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Noise Attenuation City Wide Data Collection
Phase 2

For the

City of St. Albert

PERMIT TO PRACTICE
ACI ACOUSTICAL CONSULTANTS INC.
Signature
Date 06/21/2022
PERMIT NUMBER: P 7735
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

PROFESSIONAL LICENSEE (ENGINEERING) ALBERTA
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6/21/2022

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Executive Summary

aci Acoustical Consultants Inc., of Edmonton AB, was retained by the City of St. Albert (the City) AB, to complete their Noise Attenuation City Wide Data Collection Phase 2 Study (the Project). As part of the Project aci conducted 24-hour environmental noise monitoring at various residential locations throughout the City. The noise monitoring locations were selected based on previous work conducted in Phase 1 and in discussions with City representatives. A greater emphasis was placed on residential locations adjacent to major roadways within the City. From the monitoring data, specific locations within the City could be categorized as low to high priority for future investigations for noise mitigation. Site work was conducted for aci during the spring, summer and fall months of 2021 by P. Froment, B.Sc., B.Ed., P.L.(Eng.).

Noise monitoring was conducted throughout the City of St. Albert starting in June 2021 and finishing in October 2021. As part of the noise monitoring program, a total of 18 noise monitorings were conducted at residential locations throughout the City. The monitoring locations were selected based on their proximity to major arterial and collector roadways and represented the various neighbourhoods within the City. Additionally, data collected from Phase 1 of the noise monitoring program and feedback from residents were also utilized to select the specific locations within each monitoring area.

The isolated measured Leq24 values for all residential monitoring locations were below 65 dBA and ranged from 47.8 dBA to 59.3 dBA. As anticipated, the dominant noise source was vehicle traffic on all roads. At all locations, the 1/3 octave band L_{eq} sound levels (frequency content) were very similar as all locations showed the typical trend of low frequency noise (near 63 – 80 Hz) resulting from engines and exhaust, mid-high frequency noise (near 1,000 Hz) resulting from tire noise. These results confirmed that the noise contributions at each monitoring location could be largely attributed to the nearby roadways.

Lastly, it was found that that certain locations experienced a high number of short-term loud bursts of noise from engine exhausts and heavy trucks. Although the total L_{eq}24 noise levels for these locations were not close to the permissible sound level of 65 dBA L_{eq}24, it was determined that the number of short-term high noise level events could cause significant annoyance for residents adjacent to the roadways.

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1.0 Introduction

aci Acoustical Consultants Inc., of Edmonton AB, was retained by the City of St. Albert (the City) AB, to complete their Noise Attenuation City Wide Data Collection Phase 2 Study (the Project). As part of the Project aci conducted 24-hour environmental noise monitoring at various residential locations throughout the City. The noise monitoring locations were selected based on previous work conducted in Phase 1 and in discussions with City representatives. A greater emphasis was placed on residential locations adjacent to major roadways within the City. From the monitoring data, specific locations within the City could be categorized as low to high priority for future investigations for noise mitigation. Site work was conducted for aci during the spring, summer and fall months of 2021 by P. Froment, B.Sc., B.Ed., P.L.(Eng.).

2.0 Project Description

The City of St. Albert is currently the sixth largest city in Alberta with over 66,000 residents and as such, has a significant volume of traffic passing through it each day. Accordingly, a consequence of increased traffic is increased noise levels for residents, particularly those adjacent to major arterial roads.

In 2018, as part of Phase 1 of the Project, the City retained a professional services company to conduct preliminary noise monitoring at 49 locations throughout the City. The scope of work included the identification of areas of concern, the collection and preliminary analysis of the noise monitoring data in addition to the public consultation with City residents to outline the methodologies and goals of the data collection program.

As part of Phase 2, aci initially reviewed the work conducted during Phase 1. This allowed aci and City representatives to determine the high priority areas in which to conduct detailed long-term noise monitorings (at least 48-hours). The detailed measurements could then be compared to the criteria set forth in the Municipal Engineering Standards, Section 3.9 on Noise Attenuation (discussed further in Section 5.0) to determine if noise mitigation would be required. Additionally, the noise monitorings allowed for the determination of areas with significant short-term loud bursts of noise from engine exhausts, heavy trucks, etc.

