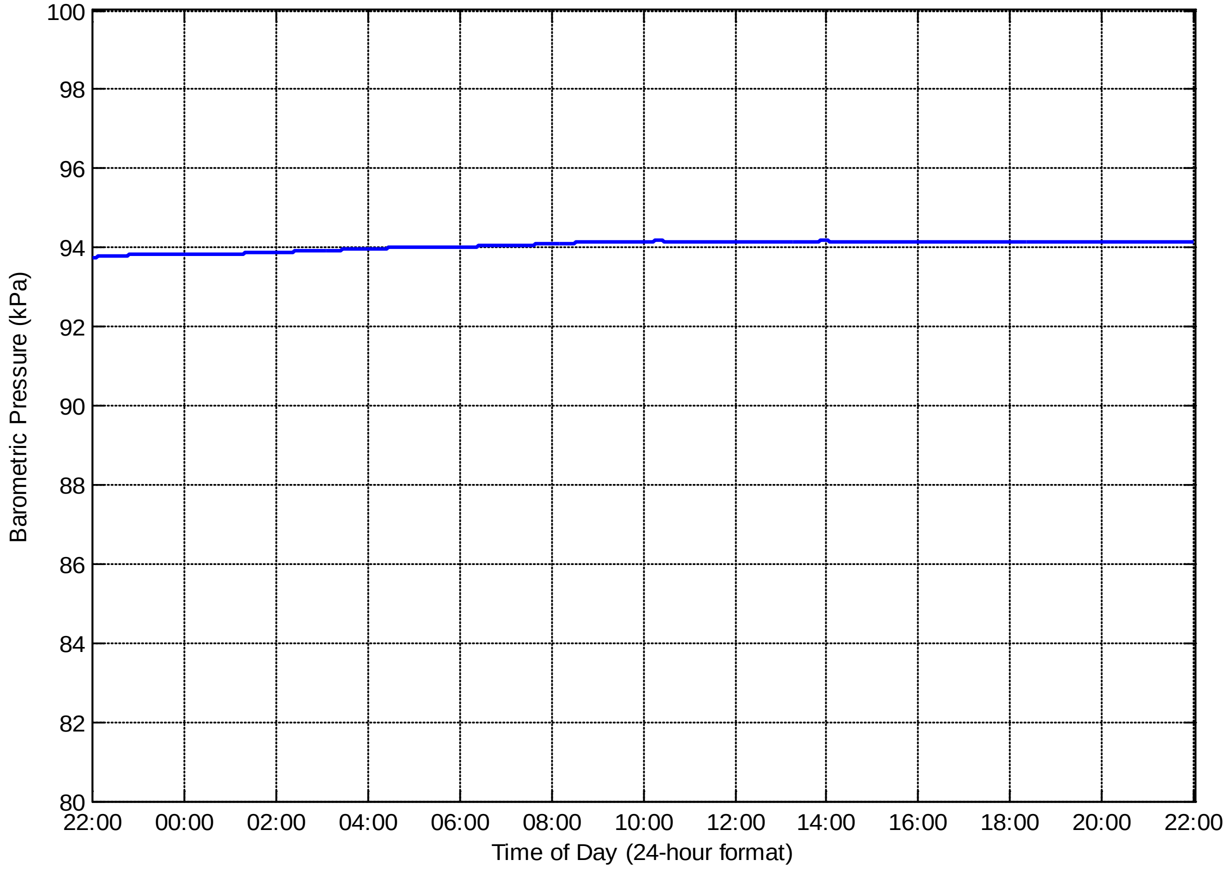

**Monitored Wind Direction (June 16 – June 17, 2014) at Noise Monitor Location 4**




**Monitored Temperature (June 16 – June 17, 2014) at Noise Monitor Location 4**

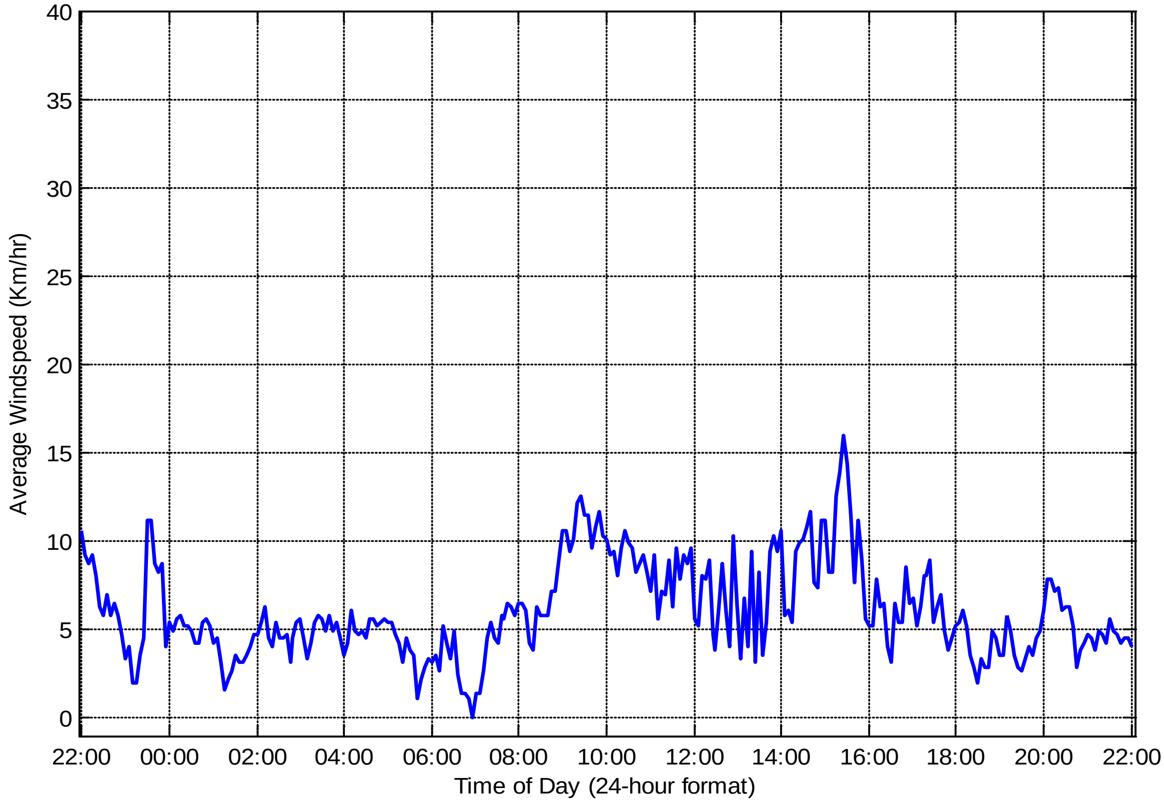



**Monitored Humidity (June 16 – June 17, 2014) at Noise Monitor Location 4**

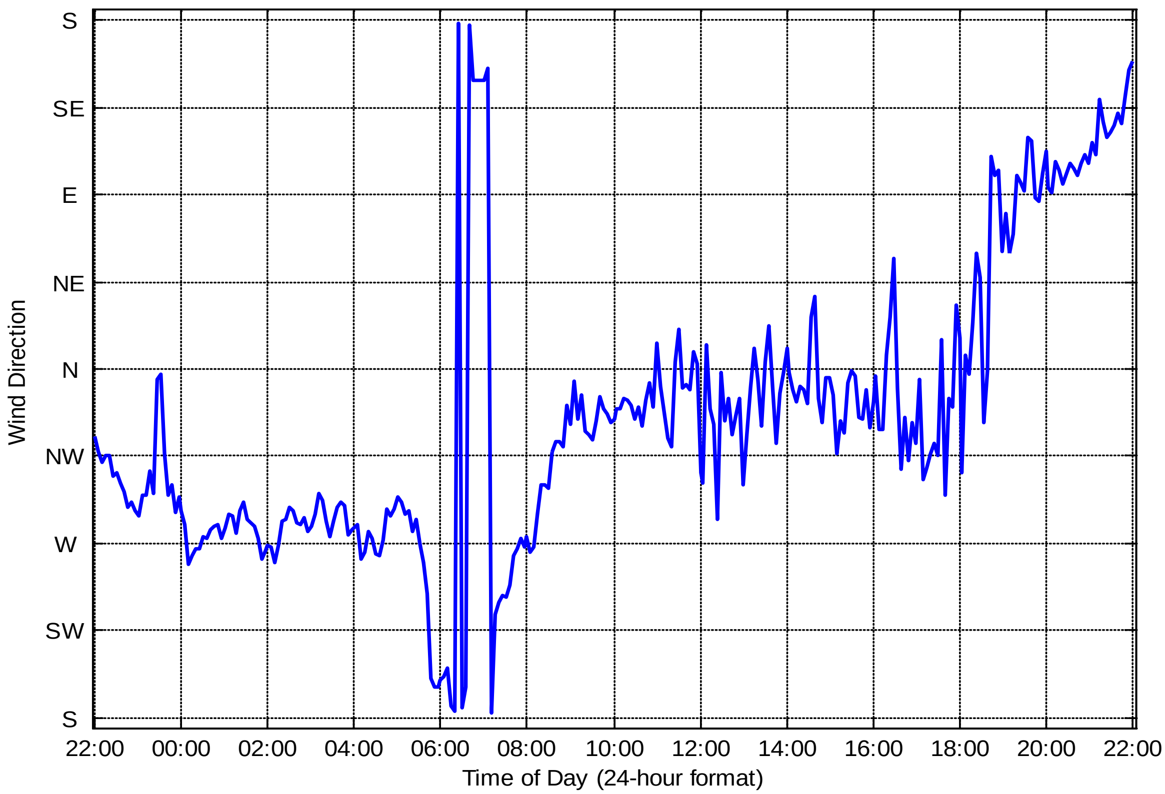



**Monitored Barometric Pressure (June 16 – June 17, 2014) at Noise Monitor Location 4**

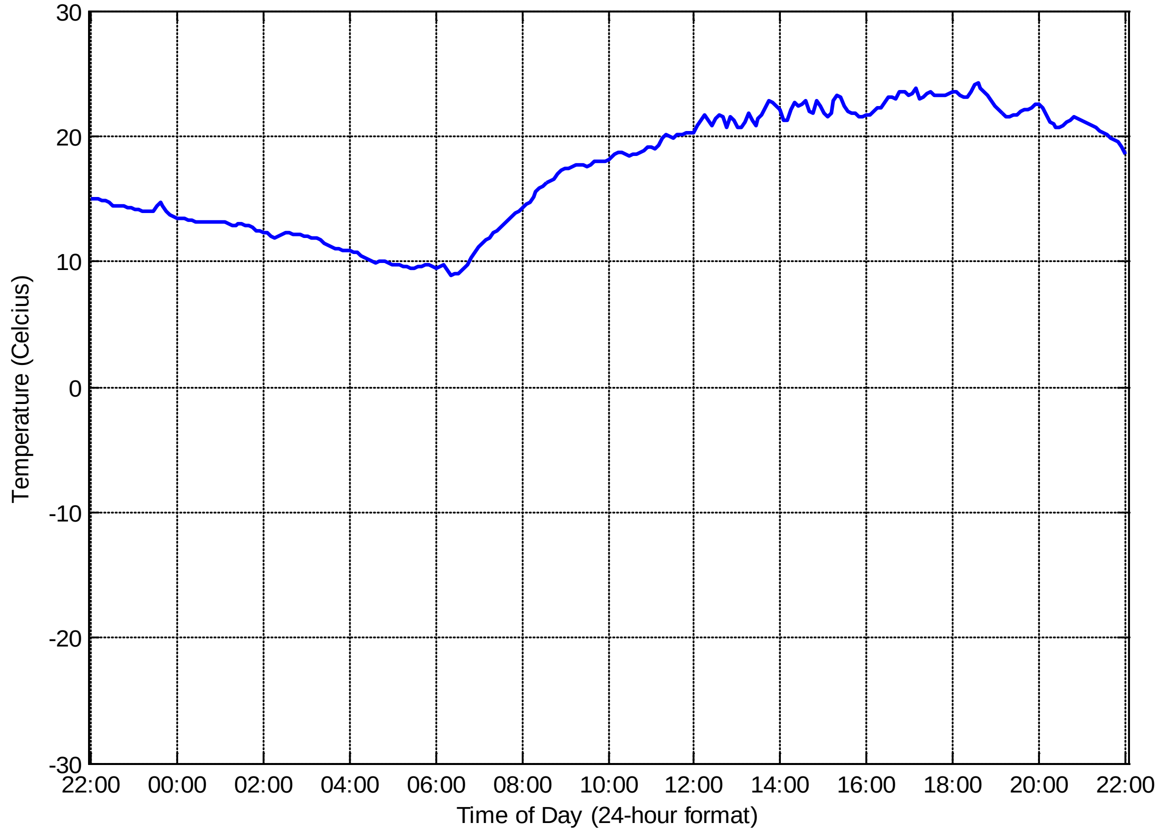
# June 25 – 26, 2014 Weather Data



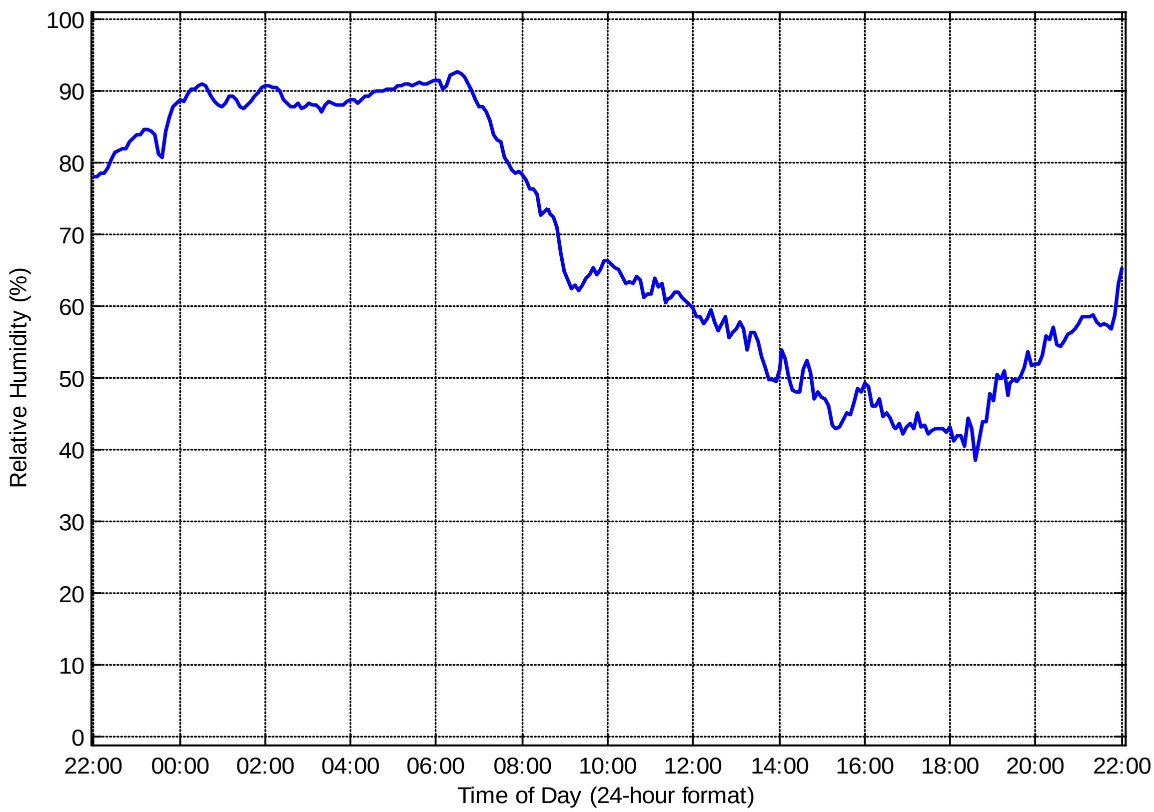

**Monitored Wind Speed (June 25 – June 26, 2014) at Noise Monitor Location 4**



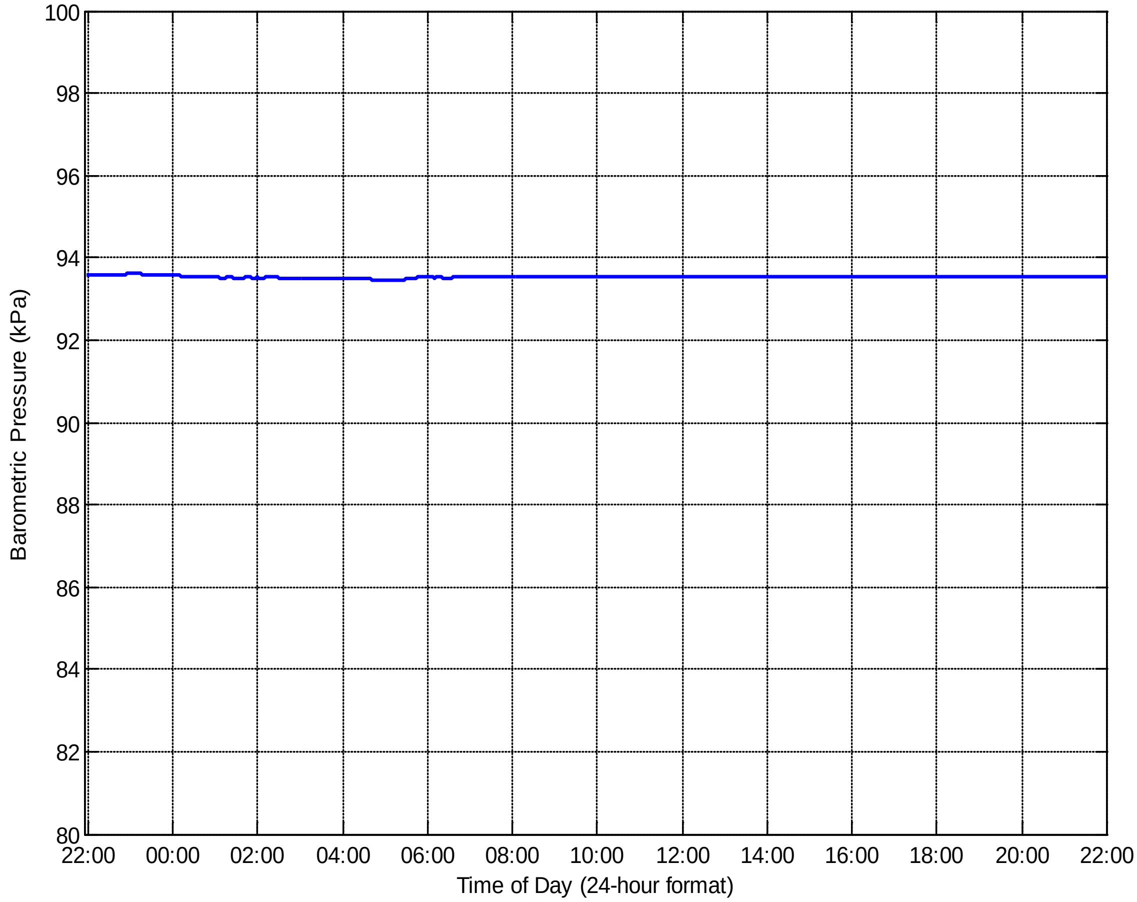

**Monitored Wind Direction (June 25 – June 26, 2014) at Noise Monitor Location 4**




**Monitored Temperature (June 25 – June 26, 2014) at Noise Monitor Location 4**

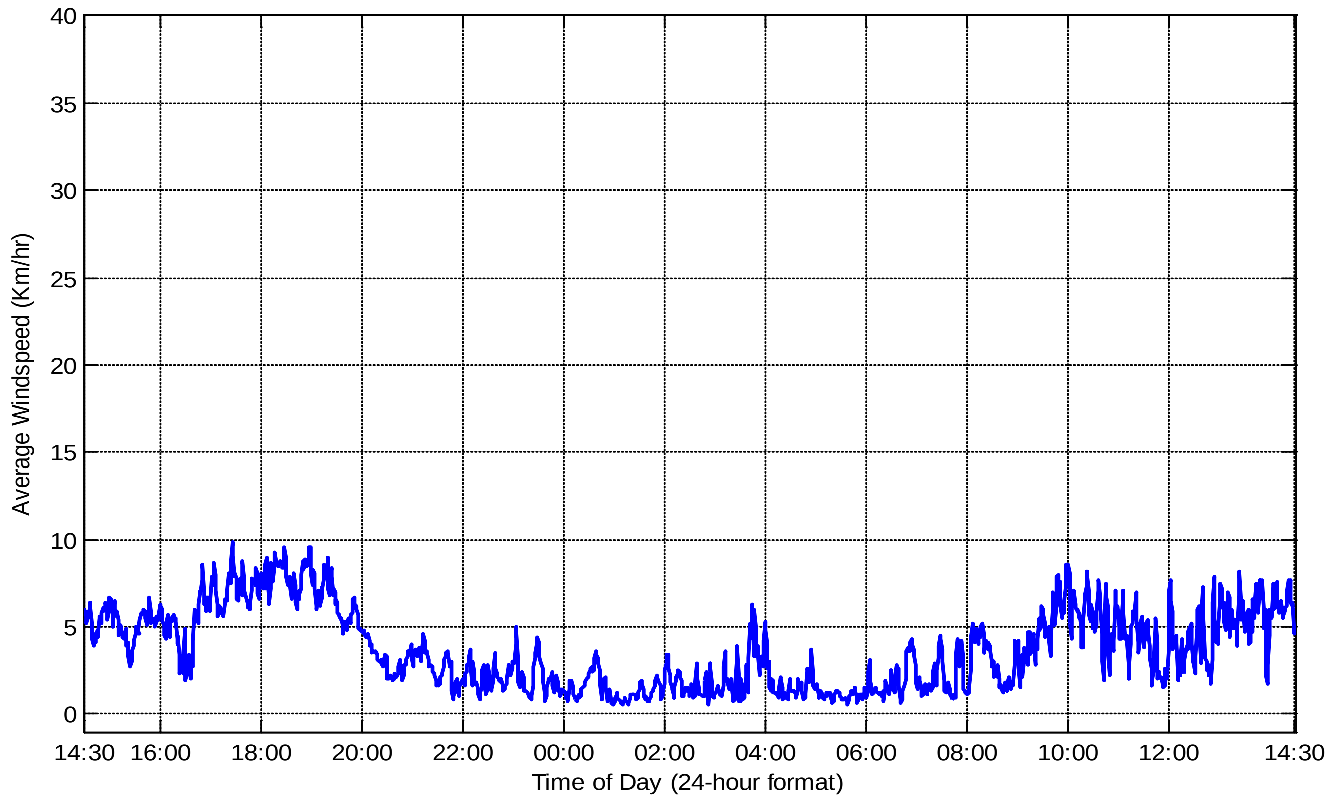



**Monitored Humidity (June 25 – June 26, 2014) at Noise Monitor Location 4**

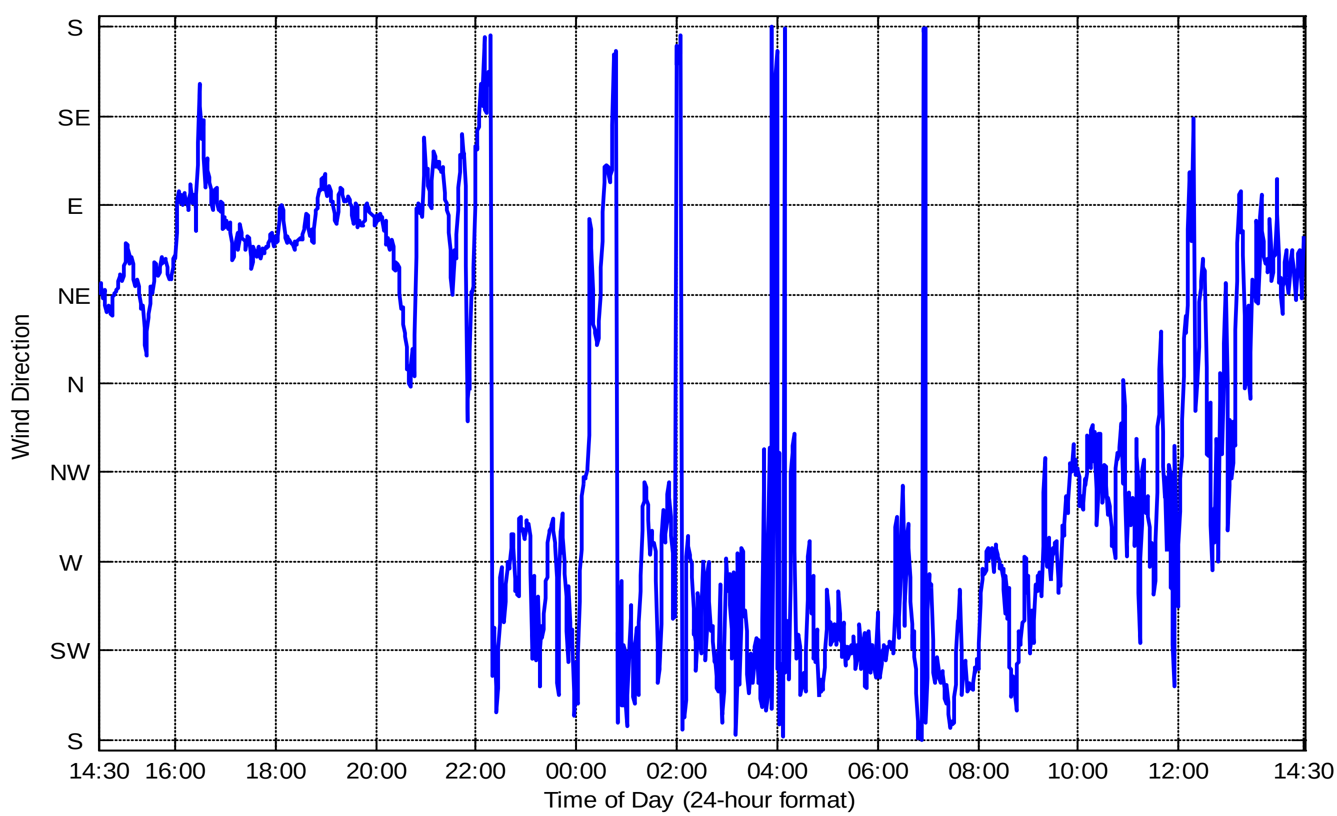



**Monitored Barometric Pressure (June 25 – June 26, 2014) at Noise Monitor Location 4**

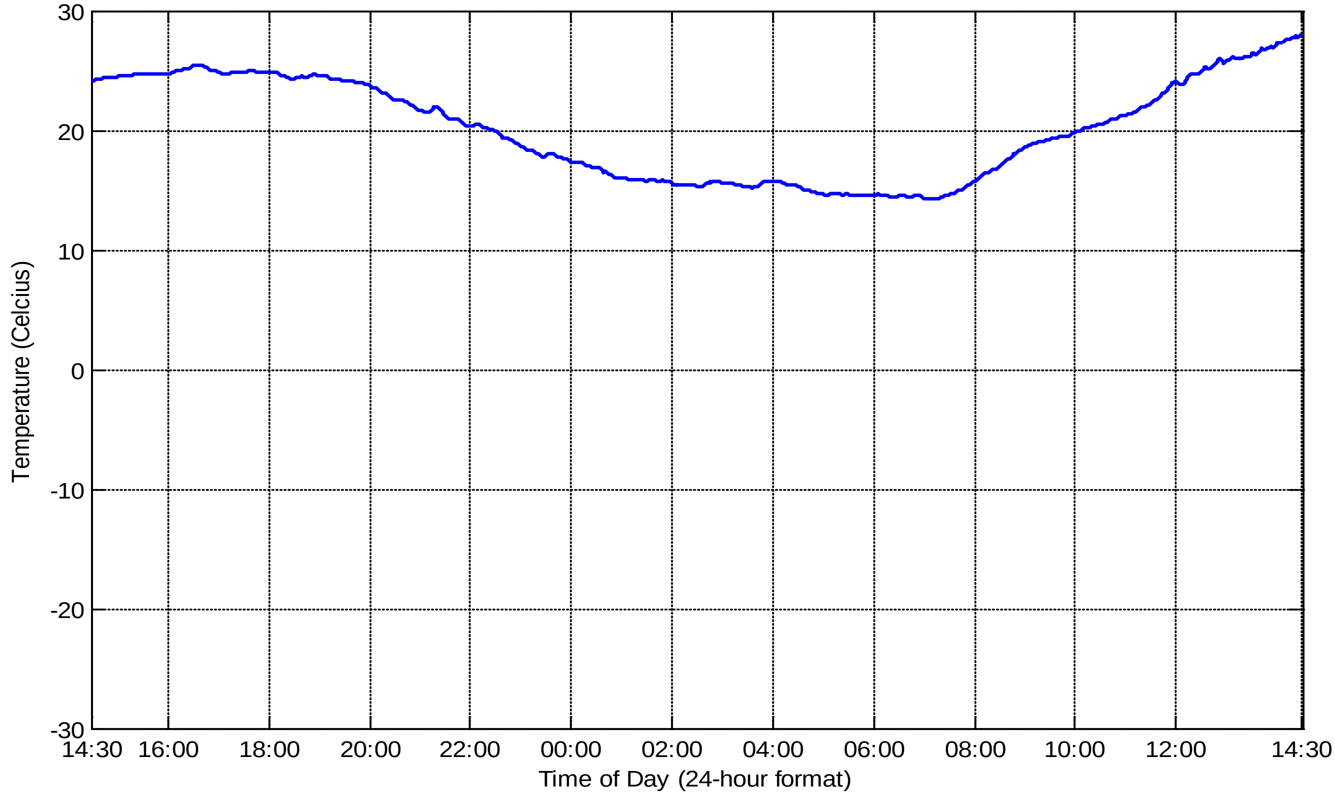
# August 13 - 14, 2014 Weather Data



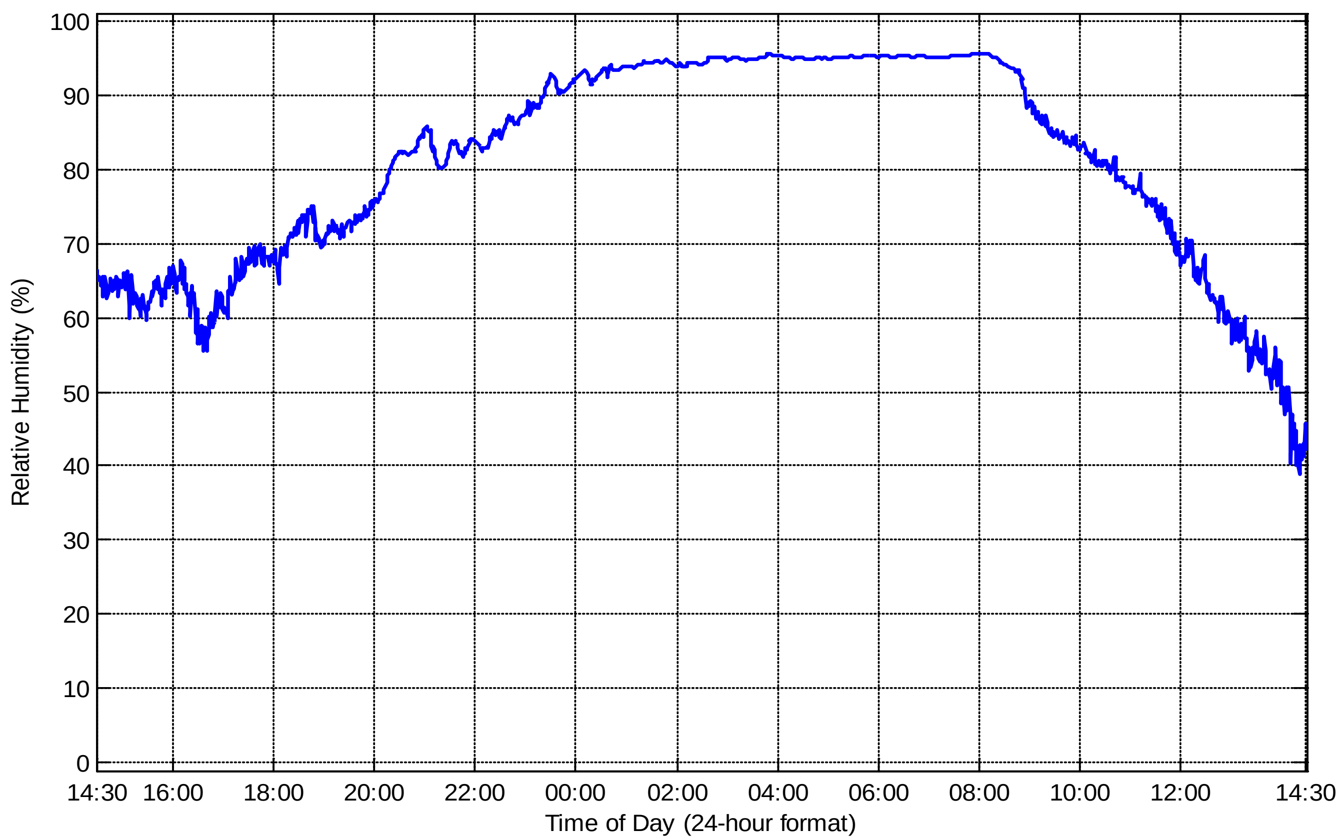

**Monitored Wind Speed (August 13 – August 14, 2014) at Noise Monitor Location 4**



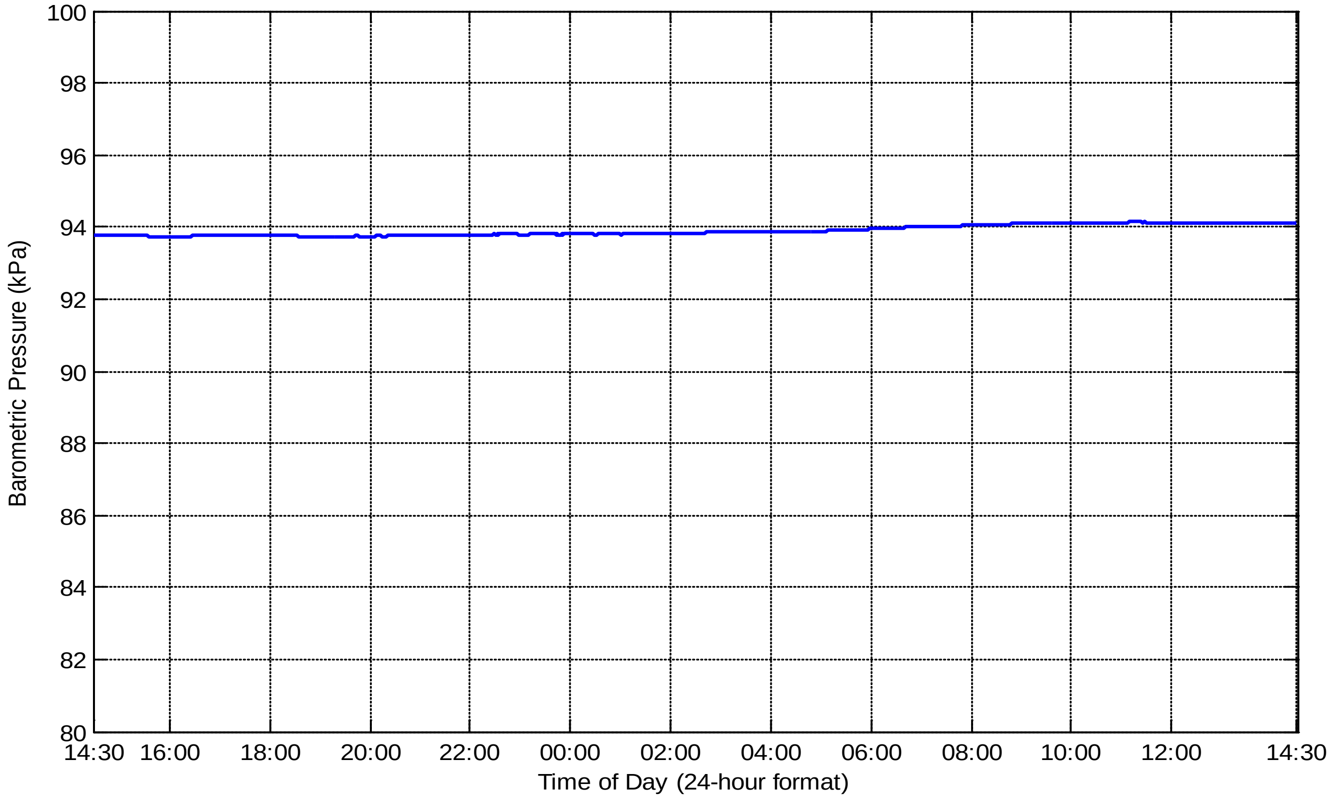

**Monitored Wind Direction (August 13 – August 14, 2014) at Noise Monitor Location 4**



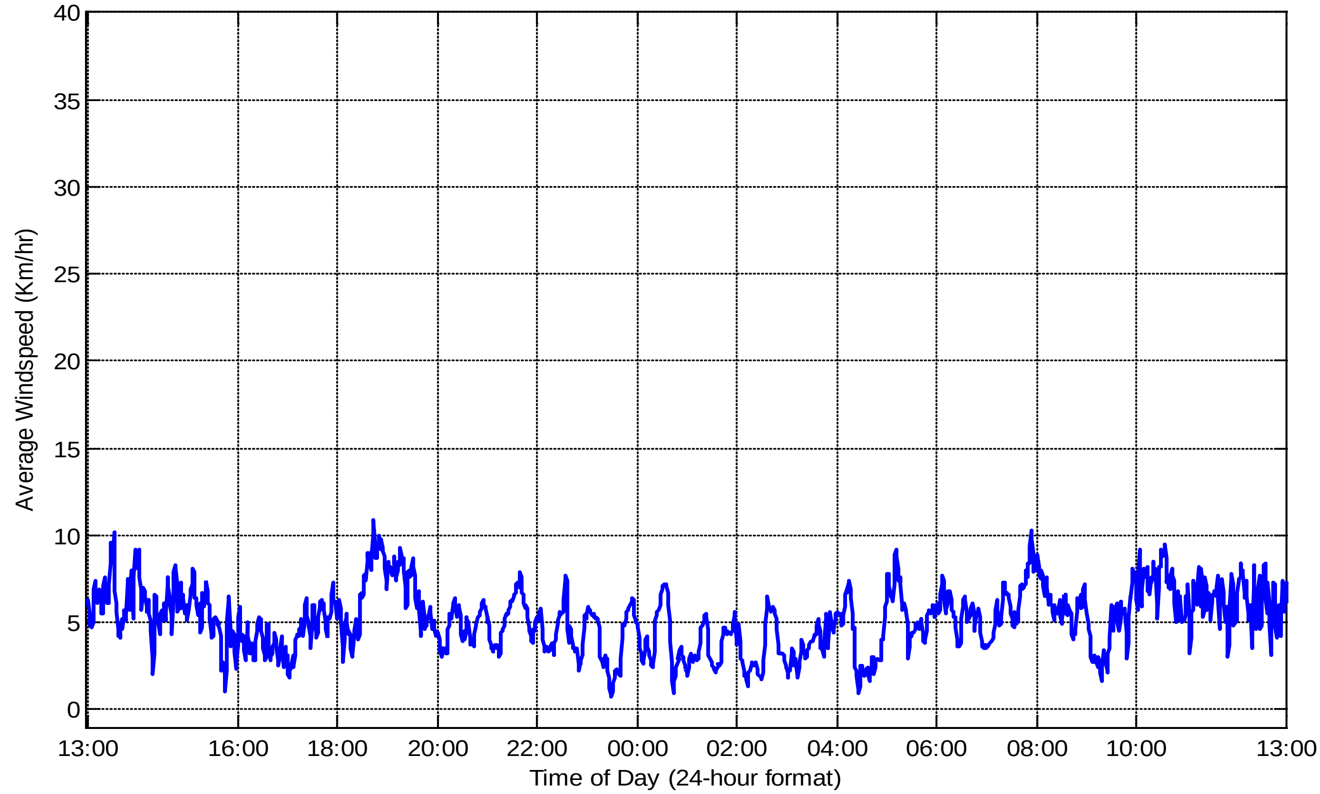

**Monitored Temperature (August 13 – August 14, 2014) at Noise Monitor Location 4**



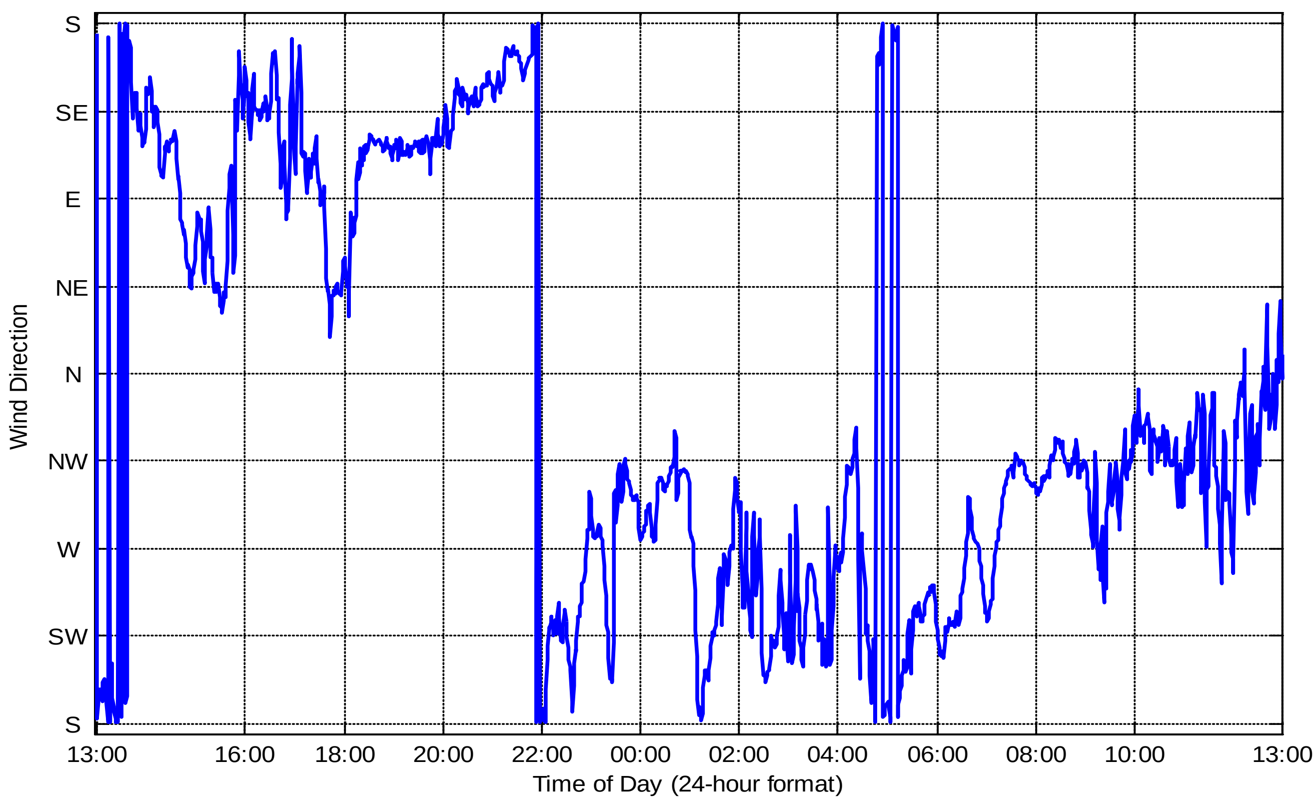

**Monitored Humidity (August 13 – August 14, 2014) at Noise Monitor Location 4**



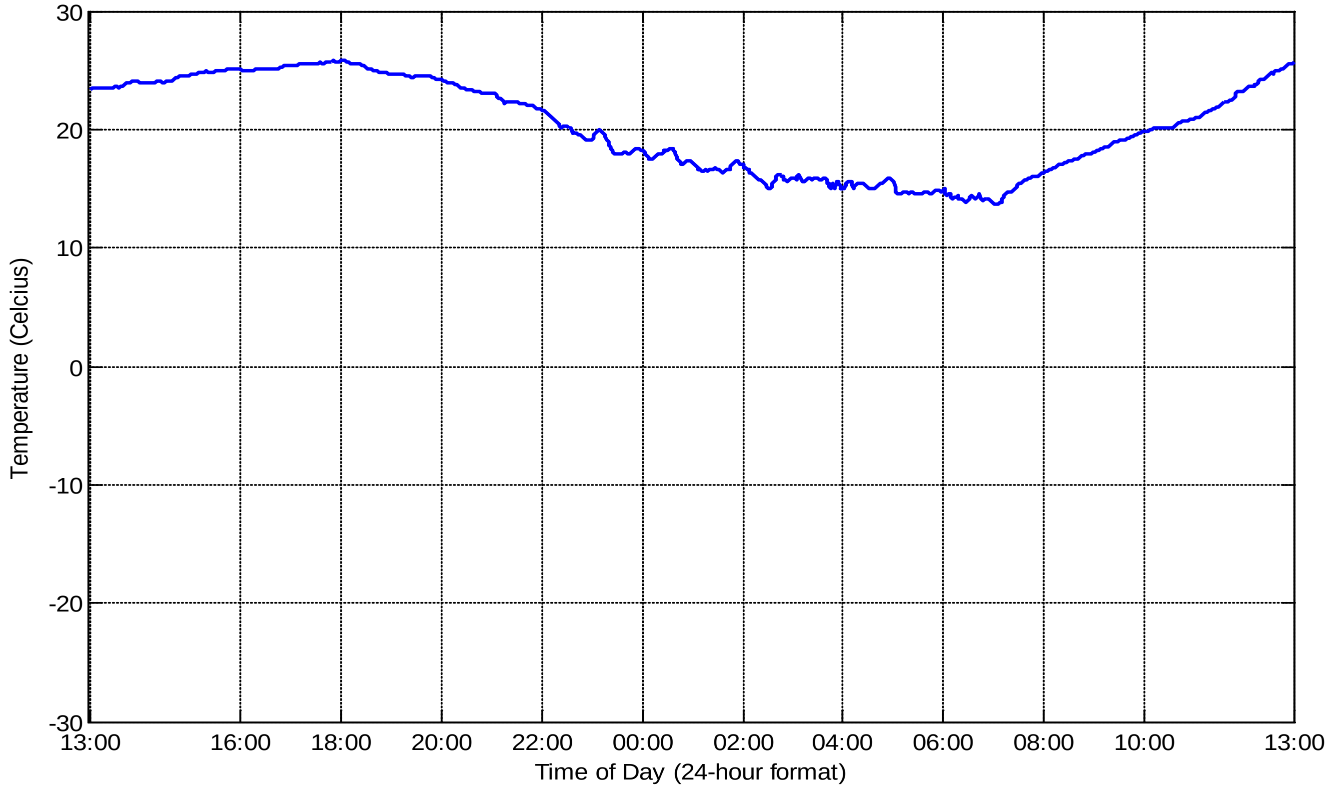

**Monitored Barometric Pressure (August 13 – August 14, 2014) at Noise Monitor Location 4**



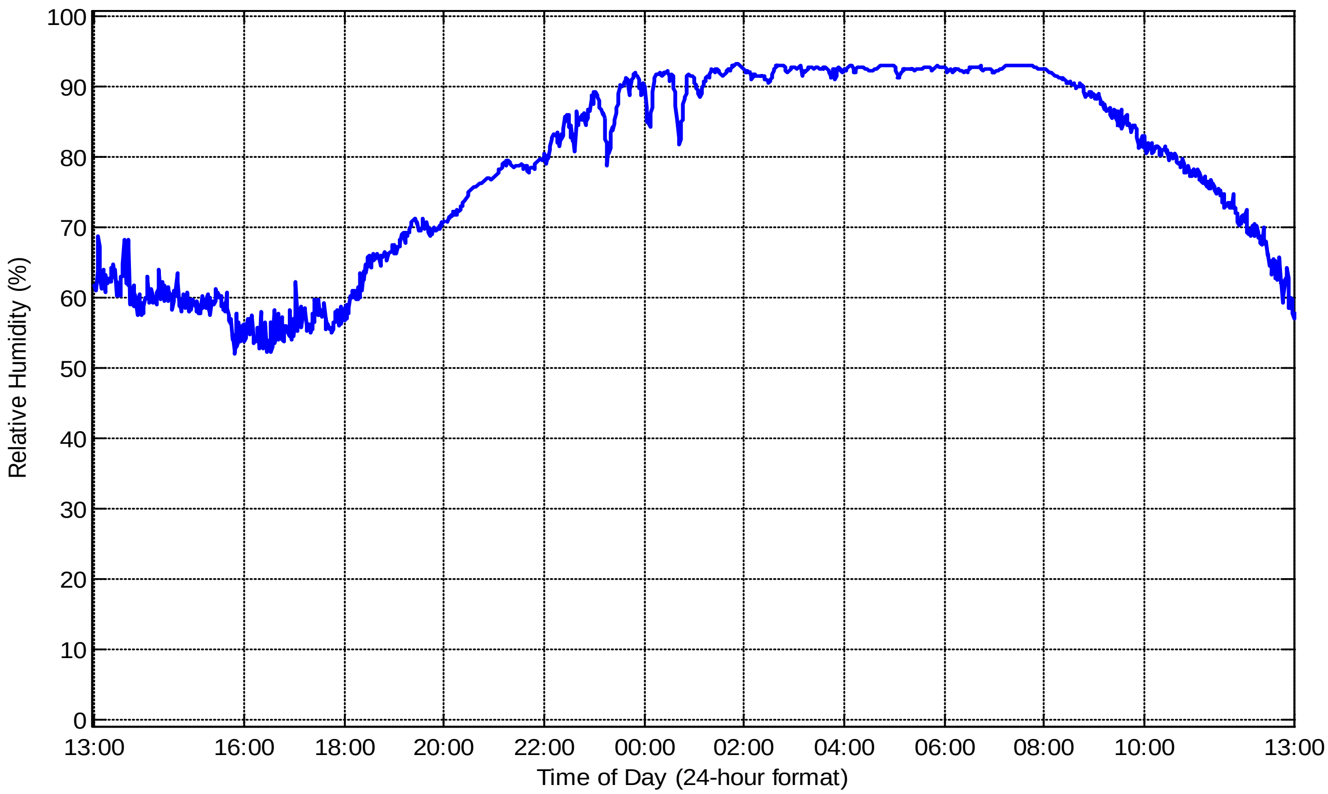

**Monitored Wind Speed (August 13 – August 14, 2014) at Noise Monitor Location 5**



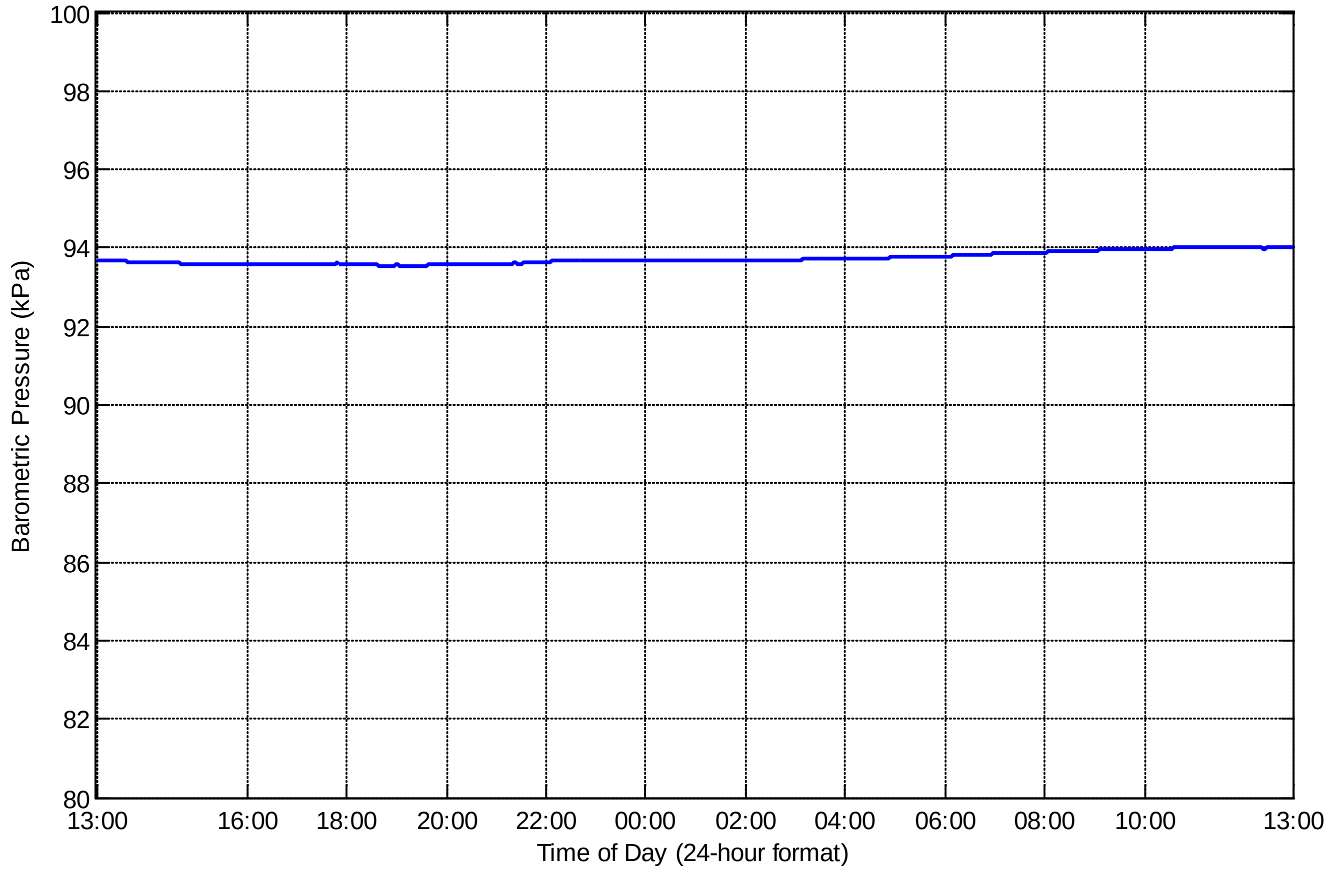

**Monitored Wind Direction (August 13 – August 14, 2014) at Noise Monitor Location 5**



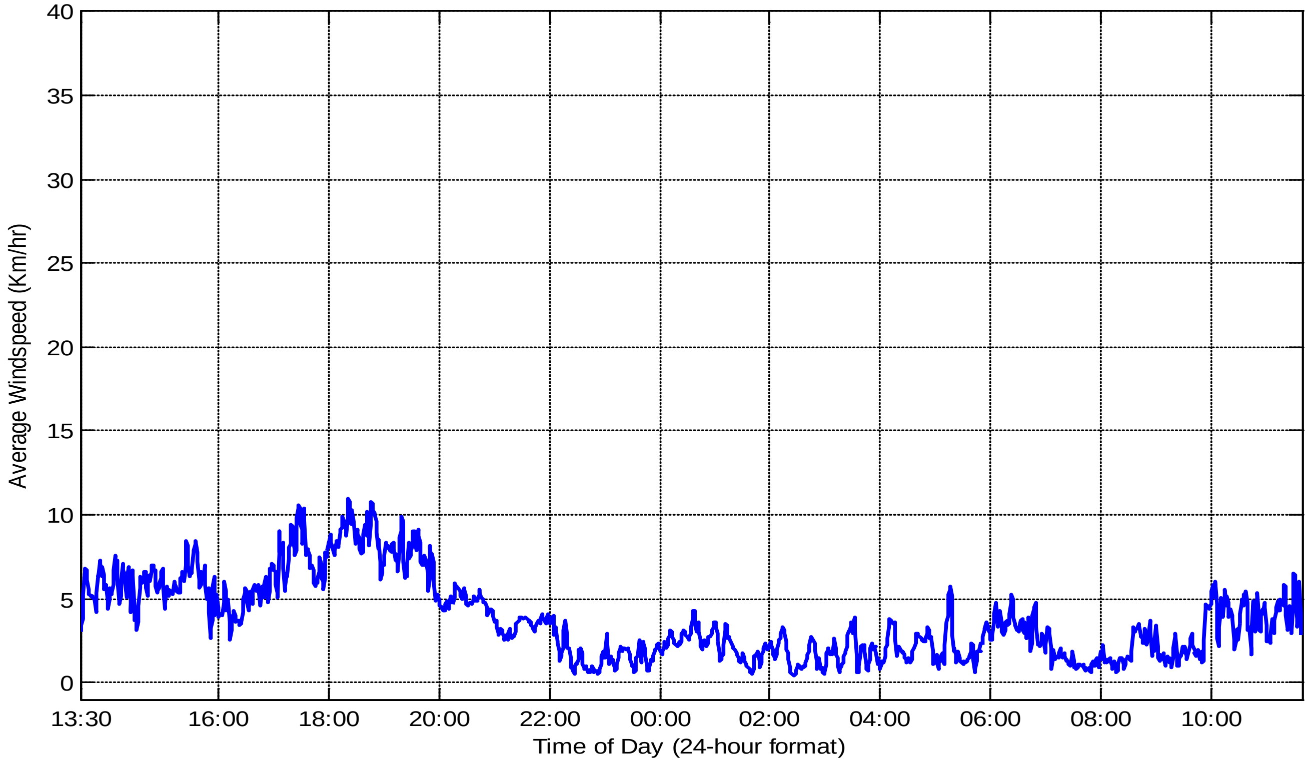

**Monitored Temperature (August 13 – August 14, 2014) at Noise Monitor Location 5**



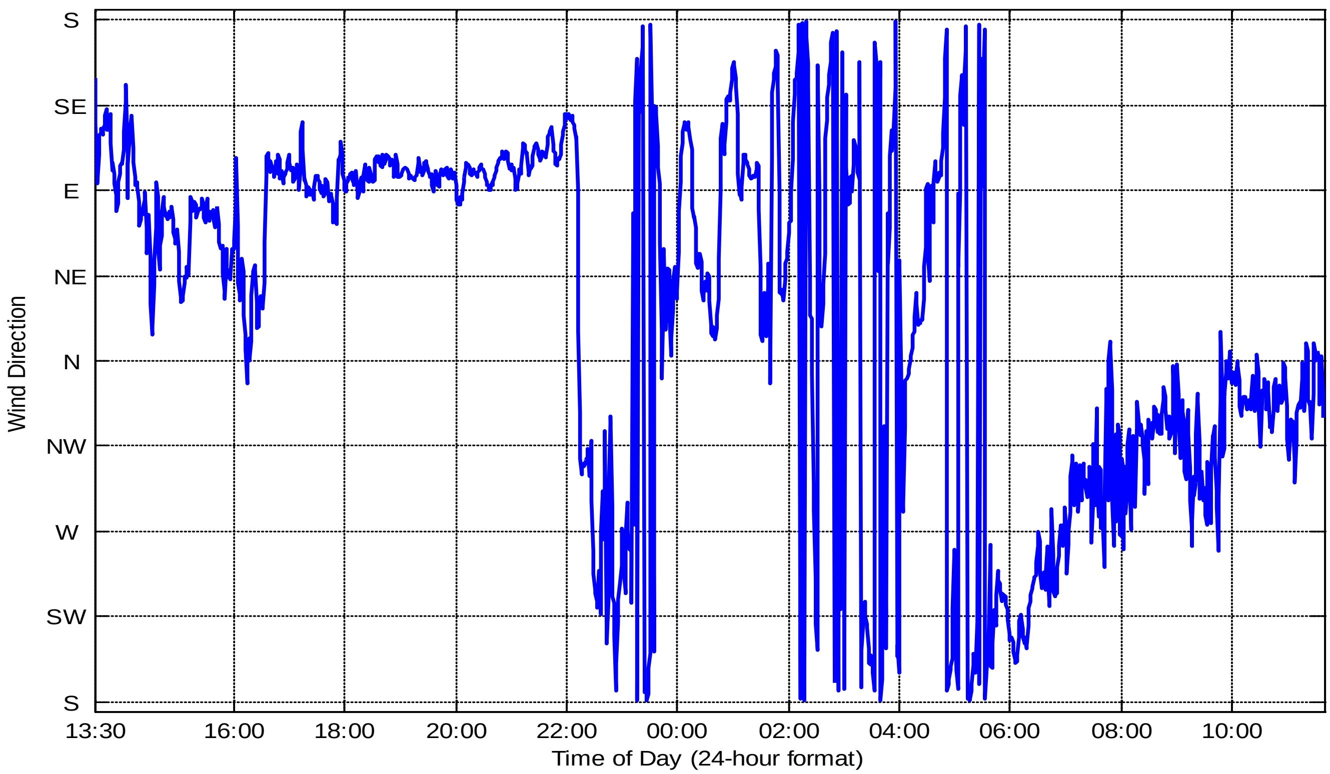

**Monitored Humidity (August 13 – August 14, 2014) at Noise Monitor Location 5**




**Monitored Barometric Pressure (August 13 – August 14, 2014) at Noise Monitor Location 5**

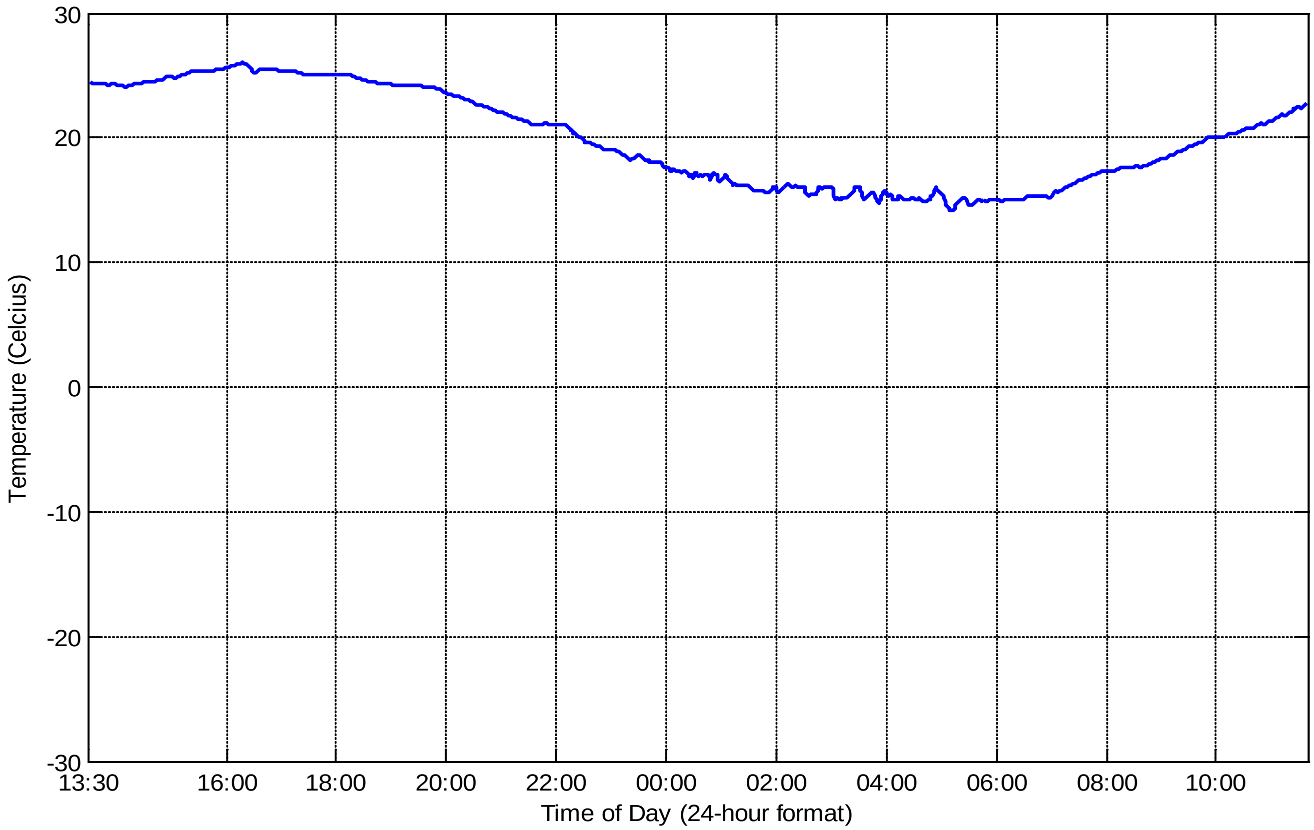



**Monitored Wind Speed (August 13 – August 14, 2014) at Noise Monitor Location 6**[1]

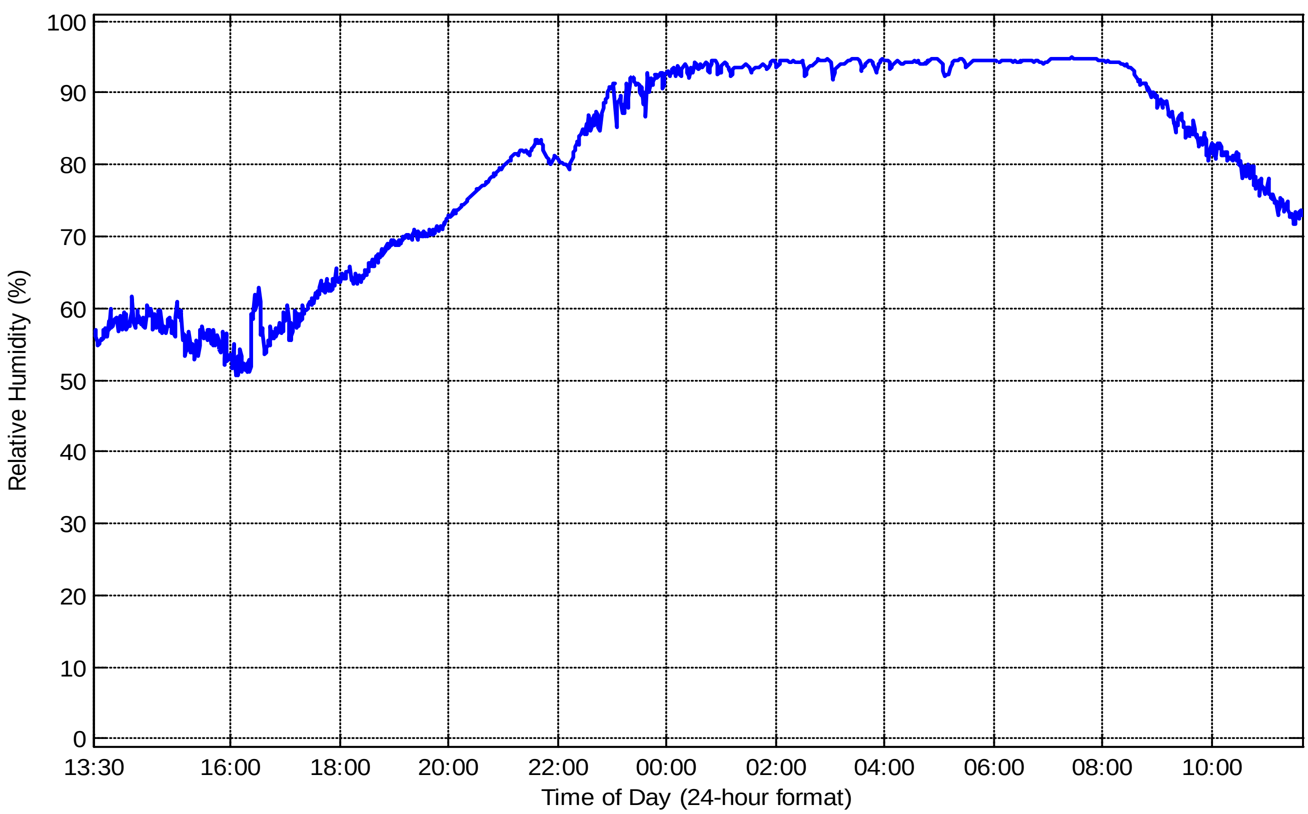



**Monitored Wind Direction (August 13 – August 14, 2014) at Noise Monitor Location 6**

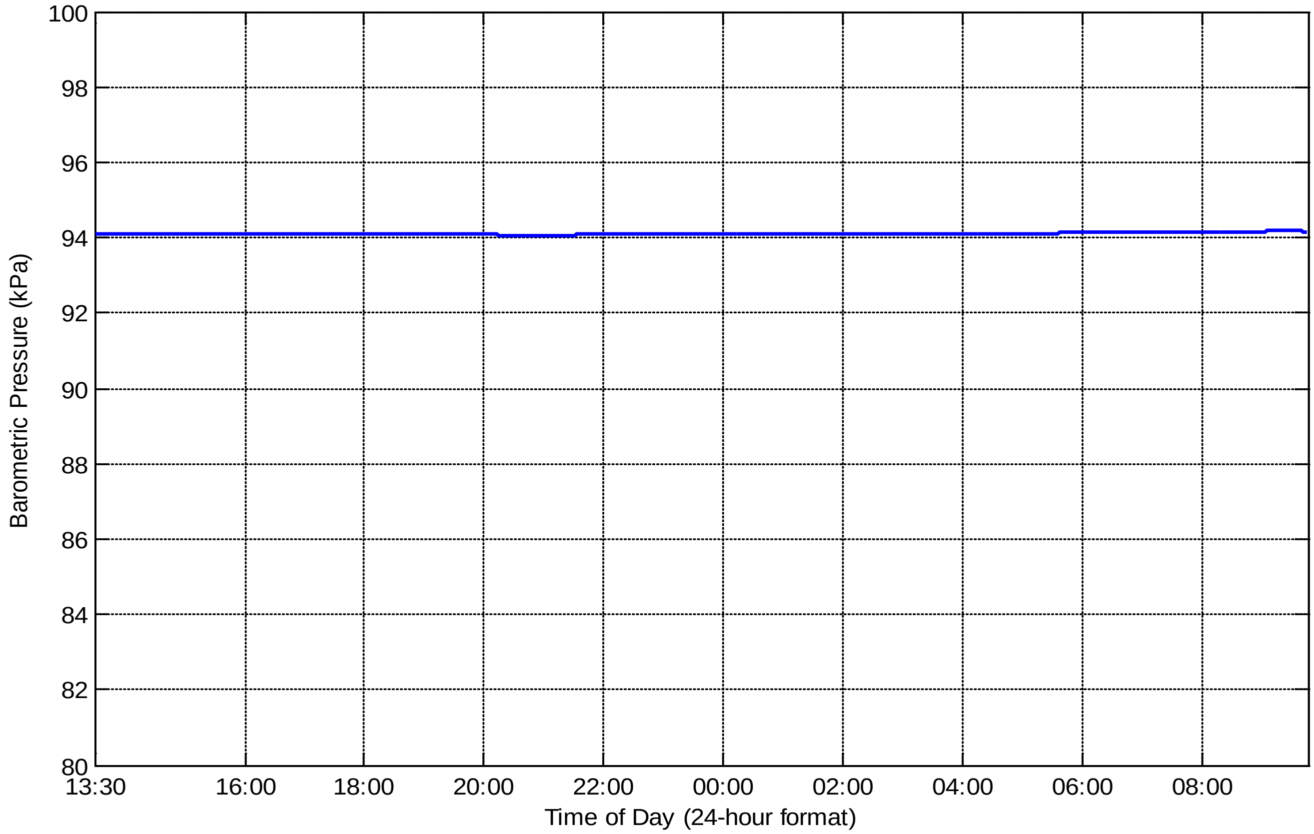
[1] Due to an equipment malfunction the data from 11:38 – 20:13 on August 14 was not recorded. Fortunately this did not affect any night-time hours.