3.0 Study Area Description

As previously mentioned, as part of Phase 2, noise monitoring was conducted throughout the City starting in June 2021 and finishing in October 2021. As part of the noise monitoring program, a total of 18 noise monitorings were conducted at residential locations throughout the City, as identified in Figure 1. The monitoring locations were selected based on their proximity to major arterial and collector roadways and represented the various neighbourhoods within the City. Data collected from Phase 1 of the noise monitoring program and feedback from residents were used to pick specific locations within each monitoring area. A brief discussion of each monitoring area and the reason for their selection be found in the following sections.

3.1. St. Albert Trail (Erin Ridge Road to Coal Mine Road)

St. Albert Trail is a 6-lane major roadway with a high number of vehicles per day and a high percentage of heavy vehicles. Specifically, it is the major throughfare for traffic coming and going from northern Alberta communities into Edmonton and surrounding municipalities. At the time of the noise monitoring, the northbound and southbound lanes were separated by a large centre median (approximately 50 m at its widest location). The speed limit on this road was 60 km/hr.

As part of the update to the traffic network, the southbound lanes, south of Coal Mine Road, were re-aligned to the east during the summer of 2021. Construction work on this portion of the road will continue into 2022.

The residents most affected by the traffic along St. Albert Trail and from the realignment are found in the Erin Ridge neighbourhood. Specifically, residents along Emerald Terrace, Emery Court, Enfield Place and Eastwood Place are the most impacted as there are residential properties that back directly onto the St. Albert Trail.

Currently, there is a 1.83 m noise barrier along the entire western perimeter of the neighborhood. The barrier is a masonry wall that does not have any gaps/holes along its entire span from Erin Ridge Road to Coal Mine Road. In addition, topographically, there is an earth berm along the western residential boundary north of Euston Place.

As part of the Project, noise monitoring was conducted at two (2) residential properties that back directly onto St. Albert Trail. This monitoring area was specifically selected due to the high volumes along St. Albert Trail and due to the re-alignment of the road. It should be noted that the measurements were conducted prior to the start of construction, and thus the measured values can be used as a baseline prior to modifications to the road.

3.2. Boudreau Road (St. Albert Trail to Campbell Road)

Boudreau Road is a 4-lane major arterial road within the City that spans from St. Albert Trail to Veness Road in the Campbell Business Park. This road has a high number of vehicles per day and crosses through several residential neighbourhoods. Additionally, it also serves as a by-pass for traffic along Northeast Anthony Henday Drive trying to access Highway 2 north, towards Morinville. The eastbound and westbound lanes are separated with a centre median throughout. Currently the speed limit on this road is 60 km/hr.

As part of the Project, noise monitoring was conducted at nine (9) residential properties that back directly onto Boudreau Road. Annually, the City receives many complaints from residents along Boudreau Road. The complaints include high noise levels from after market mufflers, heavy vehicles accessing this road in addition to simply having high traffic volumes. The measurements along Boudreau Road will allow the City to quantify the anticipated noise levels from these various events in addition to determining whether noise mitigation should be considered.

Due to the extended length of Boudreau Road, it has been divided into even smaller segments, which will be discussed below.

3.2.1. Boudreau Road (Inglewood Drive to Bellerose Drive)

Starting east of Inglewood Drive the road drops significantly in elevation until it meets Bellerose Drive which is also a relatively significant roadway within St. Albert. The intersection between Boudreau Road and Bellerose Drive was upgraded during the summer of 2021.

There are residential locations on the north and south of Boudreau Road within this span. Apart from residents within Evergreen Close, all residential locations have masonry noise barrier, approximately 2.0 m in height, along their property lines. For residents within Evergreen Close, there is a 1.83 m wooden barrier along the property line. Four (4) noise monitorings were conducted within this span of Boudreau Road with two (2) locations being at the corner properties directly adjacent to the Boudreau Road and Bellerose Drive intersection. It should be noted that the monitoring adjacent to this intersection was performed after the completion of the 2021 summer construction. Therefore, the results are reflective of the new alignments and turning movements.