**Monitored Temperature (August 13 – August 14, 2014) at Noise Monitor Location 6**

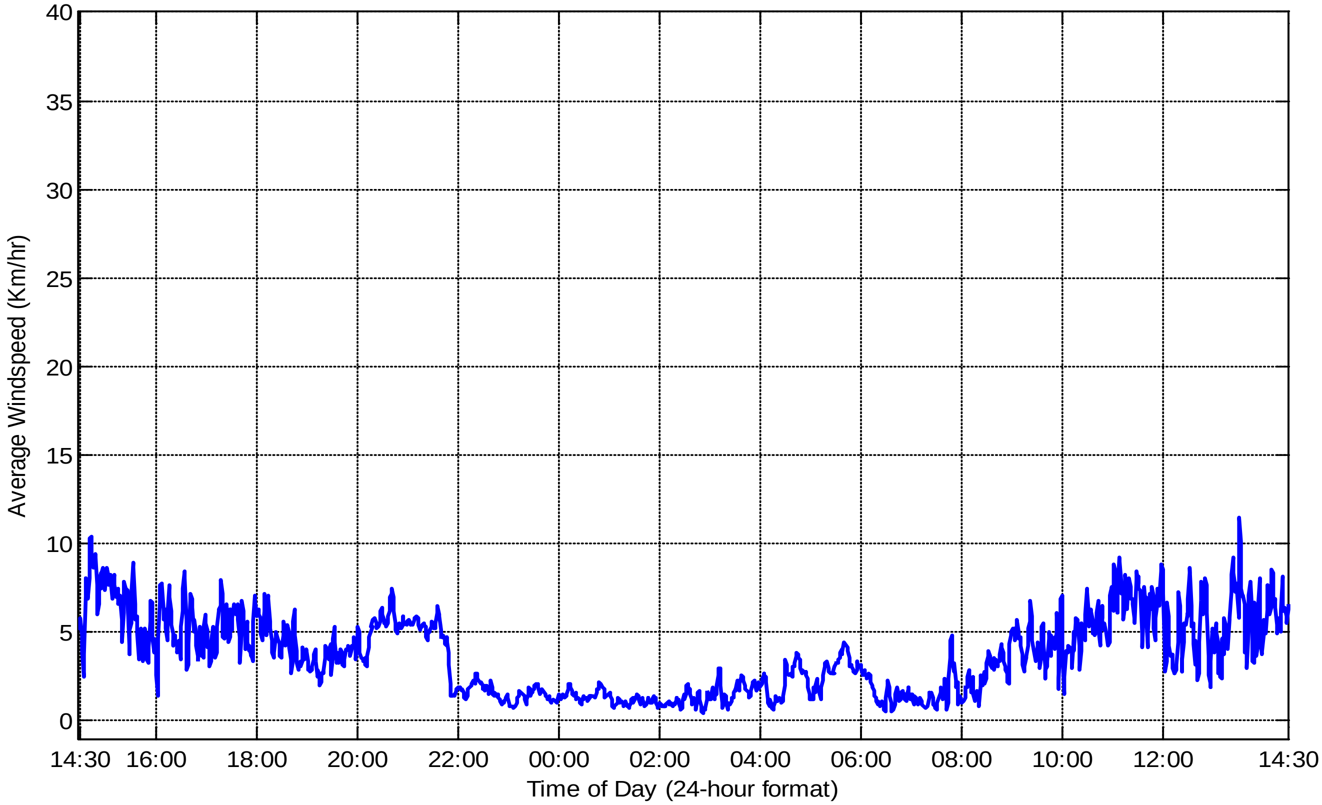



**Monitored Humidity (August 13 – August 14, 2014) at Noise Monitor Location 6**

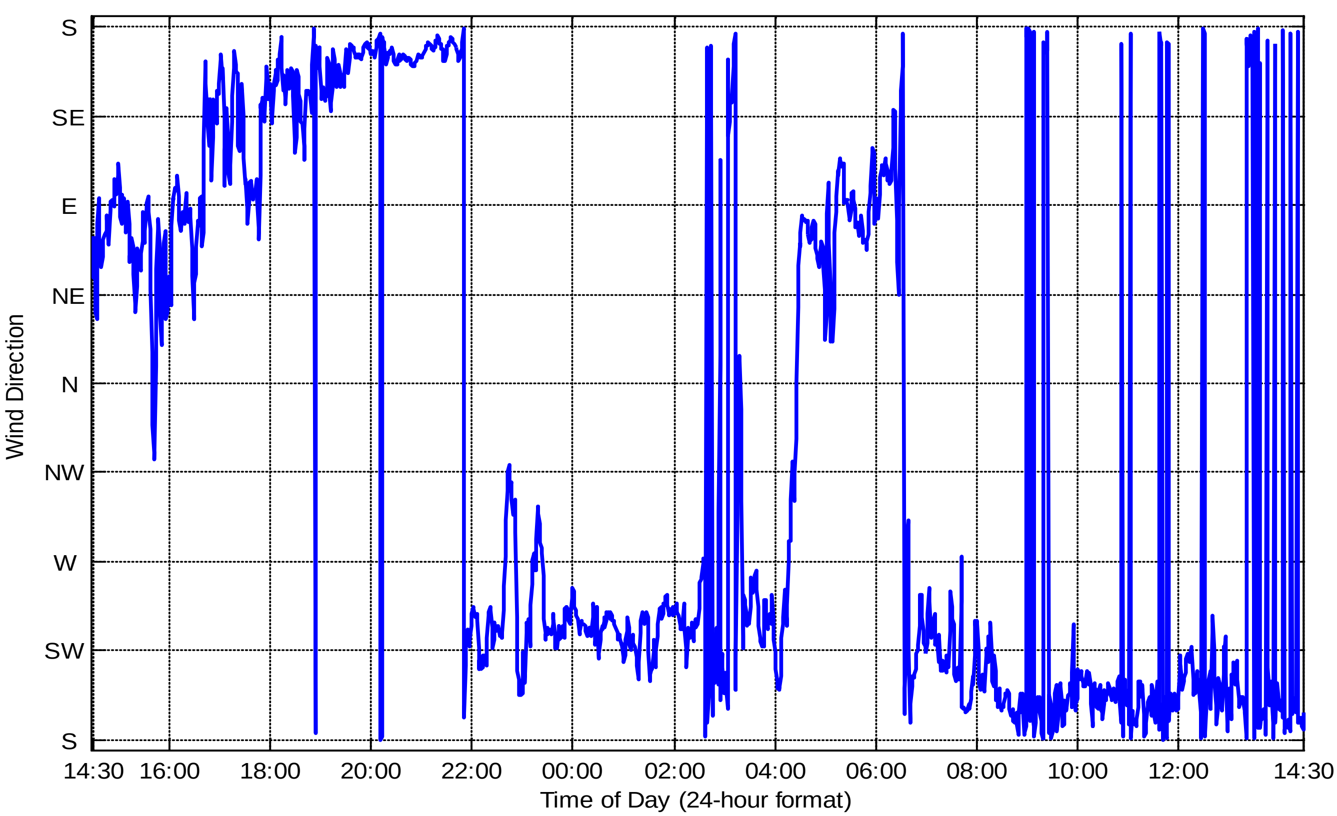



**Monitored Barometric Pressure (August 13 – August 14, 2014) at Noise Monitor Location 6**

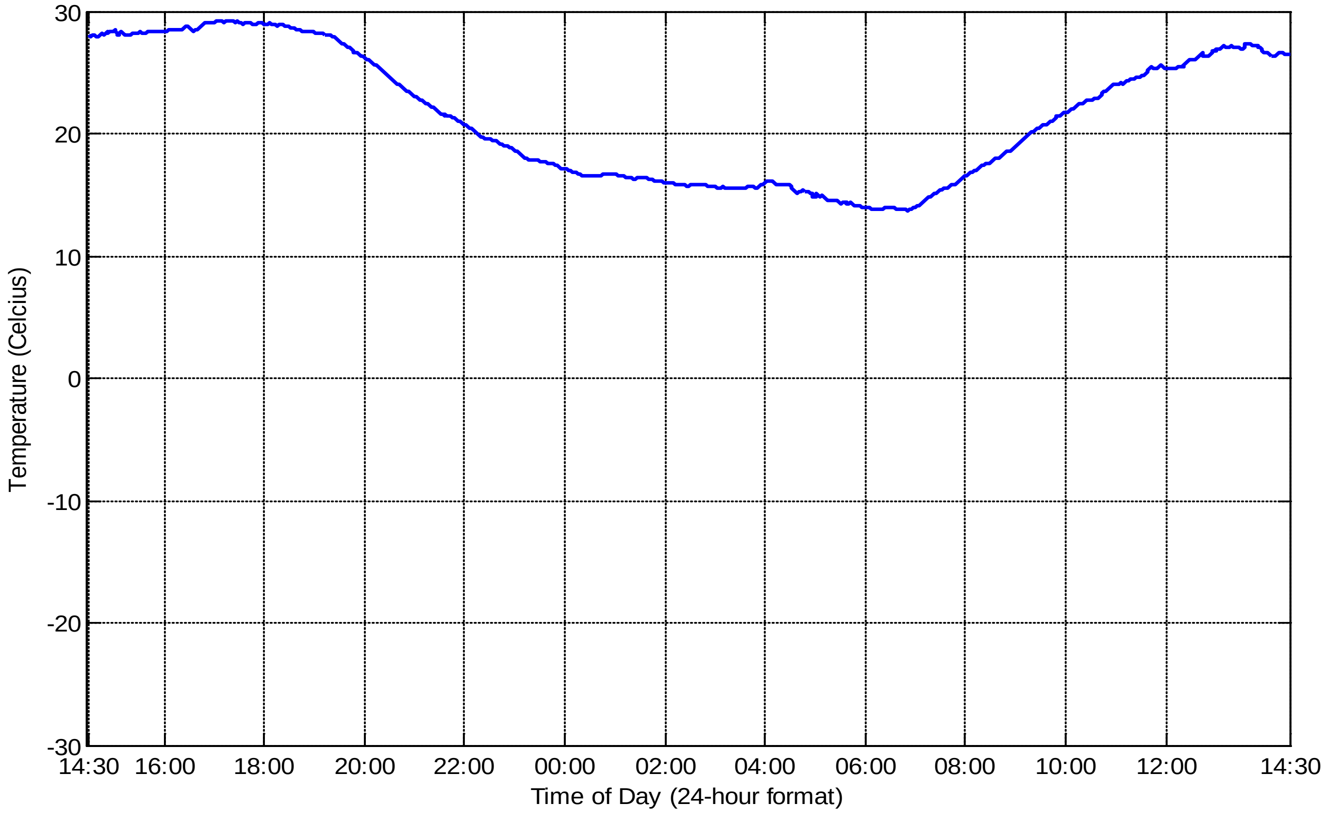
# August 14 - 15, 2014 Weather Data



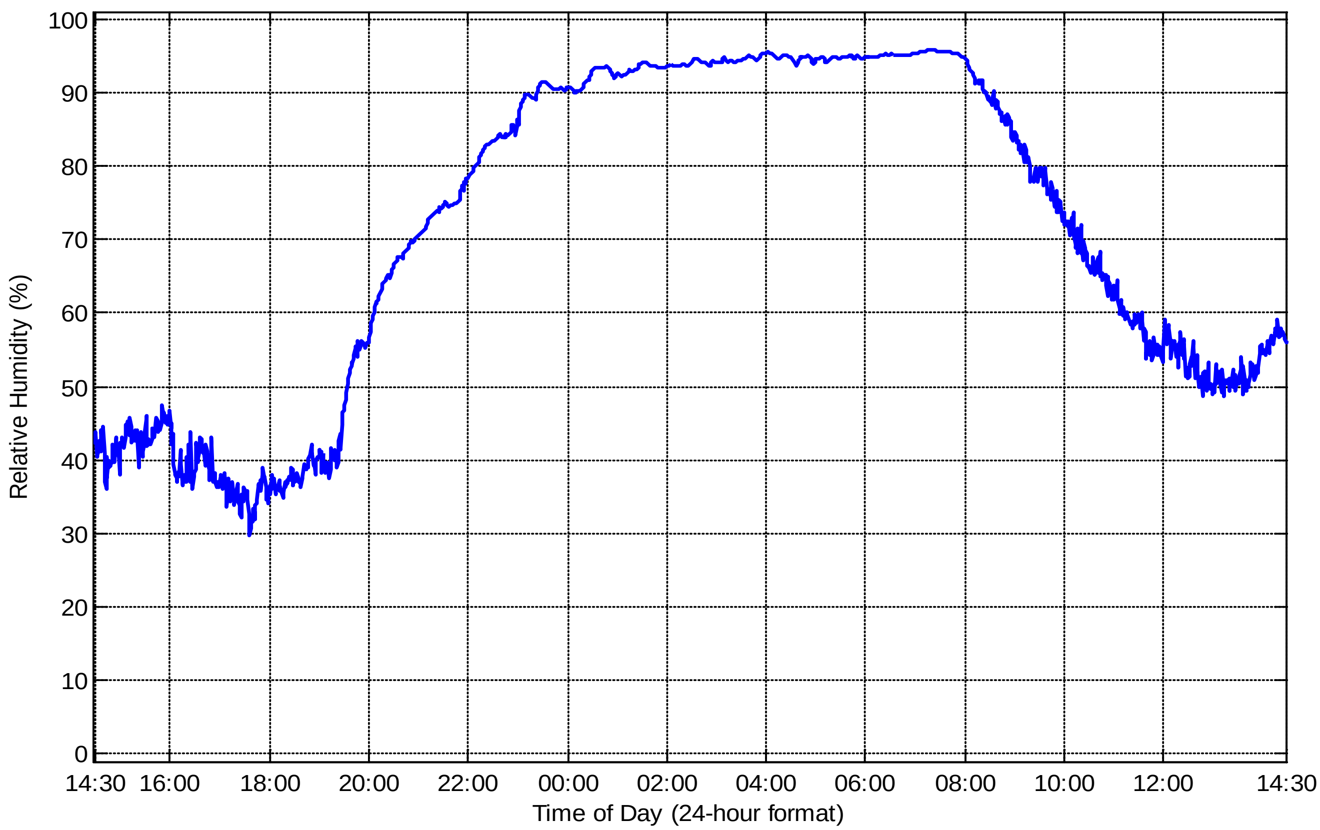

**Monitored Wind Speed (August 14 – August 15, 2014) at Noise Monitor Location 4**



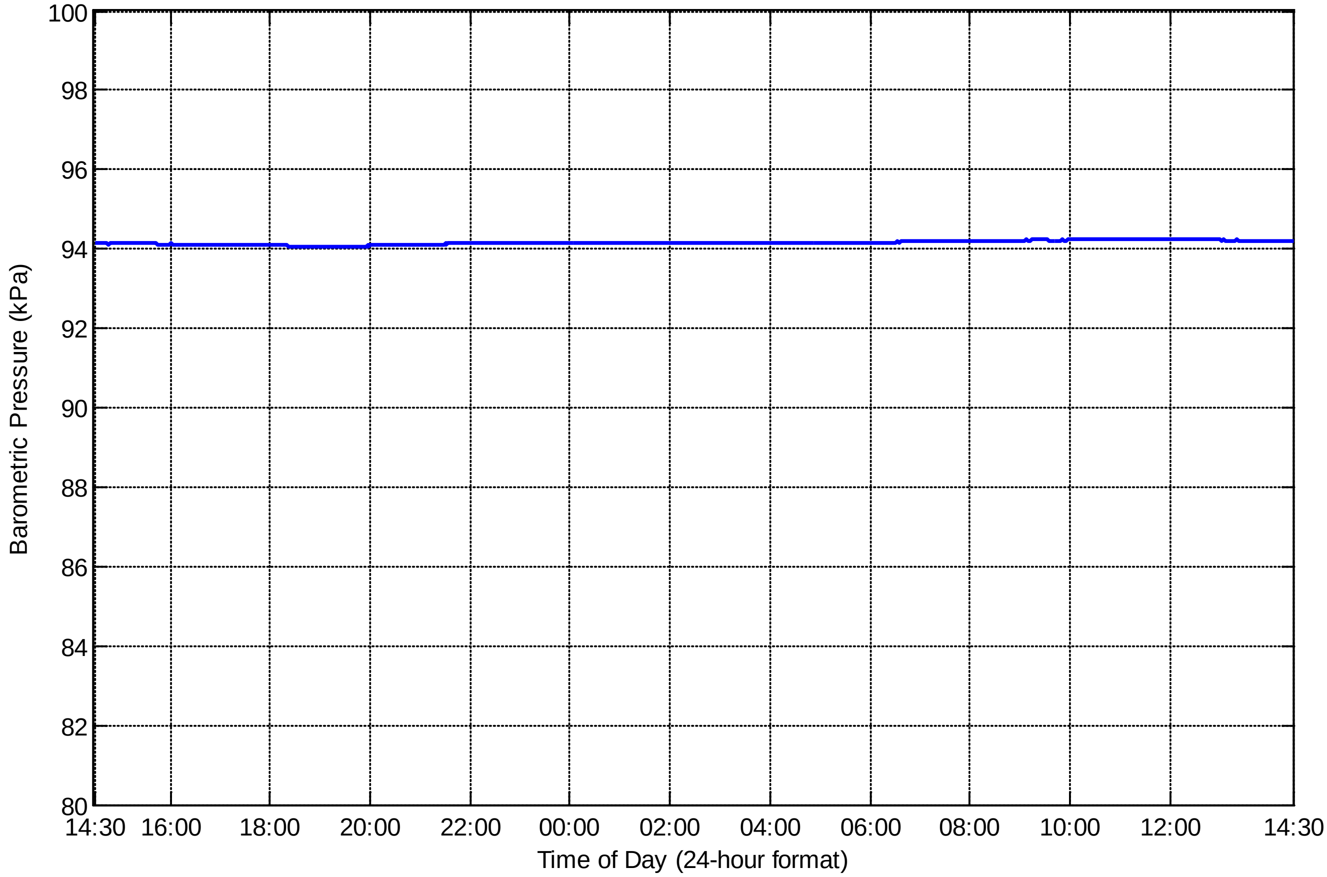

**Monitored Wind Direction (August 14 – August 15, 2014) at Noise Monitor Location 4**



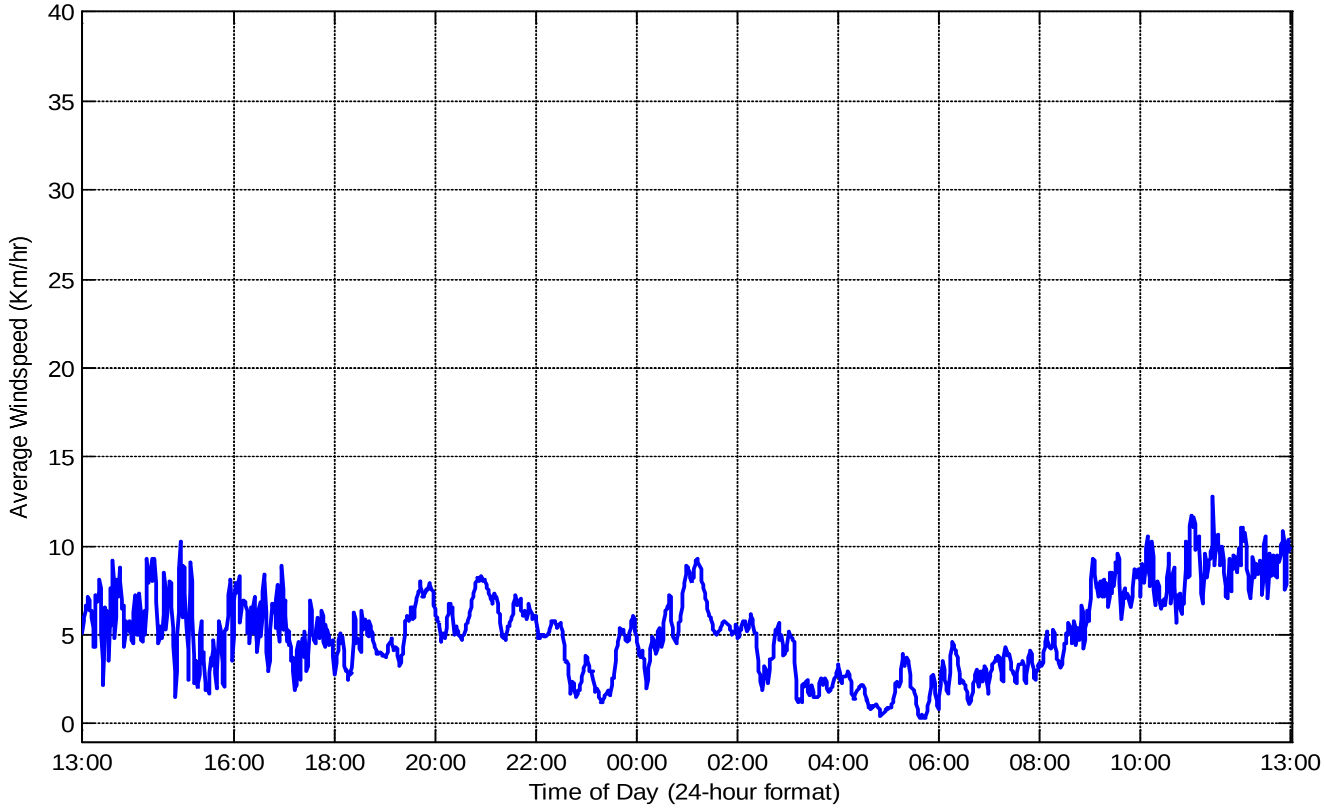

**Monitored Temperature (August 14 – August 15, 2014) at Noise Monitor Location 4**



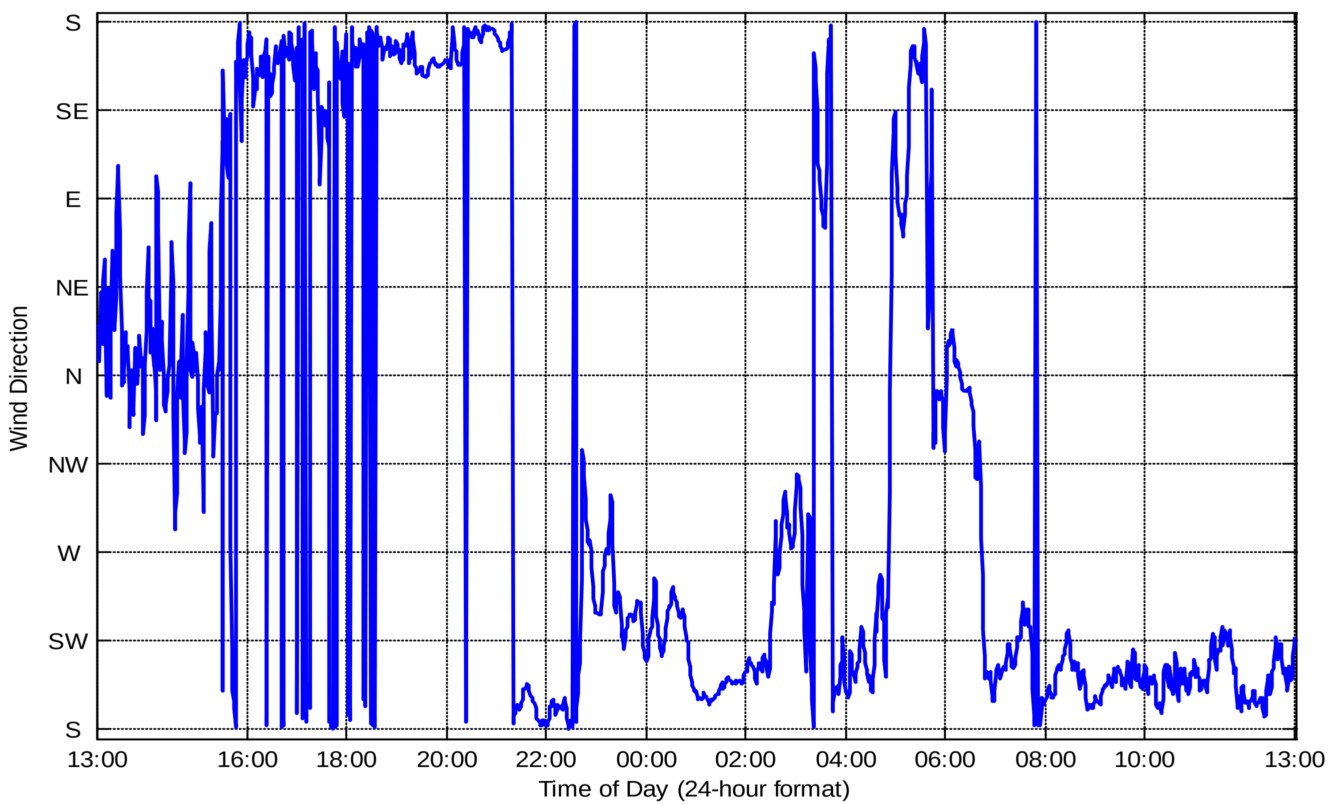

**Monitored Humidity (August 14 – August 15, 2014) at Noise Monitor Location 4**



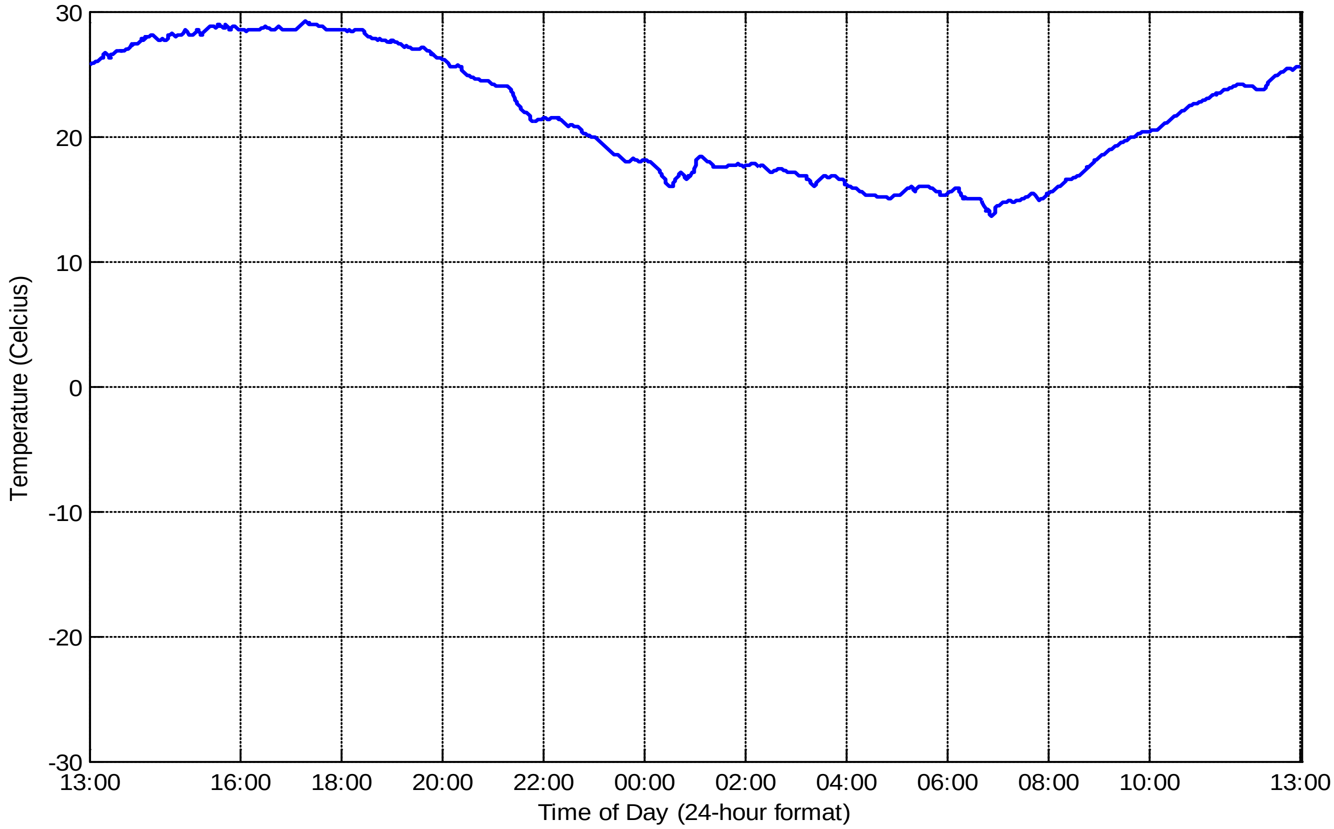

**Monitored Barometric Pressure (August 14 – August 15, 2014) at Noise Monitor Location 4**



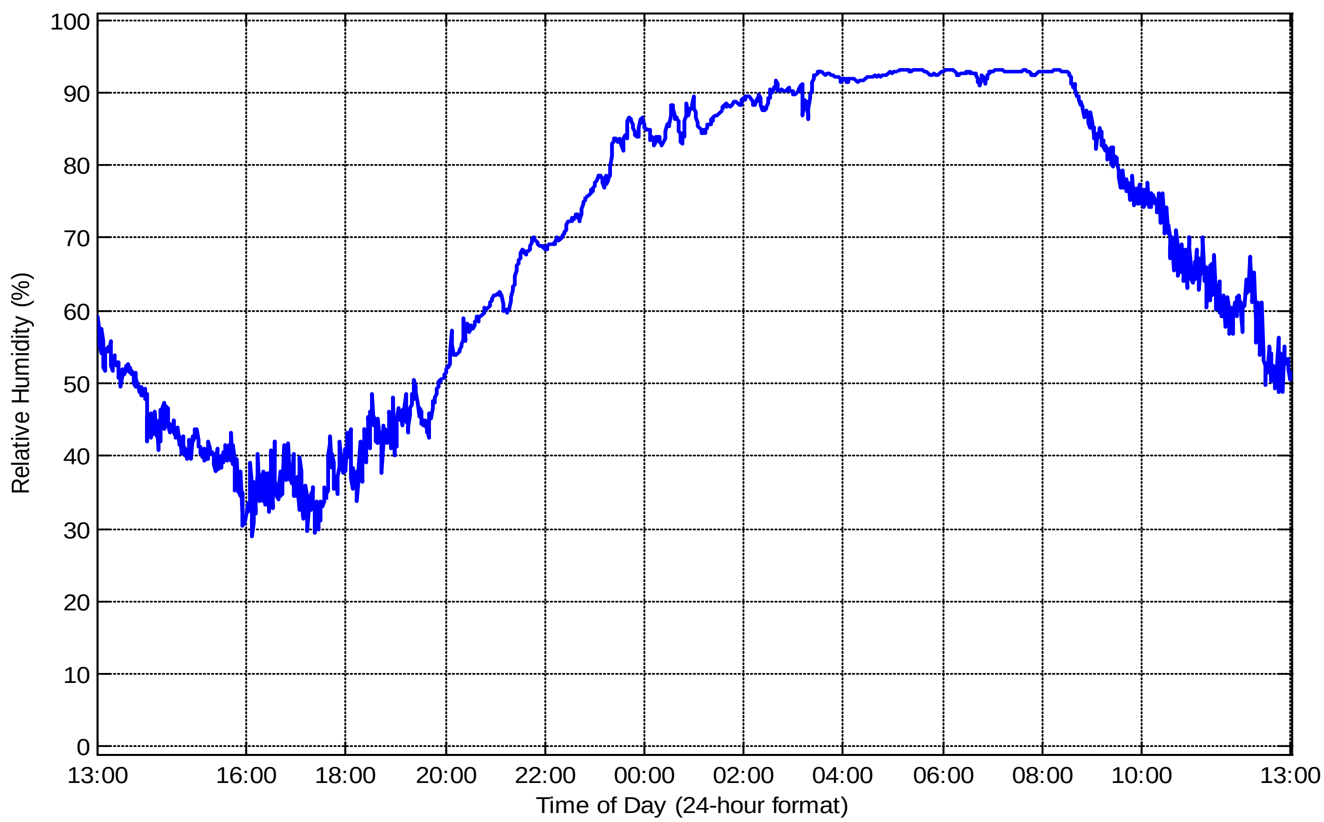

**Monitored Wind Speed (August 14 – August 15, 2014) at Noise Monitor Location 5**



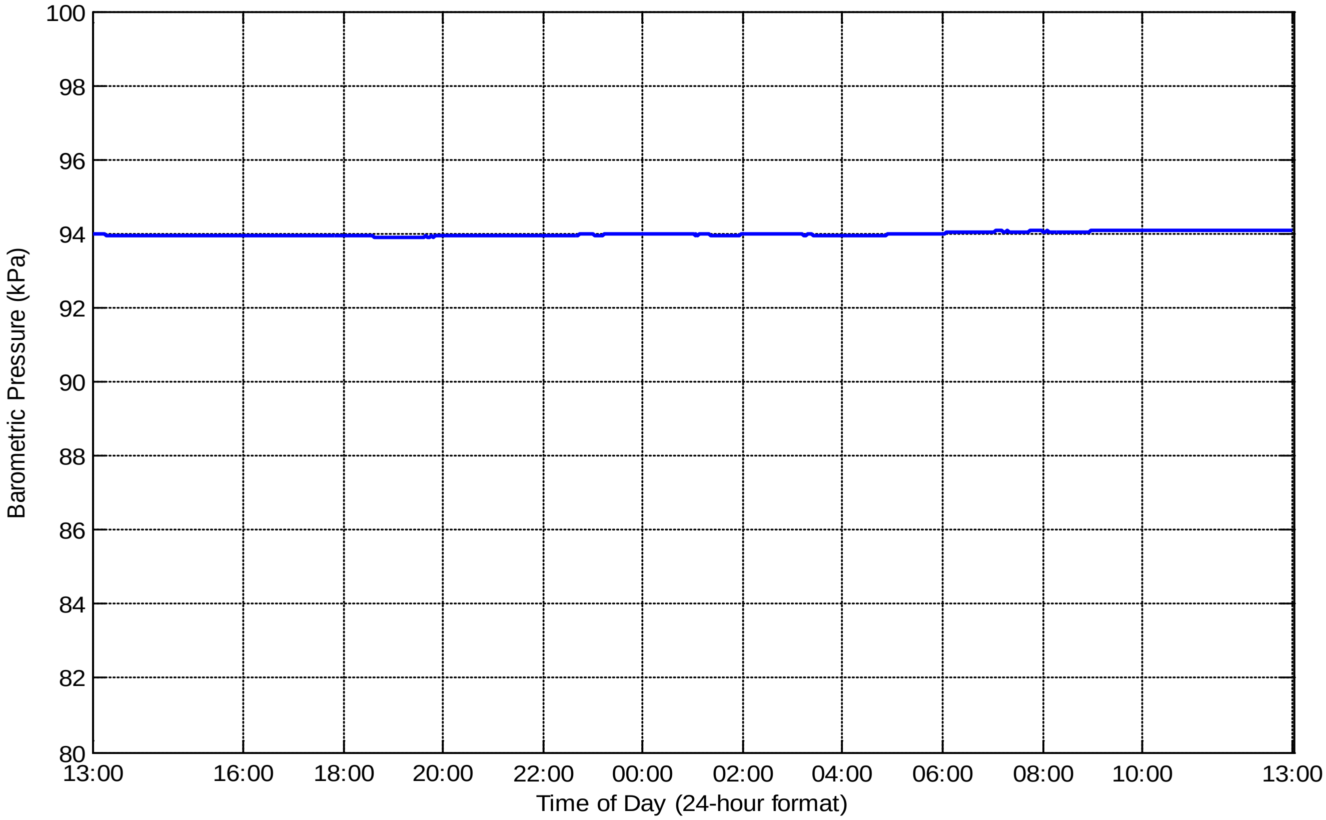

**Monitored Wind Direction (August 14 – August 15, 2014) at Noise Monitor Location 5**



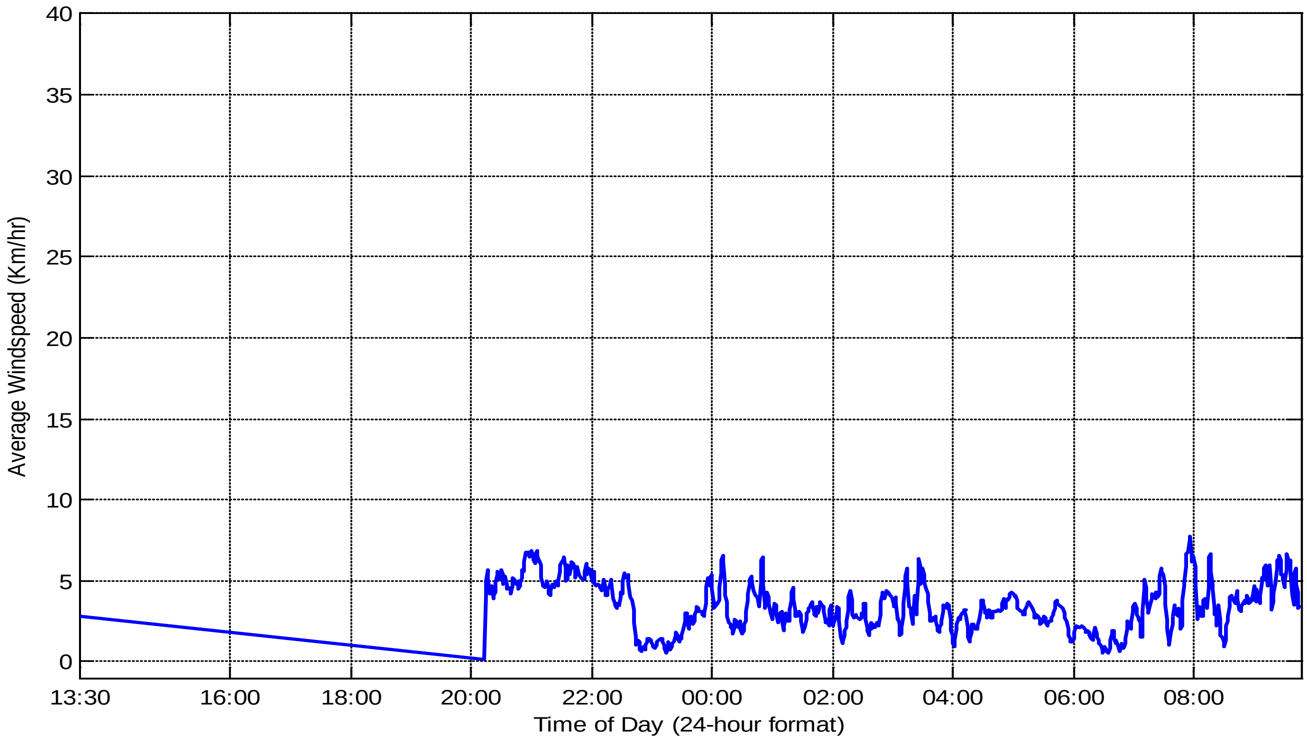

**Monitored Temperature (August 14 – August 15, 2014) at Noise Monitor Location 5**



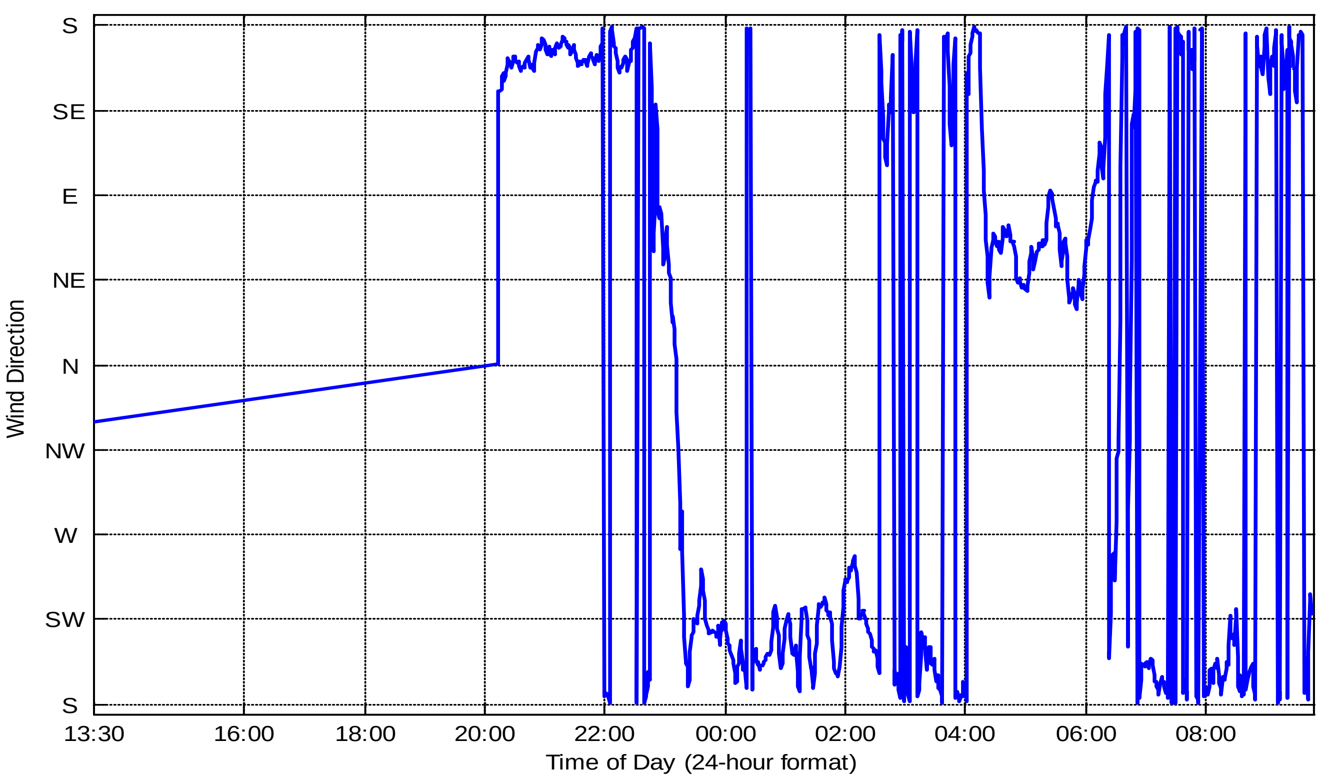

**Monitored Humidity (August 14 – August 15, 2014) at Noise Monitor Location 5**




**Monitored Barometric Pressure (August 14 – August 15, 2014) at Noise Monitor Location 5**




**Monitored Wind Speed (August 14 – August 15, 2014) at Noise Monitor Location 6**[1]




**Monitored Wind Direction (August 14 – August 15, 2014) at Noise Monitor Location 6**

[1] Due to an equipment malfunction the data from 11:38 – 20:13 on August 14 was not recorded. Fortunately this did not affect any night-time hours.



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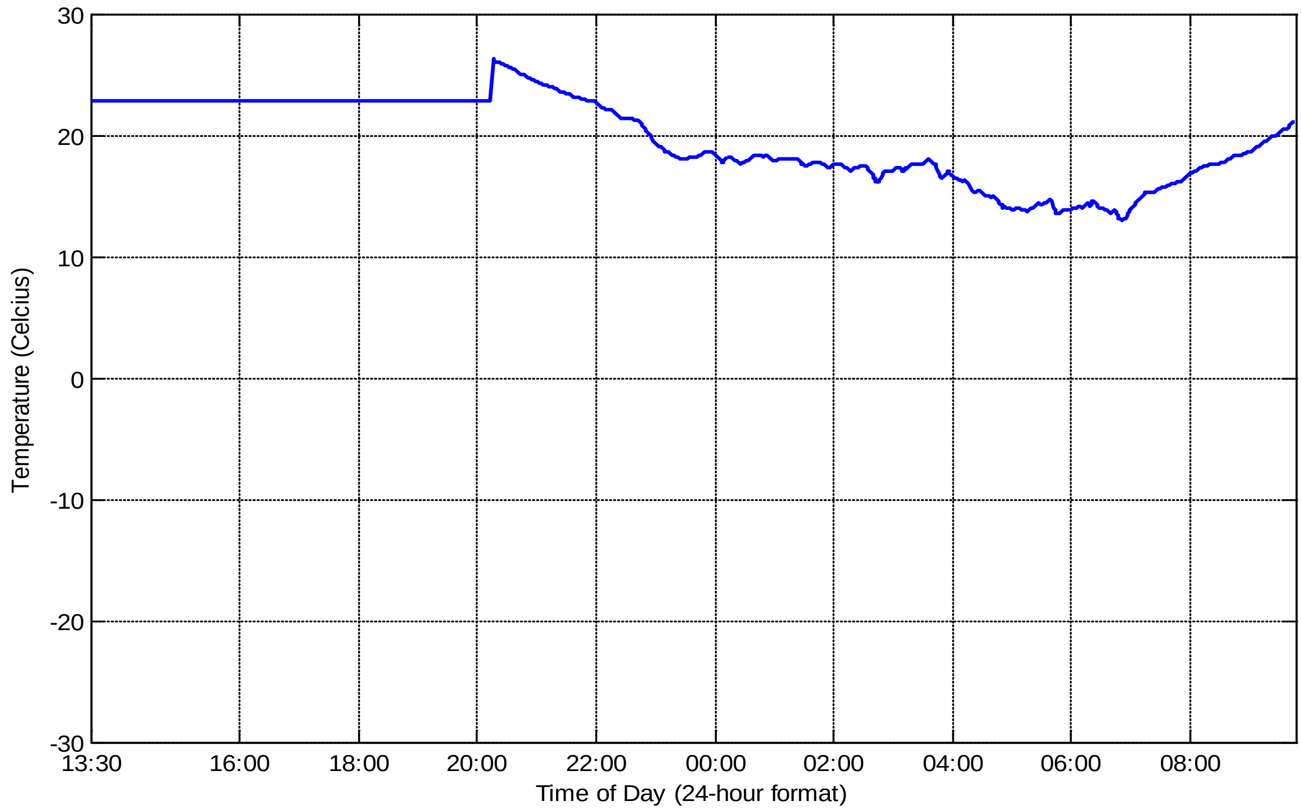
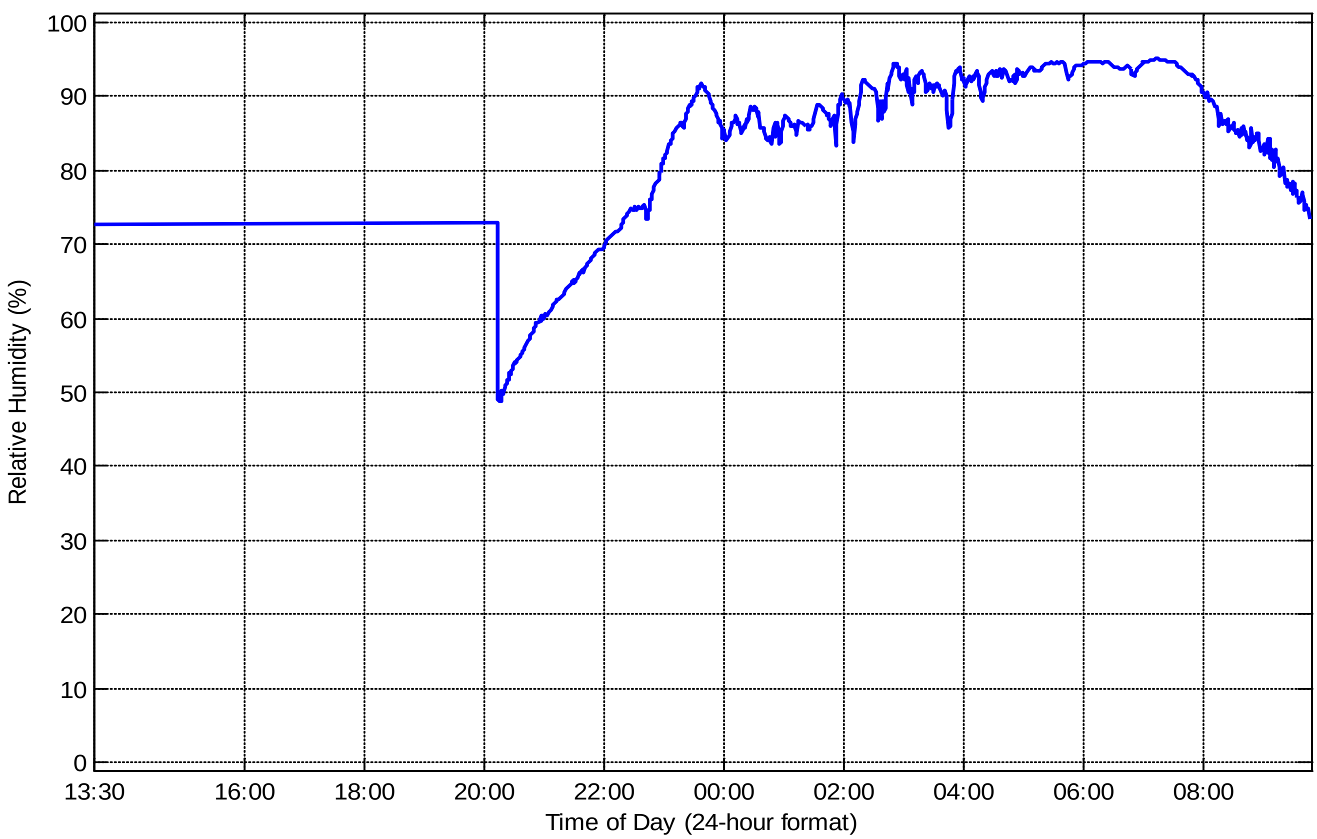
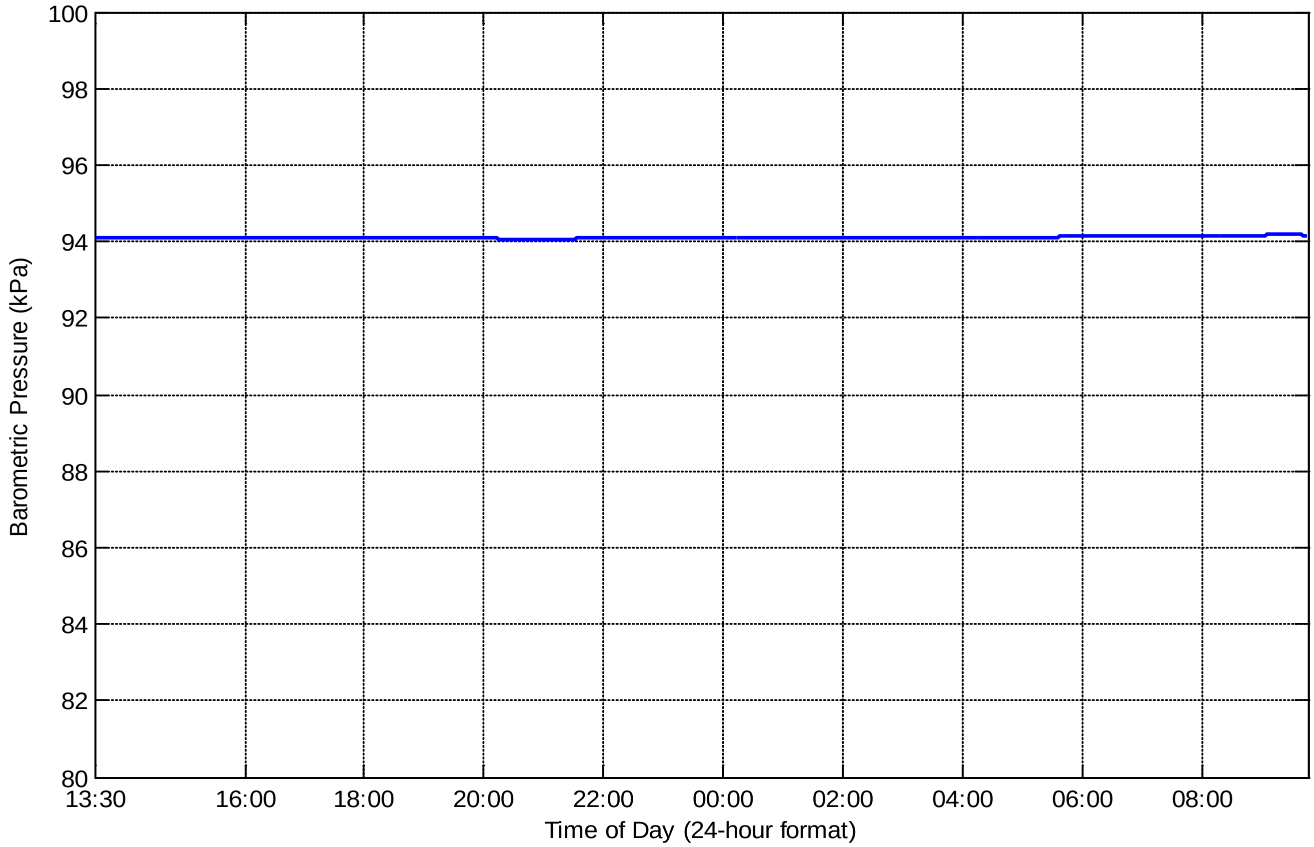