3.2.2. Boudreau Road (Bellerose Drive to Sturgeon Road)

East of Bellerose Drive, Boudreau Road remains relatively flat before passing over the Sturgeon River and remains relatively flat before it meets Sturgeon Road. The only residential locations within this area are residents within the multi-family Botanica development and residents within the Braeside Development. However, most residents within Braeside have a significant greenspace (ranging from 15 m to 50 m) between their backyards and the roadway. As such, their noise impact is less significant than other residential locations which back directly onto Boudreau. Thus a noise monitoring was not conducted in this area.

3.2.3. Boudreau Road (Sturgeon Road to Sir Winston Churchill)

Continuing east along Boudreau past Sturgeon Road, the elevation of the road increases significantly (an approximate 25 m increase in elevation) before flattening out at Sir Winston Churchill Avenue. Development directly adjacent to Boudreau (north and south sides) within this area is composed entirely of single-family residential dwellings. Residential fences within this area vary from well-built wooden fences that will provide a certain level of noise attenuation to fences with large gaps that are currently providing little to negligible amounts of acoustic mitigation.

In addition, residents to the north side of Boudreau are at a lower elevation relative to the roadway and in certain instances have direct line-of-sight to the roadway from their backyards. Therefore, even if the fences were capable of providing noise attenuation, they are not typically tall enough. Residents to the south of Boudreau are either at grade or elevated relative to the roadway and thus well-built fences have the potential to provide acoustic attenuation. Two (2) monitorings were conducted on either side of Boudreau in this area (north and south). Specifically, the northern location was purposely selected to reflect the noise contributions of Boudreau Road for residential location below the height of the roadway and thus residents with direct line-of-sight to the roadway.

3.2.4. Boudreau Road (Sir Winston Churchill Avenue to Hebert Road)

Directly southeast of Sir Winston Churchill Avenue and Boudreau Road is a single-family residential development. As Boudreau continues east, the eastbound lane splits into Boudreau and Fraser Drive, which provides access to the Forest Lawn neighbourhood. Further east and south of Boudreau Road development is composed of multi-family development. Similarly to Braeside, these residents have a significant greenspace (primarily around 30 m) between their backyards and the roadway.

Northeast of Sir Winston Churchill Avenue and Boudreau Road is a school site for École Secondaire Sainte Marguerite d'Youville (ESSMY). The school site (and field) extends 400 m east before transitioning to single-family residential development. In general, the rear yards of the residential receptor locations north of Boudreau are slightly elevated (2 – 3 m) relative to the roadway.

Currently, all residents within this area have fences along their rear/side property lines. These fences vary from well-built wooden fences that will provide a certain level of noise attenuation to fences with large gaps that are currently providing little to negligible amounts of acoustic mitigation.

One (1) monitoring was conducted on the south side of Boudreau immediately south of ESSMY.

3.2.5. Boudreau Road (Hebert Road to Campbell Road)

Development along Boudreau Road from Hebert Road to Campbell road is entirely composed of single-family dwellings. The rear/side yards for residents to the north of Boudreau are slightly elevated relative to the road (2 – 3 m) while properties to the south are at the same elevation as Boudreau Road.

Similarly, all residents within this area have fences along their rear/side property lines which vary from well-built wooden fences to fences with large gaps. Two (2) monitorings were conducted on the south side of Boudreau Road in this area[1]. Specifically, the eastern most location was purposely selected to reflect the noise contributions of the intersection of Boudreau Road and Campbell Road.

[1] It should be noted again that, in most cases, the preference was to conduct a noise monitoring on both side of Boudreau Road. However, in this case, responses were only received from residents on the south side of the Road.

3.3. Giroux Road (Lodgepole Crescent to Dawson Road)

Giroux Road is a 4-lane major arterial road within the City that spans from Ray Gibbon Drive to St. Albert Trail. This road has a high number of vehicles per day and crosses through several residential neighbourhoods. Traffic has decreased on this road since the extension of Ray Gibbon Drive to Villeneuve Road to the north. The eastbound and westbound lanes are separated with a centre median throughout. Currently the speed limit on this road is 60 km/hr.

Two specific areas were investigated for Giroux Road. The first was for residents between Lockhart Drive and Larson Avenue. Specifically, the monitoring in this area was focused on the difference between the noise contributions for residents in the Lacombe Park and Deer Ridge neighbourhoods, respectively. Residents in Lacombe Park are at the same elevation as Giroux Road while residents in Deer Ridge are elevated. Therefore, through their fences, residents in Lacombe Park have direct line-of-sight to traffic while residents in Deer Ridge have a more obstructed view. The fences for both residential locations were similar in that they both had large gaps between boards and thus did not provide a significant amount of acoustic mitigation.