**Monitored Temperature (August 14 – August 15, 2014) at Noise Monitor Location 6**

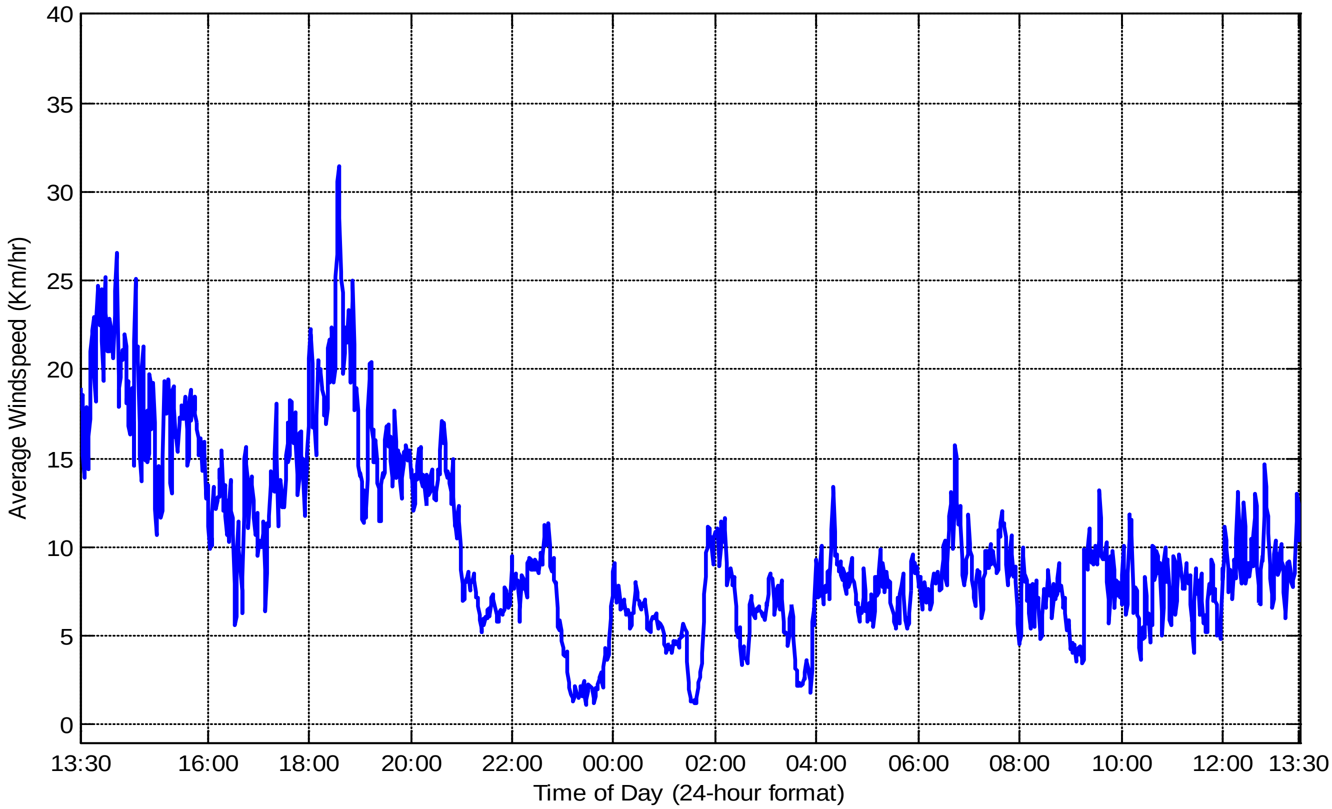



**Monitored Humidity (August 14 – August 15, 2014) at Noise Monitor Location 6**

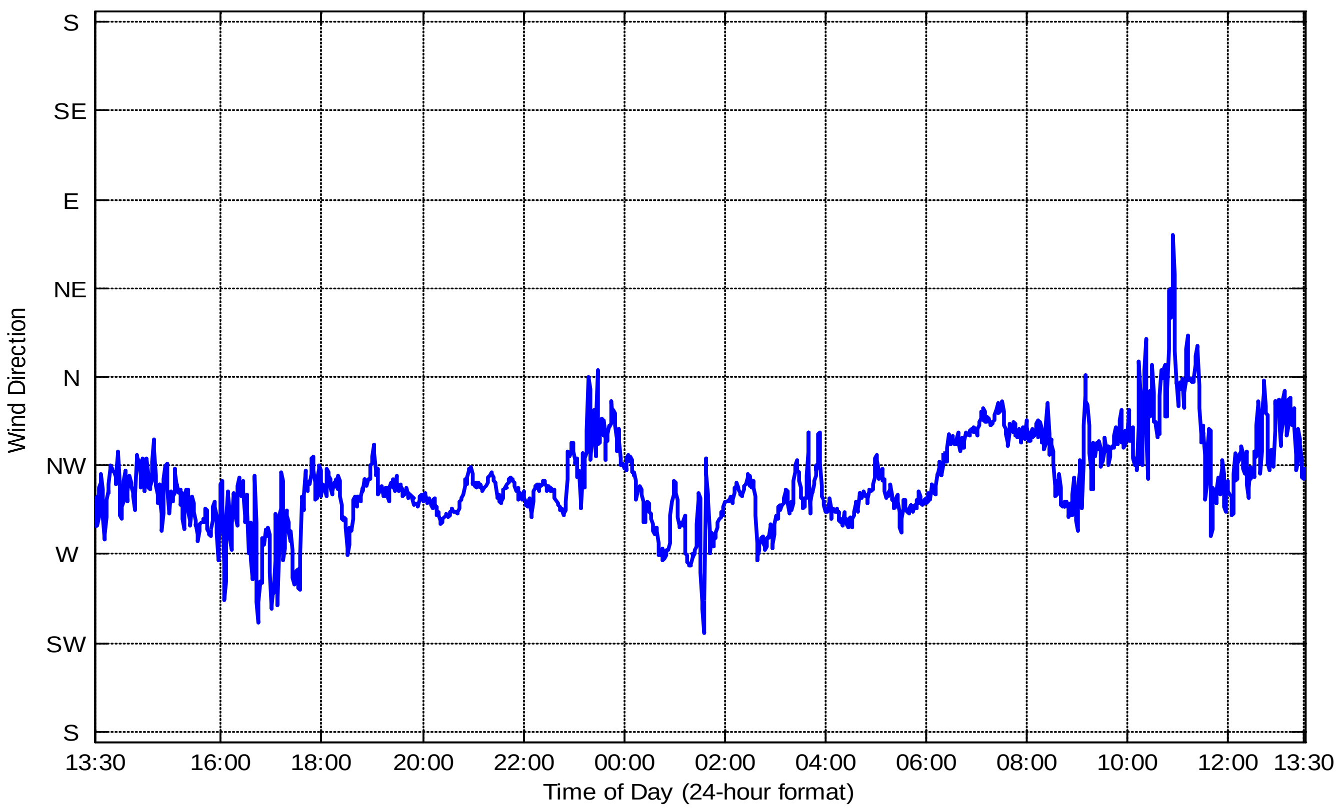



**Monitored Barometric Pressure (August 14 – August 15, 2014) at Noise Monitor Location 6**

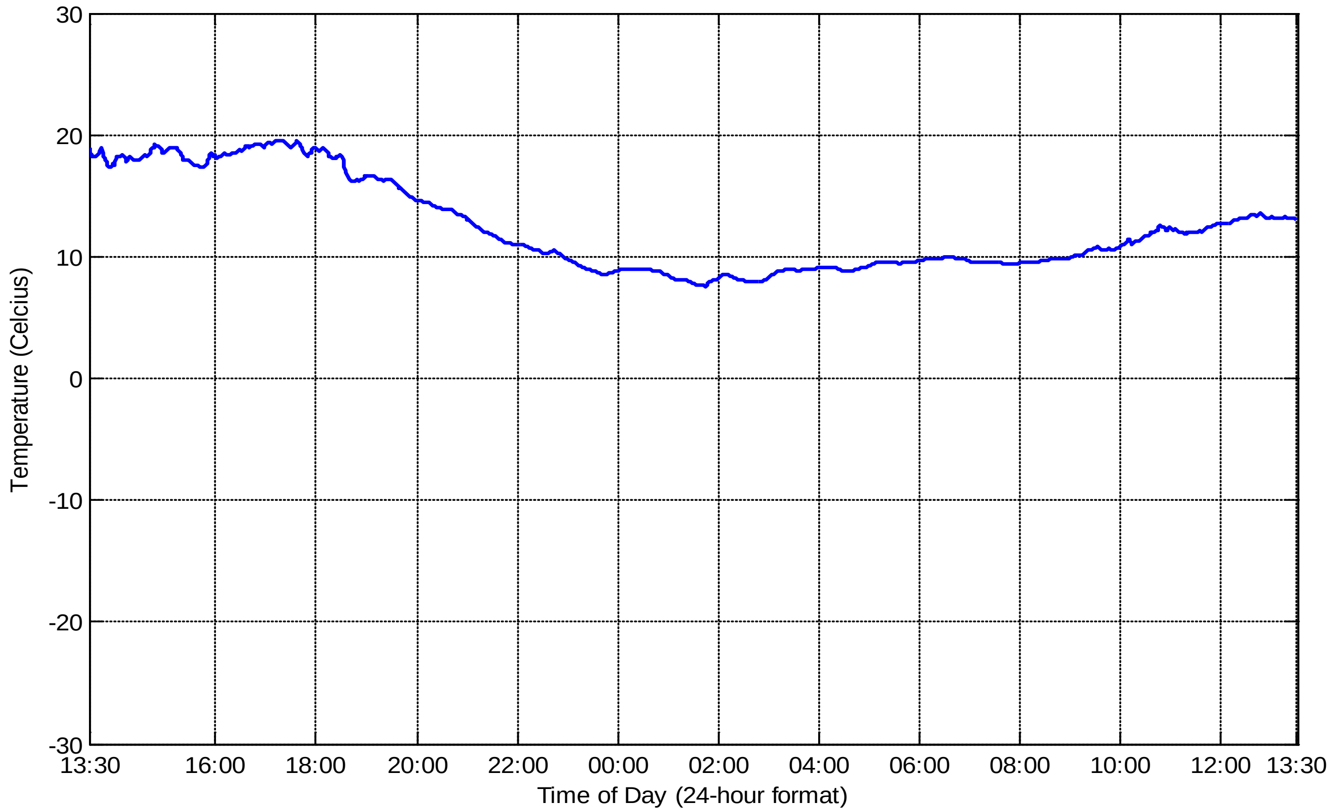
# August 20 - 21, 2014 Weather Data



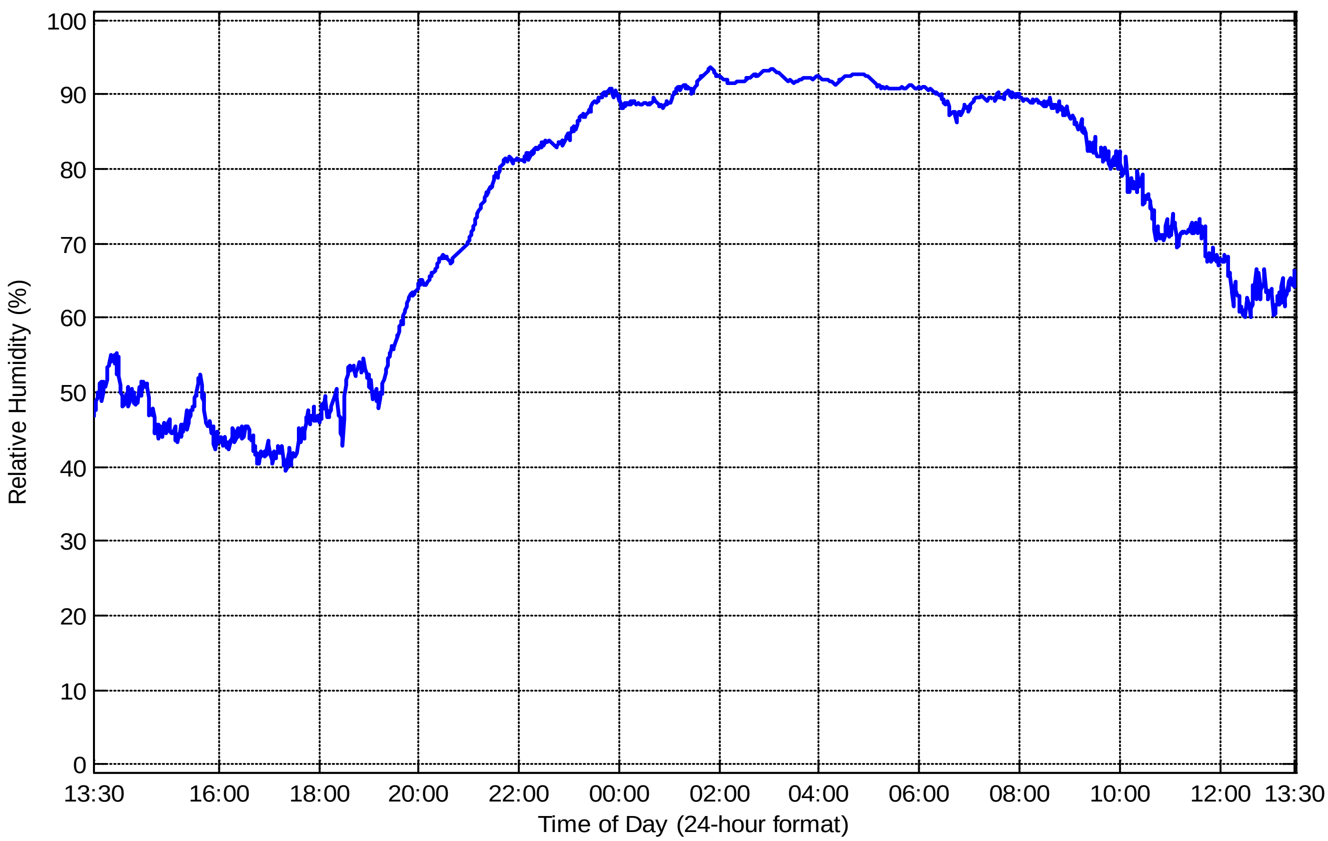

**Monitored Wind Speed (August 20 – August 21, 2014) at Noise Monitor Location 4**



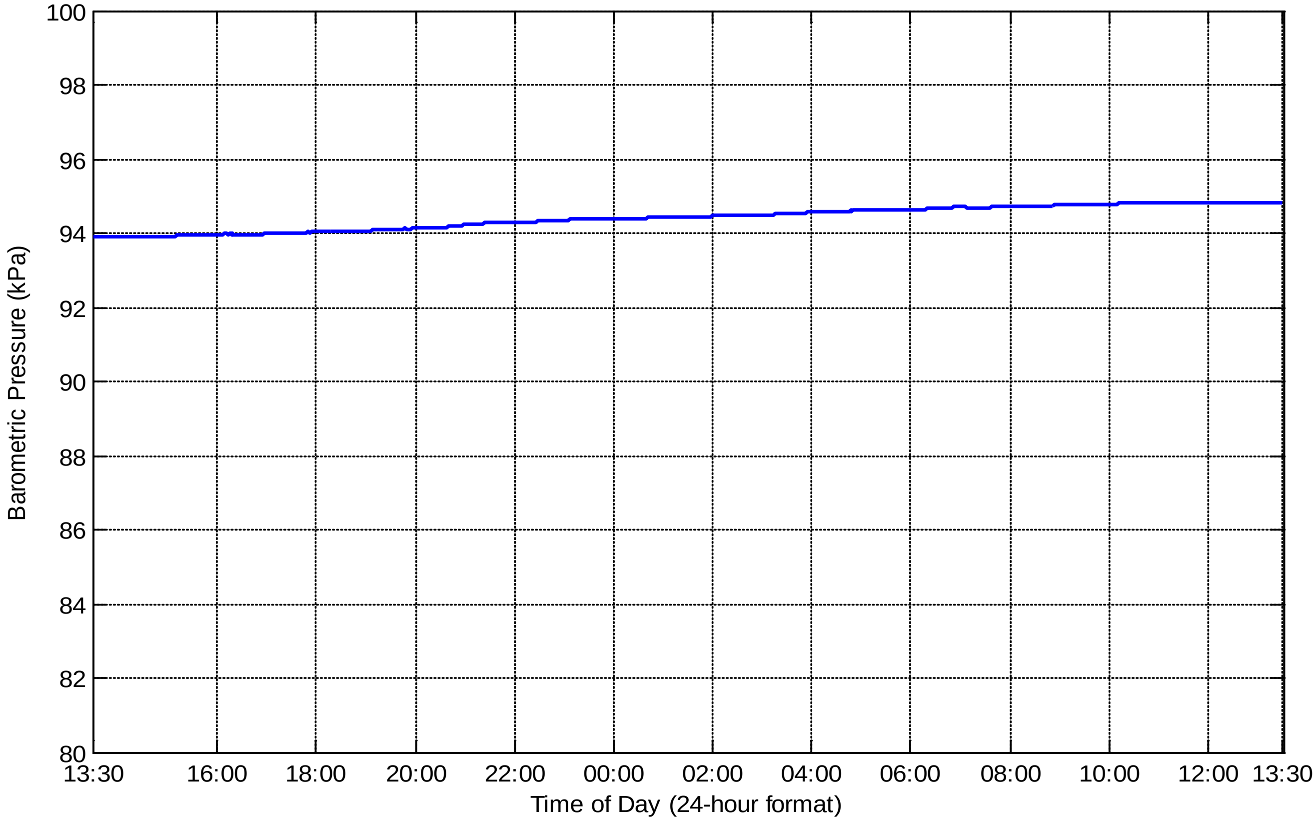

**Monitored Wind Direction (August 20 – August 21, 2014) at Noise Monitor Location 4**



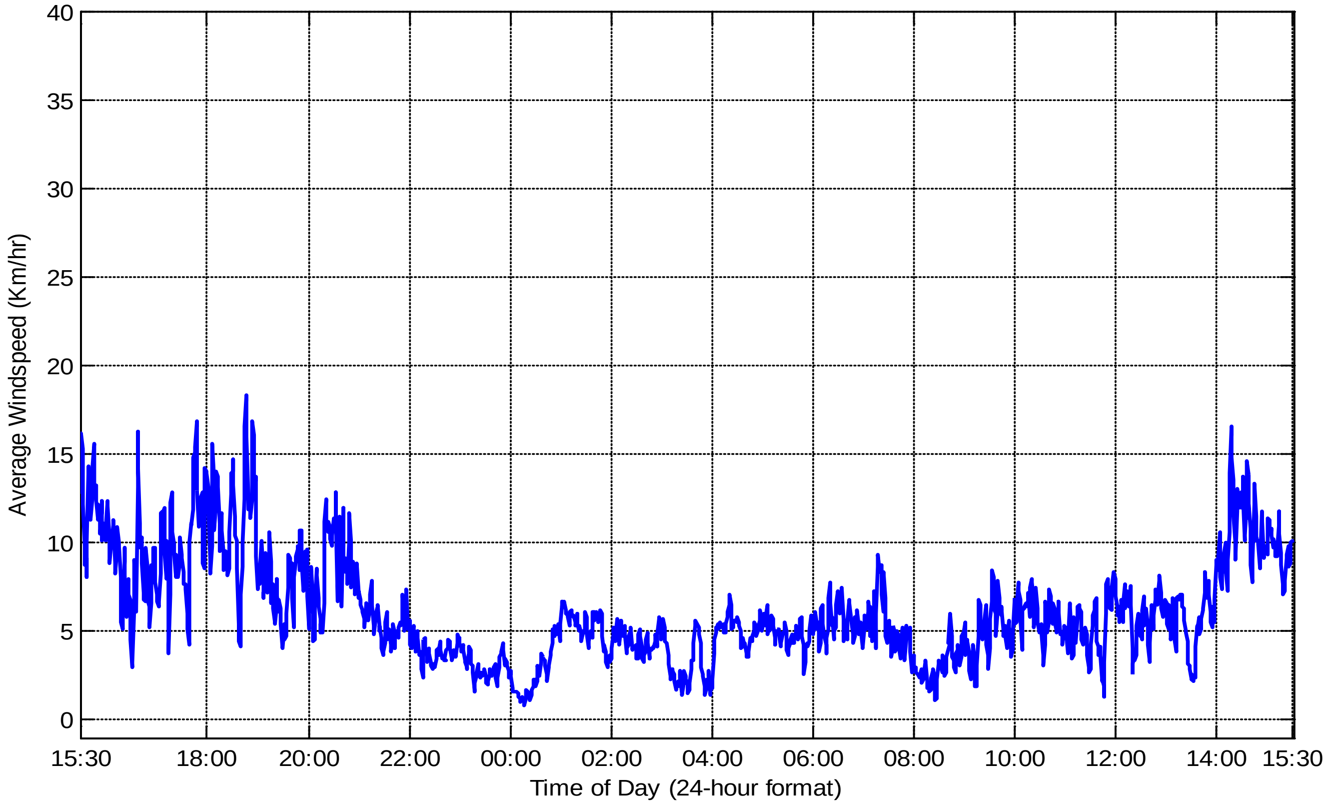

**Monitored Temperature (August 20 – August 21, 2014) at Noise Monitor Location 4**



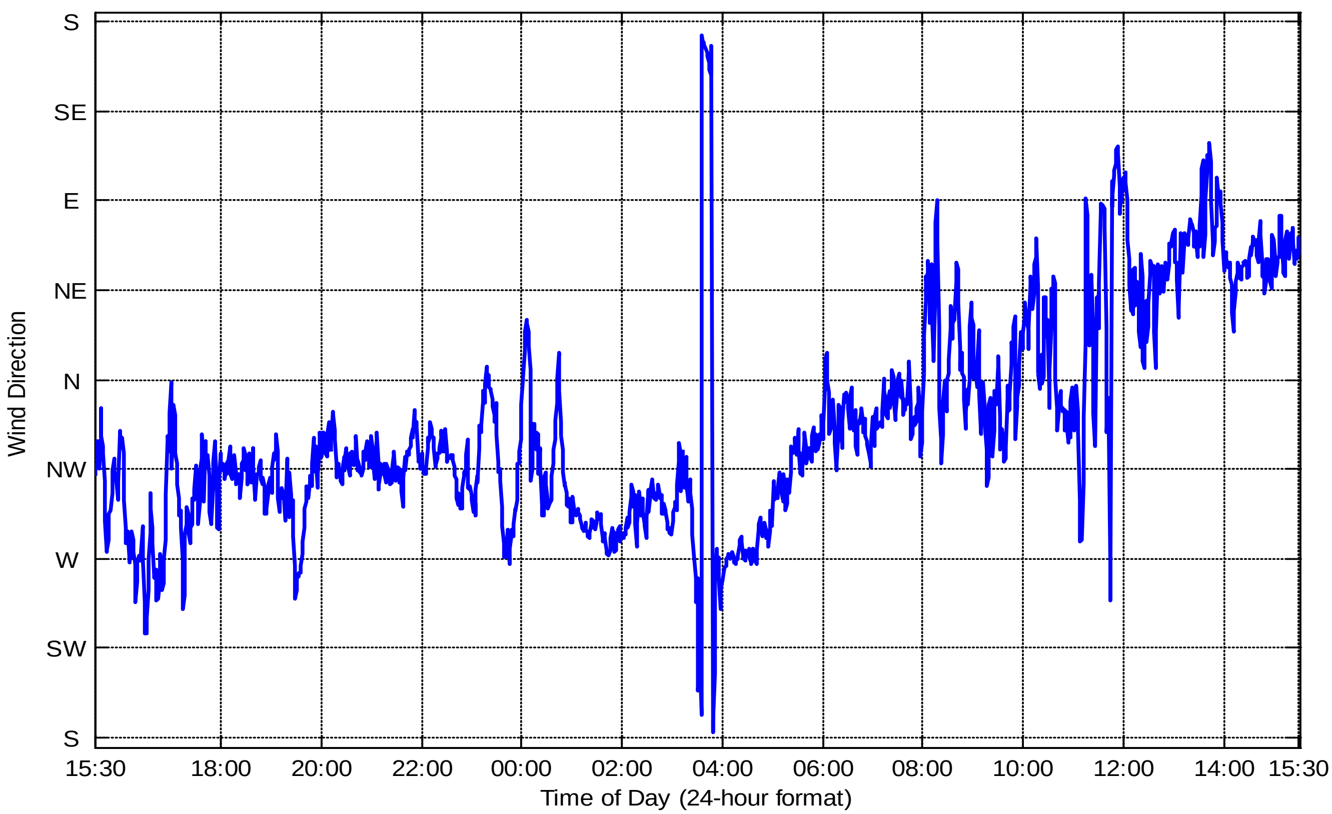

**Monitored Humidity (August 20 – August 21, 2014) at Noise Monitor Location 4**



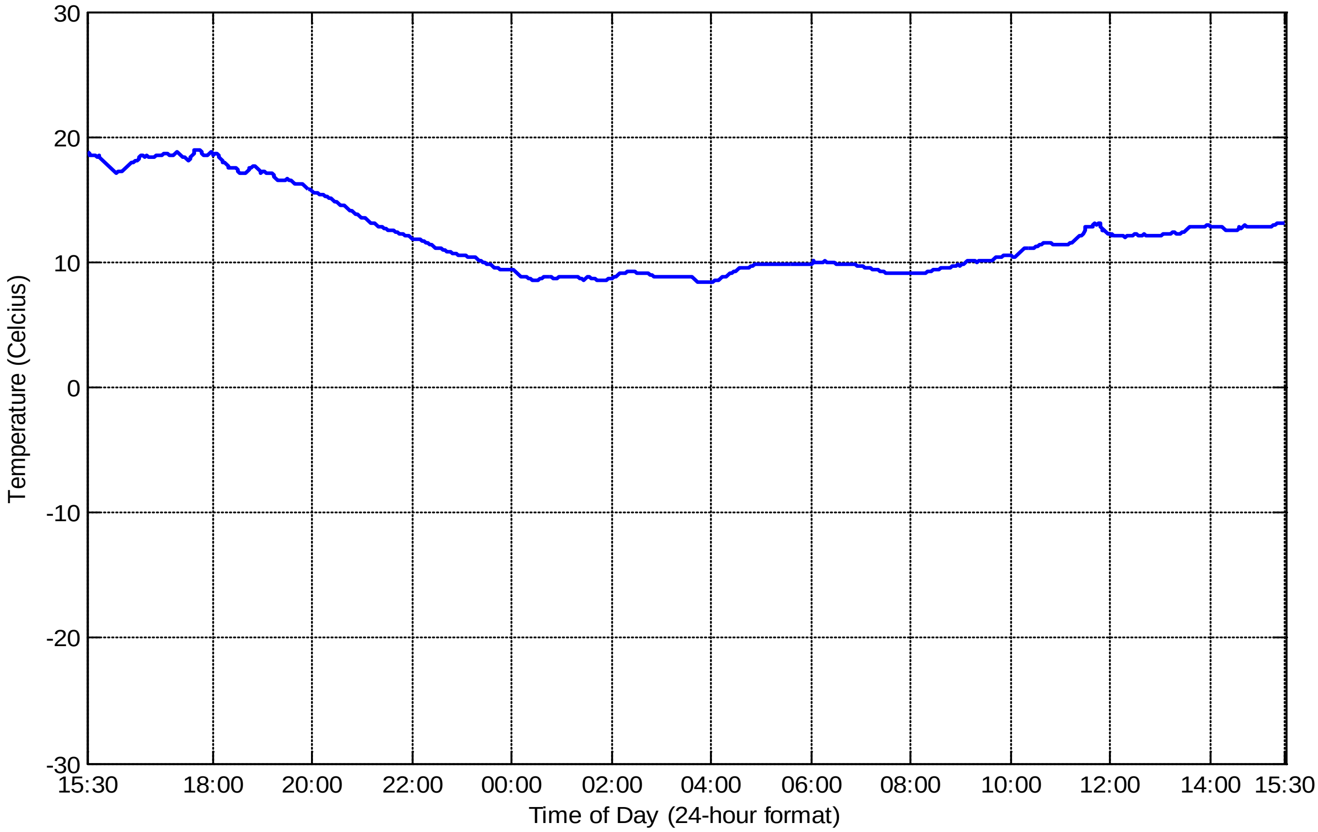

**Monitored Barometric Pressure (August 20 – August 21, 2014) at Noise Monitor Location 4**



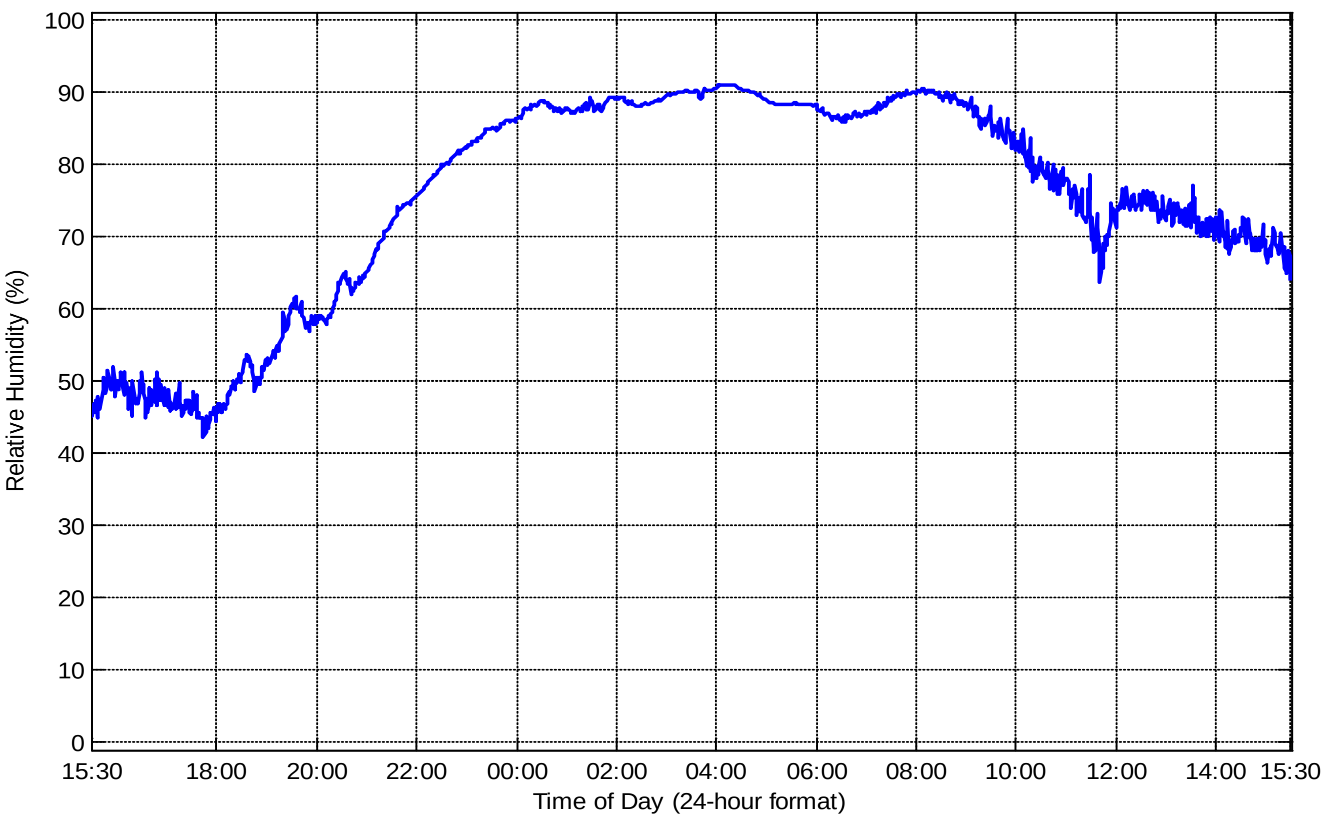

**Monitored Wind Speed (August 20 – August 21, 2014) at Noise Monitor Location 5**



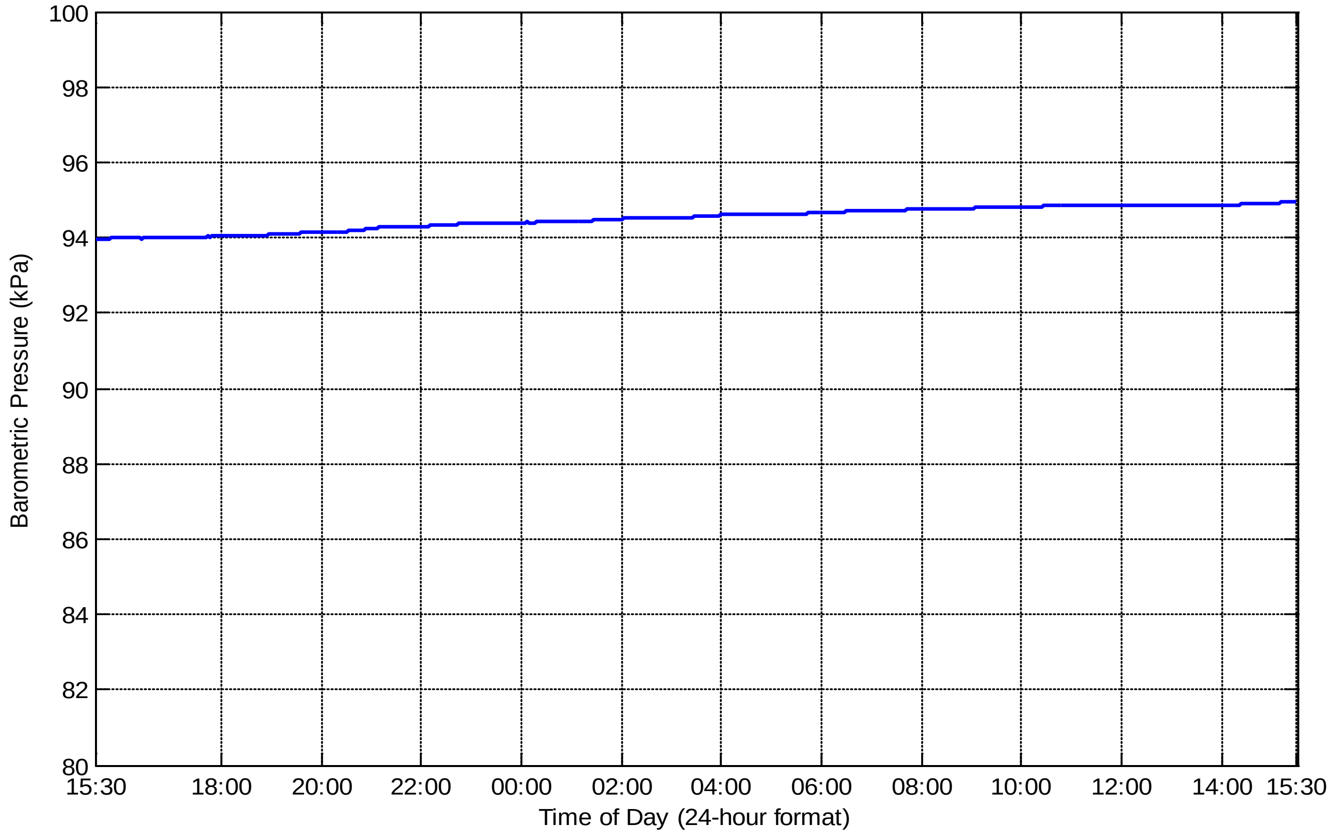

**Monitored Wind Direction (August 20 – August 21, 2014) at Noise Monitor Location 5**



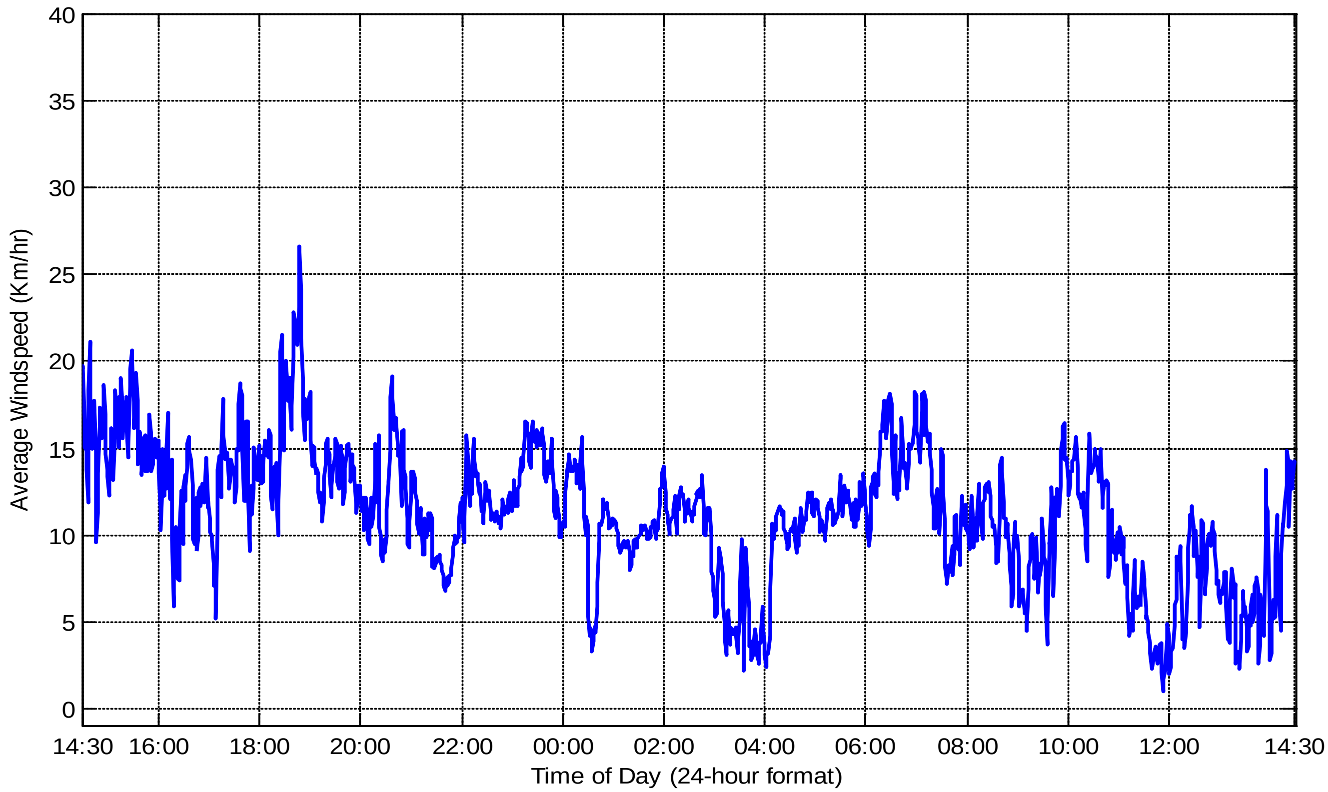

**Monitored Temperature (August 20 – August 21, 2014) at Noise Monitor Location 5**



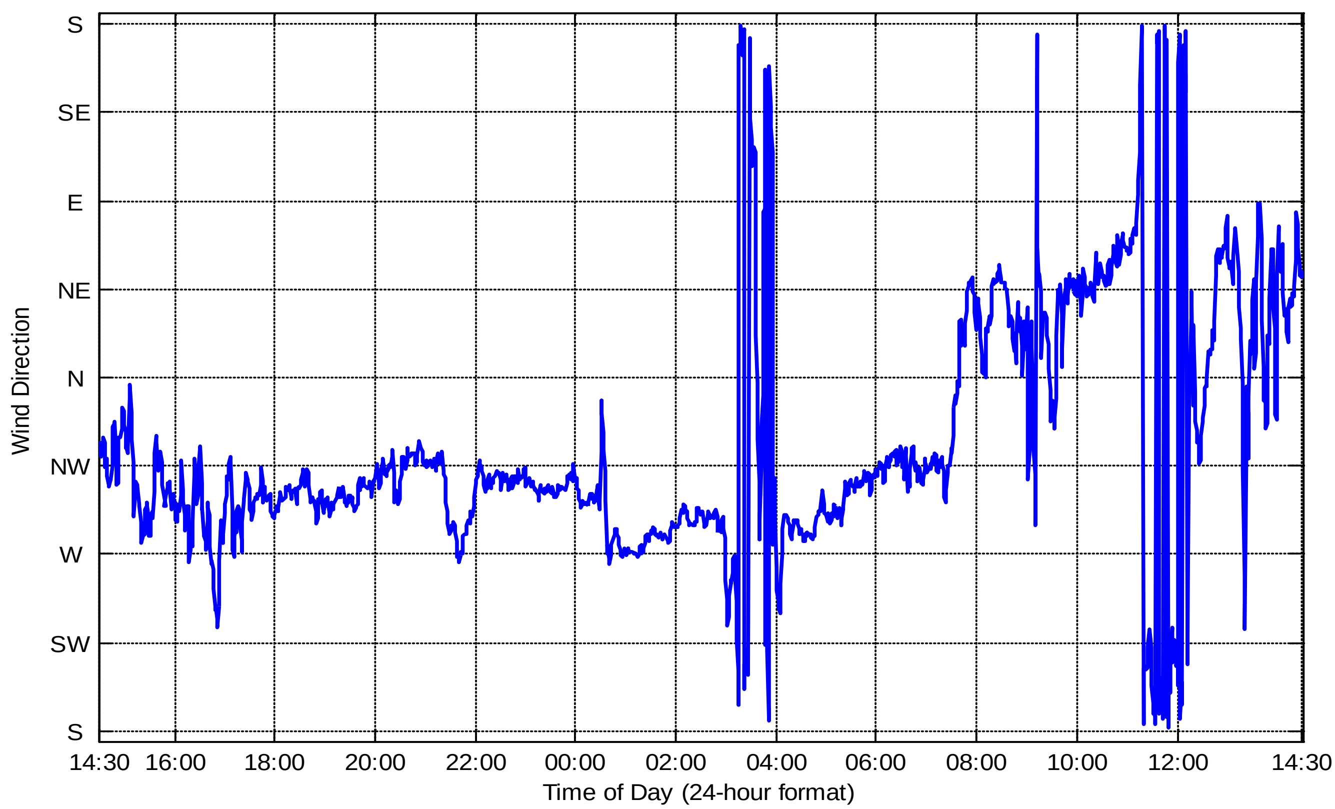

**Monitored Humidity (August 20 – August 21, 2014) at Noise Monitor Location 5**



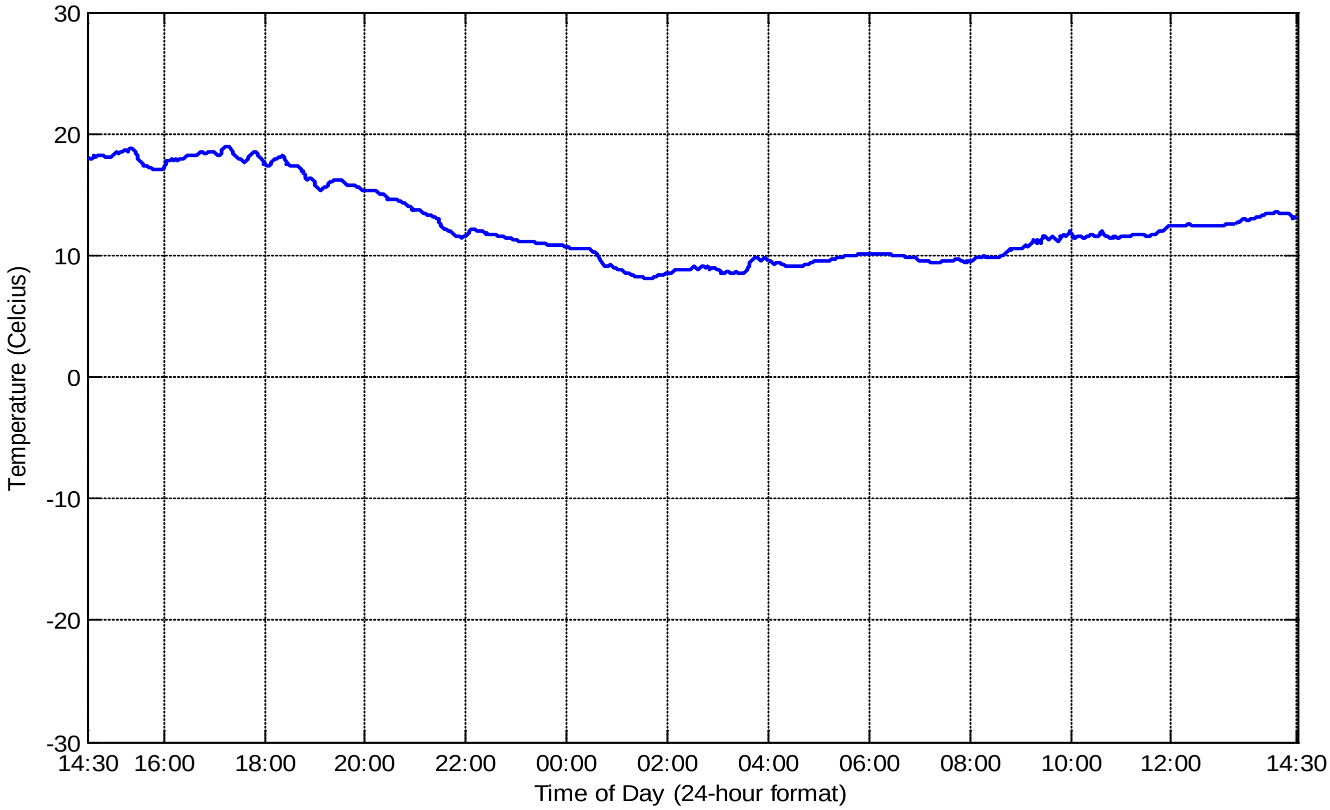

**Monitored Barometric Pressure (August 20 – August 21, 2014) at Noise Monitor Location 5**



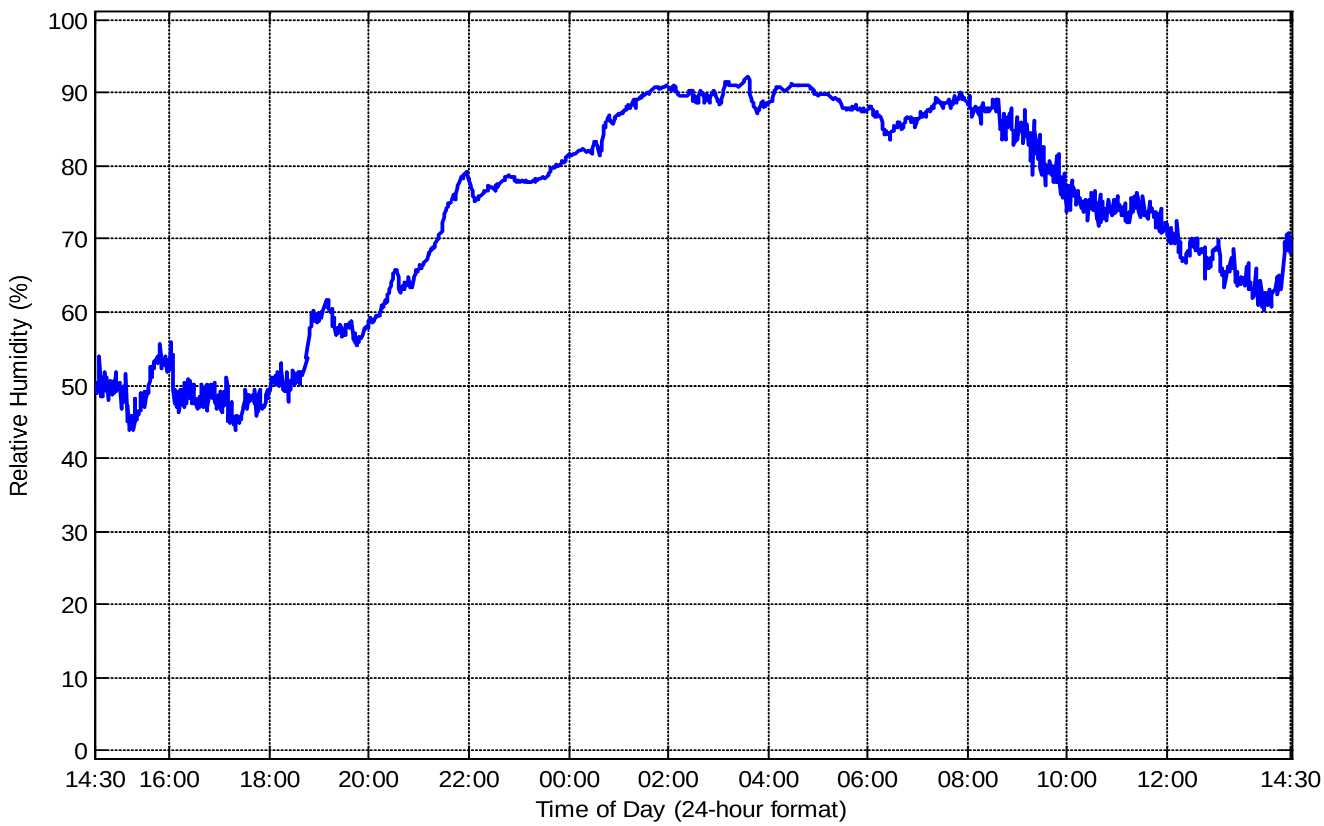

**Monitored Wind Speed (August 20 – August 21, 2014) at Noise Monitor Location 6**



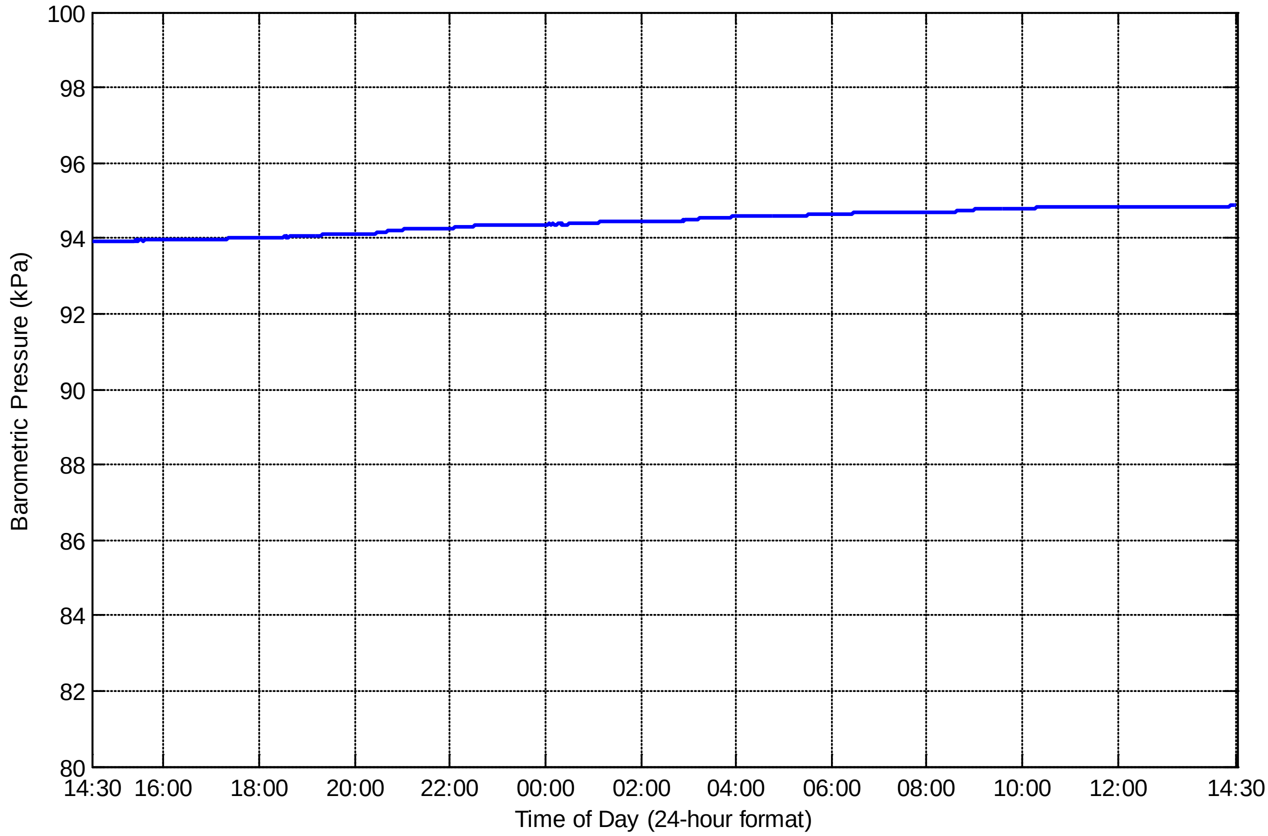

**Monitored Wind Direction (August 20 – August 21, 2014) at Noise Monitor Location 6**




**Monitored Temperature (August 20 – August 21, 2014) at Noise Monitor Location 6**

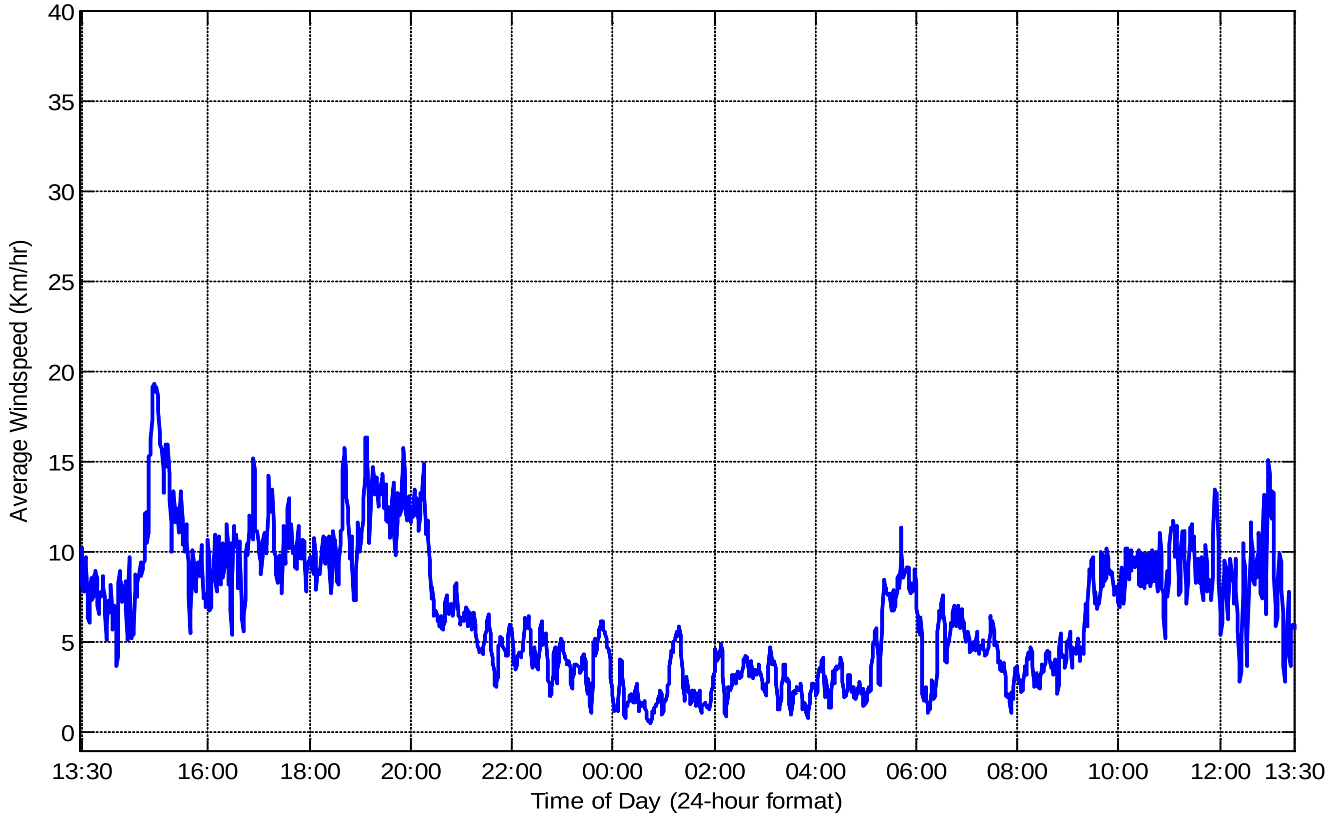



**Monitored Humidity (August 20 – August 21, 2014) at Noise Monitor Location 6**

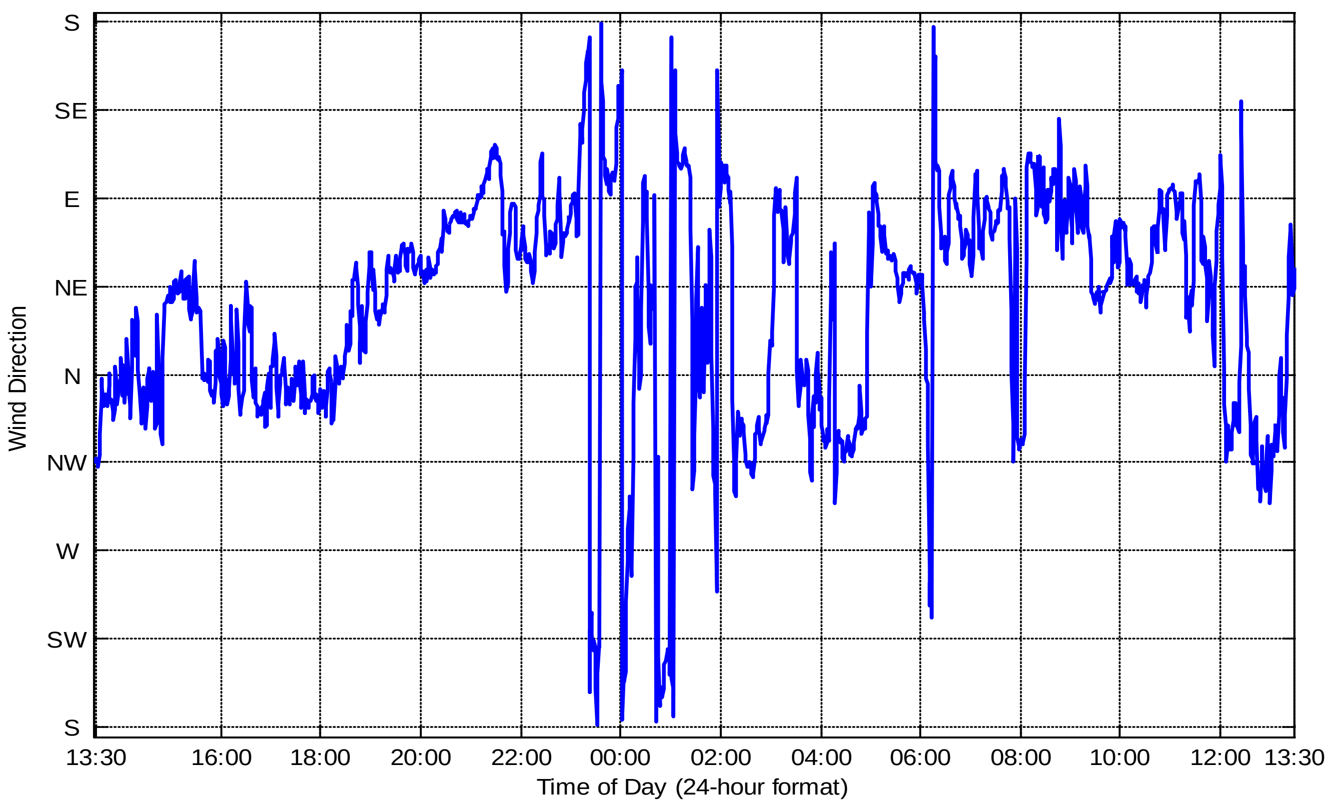



**Monitored Barometric Pressure (August 20 – August 21, 2014) at Noise Monitor Location 6**

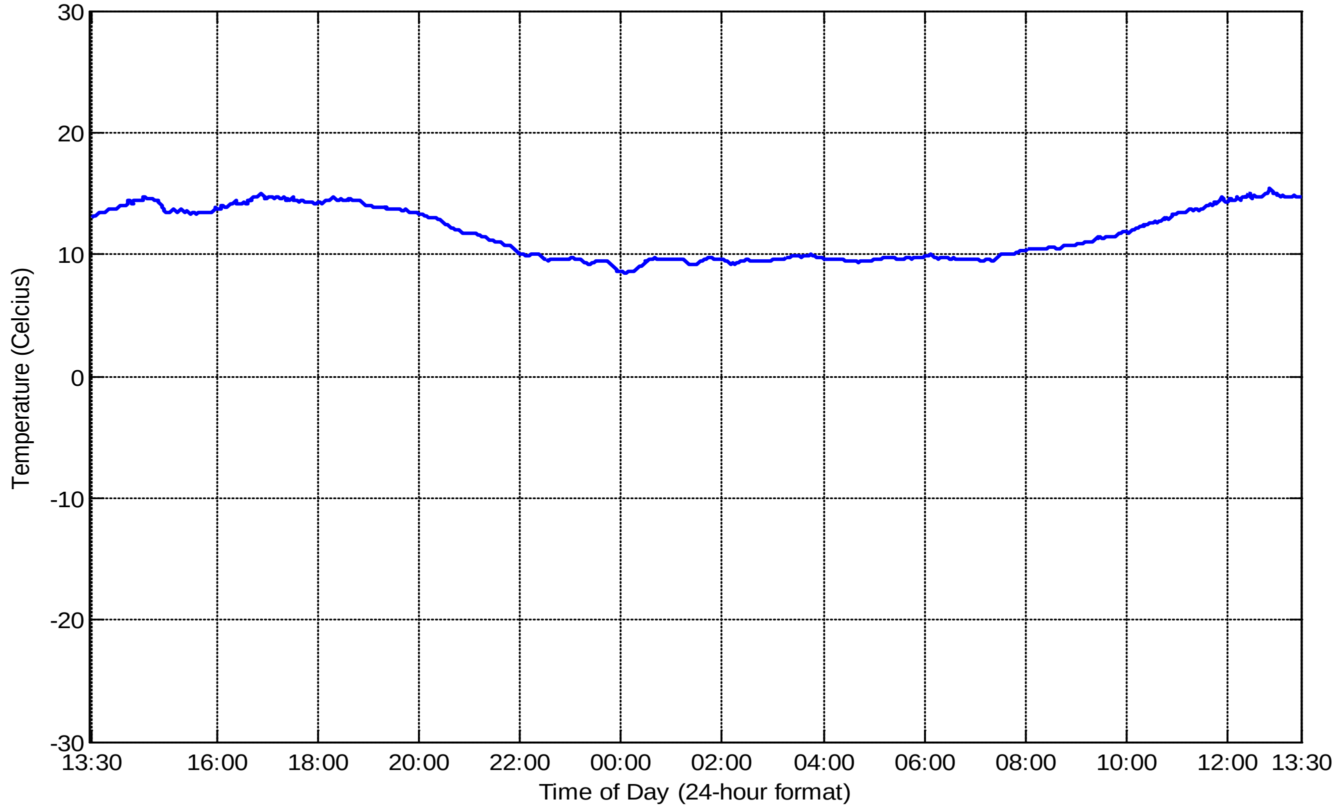
# August 21 - 22, 2014 Weather Data



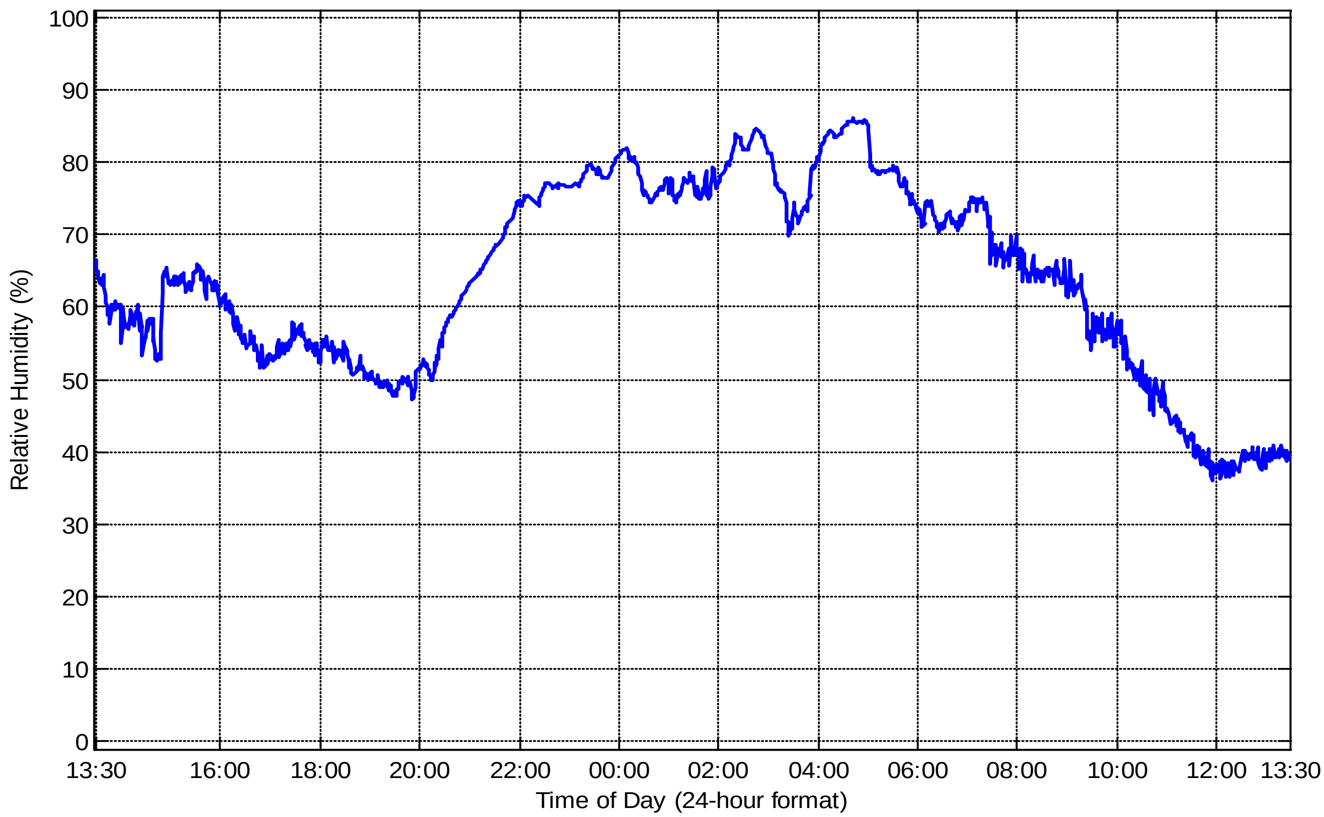

**Monitored Wind Speed (August 21 – August 22, 2014) at Noise Monitor Location 4**



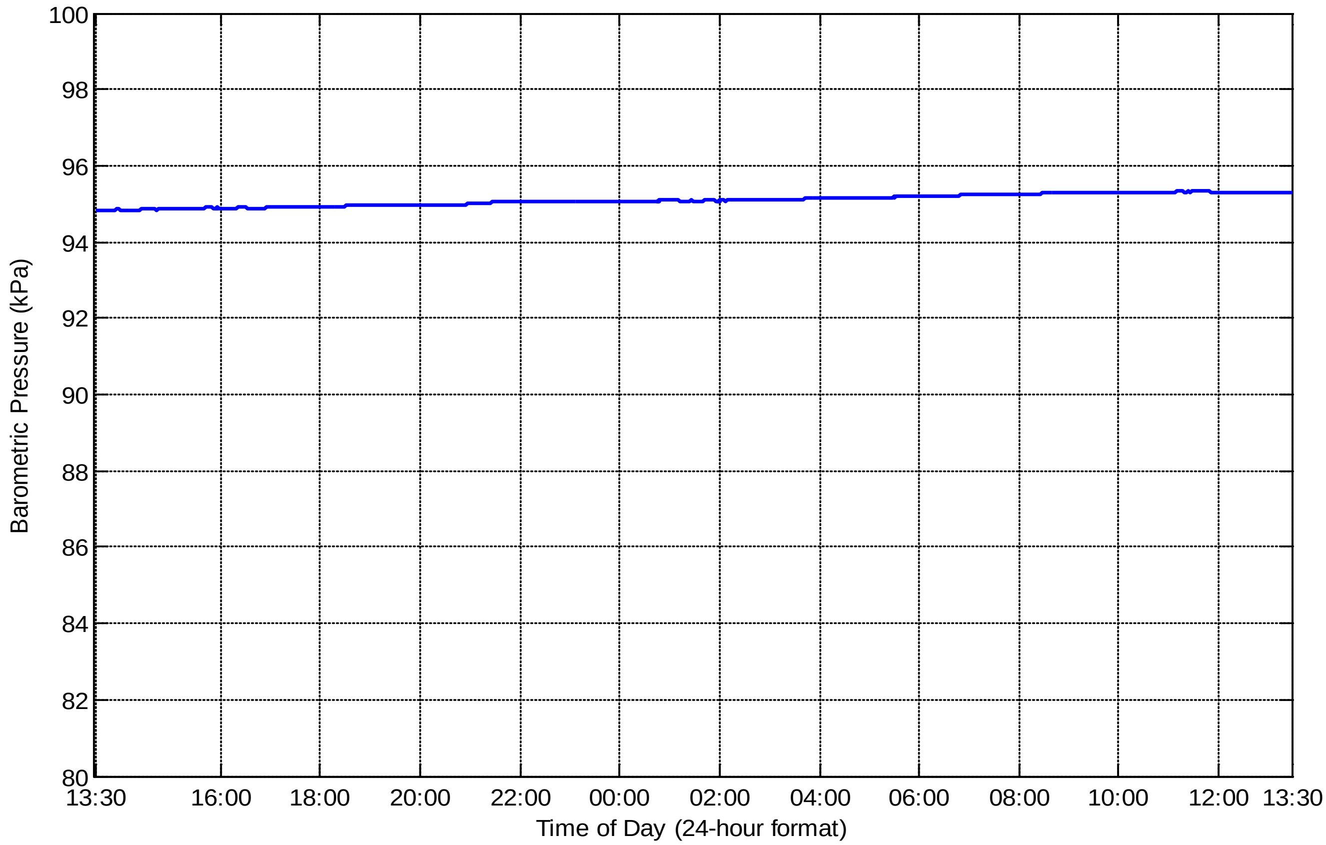

**Monitored Wind Direction (August 21 – August 22, 2014) at Noise Monitor Location 4**



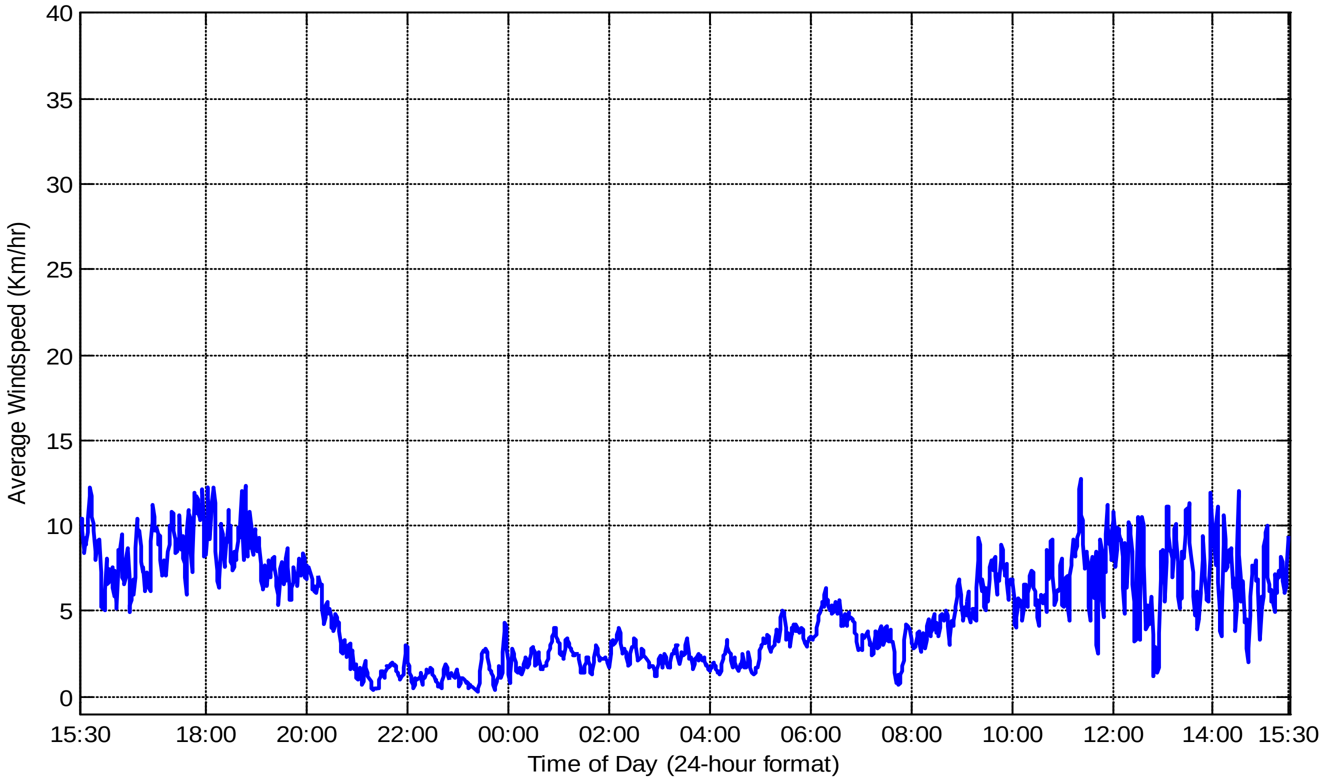

**Monitored Temperature (August 21 – August 22, 2014) at Noise Monitor Location 4**



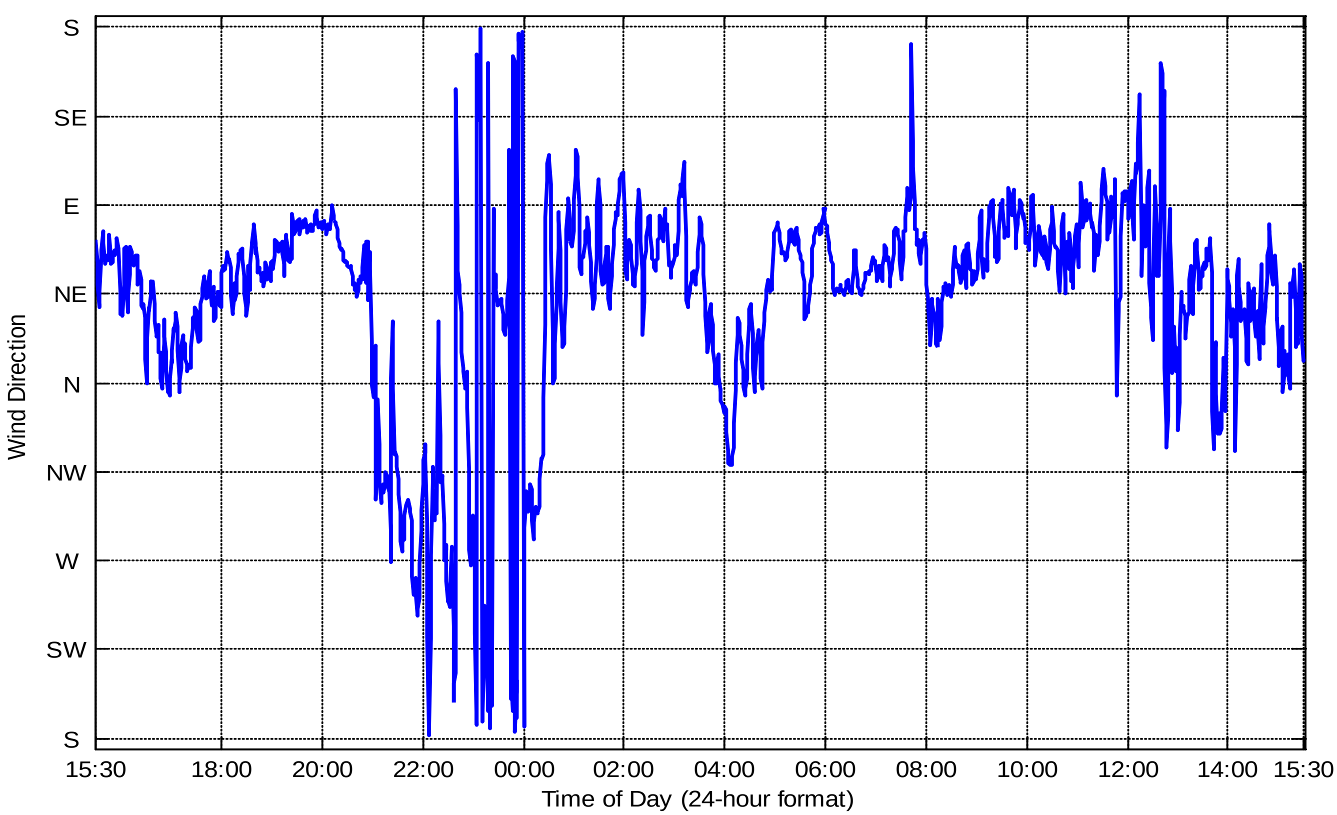

**Monitored Humidity (August 21 – August 22, 2014) at Noise Monitor Location 4**



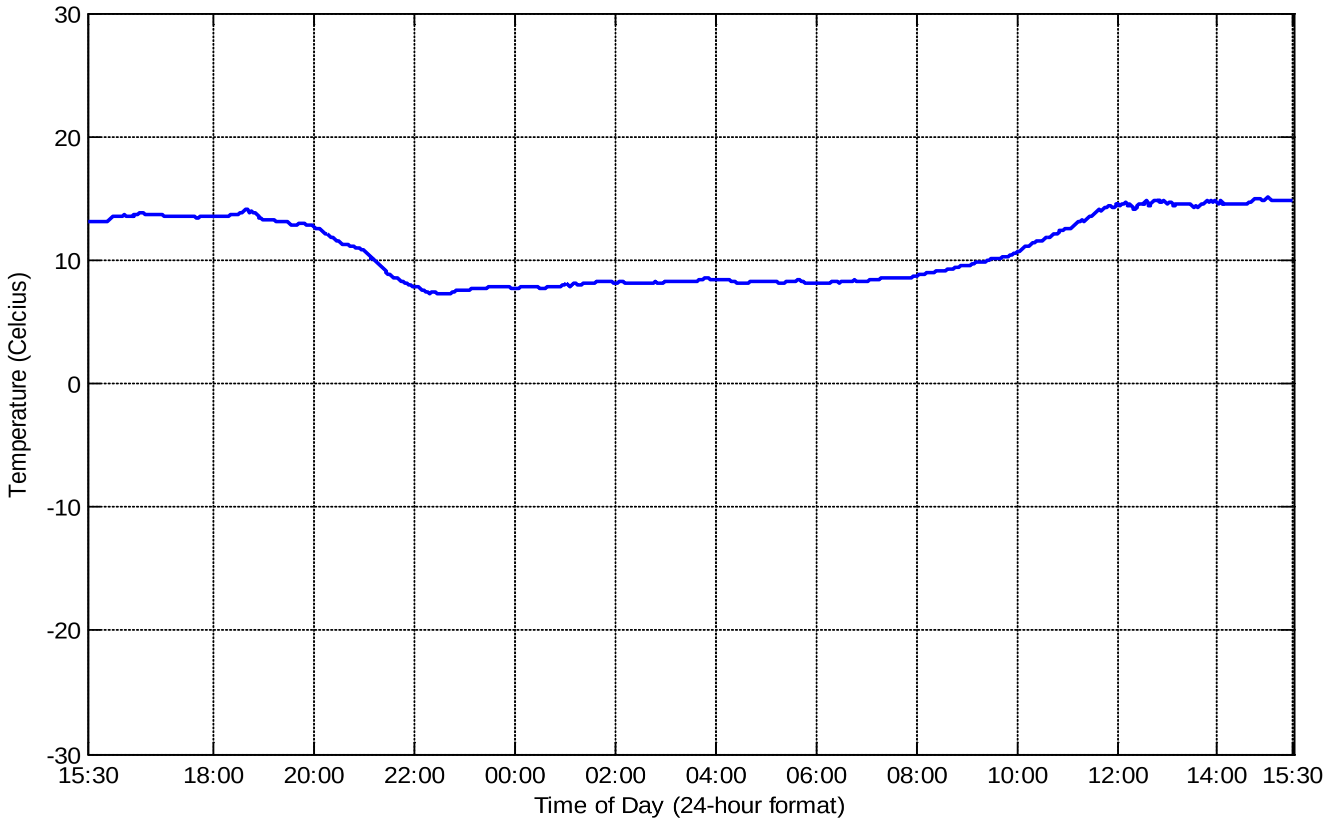

**Monitored Barometric Pressure (August 21 – August 22, 2014) at Noise Monitor Location 4**



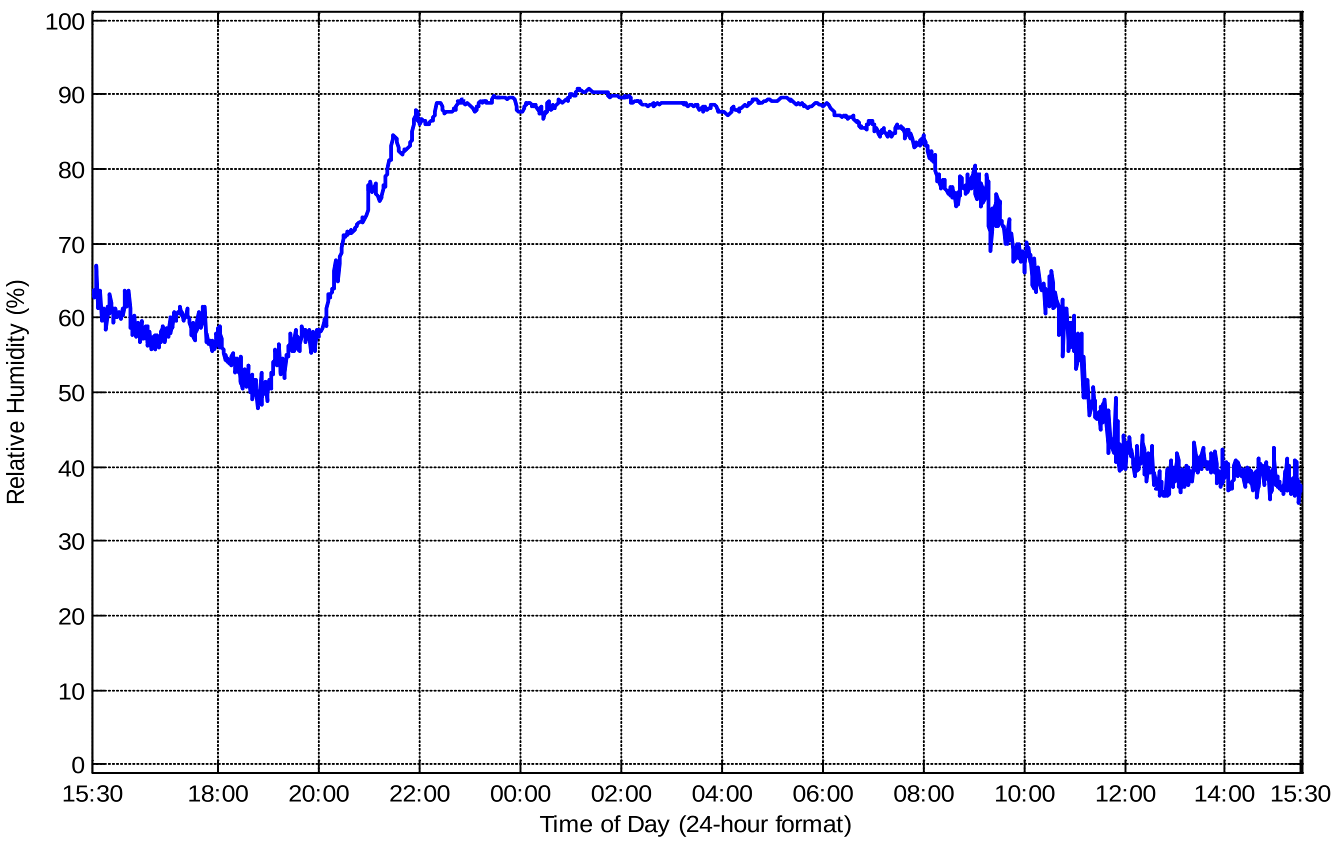

**Monitored Wind Speed (August 21 – August 22, 2014) at Noise Monitor Location 5**



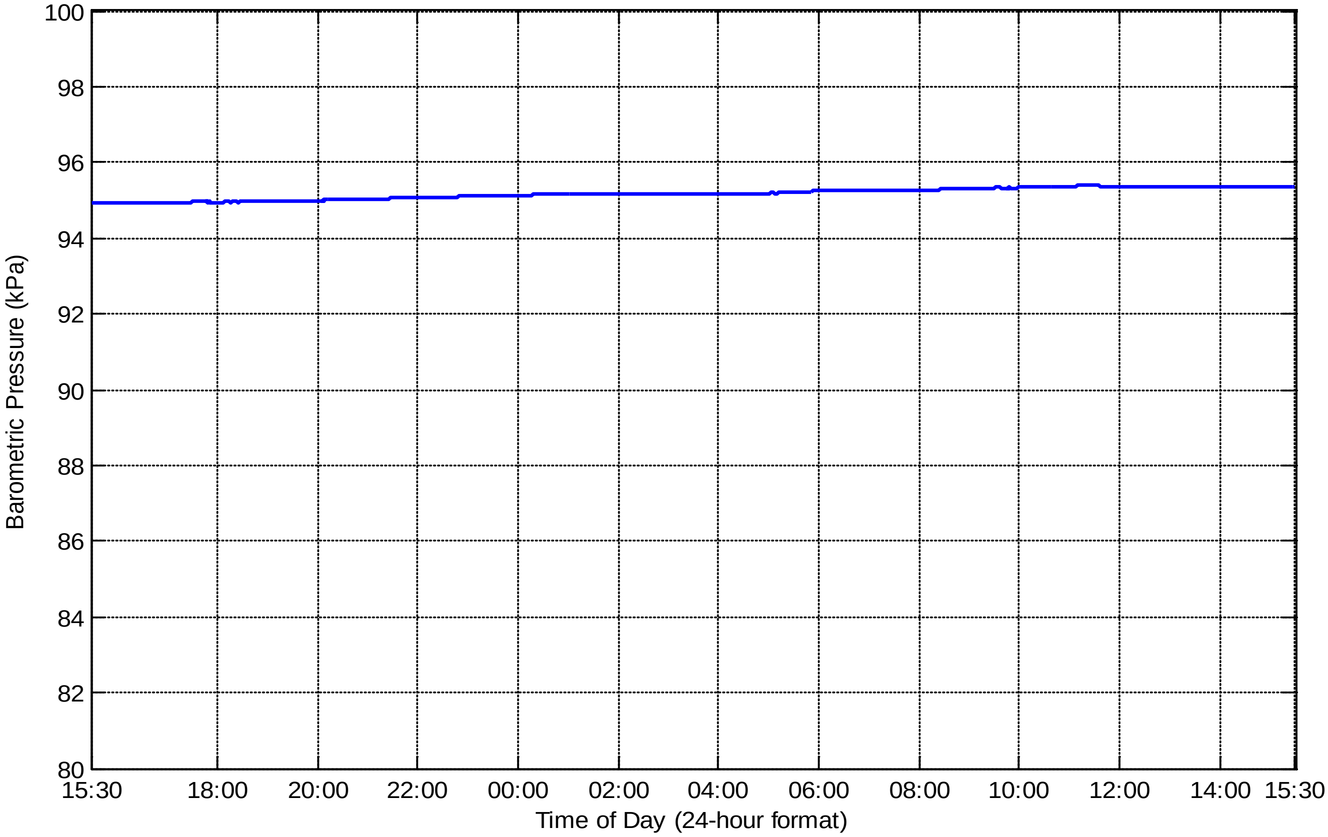

**Monitored Wind Direction (August 21 – August 22, 2014) at Noise Monitor Location 5**



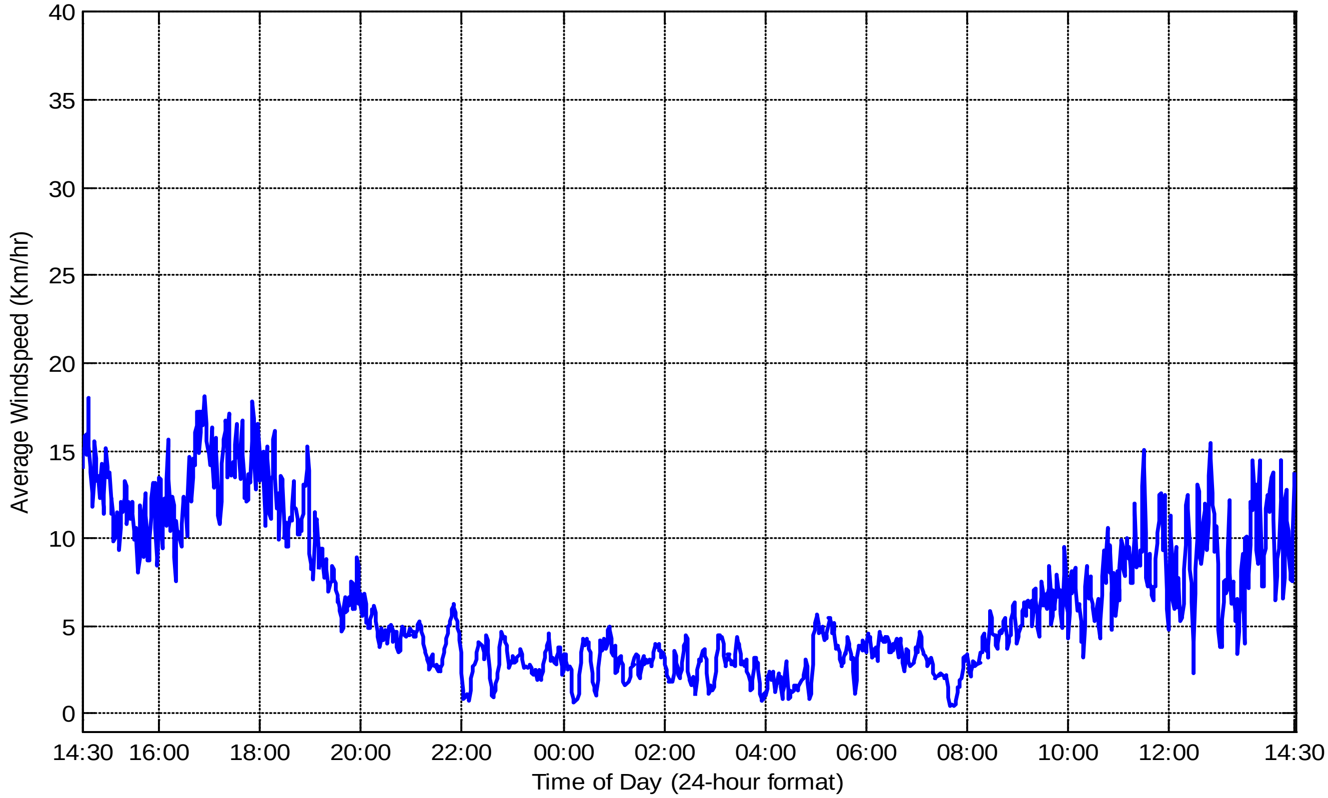

**Monitored Temperature (August 21 – August 22, 2014) at Noise Monitor Location 5**



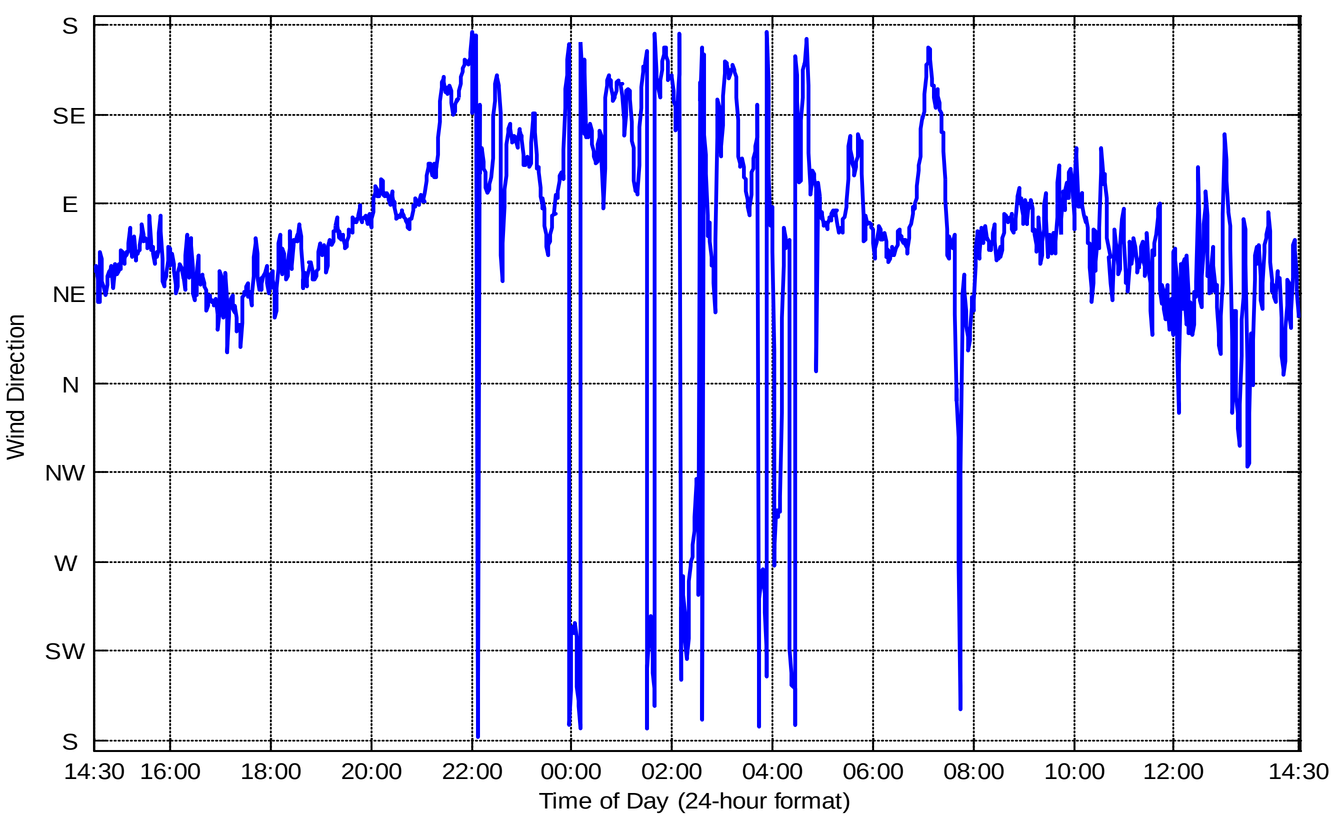

**Monitored Humidity (August 21 – August 22, 2014) at Noise Monitor Location 5**



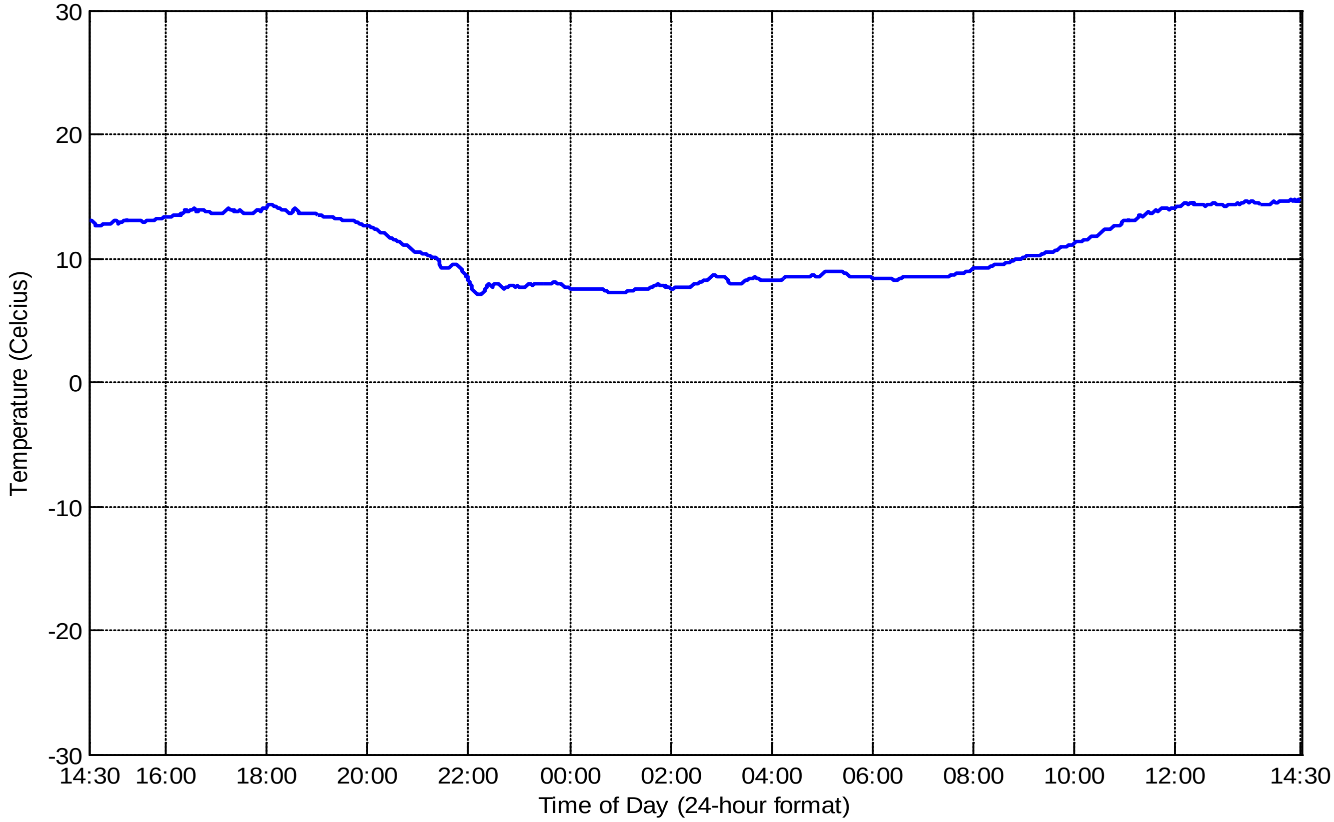

**Monitored Barometric Pressure (August 21 – August 22, 2014) at Noise Monitor Location 5**



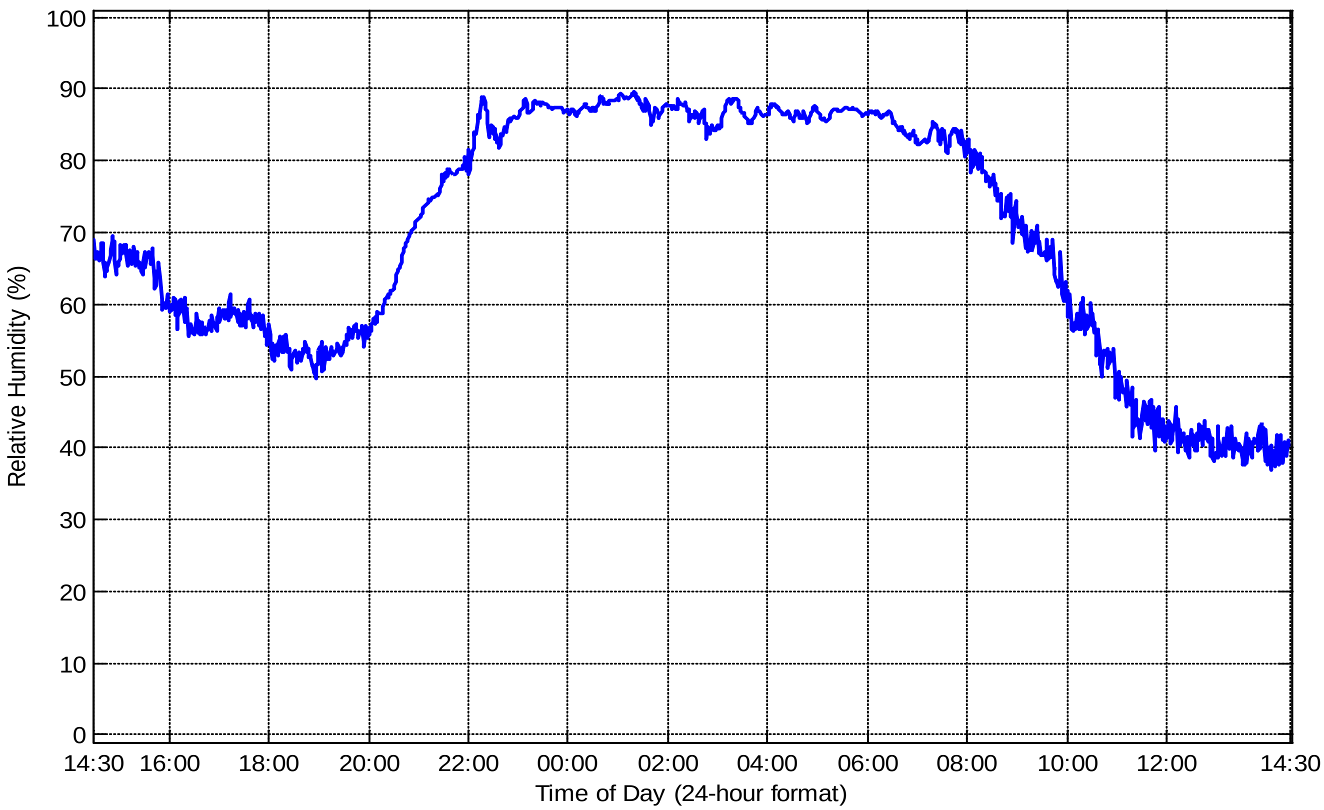

**Monitored Wind Speed (August 21 – August 22, 2014) at Noise Monitor Location 6**



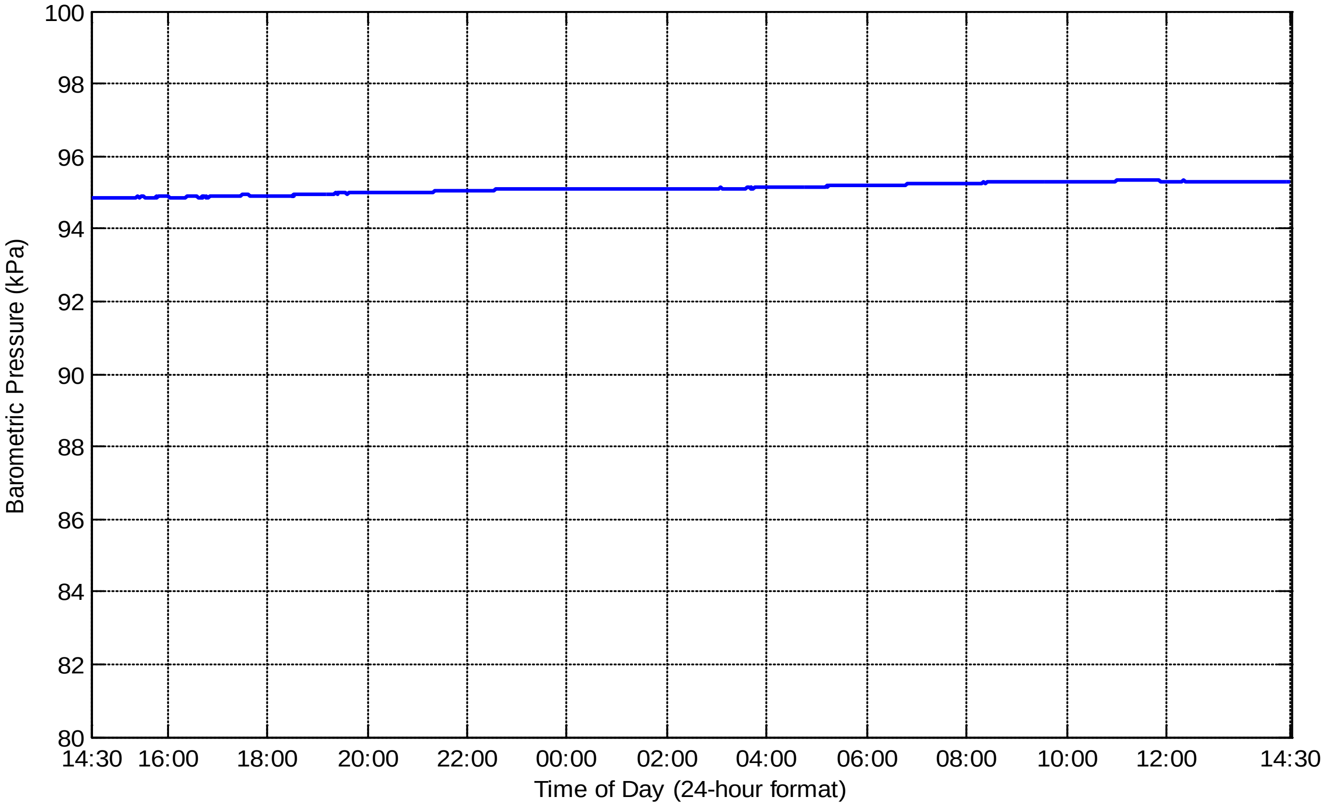

**Monitored Wind Direction (August 21 – August 22, 2014) at Noise Monitor Location 6**




**Monitored Temperature (August 21 – August 22, 2014) at Noise Monitor Location 6**




**Monitored Humidity (August 21 – August 22, 2014) at Noise Monitor Location 6**




**Monitored Barometric Pressure (August 21 – August 22, 2014) at Noise Monitor Location 6**

# Appendix VI FIELD VALIDATION MONITORING DATA SHEETS

# APPENDIX 2

NCIA MEMBER COMPANY NOISE MANAGEMENT PLAN UPDATES and REPORTS

**Access Pipeline**

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, including the Procedure/Practice/Standard reference.<br><br>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. |
| Attach results of any monitoring/assessments (fence line outward) completed in 2014.<br><br>Note, you are not required to conduct any off-site monitoring, however if you did, please provide those results electronically to NCIA. | A noise assessment was not conducted in 2014. |
| Disclose any improvements/corrective actions implemented in 2014 or status thereof that would impact the noise level output for your site (either up or down).<br><br>Did those changes result in a requirement to update your site noise model?<br><br>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? | A third pump was added to Sturgeon Terminal. However, as before, only two pumps will run at any given time. As such there was no impact to additional noise. |

| | |
|---|---|
| Disclose any improvements/projects that are approved for 2015 that would impact the noise level output for your site (either up or down).<br><br>Will these changes result in a requirement to update your site noise model?<br><br>If so, when do you anticipate having an updated site model available? | There are no anticipated projects or improvements for 2015 that may impact noise levels. |
| Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan. | None. |
| Provide a Noise Complaint summary for all noise complaints received in 2014 including any actions taken to address them. | None. |

This information is being collected as per the NMP Standard 2010-003 Document, section 5.4. 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.

## Agrium Redwater and Fort Saskatchewan

| 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, including the Procedure/Practice/Standard reference.<br><br>Note, if you have not provided an electronic copy of your site plan to NCIA, please do so. | Agrium has documented and implemented a Noise Management Plan. The plan consists of the following documents:<br><br>• ESP 3.07.01 Noise Management Overview<br>• ESP 3.07.02 Noise Management Program<br>• ESP 3.07.03 Noise Source List<br>• ESP 3.07.04 Monitoring Program |
| Attach results of any monitoring/assessments (fence line outward) completed in 2014.<br><br>Note, you are not required to conduct any off-site monitoring, however if you did, please provide those results electronically to NCIA. | In addition to the NCIA Regional Noise Model Annual Field Validation in the summer, Agrium completed quarterly offsite checks of both the Redwater and Fort Saskatchewan facilities at set locations to identity any abnormal change in the offsite noise profile of our facilities. No issues were identified during these checks. |
| Disclose any improvements/corrective actions implemented in 2014 or status thereof that would impact the noise level output for your site (either up or down).<br><br>Did those changes result in a requirement to update your site noise model?<br><br>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? | As stated in the 2013 report, Agrium engaged both SLR and Noise Solutions to proactively provide noise control options for both the compressor / gas turbine (CGT-902) and Utilities Boiler replacement projects respectively. The motive for these assessments is primarily Occupational Hygiene, but it is anticipated that Environmental Noise will also be reduced. Worthy of noting is that implementation of these projects have been rescheduled for 2017 (opposed to 2016). |

| | |
|---|---|
| Disclose any improvements/projects that are approved for 2015 that would impact the noise level output for your site (either up or down).<br><br>Will these changes result in a requirement to update your site noise model?<br><br>If so, when do you anticipate having an updated site model available? | No projects are planned for 2015. |
| Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan. | Agrium is reviewing the possibility of improving the quality of our quarterly offsite Noise Monitoring Program so that collection and assessment of data is more meaningful. |
| Provide a Noise Complaint summary for all noise complaints received in 2014 including any actions taken to address them. | There were no recorded noise complaints for either Agrium Redwater or Fort Saskatchewan in 2014. |

This information is being collected as per the NMP Standard 2010-003 Document, section 5.4. 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.

| Date | Time | Plant Site | Location | Wind Speed | Wind Direction | Sound Press. Level | | Entered By | Comment | Sound Diff dB |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | dBA | dBC | | | |
| 29-Dec-14 | 17:45 | Fort Saskatchewan | F4 | 5 | 269 | 45.1 | 64.3 | HB | Back up beepers from Dow? | **19.2** |
| 29-Dec-14 | 11:33 | Redwater | R3 | 10 | 324 | 44.3 | 63.3 | HB | Bit windy. Calibration 113.9 dBA. | **19** |
| 25-Sep-14 | 7:45 | Fort Saskatchewan | F3 | 3 | 278 | 37.1 | 56.7 | HB | Calibration is 113.7 dBA. | **19.6** |
| 25-Sep-14 | 8:00 | Redwater | R3 | 2 | 301 | 43.3 | 61.4 | HB | Calibration is 113.9 dBA. | **18.1** |
| 26-Jun-14 | 13:03 | Fort Saskatchewan | F3 | 5 | 45 | 55.1 | 73.7 | HB | Medium hum, cannot confirm if FNO or other unit like Sherrit or Praxair (east) is loud. Incident not put in as it appears to be neighbors. | **18.6** |
| 26-Jun-14 | 12:20 | Redwater | R2 | 5 | 45 | 43.7 | 56.5 | HB | Background hum of plant very noticable and constant bird song. | **12.8** |

| Date | Time | Plant Site | Location | Wind Speed | Wind Direction | Sound Press. Level | | Entered By | Comment | Sound Diff dB |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | dBA | dBC | | | |
| 26-Mar-14 | 8:13 | Redwater | R1 | 17 | 36 | 44.2 | 66.3 | HB | Performed in between wind gusts. Hum from NW Upgrader. Noticed scalehouse speaker and back up beepers. Incident not put in as high wind has probably contributed. | **22.1** |
| 26-Mar-14 | 7:30 | Fort Saskatchewan | F2 | 19 | 56 | 46.8 | 60.8 | HB | Performed in between wind gusts. Low hum, cannot confirm if FNO or other unit. Incident not put in as high wind has probably contributed. | **14** |

| | | |
|---|---|---|
| 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** **14-Apr-14** | **Rev.** **2** |

**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, including the Procedure/Practice/Standard reference.<br><br>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. |
| Attach results of any monitoring/assessments (fence line outward) completed in 2014.<br><br>Note, you are not required to conduct any off-site monitoring, however if you did, please provide those results electronically to NCIA. | 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 2014 or status thereof that would impact the noise level output for your site (either up or down).<br><br>Did those changes result in a requirement to update your site noise model?<br><br>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.<br><br>No change was made in equipment/process that warrant a new site noise model |

| | |
|---|---|
| Disclose any improvements/projects that are approved for 2015 that would impact the noise level output for your site (either up or down).<br><br>Will these changes result in a requirement to update your site noise model?<br><br>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. | A self-audit conducted on the Hearing Protection and Conservative Program. This is reviewed by senior leader in plant. |
| Provide a Noise Complaint summary for all noise complaints received in 2014 including any actions taken to address them. | None. |

This information is being collected as per the NMP Standard 2010-003 Document, section 5.4. 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.

<table>
<tr><td rowspan="1">NCIA Northeast Capital Industrial Association</td><td>NCIA Standards and Guidelines</td><td colspan="2">Document Number<br>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<br>14-Apr-14</td><td>Rev.<br>2</td></tr>
</table>

**<u>ATCO Power Canada Ltd.:</u>**

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, including the Procedure/Practice/Standard reference.<br><br>Note, if you have not provided an electronic copy of your site plan to NCIA, please do so. | ATCO Power has one facility operating in the Alberta Industrial Heartland: Scotford Cogeneration Plant. The Scotford Cogeneration Plant is located on the Shell Upgrader site and is included in the Shell Upgrader Noise Management Plan.<br><br>In 2014, ATCO Power did not have any other sites that would be subject to the NCIA Noise Management Plan BMP requirements. |
| Attach results of any monitoring/assessments (fence line outward) completed in 2014.<br><br>Note, you are not required to conduct any off-site monitoring, however if you did, please provide those results electronically to NCIA. | ATCO Power did not conduct any noise monitoring/assessments in 2014. |
| Disclose any improvements/corrective actions implemented in 2014 or status thereof that would impact the noise level output for your site (either up or down).<br><br>Did those changes result in a requirement to update your site noise model?<br><br>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? | Not applicable. |

| | |
|---|---|
| Disclose any improvements/projects that are approved for 2015 that would impact the noise level output for your site (either up or down).<br><br>Will these changes result in a requirement to update your site noise model?<br><br>If so, when do you anticipate having an updated site model available? | Not applicable |
| Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan. | Not applicable |
| Provide a Noise Complaint summary for all noise complaints received in 2014 including any actions taken to address them. | Not applicable. |

This information is being collected as per the NMP Standard 2010-003 Document, section 5.4. 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.

December 2013

ATCO POWER

# Heartland Generating Station Noise Impact Assessment

**Submitted to:**
ATCO Power Canada Ltd.
900, 919 11th Avenue Southwest
Calgary, Alberta  T2R 1P3

**Report Number:** 12-1334-0068

REPORT

Golder Associates

# Table of Contents

**TABLES**



**FIGURES**



**APPENDICES**

# 1.0 INTRODUCTION

ATCO Power Canada Ltd. (ATCO Power) is proposing to construct a combined-cycle natural gas-fired turbine (CCGT) power plant called the Heartland Generating Station (the Project) at a location approximately 14 kilometres (km) northeast of Fort Saskatchewan and 30 km northeast of Edmonton.

ATCO Power has retained Golder Associates Limited (Golder) to conduct a Noise Impact Assessment (NIA) for the Project. The results of the NIA are presented in this report.

Environmental noise from power generating facilities in Alberta is regulated by the Alberta Utilities Commission (AUC) through *Rule 012: Noise Control* (AUC 2013); hereafter referred to as Rule 012. This NIA summarizes the predicted potential noise impact of the Project under representative operating conditions, and provides a comparison of the results of these predictions to compliance criteria defined by Rule 012.

The methods and criteria used for this NIA follow the requirements of Rule 012. The following outlines the structure of this report:

- Section 1 provides an introduction to the NIA;
- Section 2 presents a brief Project description;
- Section 3 describes the specific approach used in the NIA;
- Section 4 presents the Baseline Case and Application Case results of the NIA including a comparison to Rule 012 criteria; and
- Section 5 summarizes the results of the NIA.

Four appendices are also provided, which contain technical details relevant to the NIA:

- Appendix A provides detailed Permissible Sound Level calculations;
- Appendix B provides octave-band noise emissions for Project equipment;
- Appendix C is a noise assessment for a third-party industrial facility that was used to help establish Baseline Case noise levels for the Project NIA; and
- Appendix D is a noise assessment for a third-party facility that includes a summary of noise monitoring conducted in the Project area.

## 2.0 PROJECT DESCRIPTION

Major Project equipment will consist of:

- one (1) Siemens 274 MW model SGT6-8000H gas turbine and generator;
- one (1) gas turbine air inlet;
- one (1) Heat Recovery Steam Generator (HRSG);
- one (1) steam turbine and generator;
- one (1) gas turbine/HRSG exhaust stack;
- one (1) six cell cross-flow cooling tower;
- two (2) main power transformers – one for the gas turbine generator and one for the steam turbine generator; and
- various exhaust and ventilation elements (i.e., louvers and fans).

The gas turbine and generator, HRSG, and steam turbine and generator will be located inside separate buildings. The gas turbine building, HRSG building, and steam turbine building will be joined together to form a single main Project building called the "powerhouse".

The gas turbine air inlet will be located in the west wall of the gas turbine building and the exhaust stack will be 50 m tall and located on the east side of the HRSG building. The Project cooling tower will be located approximately 60 m east of the HRSG building and oriented with its inlets (i.e., long sides) pointing east and west. The gas turbine power transformer and steam turbine power transformer will be located outdoors, side-by-side approximately 27 m west of the joint gas turbine building and the steam turbine building west wall.

Exhaust fans will be distributed across the roof of the gas turbine, steam turbine, and HRSG buildings and ventilation louvers will be disturbed across all building walls. Noise emissions for the Project equipment are presented in Section 4.3.

# 3.0 ASSESSMENT APPROACH

The purpose of this NIA is to assess potential environmental noise impact of the Project within the context of regulatory requirements specified by Rule 012. Specific regulatory requirements are described in Section 3.2. In general, to demonstrate regulatory compliance, Rule 012 requires that cumulative noise levels be compared to a mandated Permissible Sound Level (PSL). The cumulative noise level was calculated as the sum of:

- an assumed Ambient Sound Level (ASL) meant to represent the contribution of natural and non-industrial noise sources and whose value is specified by Rule 012;
- the noise contribution from existing and approved energy resource and power generating facilities in the area; and
- the noise contribution from the Project under representative operating conditions.

## 3.1 Assessment Cases

This NIA considered two assessment cases:

- the Baseline Case considered cumulative noise levels associated with natural and non-industrial noise sources in combination with existing and approved energy resource and power generating facilities; and
- the Application Case considered cumulative noise levels associated with the Baseline Case in combination with the Project.

For each assessment case the cumulative noise level at each receptor was compared to the relevant Rule 012 PSL. In addition, the change in cumulative noise level between the Baseline Case and Application Case was also calculated. Assessment of cumulative noise level increases is not required by Rule 012, and so these values were calculated for information purposes only.

Based on research conducted jointly by Golder and the Alberta Energy Regulator (AER), it is generally understood that facilities farther than 5 km from the Project are unlikely to contribute to cumulative noise levels in the Project area (Drew and South 2009). There are a total of nine existing and/or approved industrial facilities near enough to the Project to be considered relevant for the purposes of this NIA. These nine facilities are:

- Shell Scotford Upgrader (including Expansion 1);
- BA Energy Upgrader;
- Shell Bitumen Blending Facility;
- Provident/Williams Energy BB-Mix Project;
- Provident/Williams Energy C5 Hydrotreater and C2 Recovery Projects;
- Shell Quest Carbon Capture and Storage Facility;
- Total Upgrader (approved but not operating);
- Fort Hills Sturgeon Upgrader (approved but not operating); and
- North West Upgrader (approved but not operating).

The noise contribution from these nine facilities (hereafter referred to as the Baseline Case Facilities) was characterized using the results presented in Volume 2A, Section 6 of the *Quest Carbon Capture and Storage Project – Environmental Assessment* (Shell 2010), which is the most recent assessment for a facility in the area to receive regulatory approval and will hereafter be referred to as the Shell Quest EA.

As required by Rule 012, the contribution of Project noise emissions to the Application Case cumulative noise levels was predicted using a computer noise model developed in accordance with an international standard for the propagation of environmental noise (ISO 1996). As required by Rule 012, outputs from the computer noise model were added to the Baseline Case cumulative noise levels to obtain Application Case cumulative noise levels.

## 3.2 Noise Criteria

### 3.2.1 Noise Study Area and Receptor Locations

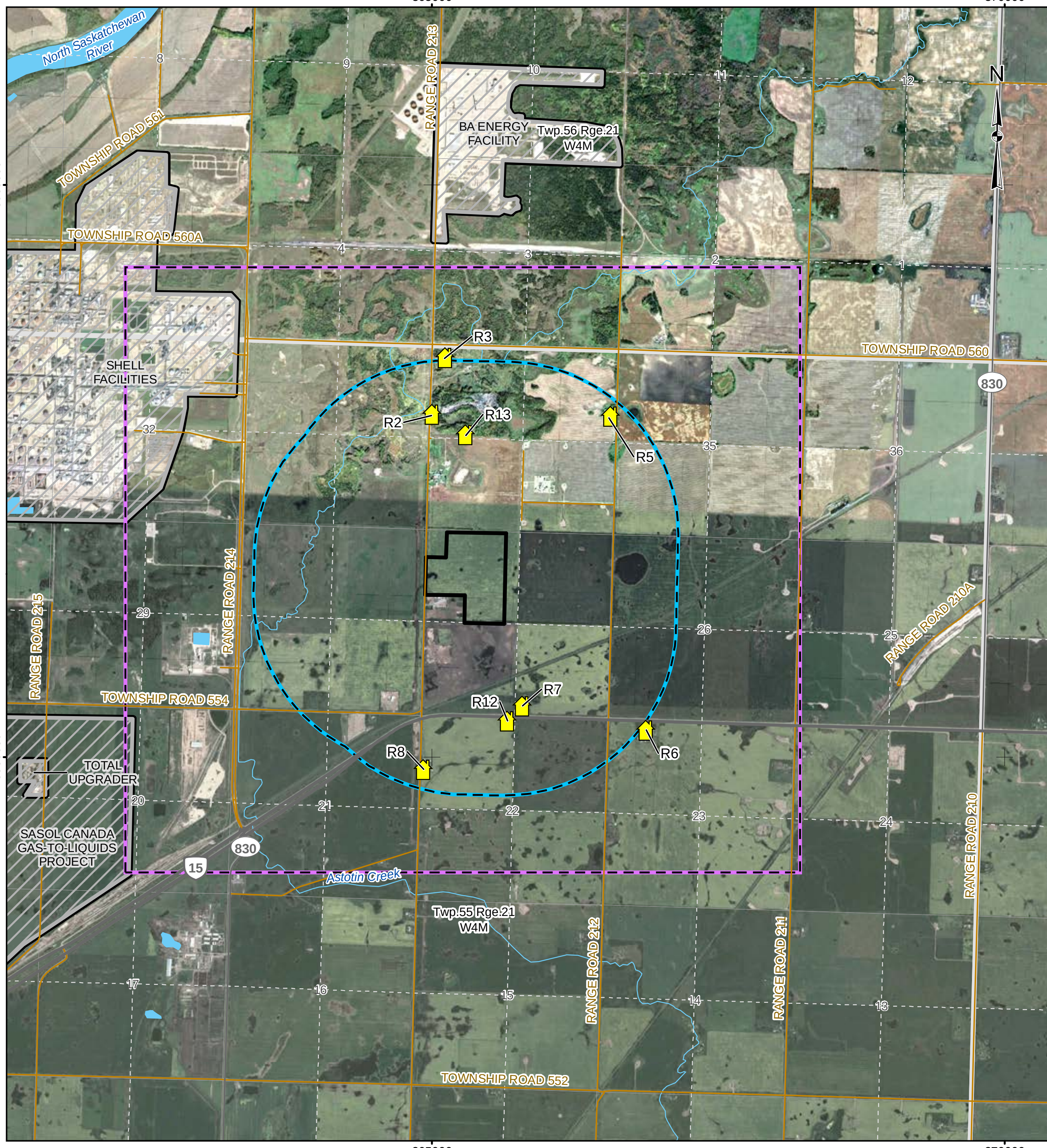
Rule 012 regulates noise from a receptor perspective. The PSL is determined at the most impacted dwellings from the Project boundary.

The area surrounding the Project is within Alberta's Industrial Heartland region and consists of a mix of industrial facilities, rural farms and residences, as well as public infrastructure including Highway 15 and various railway lines. For the assessment of noise resulting from the Project, the residences (noise sensitive receptors) within 1.5 km of the Project site boundary were considered. Field reconnaissance in the Project area identified eight dwellings within approximately 1.5 km of the Project boundary that we have assumed will be occupied at the time the Project commences operations, these eight receptors have been considered in this NIA.

Table 1 provides a list of these eight receptors, including a brief description of each receptor and their distance from the Project site boundary. Figure 1 shows the entire noise study area, including the location of the Project itself, the locations of individual noise receptors, the locations of Baseline Case Facilities, and a 1.5 km buffer surrounding the Project boundary.

**Table 1 Noise Receptor Locations**

| Noise Receptor | Description | Universal Transverse Mercator Coordinates [NAD83, Zone 12] | |
|---|---|---|---|
| | | Easting [m] | Northing [m] |
| R2 | Dwelling adjacent to auto wreckers (used only for business nighttime security reasons), located approximately 1 km north of Project boundary | 365004 | 5962997 |
| R3 | Occupied farmhouse approximately 1.5 km north of Project boundary | 365117 | 5963492 |
| R5 | Occupied farmhouse approximately 1.3 km northeast of Project boundary | 366561 | 5962983 |
| R6 | Occupied farmhouse approximately 1.5 km southeast of Project boundary | 366869 | 5960237 |
| R7 | Occupied farmhouse approximately 700 m south of Project boundary | 365791 | 5960451 |
| R8 | Occupied farmhouse approximately 1.3 km south of Project boundary | 364928 | 5959895 |
| R12 | Gas station with mobile home dwelling for employee residence approximately 800 m south of Project boundary | 365660 | 5960318 |
| R13 | Occupied residence approximately 840 m north of Project boundary | 365297 | 5962819 |




## LEGEND

RECEPTORS

**TRANSPORTATION FEATURES**

PRIMARY HIGHWAY

SECONDARY HIGHWAY

LOCAL ROAD

WATERCOURSE

EXISTING INDUSTRIAL SITE

1500 m PROJECT AREA BUFFER

NOISE STUDY AREA

PROJECT SITE

WATERBODY

1 0 1

SCALE 1:50,000 KILOMETRES

## REFERENCE

HYDROGRAPHY OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. TRANSPORTATION OBTAINED FROM GEOBASE®. IMAGERY OBTAINED FROM ESRI AND GOOGLE EARTH, USED UNDER LICENSE. IMAGERY DATE: 2013. GOOGLE EARTH IMAGERY IS NOT TO SCALE.
DATUM: NAD83 PROJECTION: UTM ZONE 12

PROJECT

ATCO Power

HEARTLAND GENERATING STATION

TITLE

# NOISE STUDY AREA AND RECEPTOR LOCATIONS

Golder Associates

| PROJECT | | PROJECT NO. | FILE No. | |
|---|---|---|---|---|
| DESIGN | VY | 06 Sep. 2013 | SCALE AS SHOWN | REV. 0 |
| GIS | HP | 04 Dec. 2013 | | |
| CHECK | VY | 04 Dec. 2013 | FIGURE: 1 | |
| REVIEW | VY | 04 Dec. 2013 | | |

I:\CLIENTS\ATCO\12-1334-0068\Mapping\MXD\Noise\Figure1_NoiseStudyArea_Receptor_FINAL.mxd

### 3.2.2 Permissible Sound Level Compliance

Rule 012 requires that noise from the Project not exceed the PSL at receptors. Noise compliance is assessed by comparing cumulative noise levels at each receptor to the relevant PSL. As discussed in Section 3.0, cumulative noise levels consisted of noise from the Project added to the contribution from natural and non-industrial sources and the Baseline Case Facilities.

Rule 012 indicates that a noise receptor can have only one daytime PSL and one nighttime PSL. Therefore, if PSL values for a receptor have been established as part of a previous regulatory application these same values must be used in all future noise assessments.

For receptors where PSL values have not been previously established, they were calculated starting with a Basic Sound Level (BSL), which is based on population density and proximity to transportation infrastructure (i.e., heavily-travelled roads and rail lines). The BSL is then adjusted for the following:

- the time of day (to account for the fact that nighttime noise is more disruptive than daytime noise);
- in special cases, measured ASL in the area (applied only with prior AUC permission); and
- responses to temporary activities.

According to Rule 012, the daytime period is defined as 7 a.m. to 10 p.m. and the nighttime period is defined as 10 p.m. to 7 a.m. Appropriate daytime and nighttime PSL values at relevant noise receptors are presented in Table 2. More detail on the calculation of PSL values is provided in Appendix A.

**Table 2 Permissible Sound Levels for Noise Receptors**

| Noise Receptor | Permissible Sound Level [dBA] | |
|---|---|---|
| | Daytime | Nighttime |
| R2[(a)] | 57 | 47 |
| R3[(a)] | 57 | 47 |
| R5 | 50 | 40 |
| R6[(b)] | 55 | 45 |
| R7[(b)] | 55 | 45 |
| R8[(b)] | 55 | 45 |
| R12[(b)] | 60 | 50 |
| R13[(a)] | 57 | 47 |

(a) These receptors were included in (Shell 2010) and have pre-established PSL values.

(b) The PSL values at these receptors have been adjusted because of their proximity to Highway 15 – a heavily-travelled road with Annual Average Daytime Traffic (AADT) rating of 12070 for the year 2012 (ATPB 2012).

### 3.2.3 Low Frequency Noise

In addition to PSL compliance, Rule 012 also requires an assessment of potential Low Frequency Noise (LFN) issues. The separate assessment of LFN addresses the fact that, depending on spectral shape, noise impact associated with LFN can be observed even when the overall broadband noise level is otherwise acceptable.

Rule 012 provides two criteria for identifying potential LFN issues. According to Rule 012, an LFN condition may exist when both:

- the value of the predicted noise level, expressed in C-weighted decibels (dBA), minus the predicted noise level, expressed in A-weighted decibels (dBA), equals or exceeds 20 decibels (dB); and
- a clear tonal component exists at a frequency below 250 Hz.

The first LFN condition was addressed in this NIA using results obtained from predictive computer modelling. The second LFN condition requires access to noise data at one-third octave-band resolution – information that will only be available via field measurements once the Project begins operations. As such, the second LFN condition could not be addressed in this NIA, and so this NIA only identified the potential for LFN issues in accordance with the first condition described above.

## 3.3 Noise Prediction Methodology

### 3.3.1 Noise Model

The computer noise model for the Project NIA was created using the Type 7810 Predictor® Version 8.10 software, which was developed by Softnoise GmbH and distributed by Bruel and Kjaer. In accordance with Rule 012, Predictor® implemented noise propagation algorithms described in the international standard ISO 9613-2 (ISO 1996). Predictor® has the ability to simulate emissions sources as a series of point, line, and area sources. Each source type was characterized by entering noise emissions in terms of octave-band components. Other parameters, such as building dimensions and equipment enclosure noise attenuation ratings, were also used in Predictor® to define the nature of the noise emissions. Predictor® also accounted for noise attenuation related to meteorological conditions, ground cover, and physical barriers.

### 3.3.2 Model Uncertainty

According to the relevant standard (ISO 1996), the overall accuracy of the propagation algorithms is +/- 3 dB for distances between source and receptor up to 1 km. The accuracy for propagation distances greater than 1 km is not stated in the standard. Model accuracy also depended on the accuracy of the noise emission inputs, which is often +/- 2 dB for measured sources. Accounting for both these sources of uncertainty, the overall accuracy of the noise model predictions presented in the Project NIA is expected to be +/- 5 dB. To account for this level of uncertainty, the computer model incorporated conservative assumptions about noise propagation. In particular, the computer model predicted noise levels assuming downwind propagation from each source to each receptor 100% of the time. Since downwind conditions are known to enhance propagation, this downwind assumption is expected to overestimate general noise levels. Furthermore, the computer model assumed that the terrain is perfectly flat and so there was no terrain-based noise screening included in the computer model. In addition, noise screening from trees and other vegetation was not considered in the computer model, even though there are quite dense patches of tree growth between the Project and some receptors – especially the receptors located immediately to the north.

### 3.3.3 Model Input Parameters

Table 3 lists the configuration of calculation parameters used in the computer noise model of the Project.

**Table 3 Noise Model Calculation Parameters**

| Parameter | Model Setting | Description/Notes |
|---|---|---|
| Standard | ISO 9613-2 (ISO 1996) | All sources and attenuations were treated as required by this standard. |
| Source Directivity | point sources; vertical area sources; horizontal area sources | ■ Point sources used to model noise emissions from outdoor equipment – e.g., transformers and exhaust fans – as well as noise breakout from ventilation louvers.<br>■ Vertical area sources used to model noise breakout from building walls and noise emissions from cooling tower inlets.<br>■ Horizontal area sources used to model noise breakout from building roofs. |
| Ground Absorption | 0.2 – Within Project boundary<br>0.8 – Rest of study area | Ground absorption coefficients selected for consistency with Shell Quest EA (Shell 2010). |
| Temperature / Humidity | 10 degrees Celsius / 70% relative humidity | Temperature and humidity values selected for consistency with Shell Quest EA (Shell 2010). |
| Wind Conditions | 1 m/s to 5 m/s from source to receptor | These represent default ISO 9613-2 wind conditions – moderate temperature inversion, wind from source to receptor 100% of the time (ISO 1996). |
| Terrain | Terrain assumed flat | Assuming flat terrain is expected to overestimate potential Project noise impacts (i.e., conservative assumption). |

Conservative assumptions about noise emissions from the Project and noise propagation from the Project to the receptor locations were incorporated throughout this NIA. In particular:

- Project transformers were assumed to operate in FA/FO mode with second-stage auxiliary cooling fans running 100% of the time;
- Project cooling tower was assumed to operate at 100% capacity during both the daytime and nighttime periods;
- in scaling the noise contribution from Baseline Case Facilities at receptor locations atmospheric absorption and ground absorption were not considered;
- each receptor was modelled as downwind from each source 100% of the time; and
- the computer model of the Project treated the terrain as perfectly flat and did not consider screening from trees or vegetation assuming a clear line of site between the Project and each receptor.

The combination of these conservative assumptions likely resulted in an overestimate of potential Project noise impacts. In other words, field measurements conducted at any of the receptors considered in this NIA, once the Project commences operations, would likely result in noise levels lower than those predicted in this NIA.

# 4.0 ASSESSMENT RESULTS

## 4.1 Ambient Sound Levels

The ASL is meant to represent noise levels at a receptor resulting from natural and non-industrial sources. Adding the ASL to the noise contribution from Baseline Case Facilities yielded the cumulative noise level, which was compared to the PSL to demonstrate noise compliance. Table 4 presents ASL values for each noise receptor considered in this NIA.

**Table 4 Ambient Sound Levels for Noise Receptors**

| Noise Receptor | Ambient Sound Level [dBA] | |
|---|---|---|
| | Daytime | Nighttime |
| R2 | 45 | 35 |
| R3 | 45 | 35 |
| R5 | 45 | 35 |
| R6 | 50 | 40 |
| R7 | 50 | 40 |
| R8 | 50 | 40 |
| R12 | 55 | 45 |
| R13 | 45 | 35 |

## 4.2 Baseline Case Noise Levels

### 4.2.1 Permissible Sound Level Compliance

As discussed in Section 3.1 of this report, Baseline Case cumulative noise levels included the contribution from natural and non-industrial sources (characterized via the ASL) and the contribution from the Baseline Case Facilities.

Cumulative noise levels for the Baseline Case are presented in Table 5 for each noise receptor. Table 6 provides a comparison of the Baseline Case cumulative noise levels to the relevant PSL values. The results presented in Table 6 indicate that Baseline Case cumulative noise levels are compliant with the PSL at all receptors during both the daytime and nighttime periods.

**Table 5 Baseline Case Noise Levels**

| Noise Receptor | Ambient Sound Level [dBA] | | Baseline Case Facility Contribution [dBA] | Baseline Case Cumulative Noise Level [dBA] | |
|---|---|---|---|---|---|
| | Daytime | Nighttime | | Daytime | Nighttime |
| R2 | 45 | 35 | 41.0 | 46.5 | 42.0 |
| R3 | 45 | 35 | 41.0 | 46.5 | 42.0 |
| R5 | 45 | 35 | 35.9 | 45.5 | 38.5 |
| R6 | 50 | 40 | 35.2 | 50.1 | 41.2 |
| R7 | 50 | 40 | 37.3 | 50.2 | 41.9 |
| R8 | 50 | 40 | 38.5 | 50.3 | 42.3 |
| R12 | 55 | 45 | 37.5 | 55.1 | 45.7 |
| R13 | 45 | 35 | 39.7 | 46.1 | 41.0 |

**Table 6 Baseline Case Cumulative Noise Levels vs. Permissible Sound Levels**

| Noise Receptor | Baseline Case Cumulative Noise Level [dBA] | | Permissible Sound Level [dBA] | | Margin of Compliance [dB] | |
|---|---|---|---|---|---|---|
| | Daytime | Nighttime | Daytime | Nighttime | Daytime | Nighttime |
| R2 | 46.5 | 42.0 | 57 | 47 | 10.5 | 5.0 |
| R3 | 46.5 | 42.0 | 57 | 47 | 10.5 | 5.0 |
| R5 | 45.5 | 38.5 | 50 | 40 | 4.5 | 1.5 |
| R6 | 50.1 | 41.2 | 55 | 45 | 4.9 | 3.8 |
| R7 | 50.2 | 41.9 | 55 | 45 | 4.8 | 3.1 |
| R8 | 50.3 | 42.3 | 55 | 45 | 4.7 | 2.7 |
| R12 | 55.1 | 45.7 | 60 | 50 | 4.9 | 4.3 |
| R13 | 46.1 | 41.0 | 57 | 47 | 10.9 | 6.0 |

The contribution of the Baseline Case Facilities to the Baseline Case cumulative noise levels is presented in Table 7. Receptors R2, R3, and R13 were included directly in the most recent assessment for a facility in the area to receive regulatory approval and at these receptors values from that assessment were used directly. For the remaining five receptors (R5, R6, R7, R8, and R12), values from the most recent assessment were scaled to account for propagation effects using a conservative 6 dB loss per doubling distance – i.e., an approach that accounts for geometric spreading but not atmospheric absorption or ground absorption.

**Table 7 Baseline Case Facility Contribution**

| Noise Receptor | Baseline Case Facility Contribution [dBA] |
|---|---|
| R2[(a)] | 41.0 |
| R3[(a)] | 41.0 |
| R5[(b)] | 35.9 |
| R6[(b)] | 35.2 |
| R7[(b)] | 37.3 |
| R8[(b)] | 38.5 |
| R12[(b)] | 37.5 |
| R13[(a)] | 39.7 |

(a) This value was taken from the Planned Development Case (PDC) presented in (Shell 2010).

(b) This value was calculated from the PDC presented in (Shell 2010) using an assumed propagation loss of 6 dB per doubling distance.

An example of this calculation approach is described for the receptor R5. The nearest receptor to R5 that was included was R2. The PDC noise level at R2 (excluding the ASL) was 41.0 dBA. Receptor R2 is approximately 1.91 km from the nearest (and assumed to be most dominant) industrial noise source and receptor R5 is approximately 3.44 km from this same industrial noise source. Propagation distances of 1.91 km and 3.44 km represent approximately 0.85 doubling distances (i.e., $3.44 = 1.91 \times 2^{0.85}$) – and so the effective noise level at R5 was calculated to be 41.0 – (6 x 0.85) = 35.9 dBA.

The conservatism of this approach can be seen by comparing the estimated value of 35.9 dBA to an actual noise measurement that was made at receptor R5 in 2007 as part of an EIA for the North American Oil Sands Corporation Upgrader (North American Oil Sands 2007); note that this facility was later cancelled. During the 2007 monitoring survey the contribution of industrial sources to the cumulative noise level at R5 was measured and found to be 33.0 dBA during the nighttime period – nearly 3 dB lower than the assumed contribution from the Baseline Case Facilities used in the Baseline Case of this NIA. In other words, the Baseline Case considered in this NIA likely overestimates noise levels at the receptors.

## 4.3 Application Case Noise Emissions

Table 8 presents noise emissions for major indoor Project equipment. Table 9 presents octave-band Transmission Loss (TL) values assumed for Project walls and roofs, and octave-band Insertion Loss (IL) values assumed for Project louvers. Table 10 presents emissions associated with noise breakout from Project buildings – i.e., based on the indoor equipment emissions presented in Table 8 and the TL/IL values presented in Table 9. Table 11 presents noise emissions for major outdoor Project equipment. Octave-band noise emissions for all sources included in the computer model of the Project are presented in Appendix B.

**Table 8 Indoor Equipment Noise Emissions**

| Equipment | Location | Sound Power Level [dBA] | Reference |
|---|---|---|---|
| gas turbine enclosure walls | gas turbine building | 90.5 | Siemens-supplied noise ratings |
| gas turbine lube oil skid | gas turbine building | 106.2 | Siemens-supplied noise ratings |
| hydrogen-cooled generator | gas turbine building | 118.4 | Siemens-supplied noise ratings |
| gas turbine inlet filter house | gas turbine building | 93.7 | Siemens-supplied noise ratings |
| gas turbine lagged inlet duct wall | gas turbine building | 99.8 | Siemens-supplied noise ratings |
| fuel gas piping | gas turbine building | 95.5 | Siemens-supplied noise ratings |
| gas turbine exhaust diffuser and expansion joint | gas turbine building | 103.8 | Siemens-supplied noise ratings |
| HRSG inlet duct | HRSG building | 111.2 | Vendor-supplied noise ratings for a similar facility |
| HRSG modules 1 – 7 | HRSG building | 103.4 | Vendor-supplied noise ratings for a similar facility |
| high pressure steam turbine | steam turbine building | 104.7 | Vendor-supplied noise ratings for a similar facility |
| low pressure steam turbine | steam turbine building | 105.4 | Vendor-supplied noise ratings for a similar facility |
| steam turbine generator | steam turbine building | 104.3 | Vendor-supplied noise ratings for a similar facility |
| steam turbine slip ring house | steam turbine building | 99.7 | Vendor-supplied noise ratings for a similar facility |
| steam turbine lube oil unit | steam turbine building | 101.1 | Vendor-supplied noise ratings for a similar facility |

**Table 9 Transmission Loss and Insertion Loss Values**

| Element | Octave-Band Reduction [dB] | | | | | | | | | Reference |
|---|---|---|---|---|---|---|---|---|---|---|
| | 31.5 Hz | 63 Hz | 125 Hz | 250 Hz | 500 Hz | 1 kHz | 2 kHz | 4 kHz | 8 kHz | |
| gas turbine building wall TL | 11 | 17 | 19 | 27 | 35 | 43 | 49 | 52 | 53 | Recommendation from ATCO Emissions Management |
| HRSG building wall TL | 11 | 17 | 19 | 27 | 35 | 43 | 49 | 52 | 53 | Recommendation from ATCO Emissions Management |
| other Project buildings wall TL | 4 | 10 | 16 | 20 | 24 | 29 | 35 | 43 | 43 | (Owens-Corning Fibreglass Corp. 1986) |
| all Project buildings roof TL | 4 | 10 | 16 | 20 | 24 | 29 | 35 | 43 | 43 | (Owens-Corning Fibreglass Corp. 1986) |
| louver IL | 0 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 5 | Professional experience |

**Table 10 Noise Breakout from Buildings**

| Source | Quantity | Sound Power Level [dBA] | Reference |
|---|---|---|---|
| gas turbine building walls | All | 96.3 | Table 8 and Table 9 |
| HRSG building walls | All | 99.0 | Table 8 and Table 9 |
| steam turbine building walls | All | 96.5 | Table 8 and Table 9 |
| gas turbine building roof | All | 103.1 | Table 8 and Table 9 |
| HRSG building roof | All | 102.0 | Table 8 and Table 9 |
| steam turbine building roof | All | 93.4 | Table 8 and Table 9 |
| gas turbine building / HRSG building ventilation louvers | 30 | 91.9 | Table 8 and Table 9 |
| steam turbine building ventilation louvers | 20 | 86.5 | Table 8 and Table 9 |

**Table 11 Outdoor Equipment Noise Emissions**

| Equipment | Quantity | Sound Power Level [dBA] | Reference |
|---|---|---|---|
| gas turbine air inlet | 1 | 99.2 | Siemens-supplied noise ratings |
| gas turbine air discharge vent | 1 | 100.7 | Siemens-supplied noise ratings |
| gas turbine / HRSG exhaust stack (including silencer) | 1 | 97.4 (112.4 without silencer) | Vendor-supplied noise ratings for a similar facility |
| 250 MVA gas turbine transformer[(a)] | 1 | 105.0 | (NEMA 2000) |
| 250 MVA steam turbine transformer[(a)] | 1 | 105.0 | (NEMA 2000) |
| gas turbine building / HRSG building exhaust fans | 15 | 98.8 | Field measurements at a similar facility |
| steam turbine building exhaust fans | 10 | 98.8 | Field measurements at a similar facility |
| cooling tower outlet fan[(b)] | 6 | 97.3 | Vendor-supplied noise ratings for a similar facility |
| cooling tower inlet[(b)] | 2 | 110.7 | Vendor-supplied noise ratings for a similar facility |
| cooling tower pumphouse exhaust fan[(b)] | 1 | 94.9 | Field measurements at a similar facility |

(a) Transformers modelled in Forced Air (FA) Forced Oil (FO) mode with second-stage auxiliary cooling fans in operation 100% of the time – conservative assumption since cooling fans unlikely to operate at all times.

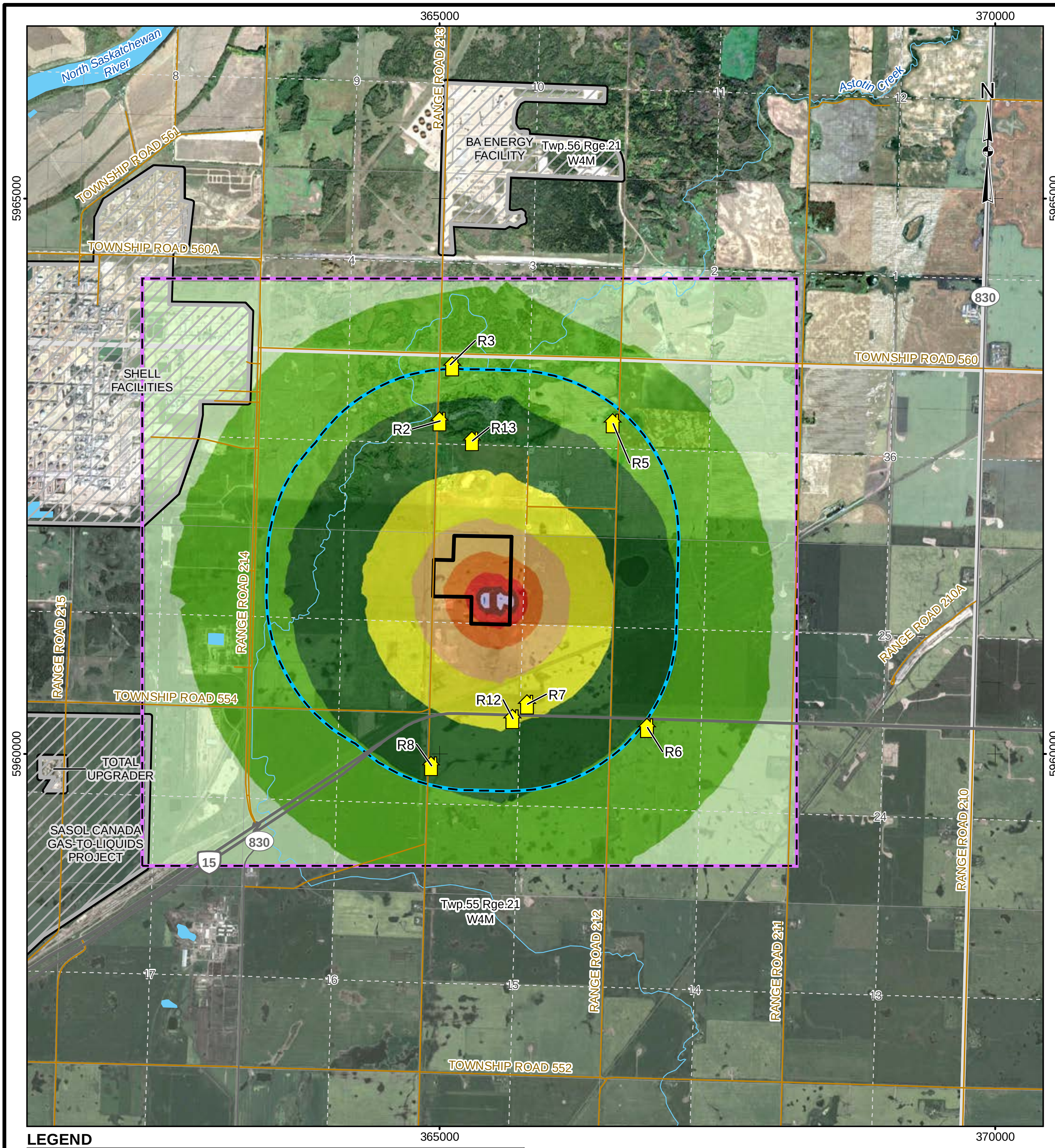
(b) Cooling tower modelled as operating at full capacity during both daytime and nighttime periods – conservative assumption since cooling tower likely to operate at less than full capacity during the nighttime.

## 4.4 Application Case Noise Level Predictions

### 4.4.1 Permissible Sound Level Compliance

As discussed in Section 3.1 of this NIA, Application Case cumulative noise levels were calculated by summing the Baseline Case cumulative noise levels with the noise contribution from the Project. The Baseline Case cumulative noise levels were presented in Section 4.2.1 of this NIA report. The noise contribution from the Project was calculated using a computer noise model.

Figure 2 presents Project noise predictions for the entire Noise Study Area. Cumulative noise levels for the Application Case are presented in Table 12 for each noise receptor. Table 13 provides a comparison of the Application Case cumulative noise levels to the relevant PSL values. The results presented in Table 13 indicate that Application Case cumulative noise levels are compliant with the PSL at all receptors during both the daytime and nighttime periods. Table 14 presents a comparison of the Baseline Case and Application Case cumulative noise levels.




## LEGEND

- RECEPTORS

**TRANSPORTATION FEATURES**

- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- EXISTING INDUSTRIAL SITE
- 1500 m PROJECT AREA BUFFER
- NOISE STUDY AREA
- PROJECT AREA

- WATERBODY

**NOISE CONTOUR INTERVALS**

- <30 dBA
- 30 - 35 dBA
- 35 - 40 dBA
- 40 - 45 dBA
- 45 - 50 dBA
- 50 - 55 dBA
- 55 - 60 dBA
- 60 - 65 dBA
- 65 - 70 dBA
- >70 dBA

1 0 1

SCALE 1:50,000 KILOMETRES

## REFERENCE

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PROJECT

ATCO Power

HEARTLAND GENERATING STATION

TITLE

# PROJECT NOISE PREDICTIONS

Golder Associates

| PROJECT | | PROJECT NO. | FILE No. | |
|---|---|---|---|---|
| DESIGN | VY | 06 Sep. 2013 | SCALE AS SHOWN | REV. 0 |
| GIS | HP | 04 Dec. 2013 | FIGURE: 2 | |
| CHECK | VY | 04 Dec. 2013 | | |
| REVIEW | VY | 04 Dec. 2013 | | |

I:\CLIENTS\ATCO\12-1334-0068\Mapping\MXD\Noise\Figure2_NoiseStudyArea_Receptor_FINAL.mxd

**Table 12 Application Case Noise Levels**

| Noise Receptor | Baseline Case Cumulative Noise Levels [dBA] | | Project Noise Contribution [dBA] | Application Case Cumulative Noise Levels [dBA] | |
|---|---|---|---|---|---|
| | Daytime | Nighttime | | Daytime | Nighttime |
| R2 | 46.5 | 42.0 | 36.1 | 46.8 | 43.0 |
| R3 | 46.5 | 42.0 | 33.2 | 46.7 | 42.5 |
| R5 | 45.5 | 38.5 | 33.5 | 45.8 | 39.7 |
| R6 | 50.1 | 41.2 | 34.6 | 50.3 | 42.1 |
| R7 | 50.2 | 41.9 | 41.4 | 50.8 | 44.6 |
| R8 | 50.3 | 42.3 | 36.2 | 50.5 | 43.3 |
| R12 | 55.1 | 45.7 | 40.7 | 55.2 | 46.9 |
| R13 | 46.1 | 41.0 | 37.7 | 46.7 | 42.6 |

**Table 13 Application Case Noise Levels vs. Permissible Sound Level**

| Noise Receptor | Application Case Cumulative Noise Level [dBA] | | Permissible Sound Level [dBA] | | Margin of Compliance [dB] | |
|---|---|---|---|---|---|---|
| | Daytime | Nighttime | Daytime | Nighttime | Daytime | Nighttime |
| R2 | 46.8 | 43.0 | 57 | 47 | 10.2 | 4.0 |
| R3 | 46.7 | 42.5 | 57 | 47 | 10.3 | 4.5 |
| R5 | 45.8 | 39.7 | 50 | 40 | 4.2 | 0.3 |
| R6 | 50.3 | 42.1 | 55 | 45 | 4.7 | 2.9 |
| R7 | 50.8 | 44.6 | 55 | 45 | 4.2 | 0.4 |
| R8 | 50.5 | 43.3 | 55 | 45 | 4.5 | 1.7 |
| R12 | 55.2 | 46.9 | 60 | 50 | 4.8 | 3.1 |
| R13 | 46.7 | 42.6 | 57 | 47 | 10.3 | 4.4 |

**Table 14 Baseline Case Noise Levels vs. Application Case Noise Levels**

| Noise Receptor | Baseline Case Cumulative Noise Level [dBA] | | Application Case Cumulative Noise Level [dBA] | | Change in Cumulative Noise Level [dB] | |
|---|---|---|---|---|---|---|
| | Daytime | Nighttime | Daytime | Nighttime | Daytime | Nighttime |
| R2 | 46.5 | 42.0 | 46.8 | 43.0 | 0.3 | 1.0 |
| R3 | 46.5 | 42.0 | 46.7 | 42.5 | 0.2 | 0.5 |
| R5 | 45.5 | 38.5 | 45.8 | 39.7 | 0.3 | 1.2 |
| R6 | 50.1 | 41.2 | 50.3 | 42.1 | 0.2 | 0.9 |
| R7 | 50.2 | 41.9 | 50.8 | 44.6 | 0.6 | 2.7 |
| R8 | 50.3 | 42.3 | 50.5 | 43.3 | 0.2 | 1.0 |
| R12 | 55.1 | 45.7 | 55.2 | 46.9 | 0.1 | 1.2 |
| R13 | 46.1 | 41.0 | 46.7 | 42.6 | 0.6 | 1.6 |

### 4.4.2 Low Frequency Noise

Table 15 presents dBA and dBC noise levels for the Project.

**Table 15 Application Case Low Frequency Noise Analysis**

| Noise Receptor | Project Noise Contribution | | Difference [dB] |
|---|---|---|---|
| | [dBA] | [dBC] | |
| R2 | 36.1 | 59.1 | 23.0 |
| R3 | 33.2 | 57.1 | 23.9 |
| R5 | 33.5 | 57.5 | 24.0 |
| R6 | 34.6 | 59.8 | 25.2 |
| R7 | 41.4 | 65.3 | 23.9 |
| R8 | 36.2 | 61.3 | 25.1 |
| R12 | 40.7 | 64.4 | 23.7 |
| R13 | 37.7 | 60.3 | 22.6 |

The results presented in Table 16 indicate that at all eight receptors the dBC – dBA difference is greater than the 20 dB threshold that Rule 012 indicates is indicative of a potential LFN issue. Therefore, there is a potential Project-related LFN issue at all eight noise receptors. As discussed in Section 3.2.3 of this NIA, field measurements of one-third octave-band noise levels at these receptors, once the Project begins operations, would be necessary to definitively identify any LFN issues; the dBC – dBA difference only indicates a potential LFN issue. In addition, it was not possible to include dBA and dBC ASL values in the LFN analysis since Rule 012 does not provide recommended ASL values in dBC. It is expected that the dBC – dBA differences would be reduced if it were possible to incorporate ASL values into the LFN analysis. If field monitoring conducted once the Project commences operations indicates that an LFN issue is present, then ATCO Power would implement reasonable mitigation to address any LFN.

# 5.0 SUMMARY AND DISCUSSION

The results presented in Table 13 indicate that the Application Case cumulative noise levels were predicted to be compliant with relevant PSL values for all receptors during both the daytime period and the nighttime period. The smallest margin of compliance was predicted to be 0.3 dB at receptor R5 during the nighttime period. At most other receptors the nighttime margin of compliance was predicted to be larger than 1 dB and at all receptors the daytime margin of compliance was predicted to be larger than 4 dB.

The results presented in Table 16 indicate potential Application Case LFN issues at all eight receptors. However, field measurements would be required to confirm LFN issues.

# 6.0 QUALIFICATIONS OF PERSONNEL RESPONSIBLE FOR NOISE IMPACT ASSESSMENT

Virgini Senden, MSc, Eur Ing, INCE was responsible for senior technical review of the emissions and modelling related to the Project NIA. Virgini is a senior acoustics engineer with a broad environmental and industrial background and over 16 years consulting experience as an acoustic specialist in the environmental and industrial fields. Her technical background and experience working for a large variety of industrial clients allows her to easily connect with industry and manufacturing, while her experience working directly for regulatory bodies allows her to connect with different regulatory regimes. Her experience in working on various large projects enables her to oversee and manage large amounts of data. Recent Canadian experience includes noise studies for oil and gas developments, conventional and wind power projects, mining projects, and the development of a regional noise model as part of a regional noise management plan for the Alberta Industrial Heartland. Other relevant experience includes integrated noise studies (road, rail, industry) as part of environmental impact studies, noise impact assessments for a wide variety of manufacturing facilities, including noise management and noise control recommendations, occupational health and safety noise studies and recommendations, the design, development, and maintenance of noise management systems for large industrial areas with multiple facilities, and road, rail, and architectural studies and recommendations (homes, schools, hospitals).

Joe Tomaselli, M.Eng., P.Eng (Ontario), was responsible for carrying out the senior review of the NIA report. Joe is an Acoustics, Noise and Vibration engineer based out of Golder's Mississauga office in Ontario with over 13 years' experience in providing Acoustics, Noise and Vibration support for a variety of projects, including, but not limited to; power, mining, infrastructure, manufacturing, and architectural. Joe obtained his Masters of Engineering through the University of Toronto, with an emphasis on noise and vibration control for industrial applications. He received his B.A.Sc., in Mechanical Engineering from Waterloo University. In recent years, Joe routinely provides support on noise assessments for projects located throughout North and South America.

Victor Young, MSc, performed noise emissions calculations, developed the computer noise model, and authored the NIA report. Victor is an acoustic scientist in the Golder Calgary office. Since starting at Golder three years ago, Victor has been involved in a variety of energy, utilities, and mining projects throughout Western Canada. Victor's experience includes field measurements and data analysis, computer noise modelling, and preparation of noise impact assessment and environmental impact assessment reports. Victor received a BSc (Physics) from the University of Guelph in 2002, and a MSc (Physics) from Dalhousie University in 2005. Prior to starting at Golder, Victor spent more than five years working as a research scientist on projects related to underwater acoustics, specifically sonar signal processing, pattern recognition, and automatic classification. During that time, Victor authored several research papers in leading scientific journals.

# 7.0 CLOSURE

We trust that the above meets your requirements. If you have any questions or require additional details, please contact the undersigned.

**GOLDER ASSOCIATES LTD.**

**ORIGINAL SIGNED**

Victor Young, M.Sc.
Acoustic Scientist

**ORIGINAL SIGNED**

Joe Tomaselli, M.Eng., P.Eng.
Associate, Acoustics, Noise, and Vibration Engineer

**ORIGINAL SIGNED**

Rick Robinson, Ph.D.
Principal, Project Director

VY/JT/RR/km

## 8.0 REFERENCES

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# APPENDIX A

## Permissible Sound Level Calculations

Rule 012 indicates that a noise receptor can have only one daytime PSL and one nighttime PSL. Therefore, if PSL values for a receptor have been established as part of a previous regulatory application these same values must be used in all future noise assessments. Among the noise receptors, the Permissible Sound Level (PSL) values for R2, R3, and R13 were established in (Shell 2010) and these PSL values were used directly in this NIA report. For the other receptors – R5, R6, R7, R8 and R12 – PSL calculations based on methods in Rule 012 are presented in Table 1.

**Table 1: Permissible Sound Level Calculations**

| Basic Nighttime Sound Level | | | | Nighttime | | | Daytime | | |
|---|---|---|---|---|---|---|---|---|---|
| **Proximity to Transportation** | **Dwelling Unit Density [# per ¼ Section of land]** | | | **R12** | **R6, R7, and R8** | **R5** | **R12** | **R6, R7, and R8** | **R5** |
| | **1 to 8 Dwellings** | **9 to 160 Dwellings** | **>160 Dwellings** | | | | | | |
| Category 1[(a)] | 40 | 43 | 46 | | | 40 | | | 40 |
| Category 2[(b)] | 45 | 48 | 51 | | 45 | | | 45 | |
| Category 3[(c)] | 50 | 53 | 56 | 50 | | | 50 | | |
| **Basic Sound Level (BSL)** | | | | **50** | **45** | **40** | **50** | **45** | **40** |
| Daytime Adjustment | | | | | | | | | |
| Reason for Adjustment | | | **Value [dBA $L_{eq}$]** | | | | | | |
| Adjustment for nighttime hours (22:00 to 07:00) | | | 0 | 0 | 0 | 0 | | | |
| Adjustment for daytime hours (07:00 to 22:00) | | | 10 | | | | 10 | 10 | 10 |
| **Nighttime/Daytime Adjustment** | | | | **0** | **0** | **0** | **10** | **10** | **10** |
| **Permissible Sound Level (PSL) [dBA]** | | | | **50** | **45** | **40** | **60** | **55** | **50** |

(a) Category 1: Dwelling(s) distance is more than or equal to 500 m from heavily travelled roads or rail lines and not subject to frequent aircraft flyovers.

(b) Category 2: Dwelling(s) distance is more than or equal to 30 m, but less than 500 m from heavily travelled roads or rail lines and not subject to frequent aircraft flyovers.

(c) Category 3: Dwelling(s) distance is less than 30 m from heavily travelled roads, or rail lines or subject to frequent aircraft flyovers.

# APPENDIX B

## Octave-Band Noise Emissions

**Table 1 Spectrum Sound Power Levels of Noise Breakout from Buildings**

| Source | Quantity | Spectrum Sound Power Levels [dBA] | | | | | | | | | Overall Sound Power Level [dBA] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 31.5 | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | |
| gas turbine building walls | all | 82.2 | 91.6 | 93.7 | 83.2 | 79.3 | 71.0 | 69.6 | 64.4 | 59.3 | 96.3 |
| HRSG building walls | all | 84.9 | 94.3 | 96.4 | 85.9 | 82.0 | 73.7 | 72.3 | 67.1 | 62.0 | 99.0 |
| steam turbine building walls | all | 90.7 | 87.3 | 88.4 | 90.4 | 88.1 | 83.2 | 74.4 | 61.6 | 55.5 | 96.5 |
| gas turbine building roof | all | 90.4 | 99.8 | 97.9 | 91.5 | 91.5 | 86.3 | 84.9 | 74.6 | 70.5 | 103.1 |
| HRSG building roof | all | 89.3 | 98.7 | 96.8 | 90.4 | 90.4 | 85.2 | 83.8 | 73.5 | 69.4 | 102.0 |
| steam turbine building roof | all | 87.7 | 84.3 | 85.3 | 87.4 | 85.1 | 80.1 | 71.3 | 58.6 | 52.4 | 93.4 |
| gas turbine building / HRSG building ventilation louvers | 30 | 64.4 | 78.8 | 82.9 | 79.5 | 83.5 | 82.3 | 86.9 | 83.7 | 78.5 | 91.9 |
| steam turbine building ventilation louvers | 20 | 65.9 | 67.5 | 74.6 | 79.6 | 81.3 | 80.4 | 77.6 | 71.8 | 64.7 | 86.5 |

**Table 2 Spectrum Sound Power Levels of Outdoor Equipment Noise Emissions**

| Equipment | Quantity | Spectrum Sound Power Levels [dBA] | | | | | | | | | Overall Sound Power Level [dBA] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 31.5 | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | |
| gas turbine air inlet | 1 | 54.6 | 74.8 | 72.9 | 82.4 | 86.8 | 90.0 | 94.2 | 94.0 | 91.9 | 99.2 |
| gas turbine air discharge vent | 1 | 55.6 | 75.8 | 73.9 | 79.4 | 81.8 | 92 | 95.2 | 96 | 93.9 | 100.7 |
| gas turbine / HRSG exhaust stack (including silencer) | 1 | 79.6 | 84.8 | 94.9 | 92.4 | 83.8 | 69 | 52.2 | 42 | 34.9 | 97.4 |
| | | 81.6 | 92.8 | 103.9 | 106.4 | 108.8 | 104 | 92.2 | 73 | 59.9 | 112.4 |
| 250 MVA gas turbine transformer(a) | 1 | 70.4 | 85.2 | 93.3 | 93.5 | 101.7 | 98.9 | 94.9 | 89.6 | 81.2 | 105.0 |
| 250 MVA steam turbine transformer(a) | 1 | 70.4 | 85.2 | 93.3 | 93.5 | 101.7 | 98.9 | 94.9 | 89.6 | 81.2 | 105.0 |
| gas turbine building / HRSG building exhaust fans | 15 | 51.7 | 67.8 | 79.9 | 88.5 | 94.8 | 94.1 | 89.4 | 82.8 | 79 | 98.8 |
| steam turbine building exhaust fans | 10 | 51.7 | 67.8 | 79.9 | 88.5 | 94.8 | 94.1 | 89.4 | 82.8 | 79 | 98.8 |
| cooling tower outlet fan(b) | 6 | 62.4 | 75.6 | 85.8 | 89.5 | 92.1 | 92.5 | 86.7 | 82.3 | 76.1 | 97.3 |
| cooling tower inlet(b) | 2 | 67.7 | 83.6 | 90.8 | 98.4 | 100.8 | 104.1 | 102.9 | 103.7 | 104.6 | 110.7 |
| cooling tower pumphouse exhaust fan(b) | 1 | 50.8 | 80.9 | 83.7 | 88.2 | 89.3 | 88.9 | 84.6 | 81.8 | 72.8 | 94.9 |

# APPENDIX C

## Quest Carbon Capture and Storage Project - Environmental Assessment, Volume 2A, Section 6

# Acronyms and Abbreviations

AIH ........ Alberta's Industrial Heartland
AOSP ........ Athabasca Oil Sands Project
ASL ........ ambient sound level
*CEAA* ........ *Canadian Environmental Assessment Act*
$CO_2$ ........ carbon dioxide
CSL ........ cumulative sound level
dBA ........ A-weighted decibels
dBC ........ C-weighted decibels
EIA ........ environmental impact assessment
ERCB ........ Alberta Energy Resources Conservation Board
HC ........ Health Canada
ISO ........ International Organization for Standardization
$L_{eq}$ ........ equivalent sound level
LAA ........ local assessment area
NCIA ........ Northeast Capital Industrial Association
PDA ........ Project development area
PSL ........ permissible sound level
RNMP ........ Regional Noise Management Plan
Shell ........ Shell Canada Limited
SPL ........ sound pressure level
the Project ........ Quest Carbon Capture and Storage Project
UTM ........ universal transverse mercator

# 6 Sound Environment

Noise is selected as a valued environmental component because excessive noise has the potential to affect the health and well-being of humans and wildlife. This section identifies and quantifies the noise emission sources from the Project, assesses the environmental effects of Project noise on nearby residences, describes the noise modelling approach, and evaluates compliance with regulatory noise control requirements.

The content of the assessment is structured to meet the requirements of the Alberta Energy Resources Conservation Board (ERCB) *Directive 038: Noise Control* (February 2010) (Directive 038) and the *Canadian Environmental Assessment Act (CEAA)*.

The objectives of the assessment are:

- identify the sound sources from the Project
- determine whether predicted sound levels at nearby residences comply with Directive 038 noise guideline limits for residences in Alberta's Industrial Heartland (AIH)
- determine the cumulative environmental effects of the Project together with other existing and approved facilities in the area (denoted as Application Case), and including other planned projects (denoted as Planned Development Case) on nearby residences
- identify measures to mitigate and manage potential environmental effects of noise

During operation, the primary noise sources will be in the $CO_2$ capture infrastructure, because no operational noise sources will be present along the $CO_2$ pipeline route or at the injection wells. Therefore, this noise assessment quantitatively assesses the environmental effects of noise from operation of the $CO_2$ capture infrastructure.

## 6.1 Boundaries – Sound Environment

### 6.1.1 Temporal Boundaries

The following temporal boundaries were used to assess Project environmental effects, some of which have a specific timeline assigned to them:

- Construction is scheduled to commence in Q3 2012 and end in Q4 2014
- Operation timeframe is for the life of the Project (estimated to be greater than 25 years)
- Decommissioning and abandonment recognizes the final reclamation of lands disturbed by construction

### 6.1.2 Spatial Boundaries

#### 6.1.2.1 Local Assessment Area

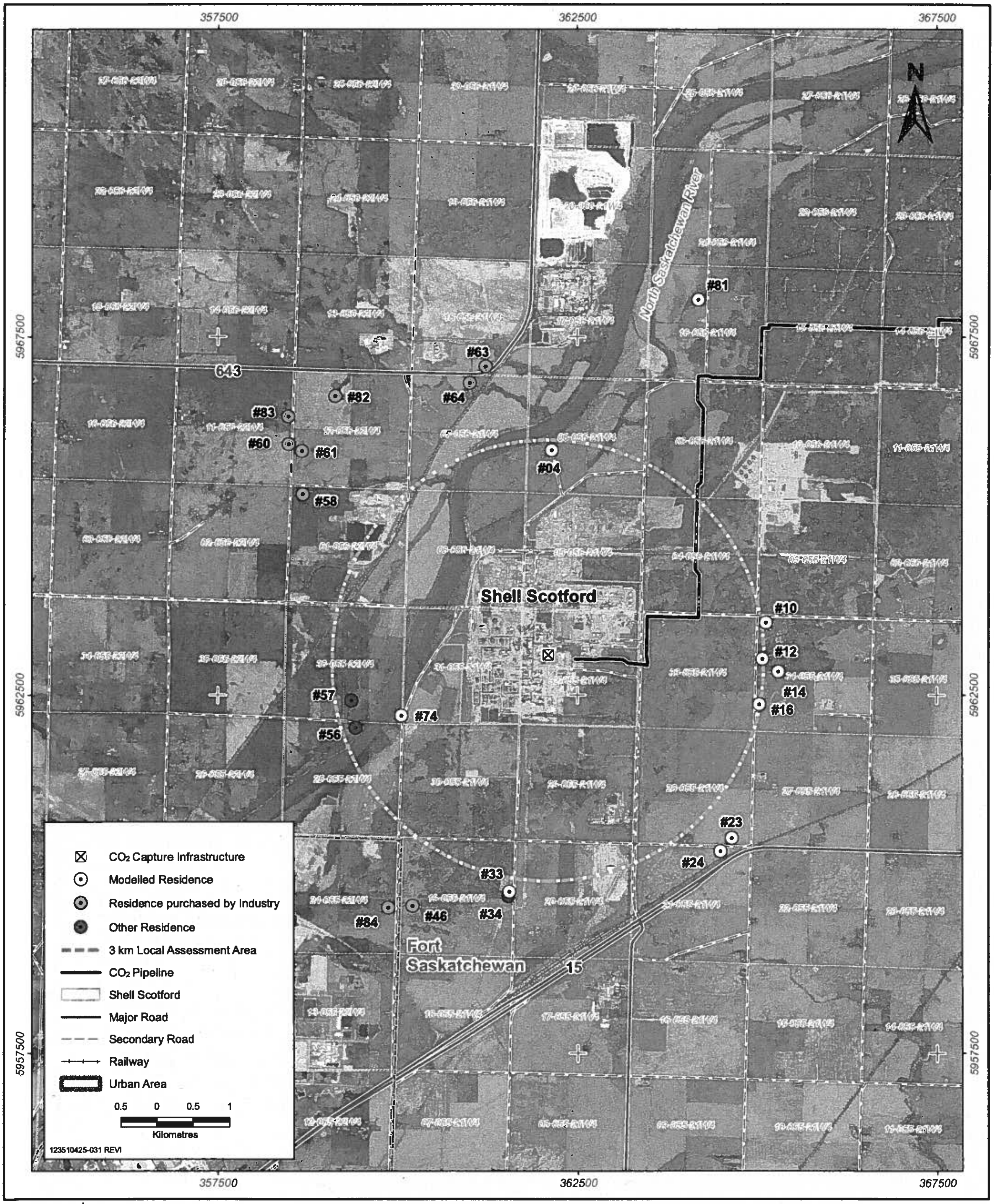
The local assessment area (LAA) encompasses the $CO_2$ capture infrastructure Project development area (PDA) and extends 3 km beyond the PDA (see Figure 6-1). Environmental effects of the $CO_2$ capture infrastructure-related noise during normal operation would be localized within the 3 km LAA, and are not expected to be audible beyond this 3 km distance. This is based on previous experience and professional judgment and is consistent with the approach taken in previously approved projects in the area (e.g., Athabasca Oil Sands Project [AOSP] Scotford Upgrader Expansion 1 Project [Shell 2005], AOSP Bitumen Blending Facility Project [Shell 2007, 2008] and the Total Upgrader Project (Total 2007).

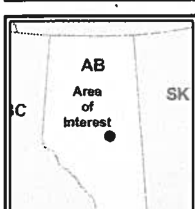
Based on review of the approved AOSP Scotford Upgrader Expansion 1 Project and AOSP Bitumen Blending Facility Project, 10 residences were identified as locations where environmental effects of noise could be a concern because of their proximity to the Project (see Figure 6-1). Some of the identified residences are outside the 3 km LAA, but have been included in the assessment for completeness and consistency with past noise assessments in the area. The ERCB had previously shown an interest in understanding the changes and trend in sound levels at some of these residences in previous environmental impact assessments (EIAs). Other residences in the area are at similar or greater setback distances from Shell Scotford. Although these residences will experience sound levels similar, or less than, the selected nearby 10 residences, they are included in the predicted noise isopleth contour maps for the area, and provide an understanding of the predicted sound levels at all the surrounding residences.

#### 6.1.2.2 Regional Assessment Area

If Directive 038 permissible sound levels or noise limits are met at nearby residences in the LAA, they will be deemed to be met at other residences outside the LAA, due to their greater distance from the $CO_2$ capture infrastructure. The environmental effects of the $CO_2$ capture infrastructure noise during normal operation are expected to be localized within the LAA because the environmental effects of noise would be imperceptible or inaudible outside the 3 km LAA.

A cumulative environmental effects assessment of the $CO_2$ capture infrastructure, together with other existing, approved and planned energy developments outside the LAA, is completed. This provides a conservative assessment and meets the cumulative environmental effects assessment requirements of Directive 038, consistent with the intent of the *CEAA*.




QUEST CARBON CAPTURE AND STORAGE PROJECT

# Noise Receptor Locations

PREPARED BY Stantec

PREPARED FOR

FIGURE NO. 6-1

Acknowledgements: Original Drawing by Stantec
Pipeline: Sunstone Engineering August 11, 2010 Basedata: National Road Network Imagery: Valtus 50cm August 2008, SPOT 10m August 2008.

Last Modified: Nov. 18, 2010 By: jpetho

## 6.2 Scope of Assessment – Sound Environment

The content of the assessment is structured to meet the requirements of Directive 038 and *CEAA*.

The objectives of the assessment are:

- identify the sound sources from the Project
- determine whether predicted sound levels at nearby residences comply with noise guideline limits in Directive 038 for residences in AIH
- determine the cumulative environmental effects of the Project together with other existing and approved facilities in the area (denoted as Application Case), and including other planned projects (denoted as Planned Development Case) on nearby residences
- identify measures to mitigate and manage potential environmental effects of noise

### 6.2.1 Regulatory Setting

Directive 038 regulates sound levels generated by energy-related facilities in the Province of Alberta. The requirements of Directive 038 have been applied in this noise assessment. This is consistent with the recommendation of Health Canada (HC 2010).

Health Canada does not have noise guidelines or enforceable noise thresholds or standards (HC 2010). Health Canada encourages responsible authorities to consult with provincial and municipal authorities, to determine which noise standards or regulations exist for the Project location, as differences may exist in approaches to limiting noise effects. In the province of Alberta, the Alberta ERCB regulates sound levels generated by energy facilities and their operation. The applicable regulatory noise control requirements are defined in Directive 038 (ERCB 2007). As recommended by Health Canada (HC 2010), the noise control guidelines in Directive 038 has been adopted for this assessment, as it is the applicable provincial noise regulatory guideline for energy-related facilities in Alberta.

### 6.2.2 Key Issues and Potential Interactions

See Table 6-1 for the potential interactions of the Project with the sound environment.

#### 6.2.2.1 Construction

Activities associated with the construction and decommissioning of the $CO_2$ capture infrastructure, $CO_2$ pipeline and $CO_2$ storage area (including the injection wells) are considered temporary, and are addressed through noise management protocols in Directive 038 (see Section 6.5). Therefore, potential interaction of the construction of the $CO_2$ capture infrastructure, $CO_2$ pipeline and $CO_2$ injection wells are ranked as 1 for interactions with noise.

## Table 6-1 Potential Project Interactions with Noise

| Project Activities and Physical Works | Description of Activity | Rank |
|---|---|---|
| **Construction** | | |
| $CO_2$ capture infrastructure | Construction equipment noise emissions. | 1 |
| $CO_2$ pipeline | Construction equipment and transportation noise emissions. | 1 |
| $CO_2$ storage (including injection wells, access roads and borrow pit areas) | Construction equipment, injection well drilling equipment and transportation noise emissions. | 1 |
| **Operation** | | |
| $CO_2$ capture infrastructure | Continuous noise emission from the operation of the $CO_2$ capture infrastructure | 2 |
| $CO_2$ pipeline | No noise emissions | 0 |
| $CO_2$ storage (including injection wells, access roads and borrow pit areas) | No noise emissions | 0 |
| | | ✓ |
| **Decommissioning and Abandonment** | | |
| $CO_2$ capture infrastructure | Decommissioning equipment noise emissions | 1 |
| $CO_2$ pipeline | Decommissioning equipment and transportation noise emissions | 1 |
| $CO_2$ storage (including injection wells, access roads and borrow pit areas) | Decommissioning equipment and transportation noise emissions | 1 |
| **Accidents, Malfunctions and Unplanned Events[1]** | | |
| **Interaction with Other Physical Works and Activities** | | |
| Interaction with other existing and planned projects in the PDA (see Project Inclusion List in Section 2, Table 2-1) | Other industry and non-industry noise emissions | ✓ |

NOTES:

0 = No interaction

1 = Interaction occurs; however, based on past experience and professional judgement the interaction would not result in a significant environmental effect, even without mitigation; or interaction would not be significant due to application of codified environmental protection practices that are known to effectively mitigate the predicted environmental effects.

2 = Interaction could result in an environmental effect of concern, even with mitigation. The potential environmental effects are considered further in the environmental assessment.

✓ = Indicates cumulative environmental effects potential, which is the potential to interact with Project environmental effects.

[1] Accidents, malfunctions and unplanned events are assessed separately from the routine Project environmental effects assessment (see Section 17).

#### 6.2.2.2 Operation

Activities associated with the continuous operation of the $CO_2$ capture infrastructure have the greatest potential to change the sound environment throughout the lifespan of the Project, and so require detailed assessment according to Directive 038. As no noise emissions are expected to be associated with the operation of the $CO_2$ pipeline and $CO_2$ injection wells, these activities are ranked as 0.

#### 6.2.2.3 Decommissioning and Abandonment

Potential interaction of the decommissioning and abandonment of the Project is ranked as 1, as noise emissions are expected to be temporary and short-term in duration.

### 6.2.3 Measurable Parameters

The measurable parameter for assessing the environmental effects of noise is the permissible sound level (PSL). The rationale for the selection of the PSL is provided in Table 6-2.

**Table 6-2 Measurable Parameter for Noise**

| Environmental Effect | Rationale for Including Environmental Effect in the Assessment | Measurable Parameter(s) | Rationale for Selecting Measurable Parameter |
|---|---|---|---|
| The exceedance of Directive 038 PSLs could result in unacceptable noise levels at the residences | • The PSL is required in Directive 038 as the noise limit for assessing compliance at residential locations<br>• When the PSL is exceeded due to Project noise, quality of life for humans living in the area will be affected | • The nighttime PSL is measured in $L_{eq}$ (9) (dBA) | • Requirement of Directive 038 (ERCB 2007) |

### 6.2.4 Residual Environmental Effects Rating Criteria

Notwithstanding that Directive 038 regulatory requirements are the primary standards for assessing the environmental effects of noise during Project construction and operation, the following environmental effects rating criteria are also considered to provide an additional understanding of potential environmental effects of noise:

***Direction***

Direction is the expected long-term trend of the environmental effect, and can be:

- positive – the sound environment in the LAA is improving compared with ambient conditions
- adverse – the sound environment in the LAA is worsening compared with ambient conditions
- neutral – the sound environment in the LAA is not changing compared with ambient conditions

### Magnitude

Magnitude is the degree of change in sound level relative to the PSL. This assessment component is ranked as one of three classes:

- low – the predicted $CO_2$ capture infrastructure sound level contribution at the residences is less than the PSL by 4 to 9 dB
- moderate – the predicted $CO_2$ capture infrastructure sound level contribution at the residences is equal to or less than the PSL by 3 dB or less
- high – the predicted $CO_2$ capture infrastructure sound level contribution at the residences is greater than the PSL

### Geographic Extent

Geographic extent is the area within which an environmental effect of a defined magnitude occurs, and can be:

- local – the environmental effect of noise is restricted to the LAA
- regional – the environmental effect of noise will extend beyond the LAA

### Duration

Duration is the time required until the sound environment returns to its ambient condition, or the environmental effect can no longer be measured or otherwise perceived, and can be:

- short term – the duration of the noise event is less than 1 month
- medium term – the duration of the noise event is greater than 1 month but less than 3 years
- long term – the duration of the noise event is throughout the Project lifespan
- permanent – the duration of the noise event is permanent and extends beyond the Project lifespan

### Frequency

Frequency is the number of times during a project or a specific project phase that an environmental effect may occur, and can be:

- once – the environmental effect occurs once throughout the Project lifespan
- sporadic – the environmental effect occurs sporadically at irregular intervals throughout the Project lifespan
- regular – the environmental effect occurs on a regular basis at regular intervals throughout the Project lifespan
- continuous – the environmental effect occurs continuously throughout the Project lifespan

#### *Reversibility*

Reversibility is the likelihood that the ambient conditions will recover from an environmental effect, and can be:

- reversible – the environmental effect on the sound environment will cease after the Project is decommissioned
- irreversibile – the environmental effect on the sound environment will persist after the Project is decommissioned

### 6.2.5 Standards or Thresholds for Determining Significance

Directive 038 is the standard used to assess the significance of environmental effects of noise during continuous operation of the Project. If the Project noise level meets the PSLs or noise limit requirements of Directive 038, the environmental effect is considered to be not significant.

### 6.2.6 Influence of Consultation on the Assessment

Consultation with regulators, stakeholders and community members related to the potential environmental effects of the Project on the sound environment was integrated into the Terms of Reference for the Quest CCS Project, on which this assessment is based.

## 6.3 Methods – Sound Environment

### 6.3.1 Noise Descriptors

Because humans are more sensitive to sound at some frequencies and less at others, weighting of sound energy is used to account for the way humans hear. To account for the time-varying nature of environmental noise, a single measurement is used: energy equivalent sound level ($L_{eq}$). The $L_{eq}$ is defined as the steady, continuous sound level over a specified time that has the same acoustic energy as the actual varying sound levels over the same period. The unit for $L_{eq}$ is dBA (A-weighted decibels), which is an absolute decibel scaled to mimic the response of the human ear to different frequencies of quiet sound levels. For low frequency noise, the unit is dBC, which also mimics the response of the human ear to loud sound levels and weights the low frequency sounds more heavily than the A-weighting. The periods recommended by the ERCB for the $L_{eq}$ metric are daytime (07:00 to 22:00h) and nighttime (22:00 to 07:00h). The daytime $L_{eq}$ is the 15-hour A-weighted energy equivalent sound level, denoted as $L_{eq}$ (15). Similarly, the nighttime $L_{eq}$ is a 9-hour A-weighted energy equivalent sound level denoted as $L_{eq}$ (9).

For commonly used noise terminology, see Appendix 6A.

### 6.3.2 Modelling

Shell is an active member of the technical working group of the Northeast Capital Industrial Association (NCIA), which is developing a regional noise model for AIH. The noise assessment for this Project has been developed using noise modelling software and methodology consistent with NCIA requirements.

Noise propagation methods used in this assessment are those prescribed by the International Organization for Standardization (ISO) *Standard 9613* (ISO 1993, 1996). The ERCB has accepted the ISO 9613 standard for noise assessments under Directive 038. Sound propagation is calculated using the latest version of Cadna-A (DataKustik 2010), an advanced noise modelling software package that incorporates ISO 9613 sound propagation algorithms.

The modelling approach accounts for:

- distance attenuation (effect of geometric dissipation of sound with respect to distance)
- atmospheric attenuation (effect of sound absorption by the mass of air between sound sources and receptors)
- ground attenuation (effect of sound absorption by the ground as sound passes over various terrain types between the sound sources and the receptors)
- screening effects of surrounding terrain
- reflection of sound waves from reflective surfaces during propagation
- mitigation measures incorporated in the equipment and building design
- meteorological conditions and effects on sound propagation

The ISO 9613 algorithms simulate downwind propagation under mildly developed temperature inversion conditions, both of which enhance sound propagation and provide a reasonable assessment of potential environmental effects of noise, as stipulated in Directive 038. To provide a representative assessment of conditions when the general public might be most affected by noise, parameters typical of nighttime conditions in spring and summer are used because these coincide with periods when outdoor activities by the public are most likely to occur. As recommended in Directive 038, the meteorological parameters that are used in the noise model are 10°C ambient air temperature, wind speed of 7.5 km/h and 70% relative humidity. The ground between the $CO_2$ capture infrastructure and residences is predominantly soft, with short grass cover. Representative ground terrain information in the form of ground contour lines consistent with surrounding areas is used in the noise model. To provide a representative assessment of the environmental effects of noise during summer and spring conditions, the ground condition is modelled as soft porous ground (80% absorptive) and partly hard ground (20% reflective). These assumptions are similar to those made in the noise assessment for the AOSP Bitumen Blending Facility Project (Shell 2007, 2008).

### 6.3.3 Determination of Permissible Sound Levels

As stipulated in Directive 038, the PSL is the maximum sound level that should not be exceeded within 15 m of the residence. The ERCB also considers AIH to be a unique area whereby PSLs for residences in this area are based, in part, on ambient sound level (ASL) data dating back to 1980 when there were few ERCB regulated facilities in the area (ERCB 2007). The PSLs used are the same as PSLs used in previously approved projects in the area (e.g., AOSP Scotford Upgrader Expansion 1 Project (Shell 2005), AOSP Bitumen Blending Facility Project (Shell 2007, 2008), BA Energy Upgrader Project (BA Energy 2004)). See Table 6-3 for the nighttime PSLs at nearby residences. If a continuous operation meets the nighttime PSLs, daytime levels will be acceptable, because the daytime limit has an additional 10 dB incremental daytime adjustment, as per Directive 038 requirements. The 10 dB incremental daytime adjustment recognizes that nighttime noise disturbances are generally considered more annoying and less acceptable than daytime (ERCB 2007).

For noise-generating activities with shorter durations (e.g., during upset and emergency conditions), the PSL noise limit is increased by:

- 5 dB for noise activities lasting longer than one week, but less than or equal to 60 days
- 10 dB for noise activities lasting more than one day, but less than or equal to one week
- 15 dB for noise activities lasting less than or equal to one day

To verify compliance with Directive 038 PSL noise limits, modelling is used to predict sound contributions from:

- the $CO_2$ capture infrastructure (Project Case)
- existing industrial activities in the area, including noise from the $CO_2$ capture infrastructure, and approved facilities (Application Case)
- planned developments in the area (Planned Development Case)

If the predicted sound level is less than, or equal to, the PSL, the noise level is in compliance. If the PSL is exceeded, mitigation measures to reduce the sound level are identified. The residual environmental effect on residents is then determined based on predicted sound level after mitigation. Assessment reports for projects approved but not yet constructed near the Project were reviewed to obtain additional information on sound sources, the measured baseline sound environment, and approved PSLs for the residences in the area (North West 2006; BA Energy 2004; Shell 2005, 2007 and 2008; TOTAL 2007).

Directive 038 contains provisions that address low-frequency noise assessment for projects and has determined that low-frequency environmental effects of noise exist when:

- the time-weighted average dBC-dBA (i.e., dBC minus dBA) value is equal to, or greater than, 20 dB
- a clear tonal component exists at a frequency below 250 Hz

These provisions have been applied in the assessment of noise from the $CO_2$ capture infrastructure (see Section 6.5).

## Table 6-3 Permissible Sound Levels at Nearby Residences

| Residence No. [a] | UTM Coordinates (Zone 12, NAD 83) (m) | | Nighttime Permissible Sound Level (PSL)[b] (dBA $L_{eq}$[9]) | Orientation from the $CO_2$ Capture Infrastructure | Approximate Distance from the $CO_2$ Capture Infrastructure (km) |
|---|---|---|---|---|---|
| | Easting | Northing | | | |
| 4 | 362137 | 5965913 | 47 | North of the $CO_2$ capture infrastructure | 2.9 |
| 10 | 365125 | 5963529 | 47 | East of the $CO_2$ capture infrastructure | 2.8 |
| 12 | 365076 | 5963011 | 47 | East of the $CO_2$ capture infrastructure | 2.8 |
| 14 | 365297 | 5962819 | 47 | East of the $CO_2$ capture infrastructure | 3.1 |
| 16 | 365021 | 5962356 | 47 | East of the $CO_2$ capture infrastructure | 2.8 |
| 23 | 364648 | 5960497 | 47 | Southeast of the $CO_2$ capture infrastructure | 3.3 |
| 24 | 364484 | 5960324 | 47 | Southeast of the $CO_2$ capture infrastructure | 3.3 |
| 33[c] | 361555 | 5959742 | 47 | South of the $CO_2$ capture infrastructure | 3.2 |
| 74 | 360059 | 5962230 | 47 | Southwest of the $CO_2$ capture infrastructure | 2.2 |
| 81 | 364175 | 5968014 | 45 | North of the $CO_2$ capture infrastructure | 5.3 |

NOTES:

[a] Some of these residences (Residences 23, 24, 81 and 33) are outside the 3 km LAA, but are included in the assessment for completeness and consistency with past project assessments in the area.

[b] Based on approved nighttime PSLs by the ERCB for these residences in previous EIA studies in AIH (e.g., AOSP Scotford Upgrader Expansion 1 Project [Shell 2005] and AOSP Bitumen Blending Facility Project [Shell 2007, 2008]). If a continuous operation meets the nighttime PSLs, daytime levels will be acceptable because the daytime limit has an additional 10 dB incremental daytime adjustment.

[c] Residence 33 is located within the fenceline of the planned TOTAL Upgrader. It is no longer occupied and is included in the assessment for information only.

# 6.4 Project Residual Environmental Effects Assessment – Sound Environment

## 6.4.1 Mitigation Measures

Mitigation measures for noise associated with the Project construction and decommissioning activities and operation include the following:

### 6.4.1.1 Construction and Decommissioning

- Where practical, noisy construction activity (e.g., piling) will be scheduled to daytime hours (i.e. 07:00 to 20:00h)
- Noise mitigation measures installed on construction equipment (e.g. mufflers) will be kept in good working condition
- Construction traffic will be restricted to approved access routes to and from the site
- Equipment will be turned off when not in use, where practical
- Screening effects resulting from placing barriers and enclosures around construction equipment will be used, where practical
- Noise complaints about construction activity will be logged and investigated to assess whether they relate to Project activities

### 6.4.1.2 Operation

- Electric-driven compressors and pumps will be used at the $CO_2$ capture infrastructure
- The compressor will be housed inside buildings with acoustical treatments
- All operational noise sources will be designed to meet a maximum noise emission level of 85 dBA at 1 m, or as low as reasonably practicable.
- To minimize the likelihood of structure-borne noise that may be induced from the vibration of indoor equipment, Shell will consider installing vibration isolation pads, resilient mounts on equipment, resilient pipe support systems, and dampers where appropriate
- Noise complaints about $CO_2$ capture infrastructure operation will be logged and investigated to assess whether they relate to Project activities
- There are no onsite rail networks planned for the $CO_2$ capture infrastructure
- Noise complaints about rail and truck activities will be logged and investigated to assess whether they relate to Project activities
- Noise mitigation measures installed on trucks (mufflers) will be kept in good working condition
- Appropriately equipped and maintained drilling rigs will be contracted
- Where applicable, Shell will consider installing an appropriate vent silencer to limit noise levels
- Emergency alarm testing will be restricted to daytime periods only

### 6.4.2 Construction and Decommissioning Noise

Noise associated with Project construction is exempted from meeting the requirements of Directive 038. However, Directive 038 requires that reasonable measures be implemented to limit environmental effects of noise from construction activities.

Noise will occur during construction-related activities associated with the $CO_2$ capture infrastructure, $CO_2$ pipeline and $CO_2$ storage (including the injection wells). At decommissioning, noise will be generated by remediation activities. Noise levels will vary as activities change in location and intensity (i.e., types and numbers of construction equipment operating). The environmental effects of noise from the construction of the $CO_2$ capture infrastructure are expected to be less than those for the approved AOSP Scotford Expansion 1 Project (Shell 2005) because the construction effort for the $CO_2$ capture infrastructure is considerably smaller. However, the following mitigation measures will be implemented to address the environmental effects of noise on nearby residents during construction and decommissioning associated with the $CO_2$ capture infrastructure, $CO_2$ pipeline and $CO_2$ storage area (including the injection wells), as recommended in Directive 038:

- Where practical, noisy construction activity (e.g., piling) will be scheduled to daytime hours (i.e., 07:00 to 20:00h).
- Noise mitigation measures installed on construction equipment (e.g., mufflers) will be kept in good working condition.
- Construction traffic will be restricted to approved access routes to and from the site.
- Equipment will be turned off when not in use, where practical.
- Screening effects resulting from placing barriers and enclosures around construction equipment will be used, where practical.
- Noise complaints will be logged and investigated to assess whether they relate to construction activities.

The environmental effect is reversible and will cease when construction ends. The frequency of exposure is sporadic and the duration is medium-term.

### 6.4.3 Railway and Road Traffic Noise

Material and personnel will be transported to and from the $CO_2$ capture infrastructure site by access roads and rail during construction, operation, and decommissioning and abandonment. No new rail networks are planned for the $CO_2$ capture infrastructure site. Although environmental effects of noise from railway and road traffic are not specifically addressed in Directive 038, it is consistent with the intent of Directive 038 that environmental effects of noise are kept to a minimum. The level of noise created by vehicle traffic will vary by type, number, and speed of vehicle. Typical maximum sound levels of a heavy truck passing by at speeds of 50 km/h and 80 km/h are 80 dBA and 85 dBA at 15 m, respectively (ERCB 2007). Maximum noise levels would decay to approximately 64 to 69 dBA within 100 m of the roadway, 40 to 45 dBA within 1.5 km of the roadway, and 34 to 39 dBA at 3 km from the roadway. Heavy trucks are defined as having more than three axles, with a general gross vehicle weight greater than 12,000 kg (ERCB 2007).

Although there are no onsite rail networks planned for the capture infrastructure, the following rail noise information is provided for information. Typical maximum sound level of a freight train passing by is 95 dBA at 15 m (ERCB 2007). Maximum noise levels would decay to approximately 79 dBA within 100 m of the rail track, 55 dBA at 1.5 km from the track, and 49 dBA at 3 km from the track.

Based on knowledge of the area and the smaller scale of this $CO_2$ capture infrastructure relative to the AOSP Scotford Expansion 1 Project (Shell 2005), it is expected that existing vehicle and rail traffic volume in the area would be more dominant than the occasional Project-related vehicle and rail traffic along existing roads and rail tracks. As a result, the noise effects are expected to be less than those described for the AOSP Scotford Expansion 1 Project because the $CO_2$ capture infrastructure will incorporate similar noise management measures and the effects of the Scotford Expansion 1 Project were predicted to be not significant. Nevertheless, noise complaints about rail and truck activities will be logged and investigated to assess whether they relate to Project activities. Also, noise mitigation measures installed on vehicles (e.g., mufflers) will be kept in good working condition and speed limits followed. The environmental effect is reversible and would cease when the traffic ends. The frequency of exposure is sporadic and the duration is short-term.

### 6.4.4 Injection Well Drilling Noise

Noise will occur during drilling of the injection wells for $CO_2$ storage underground. Directive 038 stipulates that compliance for drilling and servicing rigs is on a complaint basis only, and that all parties are expected to act quickly to remedy any noise complaints. Shell will limit environmental effects of noise as a result of injection well drilling by contracting an appropriately equipped and maintained drilling rig. The environmental effect is reversible and will cease when drilling ends. The frequency of exposure is sporadic and the duration is short-term.

### 6.4.5 $CO_2$ Venting Operations

During upset conditions, $CO_2$ venting may occur, and is a required safety measure to protect workers and the integrity of the facilities. This type of emergency activity, required to protect worker health and safety, is exempt from meeting the requirements of Directive 038. However, Directive 038 still requires reasonable measures to be implemented to limit the noise level during such activity. Therefore, Shell will consider installing an appropriate vent silencer to reduce noise levels, where applicable, during upset conditions. The environmental effect is reversible and will cease when the upset conditions and venting stops. The frequency of exposure is sporadic and the duration is short-term.

### 6.4.6 Emergency Alarm Systems

Various alarm systems will be installed at the Project, according to required safety measures. The alarms will be loud and audible in emergencies. Emergency alarm systems will be tested occasionally to ensure that the alarm systems work and that they will be functional during emergencies. Emergency alarms associated with the $CO_2$ capture infrastructure will be tested during daytime hours exclusively (07:00 to 20:00h), where reasonably practical.

The environmental effect is reversible and will cease when the alarm is switched off. The frequency of exposure is sporadic and the duration is short-term.

## 6.4.7 Operation

### 6.4.7.1 Assumptions

The following modelling parameters are used regarding the $CO_2$ capture infrastructure operation:

- Noise sources included in the model are those that will operate continuously. Spare, intermittent and stand-by equipment that will be used during equipment failure or emergency conditions are not part of normal operation, and therefore are not included in the noise model.
- All potential non-emergency noise-generating equipment (e.g., coolers, compressor, pumps and associated motors) will be designed to meet a maximum noise emission performance specification of 85 dBA at 1 m, or as low as reasonably practicable.
- The 1/1 octave band sound power levels for the sound sources are estimated from the noise emission performance specifications and published literature values, where applicable.
- A conservative estimate of noise disturbance during normal operation is predicted by assuming that all sound sources operate at the same time and at peak power (i.e., 100% load) during daytime and nighttime periods, as required in Directive 038.
- The compressor and associated electric driver will be housed inside an acoustical building, and designed to meet a maximum noise emission level of 85 dBA at 1 m from the building façade and associated ventilation openings, or as low as reasonably practicable. Where practical, the windows and doors will remain closed during normal operation, to reduce outdoor sound transmission from indoor equipment.
- To reduce the likelihood of structure-borne noise that may be induced from the vibration of indoor equipment, Shell will consider installing vibration isolation pads, resilient mounts on equipment, resilient pipe support systems, and dampers, where appropriate.
- Noise propagating through the compressor building walls and roof is modelled as an area source. At each pump location, the noise from the pump and associated electric driven motor is modelled.
- Pressure release valves are expected to operate during upset or emergency conditions for depressurization and safety purposes, where applicable. Noise from these emergency-related events has been excluded from the noise model, as required in Directive 038.
- Noise mitigation measures that will be incorporated as part of the equipment and building design are included in the noise model.
- Major sound sources associated with the $CO_2$ capture infrastructure include electric pumps and associated electric motors, $CO_2$ compressor and air cooler fans. For the modelled octave band sound power levels for these sources, see Appendix 6B.

- Notwithstanding the above measures, in the event a noise complaint is received, the following steps will be taken and will include the following:
- Shell will consult with the complainant to identify the time and weather conditions when the noise occurred and the type of noise detected.
- If appropriate, Shell will conduct a noise survey at the Shell Scotford fenceline during representative weather conditions, to determine whether the $CO_2$ capture infrastructure was the cause.
- If the $CO_2$ capture infrastructure is identified as the cause of a noise complaint, mitigation measures will be identified and implemented to reduce noise.

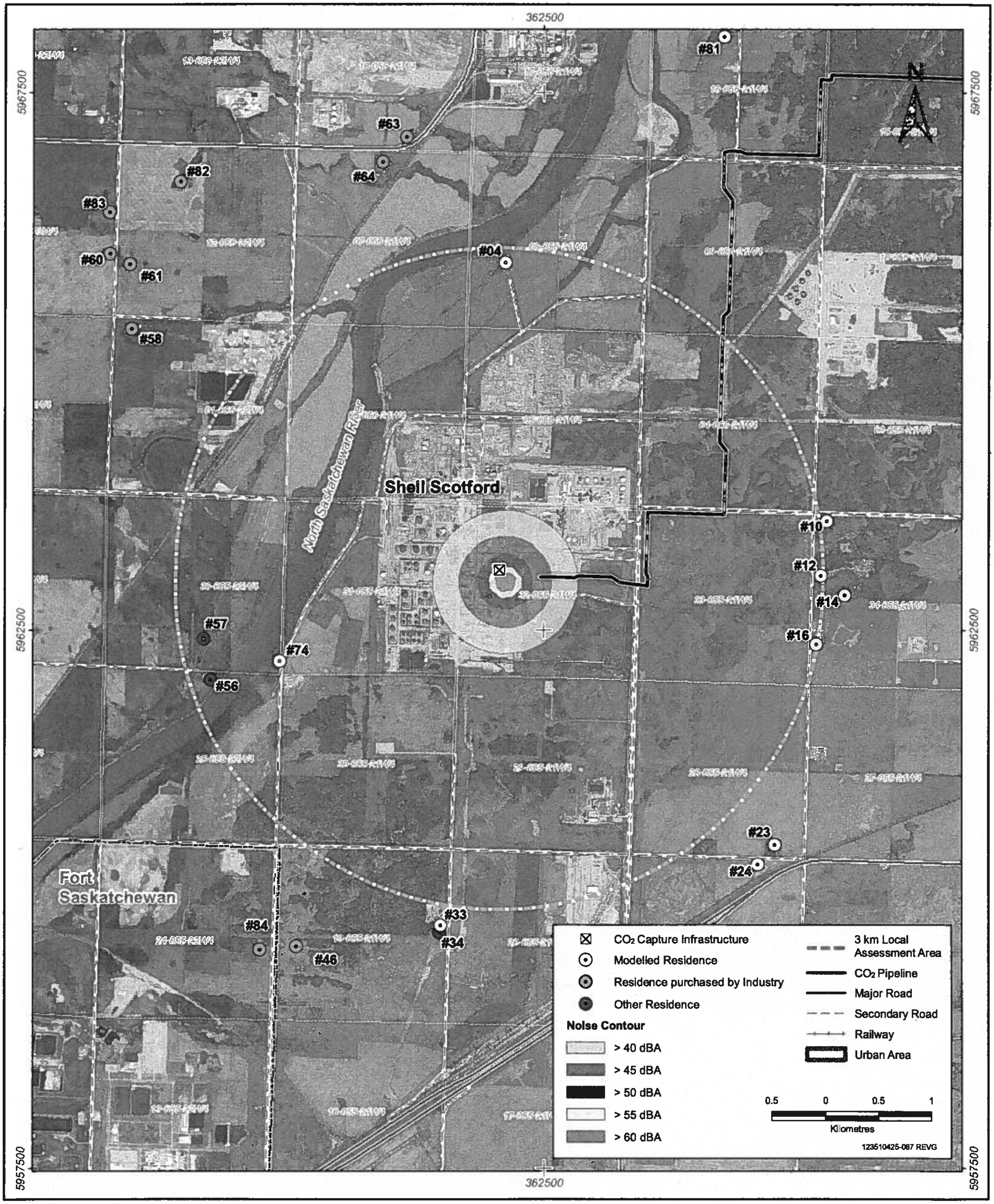
#### 6.4.7.2 Predicted Noise Levels

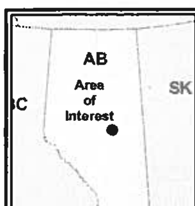
For noise contributions from the $CO_2$ capture infrastructure, see Table 6-4. Predicted sound levels are well below the nighttime PSLs at each of the residences. For the noise contour map of the area, see Figure 6-2. The noise isopleth contours start with a lower limit of 40 dBA. Based on human perception of sound, 40 dBA is the sound of a typical quiet office or living room (ERCB 2007). The potential for low-frequency noise is small because the predicted dBC-dBA (i.e., dBC minus dBA) value at each residence is less than 20 dB, as required in Directive 038.

**Table 6-4 Sound Levels from Capture Infrastructure Contributions**

| **Residence No.** | **Predicted Capture Infrastructure Sound Level Contributions** (dBA $L_{eq}$ (9)) | **Nighttime Permissible Sound Level** (dBA $L_{eq}$ (9)) | **Predicted Low Frequency Noise Check {dBC-dBA}** (dB) | **Meets ERCB Guidelines?** (Yes/No) | **Potential for Low Frequency Noise** (Yes/No) |
|---|---|---|---|---|---|
| 4 | 28 | 47 | 11 | Yes | No |
| 10 | 30 | 47 | 12 | Yes | No |
| 12 | 30 | 47 | 12 | Yes | No |
| 14 | 29 | 47 | 13 | Yes | No |
| 16 | 30 | 47 | 13 | Yes | No |
| 23 | 27 | 47 | 14 | Yes | No |
| 24 | 27 | 47 | 14 | Yes | No |
| 33[a] | 29 | 47 | 13 | Yes | No |
| 74 | 32 | 47 | 10 | Yes | No |
| 81 | 20 | 45 | 17 | Yes | No |

NOTES:
[a] Residence No. 33 is located within the fenceline of the planned TOTAL Upgrader. It is no longer occupied and is included in the assessment for information only.
Results rounded to the nearest whole number.




QUEST CARBON CAPTURE AND STORAGE PROJECT

# Predicted Noise Contours for the $CO_2$ Capture Infrastructure


Acknowledgements: Original Drawing by Stantec
Pipeline: Sunstone Engineering August 11, 2010 Basedata: National Road Network Imagery: Valtus 50cm August 2008, SPOT 10m August 2008.


PREPARED BY Stantec

PREPARED FOR

FIGURE NO. 6-2

Last Modified: Nov. 18, 2010 By: jpetho

# 6.5 Summary of Project Residual Environmental Effects on the Sound Environment

## 6.5.1 Determination of Significance

Predicted sound levels from the $CO_2$ capture infrastructure are well below the PSLs at all 10 selected residences (see Table 6-5). The potential for low-frequency noise is also predicted to be low at each of the 10 residences. The residual environmental effects of the Project will be not significant because the predicted sound level at each of the residences is well below Directive 038 guidelines.

## 6.5.2 Follow-up and Monitoring

As a member of the NCIA, Shell complies with the noise management and monitoring requirements of the ERCB within the NCIA Regional Noise Management Plan (RNMP). The RNMP is being developed by the NCIA and will include both ERCB-regulated and non-regulated facilities in AIH. Input from stakeholders in the area will be incorporated in the formulation of the RNMP. Shell is an active member of the technical working group in the development of this regional model.

Requirements for residential noise monitoring according to Directive 038 are complaint driven. No follow-up post-construction monitoring is required at the residences, unless a complaint is received. Any monitoring that might be necessary will be addressed at that time. Shell plans to manage noise concerns and to promptly respond to any noise complaint.

### *Best Practices*

The ERCB and Health Canada encourage licensees to adopt and incorporate best management practices for noise management into their design, construction, maintenance and operating procedures. These measures may include such activities as:

- taking regular noise measurements at the Shell Scotford fenceline, to determine whether any considerable changes in noise levels occur near the $CO_2$ capture infrastructure during operation
- restricting high noise-generating activities to the daytime, whenever practical

Shell is committed to incorporating best management practices into its design, construction, maintenance and operating procedures to limit noise disturbances, where reasonably practical.

## Table 6-5 Summary of Project Residual Environmental Effects on Sound Environment

| Activity | Potential Residual Environmental Effects | Mitigation and Compensation Measures | Residual Environmental Effect | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Direction | Magnitude | Geographic Extent | Duration | Frequency | Reversibility | Significance |
| **Construction** | | | | | | | | | |
| Noise associated with the Project construction activities for the $CO_2$ capture infrastructure, $CO_2$ pipeline and $CO_2$ storage area and injection wells. | Increase in sound levels at nearby residences | • Where practical, noisy construction activity (e.g., piling) will be scheduled to daytime hours (i.e. 07:00 to 20:00h)<br>• Noise mitigation measures installed on construction equipment (e.g. mufflers) will be kept in good working condition<br>• Construction traffic will be restricted to approved access routes to and from the site<br>• Equipment will be turned off when not in use, where practical<br>• Screening effects resulting from placing barriers and enclosures around construction equipment will be used, where practical<br>• Noise complaints about construction activity will be logged and investigated to assess whether they relate to Project activities | A | L to M | L | MT | S | R | N |

## Table 6-5 Summary of Project Residual Environmental Effects: Sound Environment (cont'd)

| Activity | Potential Residual Environmental Effects | Mitigation and Compensation Measures | Residual Environmental Effect | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Direction | Magnitude | Geographic Extent | Duration | Frequency | Reversibility | Significance |
| **Operation** | | | | | | | | | |
| Noise from continuous operation of the $CO_2$ capture infrastructure | Increase in sound levels at nearby residences | • Electric-driven compressors and pumps will be used at the $CO_2$ capture infrastructure<br>• The compressor will be housed inside buildings with acoustical treatments<br>• All operational noise sources will be designed to meet a maximum noise emission level of 85 dBA at 1 m, or as low as reasonably practicable.<br>• To minimize the likelihood of structure-borne noise that may be induced from the vibration of indoor equipment, Shell will consider installing vibration isolation pads, resilient mounts on equipment, resilient pipe support systems, and dampers where appropriate<br>• Noise complaints about $CO_2$ capture infrastructure operation will be logged and investigated to assess whether they relate to Project activities | A | L | L | LT | C | R | N |

## Table 6-5 Summary of Project Residual Environmental Effects: Sound Environment (cont'd)

| Activity | Potential Residual Environmental Effects | Mitigation and Compensation Measures | Residual Environmental Effect | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Direction | Magnitude | Geographic Extent | Duration | Frequency | Reversibility | Significance |
| **Operation (cont'd)** | | | | | | | | | |
| Noise from $CO_2$ capture infrastructure related railway and vehicular traffic during normal operation | Increase in sound levels at nearby residences | • There are no onsite rail networks planned for the $CO_2$ capture infrastructure<br>• Noise complaints about rail and truck activities will be logged and investigated to assess whether they relate to Project activities<br>• Noise mitigation measures installed on trucks (mufflers) will be kept in good working condition | A | L to M | L | ST | S | R | N |
| Well drilling and servicing | Increase in sound levels | • Appropriately equipped and maintained drilling rigs will be contracted | A | L to M | L | ST | S | R | N |
| Emergency venting during upset conditions | Increase in sound levels at nearby residences | • Where applicable, Shell will consider installing an appropriate vent silencer to limit noise levels | A | L to M | L | ST | S | R | N |
| Alarm system operation during emergency conditions | Increase in ASLs | • Emergency alarm testing will be restricted to daytime periods only | A | L to H | L | ST | S | R | N |

## Table 6-5 Summary of Project Residual Environmental Effects: Sound Environment (cont'd)

| | | | |
|---|---|---|---|
| **KEY**<br>***Direction:***<br>P Positive<br>A Adverse<br>N Neutral<br><br>***Magnitude:***<br>L Low: the predicted $CO_2$ capture infrastructure sounds level contribution at the residences is less than the PSL by 4 to 9 dB<br>M Moderate: the predicted $CO_2$ capture infrastructure sounds level contribution at the residences is equal to or less than the PSL by 3 dB or less<br>H High: the predicted $CO_2$ capture infrastructure sounds level contribution at the residences is greater than the PSL | ***Geographic Extent:***<br>Use quantitative measure; or<br>L Local: the environmental effect of noise is restricted to the LAA<br>R Regional: the environmental effect of noise will extend beyond the LAA<br><br>***Duration:***<br>Use quantitative measure; or<br>ST Short term: duration of the noise event is less than 1 month<br>MT Medium term: duration of the noise event is greater than 1 month but less than 3 years<br>LT Long term: duration of the noise event is throughout the Project lifespan<br>P Permanent: duration of the noise event is permanent and extends beyond the Project lifespan | ***Frequency:***<br>Use quantitative measure; or<br>O Occurs once<br>S Occurs sporadically at irregular intervals<br>R Occurs on a regular basis and at regular intervals<br>C Continuous | ***Reversibility:***<br>R Reversible<br>I Irreversible<br><br>***Significance:***<br>S Significant<br>N Not Significant |

## 6.6 Cumulative Environmental Effects Assessment on the Sound Environment

Directive 038 and *CEAA* require consideration and assessment of cumulative environmental effects of noise, where applicable. Noise contributions from the $CO_2$ capture infrastructure, as well as from existing, approved and planned industrial facilities in the area are considered. See Table 6-6 for the facilities that are included in the cumulative environmental effects assessment.