The second area investigated for Giroux Road was for a residential property within proximity to Bellerose High School. Therefore, the noise monitoring was specifically conducted during the school year. The rear yard at this location was at the same elevation as Giroux Road and the fence was well built with minimal gaps between the boards. As such it would be anticipated that it would provide a certain level of noise mitigation.

3.4. Northwest Anthony Henday Drive (Arbour Crescent)

Northwest Anthony Henday Drive (NWAHD) is a 78 km major freeway that encircles Edmonton. Specifically for this project, the noise contributions from NWAHD between Campbell Road and Mark Messier Trail were investigated for a residential receptor along Arbour Crescent. This section of NWAHD is a twinned road with 3-lanes in the eastbound and westbound directions. There are grade separated interchanges at both Campbell Road and Mark Messier Trail. The posted speed limit throughout is 100 km/hr and the % heavy vehicle traffic is 6.7 %[1]. As such, this is the dominant noise source for the area.

[1] 2021 Estimates obtained from the Alberta Transportation website.

Topographically, NWAHD is lower in elevation than residential properties to the north. Currently, there are no substantial hills or berms between the road and residents. There is band of trees immediately south of the residents in this area that could provide a small amount of acoustic absorption during the summer months. However, it would be anticipated that the acoustic absorption during the late fall to early spring months would be minimal. The rear fence at this location had large gaps between boards and thus did not provide a significant amount of acoustic mitigation.

One (1) noise monitoring was conducted within this area which was based on a complaint.

3.5. Bellerose Drive (Erin Ridge Drive)

Bellerose Drive is 2 to 4-lane arterial road within the City that spans from Boudreau Road to Coal Mine Road. This road has a moderate number of vehicles per day and crosses through the Oakmont and Erin Ridge neighbourhoods. In addition to Sturgeon Road to the east, this road is a primary access road for residential developments within Sturgeon County to the northeast. Currently the speed limit on this road ranges from 50 – 60 km/hr.

One (1) noise monitoring was conducted for a resident within the Erin Ridge Lane cul-de-sac. This location backs directly onto Bellerose Drive and is slightly elevated relative to the roadway. The rear fence has small gaps between boards and thus currently provides a minimal amount of acoustic mitigation. The noise monitoring was conducted based on a complaint from the resident that indicated that there are several short-term loud bursts of noise from engine exhausts and heavy trucks along Bellerose Drive.

3.6. Sir Winston Churchill Avenue (Sylvan Drive)

Sir Winston Churchill Avenue is an 8.4 km arterial road within the City that spans from 137 Avenue to Sturgeon Road (south boundary to the north boundary). This road has a moderate number of vehicles per day and crosses through several residential neighbourhoods. Apart from 137 Avenue to Levasseur Road and again from Poirier Avenue to Poundmaker Road, the lanes are separated with a centre median. Currently the speed limit on this road ranges from 50 – 60 km/hr.

One (1) noise monitoring was conducted for a resident along Sylvan Drive, that backs onto Sir Winston Churchill Avenue and Cunningham Road. At this location, the rear/side yard is at the same elevation as the adjacent roads and in general the fence has small gaps between boards and thus currently provides a minimal amount of acoustic mitigation. The noise monitoring was conducted based on a complaint from the resident that indicated that there are several short-term loud bursts of noise from engine exhausts and heavy trucks along Sir Winston Churchill Avenue. It was noted that these events often increase during the school year, therefore, the noise monitoring was conducted in October 2021.

3.7. Hebert Road (Finch Crescent)

Hebert Road is a 4-lane arterial road within the City that spans from St. Albert Trail to Boudreau Road. This road has a moderate number of vehicles per day and crosses through several residential neighbourhoods. The northeast and southwest lanes are separated with a centre median throughout. Currently the speed limit on this road is 60 km/hr.

The monitoring location was directly adjacent to Hebert Road to the east and was for a residential receptor in Finch Crescent. The rear/side yard is at the same grade as Hebert Road and the fence at this location had large gaps between boards and thus did not provide a significant amount of acoustic mitigation.

One (1) noise monitoring was conducted within this area which was based on a complaint.

4.0 Measurement Methods

4.1. Environmental Noise Monitoring

As part of the study, a 24-hour environmental noise monitoring was conducted at eighteen (18) different locations throughout the City. The noise monitoring locations, as indicated in Figure 1, were based on previous work conducted in Phase 1 and in discussions with City representatives. A greater emphasis was placed on residential locations adjacent to major roadways within the City, which were also identified in 2018 as having the highest noise levels.

The noise measurements were conducted collecting continuous broadband A-weighted as well as 1/3 octave band sound levels. These samples were averaged every 15-seconds which allowed for a detailed analysis of the noise climate. The noise monitoring was conducted on weekdays under "typical" traffic conditions. In particular, measurements avoided any holidays, major construction activity that would re-route traffic nearby, and other occurrences which would affect the normal traffic on the road. In addition, the monitoring was conducted in summer-like conditions (i.e. no snow cover) with dry road surfaces and no precipitation. The monitoring was accompanied by a 24-hour digital audio recording for more detailed post process analysis. Finally, a portable weather monitor was used within the study area to obtain local weather conditions for all noise monitoring periods.

The noise monitors were placed at a height of 1.5 m from the ground (common industry practice) and were placed in the most acoustically logical location within the outdoor amenity space[1].

All noise measurement instrumentation was calibrated at the start of the measurements and then checked afterwards to ensure that there had been no calibration drift over the duration of the measurements. Refer to Appendix I for a detailed description of the measurement equipment used and calibration records and certificates, Appendix II for a description of the acoustical terminology, and Appendix III for a list of common noise sources.

[1] It should be noted that some locations were selected based on the preferences of the residents. However, they were still acceptable for the purposes of the scope of work.

4.1.1. Noise Monitoring Location Description

Noise Monitor 1 (35 Lorraine Crescent - Giroux Road)

Noise Monitor 1 was located approximately 13 m south of Giroux Road and 235 m west of Larson Avenue as shown in Figure 1 and Figure 2. This placed the noise monitor approximately 5 m south of the back-property line at 35 Lorraine Crescent. The noise monitor had direct line-of-sight through the fence to Giroux Road. The noise monitoring data for this location was taken from 12:00 on Wednesday June 2 to 12:00 on Thursday June 3, 2021 (entire 24-hour period).

Noise Monitor 2 (40 Danforth Crescent - Giroux Road)

Noise Monitor 2 was located approximately 15 m north of Giroux Road and 150 m east of Durham Avenue as shown in Figure 1 and Figure 3. This placed the noise monitor approximately 5 m north of the back-property line at 40 Danforth Crescent. The noise monitor had direct line-of-sight through the fence to Giroux Road. The noise monitoring data for this location was taken from 12:00 on Wednesday June 2 to 12:00 on Thursday June 3, 2021 (entire 24-hour period).

Noise Monitor 3 (4 Invermere Place - Boudreau Road)

Noise Monitor 3 was located approximately 20 m south of Boudreau Road and 80 m east of Inglewood Drive as shown in Figure 1 and Figure 4. This placed the noise monitor approximately 6 m south of the back-property line at 4 Invermere Place. The noise monitor did not have line-of-sight to Boudreau Road due to the masonry wall along the rear property line. The noise monitoring data for this location was taken from 12:00 on Wednesday June 2 to 12:00 on Thursday June 3, 2021 (entire 24-hour period).

Noise Monitor 4 (5 Ellis Court - Boudreau Road)

Noise Monitor 4 was located approximately 25 m north of Boudreau Road and 115 m west of Ellesmere Drive as shown in Figure 1 and Figure 5. This placed the noise monitor approximately 5 m north of the back-property line at 5 Ellis Court. The noise monitor did not have line-of-sight to Boudreau Road due to the masonry wall along the rear property line. The noise monitoring data for this location was taken from 12:00 on Wednesday June 2 to 12:00 on Thursday June 3, 2021 (entire 24-hour period).