### Table 6-6 Summary of Facilities in the Cumulative Environmental Effects Assessment Cases

| Cumulative Environmental Effects Assessment Case | Sound Sources Included in Noise Model |
|---|---|
| Base Case | ASLs (per Directive 038) |
| | Predicted contributions from existing facilities near the Project (obtained from other approved EIAs in the area (e.g., Shell 2005, TOTAL 2007) |
| | BA Energy Upgrader (approved)[1] |
| | AOSP Scotford Upgrader Expansion 1 Project (approved) |
| | North West Upgrader (approved) [1] |
| | AOSP Bitumen Blending Facility (approved) |
| | Provident/Williams Energy BB-Mix Project (approved) |
| | Fort Hills Sturgeon Upgrader Project (approved) [1] |
| Application Case | Base Case |
| | $CO_2$ capture infrastructure |
| Planned Development Case | Application Case |
| | TOTAL Upgrader Project (planned) |
| | Provident/Williams Energy C5 Hydrotreater and C2 Recovery Projects (planned) |

NOTE:
[1] These approved projects are currently on hold and were included in the noise model to provide a conservative assessment.

### 6.6.1 Base Case

For the Base Case, the predicted sound levels from existing and approved projects within and near the LAA are added to the ASLs. Although some of the approved upgrader projects are currently on hold (e.g., BA Energy Upgrader, Fort Hills Sturgeon Upgrader and Northwest Upgrader), their sound contributions have been included in the modelling to provide a conservative assessment. For the predicted Base Case cumulative sound levels (CSLs) at the 10 residences, see Table 6-7. Predicted nighttime Base Case CSLs are below, or equal to, the ERCB PSLs at each of the residences.

**Table 6-7 Base Case Sound Levels**

| Column 1 | Column 2 | Column 3 | Column 4 | Column 5 | Column 6 |
|---|---|---|---|---|---|
| **Residence No** | **Predicted Contributions from Existing and Approved Projects**[1] (dBA $L_{eq}$ (9)) | **ASL**[2] (dBA $L_{eq}$ (9)) | **Predicted Base Case CSL (Column 2+3)**[3] (dBA $L_{eq}$ (9)) | **Nighttime Permissible Sound Level**[4] (dBA $L_{eq}$ (9)) | **Meets ERCB Guidelines?** (Yes/No) |
| 4 | 44 | 35 | 45 | 47 | Yes |
| 10 | 41 | 35 | 42 | 47 | Yes |
| 12 | 41 | 35 | 42 | 47 | Yes |
| 14 | 40 | 35 | 41 | 47 | Yes |
| 16 | 40 | 35 | 41 | 47 | Yes |
| 23 | 39 | 35 | 41 | 47 | Yes |
| 24 | 40 | 35 | 41 | 47 | Yes |
| 33[5] | 43 | 35 | 44 | 47 | Yes |
| 74 | 46 | 35 | 46 | 47 | Yes |
| 81 | 45 | 35 | 45 | 45 | Yes |

NOTES:

1 Based on extensive data available from other EIAs in the area and calibrated using data from field measurements (e.g., Shell 2005, 2007 and 2008; BA Energy 2004).

2 Based on Directive 038, the ASL data for AIH is based on data dating back as far as 1980, when there were few ERCB regulated facilities in the area.

3 For an explanation of logarithmic addition of sound levels, see "Decibel Addition" in Appendix 6A.

4 Based on approved PSLs by the ERCB for these residences in previous assessments in AIH(e.g., Shell 2005, 2007 and 2008; BA Energy 2004).

5 Residence No. 33 is located within the fenceline of the planned TOTAL Upgrader. It is no longer occupied and is included in the assessment for information only.

Results rounded to the nearest whole number.

### 6.6.2 Application Case

See Appendix 6B for sources of sound associated with the $CO_2$ capture infrastructure as well as the 1/1 octave band sound power level for each sound source. For results of the Application Case, see Table 6-8. For the noise contour map of the Application Case, see Figure 6-3. Predicted nighttime Application Case CSLs are less than or equal to the ERCB's PSLs at each of the 10 residences. Therefore, sound levels for the Application Case meet the requirements of Directive 038 at each of the 10 residences. For the predicted changes in perception in relation to the Application Case results, see Table 6-9. The results show that the predicted sound contribution by the $CO_2$ capture infrastructure at each of the 10 residences is considerably less than the Application Case sound level by more than 10 dB. The predicted sound level contribution by the $CO_2$ capture infrastructure at the 10 residences ranges from 20 to 32 dBA. Based on human perception of familiar sound levels, such low predicted sound levels in the range of 20 to 32 dBA are as quiet as a bedroom of a country home (ERCB 2007). Therefore, the sound contribution and environmental effects as a result of the $CO_2$ capture infrastructure will not be noticeable at each of the 10 residences. Therefore, the $CO_2$ capture infrastructure will not result in any significant changes in the sound environment at the residences.

**Table 6-8 Predicted Application Case Sound Levels**

| Column 1 | Column 2 | Column 3 | Column 4 | Column 5 | Column 6 |
|---|---|---|---|---|---|
| **Residence No.** | **Predicted Base Case CSL** (dBA $L_{eq}$ (9)) | **Predicted Sound Level Contribution from the $CO_2$ Capture Infrastructure** (dBA $L_{eq}$ (9)) | **Predicted Application Case CSL (column 2+3)** (dBA $L_{eq}$ (9))[1,2] | **Nighttime Permissible Sound Level** (dBA $L_{eq}$ (9)) | **Meets ERCB Guidelines?** (Yes/No) |
| 4 | 45 | 28 | 45 | 47 | Yes |
| 10 | 42 | 30 | 42 | 47 | Yes |
| 12 | 42 | 30 | 42 | 47 | Yes |
| 14 | 41 | 29 | 41 | 47 | Yes |
| 16 | 41 | 30 | 41 | 47 | Yes |
| 23 | 41 | 27 | 41 | 47 | Yes |
| 24 | 41 | 27 | 41 | 47 | Yes |
| 33[c] | 44 | 29 | 44 | 47 | Yes |
| 74 | 46 | 32 | 46 | 47 | Yes |
| 81 | 45 | 20 | 45 | 45 | Yes |

NOTES:

[1] Predicted nighttime CSLs for the Application Case include the Base Case and sound levels from the $CO_2$ capture infrastructure.

[2] For an explanation of logarithmic addition of sound levels, see "Decibel Addition" in Appendix 6A.

[3] Residence No. 33 is located within the fenceline of the planned TOTAL Upgrader. It is no longer occupied and is included in the assessment for information purposes only.

Results rounded to the nearest whole number.

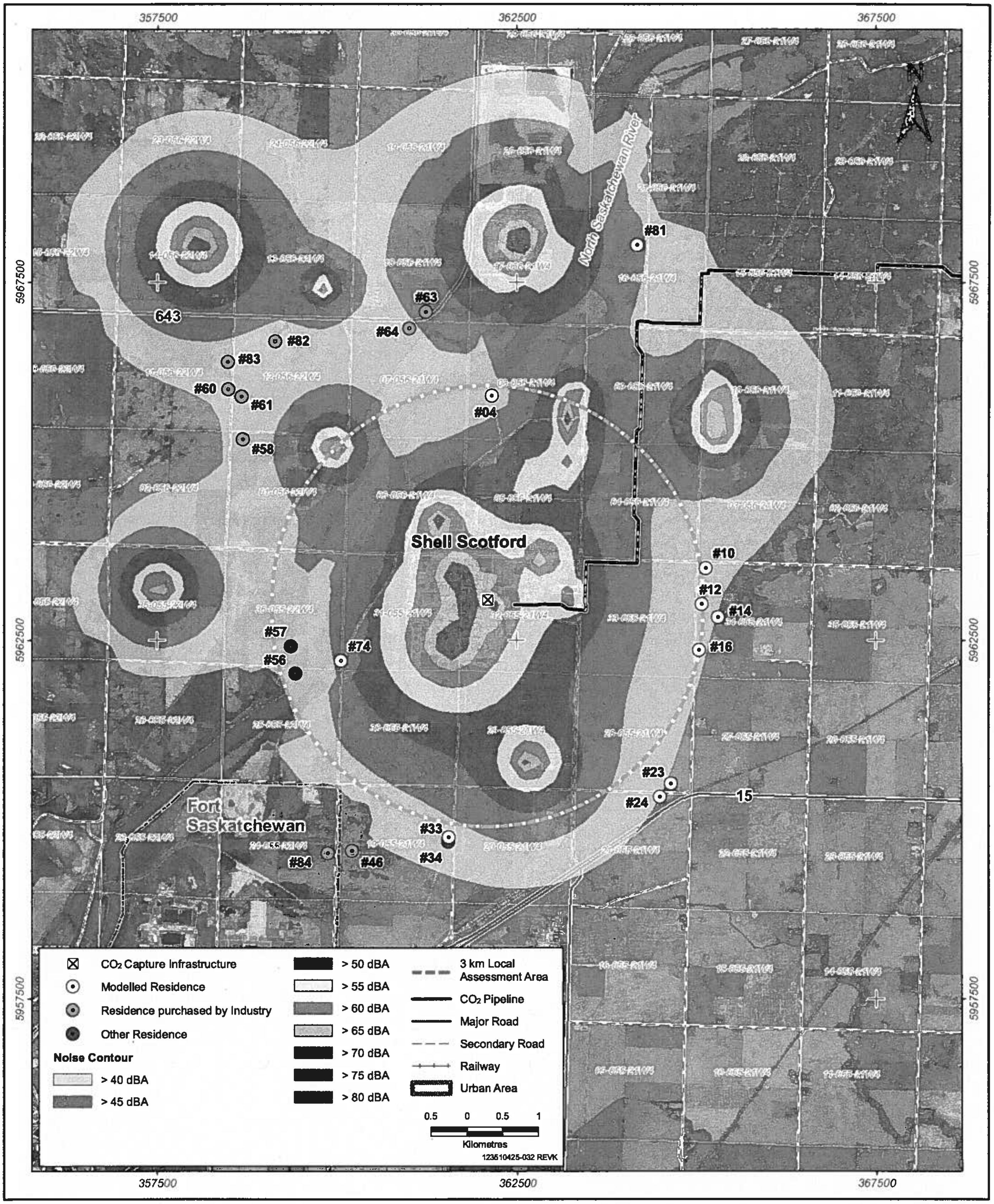
**Table 6-9 Predicted Human Perception Resulting from Comparing the Sound Level Contribution by the $CO_2$ Capture Infrastructure to the Application Case CSL**

| Column 1 | Column 2 | Column 3 | Column 4 | Column 5 |
|---|---|---|---|---|
| **Residence No.** | **Predicted Application Case CSL** (dBA $L_{eq}$ (9)) | **Predicted Sound Level Contribution from the $CO_2$ Capture Infrastructure** (dBA $L_{eq}$ (9)) | **Difference (Column 2-3)** dB | **Predicted Human Perception Resulting from Comparing the Sound Level Contribution by the $CO_2$ Capture Infrastructure to the Application Case CSL** |
| 4 | 45 | 28 | 17 | The predicted sound contribution and environmental effects as a result of the $CO_2$ capture infrastructure are not significant |
| 10 | 42 | 30 | 12 | The predicted sound contribution and environmental effects as a result of the $CO_2$ capture infrastructure are not significant |
| 12 | 42 | 30 | 12 | The predicted sound contribution and environmental effects as a result of the $CO_2$ capture infrastructure are not significant |
| 14 | 41 | 29 | 12 | The predicted sound contribution and environmental effects as a result of the $CO_2$ capture infrastructure are not significant |
| 16 | 41 | 30 | 11 | The predicted sound contribution and environmental effects as a result of the $CO_2$ capture infrastructure are not significant |
| 23 | 41 | 27 | 14 | The predicted sound contribution and environmental effects as a result of the $CO_2$ capture infrastructure are not significant |
| 24 | 41 | 27 | 14 | The predicted sound contribution and environmental effects as a result of the $CO_2$ capture infrastructure are not significant |
| 33[a] | 44 | 29 | 15 | The predicted sound contribution and environmental effects as a result of the $CO_2$ capture infrastructure are not significant |
| 74 | 46 | 32 | 14 | The predicted sound contribution and environmental effects as a result of the $CO_2$ capture infrastructure are not significant |
| 81 | 45 | 20 | 25 | The predicted sound contribution and environmental effects as a result of the $CO_2$ capture infrastructure are not significant |

NOTES:

[a] Residence No. 33 is located within the fenceline of the planned TOTAL Upgrader. It is no longer occupied and is included in the assessment for information only.

Results rounded to the nearest whole number.




QUEST CARBON CAPTURE AND STORAGE PROJECT

# Predicted Noise Contours - Application Case

*Acknowledgements: Original Drawing by Stantec*
*Pipeline: Sunstone Engineering August 11, 2010 Basedata: National Road Network Imagery: Valtus 50cm August 2008, SPOT 10m August 2008.*

PREPARED BY Stantec

PREPARED FOR

FIGURE NO. 6-3

Last Modified: Nov. 18, 2010 By: jpetho

### 6.6.3 Planned Development Case

For the Planned Development Case, the following planned facilities are considered and added to those included in the Application Case:

- TOTAL Upgrader Project
- Provident/Williams Energy C5 Hydrotreater and C2 Recovery Projects

The sound level contributions from the TOTAL Upgrader Project were determined from the noise emission data provided in the assessment (TOTAL 2007). At the time of completing this assessment, the comprehensive list of the noise emission sources for the planned Provident/Williams Energy C5 Hydrotreater and C2 Recovery Projects were not known. It was assumed that the total sound output from these two planned projects will be similar to those of the existing Provident/Williams Energy Redwater Fractionation and Storage Plant and approved BB-Mix Plant (Williams Energy 2009).

For results of the Planned Development Case, see Table 6-10. For the noise contour map of the Planned Development Case, see Figure 6-4. Predicted CSLs for the Planned Development Case are below or equal to the ERCB nighttime PSLs at all residences.

For the predicted changes in perception in relation to the Planned Development Case results, see Table 6-11. The results show that the predicted sound contribution by the $CO_2$ capture infrastructure at each of the 10 residences is considerably less than the Planned Development Case sound level by more than 10 dB. The predicted sound level contribution by the $CO_2$ capture infrastructure alone at the 10 residences ranges from 20 to 32 dBA. Based on human perception of familiar sound levels, such low predicted sound levels in the range of 20 to 32 dBA are as quiet as a bedroom of a country home (ERCB 2007). Therefore, the sound contribution and environmental effects as a result of the $CO_2$ capture infrastructure will not be noticeable at each of the 10 residences. As such, the $CO_2$ capture infrastructure would not result in any significant changes in the sound environment at the residences.

## Table 6-10 Predicted Planned Development Case Sound Levels

| Column 1 | Column 2 | Column 3 | Column 4 | Column 5 | Column 6 |
|---|---|---|---|---|---|
| **Residence No.** | **Predicted Application Case CSL** (dBA $L_{eq}$ (9)) | **Predicted Sound Level Contribution from other Publicly Disclosed Planned Projects** (dBA $L_{eq}$ (9)) | **Predicted Planned Development Case CSL (Columns 2+3)** (dBA $L_{eq}$ (9))[1,2] | **Nighttime Permissible Sound Level** (dBA $L_{eq}$ (9)) | **Meets ERCB Guidelines?** (Yes/No) |
| 4 | 45 | 29 | 45 | 47 | Yes |
| 10 | 42 | 18 | 42 | 47 | Yes |
| 12 | 42 | 18 | 42 | 47 | Yes |
| 14 | 41 | 18 | 41 | 47 | Yes |
| 16 | 41 | 19 | 41 | 47 | Yes |
| 23 | 41 | 22 | 41 | 47 | Yes |
| 24 | 41 | 22 | 41 | 47 | Yes |
| 33[c] | 44 | 44 | 47 | 47 | Yes |
| 74 | 46 | 28 | 46 | 47 | Yes |
| 81 | 45 | 15 | 45 | 45 | Yes |

NOTES:

[1] Predicted nighttime CSLs for the Planned Development Case include the Application Case and sound contributions from other publicly disclosed projects in the area.

[2] For an explanation of logarithmic addition of sound levels, see "Decibel Addition" in Appendix 6A.

[3] Residence No. 33 is located within the fenceline of the planned TOTAL Upgrader. It is no longer occupied and is included in the assessment for information only.

Results rounded to the nearest whole number.

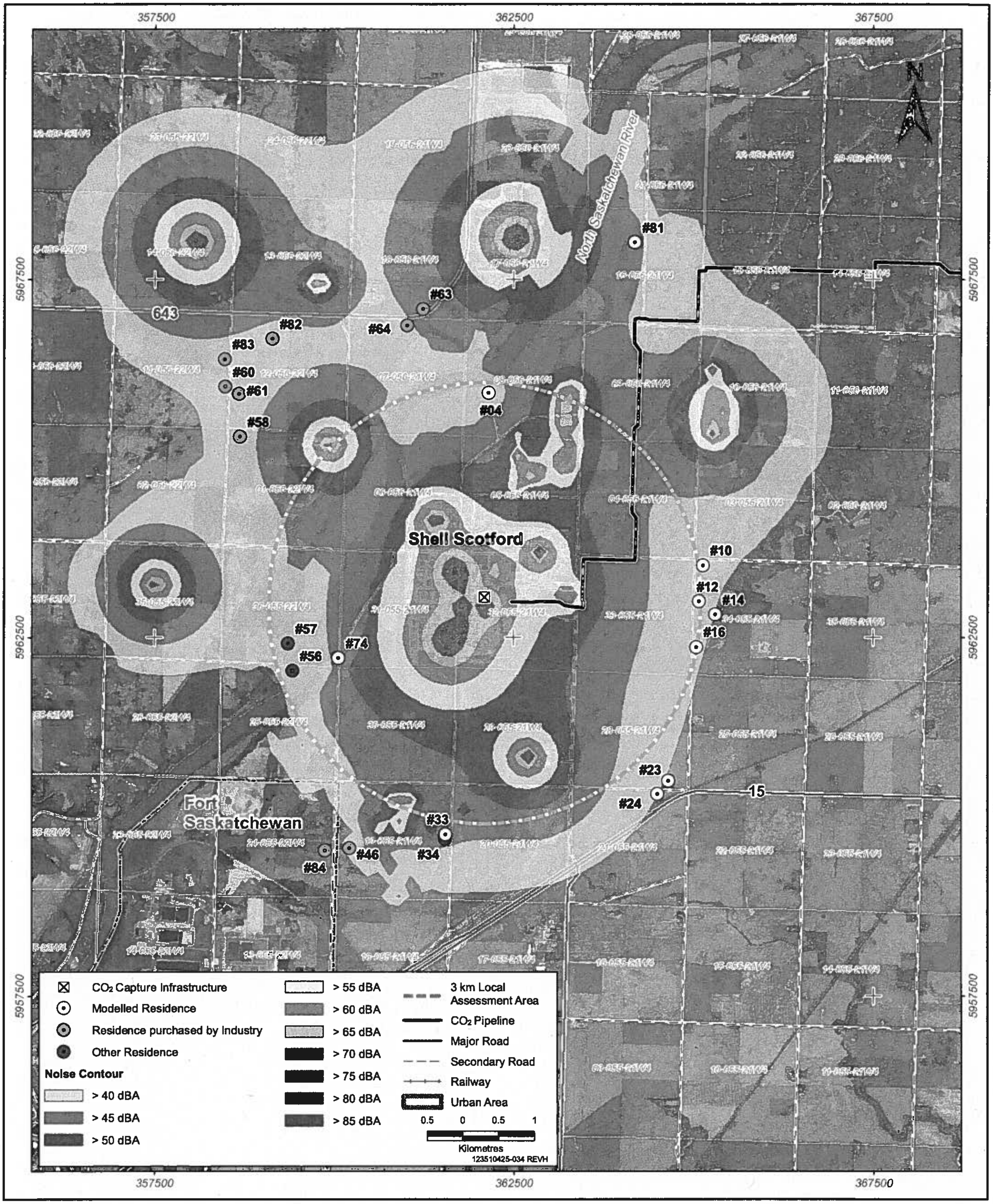
## Table 6-11 Predicted Human Perception Resulting from Comparing the Sound Level Contribution by the $CO_2$ Capture Infrastructure with the Planned Development Case CSL

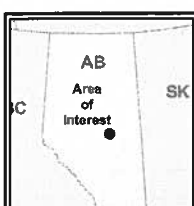
| Column 1 | Column 2 | Column 3 | Column 4 | Column 5 |
|---|---|---|---|---|
| **Residence No.** | **Predicted Planned Development Case CSL** (dBA $L_{eq}$ (9)) | **Predicted Sound Level Contribution from the $CO_2$ Capture Infrastructure** (dBA $L_{eq}$ (9)) | **Difference (Column 2-3)** (dB) | **Predicted Human Perception Resulting from Comparing the Sound Level Contribution by the $CO_2$ Capture Infrastructure with the Planned Development Case CSL** |
| 4 | 45 | 28 | 17 | The predicted sound contribution and environmental effects as a result of the $CO_2$ capture infrastructure are not significant |
| 10 | 42 | 30 | 12 | The predicted sound contribution and environmental effects as a result of the $CO_2$ capture infrastructure are not significant |
| 12 | 42 | 30 | 12 | The predicted sound contribution and environmental effects as a result of the $CO_2$ capture infrastructure are not significant |
| 14 | 41 | 29 | 12 | The predicted sound contribution and environmental effects as a result of the $CO_2$ capture infrastructure are not significant |
| 16 | 41 | 30 | 11 | The predicted sound contribution and environmental effects as a result of the $CO_2$ capture infrastructure are not significant |
| 23 | 41 | 27 | 14 | The predicted sound contribution and environmental effects as a result of the $CO_2$ capture infrastructure are not significant |
| 24 | 41 | 27 | 14 | The predicted sound contribution and environmental effects as a result of the $CO_2$ capture infrastructure are not significant |
| 33[a] | 47 | 29 | 18 | The predicted sound contribution and environmental effects as a result of the $CO_2$ capture infrastructure are not significant |
| 74 | 46 | 32 | 14 | The predicted sound contribution and environmental effects as a result of the $CO_2$ capture infrastructure are not significant |
| 81 | 45 | 20 | 25 | The predicted sound contribution and environmental effects as a result of the $CO_2$ capture infrastructure are not significant |

NOTES:

[a] Residence No. 33 is located within the fenceline of the planned TOTAL Upgrader. It is no longer occupied and is included in the assessment for information only.

Results rounded to the nearest whole number.




QUEST CARBON CAPTURE AND STORAGE PROJECT

# Predicted Noise Contours - Planned Development Case


*Acknowledgements: Original Drawing by Stantec*
*Pipeline: Sunstone Engineering August 11, 2010 Basedata: National Road Network Imagery: Valtus 50cm August 2008, SPOT 10m August 2008.*


PREPARED BY
Stantec

PREPARED FOR

FIGURE NO.
6-4

Last Modified: Nov. 18, 2010 By: jpetho

### 6.6.4 Summary of Cumulative Environmental Effects on the Sound Environment

CSLs from concurrent operation of the $CO_2$ capture infrastructure together with other existing facilities, approved projects (Application Case), and planned developments (Planned Development Case) are expected to be less than or equal to the PSLs at all the residences. The predicted Base Case sound contribution by the $CO_2$ capture infrastructure at each of the 10 residences is considerably less than the Application Case and Planned Development Case sound levels, by more than 10 dB. The predicted sound level contribution by the $CO_2$ capture infrastructure alone at the 10 residences ranges from 20 to 32 dBA. Based on human perception of familiar sound levels, such low predicted sound levels in the range of 20 to 32 dBA are as quiet as a bedroom of a country home (ERCB 2007). Therefore, the sound contribution by the $CO_2$ capture infrastructure will not be noticeable at any of the 10 residences. As such, the $CO_2$ capture infrastructure would not result in any significant environmental effects and changes in the sound environment at the residences. For a summary of the $CO_2$ capture infrastructure contributions to cumulative environmental effects, see Table 6-12.

### 6.6.5 Prediction Confidence

Prediction accuracy depends on two factors: the accuracy of the noise emission level source data and the accuracy of the sound propagation model. The noise emission level data for the $CO_2$ capture infrastructure are estimated from the equipment noise emission performance specifications and from published literature values, where applicable. The ISO 9613 sound propagation algorithms adopted in this assessment have been specifically recommended by the ERCB in Directive 038. The ISO 9613 model also produces conservative results representative of meteorological conditions enhancing sound propagation from the source to the residences (e.g., downwind and temperature inversion conditions). As these conditions do not occur all the time in the area, the model predictions are expected to be conservative. Therefore, actual sound level contributions by the $CO_2$ capture infrastructure at the residences are expected to be less than predicted by the model. Additionally, although some of the approved upgrader projects in the area are currently on hold (e.g., BA Energy Upgrader, Fort Hills Sturgeon Upgrader and Northwest Upgrader), their sound contributions have been included in the cumulative environmental effects assessment, to provide a conservative assessment. Based on these factors, confidence is high that the model has not underpredicted the noise level and environmental effects from the $CO_2$ capture infrastructure.

## Table 6-12 Project Contributions to Cumulative Environmental Effects on the Sound Environment

| Environmental Effect | Other Projects, Activities and Actions | Proposed Mitigation and Compensation Measures | Residual Environmental Effects Characteristics: Direction | Magnitude | Geographic Extent | Duration | Frequency | Reversibility | Significance | Proposed Follow-up and Monitoring Programs |
|---|---|---|---|---|---|---|---|---|---|---|
| Potential for operational noise at the $CO_2$ capture infrastructure to result in higher noise level at the residences | See Section 6.6, where the other projects considered in the cumulative environmental effects assessment are presented under Base Case, Application Case and Planned Development Case (see Table 6-6). | • Electric driven compressors and pumps will be used at the $CO_2$ capture infrastructure<br>• The compressor will be housed inside buildings with acoustical treatments<br>• All operational noise sources will be designed to meet a maximum noise emission level of 85 dBA at 1 m, or as low as reasonably practical<br>• To limit the likelihood of structure-borne noise that may be induced from the vibration of indoor equipment, Shell would consider installing vibration isolation pads, resilient mounts on equipment, resilient pipe support systems, and dampers, where appropriate<br>• Noise complaints about $CO_2$ capture infrastructure operation will be logged and investigated to assess whether they relate to Project activities | A | L | L | LT | C | R | N | Shell will comply with the noise management and monitoring requirements of the ERCB within the NCIA's RNMP.<br>If a noise complaint is received, Shell will comply with the steps in Directive 038. |

## Table 6-12 Project Contributions to Cumulative Environmental Effects on the Sound Environment (cont'd)

| | | | |
|---|---|---|---|
| **KEY**<br>***Direction:***<br>P Positive<br>A Adverse<br>N Neutral<br><br>***Magnitude:***<br>L Low: the predicted $CO_2$ capture infrastructure sounds level contribution at the residences is less than the PSL by 4 to 9 dB<br>M Moderate: the predicted $CO_2$ capture infrastructure sounds level contribution at the residences is equal to or less than the PSL by 3 dB or less<br>H High: the predicted $CO_2$ capture infrastructure sounds level contribution at the residences is greater than the PSL | ***Geographic Extent:***<br>Use quantitative measure; or<br>L Local: the environmental effect of noise is restricted to the LAA<br>R Regional: the environmental effect of noise will extend beyond the LAA<br><br>***Duration:***<br>Use quantitative measure; or<br>ST Short term: duration of the noise event is less than 1 month<br>MT Medium term: duration of the noise event is greater than 1 month but less than 3 years<br>LT Long term: duration of the noise event is throughout the Project lifespan<br>P Permanent: duration of the noise event is permanent and extends beyond the Project lifespan | ***Frequency:***<br>Use quantitative measure; or<br>O Occurs once<br>S Occurs sporadically at irregular intervals<br>R Occurs on a regular basis and at regular intervals<br>C Continuous | ***Reversibility:***<br>R Reversible<br>I Irreversible<br><br>***Significance:***<br>S Significant<br>N Not Significant |

# 6.7 References

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# APPENDIX D

## North American Oil Sands Corporation Upgrader Project Environmental Impact Assessment Volume 2, Section 3 - Noise

# 3 NOISE

## 3.1 Introduction

An environmental Noise Impact Assessment (NIA) for the North American Upgrader Project (the Project) near Fort Saskatchewan, Alberta, was completed, and the results are presented in this section. The purpose of the work was to measure the baseline noise levels for the existing surrounding residents (due to traffic and existing industrial facilities), and to determine the projected application case and cumulative case noise effect from the Project and other existing, approved and planned facilities within the region. Site work was conducted in March 2007.

The methods and analysis techniques used for the Project NIA are defined in Section 4.7.1 of the Final Terms of Reference (TOR) (Volume 1, Appendix A).

## 3.2 Study Area

The Study Area for the Project, as shown in Figure 3.2-1, is within Alberta's Industrial Heartland in Strathcona County, Alberta, approximately 13 km northeast of Fort Saskatchewan.

The Local Study Area (LSA) for noise is defined as encompassing all receptor locations within 4.5 km of the Project boundary. The Regional Study Area (RSA) for noise is defined as encompassing all of the major industrial noise sources in the area, which include: the proposed Synenco Northern Lights Upgrader to the north; the Shell Canada Scotford Complex, Petro-Canada Oil Sands Inc. Proposed Sturgeon Upgrader and the Gulf Chemical and Metallurgical Spent Catalyst Processing Facility to the west; and the Agrium Fertilizer Plants to the northwest. The eastern extent of the RSA includes Bruderheim.

The Project is situated in open farmland with the North Saskatchewan River (NSR) to the north and west of the site. Highway 15 runs east-west, approximately 800 m south of the Project, while Highway 830 runs north-south, approximately 800 m east of the Project. In addition, Range Road 560 and Township Road 211 and 212 currently intersect the Project site, along with a Canadian National Rail line along the southern area. There is also a Canadian Pacific Rail line approximately 2.5 km south, and a spur line to the north.

Nearby existing industrial facilities include the Shell Canada Scotford Complex approximately 4 km west, the Gulf Chemical and Metallurgical Spent Catalyst Processing Facility approximately 4 km west, the Agrium Fertilizer Facility approximately 4.5 km to the northwest and various other industrial facilities towards Fort Saskatchewan and on the west side of the NSR. There are also numerous oil/gas wells near the Project site.

In addition to the existing facilities, other energy facilities have been approved by the regulatory authorities and are under construction, including:

- BA Energy Heartland Oil Sands Bitumen Upgrader (located approximately 3 km northwest of the Project);
- Shell Canada Scotford Upgrader Expansion 1 Project (located approximately 4.5 km west of the Project); and
- North West Upgrading's Bitumen Upgrader (located approximately 9 km northwest of the Project).

There are also other facilities which have submitted their applications for regulatory approval, including:

- Synenco Northern Lights Upgrader (located approximately 10 km north-northwest of the Project);
- Petro-Canada Oil Sands Inc. Sturgeon Upgrader (located approximately 10 km west-northwest of the Project); and
- Shell Canada Scotford Upgrader 2 Project (located approximately 2 km west of the Project).

The Trim Blend Facility located immediately south of the North West Bitumen Upgrader was not included in the assessment. Previous work conducted in the North West Upgrading Inc. (2005) noise impact assessment indicated that the noise associated with the Trim Blend Facility would have a negligible effect on receptor locations near the North West Facility. As such, there would be a negligible effect for receptor locations further east (near the Project). The same is also true for the Kinder Morgan (Terasen Pipelines) Heartland Terminal, which, as indicated in the BA Energy Heartland Oil Sands Bitumen Upgrader EIA (2004), will result in a negligible effect on the receptor locations within this study.

There are numerous receptor locations surrounding the Project site. Specific locations at which noise monitoring and modelling were conducted are listed in Table 3.2-1 and illustrated on Figure 3.2-1. The receptors have been divided into two groups. Group 1 receptors are those within 1,500 m of the nearest Project noise source on the Project boundary. Group 2 receptors are those between 1,500 m and approximately 4,500 m of the Project boundary. Receptors outside this boundary are not considered, since, if the noise mitigation measures result in acceptable sound levels for Group 1 receptors, then receptors beyond Group 2 will be well within acceptable criteria. Also, the majority of the receptors are within Strathcona County. However, those receptors east of Highway 830 and north of Highway 15 are within Lamont County.

Topographically, the land in the Study Area is generally flat, with only small rolling hills breaking line-of-sight between some of the receptor locations and the Project. Most of the surrounding land is agricultural, with some small patches of trees and bush. As such, there will be a notable level of sound absorption in the summer months. In the winter months, when there is snow cover on the ground and no foliage on the trees, there will be less sound absorption. However, people tend to keep their windows closed more in the winter than in the summer, so the different seasonal conditions tend to balance each other.

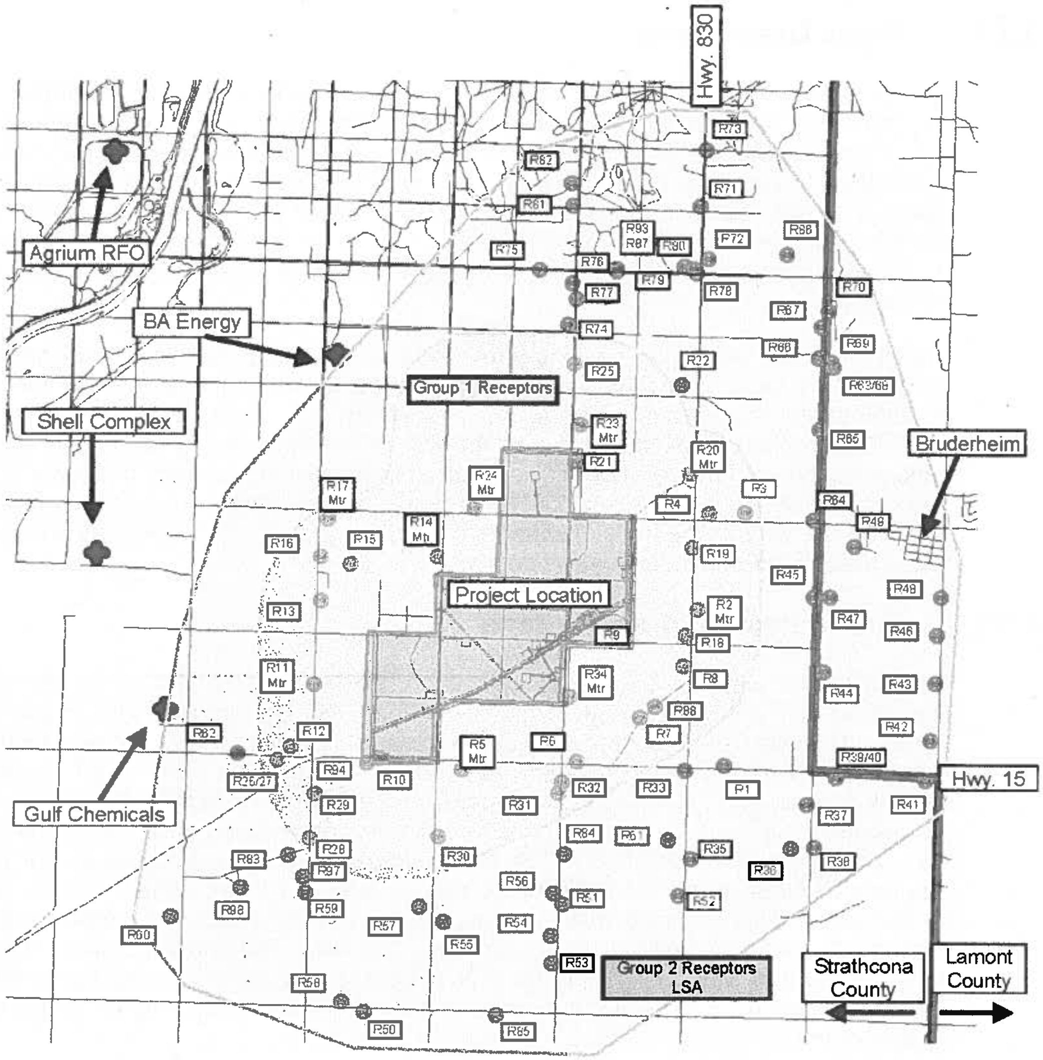
## Table 3.2-1 Receptor Locations in LSA

| Receptor ID | Description | NAD 83 UTM Zone 12 | | PSL-Night (dBA) |
|---|---|---|---|---|
| | | Easting | Northing | |
| Group 1 Receptors | | | | |
| R34 (M) | House/Farmyard | 368264 | 5961160 | 40 |
| R5 (M) | House/Farmyard | 366867 | 5960212 | 45 |
| R2 (M) | House/Farmyard | 369930 | 5962298 | 45 |
| R20 (M) | House/Farmyard | 369832 | 5964079 | 45 |
| R23 (M) | House/Farmyard | 368408 | 5964719 | 40 |
| R24 (M) | House/Farmyard | 367030 | 5963624 | 40 |
| R14 (M) | House/Farmyard | 366546 | 5962995 | 40 |
| R17 (M) | House/Farmyard | 365116 | 5963482 | 47 |
| R11 (M) | House/Farmyard | 364939 | 5961328 | 47 |
| R3 | House/Farmyard | 370552 | 5963564 | 45 |
| R4 | House/Farmyard | 370087 | 5963561 | 45 |

| Receptor ID | Description | NAD 83 UTM Zone 12 | | PSL-Night (dBA) |
|---|---|---|---|---|
| | | Easting | Northing | |
| **Group 1 Receptors (continued)** | | | | |
| R6 | House/Farmyard | 368360 | 5960315 | 45 |
| R7 | House/Farmyard | 369188 | 5960895 | 45 |
| R8 | House/Farmyard | 369751 | 5961562 | 45 |
| R9 | Grain Business | 368507 | 5962145 | 45 |
| R10 | House/Farmyard | 365790 | 5960355 | 45 |
| R12 | House/Farmyard | 364632 | 5960507 | 47 |
| R13 | House/Farmyard | 365024 | 5962425 | 47 |
| R15 | House/Farmyard | 365417 | 5962893 | 47 |
| R16 | House/Farmyard | 365025 | 5962997 | 47 |
| R18 | House/Farmyard | 369786 | 5961968 | 45 |
| R19 | House/Farmyard | 369872 | 5963113 | 45 |
| R21 | House/Farmyard | 368335 | 5964240 | 40 |
| R25 | House/Farmyard | 368326 | 5965508 | 40 |
| R26/27 | House/Farmyard | 364457 | 5960341 | 47 |
| R28 | House/Farmyard | 364883 | 5959319 | 40 |
| R29 | House/Farmyard | 364943 | 5959893 | 45 |
| R30 | House/Farmyard | 366566 | 5959343 | 40 |
| R31 | House/Farmyard | 368124 | 5959901 | 45 |
| R32 | House/Farmyard | 368169 | 5960050 | 45 |
| R88 | House/Farmyard | 369376 | 5961036 | 45 |
| R94 | House/Farmyard | 365627 | 5960298 | 45 |
| **Group 2 Receptors** | | | | |
| R1 | House/Farmyard | 370275 | 5960257 | 45 |
| R22 | House/Farmyard | 369731 | 5965243 | 45 |
| R33 | House/Farmyard | 369773 | 5960194 | 45 |
| R35 | House/Farmyard | 369842 | 5959053 | 40 |
| R36 | House/Farmyard | 371151 | 5959194 | 40 |
| R37 | House/Farmyard | 371355 | 5959756 | 40 |
| R38 | House/Farmyard | 371454 | 5959205 | 40 |
| R39/40 | House/Farmyard | 371728 | 5960095 | 45 |
| R41 | House/Farmyard | 372906 | 5960067 | 45 |
| R42 | House/Farmyard | 372967 | 5960587 | 40 |
| R43 | House/Farmyard | 373037 | 5961334 | 40 |
| R44 | House/Farmyard | 371572 | 5961490 | 40 |
| R45 | House/Farmyard | 371440 | 5962468 | 40 |
| R46 | House/Farmyard | 373055 | 5961967 | 40 |
| R47 | House/Farmyard | 371660 | 5962466 | 40 |
| R48 | House/Farmyard | 373113 | 5962465 | 40 |
| R49 | House/Farmyard | 371967 | 5963123 | 48 |
| R50 | House/Farmyard | 365585 | 5957062 | 40 |
| R51 | House/Farmyard | 368179 | 5958462 | 40 |
| R52 | House/Farmyard | 369689 | 5958576 | 40 |
| R53 | House/Farmyard | 368039 | 5957693 | 40 |
| R54 | House/Farmyard | 368020 | 5958047 | 40 |
| R55 | House/Farmyard | 366630 | 5958239 | 40 |
| R56 | House/Farmyard | 368057 | 5958605 | 40 |
| R57 | House/Farmyard | 366314 | 5958425 | 40 |
| R58 | House/Farmyard | 365291 | 5957189 | 40 |
| R59/95/96 | House/Farmyard | 364825 | 5958616 | 40 |
| R60 | House/Farmyard | 363072 | 5958305 | 40 |
| R61 | House/Farmyard | 369554 | 5959301 | 40 |
| R62 | House/Farmyard | 363936 | 5960424 | 47 |
| R63/68 | House/Farmyard | 371705 | 5965471 | 40 |
| R64 | House/Farmyard | 371440 | 5963472 | 45 |
| R65 | House/Farmyard | 371517 | 5964655 | 40 |
| R66 | House/Farmyard | 371505 | 5965582 | 40 |
| R67 | House/Farmyard | 371543 | 5966013 | 40 |
| R69 | House/Farmyard | 371672 | 5965528 | 40 |
| R70 | House/Farmyard | 371636 | 5966210 | 40 |
| R71 | House/Farmyard | 369963 | 5967577 | 45 |

| Receptor ID | Description | NAD 83 UTM Zone 12 | | PSL-Night (dBA) |
|---|---|---|---|---|
| | | Easting | Northing | |
| Group 2 Receptors (continued) | | | | |
| R72 | House/Farmyard | 370078 | 5966896 | 45 |
| R73 | House/Farmyard | 370041 | 5968315 | 45 |
| R74 | House/Farmyard | 368243 | 5966039 | 40 |
| R75 | House/Farmyard | 367868 | 5966756 | 40 |
| R76 | House/Farmyard | 368291 | 5966578 | 40 |
| R77 | House/Farmyard | 368345 | 5966376 | 40 |
| R78 | House/Farmyard | 369919 | 5966711 | 45 |
| R79 | House/Farmyard | 369764 | 5966800 | 45 |
| R80 | House/Farmyard | 369884 | 5966768 | 45 |
| R81 | House/Farmyard | 368311 | 5967597 | 40 |
| R82 | House/Farmyard | 368289 | 5967882 | 40 |
| R83 | House/Farmyard | 364602 | 5959099 | 40 |
| R84 | House/Farmyard | 368197 | 5959112 | 40 |
| R85 | House/Farmyard | 367310 | 5957015 | 40 |
| R86 | House/Farmyard | 371094 | 5966951 | 40 |
| R87 | House/Farmyard | 368882 | 5966738 | 40 |
| R93 | House/Farmyard | 368884 | 5966764 | 40 |
| R97 | House/Farmyard | 364794 | 5958821 | 40 |
| R98 | House/Farmyard | 363977 | 5958680 | 40 |

Notes: PSL = Permissible Sound Level
dBA = A-weighted decibels
R = Receptor
(M) = Location where a noise monitoring was conducted
UTM Zone 12




**Study Area**

NORTH AMERICAN OIL SANDS CORPORATION

| | |
|---|---|
| Approved: | Revision Date: Oct. 12/07 |
| File: Figure 3.2-1 Study Area.doc | |

| Drawn by: | Checked: | Fig. No.: |
|---|---|---|
| SB | BE | 3.2-1 |

# 3.3 Issues and Assessment Criteria

## 3.3.1 Noise Descriptors

Environmental noise levels from various sources (including industry, road traffic and rail traffic) 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 fluctuating sound. In addition, this energy averaged level is A-weighted to account for the reduced sensitivity of average human hearing to low-frequency sounds. These $L_{eq}$ in A-weighed decibels (dBA), which are the most common environmental noise measure, are often given for daytime (07:00 to 22:00) ($L_{eq}$Day) and nighttime (22:00 to 07:00) ($L_{eq}$Night), while other criteria use the entire 24-hour period ($L_{eq}$24).

Another method of conveying long-term noise levels uses statistical descriptors. These are calculated by taking a cumulative distribution of the sound levels over the entire measurement duration and then determining the sound level at X% of the time. In particular for this study, the $L_{90}$ (i.e., sound level that was sustained for 90% of the time) descriptor is used, since it is a good indicator of typical "steady-state" noise levels, irrespective of the effect of events of short duration such as vehicle pass-bys. Appendix 3A presents a more detailed description of the terminology used and the various methods of sound propagation. Appendix 3B presents a list of typical noise levels associated with various noise sources.

## 3.3.2 Environmental Noise Criteria

The document which most directly relates to the Permissible Sound Levels (PSLs) for this Project[1] is the Alberta Energy and Utilities Board (EUB) Directive 038: Noise Control (EUB, 2007). This directive sets the PSL at the receiver location based on population density and relative distances to heavily traveled road and rail, as shown in Table 3.3-1. In most instances, there is a Basic Sound Level (BSL) of 40 dBA for the nighttime and 50 dBA for the daytime. This BSL is then adjusted, according to Table 3.3-1, for each receptor to determine their individual PSL, as presented in Table 3.2-1 (PSL-Night values shown; PSL-Day values are 10 dBA higher). The result is that, while many of the receptors have a PSL of 40 dBA, some have a PSL of 45 dBA due to their proximity to either Highway 15 or Highway 830. In addition to the PSL values determined using Table 3.3-1, the Study Area falls within Alberta's Industrial Heartland. Noise levels associated with pre-existing facilities (EUB regulated and non-regulated) have resulted in the EUB allowing higher PSLs for some of the residents. These higher sound levels apply to receptors 11, 12, 13, 15, 16, 17, 26/27 and 62 (Table 3.2-1).

[1] There is a noise bylaw within Strathcona County; however, it does not contain specific allowable noise levels and is generally regarded as a nuisance bylaw. There is no noise bylaw in Lamont County.

## Table 3.3-1 Nighttime Basic Sound Levels (as per EUB Directive 038)

| | Dwelling Density per Quarter Section of Land | | |
|---|---|---|---|
| **Proximity to Transportation** | **1-8 Dwellings** | **9-160 Dwellings** | **>160 Dwellings** |
| Category 1 | 40 | 43 | 46 |
| Category 2 | 45 | 48 | 51 |
| Category 3 | 50 | 53 | 56 |

Category 1 — Dwelling units more than 500 m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers

Category 2 — Dwelling units more than 30 m but less than 500 m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers

Category 3 — Dwelling units less than 30 m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers

# 3.4 Methods

## 3.4.1 Baseline Measurement Methods

In order to determine the baseline noise levels in the LSA, a total of nine long-term noise monitoring events were conducted at various receptor locations, as outlined in Table 3.2-1 and Figure 3.2-1. The noise-monitoring events at each location varied in duration but, at a minimum, encompassed the entire nighttime and at least 12 daytime hours. Measurement data obtained included broadband A-weighted and C-weighted sound levels and 1/3 octave-band spectra in 5-second $L_{eq}$ sampling intervals. This allowed for a detailed analysis of the noise levels as well as the ability to determine the nighttime $L_{90}$ sound levels and obtain a measure of the industry related noise levels irrespective of traffic and other noises. In addition, simultaneous digital audio recordings were conducted at each of the monitoring sites for post-processing data adjustment in accordance with Directive 038 (e.g., removal of non-typical events such as dogs barking nearby). Finally, a portable meteorological station was used within the LSA on all measurement nights to obtain local weather data, including wind speed, wind direction, temperature and relative humidity. Appendix 3C provides a detailed list of the measurement equipment used.

## 3.4.2 Baseline Monitoring Locations

### 3.4.2.1 Monitor #1

Receptor #34 is located approximately 50 m east of Range Road 211 and 900 m north of Highway 15. The noise monitor was located approximately 30 m SE of the house. There were a few rows of trees surrounding the house and much of the yard. Thus, there was only partial line-of-sight to Range Road 211 and Highway 15 from the noise monitor location. The amount of vegetation, however, was not sufficient to result in a notable level of noise shielding. The noise monitor was started at 11:00 on Tuesday, March 13, 2007, and ran for 24 hours until 11:00 on Wednesday, March 14, 2007.

### 3.4.2.2 Monitor #2

Receptor #5 is located approximately 90 m south of Highway 15 and 350 m east of Range Road 210. The noise monitor was located approximately 15 m SE of the house in an open area adjacent to the driveway. There were trees between the house and Highway 15, blocking the line-of-sight from the house westward (and blocking the line-of-sight to the Project). However, there was direct line-of-sight to Highway 15 east of the house. The noise monitor was started at 11:45 on Tuesday, March 13, 2007, and ran for just under 24 hours until 11:27 on Wednesday, March 14, 2007, when it was shut down due to dog-barking noise.

#### 3.4.2.3 Monitor #3

Receptor #2 is located approximately 50 m east of Highway 830 and 2 km north of Highway 15. The noise monitor was located approximately 15 m SE of the house in an open area in the yard. There was direct line-of-sight from the house and noise monitor to Highway 830, as well as the Project location. The noise monitor was started at 12:30 on Tuesday, March 13, 2007, and ran for just under 24 hours until 12:00 on Wednesday, March 14, 2007, when it was shut down due to increasing wind noise.

#### 3.4.2.4 Monitor #4

Receptor #20 is located approximately 70 m east of Highway 830 and 600 m north of Township Road 560. The noise monitor was located approximately 15 m west of the house. There were several rows of trees, as well as the house and garage blocking line-of-sight to Highway 830, but there was partial line-of-sight to the Project boundary. The noise monitor was started at 13:15 on Tuesday, March 13, 2007, and ran for just under 23 hours until 12:00 on Wednesday, March 14, 2007, when it was shut down due to increasing wind noise.

#### 3.4.2.5 Monitor #5

Receptor #23 is located approximately 100 m east of Range Road 211 (400 m north of the Project boundary) and 1,200 m north of TWP RD 560. The resident could not be contacted to give permission to put the noise monitor on the property, so the noise monitor was located approximately 200 m SW of the house, adjacent to Range Road 211. At this location, there was direct line-of-sight to Range Road 211 and the nearby rail line, as well as the stack construction at the BA Energy Heartland Oil Sands Bitumen Upgrader to the west. There was no direct line-of-sight to the Project boundary due to thin rows of trees in between. The noise monitor was started at 15:00 on Thursday, March 22, 2007, and ran for 21.5 hours until 12:30 on Friday, March 23, 2007.

#### 3.4.2.6 Monitor #6

Receptor #24 (21162 TWP RD 560) is located approximately 100 m north TWP RD 560 and approximately 400 m east of RG RD 212 (400 m west of the Project boundary). The noise monitor was located approximately 20 m NW of the house in an open area within the yard. At this location there was partial line-of-sight to TWP RD 560, as well as direct line-of-sight to the Project location. The noise monitor was started at 15:00 on Thursday, March 22, 2007, and ran for 21.5 hours until 12:30 on Friday, March 23, 2007.

#### 3.4.2.7 Monitor #7

Receptor #14 is located approximately 60 m west of Range Road 212 and approximately 600 m south of Township Road 560. The noise monitor was located approximately 80 m west of the house near the back of the yard. The monitor was located here to ensure that it was not surrounded by the numerous buildings and other equipment in the yard. At this location there was no direct line-of-sight to any of the nearby roads, noise-producing facilities or the Project location. However, the noise monitor was located as close to the existing noise-producing facilities as possible while still being within the yard. The noise monitor was started at 15:00 on Thursday, March 22, 2007, and ran for 22 hours until 13:00 on Friday, March 23, 2007.

#### 3.4.2.8 Monitor #8

Receptor #17 is located approximately 100 m east of Range Road 213 and 100 m south of Township Road 560. The noise monitor was located approximately 40 m west of the house in an open area of the yard. At this location there was partial line-of-sight to Range Road 213 but none to the nearby existing facilities or the Project location. The noise monitor was started at 15:00 on Thursday, March 22, 2007, and ran for 22 hours until 13:00 on Friday, March 23, 2007.

#### 3.4.2.9 Monitor #9

Receptor #11 is located approximately 50 m east of Range Road 213 and 1 km north of Highway 15. The resident could not be contacted to give permission to put the noise monitor on the property, so the noise monitor was located approximately 400 m north of the house, approximately 7 m west of the centre line of Range Road 213. At this location there was direct line-of-sight to Range Road 213, and also to the house, the existing industrial facilities to the west and northwest, and east to the Project location. The noise monitor was started at 16:00 on Thursday, March 22, 2007, and ran for 22 hours until 14:00 on Friday, March 23, 2007.

#### 3.4.2.10 Weather Monitor

The same weather monitor location was used for both monitoring nights. The monitor was located just east of Range Road 211, approximately 400 m north of Highway 15. At this location the weather monitor was completely unobstructed by trees or structures. The weather monitor for the first monitoring night was started at 11:20 on Tuesday, March 13, 2007, and ran for almost 26 hours until 13:10 on Wednesday, March 14, 2007. The weather monitor for the second monitoring night was started at 14:00 on Thursday, March 22, 2007, and ran for 24 hours until 14:00 on Friday, March 23, 2007.

### 3.4.3 Modelling Methods

The computer noise modelling was conducted using the CADNA/A (version 3.6.119) software package. CADNA/A allows for the modelling of various noise sources such as road, rail and various stationary sources. In addition, topographical features such as land contours, vegetation and bodies of water can be included. Finally, meteorological conditions such as temperature, relative humidity, wind speed and wind direction can be included in the calculations.

The modelling was conducted using representative conditions and not using worst-case scenarios, as per Directive 038. As such, the calculation method used for noise propagation follows the International Standards Organization (ISO) Standard 9613 (ISO 1993 and 1996). All receiver locations were assumed to be downwind from the source(s). In particular, as stated in Section 5 of the ISO standard:

> "Downwind propagation conditions for the method specified in this part of IS0 9613 are as specified in 5.4.3.3 of IS0 1996-2:1987, namely
> - wind direction within an angle of ± 45° of the direction connecting the centre of the dominant sound source and the centre of the specified receiver region, with the wind blowing from source to receiver, and
> - wind speed between approximately 1 m/s and 5 m/s, measured at a height of 3 m to 11 m above the ground.
>
> The equations for calculating
>
> the average downwind sound pressure level LAT(DW) in this part of IS0 9613, including the equations for attenuation given in clause 7, are the average for

meteorological conditions within these limits. The term average here means the average over a short time interval, as defined in 3.1.

These equations also hold, equivalently, for average propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs on clear, calm nights."

The modelled temperature and relative humidity were 10°C and 70%, respectively. In addition, the ground absorption was assumed to be 0.8 (i.e., typical of summer vegetation conditions). As a result, all sound level propagation calculations for surrounding receptors match closely with those which would be present during typical summer conditions.

The computer noise modelling results were calculated in two ways. First, sound levels were calculated at specific receptor locations. Next, the sound levels were calculated using a 20 m × 20 m grid over the entire LSA. This provided colour noise contours for easier visualization of the results.

#### 3.4.3.1 Baseline Case

The baseline case models conditions present during the baseline noise measurements (in the absence of local traffic noise). This was done to provide a means of model calibration with the measured sound levels, as well as to provide a baseline case to which the future Project sound levels (and those of other approved and planned facilities) could be compared. Although the monitoring events were conducted during winter conditions (i.e., snow-covered ground and cold temperatures), the results are still valid as a means of model calibration. Typically, the noise levels will be slightly higher in winter due to more favorable sound propagation conditions. This will result in higher modelled sound levels for existing noise sources than may be present in summer modelling conditions. This provides slightly more conservative results than if the monitoring events were conducted in the summer. Sound sources incorporated into the model include:

- Agrium Products Fertilizer Plants;
- Provident (Williams) Redwater Fractionation and Storage Facility;
- Degussa Canada Gibbons Hydrogen Peroxide Manufacturing Plant;
- Shell Canada Scotford Complex and existing Upgrader 1;
- Gulf Chemical and Metallurgical Spent Catalyst Processing Facility; and
- Ambient adjustment based on noise monitoring results.

Appendix 3E presents a detailed list of the baseline case sound levels included in the model.

#### 3.4.3.2 Construction Case

The construction case includes the baseline conditions (i.e., existing industrial noise sources) with the construction activities of the Project, using generally accepted information provided in a published paper by Teplitzky and Wood (1978). Typical activities included in the model are:

- Earth-moving equipment;
- Cranes;

- Concrete-pouring equipment;
- Pile drivers; and
- Air compressors.

Appendix 3E provides a detailed list of the construction noise levels included in the model. The noise sources were lumped together as a single point source and located at the center of the main plant site. In addition to the site equipment, there will be an increase in traffic on nearby highways bringing supplies and personnel to the site.

### 3.4.3.3 Application Case

The application case includes the baseline conditions (i.e., existing industrial noise sources) with the operation of the Project.

After completion of construction, the next case modelled was typical operation of the Project without any other proposed noise sources. Information for site layout, building dimensions and equipment sound levels was used for all large noise-producing equipment associated with the Project. Engineering sound level mitigation controls are to be implemented for some of the equipment. Appendix 3E provides a detailed list of the site equipment, associated sound levels and proposed noise mitigation measures.

### 3.4.3.4 Cumulative Effects Cases

The cumulative effects cases include the following:

- **Approved and Proposed Facilities Case**, which models conditions present during the baseline case, as well as including noise sources from facilities already approved (and not yet operational), and also those which have submitted their applications to the regulatory authorities. Sound sources incorporated into the model include:
  - Baseline Case sound sources;
  - BA Energy Heartland Oil Sands Bitumen Upgrader;
  - Proposed Synenco Northern Lights Upgrader;
  - Proposed North West Upgrading Facility;
  - Proposed Petro-Canada Oil Sands Inc. Sturgeon Upgrader Facility; and
  - Proposed Shell Canada Scotford Upgrader Expansion 1 and Upgrader 2.

Appendix 3E provides a detailed list of the future baseline case sound levels included in the model. At the time of modelling, information was not available for the announcement of Total E&P Canada's Bitumen Upgrader.

- **Approved, Proposed and Application Case**, which models conditions present during the baseline case, the approved and proposed facilities and the Project. It is the noise levels determined from this case which will be compared to the EUB Directive 038, since noise from the Project is not to exceed the guidelines, with all other approved and proposed noise sources taken into account. As of the time of completing these model runs, there are no known proposed facilities in addition to those modelled in the approved, proposed and application case.

#### 3.4.3.5 Modelling Confidence

As mentioned previously, the algorithms used for the noise modelling follow the ISO 9613 standard. The published accuracy for this standard is ±3 dBA between 100 m and 1,000 m. Accuracy levels beyond 1,000 m are not published. Experience on similar noise models over large distances shows that, as expected, as the distance increases, the associated accuracy in prediction decreases. Environmental factors such as wind, temperature inversions, topography and ground cover all have increasing effects over distances larger than approximately 1,500 m. As such, for all receptors within approximately 1,500 m of the Project boundary, the prediction confidence is considered high, while for all receptors beyond 1,500 m, the prediction confidence is considered moderate. The noise mitigation measures proposed for the Project are designed to reduce the noise levels for the closest affected receptors to levels below the EUB Directive 038 guidelines. Thus, for receptors further away, the noise levels will be even lower. Therefore, the decreasing accuracy associated with the model will not be as important.

## 3.5 Existing Conditions

### 3.5.1 Baseline Measurement Results (Overall)

A summary of the monitoring results at all locations is provided in Table 3.5-1. The data presented show the adjusted $L_{eq}$Day and $L_{eq}$Night sound levels. The data have been adjusted in accordance with Directive 038 to remove non-typical noise events such as dogs barking near the monitor, abnormally loud vehicles very nearby, train passages, etc. Some of the $L_{eq}$Day results are "partial," in that a full 15 daytime hours were not obtained. In addition, the typical nighttime industry-related sound levels are shown, providing an indication of the typical steady-state noise levels, irrespective of events of short duration such as vehicle passages, airplane flyovers, etc. These are the sound levels that will be used as the baseline conditions calibration for the noise modelling.

**Table 3.5-1 Baseline Noise Monitoring Receptor Sound Levels**

| Receptor | $L_{eq}$24* (dBA) | $L_{eq}$Day* (dBA) | $L_{eq}$Night (dBA) | Nighttime Industry Noise Level (dBA) |
|---|---|---|---|---|
| #34 | 43.3 | 44.6 | 39.3 | 30.0 |
| #5 | 59.3 | 60.3 | 56.6 | 30.0 |
| #2 | 52.9 | 53.8 | 50.6 | 28.0 |
| #20 | 50.8 | 51.1 | 50.3 | 30.0 |
| #23 | 37.8 | 38.8 | 35.4 | 29.0 |
| #24 | 40.8 | 41.7 | 38.9 | 32.0 |
| #14 | 37.9 | 38.8 | 35.9 | 33.0 |
| #17 | 44.2 | 45.2 | 39.2 | 37.0 |
| #11 | 57.2 | 58.2 | 41.1 | 37.0 |

* Partial Values. Daytime not a full 15 hours

In general, the results are as expected, with the locations closer to the nearby highways resulting in higher sound levels. $L_{eq}$Night sound levels in the mid 30 dBA range are considered typical for rural locations further than 500 m from a highway. The typical industry noise levels were in the mid 30 dBA range. These were obtained upon review of the audio files and removed the strong influence of the morning commuter traffic increase.

The nighttime A-weighted 1/3 octave band sound levels show a typical traffic-dominated noise climate. There is a notable amount of energy in the mid bands near 1,000 Hz, resulting from tire noise. There is, however, a distinct tone at 63 Hz which emanates completely from industrial sources. This tone was observed at all other measurement locations which were not directly adjacent to a major highway. As expected, the tone was present throughout the entire monitoring period and was more pronounced during the quieter nighttime and early-morning hours when the other noise sources subsided.

## 3.5.2 Baseline Measurement Results (Specific Locations)

### 3.5.2.1 Monitor #1

The broadband A-weighted monitoring results at Noise Monitor #1 (Receptor #34) are shown in Appendix 3D, Figure 3D-1, while the nighttime A-weighted 1/3 octave band sound levels are shown in Appendix 3D, Figure 3D-2. The results show a typical trend of slightly decreasing sound levels during the evening and overnight, with an increase in the morning as local traffic volumes increase. A section of data from 02:00–06:00 on March 14 was removed due to high wind-generated noise. Upon review of the simultaneous digital audio recording, the subjectively dominant noise source for much of the monitoring was traffic on Highway 15, followed by the many vehicle passages on Range Road 211. The wind started out of the west, then shifted to the east in the early morning. As such, Highway 15 was perpendicular to the wind at all times, resulting in a negligible effect on road noise from the wind. Due to the wind direction, noise from existing facilities was observed at the start of the monitoring but not at the end of it. There were also several train passages on the CN rail line to the north. The nighttime noise levels prior to the morning commuter traffic increase were approximately 30 dBA. This is more indicative of the actual baseline (i.e., industry-related) sound levels and, as such, will be used for comparison purposes for the remainder of the evaluation.

### 3.5.2.2 Monitor #2

The broadband A-weighted monitoring results at Noise Monitor #2 (Receptor #5) are shown in Appendix 3D, Figure 3D-3, while the nighttime A-weighted 1/3 octave band sound levels are shown in Appendix 3D, Figure 3D-4. The results show a noise climate which is completely dominated by local traffic on Highway 15. The lower noise levels decrease during the evening and overnight, but the maximum sound levels remain consistently near 70 dBA. As with Monitor #1, a section of data from 02:00–06:00 on March 14 was removed due to high wind-generated noise. Also, as with Monitor #1, Highway 15 was perpendicular to the wind at all times. This, coupled with the relatively short distance to the road, resulted in a negligible effect on road noise from the wind. Noise from existing facilities was inaudible at all times due to the traffic noise. The nighttime noise levels during times of low traffic (not occurring very often) and prior to the moming commuter traffic increase were approximately 30 dBA. This is indicative of the actual baseline (i.e., industry-related) sound levels and, as such, will be used for comparison purposes for the remainder of the evaluation.

### 3.5.2.3 Monitor #3

The broadband A-weighted monitoring results at Noise Monitor #3 (Receptor #2) are shown in Appendix 3D, Figure 3D-5, while the nighttime A-weighted 1/3 octave band sound levels are shown in Appendix 3D, Figure 3D-6. The results show a noise climate which is completely dominated by local traffic on Highway 830. The lower noise levels decrease during the evening and overnight, but the maximum sound levels remain consistently near 65 dBA. As with monitoring events #1 and #2, a section of data from 02:00–06:00 on March 14 was removed due to high wind-generated noise. Although the wind was initially from the west and then shifted out of the east (i.e., monitor was downwind and then upwind), the relatively close distance to the road resulted in a negligible effect on road noise from the wind. Noise from existing facilities was audible in the early morning during rare times with low traffic. The nighttime noise levels during these times and prior to the morning commuter traffic increase were approximately 28 dBA.

This is indicative of the actual baseline (i.e., industry-related) sound levels and, as such, will be used for comparison purposes for the remainder of the evaluation.

#### 3.5.2.4 Monitor #4

The broadband A-weighted monitoring results at Noise Monitor #4 (Receptor #20) are shown in Appendix 3D, Figure 3D-7, while the nighttime A-weighted 1/3 octave band sound levels are shown in Appendix 3D, Figure 3D-8. Again, the results show a noise climate which is completely dominated by local traffic on Highway 830. The lower noise levels decrease slightly during the evening and overnight, but the maximum sound levels remain consistently near 65 dBA. Unlike the previous monitoring events on the same night, no data were removed due to the high wind. The location of the monitor provided shielding from wind-generated noise. However, it can be seen that there was an initial increase in the maximum sound levels when the wind was out of the west (i.e., monitor upwind from the road) to the end, when the wind was out of the east (i.e., monitor downwind of the road). Noise from existing facilities was audible in the early morning during rare times with low traffic. The nighttime noise levels during these times and prior to the morning commuter traffic increase were approximately 30 dBA. This is indicative of the actual baseline (i.e., industry-related) sound levels and, as such, will be used for comparison purposes for the remainder of the evaluation.

#### 3.5.2.5 Monitor #5

The broadband A-weighted monitoring results at Noise Monitor #5 (Receptor #23) are shown in Appendix 3D, Figure 3D-9, while the nighttime A-weighted 1/3 octave band sound levels are shown in Appendix 3D, Figure 3D-10. The results show a slight reduction in noise levels during the nighttime as distant traffic noise was reduced. Review of the audio revealed that traffic noise and low-frequency industrial noise were dominant during the daytime. During the nighttime there was very little audible, with just a slight impact from industry to the west. All of the peaks shown in Appendix 3D, Figure 3D-9 are the result of louder vehicles on Highway 830. The wind (starting from the west, then shifting to the southeast and south during the nighttime) did not appear to have an appreciable impact on the noise levels. Finally, the 63 Hz tone can be readily seen in Appendix 3D, Figure 3D-10. The nighttime noise levels during times of low distant traffic and prior to the morning commuter traffic increase were approximately 29 dBA. This is indicative of the actual baseline (i.e., industry-related) sound levels and, as such, will be used for comparison purposes for the remainder of the evaluation.

#### 3.5.2.6 Monitor #6

The broadband A-weighted monitoring results at Noise Monitor #6 (Receptor #24) are shown in Appendix 3D, Figure 3D-11, while the nighttime A-weighted 1/3 octave band sound levels are shown in Appendix 3D, Figure 3D-12. Site observations and review of the audio revealed that facility construction and operational noise was dominant during the daytime, while low-frequency operational noise was dominant during the nighttime. All of the short-duration peaks shown in Appendix 3D, Figure 3D-11 were caused by traffic on Township Road 560. In addition, there were several train horns and train passages noted. Again, the wind did not appear to have an appreciable impact on the noise levels. Finally, the 63 Hz tone can be readily seen in Appendix 3D, Figure 3D-12. The nighttime noise levels during times of low traffic and prior to the morning commuter traffic increase were approximately 32 dBA. This is indicative of the actual baseline (i.e., industry-related) sound levels and, as such, will be used for comparison purposes for the remainder of the evaluation.

### 3.5.2.7 Monitor #7

The broadband A-weighted monitoring results at Noise Monitor #7 (Receptor #14) are shown in Appendix 3D, Figure 3D-13, while the nighttime A-weighted 1/3 octave band sound levels are shown in Appendix 3D, Figure 3D-14. Site observations and review of the audio revealed that facility construction and operational noise was dominant during the daytime, while low-frequency operational noise was dominant during the nighttime. All of the short-duration peaks shown in Appendix 3D, Figure 3D-13 were caused by traffic on Range Road 212. In addition, there were several train horns and train passages noted. The ATCO plant to the south was inaudible at all times. Again, the wind did not appear to have an appreciable impact on the noise levels. Finally, the 63 Hz tone can be readily seen in Appendix 3D, Figure 3D-14. The nighttime noise levels during times of low traffic and prior to the morning commuter traffic increase were approximately 33 dBA. This is indicative of the actual baseline (i.e., industry-related) sound levels and, as such, will be used for comparison purposes for the remainder of the evaluation.

### 3.5.2.8 Monitor #8

The broadband A-weighted monitoring results at Noise Monitor #8 (Receptor #17) are shown in Appendix 3D, Figure 3D-15, while the nighttime A-weighted 1/3 octave band sound levels are shown in Appendix 3D, Figure 3D-16. Site observations and review of the audio revealed that facility construction and operational noise was dominant during the daytime, while low-frequency operation noise was dominant during the nighttime. All of the short-duration peaks shown in Appendix 3D, Figure 3D-15 were caused by traffic on either Range Road 213 or Township Road 560. Again, the wind did not appear to have an appreciable impact on the noise levels. Finally, the 63 Hz tone can be readily seen in Appendix 3D, Figure 3D-16. The nighttime noise levels during times of low traffic and prior to the morning commuter traffic increase were approximately 37 dBA. This matched the $L_{eq}$Night value and is very indicative of the actual baseline (i.e., industry-related) sound levels and, as such, will be used for comparison purposes for the remainder of the evaluation, as well as a good noise model calibration for noise from the Shell Canada Scotford Complex.

### 3.5.2.9 Monitor #9

The broadband A-weighted monitoring results at Noise Monitor #8 (Receptor #11) are shown in Appendix 3D, Figure 3D-17, while the nighttime A-weighted 1/3 octave band sound levels are shown in Appendix 3D, Figure 3D-18. Site observations and review of the audio revealed that facility construction and operational noise was dominant during the daytime, while low-frequency operation noise was dominant during the nighttime. All of the short-duration peaks shown in Appendix 3D, Figure 3D-17 were caused by traffic on either Range Road 213 or (to a much lesser extent) Highway 15. Again, the wind did not appear to have an appreciable impact on the noise levels. Finally, the 63 Hz tone can be seen in Appendix 3D, Figure 3D-18. The nighttime noise levels during times of low traffic and prior to the morning commuter traffic increase were approximately 37 dBA. This matched the $L_{eq}$Night value and is very indicative of the actual baseline (i.e., industry-related) sound levels and, as such, will be used for comparison purposes for the remainder of the evaluation, as well as a good noise model calibration for noise from the Shell Canada Scotford Complex and Gulf Chemical and Metallurgical Spent Catalyst Processing Facility.

### 3.5.2.10 Weather Monitoring

During noise-monitoring events #1–#4, the weather was initially clear, with a light west wind and a temperature of approximately -2°C. Overnight, the wind became reduced and shifted out of the east until about 01:00. After this point, the wind increased sharply and then reduced again at about 06:00. Upon takedown of equipment, the sky was clear, with a stiff east breeze and a temperature of approximately -10°C. Other than the 4-hour period between 02:00 and 06:00, when much of the noise-monitoring data were removed, at no other point during the nighttime was the weather considered to be in violation of the requirements specified in Directive 038 for the results obtained.

During noise-monitoring events #5–#9, the weather was initially clear, with a light west wind and a temperature of approximately 5°C. Overnight, the wind reduced slightly and became steady out of the southeast, while the temperature dropped to approximately -5°C. In the morning, the wind remained steady and shifted out of the south. At no point during the nighttime was the weather considered to be in violation of the requirements specified in Directive 038 for the results obtained.

Appendix 3F provides complete weather-monitoring data obtained on-site during the noise-monitoring events.

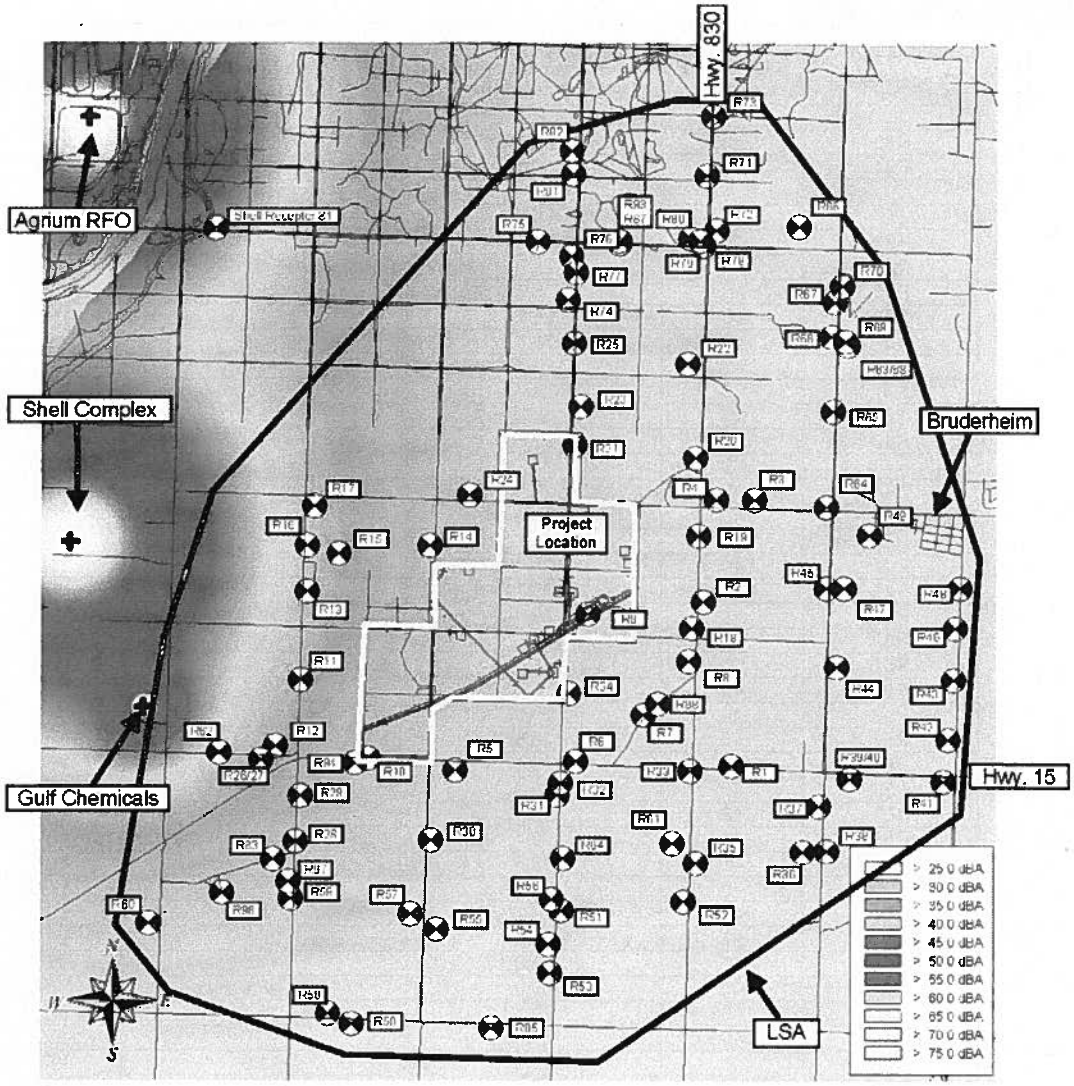
### 3.5.3 Baseline Case Noise Modelling Results

The results of the baseline case noise modelling are provided in Table 3.5-2 and Figure 3.5-1. The results match very well with those obtained during the baseline monitoring, and indicate that the current dominant industrial sources within the study area are associated with the Shell Canada Scotford Complex, the Gulf Chemical and Metallurgical Spent Catalyst Processing Facility and the Agrium Redwater Fertilizer Plant. All the baseline noise levels are well below the PSLs throughout the study area.

## Table 3.5-2 Baseline Case Noise Modelling Results

| Receptor ID | PSL-Night (dBA) | Baseline Nighttime Sound Level (dBA) | Baseline Night Minus PSL-Night (dBA) | Compliant |
|---|---|---|---|---|
| Group 1 Receptors | | | | |
| R34 | 40 | 29.4 | -10.6 | YES |
| R5 | 45 | 30.2 | -14.8 | YES |
| R2 | 45 | 29.2 | -15.8 | YES |
| R20 | 45 | 29.3 | -15.7 | YES |
| R23 | 40 | 29.8 | -10.2 | YES |
| R24 | 40 | 31.4 | -8.6 | YES |
| R14 | 40 | 32.2 | -7.8 | YES |
| R17 | 47 | 37.0 | -10.0 | YES |
| R11 | 47 | 36.1 | -10.9 | YES |
| R3 | 45 | 29.2 | -15.8 | YES |
| R4 | 45 | 29.3 | -15.7 | YES |
| R6 | 45 | 29.2 | -15.8 | YES |
| R7 | 45 | 29.1 | -15.9 | YES |
| R8 | 45 | 29.1 | -15.9 | YES |
| R9 | 45 | 29.5 | -15.5 | YES |
| R10 | 45 | 31.9 | -13.1 | YES |
| R12 | 47 | 35.5 | -11.5 | YES |
| R13 | 47 | 37.3 | -9.7 | YES |
| R15 | 47 | 35.7 | -11.3 | YES |
| R16 | 47 | 37.5 | -9.5 | YES |
| R18 | 45 | 29.2 | -15.8 | YES |
| R19 | 45 | 29.3 | -15.7 | YES |
| R21 | 40 | 29.8 | -10.2 | YES |
| R25 | 40 | 29.9 | -10.1 | YES |
| R26/27 | 47 | 35.7 | -11.3 | YES |
| R28 | 40 | 31.8 | -8.2 | YES |
| R29 | 45 | 33.0 | -12.0 | YES |
| R30 | 40 | 29.8 | -10.2 | YES |
| R31 | 45 | 29.1 | -15.9 | YES |
| R32 | 45 | 29.2 | -15.8 | YES |

| Receptor ID | PSL-Night (dBA) | Baseline Nighttime Sound Level (dBA) | Baseline Night Minus PSL-Night (dBA) | Compliant |
|---|---|---|---|---|
| **Group 1 Receptors (continued)** | | | | |
| R88 | 45 | 29.1 | -15.9 | YES |
| R94 | 45 | 32.1 | -12.9 | YES |
| **Group 2 Receptors** | | | | |
| R1 | 45 | 28.9 | -16.1 | YES |
| R22 | 45 | 29.4 | -15.6 | YES |
| R33 | 45 | 28.9 | -16.1 | YES |
| R35 | 40 | 28.7 | -11.3 | YES |
| R36 | 40 | 28.5 | -11.5 | YES |
| R37 | 40 | 28.6 | -11.4 | YES |
| R38 | 40 | 28.5 | -11.5 | YES |
| R39/40 | 45 | 28.7 | -16.3 | YES |
| R41 | 45 | 28.5 | -16.5 | YES |
| R42 | 40 | 28.6 | -11.4 | YES |
| R43 | 40 | 28.7 | -11.3 | YES |
| R44 | 40 | 28.9 | -11.1 | YES |
| R45 | 40 | 29.0 | -11.0 | YES |
| R46 | 40 | 28.7 | -11.3 | YES |
| R47 | 40 | 28.9 | -11.1 | YES |
| R48 | 40 | 28.7 | -11.3 | YES |
| R49 | 48 | 29.0 | -19.0 | YES |
| R50 | 40 | 28.5 | -11.5 | YES |
| R51 | 40 | 28.8 | -11.2 | YES |
| R52 | 40 | 28.5 | -11.5 | YES |
| R53 | 40 | 28.5 | -11.5 | YES |
| R54 | 40 | 28.6 | -11.4 | YES |
| R55 | 40 | 29.1 | -10.9 | YES |
| R56 | 40 | 28.9 | -11.1 | YES |
| R57 | 40 | 29.3 | -10.7 | YES |
| R58 | 40 | 28.7 | -11.3 | YES |
| R59/95/96 | 40 | 30.5 | -9.5 | YES |
| R60 | 40 | 31.1 | -8.9 | YES |
| R61 | 40 | 28.7 | -11.3 | YES |
| R62 | 47 | 38.6 | -8.4 | YES |
| R63/68 | 40 | 29.0 | -11.0 | YES |
| R64 | 45 | 29.0 | -16.0 | YES |
| R65 | 40 | 29.0 | -11.0 | YES |
| R66 | 40 | 29.0 | -11.0 | YES |
| R67 | 40 | 29.0 | -11.0 | YES |
| R69 | 40 | 29.0 | -11.0 | YES |
| R70 | 40 | 29.0 | -11.0 | YES |
| R71 | 45 | 29.2 | -15.8 | YES |
| R72 | 45 | 29.2 | -15.8 | YES |
| R73 | 45 | 29.0 | -16.0 | YES |
| R74 | 40 | 30.0 | -10.0 | YES |
| R75 | 40 | 30.3 | -9.7 | YES |
| R76 | 40 | 29.9 | -10.1 | YES |
| R77 | 40 | 29.9 | -10.1 | YES |
| R78 | 45 | 29.3 | -15.7 | YES |
| R79 | 45 | 29.3 | -15.7 | YES |
| R80 | 45 | 29.3 | -15.7 | YES |
| R81 | 40 | 29.9 | -10.1 | YES |
| R82 | 40 | 29.9 | -10.1 | YES |
| R83 | 40 | 31.8 | -8.2 | YES |
| R84 | 40 | 28.9 | -11.1 | YES |
| R85 | 40 | 28.3 | -11.7 | YES |
| R86 | 40 | 29.0 | -11.0 | YES |
| R87 | 40 | 29.6 | -10.4 | YES |
| R93 | 40 | 29.6 | -10.4 | YES |
| R97 | 40 | 30.9 | -9.1 | YES |
| R98 | 40 | 31.5 | -8.5 | YES |




| | | | |
|---|---|---|---|
| **Baseline Case Night-Time Noise Modelling Results** | NORTH AMERICAN OIL SANDS CORPORATION | | |
| | Approved: | Revision Date: October 22, 2007 | |
| | File: Figure 3.5-1 Baseline Case.doc | | |
| | Drawn by: SB | Checked: BE | Fig. No.: **3.5-1** |

# 3.6 Impact Assessment

## 3.6.1 Construction Case Modelling Results

The modelling results for the Construction Case are presented in Table 3.6-1 and Figure 3.6-1. Although not specifically applicable, the results have been compared to the PSL for each receptor. The noise levels at all receptors, except for R14 and R24 (residences), are below their PSLs. However, the nighttime noise levels at the two locations will only be slightly above 40 dBA, so the impact will be negligible.

The construction sound levels included in the model are based on published sound levels for equipment likely to be used in the construction of the Project. Actual equipment used on-site may differ from those modelled. In addition, the construction noise was modelled as a single continuous point source at the center of the plant site. Under actual conditions construction activity will vary in duration, amplitude of noise levels and location. This level of detail is impossible to model, since actual construction conditions are unknown. The results provided in Table 3.6-1 give a general overall impression of the anticipated noise levels. There will be times when the sound levels are well under the modelled values, and also times when the sound levels will be higher than those modelled. Section 3.7.3 provides construction noise mitigation recommendations.

### Table 3.6-1 Construction Case Noise Modelling Results

| Receptor ID | PSL-Night (dBA) | Construction Nighttime Sound Level (dBA) | Construction Minus Baseline Nighttime Sound Level (dBA) | Construction Night Minus PSL-Night (dBA) |
|---|---|---|---|---|
| Group 1 Receptors | | | | |
| R34 | 40 | 39.0 | 9.6 | -1.0 |
| R5 | 45 | 33.7 | 3.5 | -11.3 |
| R2 | 45 | 33.7 | 4.5 | -11.3 |
| R20 | 45 | 32.3 | 3.0 | -12.7 |
| R23 | 40 | 33.6 | 3.8 | -6.4 |
| R24 | 40 | 40.6 | 9.2 | 0.6 |
| R14 | 40 | 41.5 | 9.3 | 1.5 |
| R17 | 47 | 37.7 | 0.7 | -9.3 |
| R11 | 47 | 36.7 | 0.6 | -10.3 |
| R3 | 45 | 31.2 | 2.0 | -13.8 |
| R4 | 45 | 32.4 | 3.1 | -12.6 |
| R6 | 45 | 33.8 | 4.6 | -11.2 |
| R7 | 45 | 34.1 | 5.0 | -10.9 |
| R8 | 45 | 33.7 | 4.6 | -11.3 |
| R9 | 45 | 44.6 | 15.1 | -0.4 |
| R10 | 45 | 33.6 | 1.7 | -11.4 |
| R12 | 47 | 35.8 | 0.3 | -11.2 |
| R13 | 47 | 38.0 | 0.7 | -9.0 |
| R15 | 47 | 37.3 | 1.6 | -9.7 |
| R16 | 47 | 38.2 | 0.7 | -8.8 |
| R18 | 45 | 34.1 | 4.9 | -10.9 |
| R19 | 45 | 33.6 | 4.3 | -11.4 |
| R21 | 40 | 35.9 | 6.1 | -4.1 |
| R25 | 40 | 31.7 | 1.8 | -8.3 |
| R26/27 | 47 | 36.0 | 0.3 | -11.0 |
| R28 | 40 | 32.2 | 0.4 | -7.8 |
| R29 | 45 | 33.5 | 0.5 | -11.5 |
| R30 | 40 | 31.3 | 1.5 | -8.7 |
| R31 | 45 | 32.5 | 3.4 | -12.5 |
| R32 | 45 | 32.9 | 3.7 | -12.1 |
| R88 | 45 | 33.9 | 4.8 | -11.1 |
| R94 | 45 | 33.5 | 1.4 | -11.5 |

| Receptor ID | PSL-Night (dBA) | Construction Nighttime Sound Level (dBA) | Construction Minus Baseline Nighttime Sound Level (dBA) | Construction Night Minus PSL-Night (dBA) |
|---|---|---|---|---|
| Group 2 Receptors | | | | |
| R1 | 45 | 30.4 | 1.5 | -14.6 |
| R22 | 45 | 30.8 | 1.4 | -14.2 |
| R33 | 45 | 31.0 | 2.1 | -14.0 |
| R35 | 40 | 29.6 | 0.9 | -10.4 |
| R36 | 40 | 29.1 | 0.6 | -10.9 |
| R37 | 40 | 29.2 | 0.6 | -10.8 |
| R38 | 40 | 28.9 | 0.4 | -11.1 |
| R39/40 | 45 | 29.2 | 0.5 | -15.8 |
| R41 | 45 | 28.8 | 0.3 | -16.2 |
| R42 | 40 | 28.8 | 0.2 | -11.2 |
| R43 | 40 | 28.9 | 0.2 | -11.1 |
| R44 | 40 | 29.8 | 0.9 | -10.2 |
| R45 | 40 | 30.1 | 1.1 | -9.9 |
| R46 | 40 | 29.0 | 0.3 | -11.0 |
| R47 | 40 | 29.9 | 1.0 | -10.1 |
| R48 | 40 | 29.0 | 0.3 | -11.0 |
| R49 | 48 | 29.7 | 0.7 | -18.3 |
| R50 | 40 | 28.8 | 0.3 | -11.2 |
| R51 | 40 | 29.7 | 0.9 | -10.3 |
| R52 | 40 | 29.3 | 0.8 | -10.7 |
| R53 | 40 | 29.0 | 0.5 | -11.0 |
| R54 | 40 | 29.3 | 0.7 | -10.7 |
| R55 | 40 | 29.7 | 0.6 | -10.3 |
| R56 | 40 | 29.9 | 1.0 | -10.1 |
| R57 | 40 | 30.0 | 0.7 | -10.0 |
| R58 | 40 | 28.9 | 0.2 | -11.1 |
| R59/95/96 | 40 | 30.9 | 0.4 | -9.1 |
| R60 | 40 | 31.2 | 0.1 | -8.8 |
| R61 | 40 | 30.0 | 1.3 | -10.0 |
| R62 | 47 | 38.7 | 0.1 | -8.3 |
| R63/68 | 40 | 29.4 | 0.4 | -10.6 |
| R64 | 45 | 30.0 | 1.0 | -15.0 |
| R65 | 40 | 29.7 | 0.7 | -10.3 |
| R66 | 40 | 29.5 | 0.5 | -10.5 |
| R67 | 40 | 29.3 | 0.3 | -10.7 |
| R69 | 40 | 29.4 | 0.4 | -10.6 |
| R70 | 40 | 29.3 | 0.3 | -10.7 |
| R71 | 45 | 29.4 | 0.2 | -15.6 |
| R72 | 45 | 29.6 | 0.4 | -15.4 |
| R73 | 45 | 29.2 | 0.2 | -15.8 |
| R74 | 40 | 31.0 | 1.0 | -9.0 |
| R75 | 40 | 30.8 | 0.5 | -9.2 |
| R76 | 40 | 30.6 | 0.7 | -9.4 |
| R77 | 40 | 30.7 | 0.8 | -9.3 |
| R78 | 45 | 29.7 | 0.4 | -15.3 |
| R79 | 45 | 29.7 | 0.4 | -15.3 |
| R80 | 45 | 29.7 | 0.4 | -15.3 |
| R81 | 40 | 30.2 | 0.3 | -9.8 |
| R82 | 40 | 30.1 | 0.2 | -9.9 |
| R83 | 40 | 32.1 | 0.3 | -7.9 |
| R84 | 40 | 30.5 | 1.6 | -9.5 |
| R85 | 40 | 28.6 | 0.3 | -11.4 |
| R86 | 40 | 29.2 | 0.2 | -10.8 |
| R87 | 40 | 30.1 | 0.5 | -9.9 |
| R93 | 40 | 30.1 | 0.5 | -9.9 |
| R97 | 40 | 31.3 | 0.4 | -8.7 |
| R98 | 40 | 31.7 | 0.2 | -8.3 |

## 3.6.2 Application Case Modelling Results

The results of the Application Case noise modelling are provided in Table 3.6-2 and Figure 3.6-2. It can be seen that the noise levels at all receptor locations, with the baseline conditions and operation of the Project, are in compliance with their respective PSLs. This is due largely to the limitation imposed by North American on the equipment supply vendors that the noise levels not exceed a maximum of 85 dBA at a distance of 0.9 m. As indicated in Appendix 3E, this limitation will substantially lower the sound levels of most noise sources compared to the un-attenuated sound levels.

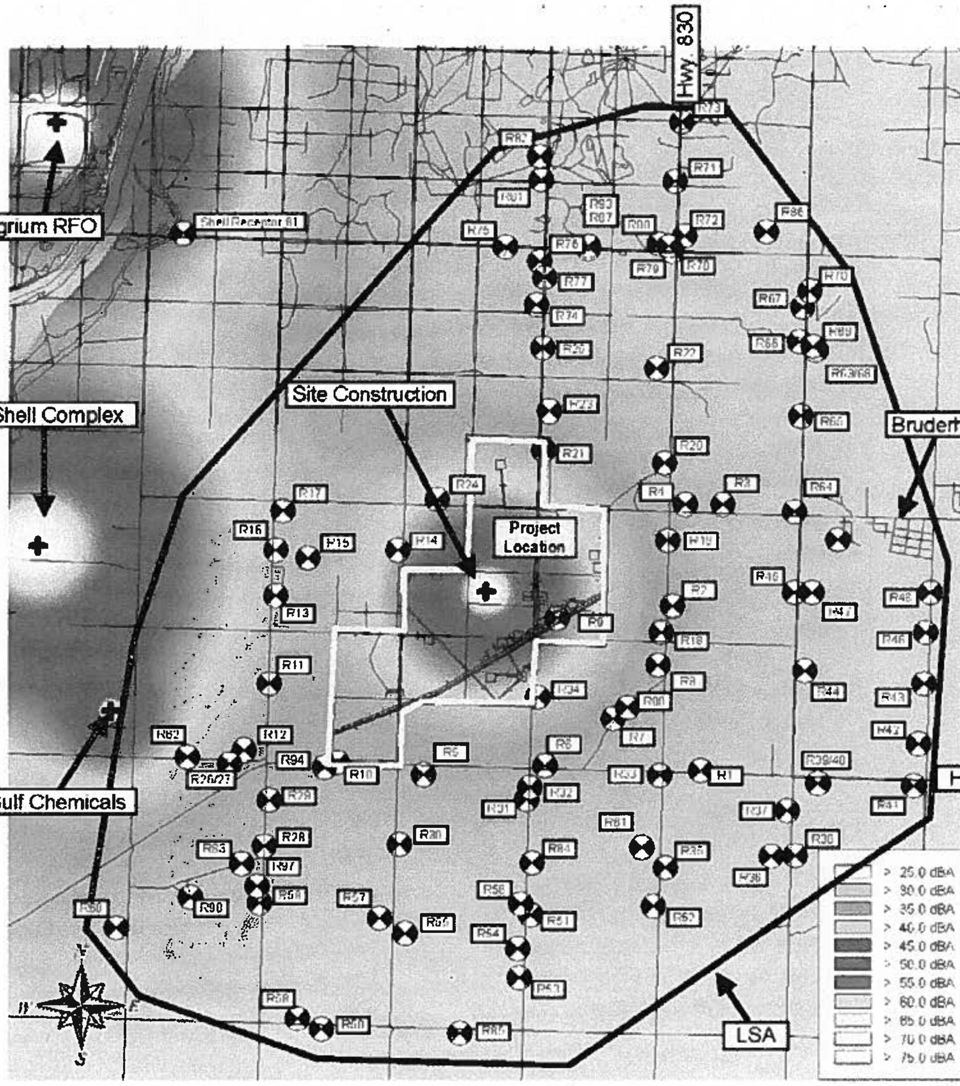
As expected, the largest increases in noise levels are at the receptors which are closest to the Project. Receptor R9 will experience the largest increase (12.6 dBA); however, this location is not a residence. Receptor R34, a vacant residential building, will experience an increase of approximately 7.0 dBA. This increase will be subjectively quite noticeable, although still well below the PSL.

Finally, the spectral analysis of the projected noise levels indicates that there will not be a strong low-frequency tonal component. Most of the noise sources are quite broadband in nature. The only sources with a strong low-frequency component are the heaters; however, these heaters are generally small and result in much lower sound levels than the other equipment.

### Table 3.6-2 Application Case Noise Modelling Results

| Receptor ID | PSL-Night (dBA) | Application Case Nighttime Sound Level (dBA) | Application Case Minus Baseline Nighttime Sound Level (dBA) | Application Case Night Minus PSL-Night (dBA) | Compliant |
|---|---|---|---|---|---|
| Group 1 Receptors | | | | | |
| R34 | 40 | 36.4 | 7.0 | -3.6 | YES |
| R5 | 45 | 33.2 | 3.0 | -11.8 | YES |
| R2 | 45 | 32.4 | 3.2 | -12.6 | YES |
| R20 | 45 | 31.4 | 2.1 | -13.6 | YES |
| R23 | 40 | 32.5 | 2.7 | -7.5 | YES |
| R24 | 40 | 37.2 | 5.8 | -2.8 | YES |
| R14 | 40 | 38.1 | 5.9 | -1.9 | YES |
| R17 | 47 | 37.4 | 0.4 | -9.6 | YES |
| R11 | 47 | 36.5 | 0.4 | -10.5 | YES |
| R3 | 45 | 30.7 | 1.5 | -14.3 | YES |
| R4 | 45 | 31.5 | 2.2 | -13.5 | YES |
| R6 | 45 | 32.3 | 3.1 | -12.7 | YES |
| R7 | 45 | 32.5 | 3.4 | -12.5 | YES |
| R8 | 45 | 32.3 | 3.2 | -12.7 | YES |
| R9 | 45 | 42.1 | 12.6 | -2.9 | YES |
| R10 | 45 | 33.3 | 1.4 | -11.7 | YES |
| R12 | 47 | 35.7 | 0.2 | -11.3 | YES |
| R13 | 47 | 37.7 | 0.4 | -9.3 | YES |
| R15 | 47 | 36.6 | 0.9 | -10.4 | YES |
| R16 | 47 | 37.9 | 0.4 | -9.1 | YES |
| R18 | 45 | 32.7 | 3.5 | -12.3 | YES |
| R19 | 45 | 32.4 | 3.1 | -12.6 | YES |
| R21 | 40 | 34.3 | 4.5 | -5.7 | YES |
| R25 | 40 | 31.1 | 1.2 | -8.9 | YES |
| R26/27 | 47 | 35.9 | 0.2 | -11.1 | YES |
| R28 | 40 | 32.2 | 0.4 | -7.8 | YES |
| R29 | 45 | 33.4 | 0.4 | -11.6 | YES |
| R30 | 40 | 31.0 | 1.2 | -9.0 | YES |
| R31 | 45 | 31.6 | 2.5 | -13.4 | YES |
| R32 | 45 | 31.8 | 2.6 | -13.2 | YES |
| R88 | 45 | 32.4 | 3.3 | -12.6 | YES |
| R94 | 45 | 33.2 | 1.1 | -11.8 | YES |

| Receptor ID | PSL-Night (dBA) | Application Case Nighttime Sound Level (dBA) | Application Case Minus Baseline Nighttime Sound Level (dBA) | Application Case Night Minus PSL-Night (dBA) | Compliant |
|---|---|---|---|---|---|
| Group 2 Receptors | | | | | |
| R1 | 45 | 30.0 | 1.1 | -15.0 | YES |
| R22 | 45 | 30.4 | 1.0 | -14.6 | YES |
| R33 | 45 | 30.4 | 1.5 | -14.6 | YES |
| R35 | 40 | 29.4 | 0.7 | -10.6 | YES |
| R36 | 40 | 29.0 | 0.5 | -11.0 | YES |
| R37 | 40 | 29.1 | 0.5 | -10.9 | YES |
| R38 | 40 | 28.9 | 0.4 | -11.1 | YES |
| R39/40 | 45 | 29.1 | 0.4 | -15.9 | YES |
| R41 | 45 | 28.8 | 0.3 | -16.2 | YES |
| R42 | 40 | 28.8 | 0.2 | -11.2 | YES |
| R43 | 40 | 28.9 | 0.2 | -11.1 | YES |
| R44 | 40 | 29.6 | 0.7 | -10.4 | YES |
| R45 | 40 | 29.8 | 0.8 | -10.2 | YES |
| R46 | 40 | 29.0 | 0.3 | -11.0 | YES |
| R47 | 40 | 29.7 | 0.8 | -10.3 | YES |
| R48 | 40 | 29.0 | 0.3 | -11.0 | YES |
| R49 | 48 | 29.5 | 0.5 | -18.5 | YES |
| R50 | 40 | 28.8 | 0.3 | -11.2 | YES |
| R51 | 40 | 29.5 | 0.7 | -10.5 | YES |
| R52 | 40 | 29.1 | 0.6 | -10.9 | YES |
| R53 | 40 | 28.9 | 0.4 | -11.1 | YES |
| R54 | 40 | 29.2 | 0.6 | -10.8 | YES |
| R55 | 40 | 29.6 | 0.5 | -10.4 | YES |
| R56 | 40 | 29.7 | 0.8 | -10.3 | YES |
| R57 | 40 | 29.9 | 0.6 | -10.1 | YES |
| R58 | 40 | 28.9 | 0.2 | -11.1 | YES |
| R59/95/96 | 40 | 30.8 | 0.3 | -9.2 | YES |
| R60 | 40 | 31.2 | 0.1 | -8.8 | YES |
| R61 | 40 | 29.7 | 1.0 | -10.3 | YES |
| R62 | 47 | 38.7 | 0.1 | -8.3 | YES |
| R63/68 | 40 | 29.4 | 0.4 | -10.6 | YES |
| R64 | 45 | 29.8 | 0.8 | -15.2 | YES |
| R65 | 40 | 29.6 | 0.6 | -10.4 | YES |
| R66 | 40 | 29.4 | 0.4 | -10.6 | YES |
| R67 | 40 | 29.3 | 0.3 | -10.7 | YES |
| R69 | 40 | 29.4 | 0.4 | -10.6 | YES |
| R70 | 40 | 29.2 | 0.2 | -10.8 | YES |
| R71 | 45 | 29.4 | 0.2 | -15.6 | YES |
| R72 | 45 | 29.6 | 0.4 | -15.4 | YES |
| R73 | 45 | 29.2 | 0.2 | -15.8 | YES |
| R74 | 40 | 30.7 | 0.7 | -9.3 | YES |
| R75 | 40 | 30.7 | 0.4 | -9.3 | YES |
| R76 | 40 | 30.5 | 0.6 | -9.5 | YES |
| R77 | 40 | 30.5 | 0.6 | -9.5 | YES |
| R78 | 45 | 29.7 | 0.4 | -15.3 | YES |
| R79 | 45 | 29.7 | 0.4 | -15.3 | YES |
| R80 | 45 | 29.6 | 0.3 | -15.4 | YES |
| R81 | 40 | 30.2 | 0.3 | -9.8 | YES |
| R82 | 40 | 30.1 | 0.2 | -9.9 | YES |
| R83 | 40 | 32.0 | 0.2 | -8.0 | YES |
| R84 | 40 | 30.1 | 1.2 | -9.9 | YES |
| R85 | 40 | 28.6 | 0.3 | -11.4 | YES |
| R86 | 40 | 29.2 | 0.2 | -10.8 | YES |
| R87 | 40 | 30.0 | 0.4 | -10.0 | YES |
| R93 | 40 | 30.0 | 0.4 | -10.0 | YES |
| R97 | 40 | 31.2 | 0.3 | -8.8 | YES |
| R98 | 40 | 31.7 | 0.2 | -8.3 | YES |

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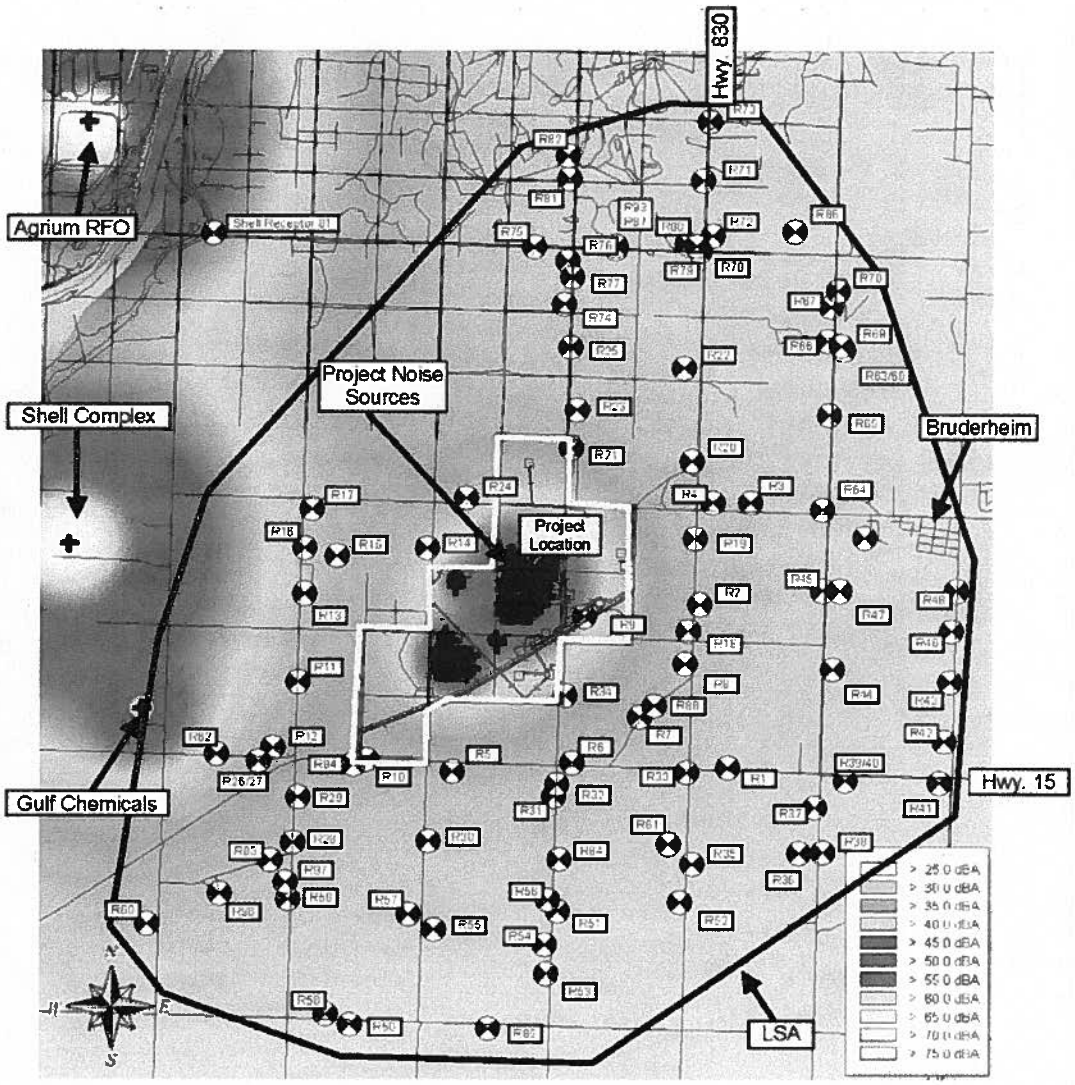
| **Construction Case Nighttime Noise Modelling Results** | Approved: | Revision Date: October 22, 2007 | |
| | File: Figure 3.6-1 Construction Case.doc | | |
| | Drawn by: SB | Checked: BE | Fig. No.: **3.6-1** |

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| **Application Case Nighttime Noise Modelling Results** | NORTH AMERICAN OIL SANDS CORPORATION | |
| | Approved: | Revision Date: October 22, 2007 |
| | File: Figure 3.6-2 Application Case.doc | |
| | Drawn by: SB · Checked: BE | Fig. No.: 3.6-2 |

# 3.7 Cumulative Effects Assessment and Mitigative Measures

## 3.7.1 Approved and Proposed Case Modelling Results

The results of the Approved and Proposed Case noise modelling are provided in Table 3.7-1 and Figure 3.7-1. The noise levels at all receptor locations are in compliance with their respective PSLs. There are, however, some locations which are at or very close to the limit. These include locations near the proposed Shell Canada Upgraders immediately west and northwest of the Project. As a result, there is very little room left to "add" to the noise climate for these receptors.

**Table 3.7-1 Approved and Proposed Case Noise Modelling Results**

| Receptor ID | PSL-Night (dBA) | Approved + Proposed Case Nighttime Sound Level (dBA) | Approved + Proposed Minus Baseline Nighttime Sound Level (dBA) | Approved + Proposed Case Night Minus PSL-Night (dBA) | Compliant |
|---|---|---|---|---|---|
| **Group 1 Receptors** | | | | | |
| R34 | 40 | 30.9 | 1.5 | -9.1 | YES |
| R5 | 45 | 32.6 | 2.4 | -12.4 | YES |
| R2 | 45 | 30.1 | 0.9 | -14.9 | YES |
| R20 | 45 | 30.5 | 1.2 | -14.5 | YES |
| R23 | 40 | 32.5 | 2.7 | -7.5 | YES |
| R24 | 40 | 36.4 | 5.0 | -3.6 | YES |
| R14 | 40 | 37.4 | 5.2 | -2.6 | YES |
| R17 | 47 | 45.0 | 8.0 | -2.0 | YES |
| R11 | 47 | 43.1 | 7.0 | -3.9 | YES |
| R3 | 45 | 30.1 | 0.9 | -14.9 | YES |
| R4 | 45 | 30.2 | 0.9 | -14.8 | YES |
| R6 | 45 | 30.3 | 1.1 | -14.7 | YES |
| R7 | 45 | 30.1 | 1.0 | -14.9 | YES |
| R8 | 45 | 30.0 | 0.9 | -15.0 | YES |
| R9 | 45 | 31.2 | 1.7 | -13.8 | YES |
| R10 | 45 | 35.4 | 3.5 | -9.6 | YES |
| R12 | 47 | 39.7 | 4.2 | -7.3 | YES |
| R13 | 47 | 47.0 | 9.7 | 0.0 | YES |
| R15 | 47 | 43.4 | 7.7 | -3.6 | YES |
| R16 | 47 | 46.7 | 9.2 | -0.3 | YES |
| R18 | 45 | 30.1 | 0.9 | -14.9 | YES |
| R19 | 45 | 30.3 | 1.0 | -14.7 | YES |
| R21 | 40 | 32.5 | 2.7 | -7.5 | YES |
| R25 | 40 | 32.8 | 2.9 | -7.2 | YES |
| R26/27 | 47 | 39.4 | 3.7 | -7.6 | YES |
| R28 | 40 | 34.3 | 2.5 | -5.7 | YES |
| R29 | 45 | 36.1 | 3.1 | -8.9 | YES |
| R30 | 40 | 31.8 | 2.0 | -8.2 | YES |
| R31 | 45 | 30.4 | 1.3 | -14.6 | YES |
| R32 | 45 | 30.3 | 1.1 | -14.7 | YES |
| R88 | 45 | 30.0 | 0.9 | -15.0 | YES |
| R94 | 45 | 35.7 | 3.6 | -9.3 | YES |
| **Group 2 Receptors** | | | | | |
| R1 | 45 | 29.4 | 0.5 | -15.6 | YES |
| R22 | 45 | 30.7 | 1.3 | -14.3 | YES |
| R33 | 45 | 29.5 | 0.6 | -15.5 | YES |
| R35 | 40 | 29.1 | 0.4 | -10.9 | YES |
| R36 | 40 | 28.9 | 0.4 | -11.1 | YES |
| R37 | 40 | 29.0 | 0.4 | -11.0 | YES |
| R38 | 40 | 28.9 | 0.4 | -11.1 | YES |
| R39/40 | 45 | 29.0 | 0.3 | -16.0 | YES |

| Receptor ID | PSL-Night (dBA) | Approved + Proposed Case Nighttime Sound Level (dBA) | Approved + Proposed Minus Baseline Nighttime Sound Level (dBA) | Approved + Proposed Case Night Minus PSL-Night (dBA) | Compliant |
|---|---|---|---|---|---|
| Group 2 Receptors (continued) | | | | | |
| R41 | 45 | 28.8 | 0.3 | -16.2 | YES |
| R42 | 40 | 28.9 | 0.3 | -11.1 | YES |
| R43 | 40 | 29.0 | 0.3 | -11.0 | YES |
| R44 | 40 | 29.3 | 0.4 | -10.7 | YES |
| R45 | 40 | 29.5 | 0.5 | -10.5 | YES |
| R46 | 40 | 29.0 | 0.3 | -11.0 | YES |
| R47 | 40 | 29.5 | 0.6 | -10.5 | YES |
| R48 | 40 | 29.1 | 0.4 | -10.9 | YES |
| R49 | 48 | 29.5 | 0.5 | -18.5 | YES |
| R50 | 40 | 29.5 | 1.0 | -10.5 | YES |
| R51 | 40 | 29.5 | 0.7 | -10.5 | YES |
| R52 | 40 | 29.0 | 0.5 | -11.0 | YES |
| R53 | 40 | 29.3 | 0.8 | -10.7 | YES |
| R54 | 40 | 29.5 | 0.9 | -10.5 | YES |
| R55 | 40 | 30.3 | 1.2 | -9.7 | YES |
| R56 | 40 | 29.8 | 0.9 | -10.2 | YES |
| R57 | 40 | 30.8 | 1.5 | -9.2 | YES |
| R58 | 40 | 29.8 | 1.1 | -10.2 | YES |
| R59/95/96 | 40 | 32.4 | 1.9 | -7.6 | YES |
| R60 | 40 | 32.6 | 1.5 | -7.4 | YES |
| R61 | 40 | 29.3 | 0.6 | -10.7 | YES |
| R62 | 47 | 41.4 | 2.8 | -5.6 | YES |
| R63/68 | 40 | 29.6 | 0.6 | -10.4 | YES |
| R64 | 45 | 29.7 | 0.7 | -15.3 | YES |
| R65 | 40 | 29.7 | 0.7 | -10.3 | YES |
| R66 | 40 | 29.7 | 0.7 | -10.3 | YES |
| R67 | 40 | 29.6 | 0.6 | -10.4 | YES |
| R69 | 40 | 29.6 | 0.6 | -10.4 | YES |
| R70 | 40 | 29.6 | 0.6 | -10.4 | YES |
| R71 | 45 | 30.1 | 0.9 | -14.9 | YES |
| R72 | 45 | 30.2 | 1.0 | -14.8 | YES |
| R73 | 45 | 29.9 | 0.9 | -15.1 | YES |
| R74 | 40 | 32.9 | 2.9 | -7.1 | YES |
| R75 | 40 | 33.5 | 3.2 | -6.5 | YES |
| R76 | 40 | 32.6 | 2.7 | -7.4 | YES |
| R77 | 40 | 32.6 | 2.7 | -7.4 | YES |
| R78 | 45 | 30.4 | 1.1 | -14.6 | YES |
| R79 | 45 | 30.5 | 1.2 | -14.5 | YES |
| R80 | 45 | 30.4 | 1.1 | -14.6 | YES |
| R81 | 40 | 31.9 | 2.0 | -8.1 | YES |
| R82 | 40 | 31.7 | 1.8 | -8.3 | YES |
| R83 | 40 | 34.0 | 2.2 | -6.0 | YES |
| R84 | 40 | 29.8 | 0.9 | -10.2 | YES |
| R85 | 40 | 29.0 | 0.7 | -11.0 | YES |
| R86 | 40 | 29.7 | 0.7 | -10.3 | YES |
| R87 | 40 | 31.4 | 1.8 | -8.6 | YES |
| R93 | 40 | 31.4 | 1.8 | -8.6 | YES |
| R97 | 40 | 33.0 | 2.1 | -7.0 | YES |
| R98 | 40 | 33.3 | 1.8 | -6.7 | YES |

### 3.7.2 Approved, Proposed and Application Case Modelling Results

The results of the Approved, Proposed and Application Case noise modelling are provided in Table 3.7-2 and Figure 3.7-2. The noise levels at all receptor locations are in compliance with their respective PSLs. Most of the receptors will see only minimal increases relative to the Approved and Proposed Case (approximately ½ of the Group 1 receptors and all of the Group 2 receptors). The largest increases will be for those receptors relatively near the Project but still far east enough that there is a lesser impact from the proposed Shell Canada Upgraders (Scotford Upgrader Expansion 1 and Scotford Upgrader 2).

The modelling indicates sound levels which are at or very near the PSLs for several of the receptors. The modelling was conducted under "representative" summertime environmental conditions (i.e., mild downwind from all sources to all receptors, as well as highly absorptive ground cover). There will be times at which atmospheric conditions and/or more reflective ground conditions will result in sound levels in excess of the PSLs for some receptors. These occasional occurrences do not mean noncompliance according to Directive 038.

## Table 3.7-2 Approved, Proposed and Application Case Noise Modelling Results

| Receptor ID | PSL-Night (dBA) | Approved + Proposed + Application Case Nighttime Sound Level (dBA) | Approved + Proposed + Application Minus Approved + Proposed Nighttime Sound Level (dBA) | Approved + Proposed + Application Case Night Minus PSL-Night (dBA) | Compliant |
|---|---|---|---|---|---|
| Group 1 Receptors | | | | | |
| R34 | 40 | 36.8 | 5.9 | -3.2 | YES |
| R5 | 45 | 34.6 | 2.0 | -10.4 | YES |
| R2 | 45 | 32.8 | 2.7 | -12.2 | YES |
| R20 | 45 | 32.2 | 1.7 | -12.8 | YES |
| R23 | 40 | 34.2 | 1.7 | -5.8 | YES |
| R24 | 40 | 39.2 | 2.8 | -0.8 | YES |
| R14 | 40 | 39.9 | 2.5 | -0.1 | YES |
| R17 | 47 | 45.1 | 0.1 | -1.9 | YES |
| R11 | 47 | 43.2 | 0.1 | -3.8 | YES |
| R3 | 45 | 31.3 | 1.2 | -13.7 | YES |
| R4 | 45 | 32.1 | 1.9 | -12.9 | YES |
| R6 | 45 | 32.9 | 2.6 | -12.1 | YES |
| R7 | 45 | 33.0 | 2.9 | -12.0 | YES |
| R8 | 45 | 32.7 | 2.7 | -12.3 | YES |
| R9 | 45 | 42.2 | 11.0 | -2.8 | YES |
| R10 | 45 | 36.1 | 0.7 | -8.9 | YES |
| R12 | 47 | 39.8 | 0.1 | -7.2 | YES |
| R13 | 47 | 47.0 | 0.0 | 0.0 | YES |
| R15 | 47 | 43.6 | 0.2 | -3.4 | YES |
| R16 | 47 | 46.8 | 0.1 | -0.2 | YES |
| R18 | 45 | 33.1 | 3.0 | -11.9 | YES |
| R19 | 45 | 32.9 | 2.6 | -12.1 | YES |
| R21 | 40 | 35.4 | 2.9 | -4.6 | YES |
| R25 | 40 | 33.5 | 0.7 | -6.5 | YES |
| R26/27 | 47 | 39.5 | 0.1 | -7.5 | YES |
| R28 | 40 | 34.5 | 0.2 | -5.5 | YES |
| R29 | 45 | 36.3 | 0.2 | -8.7 | YES |
| R30 | 40 | 32.5 | 0.7 | -7.5 | YES |
| R31 | 45 | 32.3 | 1.9 | -12.7 | YES |
| R32 | 45 | 32.4 | 2.1 | -12.6 | YES |
| R88 | 45 | 32.8 | 2.8 | -12.2 | YES |
| R94 | 45 | 36.2 | 0.5 | -8.8 | YES |
| Group 2 Receptors | | | | | |
| R1 | 45 | 30.4 | 1.0 | -14.6 | YES |
| R22 | 45 | 31.5 | 0.8 | -13.5 | YES |
| R33 | 45 | 30.9 | 1.4 | -14.1 | YES |
| R35 | 40 | 29.8 | 0.7 | -10.2 | YES |
| R36 | 40 | 29.3 | 0.4 | -10.7 | YES |
| R37 | 40 | 29.5 | 0.5 | -10.5 | YES |
| R38 | 40 | 29.2 | 0.3 | -10.8 | YES |
| R39/40 | 45 | 29.5 | 0.5 | -15.5 | YES |
| R41 | 45 | 29.0 | 0.2 | -16.0 | YES |

| Receptor ID | PSL-Night (dBA) | Approved + Proposed + Application Case Nighttime Sound Level (dBA) | Approved + Proposed + Application Minus Approved + Proposed Nighttime Sound Level (dBA) | Approved + Proposed + Application Case Night Minus PSL-Night (dBA) | Compliant |
|---|---|---|---|---|---|
| Group 2 Receptors (continued) | | | | | |
| R42 | 40 | 29.1 | 0.2 | -10.9 | YES |
| R43 | 40 | 29.2 | 0.2 | -10.8 | YES |
| R44 | 40 | 30.0 | 0.7 | -10.0 | YES |
| R45 | 40 | 30.3 | 0.8 | -9.7 | YES |
| R46 | 40 | 29.3 | 0.3 | -10.7 | YES |
| R47 | 40 | 30.1 | 0.6 | -9.9 | YES |
| R48 | 40 | 29.3 | 0.2 | -10.7 | YES |
| R49 | 48 | 30.0 | 0.5 | -18.0 | YES |
| R50 | 40 | 29.7 | 0.2 | -10.3 | YES |
| R51 | 40 | 30.2 | 0.7 | -9.8 | YES |
| R52 | 40 | 29.5 | 0.5 | -10.5 | YES |
| R53 | 40 | 29.6 | 0.3 | -10.4 | YES |
| R54 | 40 | 30.0 | 0.5 | -10.0 | YES |
| R55 | 40 | 30.7 | 0.4 | -9.3 | YES |
| R56 | 40 | 30.5 | 0.7 | -9.5 | YES |
| R57 | 40 | 31.2 | 0.4 | -8.8 | YES |
| R58 | 40 | 29.9 | 0.1 | -10.1 | YES |
| R59/95/96 | 40 | 32.6 | 0.2 | -7.4 | YES |
| R60 | 40 | 32.6 | 0.0 | -7.4 | YES |
| R61 | 40 | 30.1 | 0.8 | -9.9 | YES |
| R62 | 47 | 41.5 | 0.1 | -5.5 | YES |
| R63/68 | 40 | 29.9 | 0.3 | -10.1 | YES |
| R64 | 45 | 30.3 | 0.6 | -14.7 | YES |
| R65 | 40 | 30.1 | 0.4 | -9.9 | YES |
| R66 | 40 | 30.0 | 0.3 | -10.0 | YES |
| R67 | 40 | 29.9 | 0.3 | -10.1 | YES |
| R69 | 40 | 29.9 | 0.3 | -10.1 | YES |
| R70 | 40 | 29.8 | 0.2 | -10.2 | YES |
| R71 | 45 | 30.3 | 0.2 | -14.7 | YES |
| R72 | 45 | 30.5 | 0.3 | -14.5 | YES |
| R73 | 45 | 30.0 | 0.1 | -15.0 | YES |
| R74 | 40 | 33.3 | 0.4 | -6.7 | YES |
| R75 | 40 | 33.7 | 0.2 | -6.3 | YES |
| R76 | 40 | 32.9 | 0.3 | -7.1 | YES |
| R77 | 40 | 32.9 | 0.3 | -7.1 | YES |
| R78 | 45 | 30.7 | 0.3 | -14.3 | YES |
| R79 | 45 | 30.8 | 0.3 | -14.2 | YES |
| R80 | 45 | 30.7 | 0.3 | -14.3 | YES |
| R81 | 40 | 32.0 | 0.1 | -8.0 | YES |
| R82 | 40 | 31.9 | 0.2 | -8.1 | YES |
| R83 | 40 | 34.1 | 0.1 | -5.9 | YES |
| R84 | 40 | 30.8 | 1.0 | -9.2 | YES |
| R85 | 40 | 29.3 | 0.3 | -10.7 | YES |
| R86 | 40 | 29.9 | 0.2 | -10.1 | YES |
| R87 | 40 | 31.7 | 0.3 | -8.3 | YES |
| R93 | 40 | 31.7 | 0.3 | -8.3 | YES |
| R97 | 40 | 33.1 | 0.1 | -6.9 | YES |
| R98 | 40 | 33.4 | 0.1 | -6.6 | YES |

## 3.7.3 Mitigation

### 3.7.3.1 Construction Noise

Although there are no specific construction noise level limits detailed by Directive 038, there are general recommendations for construction noise mitigation. The document states:

> "While Directive 038 is not applicable to construction noise, licensees should attempt to take the following reasonable mitigating measures to reduce the impact on nearby dwellings of construction noise from new facilities or modifications to existing facilities. Licensees should:
>
> - Limit construction activity to the hours of between 07:00 and 22:00 to reduce the potential impact of construction noise.
> - Advise nearby residents of significant noise-causing activities and schedule these to create the least disruption to neighbours.
> - Ensure all internal combustion engines are fitted with appropriate muffler systems.
> - Take advantage of acoustical screening from existing on-site buildings to shield residential locations from construction equipment noise.
> - Where possible, schedule steam blow downs and venting to the daytime period of between 07:00 and 22:00 hours.
>
> Should a complaint be made during construction, the licensee will be expected to respond expeditiously and take appropriate action to ensure that the issue has been managed responsibly."

Further to the information listed above, if construction activities are scheduled between the hours of 22:00–07:00, they should be limited as much as possible to "quiet" operations.

North American is committed to the implementation of the above recommendation set out in Directive 038.

### 3.7.3.2 Transportation Noise

During construction and regular operation activities at the Project, most material deliveries will be made during the hours of 07:00–22:00. While the movement of heavy loads during nighttime will increase the nighttime sound levels, the duration will be short and frequency relatively low. Large dimensional heavy loads requiring specific traffic control measures will be limited to nighttime (01:00–5:00), and will be announced to the community. As such, the noise associated with them is not typically the source of noise complaints.

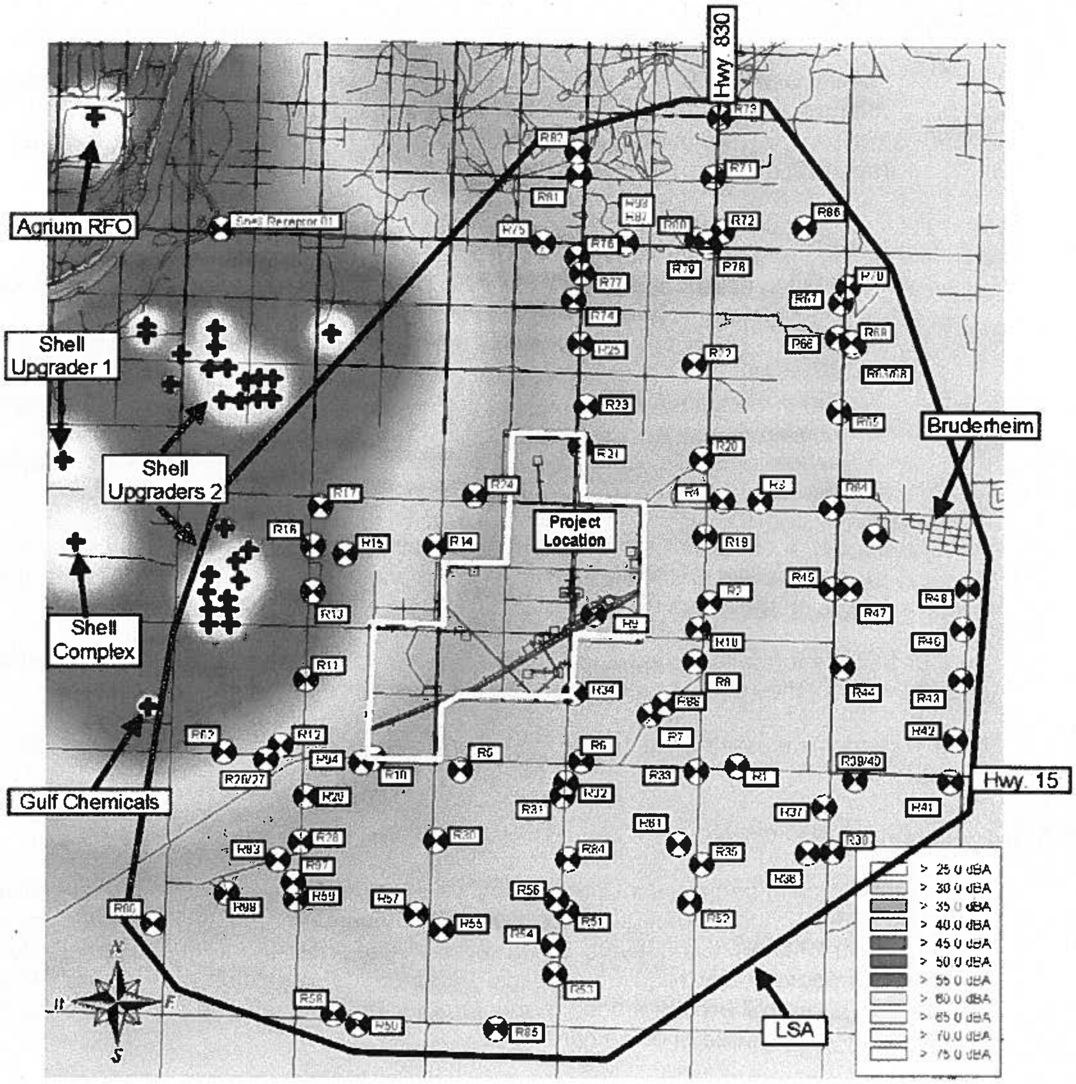
### 3.7.3.3 Flaring Noise

For non-emergency situations, flaring activity will be scheduled between the hours of 07:00–20:00. Group 1 residents will also be notified prior to any scheduled major flaring activity.

### 3.7.3.4 Additional Recommendations

The site-specific noise level information in Appendix 3E provides the approximate level of noise mitigation required by the equipment suppliers to meet the North American requirement of 85 dBA at 0.9 m. Given the already high noise levels in the area from industrial sources and the increases as a result of approved and proposed facilities, and the relatively minimal increases associated with the Project (except at receptors located immediately adjacent to the Project), there is no notable improvement which would be realized with additional mitigation on the Project stationary noise sources.

Notwithstanding the aforementioned statement, North American will reduce noise during planned events, such as start-up and shutdown, by use of silencers on steam-venting systems and attempt to schedule noise events during daytime. In addition, North American's commissioning and start-up plans will be tailored to the sensitivity of the residents.

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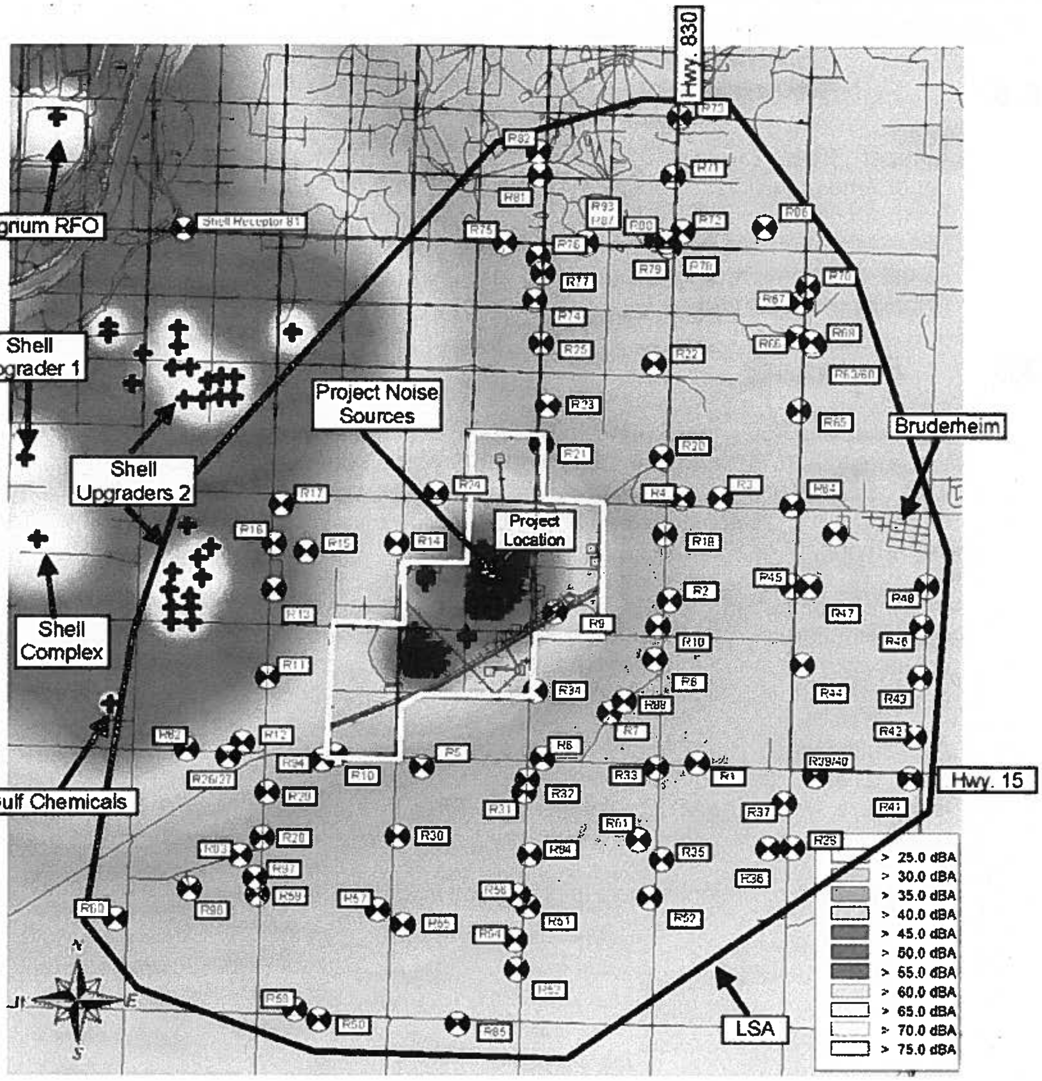
| | Approved: | Revision Date: October 22, 2007 |
| | File: Figure 3.7-1 Approved Proposed Case.doc | |
| | Drawn by: SB | Checked: BE |
| | Fig. No.: 3.7-1 | |




**Approved, Proposed, and Application Case Nighttime Noise Modelling Results**

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|---|---|
| Approved: | Revision Date: October 22, 2007 |
| File: Figure 3.7-2 Approved Proposed Application.doc | |

| Drawn by: | Checked: | Fig. No.: |
|---|---|---|
| SB | BE | 3.7-2 |

## 3.8 Follow-up and Monitoring

As per EUB Directive 038, there are no follow-up noise measurements required by North American unless a complaint is lodged with either the EUB or North American. However, North American will actively participate in the Northeast Capital Industrial Association (NCIA) Noise Management Plan. As a participant, North American will conduct ongoing assessments of its noise mitigation program and maintain best practices and continuous improvement programs in facility noise control.

## 3.9 Summary

The baseline noise monitoring indicated that there are currently relatively high noise levels for those residents near the existing industrial noise sources. The dominant noise sources in the area are associated with the industrial facilities as well as the local highways. The noise modelling of the baseline conditions indicated results similar to those obtained from the baseline noise monitorings.

Project construction noise is likely to be within acceptable limits due to the existing noise levels and mitigation measures to be utilized by North American. There will be times, however, when construction-related activities result in subjectively noticeable noise levels for the adjacent residents. Efforts will be undertaken to minimize these impacts.

Application case noise levels resulted in low increases for most surrounding residents. Only those directly near the Project will experience medium noise level increases. All projected sound levels are within the EUB Directive 038 PSLs. Cumulative noise levels with all existing and proposed nearby facilities, as well as the Project, will be at or under the PSLs at all receptors.

The summary of project effects is presented in Table 3.9-1.

## Table 3.9-1 Summary of Project Effects

| Receptors | Type of Impact or Effect | Nature of Potential Impact or Effect | Mitigation / Protection Plan | Geographical Extent [1] | Magnitude [2] | Duration [3] | Frequency [4] | Reversibility [5] | Confidence Rating [6] | Final Impact Rating |
|---|---|---|---|---|---|---|---|---|---|---|
| Within 1,500 m | Construction | Noise Disturbance | Activity Times Restricted | Local | Medium | Short-term | Occasional | Reversible in Short-term | High | Low |
| Within 1,500 m | Operation Project | Noise Disturbance | Noise Source Mitigation | Local | Medium | Long-term | Continuous | Reversible in Short-term | High | Medium |
| Greater than 1,500 m | Construction | Noise Disturbance | Activity Times Restricted | Local | Low | Short-term | Occasional | Reversible in Short-term | High | Low |
| Greater than 1,500 m | Operation Project | Noise Disturbance | Noise Source Mitigation | Local | Low | Long-term | Continuous | Reversible in Short-term | High | Low |

1. Local, Regional, Extra-regional
2. Nil (less than 1 dBA increase), Low (1-5 dBA increase) , Medium (6-10 dBA increase), High (greater than 10 dBA increase)
3. Short, Long, Extended, Residual
4. Continuous, Isolated, Periodic, Occasional, Accidental, Seasonal
5. Reversible in Short-Term, Reversible in Long-Term, Irreversible - rare
6. Low, Moderate, High

## 3.10 Literature Cited

ACI Acoustical Consultants Inc. 2006. Environmental Noise Survey and Computer Modelling for Northern Lights Upgrader Project. Prepared for Northern Lights Partnership.

Alberta Energy and Utilities Board (EUB). 2007. Directive 038: Noise Control. Calgary, Alberta. Revised February 16, 2007.

BA Energy Inc. 2004. Application for Approval of the Heartland Upgrader Project. Volume 2, Environmental Impact Assessment. Submitted to Alberta Environment and Alberta Energy and Utilities Board. May 2004.

Environment Canada (EC). 1989. Environmental Codes of Practice for Steam Electric Power Generation – Construction Phase. Report EPS 1/PG/3.\

HFP Acoustical Consultants Corp. 2001. Facility Noise Model and Noise Source Order Ranking for the Agrium Redwater Fertilizer Plant. Prepared for Agrium Inc.

HFP Acoustical Consultants Corp. 2006. North West Upgrading Inc. North West Upgrader Project Noise Impact Assessment: Part 1 – Impact Assessment: Part 2 – Baseline Noise Survey. Prepared for North West Upgrading Inc.

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Teplitzky, Allan M. and Eric W. Wood. 1978. Power Plant Construction Noise Emissions, Internoise '78 Conference Proceedings. Pages 279–284.

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## TABLES

**FIGURES**

## APPENDICES

**Golder Associates Ltd.**
**102, 2535 - 3rd Avenue S.E.**
**Calgary, Alberta, T2A 7W5**
**Canada**
**T: +1 (403) 299 5600**

Golder Associates

**<u>Aux Sable Canada</u>**

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, including the Procedure/Practice/Standard reference.<br><br>Note, if you have not provided an electronic copy of your site plan to NCIA, please do so. | Aux Sable continues to follow 2014 Noise Management Plan |
| Attach results of any monitoring/assessments (fence line outward) completed in 2014.<br><br>Note, you are not required to conduct any off-site monitoring, however if you did, please provide those results electronically to NCIA. | No sound monitoring was completed in 2014. As noted in 2013 comments; most recent sound survey was a “fenceline outward” and a residence noise monitoring/assessments conducted from September 20 to October 5, 2012 to satisfy a noise assessment for a future development project.<br>Attached is the Aux Sable Canada Comprehensive Sound Survey completed by Patching Associates Acoustical Engineering Ltd. on September 20 – October 5, 2012 for this study |
| Disclose any improvements/corrective actions implemented in 2014 or status thereof that would impact the noise level output for your site (either up or down).<br><br>Did those changes result in a requirement to update your site noise model?<br><br>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<br><br>No changes in 2014; no update done<br><br>With no changes in 2014 ; please reference existing 2012 report submitted |

| | |
|---|---|
| Disclose any improvements/projects that are approved for 2015 that would impact the noise level output for your site (either up or down).<br><br>Will these changes result in a requirement to update your site noise model?<br><br>If so, when do you anticipate having an updated site model available? | Installation of a new pump in the Plant will take place in 2015. A review of the Noise model will take place with the installation. No change in noise is to take place with the new pump |
| Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan. | As noted in 2013; a detailed occupational Noise map of the facility with doors open and closed were completed in September 2012 and submitted in 2013 for industrial Hygenie purposes. With no changes made in 2014 and no issues from site personel were tabled/reported in 2014 |
| Provide a Noise Complaint summary for all noise complaints received in 2014 including any actions taken to address them. | Aux Sable has had zero noise complaints in 2014. |

This information is being collected as per the NMP Standard 2010-003 Document, section 5.4. 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 14-Apr-14 | Rev. 2 |

**Insert your Company Name here:** Chemtrade

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, including the Procedure/Practice/Standard reference.<br><br>Note, if you have not provided an electronic copy of your site plan to NCIA, please do so. | Both Fort Saskatchewan facilities (CSC and Sulphides) have implemented a management program to address environmental noise as per NCIA Noise Management Plan Standard 2010-001. |
| Attach results of any monitoring/assessments (fence line outward) completed in 2014.<br><br>Note, you are not required to conduct any off-site monitoring, however if you did, please provide those results electronically to NCIA. | A report was submitted via email in December of 2015 by Chemtrade's EHS Supervisor Karl Peet. |
| Disclose any improvements/corrective actions implemented in 2014 or status thereof that would impact the noise level output for your site (either up or down).<br><br>Did those changes result in a requirement to update your site noise model?<br><br>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 changes that would impact the noise level have been made in 2014. |

| | |
|---|---|
| Disclose any improvements/projects that are approved for 2015 that would impact the noise level output for your site (either up or down).<br><br>Will these changes result in a requirement to update your site noise model?<br><br>If so, when do you anticipate having an updated site model available? | Not applicable |
| Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan. | Submitted via email on September 28, 2015 |
| Provide a Noise Complaint summary for all noise complaints received in 2014 including any actions taken to address them. | No complaints have been received in 2014. |

This information is being collected as per the NMP Standard 2010-003 Document, section 5.4. 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.

CHEMTRADE

NCIA office, Fort Saskatchewan
#204 9902-102 Street
Fort Saskatchewan, AB
Attn.: Dr. Laurie J. Danielson, P. Chem.
Executive Director, Northeast Capital Industrial Association

September 23, 2015

**RE: Annual self-assessment of Chemtrade's Environmental Noise Management program for the Fort Saskatchewan CSC and Sulphides sites**

As per Chemtrade's Environmental Noise Monitoring and Control Procedure CHE-FSK-ESH-001, Jon Stevens (Plant Manager) and Kathryn Dragowska (EHS Supervisor) have performed an annual self-assessment of our program. The following items have been examined and corrective actions have been noted below:

**Items examined:**

1. Noise survey results from 2014
2. Review of any noise complaints and their follow-up
3. Review of worker training records (TLM)
4. Review of capital projects and changes made which may impact environmental noise from either facility
5. General review of the procedure

**Corrective actions required:**

| Page | Section | Item | Target date | PPR | Progress |
|---|---|---|---|---|---|
| 3 | 5.2.1 | Sound level meter to be calibrated by the instrument manufacturer or an authorized instrument calibration facility. | 12/15/2015 | K. Dragowska | In progress |
| 5 | 6.0 | Ensure all employees at the CSC and Sulphides sites complete the noise monitoring module on the Chemtrade Total Learning Management system. | 12/30/2015 | K.Dragowska | |

End of corrective actions.

If there are any questions concerning this assessment, please contact Kathryn Dragowska at (780) 288-3984.

Yours truly,

Jon Stevens
Plant Manager

Kathryn Dragowska
EH&S Supervisor

**Dow Chemical Canada ULC**
Bag 16, Highway 15
Fort Saskatchewan, Alberta
T8L 2P4, Canada

August 27, 2015

Northeast Capital Industrial Association
Laurie Danielson, Executive Director
#204, 9902 - 102 Street
Fort Saskatchewan, AB T8L 2C3

Dear Dr. Danielson,

**Subject: 2014 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 Inc. (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 - 998 - 5720 if you require any further information or clarification.

Yours truly,

Mike Dziarmaga, P. Eng.
Responsible Care Leader
Dow Alberta Operations

Copy: Pravind Ramdial, Responsible Care Leader MEGlobal Canada Inc.

Dow Fort Saskatchewan Site
2014 Noise Management Annual Report
Prepared for Northeast Capital Industrial Association (NCIA)

This report provides Dow and MEGlobal's 2014 input to the NCIA Regional Noise Management Plan report to be submitted to the AER in September 2015. 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-10, revised 14-Apr-14, 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. This plan was last updated in 2014 and has been reviewed with no changes in 2015. A copy of the most recent version is included with this report.<br><br>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 / assessments (fenceline outward) completed in 2014.*<br><br>*Note, you are not required to conduct any off-site monitoring, however if you did, please provide those results electronically to NCIA.* | No noise monitoring (fenceline outward) was completed in 2014. The site noise model was updated in 2014 for all sources (other than on-site transportation) within the Dow Fort Saskatchewan Site, including MEGlobal.<br><br>Recent updates to the Dow site model have been incorporated into the NCIA regional noise model. |
| *Disclose any improvements/corrective actions implemented in 2014 or status thereof that would impact the noise level output for your site (either up or down).*<br><br>*Did those changes result in a requirement to update your site noise model?*<br><br>*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.<br><br>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. |
| *Disclose any improvements/projects that are approved for 2015 that would impact the noise level output for your site (either up or down).*<br><br>*Will these changes result in a requirement to update your site noise model?*<br><br>*If so, when do you anticipate having an updated site model available?* | In 2015, 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-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.* | 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 conducted in November 2014 by the site leader. No actions or gaps were identified related to the Noise Management Plan.<br><br>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.<br><br>As a follow-up to the audit, Dow committed to evaluate whether on-site transportation is a significant cumulative noise source from the Dow site. A review of the 2014 field monitoring conducted by NCIA shows that field monitoring at two of the three locations near the Dow site correlates very well with the model predictions (locations 2 and 9). Field measurements at the third location were lower than model predictions (location 10). Based on this, the current model adequately predicts noise from the Dow site and on-site transportation is not a significant cumulative noise source. Dow will continue to review field monitoring versus model predictions in the future. |
| *Provide a Noise Complaint summary for all noise complaints received in 2014 including any actions taken to address them.* | There were no noise complaints in 2014 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 Inc. (MEGlobal) Operations on the Dow Fort Saskatchewan Site follows 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 MyLearning), which includes environmental noise.
- Noise exposed workers receive MyLearning training on hearing conservation.
- Personnel conducting noise monitoring receive training from the Industrial Hygiene specialists.
- Personnel delivering unit industrial hygiene programs receive MyLearning training on these programs.

| | |
|---|---|
| **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.<br><br>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.<br><br>Dow has a current Noise Model prepared by HFP Acoustical Consultants Corp 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.<br><br>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.<br><br>Dow responds to external noise complaints appropriately, including monitoring if necessary.<br><br>Dispatch Noise Complaint Procedure<br>EH&S On-Call Noise Complaint Procedure<br>EH&S On-Call Noise Complaint Logsheet<br><br>Individual production units do their own noise surveys at least every five years, or when equipment is added, modified or removed.<br><br>The onsite noise monitoring program is managed as per in ODMS 06.05.C14<br><br>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.<br><br>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.<br><br>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.<br><br>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 |

**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. |

**Enbridge Pipelines**

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, including the Procedure/Practice/Standard reference.<br><br>Note, if you have not provided an electronic copy of your site plan to NCIA, please do so. | N/A |
| Attach results of any monitoring/assessments (fence line outward) completed in 2014.<br><br>Note, you are not required to conduct any off-site monitoring, however if you did, please provide those results electronically to NCIA. | Not required to conduct any noise survey and Enbridge did not conduct any noise survey in 2014. |
| Disclose any improvements/corrective actions implemented in 2014 or status thereof that would impact the noise level output for your site (either up or down).<br><br>Did those changes result in a requirement to update your site noise model?<br><br>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? | Nothing changed in Enbridge's facility in 2014. |

| | |
|---|---|
| Disclose any improvements/projects that are approved for 2015 that would impact the noise level output for your site (either up or down).<br><br>Will these changes result in a requirement to update your site noise model?<br><br>If so, when do you anticipate having an updated site model available? | N/A |
| Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan. | N/A |
| Provide a Noise Complaint summary for all noise complaints received in 2014 including any actions taken to address them. | No complaint. |

This information is being collected as per the NMP Standard 2010-003 Document, section 5.4. 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.

aci Acoustical Consultants Inc.
5031 – 210 Street
Edmonton, Alberta, Canada T6M 0A8
Phone: (780) 414-6373
www.aciacoustical.com

To: Enbridge Pipelines (Athabasca) Inc.
10130 - 103 Street NW
Edmonton, Alberta
T5J 3N9

October 24, 2014

**Attn: Suzie Poirier**

**re: Site Sound Level Measurements at Stonefell Station**

Dear Suzie,

Please find attached the results of the site sound level measurements conducted at the Enbridge Stonefell Station (LSD 01-09-56-21-W4M), in accordance with the requirements of the Northeast Capital Industrial Association (NCIA) Regional Noise Management Plan (RNMP). We trust the information provided is sufficient; if there are further questions, please contact us. Thank you for retaining aci for this work.

Yours very truly,
**aci Acoustical Consultants Inc.**,

Steven Bilawchuk, M.Sc., P.Eng.
Principal Partner
APEGA Permit to Practice # P7735

## INTRODUCTION

aci Acoustical Consultants Inc. was retained by Enbridge Pipelines (Athabasca) Inc. (Enbridge) to conduct sound level measurements at the Stonefell Station (the Station) located within the Alberta Industrial Heartland at LSD 01-09-56-21-W4M. The purpose was to obtain the sound levels at various fence-line and interior locations while the Station was operating normally. The sound level measurement methods and reporting comply with the Enbridge document entitled "*Noise Management Plan For The Stonefell Station*, Enbridge Pipelines (Athabasca) Inc., February 27, 2014". Site work was conducted for aci by S. Bilawchuk, M.Sc., P.Eng., on October 21, 2014.

## MEASUREMENT METHODS

As part of the project, sound level measurements were conducted at various locations at the Station. As indicated in Figure 1, the sound level measurements were conducted near the operational Mainline Pump #3, near the variable frequency drive (VFD) building ventilation fans, and at various Station fence-line locations. Sound level measurements were not specifically conducted adjacent to the electrical substation or the electrical services building (ESB) because, relative to the sound level contribution from the Mainline Pumps and the VFD ventilation fans, the sound level contribution from the substation and the ESB is insignificant and cannot be accurately measured due to contamination from the other noise sources. The sound level measurements were conducted using a Brüel and Kjær Type 2250 Precision Integrating Sound Level Meter with an external windscreen. At each location, the sound level meter acquired data for a minimum 30-second $L_{eq}$ samples using 1/3 octave band frequency analysis and overall A-weighted and C-weighted sound levels. Refer to Appendix I for a detailed description of the measurement equipment used, along with calibration information. During the sound level measurements, the microphone was located approximately 1.5 m above ground and pointed in the direction of the noise source.

## MEASUREMENT RESULTS

The measured sound pressure levels are provided in Table 1 and in Figure 1. In addition, the detailed 1/3 octave band results are provided in Appendix II. For most locations, the sound level measurements were conducted twice. During the first round (locations 1 - 21), the Station was operating with the Mainline Pump Building Ventilation Fans turned off. During the second round (locations 22 - 40), the Station was operating with one of each of the east and west Mainline Pump Building Ventilation Fans turned on. The operational conditions for the Station were as follows:

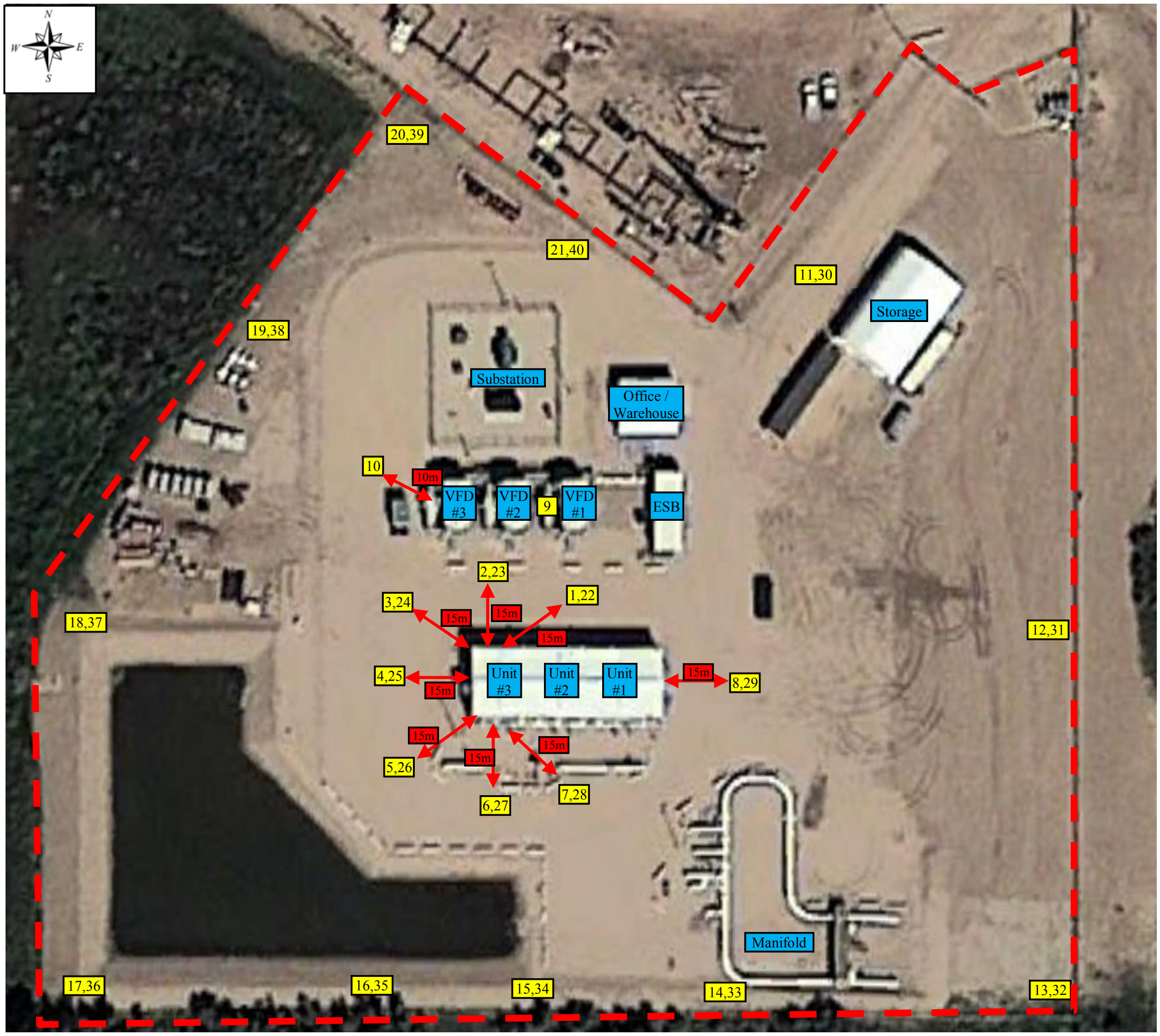
- Mainline Pump #3 (6,000 HP) operating at 93% capacity.
- Mainline Pump #2 (6,000 HP) Off.
- Mainline Pump #1 (6,000 HP) Off.
- VFD Ventilation Fans for Units #1, #2, #3 operating
- Mainline Pump Building Ventilation Fans (off/on)

Operations personnel on site confirmed that the Station was operating normally and that the most common operational condition was to have only one Mainline Pump running.

The weather conditions during the sound level measurements were clear with a light west wind (5 - 10 km/hr), a temperature of approximately $12^0$C, and a relative humidity of approximately 40%. The sound level measurements were conducted in Fall conditions with no snow and no foliage on the adjacent trees. The weather conditions adhere to the requirements of Section 4.2.3 of the Enbridge Noise Management Plan for the Stonefell Station.

## Table 1. Sound Level Measurement Results (dBA, dBC, and Octave Bands)

| Operational Description | Location No. | Location Description | Distance From Noise Source (m) | dBA | dBC | 31.5 Hz | 63 Hz | 125 Hz | 250 Hz | 500 Hz | 1 kHz | 2 kHz | 4 kHz | 8 kHz |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mainline Pump #3 Running, Mainline Pump #1 #2 Off **Building Vent Fans Off** All VFD Fans Running | 1 | Northeast of Unit 3 Mainline Pump North Louvers | 15 | 64.0 | 74.3 | 69.3 | 69.8 | 70.1 | 63.5 | 60.2 | 56.7 | 58.6 | 47.0 | 39.7 |
| | 2 | North of Unit 3 Mainline Pump North Louvers | 15 | 66.5 | 78.5 | 72.7 | 75.7 | 73.3 | 67.9 | 61.9 | 59.3 | 60.9 | 47.8 | 40.9 |
| | 3 | Northwest of Mainline Pump Building | 15 | 63.6 | 75.1 | 71.3 | 69.9 | 71.1 | 64.8 | 60.4 | 55.0 | 58.5 | 44.0 | 36.1 |
| | 4 | West of Mainline Pump Building | 15 | 56.2 | 71.5 | 71.0 | 66.8 | 64.5 | 58.7 | 54.2 | 48.2 | 46.5 | 36.8 | 30.5 |
| | 5 | Southwest of Mainline Pump Building | 15 | 58.9 | 72.1 | 72.1 | 67.0 | 64.4 | 56.4 | 57.8 | 53.4 | 51.1 | 42.3 | 35.7 |
| | 6 | South of Mainline Pump Building | 15 | 63.7 | 73.2 | 72.5 | 68.0 | 65.2 | 59.8 | 61.2 | 58.4 | 57.7 | 46.1 | 40.8 |
| | 7 | Southeast of Unit 3 Mainline Pump North Louvers | 15 | 65.3 | 73.7 | 72.7 | 67.0 | 66.7 | 60.5 | 65.3 | 57.8 | 58.4 | 47.1 | 40.7 |
| | 8 | East of Mainline Pump Building | 15 | 52.8 | 71.1 | 71.0 | 66.5 | 64.2 | 53.0 | 51.2 | 44.2 | 42.0 | 33.7 | 25.4 |
| | 9 | Adjacent to Unit #1 VFD Fan | 1 | 75.8 | 84.3 | 81.5 | 77.7 | 79.0 | 75.1 | 74.1 | 70.1 | 67.4 | 62.9 | 56.2 |
| | 10 | Northwest of Unit #3 VFD Fan | 10 | 60.8 | 73.9 | 72.1 | 70.2 | 67.9 | 57.6 | 58.3 | 54.9 | 53.0 | 48.9 | 42.9 |
| | 11 | Northeast Fenceline Area | 70 | 48.0 | 66.0 | 65.1 | 63.1 | 57.5 | 49.4 | 45.6 | 39.7 | 39.5 | 27.2 | 17.7 |
| | 12 | East Fenceline | 67 | 49.9 | 67.3 | 66.4 | 64.5 | 57.7 | 54.5 | 45.9 | 43.0 | 39.6 | 28.6 | 18.4 |
| | 13 | Southeast Fenceline | 85 | 49.8 | 67.8 | 66.7 | 65.5 | 57.2 | 49.6 | 45.8 | 46.5 | 39.0 | 28.7 | 19.0 |
| | 14 | South Fenceline Adjacent to Pipe Mainfold | 50 | 53.7 | 68.8 | 67.4 | 66.6 | 59.0 | 49.8 | 50.4 | 47.7 | 48.3 | 36.8 | 26.9 |
| | 15 | South Fenceline Directly South of Concrete Parking Barrier | 48 | 56.1 | 69.3 | 68.5 | 66.5 | 57.4 | 50.4 | 55.4 | 50.6 | 48.0 | 36.6 | 29.5 |
| | 16 | South Fenceline | 50 | 55.0 | 67.9 | 66.5 | 65.3 | 58.3 | 52.5 | 53.0 | 49.6 | 48.1 | 37.2 | 28.6 |
| | 17 | Southwest Fenceline | 85 | 49.4 | 66.9 | 65.4 | 64.6 | 58.2 | 46.2 | 47.0 | 43.6 | 40.8 | 31.5 | 21.2 |
| | 18 | West Fenceline (northwest corner of Pond) | 70 | 48.9 | 68.1 | 67.6 | 65.4 | 57.5 | 49.4 | 48.2 | 41.3 | 36.1 | 29.0 | 19.3 |
| | 19 | Northwest Fenceline | 65 | 53.7 | 67.5 | 66.1 | 63.4 | 60.7 | 55.6 | 51.3 | 45.8 | 46.1 | 38.3 | 30.5 |
| | 20 | Northwest Fenceline | 95 | 47.2 | 64.0 | 64.1 | 58.9 | 57.3 | 44.8 | 44.1 | 41.2 | 38.7 | 28.7 | 20.3 |
| | 21 | North Fenceline | 70 | 48.6 | 65.3 | 63.6 | 61.0 | 60.6 | 46.6 | 44.6 | 41.0 | 40.0 | 29.3 | 19.2 |
| | | | | | | | | | | | | | | |
| Mainline Pump #3 Running, Mainline Pump #1 #2 Off **Building Vent Fans On** All VFD Fans Running | 22 | Northeast of Unit 3 Mainline Pump North Louvers | 15 | 72.7 | 80.0 | 68.6 | 74.7 | 73.4 | 74.4 | 72.2 | 67.4 | 61.7 | 51.5 | 47.0 |
| | 23 | North of Unit 3 Mainline Pump North Louvers | 15 | 71.1 | 80.6 | 72.1 | 74.2 | 75.5 | 76.1 | 67.0 | 64.4 | 62.1 | 50.1 | 43.5 |
| | 24 | Northwest of Mainline Pump Building | 15 | 72.6 | 79.9 | 69.8 | 72.4 | 74.9 | 73.8 | 72.6 | 65.6 | 61.9 | 53.1 | 48.6 |
| | 25 | West of Mainline Pump Building | 15 | 74.4 | 80.2 | 67.0 | 72.4 | 71.8 | 75.0 | 75.2 | 68.7 | 60.1 | 55.7 | 51.7 |
| | 26 | Southwest of Mainline Pump Building | 15 | 73.1 | 79.6 | 66.7 | 75.9 | 70.6 | 70.1 | 74.7 | 67.0 | 59.9 | 53.9 | 49.5 |
| | 27 | South of Mainline Pump Building | 15 | 69.4 | 77.2 | 64.4 | 73.5 | 71.0 | 69.6 | 69.3 | 63.5 | 59.6 | 49.6 | 43.9 |
| | 28 | Southeast of Unit 3 Mainline Pump North Louvers | 15 | 71.0 | 79.3 | 65.0 | 77.3 | 69.5 | 71.7 | 70.8 | 64.4 | 61.7 | 51.1 | 44.6 |
| | 29 | East of Mainline Pump Building | 15 | 75.0 | 80.4 | 65.8 | 71.4 | 74.2 | 71.6 | 76.9 | 67.6 | 60.4 | 56.4 | 53.6 |
| | 30 | Northeast Fenceline Area | 70 | 57.3 | 67.1 | 61.6 | 62.5 | 60.8 | 61.2 | 54.9 | 50.3 | 47.0 | 41.7 | 33.0 |
| | 31 | East Fenceline | 67 | 60.7 | 69.9 | 62.3 | 60.6 | 65.5 | 65.7 | 57.7 | 54.0 | 48.8 | 42.1 | 36.0 |
| | 32 | Southeast Fenceline | 85 | 58.9 | 68.9 | 64.2 | 64.3 | 63.0 | 62.4 | 52.6 | 55.6 | 46.3 | 40.9 | 32.2 |
| | 33 | South Fenceline Adjacent to Pipe Mainfold | 50 | 60.0 | 71.7 | 65.6 | 70.1 | 63.9 | 58.6 | 59.2 | 54.8 | 50.6 | 41.1 | 33.6 |
| | 34 | South Fenceline Directly South of Concrete Parking Barrier | 48 | 61.1 | 73.6 | 66.3 | 72.9 | 63.6 | 60.0 | 60.0 | 56.6 | 50.5 | 39.1 | 32.5 |
| | 35 | South Fenceline | 50 | 62.2 | 73.2 | 64.3 | 72.1 | 63.3 | 63.6 | 61.1 | 57.0 | 51.2 | 42.8 | 34.7 |
| | 36 | Southwest Fenceline | 85 | 60.5 | 69.7 | 64.1 | 66.1 | 63.5 | 58.1 | 61.7 | 53.7 | 48.5 | 41.2 | 32.2 |
| | 37 | West Fenceline (northwest corner of Pond) | 70 | 60.7 | 69.3 | 64.5 | 64.2 | 62.1 | 63.3 | 57.7 | 57.2 | 46.5 | 41.7 | 34.0 |
| | 38 | Northwest Fenceline | 65 | 59.9 | 69.8 | 65.7 | 65.4 | 62.3 | 63.5 | 58.5 | 53.8 | 48.8 | 40.2 | 32.6 |
| | 39 | Northwest Fenceline | 95 | 49.2 | 65.4 | 64.3 | 61.9 | 58.3 | 51.2 | 46.6 | 42.8 | 38.1 | 28.9 | 19.2 |
| | 40 | North Fenceline | 70 | 55.3 | 68.5 | 63.4 | 65.3 | 63.5 | 58.3 | 53.1 | 49.4 | 43.9 | 32.8 | 25.8 |




Note, Measurement locations in yellow boxes correspond to locations in Table 1

**<u>Figure 1. Sound Level Measurement Locations</u>**

# APPENDIX I    MEASUREMENT EQUIPMENT USED

The sound level measurement equipment used consisted of a Brüel and Kjær Type 2250 Precision Integrating Sound Level Meter with an external windscreen. The sound level meter acquired data for a minimum 30-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 October 9, 2014 and the calibrator (type B&K 4231) was certified on October 06, 2014 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 and to Section 4.2.2 of the Enbridge Noise Management Plan for the Stonefell Station.