Noise Monitor 5 (9 Evergreen Close - Boudreau Road)

Noise Monitor 5 was located approximately 10 m northwest of the intersection of Boudreau Road and Bellerose Drive as shown in Figure 1 and Figure 6. This placed the noise monitor approximately 5 m northwest of the back-property line at 9 Evergreen Close. The noise monitor had direct line-of-sight to through the fence but also over top of the fence to both roadways. It should be noted that the backyard space for this property was above the roadways. The noise monitoring data for this location was taken from 00:00 on Tuesday October 5 to 00:00 on Wednesday October 6, 2021 (entire 24-hour period).

Noise Monitor 6 (78 Beaverbrook Crescent - Boudreau Road)

Noise Monitor 6 was located approximately 15 m south of Boudreau Road and 130 m west of Sturgeon Road as shown in Figure 1 and Figure 7. This placed the noise monitor approximately 3.5 m south of the back-property line at 78 Beaverbrook Crescent. The noise monitor did not have line-of-sight to Boudreau Road due to the well-built (meaning no large gaps) wooden fence along the rear property line. The noise monitoring data for this location was taken from 12:00 on Wednesday June 2 to 12:00 on Thursday June 3, 2021 (entire 24-hour period).

Noise Monitor 7 (49 Woodcrest Avenue - Boudreau Road)

Noise Monitor 7 was located approximately 18 m north of Boudreau Road and 225 m east of Westwood Drive as shown in Figure 1 and Figure 8. This placed the noise monitor approximately 6 m north of the back-property line at 49 Woodcrest Avenue. The noise monitor had direct line-of-sight to Boudreau Road through the fence but also over top of the fence. It should be noted that the backyard space for this property is well below the roadway. The noise monitoring data for this location was taken from 12:00 on Wednesday June 2 to 12:00 on Thursday June 3, 2021 (entire 24-hour period).

Noise Monitor 8 (32 Fleetwood Crescent - Boudreau Road)

Noise Monitor 8 was located approximately 15 m south of Boudreau Road and 130 m east of Sir Winston Churchill Avenue as shown in Figure 1 and Figure 9. This placed the noise monitor approximately 5 m south of the back-property line at 32 Fleetwood Crescent. The noise monitor did not have line-of-sight to Boudreau Road due to the well-built (meaning no large gaps) wooden fence along the rear property line. The noise monitoring data for this location was taken from 12:00 on Wednesday June 2 to 12:00 on Thursday June 3, 2021 (entire 24-hour period).

Noise Monitor 9 (60 Aspen Crescent - Boudreau Road)

Noise Monitor 9 was located approximately 15 m south of Boudreau Road and 130 m west of Akins Drive as shown in Figure 1 and Figure 10. This placed the noise monitor approximately 2 m south of the back-property line at 60 Aspen Crescent. The noise monitor had partial line-of-sight to Boudreau Road through small gaps in the wooden fence along the rear property line. The noise monitoring data for this location was taken from 22:00 on Wednesday October 6 to 22:00 on Thursday October 7, 2021 (entire 24-hour period).

Noise Monitor 10 (44 Andrew Crescent - Boudreau Road)

Noise Monitor 10 was located approximately 15 m south of Boudreau Road and 80 m west of Campbell Road as shown in Figure 1 and Figure 11. This placed the noise monitor approximately 5 m south of the back-property line at 44 Andrew Crescent. The noise monitor had partial line-of-sight to Boudreau Road through small gaps in the wooden fence along the rear property line. The noise monitoring data for this location was taken from 22:00 on Monday October 4 to 22:00 on Tuesday October 5, 2021 (entire 24-hour period).

Noise Monitor 11 (14 Emery Court – St. Albert Trail)

Noise Monitor 11 was located approximately 32 m east of St. Albert Trail and 280 m north of Erin Ridge Road as shown in Figure 1 and Figure 12. This placed the noise monitor approximately 7 m east of the back-property line at 14 Emery Court. The noise monitor did not have line-of-sight to St. Albert Trail due to the masonry wall which is placed on a 2 – 2.5 m earth berm along the rear property line. As previously mentioned, the barrier + berm extends from Erin Ridge Road to Coal Mine Road. The noise monitoring data for this location was taken from 22:00 on Wednesday May 12 to 22:00 on Thursday May 13, 2021 (entire 24-hour period).

Noise Monitor 12 (14 Emerald Terrace – St. Albert Trail)

Noise Monitor 12 was located approximately 32 m east of St. Albert Trail and 120 m north of Erin Ridge Road as shown in Figure 1 and Figure 13. This placed the noise monitor approximately 8 m east of the back-property line at 14 Emerald Terrace. The noise monitor did not have line-of-sight to St. Albert Trail due to the masonry wall which is placed on a 2 – 2.5 m earth berm along the rear property line. As previously mentioned, the barrier + berm extends from Erin Ridge Road to Coal Mine Road. The noise monitoring data for this location was taken from 22:00 on Monday May 10 to 22:00 on Tuesday May 11, 2021 (entire 24-hour period).

Noise Monitor 13 (10 Inverness Crescent – Boudreau Road)

Noise Monitor 13 was located approximately 20 m southwest of the intersection of Boudreau Road and Bellerose Drive as shown in Figure 1 and Figure 14. This placed the noise monitor approximately 13 m southwest of the back-property line at 10 Inverness Crescent. The noise monitor did not have line-of-sight either roadway due to the masonry wall along the rear property line. The noise monitoring data for this location was taken from 00:00 on Tuesday October 5 to 00:00 on Wednesday October 6, 2021 (entire 24-hour period).

Noise Monitor 14 (71 Arbour Crescent – Northwest Anthony Henday Drive)

Noise Monitor 14 was located approximately 190 m northwest of NWAHD, and 605 m west of Campbell Road as shown in Figure 1 and Figure 15. This placed the noise monitor approximately 5 m north of the back-property line at 71 Arbour Crescent. The noise monitor did not have line-of-sight to NWAHD due to foliage between the road and the monitor. The noise monitoring data for this location was taken from 22:00 on Tuesday July 13 to 22:00 on Wednesday July 14, 2021 (entire 24-hour period).

Noise Monitor 15 (205 Erin Ridge Drive – Bellerose Drive)

Noise Monitor 15 was located approximately 15 m west of Bellerose Drive and 30 m north of Erin Ridge Drive as shown in Figure 1 and Figure 16. This placed the noise monitor approximately 5 m west of the back-property line at 205 Erin Ridge Drive. The noise monitor had direct line-of-sight to Bellerose Drive through the fence but also over top of the fence. It should be noted that the backyard space for this property was slightly elevated in relation to the roadway. The noise monitoring data for this location was taken from 12:00 on Monday June 28 to 22:00 on Tuesday June 29, 2021 (entire 24-hour period).

Noise Monitor 16 (38 Lodgepole Crescent – Giroux Road)

Noise Monitor 16 was located approximately 15 m south of Giroux Road and 180 m west of Lockhart Drive as shown in Figure 1 and Figure 17. This placed the noise monitor approximately 5 m south of the back-property line at 38 Lodgepole Crescent. The noise monitor did not have line-of-sight to Giroux Road due to the well-built (meaning no large gaps) wooden fence along the rear property line. The noise monitoring data for this location was taken from 11:00 on Tuesday October 5 to 11:00 on Wednesday October 6, 2021 (entire 24-hour period).

Noise Monitor 17 (21 Sylvan Drive – Sir Winston Churchill Avenue)

Noise Monitor 17 was located approximately 9 m west of Cunningham Road and 20 m east of Sir Winston Churchill Avenue as shown in Figure 1 and Figure 18. This placed the noise monitor approximately 5 m west of the back-property line at 21 Sylvan Drive. The noise monitor had partial line-of-sight to both roadways through small gaps in the wooden fences along the rear/side property lines. The noise monitoring data for this location was taken from 11:00 on Tuesday October 5 to 22:00 on Wednesday October 6, 2021 (entire 24-hour period).

Noise Monitor 18 (26 Finch Crescent – Hebert Road)

Noise Monitor 18 was located approximately 15 m west of Hebert Road and 200 m north of Falstaff Avenue as shown in Figure 1 and Figure 19. This placed the noise monitor approximately 5 m west of the back-property line at 26 Finch Crescent. The noise monitor had partial line-of-sight to Hebert Road through small gaps in the wooden fences along the rear/side property lines. In addition, the noise monitor was placed in the rear of the rear yard adjacent to the garage, due to the configuration of the yard. The noise monitoring data for this location was taken from 11:00 on Tuesday October 5 to 22:00 on Wednesday October 6, 2021 (entire 24-hour period).