**Record of Calibration Results**

| Description | Date | Time | Pre / Post | Calibration Level | Calibrator Model | Serial Number |
|---|---|---|---|---|---|---|
| Pre-Calibration | October 21 2014 | 9:30 | Pre | 93.9 dBA | B&K 4231 | 2594693 |
| Post-Calibration | October 21 2014 | 12:30 | Post | 93.8 dBA | B&K 4231 | 2594693 |

# Sound Level Meter Calibration Certificate

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

NVLAP®

NVLAP Lab Code: 200625-0

## Calibration Certificate No.32430

*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 / -6376**

*Date Calibrated:* **10/9/2014** *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. 6/22/2012
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 | 25747 | Jul 2, 2014 | Scantek, Inc./ NVLAP | Jul 2, 2015 |
| DS-360-SRS | Function Generator | 61646 | Nov 20, 2012 | ACR Env./ A2LA | Nov 20, 2014 |
| 34401A-Agilent Technologies | Digital Voltmeter | MY41022043 | Nov 22, 2013 | ACR Env. / A2LA | Nov 22, 2014 |
| DPI 141-Druck | Pressure Indicator | 790/00-04 | Nov 21, 2012 | ACR Env./ A2LA | Nov 21, 2014 |
| HMP233-Vaisala Oyj | Humidity & Temp. Transmitter | V3820001 | Mar 17, 2014 | ACR Env./ A2LA | Sep 17, 2015 |
| PC Program 1019 Norsonic | Calibration software | v.5.2 | Validated Mar 2011 | Scantek, Inc. | - |
| 1251-Norsonic | Calibrator | 30878 | Nov 8, 2013 | Scantek, Inc./ NVLAP | Nov 8, 2014 |

**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 °C | 100.694 kPa | 45.5 %RH |

| **Calibrated by:** | Valentin Buzduga | **Authorized signatory:** | Mariana Buzduga |
|---|---|---|---|
| Signature | [signature] | Signature | [signature] |
| Date | 10/09/2014 | Date | 10/9/2014 |

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

# Microphone Calibration Certificate

**Scantek, Inc.**
CALIBRATION LABORATORY

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

NVLAP®

NVLAP Lab Code: 200625-0

## Calibration Certificate No.32431

*Instrument:* **Microphone**
*Model:* **4189**
*Manufacturer:* **Brüel & Kjær**
*Serial number:* **2650730**
*Composed of:*

*Date Calibrated:* **10/3/2014** *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.**
*Tel/Fax:* **780-414-6373 / -6376**
*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. 11/30/2010

**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 | 25747 | Jul 2, 2014 | Scantek, Inc./ NVLAP | Jul 2, 2015 |
| DS-360-SRS | Function Generator | 61646 | Nov 20, 2012 | ACR Env./ A2LA | Nov 20, 2014 |
| 34401A-Agilent Technologies | Digital Voltmeter | MY41022043 | Nov 22, 2013 | ACR Env. / A2LA | Nov 22, 2014 |
| DPI 141-Druck | Pressure Indicator | 790/00-04 | Nov 21, 2012 | ACR Env./ A2LA | Nov 21, 2014 |
| HMP233-Vaisala Oyj | Humidity & Temp. Transmitter | V3820001 | Mar 17, 2014 | ACR Env./ A2LA | Sep 17, 2015 |
| PC Program 1017 Norsonic | Calibration software | v.6.1m | Validated July 2014 | Scantek, Inc. | - |
| 1253-Norsonic | Calibrator | 28326 | Nov 8, 2013 | Scantek, Inc./ NVLAP | Nov 8, 2014 |
| 1203-Norsonic | Preamplifier | 14059 | Jan 2, 2014 | Scantek, Inc./ NVLAP | Jan 2, 2015 |
| 4180-Brüel&Kjær | Microphone | 2246115 | Oct 15, 2013 | NPL-UK / UKAS | Oct 15, 2015 |

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

| **Calibrated by:** | Valentin Buzduga | **Authorized signatory:** | Mariana Buzduga |
|---|---|---|---|
| Signature | | Signature | |
| Date | 10/03/2014 | Date | 10/9/2014 |


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Page 1 of 2

# Calibrator Calibration Certificate

**Scantek, Inc.**
CALIBRATION LABORATORY

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

NVLAP®

NVLAP Lab Code: 200625-0

## Calibration Certificate No.32434

*Instrument:* **Acoustical Calibrator**
*Model:* **4231**
*Manufacturer:* **Brüel and Kjær**
*Serial number:* **2594693**
*Class (IEC 60942):* **1**
*Barometer type:*
*Barometer s/n:*

*Date Calibrated:* **10/6/2014** *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.**
*Tel/Fax:* **780-414-6373 / -6376**
*Address:* **5031 - 210 Street, 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 | 25747 | Jul 2, 2014 | Scantek, Inc./ NVLAP | Jul 2, 2015 |
| DS-360-SRS | Function Generator | 61646 | Nov 20, 2012 | ACR Env./ A2LA | Nov 20, 2014 |
| 34401A-Agilent Technologies | Digital Voltmeter | MY41022043 | Nov 22, 2013 | ACR Env. / A2LA | Nov 22, 2014 |
| DPI 141-Druck | Pressure Indicator | 790/00-04 | Nov 21, 2012 | ACR Env./ A2LA | Nov 21, 2014 |
| HMP233-Vaisala Oyj | Humidity & Temp. Transmitter | V3820001 | Mar 17, 2014 | ACR Env./ A2LA | Sep 17, 2015 |
| 8903A-HP | Audio Analyzer | 2514A05691 | Dec 12, 2013 | ACR Env./ A2LA | Dec 12, 2016 |
| PC Program 1018 Norsonic | Calibration software | v.6.1c | Validated July 2014 | Scantek, Inc. | - |
| 4134-Brüel&Kjær | Microphone | 906763 | Oct 15, 2013 | NPL-UK / UKAS | Oct 15, 2015 |
| 1203-Norsonic | Preamplifier | 14059 | Jan 2, 2014 | Scantek, Inc./ NVLAP | Jan 2, 2015 |

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

| **Calibrated by:** | Valentin Buzduga | **Authorized signatory:** | Mariana Buzduga |
|---|---|---|---|
| Signature | [signature] | Signature | [signature] |
| Date | 10/06/2014 | Date | 10/9/2014 |


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# APPENDIX II MEASURED 1/3 OCTAVE BAND SOUND LEVELS

## Measurement Locations 1 - 21 (Mainline Pump Building Ventilation Fans OFF)

| Location | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| dBA | 64.0 | 66.5 | 63.6 | 56.2 | 58.9 | 63.7 | 65.3 | 52.8 | 75.8 | 60.8 | 48.0 | 49.9 | 49.8 | 53.7 | 56.1 | 55.0 | 49.4 | 48.9 | 53.7 | 47.2 | 48.6 |
| dBC | 74.3 | 78.5 | 75.1 | 71.5 | 72.1 | 73.2 | 73.7 | 71.1 | 84.3 | 73.9 | 66.0 | 67.3 | 67.8 | 68.8 | 69.3 | 67.9 | 66.9 | 68.1 | 67.5 | 64.0 | 65.3 |
| 20 Hz | 66.6 | 67.7 | 66.2 | 60.1 | 61.0 | 59.8 | 58.1 | 58.6 | 79.2 | 65.8 | 58.7 | 60.2 | 57.7 | 57.2 | 58.2 | 57.0 | 57.7 | 58.9 | 59.6 | 57.7 | 60.0 |
| 25 Hz | 64.0 | 67.9 | 65.2 | 65.4 | 65.1 | 64.7 | 65.3 | 62.2 | 77.3 | 67.2 | 60.2 | 61.1 | 61.6 | 62.0 | 62.7 | 62.2 | 59.5 | 61.0 | 60.8 | 59.4 | 59.0 |
| 31.5 Hz | 65.3 | 68.6 | 66.7 | 67.6 | 66.0 | 66.4 | 66.2 | 64.5 | 77.4 | 68.3 | 61.8 | 63.1 | 63.2 | 63.1 | 64.4 | 60.9 | 60.1 | 61.6 | 61.6 | 59.3 | 58.2 |
| 40 Hz | 64.1 | 67.2 | 67.4 | 65.2 | 69.5 | 70.2 | 70.4 | 69.1 | 75.2 | 66.4 | 58.3 | 60.0 | 60.7 | 62.6 | 63.9 | 61.9 | 62.0 | 64.8 | 61.6 | 59.4 | 59.3 |
| 50 Hz | 64.0 | 67.1 | 64.6 | 62.8 | 63.3 | 64.4 | 62.5 | 62.7 | 72.2 | 64.4 | 59.2 | 60.9 | 61.8 | 64.3 | 65.0 | 63.1 | 62.3 | 63.1 | 59.9 | 56.6 | 58.1 |
| 63 Hz | 64.5 | 66.9 | 63.7 | 62.1 | 61.2 | 63.7 | 60.5 | 59.1 | 73.8 | 64.5 | 59.8 | 60.1 | 62.5 | 60.7 | 59.1 | 59.5 | 59.1 | 58.6 | 58.2 | 52.9 | 55.6 |
| 80 Hz | 66.3 | 74.3 | 66.5 | 60.8 | 62.1 | 60.9 | 63.2 | 62.6 | 72.8 | 66.9 | 54.2 | 57.6 | 54.2 | 58.1 | 57.2 | 56.6 | 55.4 | 58.2 | 57.5 | 51.0 | 54.1 |
| 100 Hz | 65.5 | 70.6 | 68.2 | 60.1 | 60.7 | 61.1 | 64.1 | 61.8 | 73.5 | 65.4 | 54.1 | 54.5 | 54.1 | 56.7 | 55.5 | 56.3 | 55.8 | 55.9 | 57.1 | 48.8 | 52.6 |
| 125 Hz | 67.0 | 68.4 | 66.7 | 60.6 | 60.4 | 61.1 | 62.4 | 59.4 | 76.4 | 62.7 | 53.0 | 53.8 | 52.9 | 53.8 | 51.6 | 53.3 | 52.8 | 50.7 | 56.3 | 56.5 | 59.6 |
| 160 Hz | 62.5 | 65.0 | 62.1 | 57.9 | 56.7 | 58.7 | 55.0 | 53.5 | 71.5 | 59.0 | 50.1 | 48.1 | 48.8 | 49.2 | 47.5 | 46.4 | 49.5 | 48.0 | 53.4 | 42.9 | 48.4 |
| 200 Hz | 60.6 | 66.7 | 62.7 | 55.6 | 53.2 | 54.0 | 54.3 | 50.5 | 69.4 | 54.8 | 47.1 | 51.8 | 48.0 | 45.5 | 43.9 | 44.1 | 43.0 | 46.8 | 52.9 | 40.6 | 44.0 |
| 250 Hz | 56.8 | 59.0 | 56.7 | 52.4 | 49.3 | 51.5 | 53.9 | 46.2 | 71.9 | 50.9 | 43.7 | 50.2 | 43.2 | 40.5 | 42.8 | 45.3 | 39.7 | 42.9 | 49.1 | 39.2 | 39.9 |
| 315 Hz | 58.0 | 59.0 | 58.2 | 52.9 | 51.4 | 57.6 | 57.8 | 46.6 | 69.0 | 51.9 | 40.4 | 44.3 | 38.6 | 46.9 | 48.2 | 50.7 | 40.9 | 42.8 | 49.3 | 40.1 | 40.4 |
| 400 Hz | 58.1 | 60.2 | 59.4 | 51.9 | 56.5 | 58.7 | 62.5 | 49.8 | 69.6 | 55.1 | 43.3 | 41.4 | 39.7 | 48.5 | 51.3 | 51.6 | 43.6 | 44.8 | 48.0 | 39.9 | 41.2 |
| 500 Hz | 50.9 | 52.3 | 49.8 | 45.5 | 48.2 | 52.5 | 53.7 | 42.5 | 70.2 | 52.6 | 38.9 | 40.2 | 40.2 | 40.5 | 45.9 | 42.1 | 40.5 | 42.4 | 44.8 | 39.1 | 39.0 |
| 630 Hz | 54.5 | 55.1 | 50.4 | 48.6 | 49.9 | 56.2 | 61.4 | 43.1 | 68.0 | 52.6 | 38.4 | 41.7 | 42.6 | 44.2 | 52.4 | 45.8 | 42.1 | 42.6 | 46.2 | 38.8 | 39.0 |
| 800 Hz | 51.0 | 53.3 | 49.6 | 44.7 | 48.5 | 53.7 | 52.2 | 40.9 | 66.3 | 51.9 | 36.5 | 41.8 | 45.0 | 42.2 | 45.6 | 43.6 | 39.7 | 38.6 | 41.9 | 36.0 | 36.5 |
| 1 kHz | 53.6 | 56.6 | 52.0 | 44.2 | 50.0 | 55.0 | 54.9 | 39.7 | 65.4 | 49.5 | 34.6 | 34.5 | 39.5 | 44.6 | 47.5 | 46.5 | 39.5 | 36.2 | 41.4 | 35.9 | 36.5 |
| 1.25 kHz | 50.4 | 52.8 | 48.1 | 40.2 | 46.8 | 51.4 | 51.0 | 36.6 | 64.1 | 48.1 | 33.2 | 32.3 | 35.9 | 41.2 | 43.4 | 43.7 | 36.9 | 32.8 | 39.4 | 37.2 | 35.7 |
| 1.6 kHz | 48.4 | 50.6 | 44.9 | 37.9 | 43.5 | 48.1 | 49.2 | 34.2 | 62.9 | 48.4 | 31.2 | 29.1 | 33.9 | 39.2 | 40.2 | 39.8 | 33.2 | 30.4 | 38.2 | 31.3 | 34.1 |
| 2 kHz | 50.9 | 53.0 | 50.1 | 39.9 | 44.1 | 50.9 | 51.7 | 35.6 | 62.9 | 48.5 | 32.0 | 31.6 | 34.2 | 40.7 | 42.0 | 42.1 | 33.9 | 30.2 | 39.2 | 31.4 | 32.9 |
| 2.5 kHz | 57.3 | 59.6 | 57.6 | 44.6 | 49.1 | 56.1 | 56.7 | 39.8 | 62.2 | 47.7 | 37.8 | 38.4 | 34.5 | 46.8 | 45.6 | 46.0 | 38.7 | 33.0 | 44.1 | 36.6 | 37.3 |
| 3.15 kHz | 44.9 | 44.5 | 41.5 | 33.6 | 39.2 | 42.3 | 43.7 | 31.4 | 59.6 | 45.4 | 25.2 | 26.2 | 26.4 | 35.0 | 32.4 | 34.4 | 29.1 | 26.1 | 35.6 | 25.0 | 26.0 |
| 4 kHz | 40.5 | 42.7 | 38.3 | 31.2 | 36.7 | 40.9 | 40.6 | 27.6 | 58.0 | 44.2 | 20.7 | 22.8 | 22.7 | 28.8 | 32.4 | 31.2 | 26.0 | 24.4 | 33.2 | 25.0 | 25.3 |
| 5 kHz | 38.9 | 41.5 | 36.1 | 30.6 | 35.7 | 40.5 | 42.1 | 25.9 | 56.0 | 42.1 | 19.0 | 20.4 | 20.6 | 29.2 | 30.5 | 30.5 | 23.5 | 20.6 | 30.4 | 20.9 | 20.7 |
| 6.3 kHz | 38.0 | 38.2 | 34.3 | 28.4 | 33.8 | 38.4 | 38.9 | 24.0 | 54.0 | 40.4 | 15.6 | 16.5 | 17.1 | 25.5 | 27.6 | 27.3 | 19.3 | 17.3 | 28.5 | 17.7 | 17.1 |
| 8 kHz | 34.0 | 35.8 | 30.5 | 24.8 | 30.0 | 34.9 | 34.0 | 18.7 | 50.4 | 37.5 | 11.5 | 12.5 | 12.9 | 20.0 | 23.5 | 21.5 | 15.8 | 13.3 | 25.2 | 15.4 | 13.5 |
| 10 kHz | 28.0 | 32.7 | 24.5 | 20.7 | 24.6 | 32.9 | 31.6 | 13.9 | 47.4 | 34.7 | 9.1 | 8.8 | 9.2 | 14.4 | 19.6 | 16.4 | 9.2 | 9.9 | 19.0 | 11.0 | 10.0 |
| 12.5 kHz | 23.8 | 27.8 | 19.5 | 15.4 | 19.2 | 28.6 | 26.4 | 9.8 | 44.3 | 31.7 | 7.8 | 7.8 | 8.0 | 10.0 | 14.0 | 10.9 | 7.8 | 8.3 | 14.4 | 9.9 | 8.1 |

# Measurement Locations 21 - 40 (Mainline Pump Building Ventilation Fans ON)

| Location | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| dBA | 72.7 | 71.1 | 72.6 | 74.4 | 73.1 | 69.4 | 71.0 | 75.0 | 57.3 | 60.7 | 58.9 | 60.0 | 61.1 | 62.2 | 60.5 | 60.7 | 59.9 | 49.2 | 55.3 |
| dBC | 80.0 | 80.6 | 79.9 | 80.2 | 79.6 | 77.2 | 79.3 | 80.4 | 67.1 | 69.9 | 68.9 | 71.7 | 73.6 | 73.2 | 69.7 | 69.3 | 69.8 | 65.4 | 68.5 |
| 20 Hz | 66.6 | 67.8 | 65.5 | 61.4 | 61.3 | 59.7 | 58.8 | 60.9 | 55.6 | 57.6 | 56.2 | 58.3 | 56.1 | 56.5 | 58.1 | 58.0 | 59.0 | 59.6 | 58.9 |
| 25 Hz | 63.7 | 67.1 | 65.0 | 61.5 | 62.2 | 59.9 | 58.9 | 60.4 | 56.0 | 56.9 | 57.2 | 59.2 | 59.8 | 57.4 | 58.4 | 59.2 | 60.4 | 60.4 | 59.3 |
| 31.5 Hz | 64.1 | 68.1 | 64.7 | 62.7 | 61.0 | 59.3 | 60.7 | 60.7 | 57.5 | 57.6 | 58.7 | 61.6 | 61.8 | 59.3 | 58.8 | 59.2 | 61.3 | 59.8 | 59.3 |
| 40 Hz | 63.7 | 66.6 | 65.4 | 62.4 | 62.5 | 59.7 | 61.0 | 61.8 | 56.7 | 58.1 | 61.3 | 61.3 | 62.6 | 61.0 | 60.6 | 60.5 | 61.1 | 57.9 | 57.0 |
| 50 Hz | 66.5 | 67.7 | 65.5 | 66.4 | 66.2 | 64.3 | 66.7 | 64.2 | 56.8 | 55.6 | 62.3 | 65.3 | 65.1 | 63.6 | 61.8 | 61.7 | 61.5 | 57.0 | 58.2 |
| 63 Hz | 73.4 | 71.6 | 70.0 | 70.3 | 75.1 | 72.6 | 76.7 | 70.0 | 59.3 | 57.5 | 59.2 | 67.9 | 71.9 | 71.2 | 63.4 | 58.9 | 62.1 | 59.8 | 64.0 |
| 80 Hz | 64.8 | 68.0 | 65.7 | 63.5 | 63.7 | 61.1 | 62.6 | 60.8 | 56.6 | 53.8 | 53.0 | 58.9 | 58.3 | 57.4 | 55.5 | 55.7 | 56.1 | 49.7 | 53.3 |
| 100 Hz | 64.7 | 68.4 | 67.8 | 63.7 | 64.2 | 63.6 | 63.1 | 63.7 | 54.7 | 55.8 | 55.0 | 57.6 | 57.1 | 57.7 | 56.4 | 54.0 | 56.4 | 48.7 | 53.1 |
| 125 Hz | 68.9 | 72.2 | 71.4 | 70.4 | 68.3 | 68.2 | 65.5 | 72.5 | 57.4 | 63.3 | 60.2 | 61.8 | 60.8 | 61.1 | 60.9 | 58.8 | 59.1 | 57.6 | 62.2 |
| 160 Hz | 70.4 | 70.8 | 70.6 | 62.7 | 63.1 | 65.8 | 65.3 | 67.8 | 55.5 | 60.2 | 58.2 | 55.1 | 57.4 | 53.8 | 57.6 | 58.0 | 56.6 | 45.0 | 55.5 |
| 200 Hz | 71.3 | 72.6 | 71.6 | 64.5 | 62.8 | 66.5 | 65.9 | 67.3 | 56.8 | 62.1 | 58.5 | 53.1 | 56.1 | 53.6 | 56.8 | 59.6 | 59.3 | 45.3 | 56.3 |
| 250 Hz | 68.2 | 72.9 | 68.5 | 71.5 | 63.7 | 63.0 | 68.7 | 64.6 | 55.6 | 60.7 | 58.0 | 52.1 | 54.3 | 60.3 | 49.3 | 59.0 | 59.8 | 48.3 | 51.3 |
| 315 Hz | 68.9 | 65.2 | 64.1 | 71.6 | 67.7 | 64.3 | 65.3 | 67.9 | 56.8 | 59.5 | 56.1 | 55.6 | 55.0 | 60.1 | 49.3 | 56.2 | 56.3 | 45.0 | 50.3 |
| 400 Hz | 69.7 | 63.0 | 66.6 | 73.2 | 72.1 | 66.4 | 67.3 | 71.9 | 53.3 | 55.8 | 49.5 | 56.0 | 55.4 | 58.0 | 57.8 | 52.5 | 55.9 | 43.5 | 50.8 |
| 500 Hz | 65.8 | 60.9 | 69.0 | 69.4 | 69.1 | 63.0 | 64.7 | 74.7 | 47.8 | 50.9 | 45.5 | 54.3 | 55.3 | 54.9 | 57.3 | 51.2 | 52.4 | 40.9 | 46.6 |
| 630 Hz | 65.4 | 62.6 | 67.7 | 65.7 | 66.9 | 63.4 | 65.8 | 66.6 | 45.6 | 49.0 | 47.5 | 52.6 | 55.2 | 55.4 | 55.3 | 54.5 | 51.5 | 40.6 | 45.6 |
| 800 Hz | 64.9 | 62.0 | 62.6 | 66.7 | 64.0 | 60.1 | 60.9 | 64.4 | 42.7 | 48.9 | 52.1 | 51.4 | 53.5 | 54.3 | 50.9 | 54.8 | 49.4 | 38.6 | 45.1 |
| 1 kHz | 62.5 | 59.0 | 60.1 | 62.9 | 62.6 | 59.3 | 60.2 | 63.4 | 47.1 | 49.2 | 51.5 | 50.5 | 52.3 | 51.8 | 48.6 | 52.4 | 49.7 | 38.4 | 45.7 |
| 1.25 kHz | 58.3 | 55.9 | 59.1 | 59.3 | 58.6 | 55.2 | 56.7 | 58.9 | 45.9 | 49.6 | 47.8 | 47.3 | 48.1 | 48.9 | 45.9 | 46.4 | 47.7 | 37.0 | 42.4 |
| 1.6 kHz | 56.2 | 55.7 | 55.0 | 56.3 | 56.2 | 53.4 | 55.8 | 56.3 | 43.7 | 46.4 | 41.8 | 45.3 | 45.5 | 46.5 | 44.9 | 41.3 | 44.4 | 33.6 | 39.5 |
| 2 kHz | 55.3 | 54.6 | 55.0 | 54.9 | 54.2 | 53.4 | 55.8 | 55.5 | 40.5 | 41.3 | 40.6 | 44.9 | 45.2 | 45.7 | 43.3 | 42.5 | 42.7 | 32.9 | 38.0 |
| 2.5 kHz | 58.6 | 59.8 | 59.6 | 54.7 | 54.7 | 56.7 | 58.7 | 55.1 | 42.1 | 43.0 | 42.1 | 47.0 | 46.4 | 47.1 | 42.5 | 41.1 | 44.8 | 33.5 | 39.6 |
| 3.15 kHz | 49.6 | 47.1 | 50.0 | 51.8 | 50.5 | 46.7 | 48.9 | 52.9 | 39.3 | 39.4 | 38.0 | 39.0 | 35.5 | 40.4 | 38.5 | 38.7 | 37.4 | 25.8 | 30.0 |
| 4 kHz | 45.4 | 44.9 | 47.6 | 50.5 | 48.5 | 44.3 | 44.3 | 51.1 | 35.8 | 36.8 | 35.6 | 34.4 | 34.6 | 36.7 | 35.6 | 36.5 | 34.7 | 24.4 | 28.0 |
| 5 kHz | 42.3 | 43.1 | 46.7 | 50.4 | 47.8 | 42.4 | 43.7 | 50.7 | 33.7 | 34.4 | 33.5 | 33.5 | 32.1 | 35.4 | 34.2 | 34.5 | 33.4 | 20.7 | 24.3 |
| 6.3 kHz | 44.0 | 40.5 | 46.2 | 48.9 | 47.0 | 41.7 | 42.8 | 51.2 | 31.8 | 34.6 | 30.9 | 32.4 | 30.9 | 33.1 | 30.8 | 32.3 | 31.2 | 16.9 | 24.0 |
| 8 kHz | 43.7 | 39.5 | 43.7 | 47.0 | 44.4 | 38.6 | 38.7 | 48.9 | 26.2 | 30.1 | 25.8 | 27.0 | 26.7 | 28.7 | 25.9 | 28.3 | 26.4 | 14.1 | 20.7 |
| 10 kHz | 32.9 | 33.6 | 38.8 | 43.2 | 40.3 | 34.2 | 33.6 | 43.2 | 17.3 | 20.5 | 16.6 | 19.3 | 19.8 | 22.0 | 17.8 | 21.4 | 19.6 | 9.5 | 11.6 |
| 12.5 kHz | 26.9 | 28.2 | 33.8 | 39.0 | 35.4 | 29.3 | 28.4 | 38.8 | 10.6 | 12.8 | 10.1 | 12.1 | 13.3 | 14.7 | 10.5 | 14.0 | 13.0 | 8.0 | 8.0 |

| 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 14-Apr-14 | Rev. 2 |

**Insert your Company Name here:** Evonik

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, including the Procedure/Practice/Standard reference.<br><br>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, has remained unchanged since then. |
| Attach results of any monitoring/assessments (fence line outward) completed in 2014.<br><br>Note, you are not required to conduct any off-site monitoring, however if you did, please provide those results electronically to NCIA. | No monitoring or assessment required or carried out in 2014. |
| Disclose any improvements/corrective actions implemented in 2014 or status thereof that would impact the noise level output for your site (either up or down).<br><br>Did those changes result in a requirement to update your site noise model?<br><br>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 |

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| | |
|---|---|
| Disclose any improvements/projects that are approved for 2015 that would impact the noise level output for your site (either up or down).<br><br>Will these changes result in a requirement to update your site noise model?<br><br>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. | 2012 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 2014 including any actions taken to address them. | No complaints. |

This information is being collected as per the NMP Standard 2010-003 Document, section 5.4. 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.

Hans Schuhbauer, for Evonik Canada Inc. Gibbons site

[signature] Aug 31, 2015

**Keyera Fort Saskatchewan**

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, including the Procedure/Practice/Standard reference.<br><br>Note, if you have not provided an electronic copy of your site plan to NCIA, please do so. | Confirmed. The site has a noise management plan based on the current NCIA standard. The document is called KFS Site Noise Management Plan.<br><br>NCIA has a copy of the current plan. |
| Attach results of any monitoring/assessments (fence line outward) completed in 2014.<br><br>Note, you are not required to conduct any off-site monitoring, however if you did, please provide those results electronically to NCIA. | No off-site monitoring was completed in 2014. |
| Disclose any improvements/corrective actions implemented in 2014 or status thereof that would impact the noise level output for your site (either up or down).<br><br>Did those changes result in a requirement to update your site noise model?<br><br>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 to the hot oil furnace (HR-15.02) and aerial coolers (HT-16.04/06) in the existing fractionation plant described in the 2013 report were completed in 2014. A Noise Impact Assessment completed in the design phase of the De-Ethanizer project resulted in the completion of burner modifications to the existing hot oil furnace and installation of low noise fans on the aerial coolers to reduce noise emissions.<br><br>These changes will be incorporated into the 2015 NCIA Regional Noise Model through SLR Consulting. |

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| Disclose any improvements/projects that are approved for 2015 that would impact the noise level output for your site (either up or down).<br><br>Will these changes result in a requirement to update your site noise model?<br><br>If so, when do you anticipate having an updated site model available? | 2014 equipment additions included receipt pumps associated with the Cochin Pipeline reversal project. The Cochin pumps were operational in the summer of 2014.<br><br>Construction of a De-ethanizer unit also took place during 2014, with expected commissioning and operation commencing in the spring of 2015.<br><br>Once the addition is complete there will be a requirement to update the site noise model, which is expected to be completed in 2016. |
| Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan. | Additional noise modeling has been conducted as part of the detailed engineering phase for construction of a new fractionation plant at the site. The design and regulatory components have been completed and equipment commissioning will occur in 2016.<br><br>The site plan has been updated following the 2014 AER audit. |
| Provide a Noise Complaint summary for all noise complaints received in 2014 including any actions taken to address them. | There were no noise complaints received in 2014. |

This information is being collected as per the NMP Standard 2010-003 Document, section 5.4. 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.

**Oerlikon Metco (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, including the Procedure/Practice/Standard reference.<br><br>Note, if you have not provided an electronic copy of your site plan to NCIA, please do so. | MSP-2-3 Occupational Health and Personnel Safety |
| Attach results of any monitoring/assessments (fence line outward) completed in 2014.<br><br>Note, you are not required to conduct any off-site monitoring, however if you did, please provide those results electronically to NCIA. | None |
| Disclose any improvements/corrective actions implemented in 2014 or status thereof that would impact the noise level output for your site (either up or down).<br><br>Did those changes result in a requirement to update your site noise model?<br><br>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<br><br>No<br><br>No |

| | |
|---|---|
| Disclose any improvements/projects that are approved for 2015 that would impact the noise level output for your site (either up or down).<br><br>Will these changes result in a requirement to update your site noise model?<br><br>If so, when do you anticipate having an updated site model available? | None that will impact noise in 2015.<br><br>No<br><br>N/A |
| Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan. | Site Management Procedure reviewed by Senior Management. Acceptance by site Vice President. |
| Provide a Noise Complaint summary for all noise complaints received in 2014 including any actions taken to address them. | No noise complaints for 2014 related to Oerlikon Metco |

This information is being collected as per the NMP Standard 2010-003 Document, section 5.4. 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 Facility**

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, including the Procedure/Practice/Standard reference.<br><br>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. |
| Attach results of any monitoring/assessments (fence line outward) completed in 2014.<br><br>Note, you are not required to conduct any off-site monitoring, however if you did, please provide those results electronically to NCIA. | Pembina did not complete any noise assessments outside the fence in 2014 related to operational equipment at RFS. |
| Disclose any improvements/corrective actions implemented in 2014 or status thereof that would impact the noise level output for your site (either up or down).<br><br>Did those changes result in a requirement to update your site noise model?<br><br>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 or corrective actions were implemented in 2014 for the RFS facility. |

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|---|---|
| Disclose any improvements/projects that are approved for 2015 that would impact the noise level output for your site (either up or down).<br><br>Will these changes result in a requirement to update your site noise model?<br><br>If so, when do you anticipate having an updated site model available? | 1) CM-201 Lube Oil Cooler Project – noise impacts were assessed by Stantec as part of AER submission for Project 560, no issues were identified.<br>2) ROF C3+ debottleneck – many pumps were replaced, installed a new heater, installed new process (SRU has a conveyor system).<br>3) SYN & SCO rail loading ceased – removal of noise as there are less crude cars shipped out and the SYN system is suspended (pumps). Impact not evaluated.<br>4) Brine Pond 5 – Control valves for pressure regulation on the system.<br><br>We anticipate that an updated site noise model will be available in Q2, 2016. |
| Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan. | None completed. |
| Provide a Noise Complaint summary for all noise complaints received in 2014 including any actions taken to address them. | None received. |

This information is being collected as per the NMP Standard 2010-003 Document, section 5.4. 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, including the Procedure/Practice/Standard reference.<br><br>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 the site ISO 14001 certified management system (FSK-P-36-00-12). |
| Attach results of any monitoring/assessments (fence line outward) completed in 2014.<br><br>Note, you are not required to conduct any off-site monitoring, however if you did, please provide those results electronically to NCIA. | No monitoring/assessments were completed in 2014. |
| Disclose any improvements/corrective actions implemented in 2014 or status thereof that would impact the noise level output for your site (either up or down).<br><br>Did those changes result in a requirement to update your site noise model?<br><br>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? | Construction activities continued on with the Phase 1 & 2 Expansion project in 2014. This development began with the final construction of a new facility brine pond, drilling of new storage caverns, installation of associated infrastructure to support the cavern development, relocating and expansion of the truck loading terminal, and earthworks for a new rail loading terminal.<br><br>The expansion has resulted in the site conducting a noise impact assessment which was subsequently used to update the Regional Noise Model in 2014.<br><br>SLR Consulting conducted the NIA and updated the model with the information. |

| | |
|---|---|
| Disclose any improvements/projects that are approved for 2015 that would impact the noise level output for your site (either up or down).<br><br>Will these changes result in a requirement to update your site noise model?<br><br>If so, when do you anticipate having an updated site model available? | The Facility will be continuing on with the Phase 1 & 2 Expansion plans in 2015. This will include the construction of a new facility brine pond, drilling of additional underground storage caverns, final construction of a rail loading terminal, and additional earthworks to facilitate future expansion plans.<br><br>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. |
| Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan. | No audits or self-assessment evaluations were completed in 2014. |
| Provide a Noise Complaint summary for all noise complaints received in 2014 including any actions taken to address them. | No noise complaints were received by the Facility in 2014. |

This information is being collected as per the NMP Standard 2010-003 Document, section 5.4. 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**

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 (attached), including the Procedure/Practice/Standard reference.<br><br>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. |
| Attach results of any monitoring/assessments (fenceline outward) completed in 2014.<br><br>Note, you are not required to conduct any off-site monitoring, however if you did, please provide those results electronically to NCIA. | In 2014 an external Noise Survey was conducted at NCIA Validation Point #4 to try to determine the discrepancy between the Model results versus actual measurements. Testing was inconclusive and the report is attached. |
| Disclose any improvements/corrective actions implemented in 2014 or status thereof that would impact the noise level output for your site (either up or down).<br><br>Did those changes result in a requirement to update your site noise model?<br><br>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? | RNM was updated with the actual model for Expansion, however, surrogate values were used for stack noise levels.<br><br>In 2014 the Chemicals, Refinery, Upgrader, and Expansion model updates were 100% completed. These updates will be included in the next RNM update. |

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|---|---|
| Disclose any improvements/projects that are approved for 2015 that would impact the noise level output for your site (either up or down).<br><br>Will these changes result in a requirement to update your site noise model?<br><br>If so, when do you anticipate having an updated site model available? | Two projects will have an impact on noise: Refinery Debottleneck Project and Quest (CO2 capture).<br>Quest will start-up in 2015 and Debottleneck Project will start-up in 2017.<br><br>Both of these will require our site model update. This will happen in 2016 -2018. |
| Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan. | Site NMP has set internal audit frequency to a 3 year cycle with the first one being in 2015. However, AER audited our site NMP in Q1 2014, which will fulfill our internal auditing requirement so next audit is 2017. |
| Provide a Noise Complaint summary for all noise complaints received in 2014 including any actions taken to address them. | No noise complaints received in 2014. |

This information is being collected as per the NMP Standard 2010-003 Document attached, section 5.4. 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** |
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Version 2

27-November-2014

<table>
<tr><td rowspan="2">Scotford Upgrader</td><td>Area: Noise Monitoring</td><td>Document Number: SUG.HSSE.ENV.AIR.NOIS.M.002</td></tr>
<tr><td>Title: Shell Scotford Site Noise Management Plan</td><td>Rev No: 2<br><br>Date: Nov 27-14</td></tr>
<tr><td colspan="2">Document Owner: Environment Manager</td><td>Document Focal: Noise Focal</td></tr>
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# 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.<br>• Reactive communications to neighbours concern.<br>• Monitor operations response to public concern. |
| Shift Supervisor or Designate | • Initiate investigation for public concern for operating units<br>• Perform fence-line noise surveys.<br>• 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.<br>• Data analysis and external noise surveys.<br>• 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.

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Environmental Noise Survey

For The

# Shell Scotford Facility

Prepared for:
**Shell Canada Ltd.**

**INSERT STAMP HERE**

Prepared by:
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S. Bilawchuk, M.Sc., P.Eng.
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Edmonton, Alberta
APEGGA Permit to Practice #P7735

**aci Project #:14-047**
**August 22, 2014**

## Executive Summary

**aci** Acoustical Consultants Inc., of Edmonton AB, was retained by Shell Canada Ltd. (Shell), of Fort Saskatchewan, to conduct an environmental noise survey for the Scotford facility near Fort Saskatchewan, AB. The purpose of the work was to conduct a long-term environmental noise monitoring in order to determine the existing noise climate within the study area. Site work was conducted for **aci** on Thursday June 12, 2014 and on Wednesday July 9, 2014 by P. Froment, B.Sc., B.Ed., C.E.T. under the supervision of S. Bilawchuk, M.Sc., P.Eng.

long-term noise monitoring was conducted at a location south of the Facility's southern fence line. The noise monitoring was conducted over a 4-week period (27 days in total) in an effort to obtain results reflective of "typical" conditions (i.e. low wind speeds and "typical" operating conditions at the Facility.) From this, 4 overnight noise monitoring periods were selected that best reflected these conditions.

The isolated $L_{eq}$Night[1] values for the noise monitoring periods ranged from 48.2 – 51.8 dBA which are consistent with the results of the August 22 – 23, 2013 NCIA regional noise monitoring results. The 1/3 octave band spectral data was consistent between all noise monitoring periods and indicated elevated noise levels in the lower frequency bands that gradually decreased as the frequency increased. This was again consistent with the 2013 NCIA regional noise monitoring results.

[1] The term $L_{eq}$ represents the energy equivalent sound level. This is a measure of the equivalent sound level for a specified period of time accounting for fluctuations.

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## List of Figures

## 1.0 Introduction

**aci** Acoustical Consultants Inc. of Edmonton, Alberta, was retained by Shell Canada Ltd. (Shell), of Fort Saskatchewan, to conduct an environmental noise survey for the Shell Scotford Facility near Fort Saskatchewan, AB. The purpose of the work was to conduct a long-term environmental noise monitoring near the Facility in order to determine the existing noise climate of the area. Site work was conducted for **aci** on Thursday June 12, 2014 and on Wednesday July 9, 2014 by P. Froment, B.Sc., B.Ed., C.E.T. under the supervision of S. Bilawchuk, M.Sc., P.Eng.

## 2.0 Location Description

The Facility is located in Alberta's Industrial Heartland (AIH) and is approximately 10 km northeast of the City of Fort Saskatchewan, Alberta, as shown in Figure 1. It consists of an upgrader, refinery and chemical facilities and covers approximately 1,700 acres. The Facility is bounded on the north by light industrial facilities, on the east by Range Road 214, on the south by relatively open fields and on the west by open fields, Range Road 220 and the North Saskatchewan River (NSR). Since the Facility is found within AIH, there are several other industrial facilities within close proximity of the site (i.e. within a 1,500 m radius).

Topographically, with the exception of the area adjacent to the NSR, the land adjacent to the Facility can be considered relatively flat with no substantial hills. The vegetation between the noise monitor and the Facility consisted of open grain fields. Due to the relative distance from the noise monitoring location to the Facility and the relatively low frequency nature of the industrial noise, the level of vegetative sound absorption is considered minimal.

## 3.0 Monitoring Methods & Location

As part of the study, a long-term noise monitoring was conducted south of the facility. The noise monitoring was conducted over a 4-week period (27 days in total) in an effort to obtain results reflective of "typical" conditions (i.e. low wind speeds and "typical" operating conditions at the Facility). From this, 4 overnight noise monitoring periods were selected that best reflected these conditions[1]. The noise monitoring was conducted collecting broadband A-weighted and C-weighted as well as 1/3 octave band sound levels. In addition, the noise monitoring was accompanied by a digital audio recording for more detailed post process analysis. A portable weather monitor was also located within the study area. The weather monitor obtained local meteorological conditions including wind speed, wind direction, temperature, and relative humidity in 1-minute samples for the duration of the noise monitoring period. Lastly, it should be noted that all measurements were performed in accordance with the methods described in the AER Directive 038 on Noise Control.

The noise monitor was placed approximately 570 m south of the Facility's southern fence line[2] and approximately 1.6 km west of Range Road 214 as shown in Figure 1 and Figure 2. At this location, there was direct line-of-sight to the Facility but not to the electrical substation to the southwest. The noise monitoring was started at 12:15 on Thursday June 12, 2014 and ran for approximately 27 days until 11:00 on Wednesday July 9, 2014. The weather monitor was located 200 m north of the noise monitor in an open area and was running concurrently to the noise monitor.

Refer to Appendix I for a detailed description of all measurement equipment used, Appendix II for a description of the acoustical terminology, and Appendix III for a list of common noise sources. The noise measurement instrumentation was calibrated at the start of the monitoring and then checked afterwards to ensure that there had been no calibration drift over the duration of the monitoring.



[1] Upon consultation with a Shell representative, it was confirmed that the operational conditions of the Facility during each of the 4 noise monitoring periods were typical (i.e. no significant shutdowns of any major pieces of equipment).
[2] This placed the noise monitor approximately 155 m north of the Noise Monitor Location 4 found within the report entitled, "*Environmental Noise Survey for the Regional Noise Model Annual Field Validation Monitoring*" prepared for the Northeast Capital Industrial Association, by **aci** Acoustical Consultants Inc. (November 2013)

# 4.0 Results and Discussion

## 4.1. Noise Monitoring Results

The results obtained from the 4 separate noise monitoring periods are provided in Table 1 and are presented in Figures 3 - 14 (un-adjusted and isolated broadband A-weighted $L_{eq}$ sound levels and 1/3 octave band $L_{eq}$ sound levels provided). Note that the data have been modified (i.e. isolated) by removing abnormal noise events such as loud vehicle pass-by's, train passages, birds chirping nearby, etc. 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 4 noise monitoring periods can be found in Appendix IV. The relative difference between the un-isolated and isolated noise levels has also been included in Table 1.

**Table 1. Noise Monitoring Results[1]**

| | Measured | | | Isolated | | | Difference | | |
|---|---|---|---|---|---|---|---|---|---|
| **Date** | **$L_{eq}$24 (dBA)** | **$L_{eq}$Day (dBA)** | **$L_{eq}$Night (dBA)** | **$L_{eq}$24 (dBA)** | **$L_{eq}$Day (dBA)** | **$L_{eq}$Night (dBA)** | **$L_{eq}$24 (dBA)** | **$L_{eq}$Day (dBA)** | **$L_{eq}$Night (dBA)** |
| June 12 - 13, 2014 | 50.8 | 50.4 | 51.4 | 49.7 | 50.4 | 48.2 | -1.1 | 0.0 | -3.2 |
| June 16 - 17, 2014 | 48.4 | 47.4 | 49.6 | 48.0 | 47.4 | 48.8 | -0.4 | 0.0 | -0.8 |
| June 17 - 18, 2014 | 48.0 | 45.2 | 50.5 | 47.8 | 45.2 | 50.3 | -0.2 | 0.0 | -0.3 |
| June 25 - 26, 2014 | 57.5 | 59.1 | 51.9 | 57.5 | 59.1 | 51.8 | 0.0 | 0.0 | -0.2 |

As indicated in Table 1, the isolated $L_{eq}$Night values for the noise monitoring periods ranged from 48.2 - 51.8 dBA (with a difference of 3.6 dBA). The results of the June 12 – 13 and June 16 – 17 noise monitoring periods indicated lower values, in comparison to the other two nights, which is consistent with the measured weather conditions during the 4 night-time periods (discussed in the following Section). It is therefore likely that the difference of 3.6 dBA between the noise monitoring periods could be attributed to varying meteorological conditions and also to minor operational fluctuations at the Facility. Furthermore, the results from Table 1 are consistent with the results of the August 22 – 23, 2013 NCIA regional noise monitoring period[2] in which the isolated $L_{eq}$Night was 50.5 dBA (taking into account the relative difference in distance to the Facility and the varying weather conditions).

The 1/3 octave band spectral data is consistent between all noise monitoring periods and indicates elevated noise levels in the lower frequency bands that gradually decrease as the frequency increases. It should be noted that the relatively significant difference in the higher frequency bands between the isolated and un-adjusted noise level within Figure 5 can be attributed to high number of rail passages (in

[1] Note that monitoring periods were from 22:00 – 22:00.
[2] *Environmental Noise Survey for the Regional Noise Model Annual Field Validation Monitoring.* Prepared for the Northeast Capital Industrial Association, by **aci** Acoustical Consultants Inc., November 13, 2013.

particular, the train whistles) which occurred during that night-time period. This is again consistent with the measurements conducted during the 2013 NCIA regional noise monitoring.

## 4.2. Night-time Weather Conditions

As previously mentioned, a local weather monitoring station was used throughout the entire noise monitoring period to obtain the wind speed, wind direction, temperature, relative humidity. All weather data are presented in Appendix V. A brief discussion of each night-time period can be found below. Note that the weather conditions were within acceptable limits as per AER Directive 038.

### 4.2.1. June 12 – June 13, 2014

The wind conditions during the night-time period were considered moderate (primarily below 10 km/hr) and from the east (creating crosswind conditions) throughout. The temperature was between 10°C - 18°C and the relative humidity ranged from approximately 52% - 72%.

### 4.2.2. June 16 – June 17, 2014

The wind conditions during the night-time period were considered moderate (primarily below 10 km/hr) and from the east and northeast (creating crosswind conditions) throughout. The temperature was consistent at approximately 11°C and the relative humidity ranged from approximately 78% - 92%.

### 4.2.3. June 16 – June 17, 2014

The wind was relatively calm (approximately 5 km/hr) and from the east at the start of the night-time period (22:00). The wind remained calm throughout the entire night-time period never exceeding 10 km/hr. The wind direction varied throughout the night-time period however due to the low wind speed its impact is considered low. The temperature was relatively consistent and ranged from -8°C to 15°C while the humidity ranged from 68% – 95%.

### 4.2.4. June 16 – June 17, 2014

The wind was relatively calm (approximately 5 km/hr) and from the south at the start of the night-time period (22:00). The wind remained calm throughout the entire night-time period only exceeding 5 km/hr for short durations. The wind direction varied throughout the night-time period but was primarily from the south (i.e. the noise monitor was upwind of the Facility). However due to the low wind speed during the entire night-time period the impact of the wind on the sound propagation is considered negligible. The temperature was relatively consistent and ranged from 9°C to 19°C while the humidity ranged from 65% – 95%.

**5.0 Conclusion**

A long-term noise monitoring was conducted at a location south of the Facility's southern fence line. The noise monitoring was conducted over a 4-week period (27 days in total) in an effort to obtain results reflective of "typical" conditions (i.e. low wind speeds and "typical" operating conditions at the Facility.) From this, 4 overnight noise monitoring periods were selected that best reflected these conditions.

The isolated $L_{eq}$Night values for the noise monitoring periods ranged from 48.2 – 51.8 dBA which are consistent with the results of the August 22 – 23, 2013 NCIA regional noise monitoring results. The 1/3 octave band spectral data was consistent between all noise monitoring periods and indicated elevated noise levels in the lower frequency bands that gradually decreased as the frequency increased. This was again consistent with the 2013 NCIA regional noise monitoring results.

## 6.0 References


- *Environmental Noise Survey for the Regional Noise Model Annual Field Validation Monitoring.* Prepared for the Northeast Capital Industrial Association, by **aci** Acoustical Consultants Inc., November 13, 2013.
- 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.

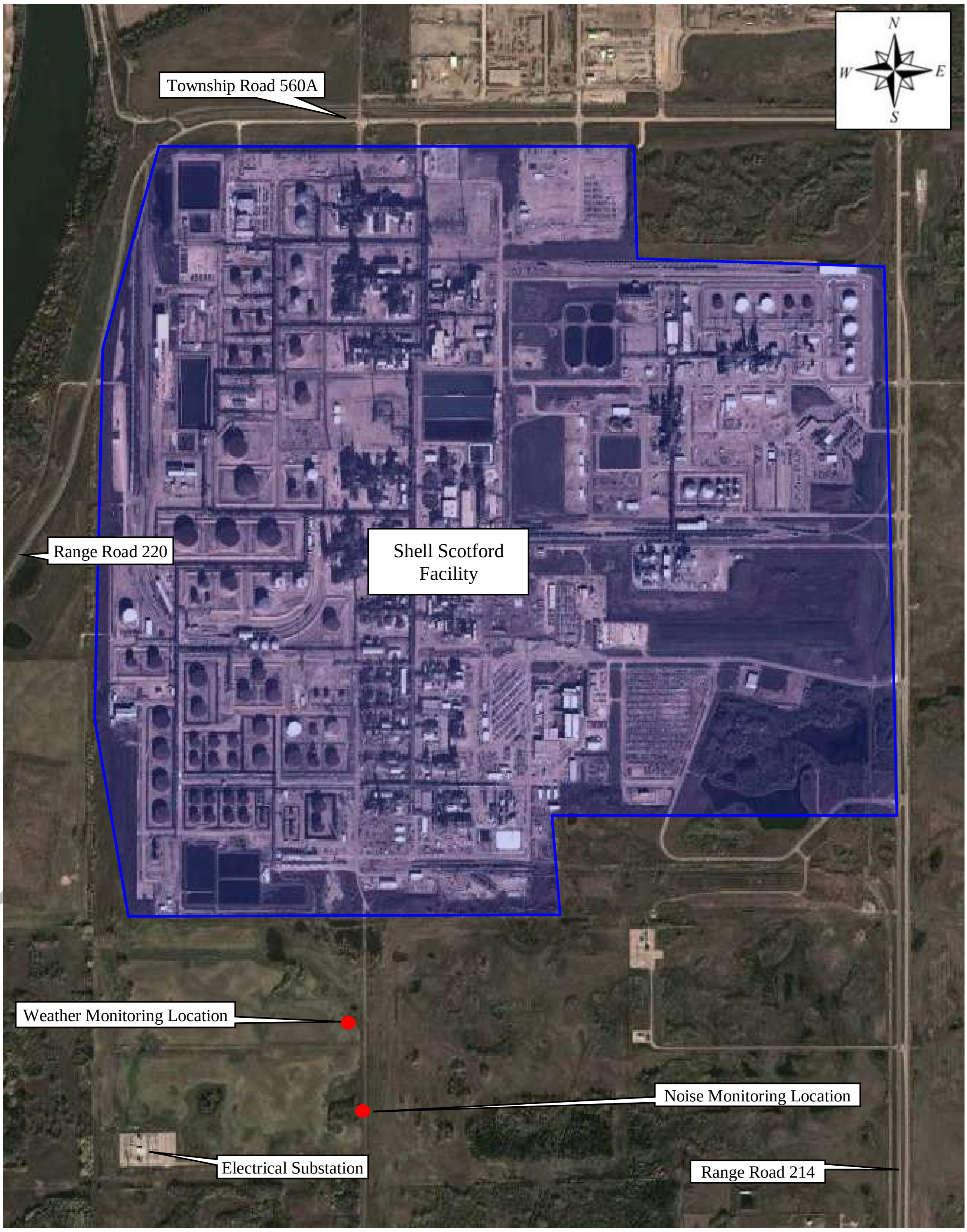


**Figure 1. Study Area**

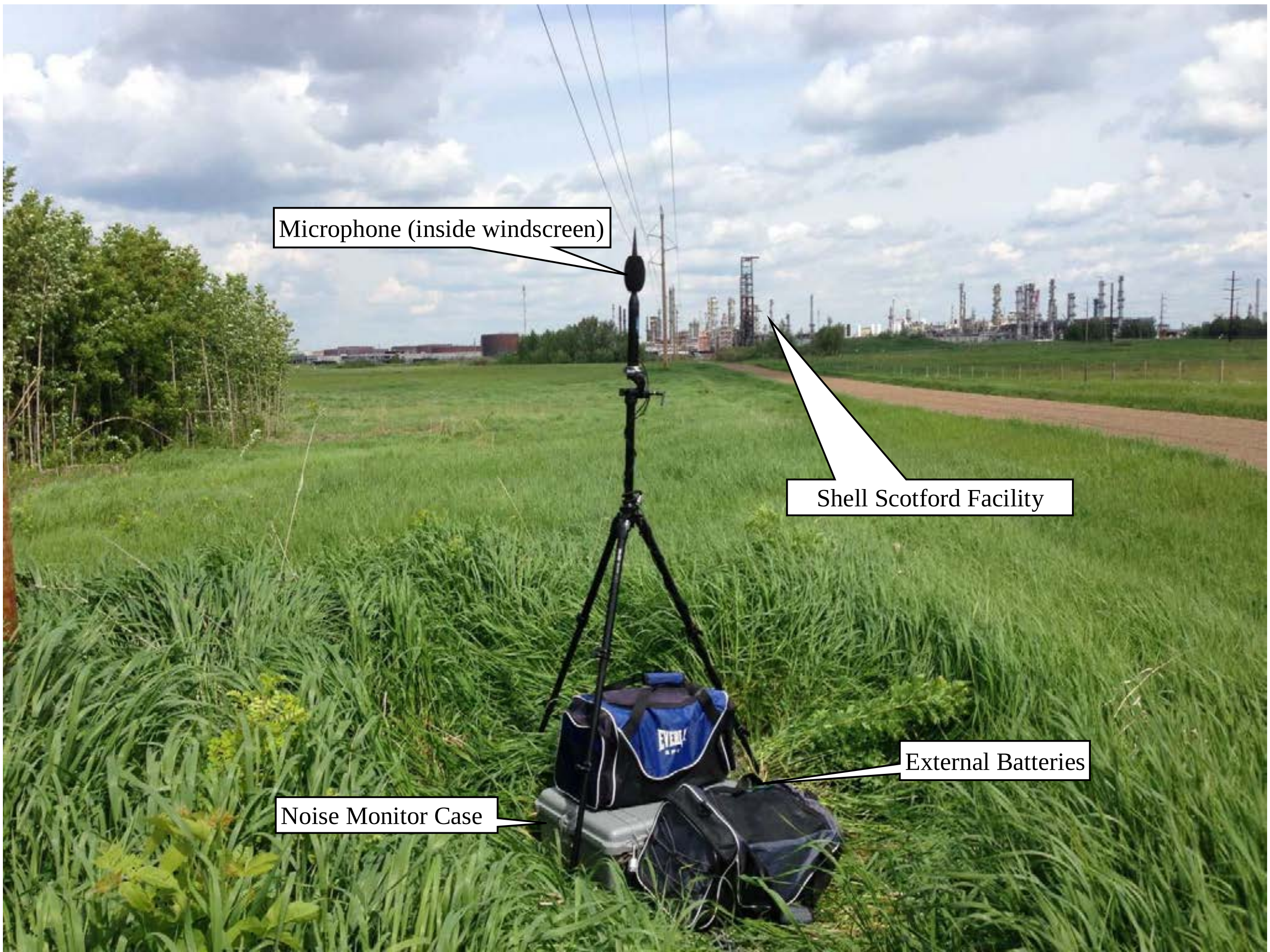


**Figure 2. Noise Monitor Used for Environmental Noise Study**

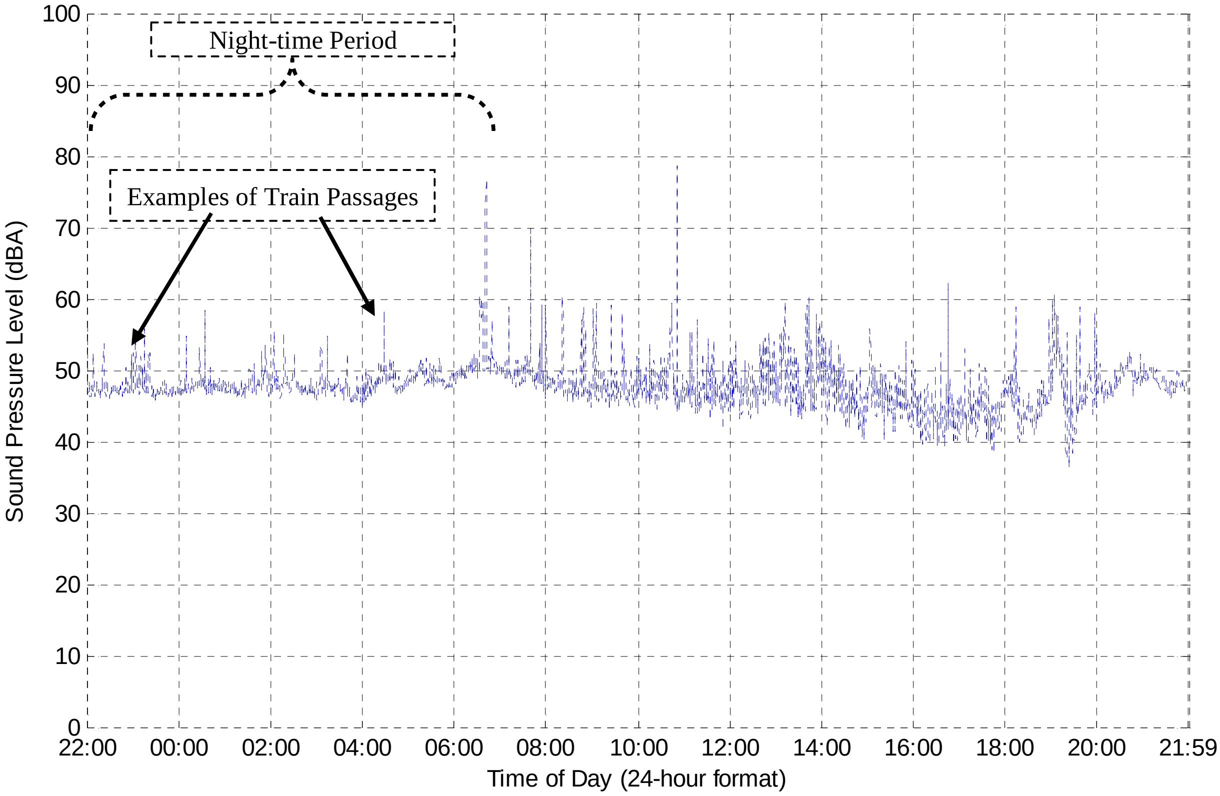


**Figure 3. Un-Adjusted 15-Second $L_{eq}$ Sound Levels (June 12 – June 13, 2014)**

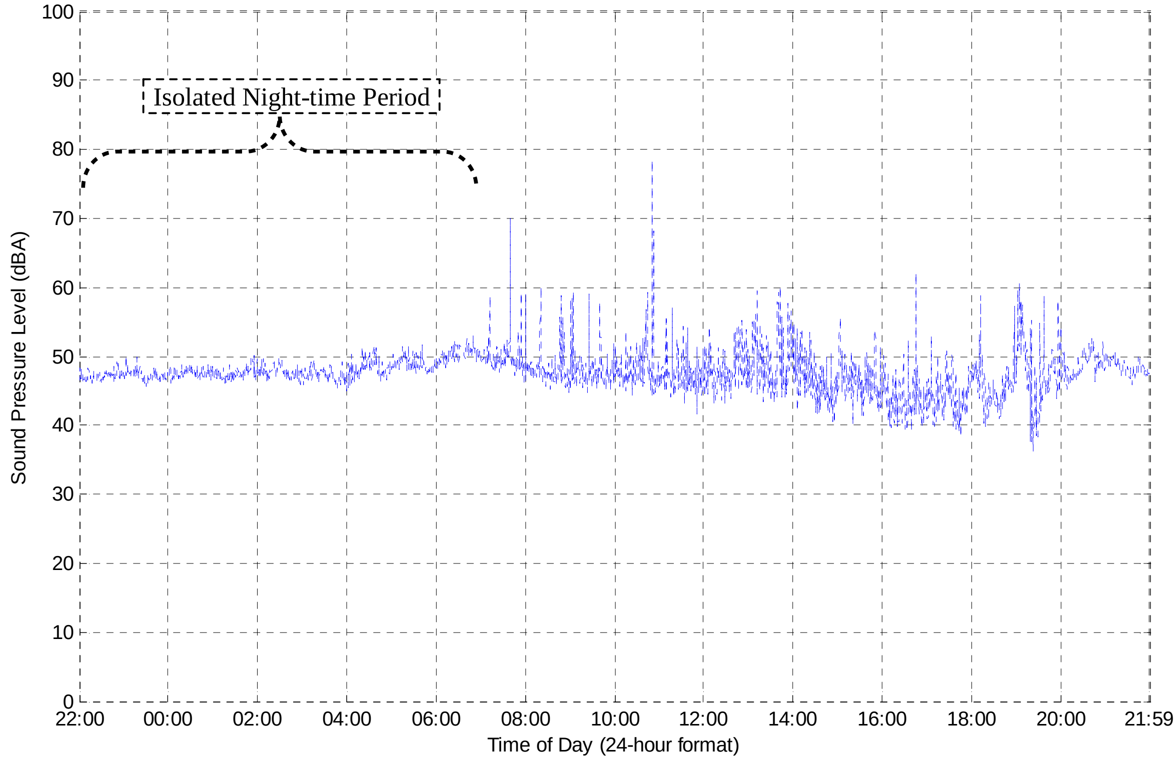


**Figure 4. Isolated 15-Second $L_{eq}$ Sound Levels (June 12 – June 13, 2014)**

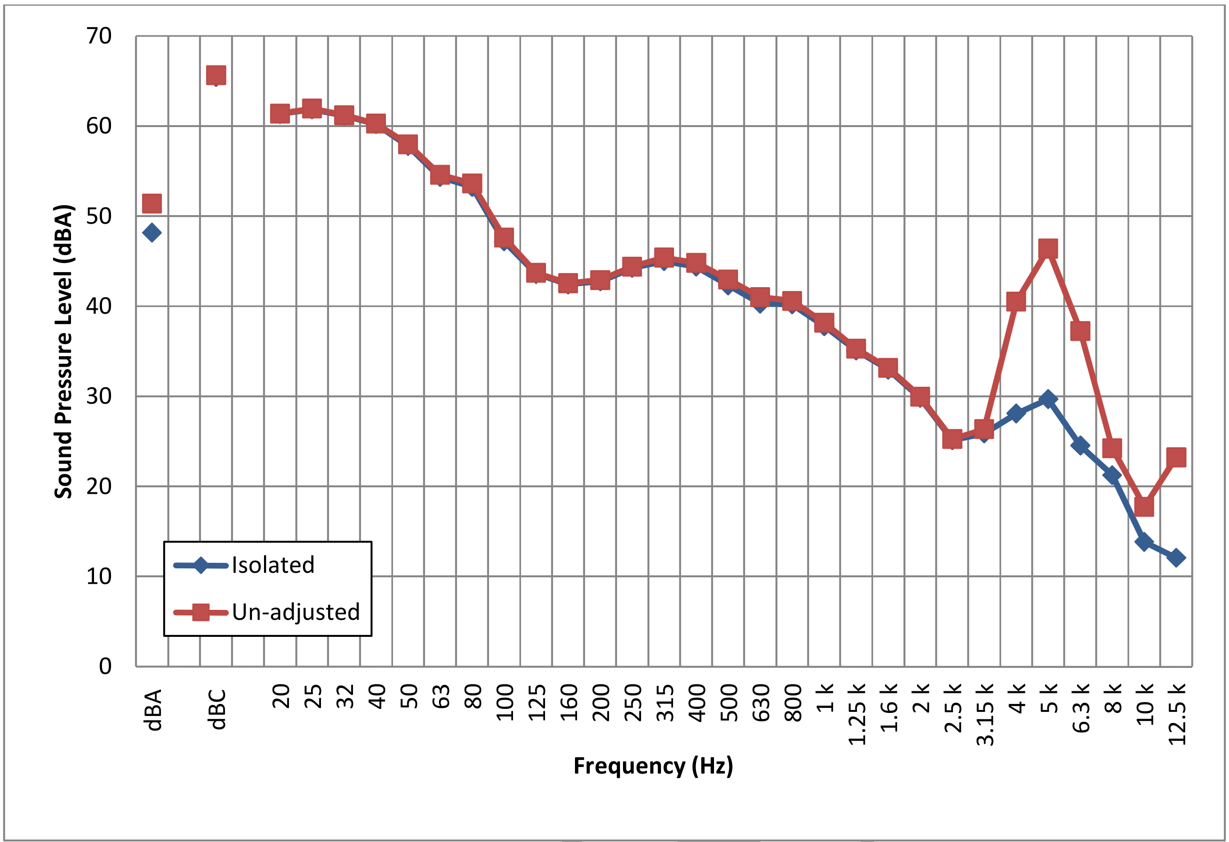


**Figure 5. 1/3 Octave $L_{eq}$ Sound Levels (June 12 – June 13, 2014)**

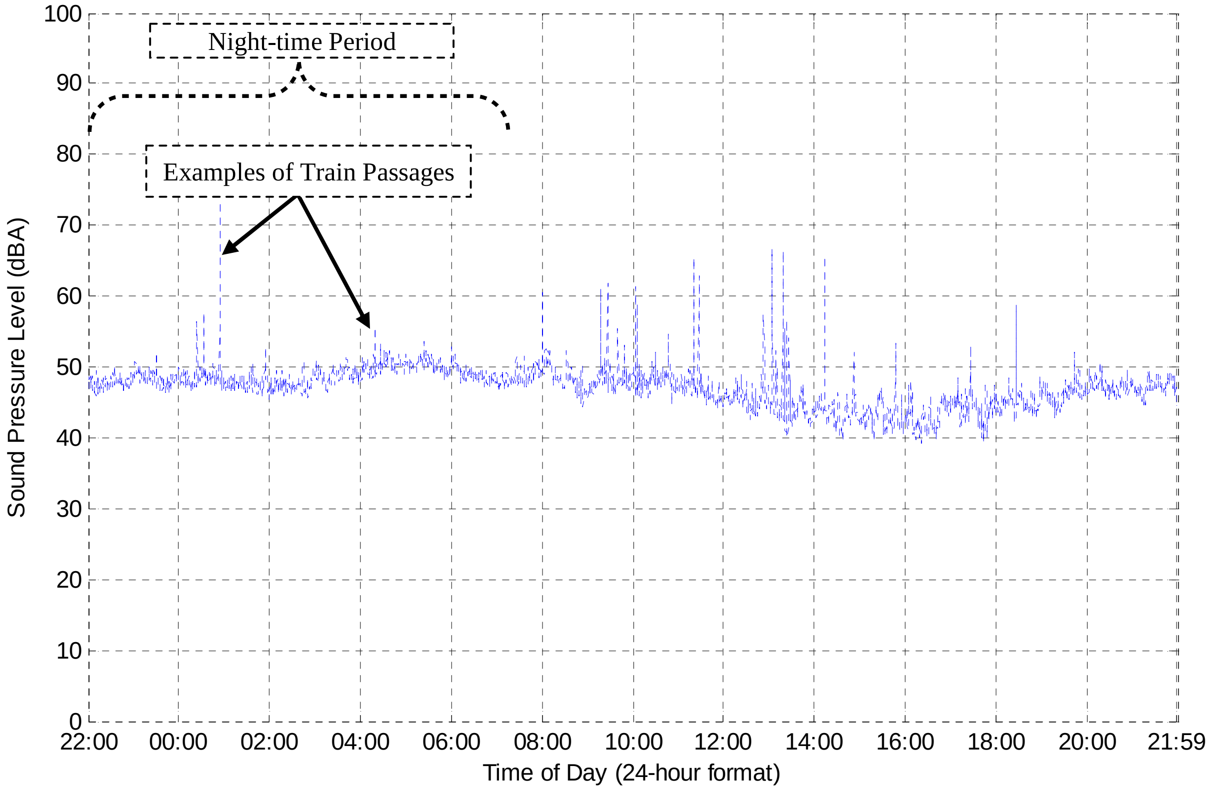


**Figure 6. Un-Adjusted 15-Second $L_{eq}$ Sound Levels (June 16 – June 17, 2014)**

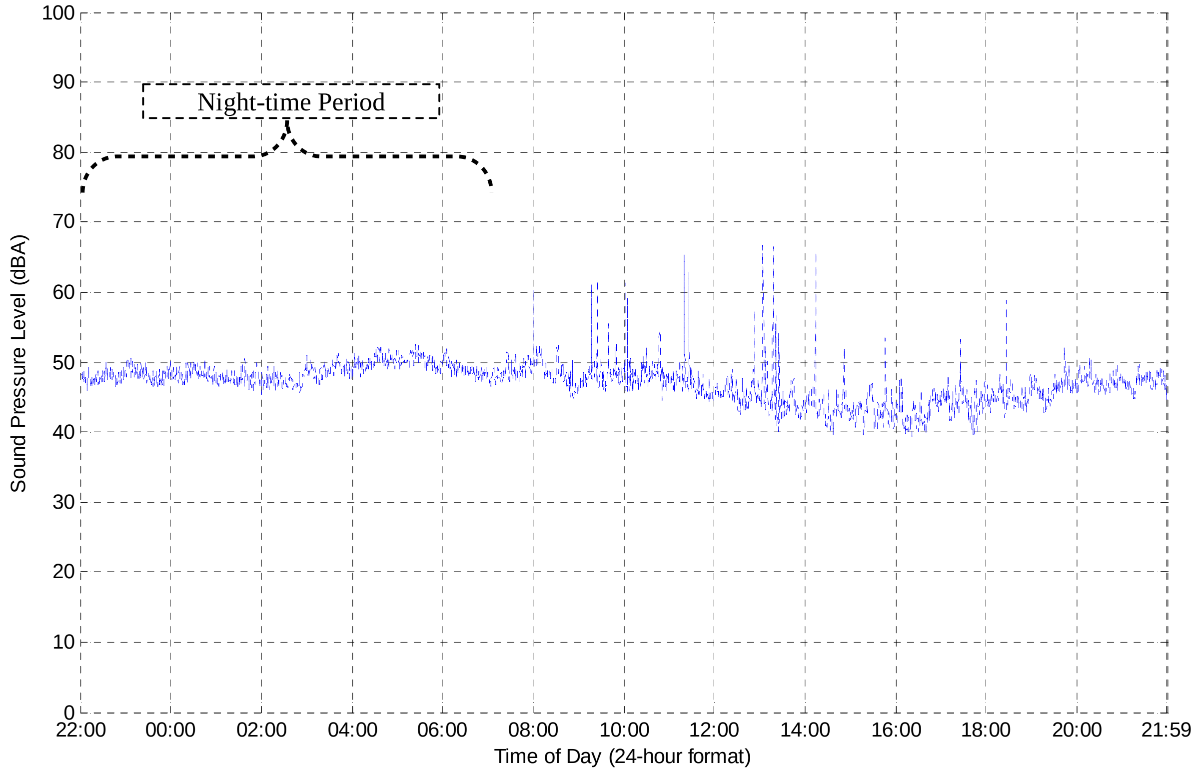


**Figure 7. Isolated 15-Second $L_{eq}$ Sound Levels (June 16 – June 17, 2014)**

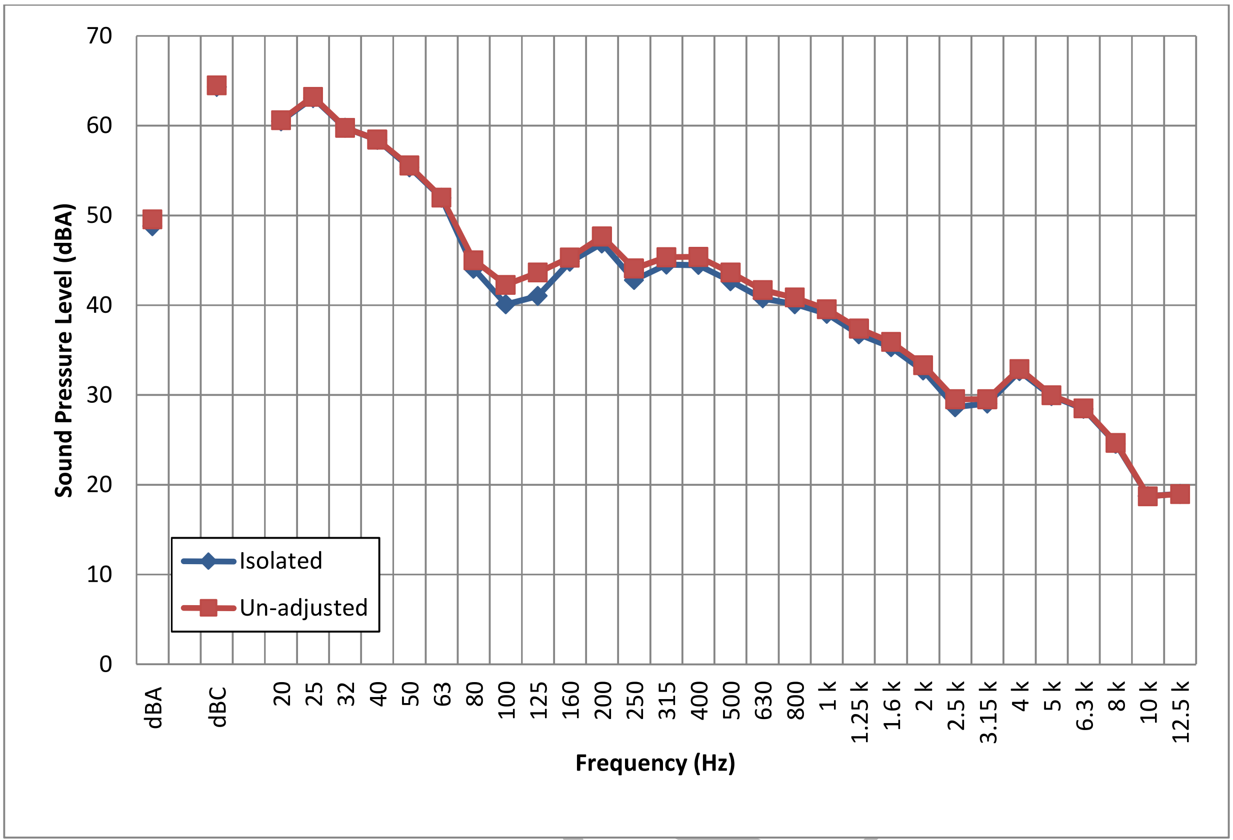


**Figure 8. 1/3 Octave $L_{eq}$ Sound Levels (June 16 – June 17, 2014)**

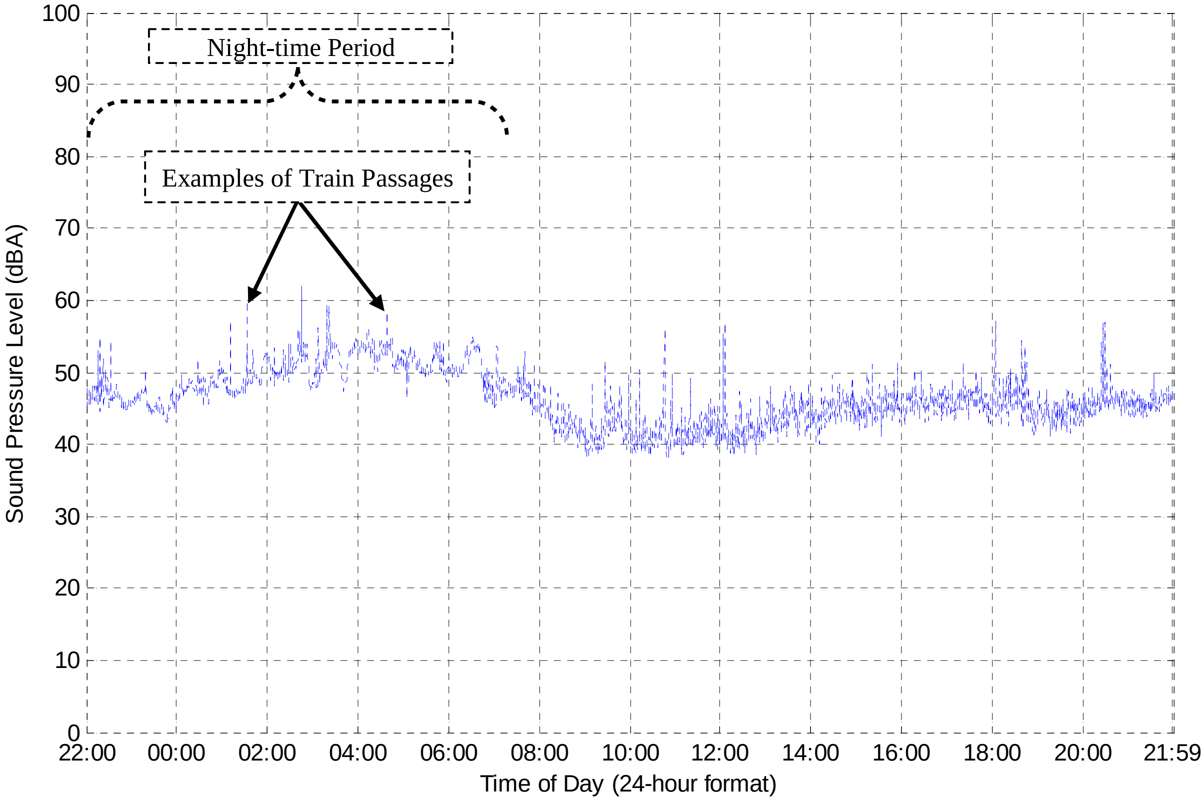


**Figure 9. Un-Adjusted 15-Second $L_{eq}$ Sound Levels (June 17 – June 18, 2014)**

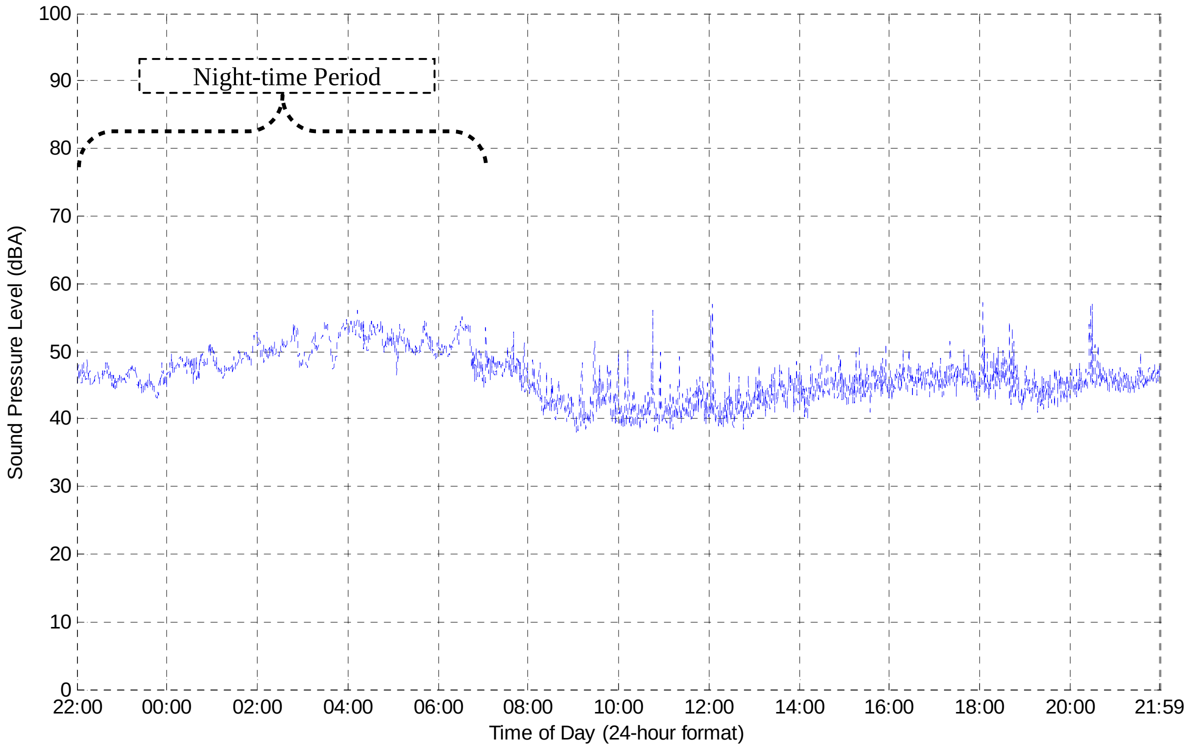


**Figure 10. Isolated 15-Second $L_{eq}$ Sound Levels (June 17 – June 18, 2014)**

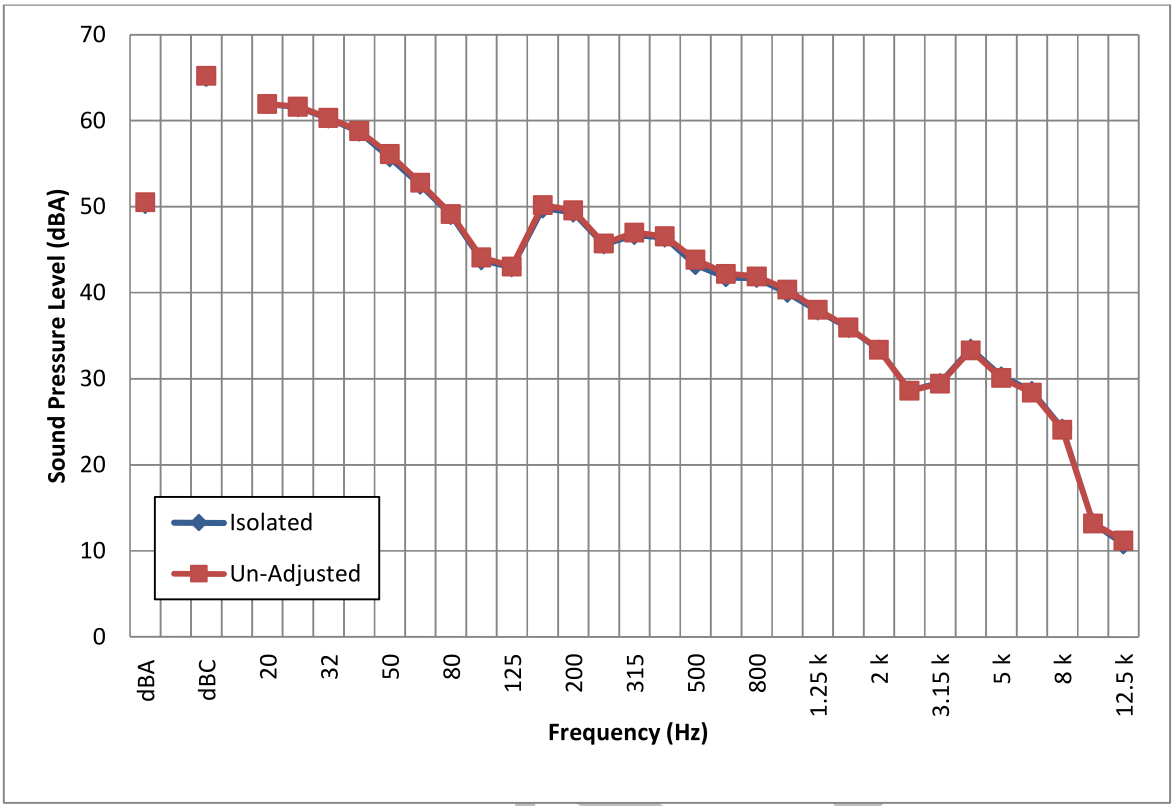


**Figure 11. 1/3 Octave $L_{eq}$ Sound Levels (June 17 – June 18, 2014)**

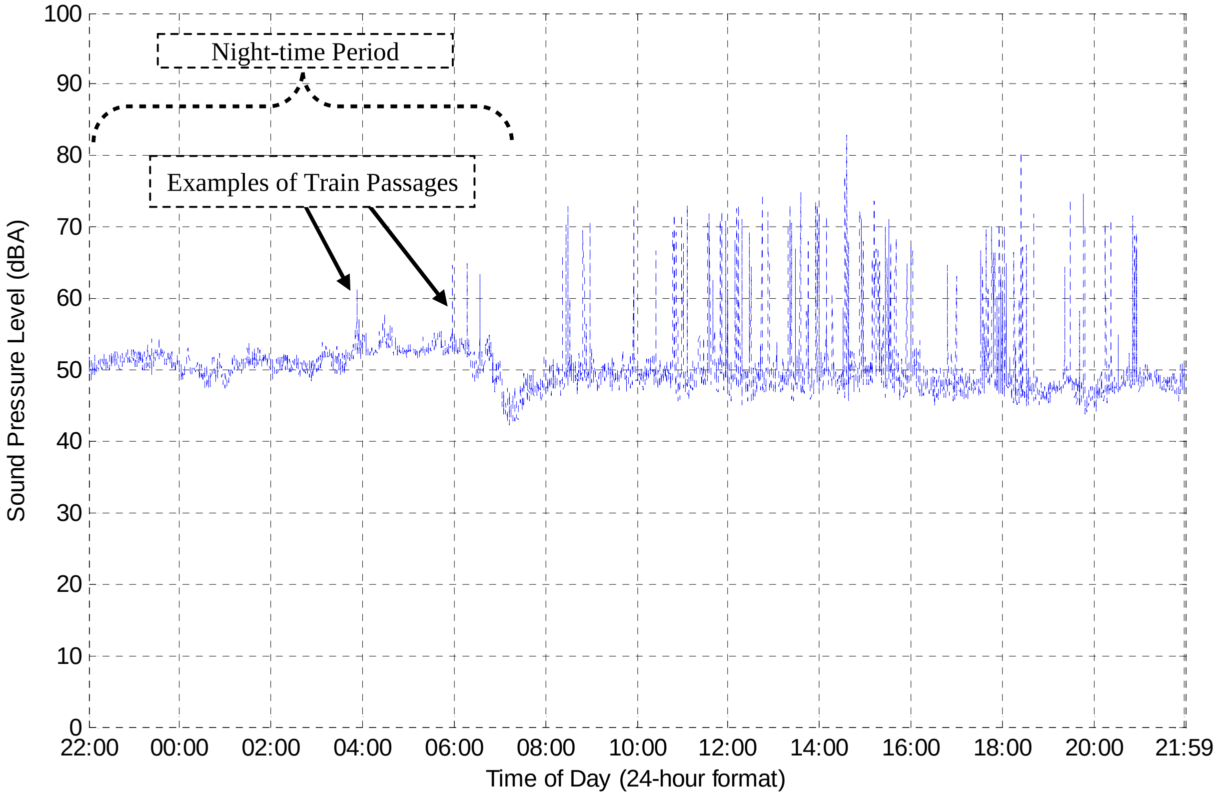


**Figure 12. Un-Adjusted 15-Second $L_{eq}$ Sound Levels (June 25 – June 26, 2014)**

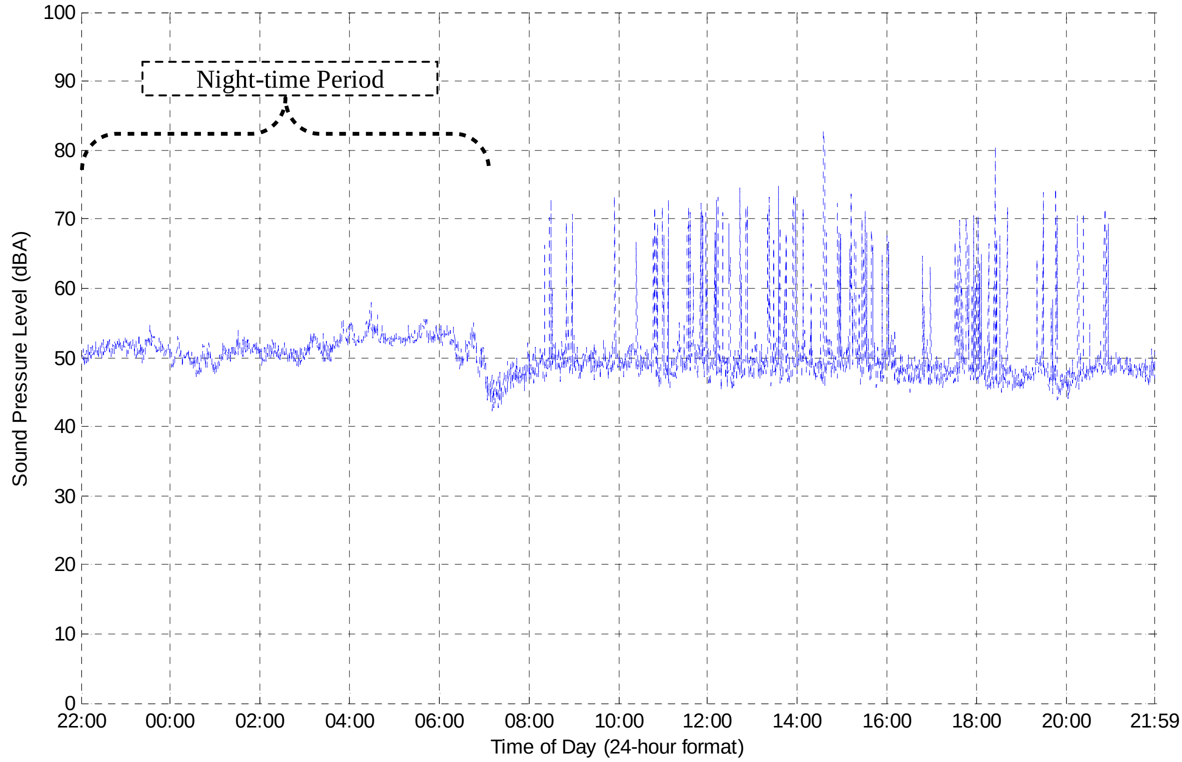


**Figure 13. Isolated 15-Second $L_{eq}$ Sound Levels (June 25 – June 26, 2014)**

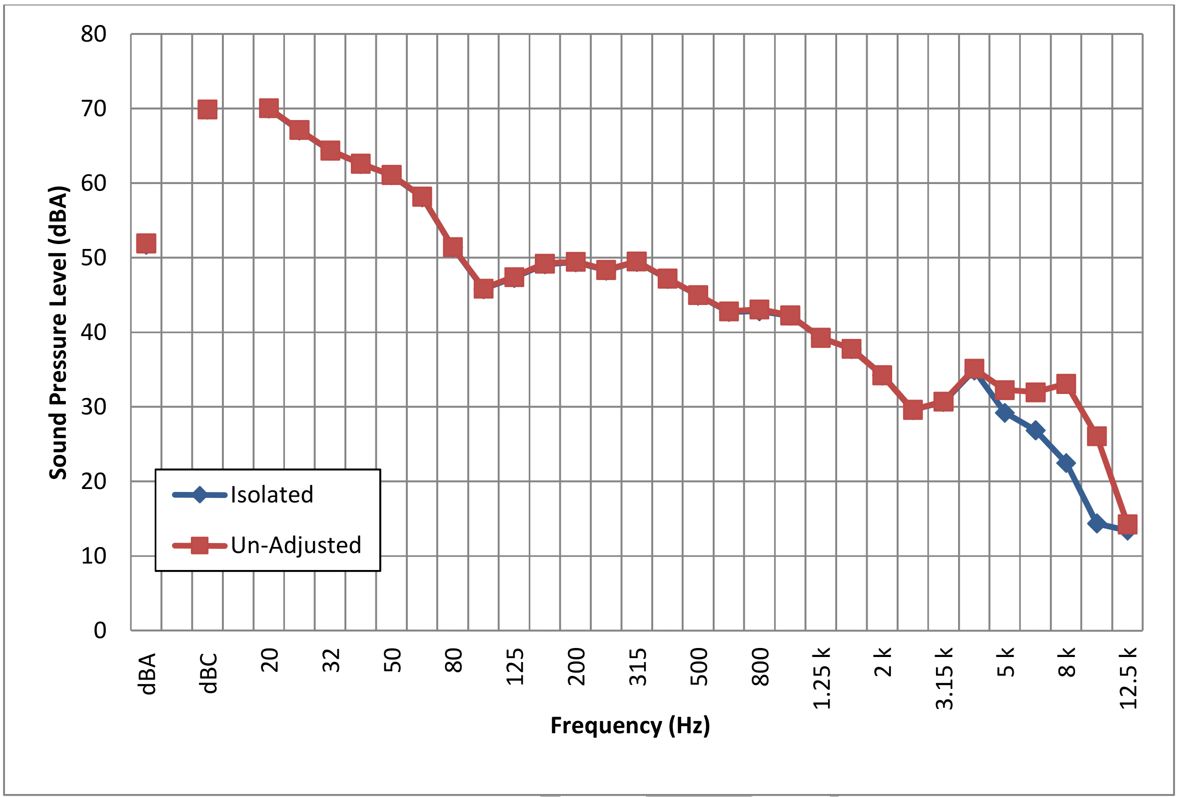


**Figure 14. 1/3 Octave $L_{eq}$ Sound Levels (June 25 – June 26, 2014)**

# Appendix I MEASUREMENT EQUIPMENT USED

**Noise Monitor**

The environmental noise monitoring equipment used consisted of a Brüel and Kjær Type 2270 Precision Integrating Sound Level Meter enclosed in an environmental case, a tripod, a weather protective microphone hood, and 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 October 2, 2012 and the calibrator (type B&K 4231) was certified on June 27, 2013 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. Simultaneous digital audio was recorded directly on the sound level meter using a 3.3 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**

The first weather monitoring equipment 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.

The second weather monitoring used for the study consisted of a NovaLynx 110-WS-16D data acquisition box, with a 200-WS-02E wind-speed and wind-direction sensor, a 110-WS-16TH temperature and relative humidity sensor and a 110-WS-16THS solar radiation shield. The data acquisition box and a battery were located in a weather protective case. The sensors were mounted on a tripod at approximately 4.5m above ground. The system was set up to record data in 5-minute averages obtaining average wind-speed, peak wind-speed, wind-direction, temperature and relative humidity.

**Record of Calibration Results**

| Description | Date | Time | Pre / Post | Calibration Level | Calibrator Model | Serial Number |
|---|---|---|---|---|---|---|
| Noise Monitor | June 12, 2014 | 12:00 | Pre | 93.9 dBA | B&K 4231 | 2575493 |
| Noise Monitor | July 9, 2014 | 11:00 | Post | 93.8 dBA | B&K 4231 | 2575493 |

## B&K 4231 Calibrator Calibration Certificate

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

NVLAP®
NVLAP Lab Code: 200625-0

# Calibration Certificate No.29121

| | |
|---|---|
| *Instrument:* | **Acoustical Calibrator** |
| *Model:* | **4231** |
| *Manufacturer:* | **Brüel and Kjær** |
| *Serial number:* | **2575493** |
| *Class (IEC 60942):* | **1** |
| *Barometer type:* | |
| *Barometer s/n:* | |

*Date Calibrated:* **6/27/2013** *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.**
*Tel/Fax:* **780-414-6373 / -6376**
*Address:* **5031 - 210 Street, 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 | 25747 | Jul 2, 2012 | Scantek, Inc./ NVLAP | Jul 2, 2013 |
| DS-360-SRS | Function Generator | 61646 | Nov 20, 2012 | ACR Env./ A2LA | Nov 20, 2014 |
| 34401A-Agilent Technologies | Digital Voltmeter | MY41022043 | Nov 20, 2012 | ACR Env. / A2LA | Nov 20, 2013 |
| DPI 141-Druck | Pressure Indicator | 790/00-04 | Nov 21, 2012 | ACR Env./ A2LA | Nov 21, 2014 |
| HMP233-Vaisala Oyj | Humidity & Temp. Transmitter | V3820001 | Sep 6, 2012 | ACR Env./ A2LA | Mar 6, 2014 |
| 8903A-HP | Audio Analyzer | 2514A05691 | Dec 1, 2010 | ACR Env./ A2LA | Dec 1, 2013 |
| PC Program 1018 Norsonic | Calibration software | v.5.2 | Validated March 2011 | Scantek, Inc. | - |
| 4134-Brüel&Kjær | Microphone | 456005 | Mar 29, 2013 | Scantek, Inc. / NVLAP | Mar 29, 2014 |
| 1203-Norsonic | Preamplifier | 14059 | Jan 4, 2013 | Scantek, Inc./ NVLAP | Jan 4, 2014 |

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

| **Calibrated by:** | Valentin Buzduga | **Authorized signatory:** | Mariana Buzduga |
|---|---|---|---|
| Signature | [signature] | Signature | [signature] |
| Date | 6/27/2013 | Date | 6/28/2013 |

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## B&K 2270 SLM Calibration Certificate

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

NVLAP®
NVLAP Lab Code: 200625-0

# Calibration Certificate No.27282

*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 / -6376**

*Date Calibrated:* **10/2/2012** *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. 6/22/2012
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 | 25747 | Jul 2, 2012 | Scantek, Inc./ NVLAP | Jul 2, 2013 |
| DS-360-SRS | Function Generator | 61646 | Nov 16, 2011 | ACR Env./ A2LA | Nov 16, 2013 |
| 34401A-Agilent Technologies | Digital Voltmeter | MY41022043 | Dec 9, 2011 | ACR Env. / A2LA | Dec 9, 2012 |
| DPI 141-Druck | Pressure Indicator | 790/00-04 | Dec 13, 2010 | ACR Env./ A2LA | Dec 13, 2012 |
| HMP233-Vaisala Oyj | Humidity & Temp. | V3820001 | Sep 6, 2012 | ACR Env./ A2LA | Mar 6, 2014 |
| PC Program 1019 Norsonic | Calibration software | v.5.2 | Validated Mar 2011 | Scantek, Inc. | - |
| 1251-Norsonic | Calibrator | 30878 | Dec 13, 2011 | Scantek, Inc./ NVLAP | Dec 13, 2012 |

**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 (%) |
|---|---|---|
| 24 °C | 100.067 kPa | 49.4 %RH |

| **Calibrated by:** | Valentin Buzduga | **Authorized signatory:** | Mariana Buzduga |
|---|---|---|---|
| Signature | [signature] | Signature | [signature] |
| Date | 10/02/2012 | Date | 10/02/2012 |

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## B&K 2270 Microphone Calibration Certificate

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

NVLAP®
NVLAP Lab Code: 200625-0

# Calibration Certificate No.27283

*Instrument:* **Microphone**
*Model:* **4189**
*Manufacturer:* **Brüel & Kjær**
*Serial number:* **2643219**
*Composed of:*

*Date Calibrated:* **10/1/2012** *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.**
*Tel/Fax:* **780-414-6373 / -6376**
*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. 11/30/2010

**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 | 25747 | Jul 2, 2012 | Scantek, Inc./ NVLAP | Jul 2, 2013 |
| DS-360-SRS | Function Generator | 61646 | Nov 16, 2011 | ACR Env./ A2LA | Nov 16, 2013 |
| 34401A-Agilent Technologies | Digital Voltmeter | MY41022043 | Dec 9, 2011 | ACR Env. / A2LA | Dec 9, 2012 |
| DPI 141-Druck | Pressure Indicator | 790/00-04 | Dec 13, 2010 | ACR Env./ A2LA | Dec 13, 2012 |
| HMP233-Vaisala Oyj | Humidity & Temp. Transmitter | V3820001 | Sep 6, 2012 | ACR Env./ A2LA | Mar 6, 2014 |
| PC Program 1017 Norsonic | Calibration software | v.5.2 | Validated Mar 2011 | Scantek, Inc. | - |
| 1253-Norsonic | Calibrator | 28326 | Dec 13, 2011 | Scantek, Inc./ NVLAP | Dec 13, 2012 |
| 1203-Norsonic | Preamplifier | 14059 | Jan 3, 2012 | Scantek, Inc./ NVLAP | Jan 3, 2013 |
| 4180-Brüel&Kjær | Microphone | 2246115 | Nov 21, 2011 | NPL-UK / UKAS | Nov 21, 2013 |

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

| **Calibrated by:** | Valentin Buzduga | **Authorized signatory:** | Mariana Buzduga |
|---|---|---|---|
| Signature | | Signature | |
| Date | 10/02/2012 | Date | 10/2/2012 |


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# Appendix II THE ASSESSMENT OF ENVIRONMENTAL NOISE (GENERAL)

## Sound Pressure Level

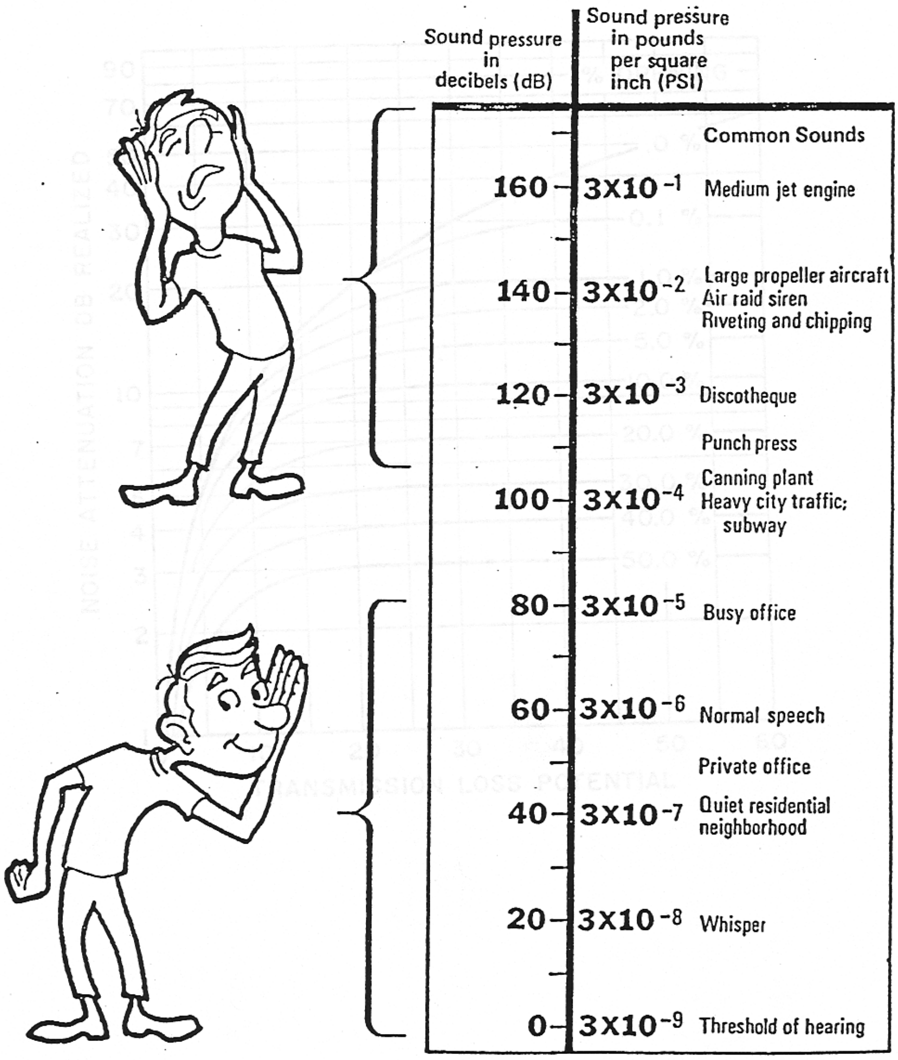
Sound pressure is initially measured in Pascal's (Pa). Humans can hear several orders of magnitude in sound pressure levels, so a more convenient scale is used. This scale is known as the decibel (dB) scale, named after Alexander Graham Bell (telephone guy). It is a base 10 logarithmic scale. When we 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 ($P_{ref} = 2\text{x}10^{-5}$ 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!


Sound pressure in decibels (dB)
Sound pressure in pounds per square inch (PSI)
Common Sounds
160 3X10$^{-1}$ Medium jet engine
140 3X10$^{-2}$ Large propeller aircraft
Air raid siren
Riveting and chipping
120 3X10$^{-3}$ Discotheque
Punch press
100 3X10$^{-4}$ Canning plant
Heavy city traffic; subway
80 3X10$^{-5}$ Busy office
60 3X10$^{-6}$ Normal speech
Private office
40 3X10$^{-7}$ Quiet residential neighborhood
20 3X10$^{-8}$ Whisper
0 3X10$^{-9}$ Threshold of hearing

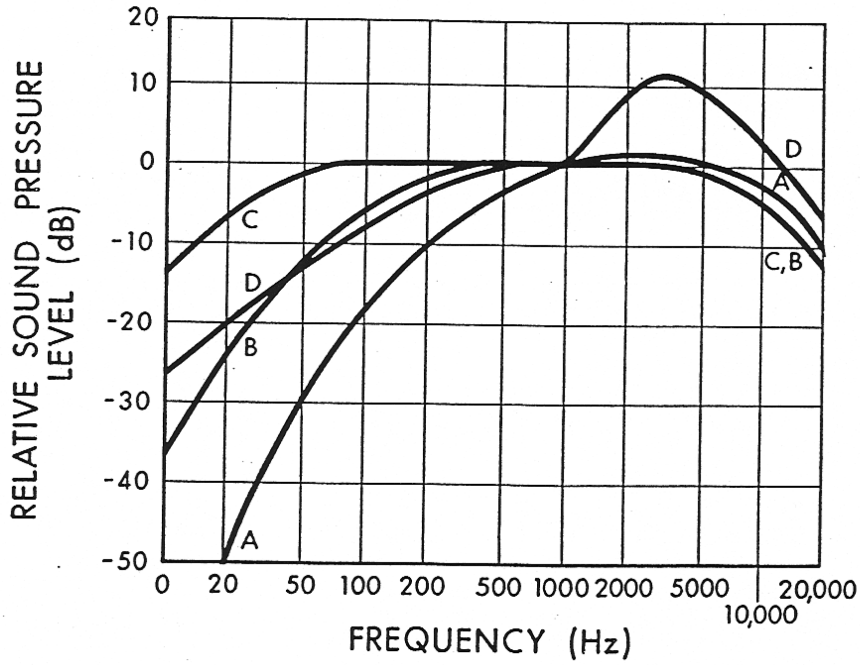
## Frequency

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 | | 1/3 Octave | | |
|---|---|---|---|---|---|
| **Lower Band Limit** | **Center Frequency** | **Upper Band Limit** | **Lower Band Limit** | **Center Frequency** | **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.

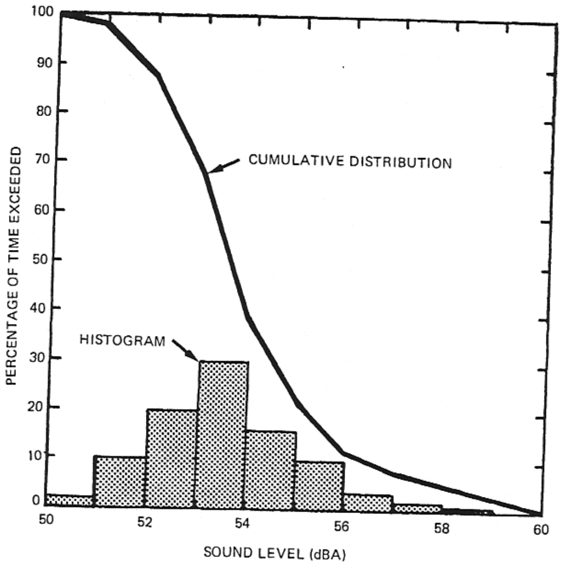



Figure 16.6 Statistically processed community noise showing histogram and cumulative distribution of A weighted sound levels.

*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

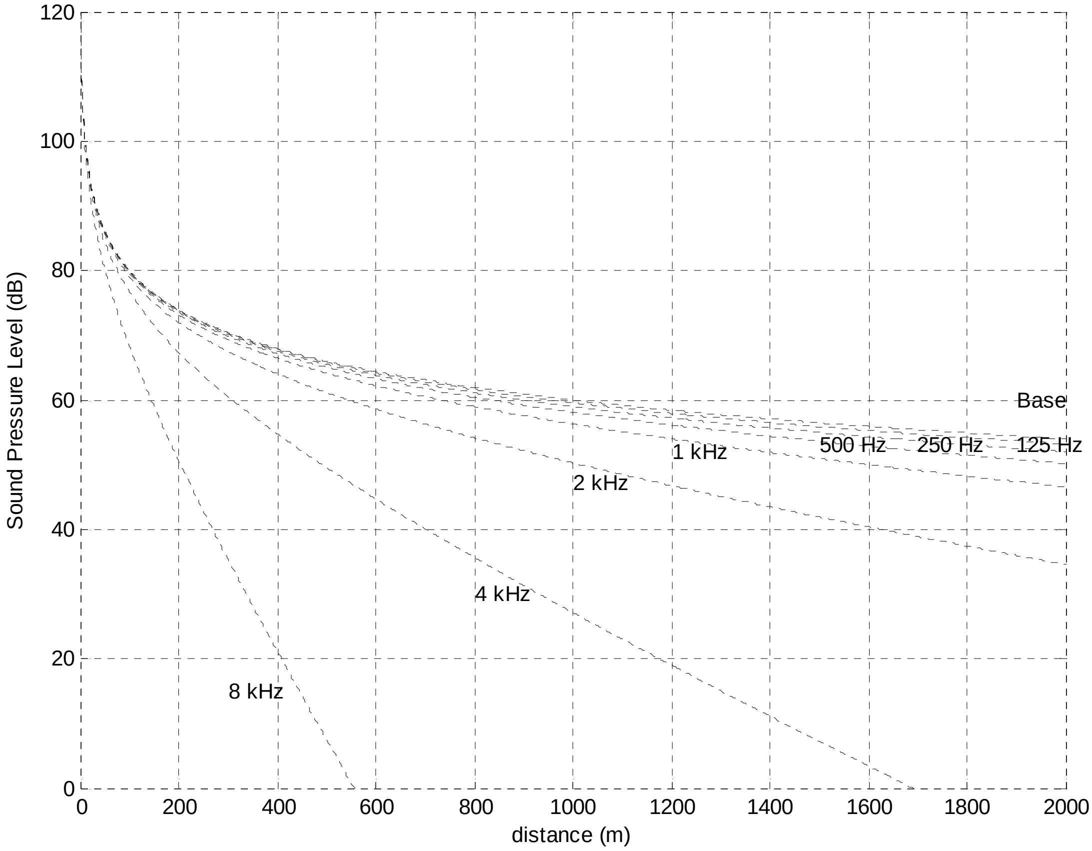
As sound transmits through a medium, there is an attenuation (or dissipation of acoustic energy) which can be attributed to three mechanisms:

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

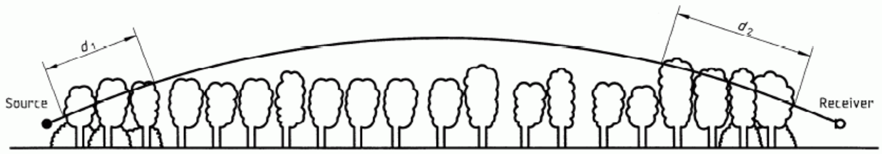
- Can be an effective absorber due to large area covered
- Only effective at low height above ground. Does not affect sound transmitted direct from source to receiver if there is line of sight.
- Typically less absorption than atmospheric absorption when there is line of sight.
- Approximate rule of 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 $d_f$** m | **Nominal midband frequency** Hz 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 AER Guide 38: Noise Control Directive User Guide (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 AER Guide 38: Noise Control Directive User Guide (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 NOISE MONITORING DATA REMOVAL

## June 12 – June 13, 2014

| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 6/12/14 22:00 | 6/12/14 22:00 | 0.5 | Loud Vehicle Passby |
| 6/12/14 22:09 | 6/12/14 22:09 | 0.7 | Train Whistle |
| 6/12/14 22:20 | 6/12/14 22:22 | 2.2 | Train Passby |
| 6/12/14 22:25 | 6/12/14 22:26 | 1.0 | Train Whistle |
| 6/12/14 22:50 | 6/12/14 22:51 | 0.7 | Train Whistle |
| 6/12/14 22:57 | 6/12/14 22:58 | 1.0 | Train Passby |
| 6/12/14 23:00 | 6/12/14 23:02 | 1.2 | Train Passby |
| 6/12/14 23:04 | 6/12/14 23:04 | 0.7 | Unknown Whistle |
| 6/12/14 23:07 | 6/12/14 23:08 | 0.7 | Banging |
| 6/12/14 23:10 | 6/12/14 23:13 | 2.8 | Train Passby |
| 6/12/14 23:14 | 6/12/14 23:15 | 1.0 | Train Whistle |
| 6/12/14 23:20 | 6/12/14 23:22 | 1.5 | Train Whistle |
| 6/13/14 00:09 | 6/13/14 00:11 | 2.0 | Train Passby |
| 6/13/14 00:26 | 6/13/14 00:28 | 1.5 | Idling Train and Whistle |
| 6/13/14 00:33 | 6/13/14 00:35 | 1.8 | Train Passby |
| 6/13/14 00:39 | 6/13/14 00:42 | 2.5 | Loud Vehicle Passby |
| 6/13/14 01:32 | 6/13/14 01:33 | 1.0 | Train Passby |
| 6/13/14 01:37 | 6/13/14 01:39 | 1.7 | Train Passby |
| 6/13/14 01:48 | 6/13/14 01:50 | 1.8 | Train Passby |
| 6/13/14 01:53 | 6/13/14 01:54 | 1.5 | Train Passby |
| 6/13/14 02:03 | 6/13/14 02:04 | 0.7 | Train Whistle |
| 6/13/14 02:16 | 6/13/14 02:17 | 1.3 | Train Passby |
| 6/13/14 02:17 | 6/13/14 02:20 | 3.0 | Train Passby |
| 6/13/14 02:30 | 6/13/14 02:32 | 2.0 | Train Passby |
| 6/13/14 03:04 | 6/13/14 03:06 | 1.7 | Train Passby |
| 6/13/14 03:13 | 6/13/14 03:14 | 1.0 | Train Whistle |
| 6/13/14 03:39 | 6/13/14 03:40 | 1.2 | Train Passby |
| 6/13/14 04:27 | 6/13/14 04:28 | 1.0 | Train Passby |
| 6/13/14 04:28 | 6/13/14 04:29 | 1.0 | Train Passby |
| 6/13/14 06:32 | 6/13/14 06:38 | 6.0 | Non-typical Event |
| 6/13/14 06:41 | 6/13/14 06:42 | 1.5 | Non-typical event |
| 6/13/14 06:48 | 6/13/14 06:50 | 2.3 | Loud Vehicle Passby |
| | TOTAL DATA | 50.7 | |

## June 16 – June 17, 2014

| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 6/16/14 23:29 | 6/16/14 23:30 | 0.7 | Train Whistle |
| 6/17/14 00:23 | 6/17/14 00:25 | 1.3 | Whistle from other equipment |
| 6/17/14 00:32 | 6/17/14 00:33 | 1.0 | Train Whistle |
| 6/17/14 00:53 | 6/17/14 00:55 | 2.0 | Helicopter |
| 6/17/14 01:54 | 6/17/14 01:55 | 1.2 | Train Whistle |
| 6/17/14 02:43 | 6/17/14 02:44 | 1.5 | Aircraft Flyover |
| 6/17/14 04:17 | 6/17/14 04:20 | 2.5 | Train Passby |
| 6/17/14 04:25 | 6/17/14 04:26 | 1.0 | Train Passby |
| 6/17/14 05:23 | 6/17/14 05:23 | 0.5 | Train Whistle |
| 6/17/14 05:59 | 6/17/14 06:00 | 1.5 | Excessive Bird Noise |
| | **TOTAL DATA** | **13.2** | |

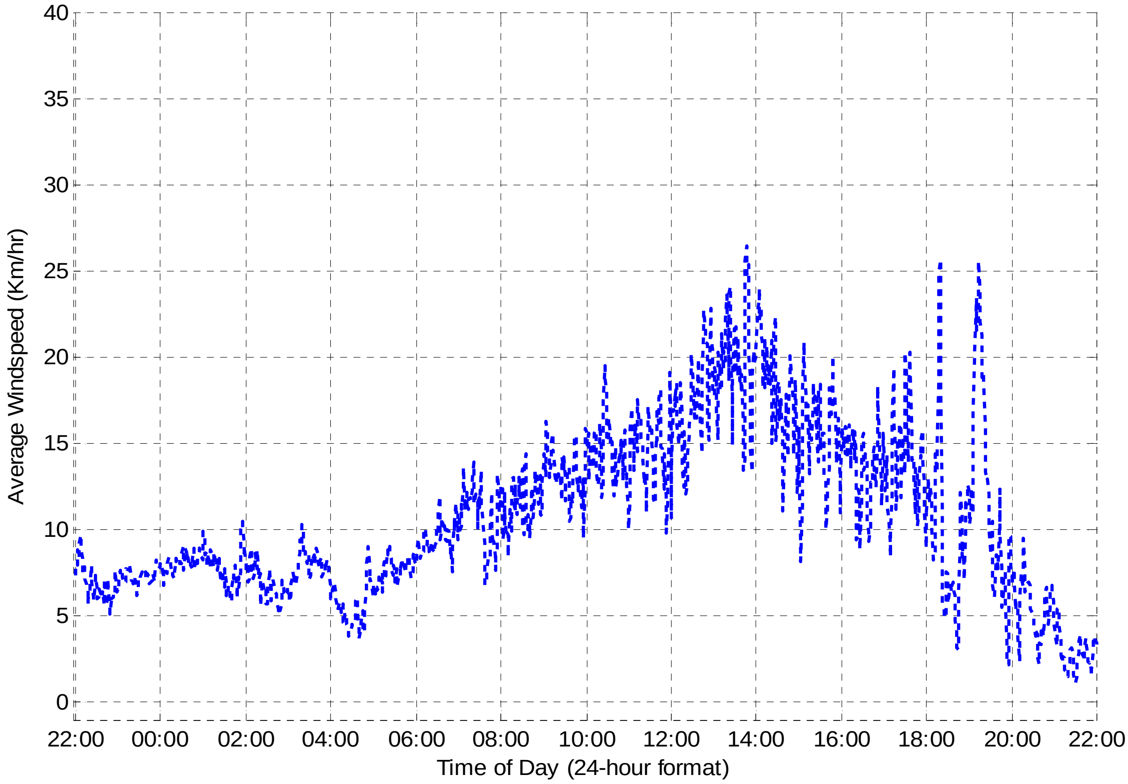
## June 17 – June 18, 2014

| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 6/17/14 22:15 | 6/17/14 22:16 | 0.5 | Loud Vehicle Passby |
| 6/17/14 22:18 | 6/17/14 22:22 | 4.2 | Loud Vehicle Passby |
| 6/17/14 22:24 | 6/17/14 22:27 | 3.2 | Train Passby |
| 6/17/14 22:28 | 6/17/14 22:29 | 1.3 | Train Whistle |
| 6/17/14 22:31 | 6/17/14 22:32 | 1.0 | Train Passby |
| 6/17/14 23:17 | 6/17/14 23:19 | 1.5 | Train Passby |
| 6/18/14 00:27 | 6/18/14 00:28 | 1.5 | Helicopter |
| 6/18/14 01:10 | 6/18/14 01:11 | 1.2 | Train Whistle |
| 6/18/14 01:31 | 6/18/14 01:32 | 0.7 | Train Whistle |
| 6/18/14 01:33 | 6/18/14 01:34 | 1.0 | Train Whistle |
| 6/18/14 01:41 | 6/18/14 01:41 | 0.5 | Train Whistle |
| 6/18/14 02:08 | 6/18/14 02:09 | 0.7 | Train Whistle |
| 6/18/14 02:20 | 6/18/14 02:21 | 0.7 | Train Whistle |
| 6/18/14 02:22 | 6/18/14 02:23 | 0.7 | Train Whistle |
| 6/18/14 02:27 | 6/18/14 02:28 | 1.3 | Train Whistle |
| 6/18/14 02:29 | 6/18/14 02:30 | 0.7 | Train Whistle |
| 6/18/14 02:39 | 6/18/14 02:44 | 4.7 | Train Passby |
| 6/18/14 02:45 | 6/18/14 02:46 | 0.7 | Non-typical Event |
| 6/18/14 03:04 | 6/18/14 03:05 | 0.7 | Train Passby |
| 6/18/14 03:07 | 6/18/14 03:08 | 1.0 | Train Passby |
| 6/18/14 03:19 | 6/18/14 03:23 | 3.5 | Train Passby |
| 6/18/14 03:23 | 6/18/14 03:25 | 2.8 | Train Passby |
| 6/18/14 04:37 | 6/18/14 04:40 | 2.5 | Train Passby |
| 6/18/14 05:48 | 6/18/14 05:49 | 0.7 | Train Whistle |
| 6/18/14 05:53 | 6/18/14 05:54 | 1.0 | Train Whistle |
| | **TOTAL DATA** | **38.7** | |

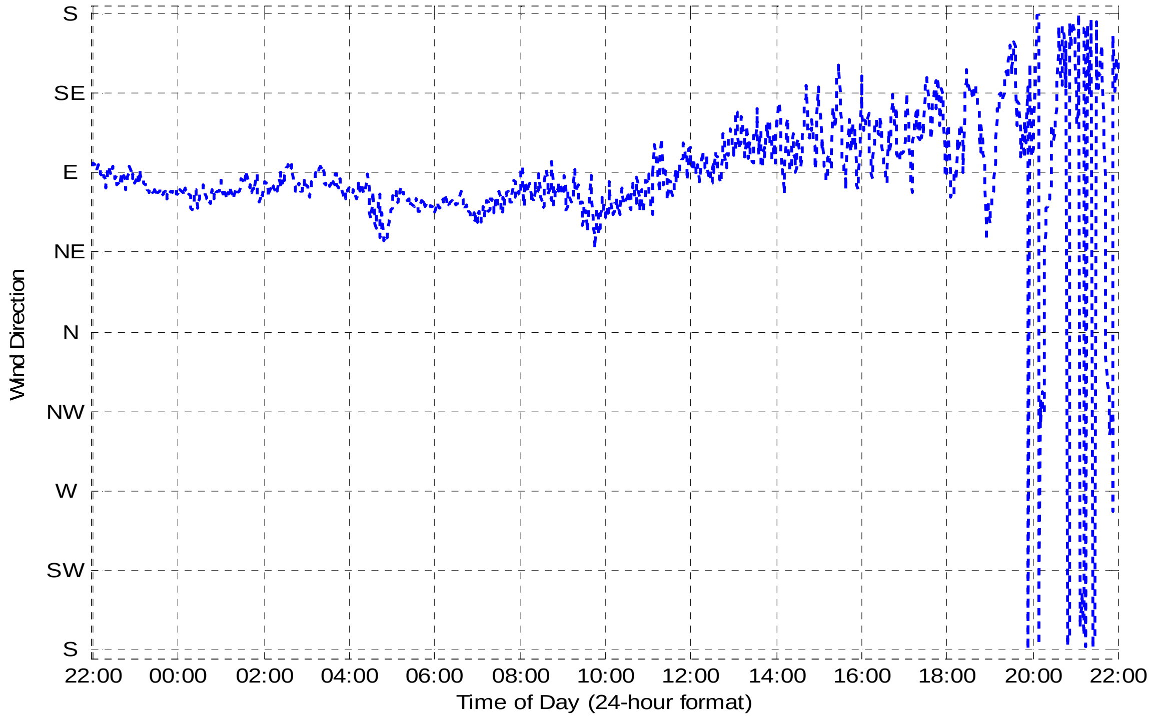
**June 25 – 26, 2014**

| Start Time | End Time | Duration (min) | Reason |
|---|---|---|---|
| 6/25/14 23:23 | 6/25/14 23:23 | 0.25 | Aircraft Flyover |
| 6/26/14 03:51 | 6/26/14 03:55 | 4.00 | Train Passby |
| 6/26/14 05:56 | 6/26/14 05:58 | 1.75 | Train Passby |
| 6/26/14 06:16 | 6/26/14 06:17 | 0.75 | Train Passby |
| 6/26/14 06:32 | 6/26/14 06:34 | 1.50 | Train Passby |
| | TOTAL DATA | 8.2 | |

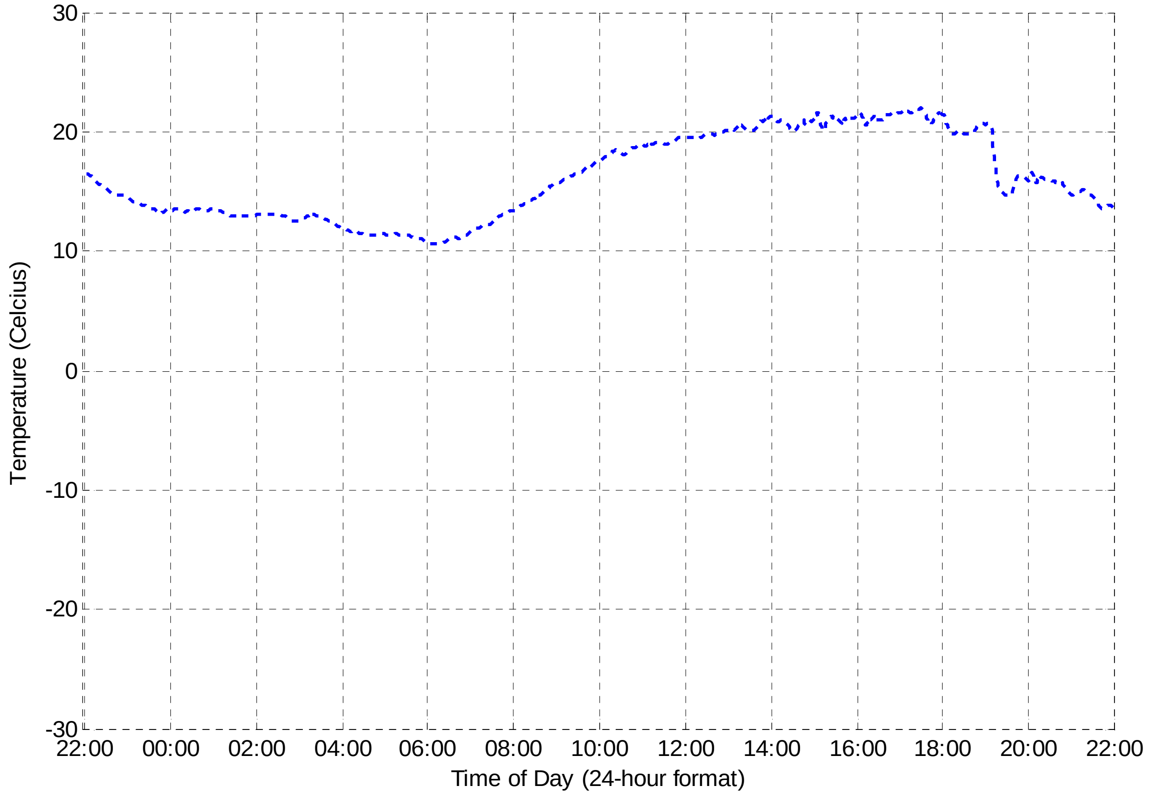
# Appendix V WEATHER DATA



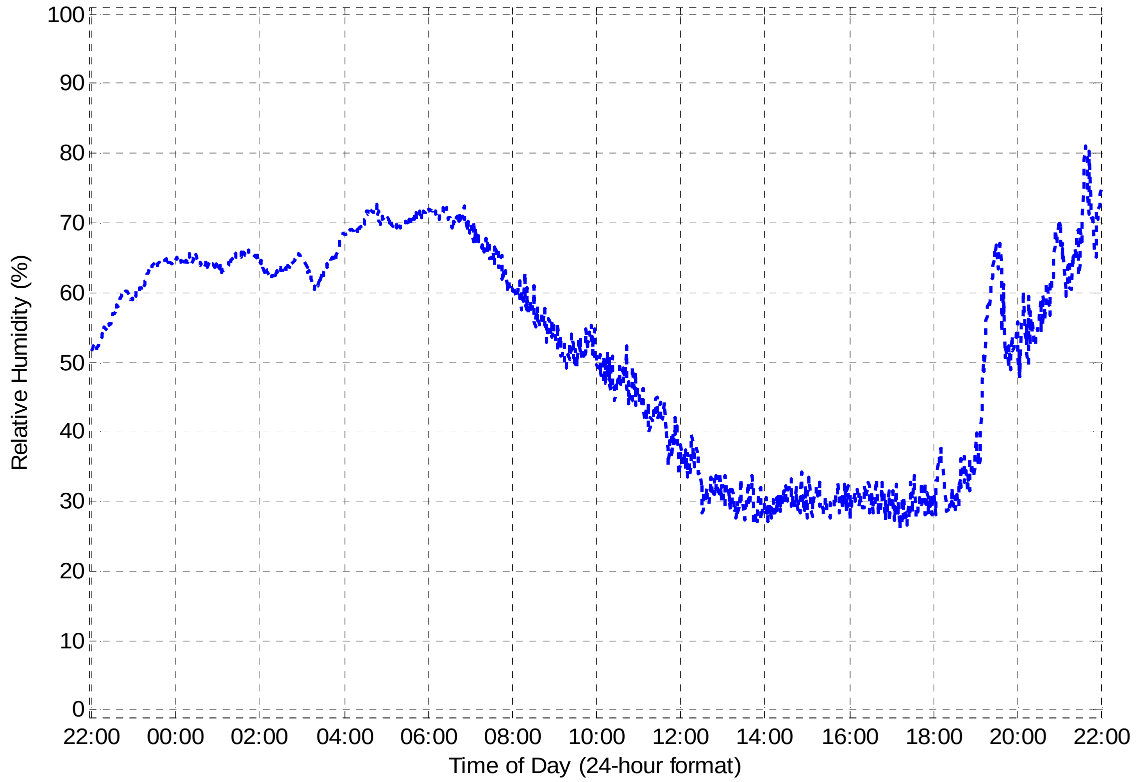

**Monitored Wind Speed (June 12 – June 13, 2014)**



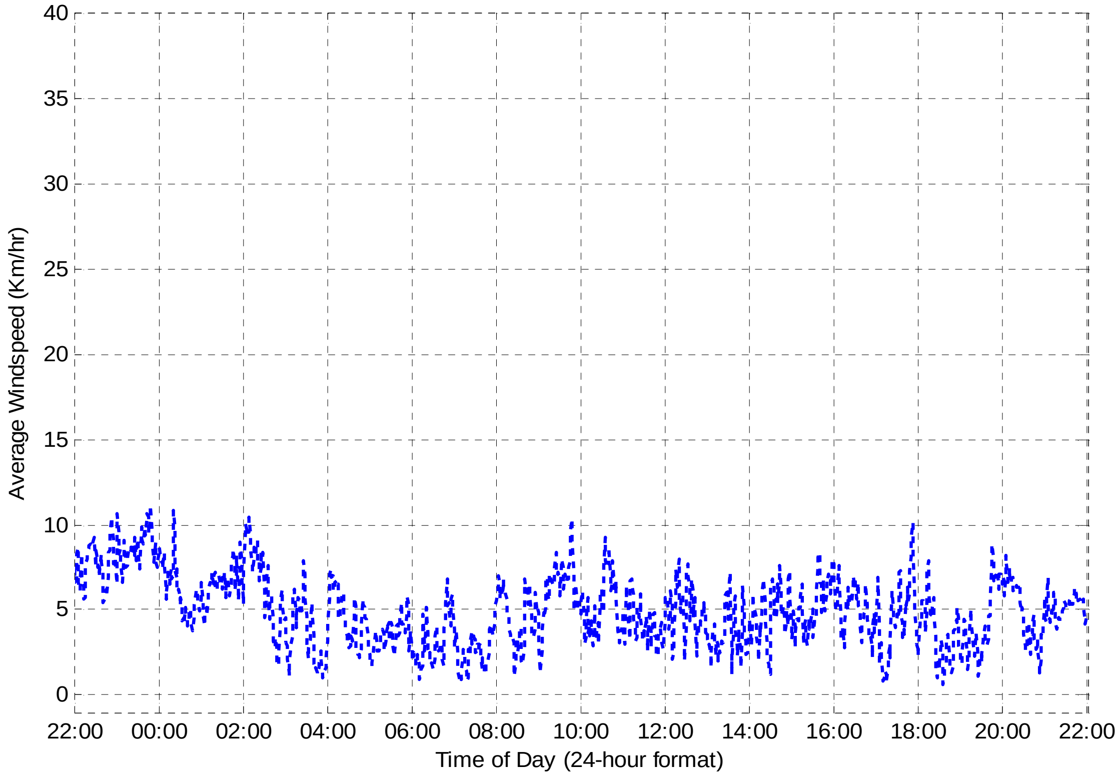

**Monitored Wind Direction (June 12 – June 13, 2014)**



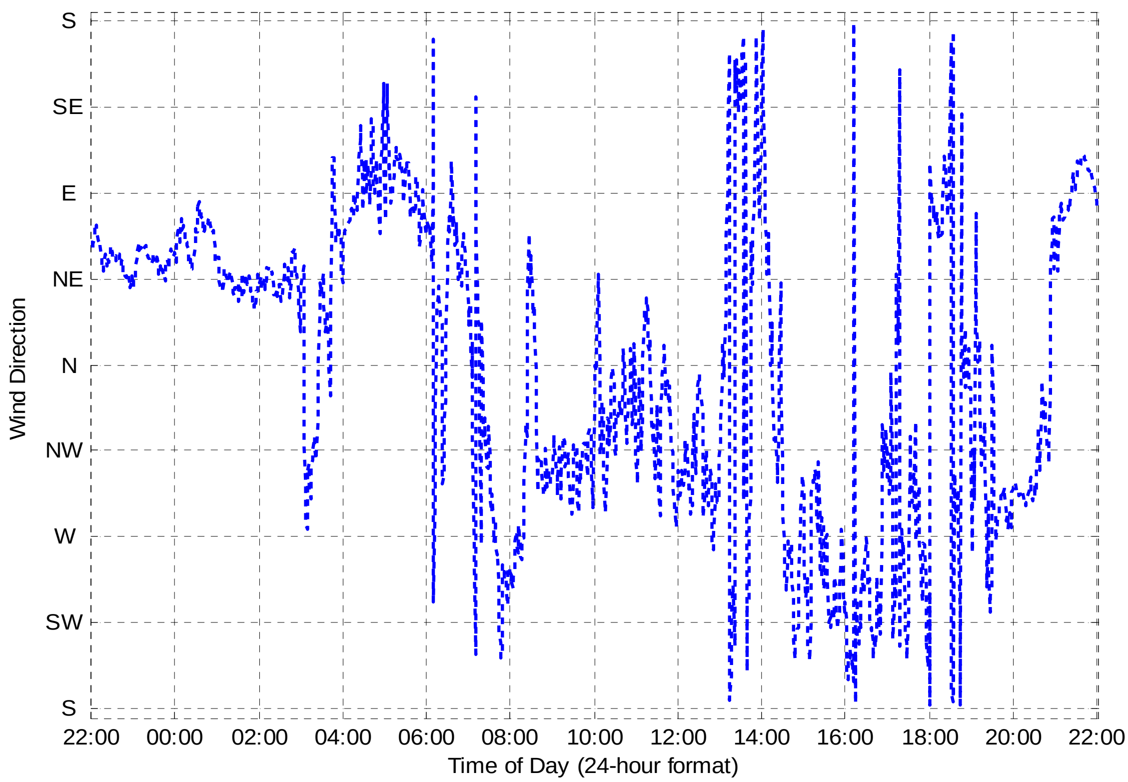

**Monitored Temperature (June 12 – June 13, 2014)**



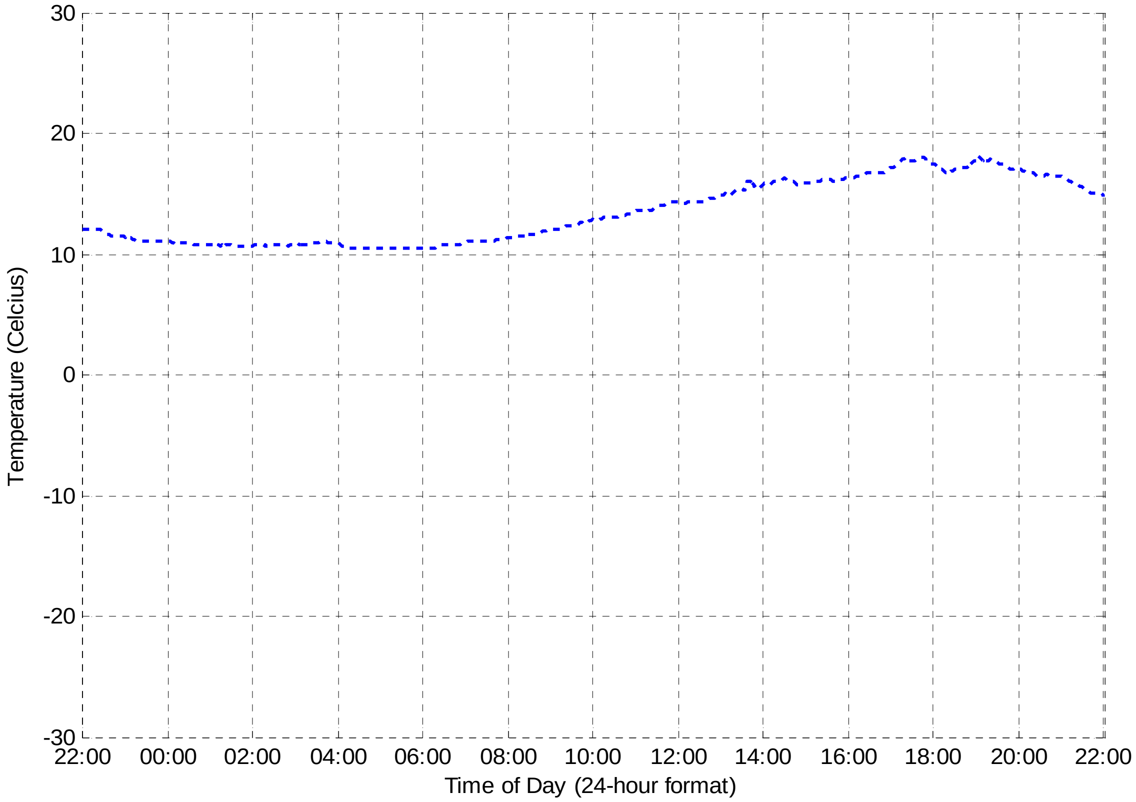

**Monitored Humidity (June 12 – June 13, 2014)**



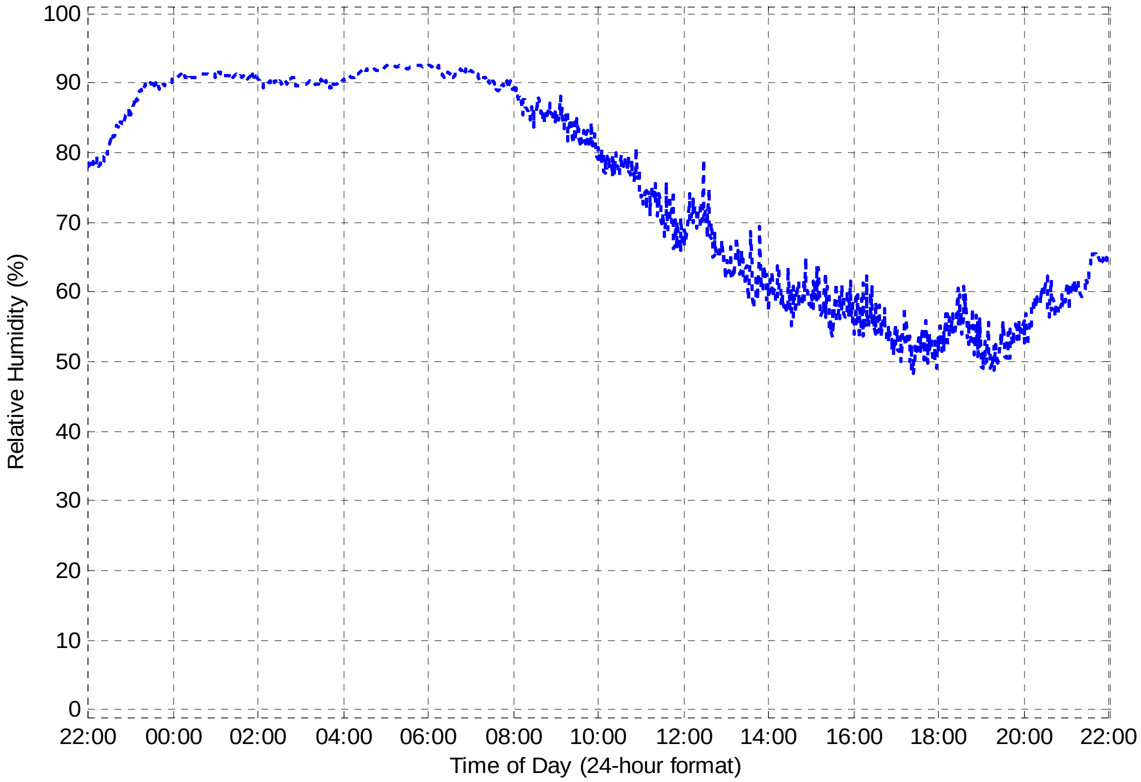

**Monitored Wind Speed (June 16 – June 17, 2014)**



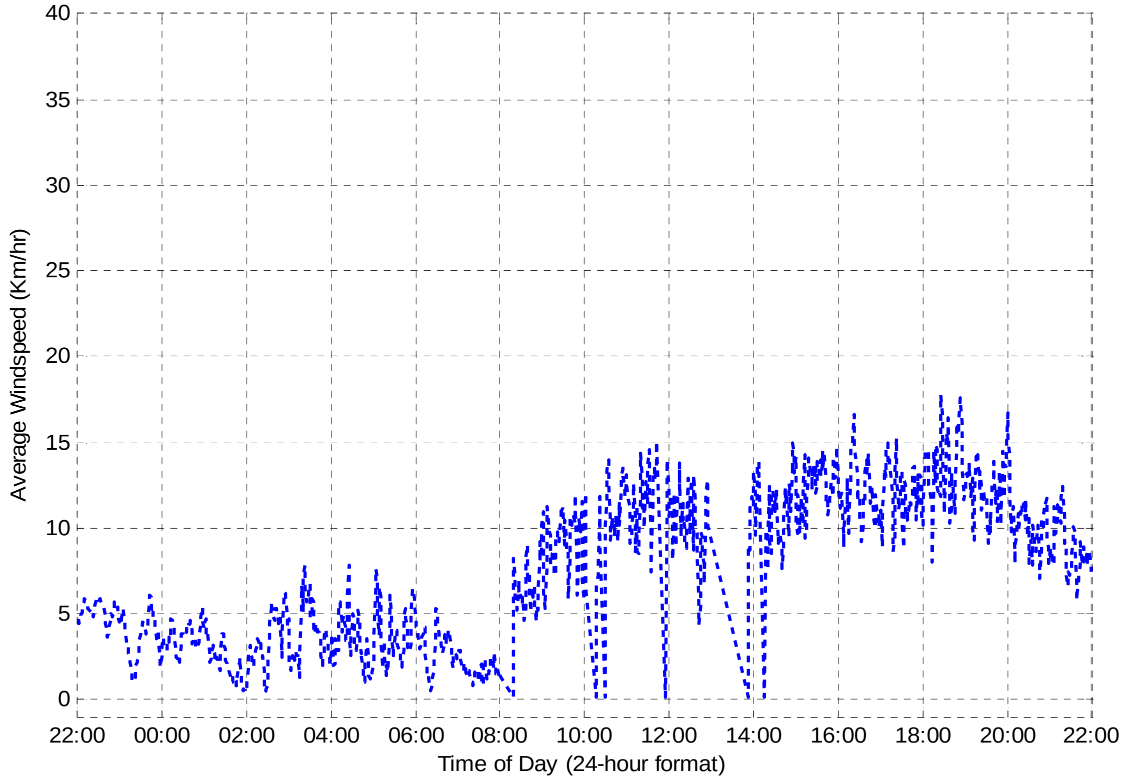

**Monitored Wind Direction (June 16 – June 17, 2014)**



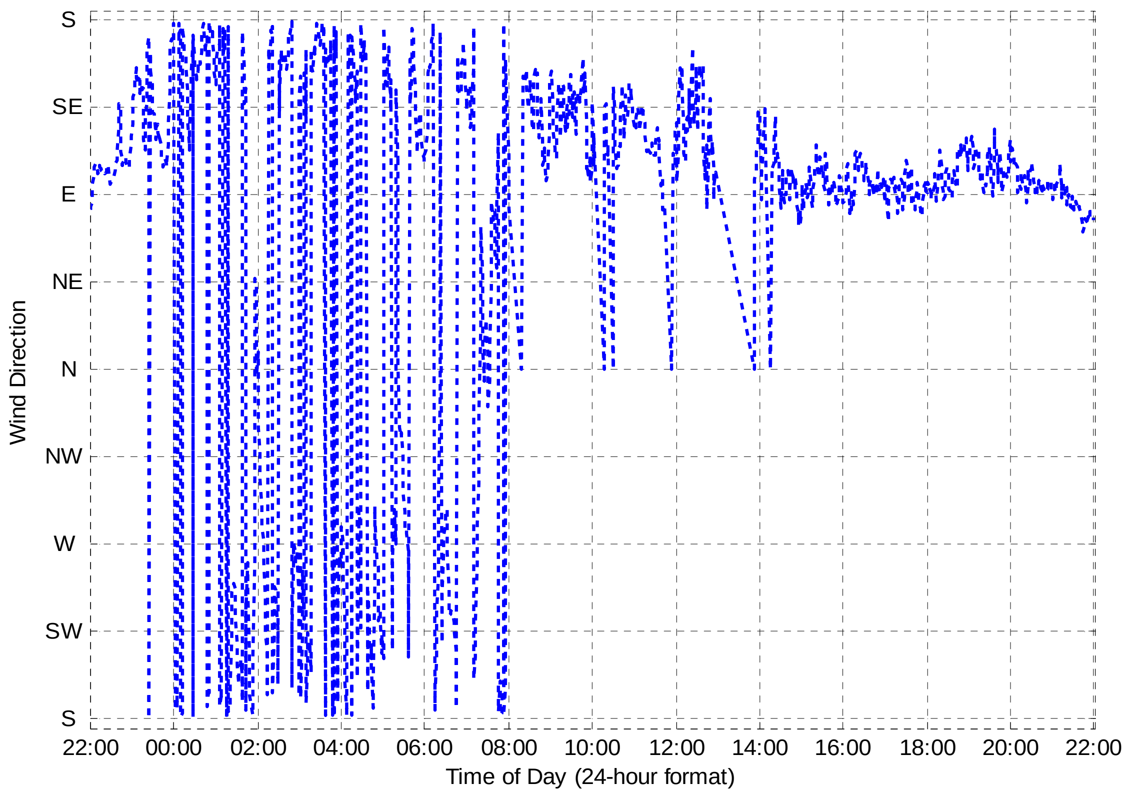

**Monitored Temperature (June 16 – June 17, 2014)**




**Monitored Humidity (June 16 – June 17, 2014)**




**Monitored Wind Speed (June 17 – June 18, 2014)**

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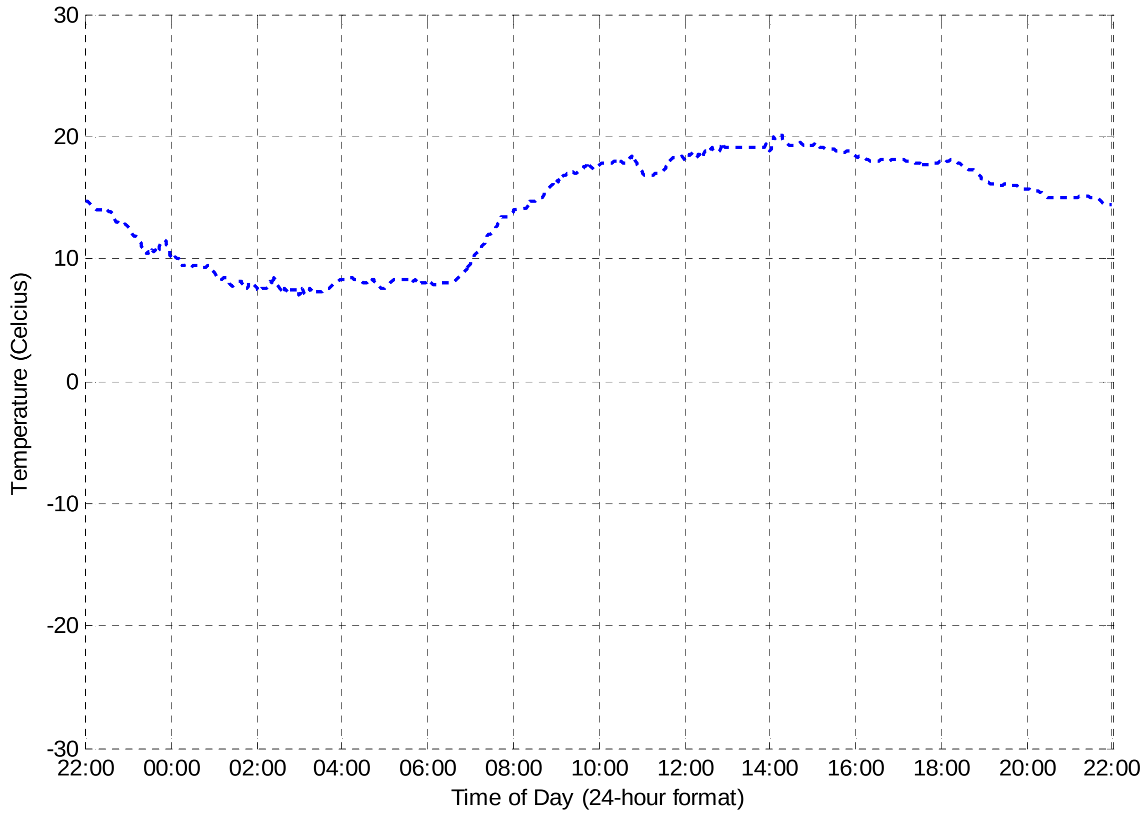
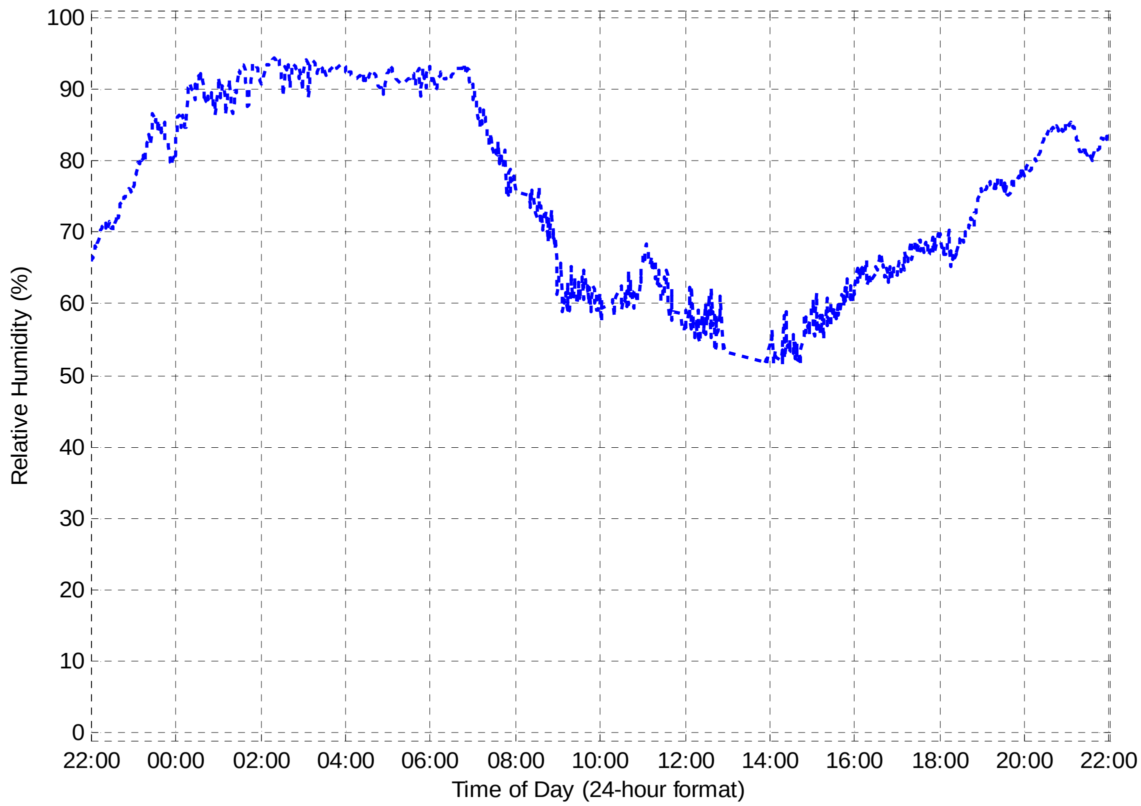
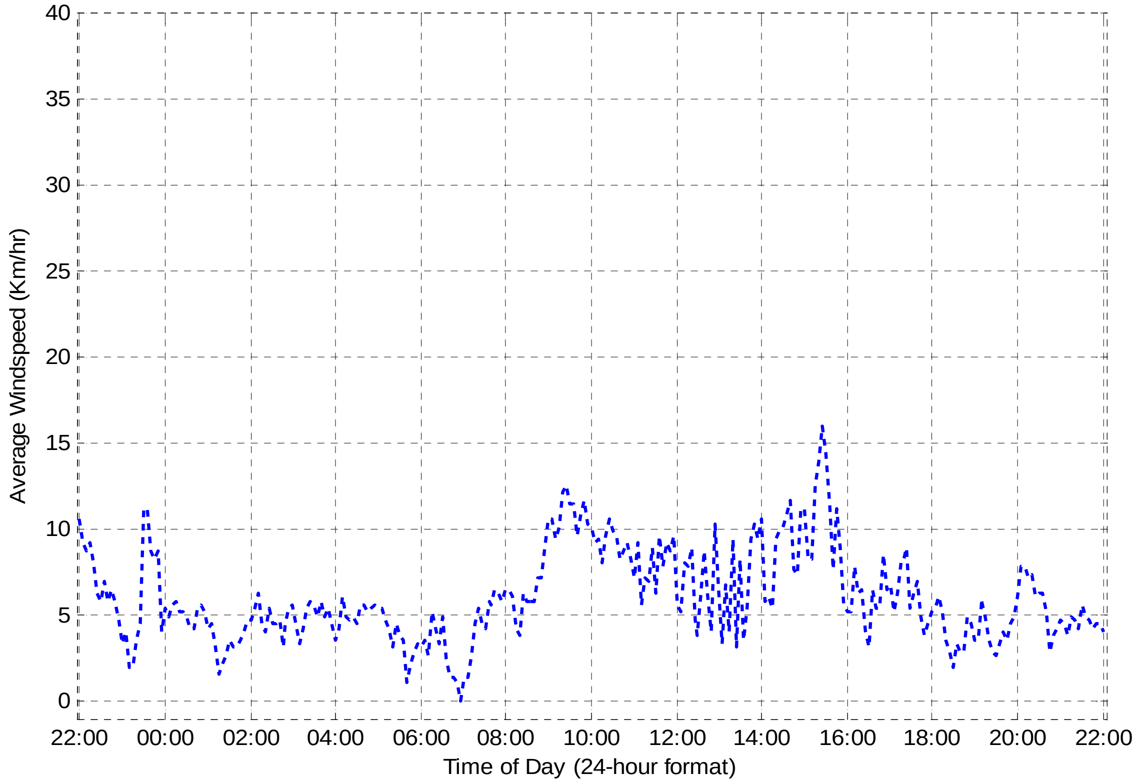


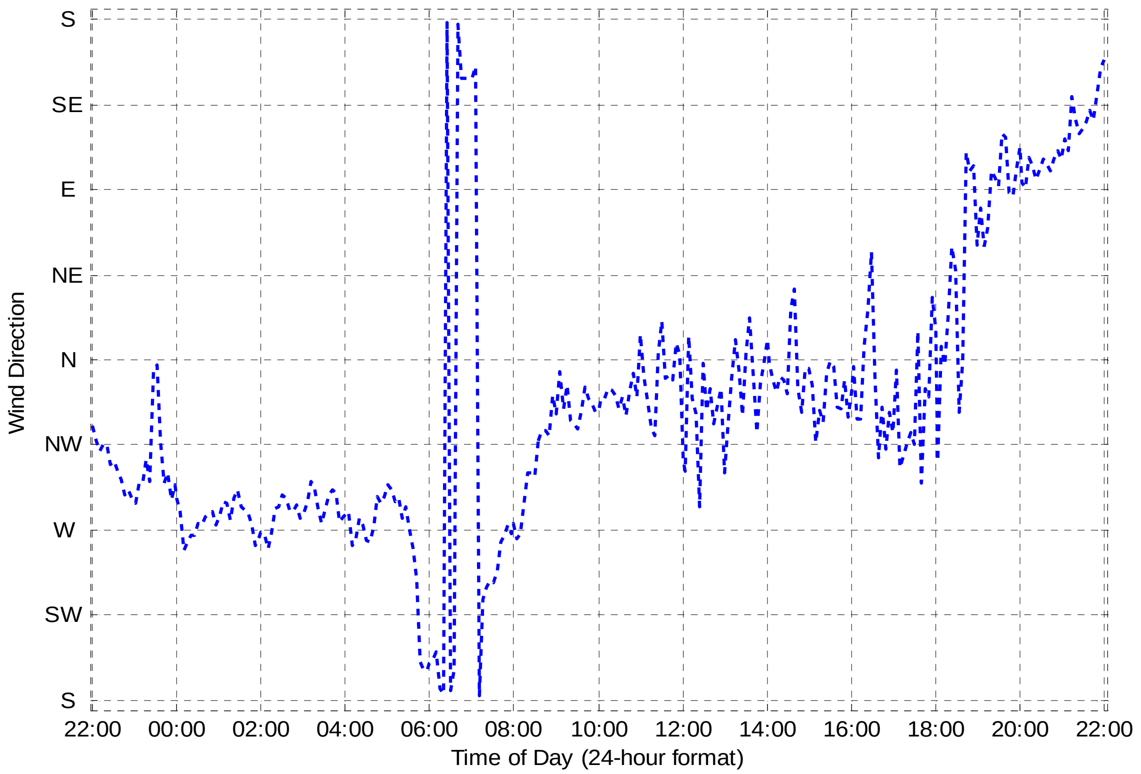

**Monitored Temperature (June 17 – June 18, 2014)**



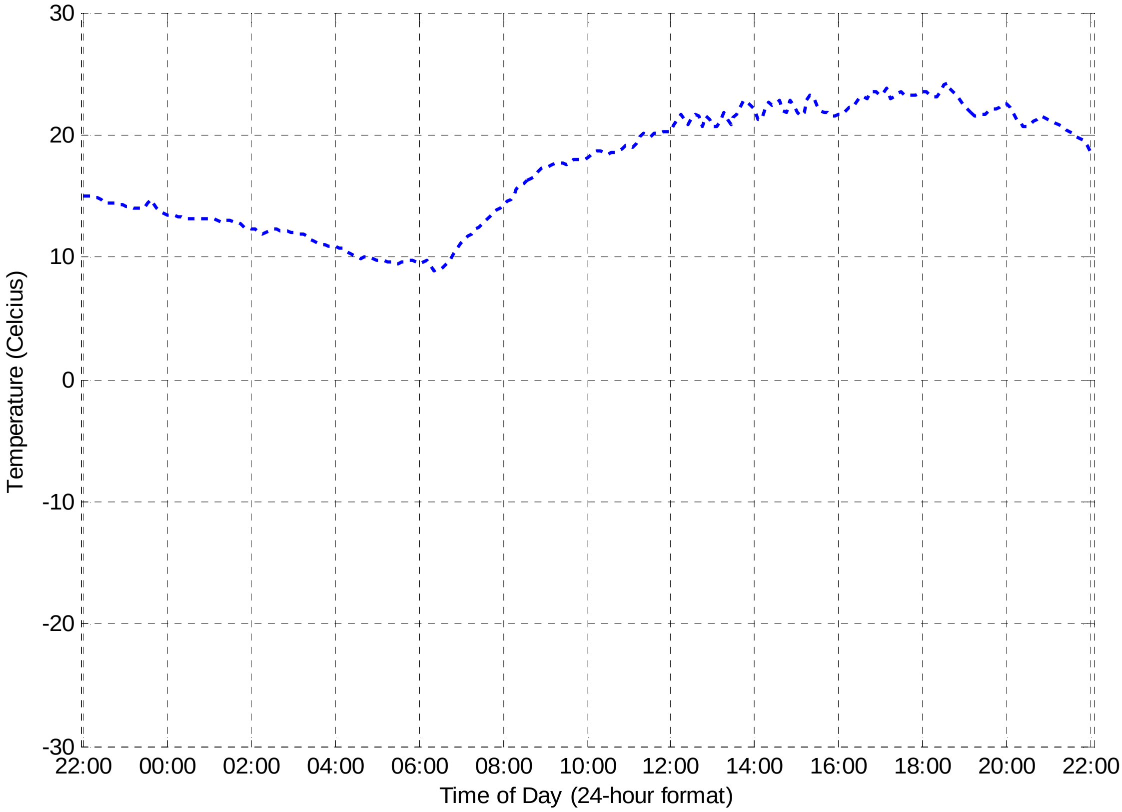

**Monitored Humidity (June 17 – June 18, 2014)**



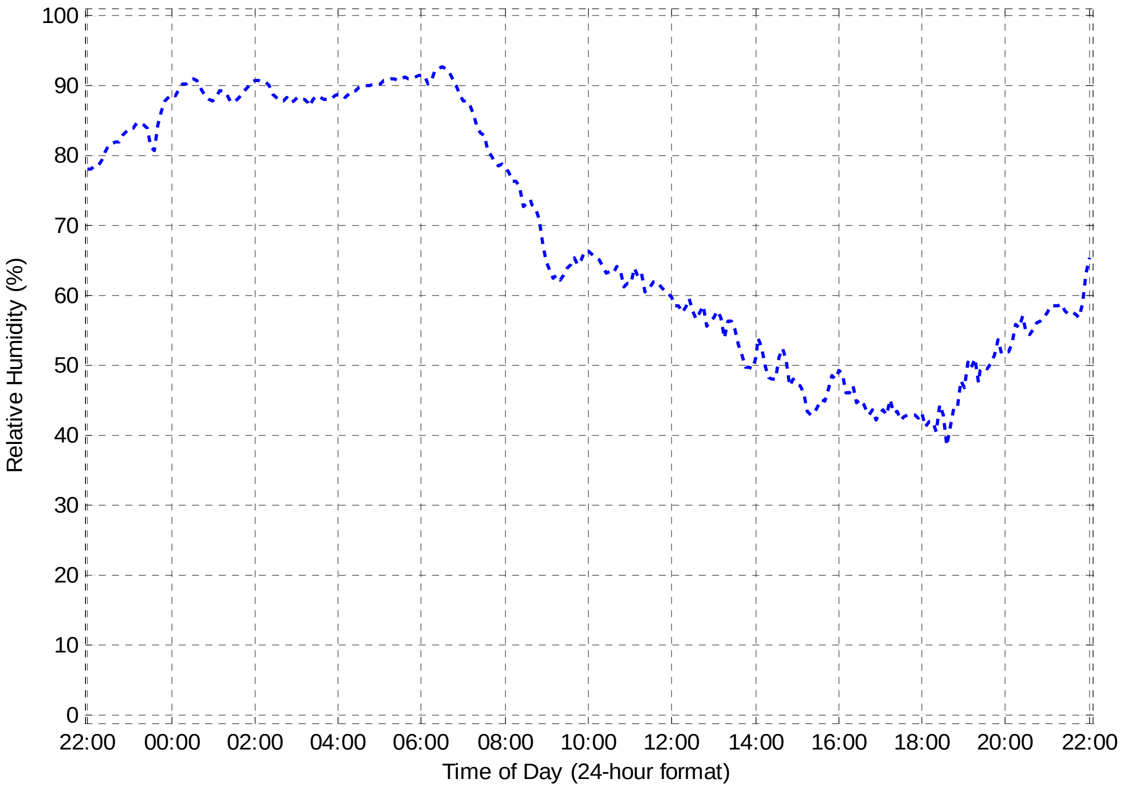

**Monitored Wind Speed (June 25 – June 26, 2014)**




**Monitored Wind Direction (June 25 – June 26, 2014)**




**Monitored Temperature (June 25 – June 26, 2014)**




**Monitored Humidity (June 25 – June 26, 2014)**

Candy Wagner, CRSP, ROHT
Health and Safety Advisor: Hygiene
Sherritt International Corporation
10101-114 Street Box 3388
Fort Saskatchewan, Alberta
Canada, T8L 2T3

August 24, 2015

Dr. Laurie J. Danielson
Executive Director
Northeast Capital Industrial Association

RE: 2014 Sherritt/Corefco Noise Management Report

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This is the 2014 annual summary of Sherritt International's Noise Management activity at the Fort Saskatchewan operating facility as a participating member of the NCIA. Sherritt is committed to work towards the reduction of noise that may affect neighbouring communities and within the plant boundaries.

**Sherritt International Noise Management Plan**

The Sherritt Noise Management Code of Practice (FSSMP001-021) was implemented in 2013. This document addresses all of the requirements that are outlined by the NCIA (NMP Standard – April 14, 2014 Final). Copies of the site Noise Management Code of Practices were shared with the NCIA in 2014. Sherritt International continues to utilize these documents as guidance for Noise Management activities at the Fort Saskatchewan site.

**Environmental Noise Studies (fence line outward)**

The last fence line noise modeling study was completed in October of 2013. No additional environmental noise studies have been completed since then.

A third party has been contracted in August 2015 to conduct a fence line monitoring study to confirm that Sherritt's site noise model is still accurate and to ensure we provide a credible contribution to the Regional Noise Model.

**Improvements/corrective actions**

Specific projects in 2014 at the Fort Saskatchewan Site that contribute to the overall Noise Management Plan are as follows:

- The Ammonia Sulphate plant updated the air hammer system on TK-213 reducing the noise produced by the dust suppression system by 12% and reduced the hearing protection requirements of the building from double hearing protection to single hearing protection.

**Noise Complaint's**

There were no noise complaints in 2014.

If there are any questions about the contents of this report, please feel free to contact me at (780) 992 -7115 or email me at cwagner@sherrittmetals.com

Sincerely,

Candy Wagner, CRSP, ROHT

| 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 14-Apr-14 | Rev. 2 |

**Insert your Company Name here:** UMICORE 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, including the Procedure/Practice/Standard reference.<br><br>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.<br><br>Reference to 'environmental noise' included in the Umicore Canada Inc. Air Quality Management Program (COP-319-2) |
| Attach results of any monitoring/assessments (fence line outward) completed in 2014.<br><br>Note, you are not required to conduct any off-site monitoring, however if you did, please provide those results electronically to NCIA. | Not applicable – noise monitoring conducted inside the plant from an industrial hygiene perspective |
| Disclose any improvements/corrective actions implemented in 2014 or status thereof that would impact the noise level output for your site (either up or down).<br><br>Did those changes result in a requirement to update your site noise model?<br><br>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.<br><br>No changes made in 2014 that would impact noise levels. |

| | |
|---|---|
| Disclose any improvements/projects that are approved for 2015 that would impact the noise level output for your site (either up or down).<br><br>Will these changes result in a requirement to update your site noise model?<br><br>If so, when do you anticipate having an updated site model available? | Removed previously decommissioned (2009) Nickel Pilot Plant equipment in early 2015 in order to install new Nitrogen Generation system:<br>• The nitrogen will be generated using a separation membrane system whereby the air will separated to produce 600 m³/hr of purified nitrogen at 830 kPa for inert blanketing of process applications then ultimately released to atmosphere, and 800 m³/hr of nitrogen-depleted air that will be released to atmosphere<br>• The air that feeds the membrane banks will be compressed using a pair of rotary screw compressors. The air compressor system will be generate air at 1390 kPa at a rate of up to 1400 m³/hr.<br>• As per the manufacturer (Kaeser) of the two air compressors, the single speed and variable speed air compressors have rated sound pressure levels of 69 dBA and 70 dBA respectively per ISO 2151 using ISO 9614-2. Both air compressors will be located inside the UCI production facility, therefore, noise assessments from an industrial hygiene perspective will conducted during commissioning to ensure the manufacturer specifications are met<br>• The exhaust vent from the nitrogen separation membrane generates sound pressure levels of 80-85 dBA however, this vent will be equipped with a silencer/muffler which reduces the sound pressure levels to 55-65 dBA.<br>• Umicore Canada Inc. will ensure appropriate information/monitoring is conducted to facilitate updating of the NCIA Regional Noise Model during the next applicable update |

| | |
|---|---|
| Disclose any audit/self-assessment evaluation (qualitative evaluation only, with senior site leader sign-off) completed for your site noise management plan. | Not applicable – noise monitoring conducted inside the plant from an industrial hygiene perspective |
| Provide a Noise Complaint summary for all noise complaints received in 2014 including any actions taken to address them. | Did not receive any noise complaints in 2014 |

This information is being collected as per the NMP Standard 2010-003 Document, section 5.4. 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.