5.0 Permissible Sound Levels

Environmental noise levels from roads 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. 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 dBA, which are the most common environmental noise measure, are often given for daytime (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.

The criteria used to evaluate the road noise in the study area include the City of St. Albert Municipal Engineering Standards, Section 3.9 on Noise Attenuation which was part of the City of St. Albert's Transportation Master Plan (2015). The following is taken directly from the document:

> "*A Noise Impact Assessment, signed and sealed by a professional engineer, must be provided in cases where a major arterial roadway and/or railway runs through or adjacent to a proposed residential development. The assessment must list the current noise levels, estimate future noise levels, and identify and implement noise attenuation measures required to achieve a* ***maximum noise level of 65 dBA Leq over a 24-hour period****, and in accordance with the City's Noise Bylaw, Bylaw 31/2006.*"

As such, the permissible sound level (PSL) is **65 dBA L_{eq}24.**

6.0 Results and Discussion

6.1. Environmental Noise Monitoring

The results of the eighteen (18) 24-hour noise monitoring's have been provided in Table 1. Table 1 provides the isolated and non-isolated "Raw" values for each 24-hour L_{eq} period, in addition to the relative difference between the two.

Non-transportation related or otherwise abnormal noise events (such as loud aircraft flyovers, loud vehicle passages, dogs barking, etc.) were identified and isolated (removed) from the noise monitoring data such that the remaining data more accurately reflects the noise levels associated with the adjacent transportation corridors. To appropriately isolate the noise monitoring data, a simultaneous digital audio recording was conducted along with the noise monitoring which identified these events. A list of all non-typical noise events removed from each of the noise monitoring locations can be found in Appendix IV.

In addition to Table 1, Figures 20 – 55, provide the isolated 15-second broadband A-weighted L_{eq} sound levels and the isolated 1/3 octave band L_{eq} sound levels. The 15-second L_{eq} sound levels provide the general trace of the noise levels over the entire 24-hour period, while the 1/3 octave band data provides the frequency content of the monitoring period.

A discussion of the results of each monitoring area will be found in the following sections.

Table 1. 2021 - L_{eq} 24-Hour Results

Monitoring Location	Location	Arterial Road	Start Time	End Time	Isolated			Raw			Difference		
					Leq24 (dBA)	LeqDay (dBA)	LeqNight (dBA)	Leq24 (dBA)	LeqDay (dBA)	LeqNight (dBA)	Leq24 (dBA)	LeqDay (dBA)	LeqNight (dBA)
Monitor 1	35 Lorraine Crescent	Giroux Road	6/02/21 12:00	6/03/21 12:00	57.5	59.1	51.1	58.1	59.6	53.1	0.7	0.5	2.0
Monitor 2	40 Danforth Crescent	Giroux Road	6/02/21 12:00	6/03/21 12:00	54.6	56.2	48.3	55.2	56.7	50.3	0.7	0.5	2.0
Monitor 3	4 Invermere Place	Boudreau Road	6/02/21 12:00	6/03/21 12:00	53.5	54.9	49.2	54.6	55.7	51.6	1.1	0.8	2.4
Monitor 4	5 Ellis Court	Boudreau Road	6/02/21 12:00	6/03/21 12:00	52.4	53.7	48.8	52.9	53.9	50.5	0.5	0.3	1.6
Monitor 5	9 Evergreen Close	Boudreau Road	10/05/21 0:00	10/06/21 0:00	59.3	61.0	53.1	61.0	62.4	56.8	1.7	1.4	3.6
Monitor 6	78 Beaverbrook Crescent	Boudreau Road	6/02/21 12:00	6/03/21 12:00	55.3	56.7	50.5	55.8	57.3	50.9	0.5	0.6	0.3
Monitor 7	49 Woodcrest Avenue	Boudreau Road	6/02/21 12:00	6/03/21 12:00	53.8	55.3	48.9	54.4	55.9	49.1	0.5	0.5	0.2
Monitor 8	32 Fleetwood Crescent	Boudreau Road	6/02/21 12:00	6/03/21 12:00	57.1	58.7	52.0	57.5	59.0	52.7	0.4	0.3	0.7
Monitor 9	60 Aspen Crescent	Boudreau Road	10/06/21 22:00	10/07/21 22:00	57.0	58.4	52.5	57.9	59.2	53.7	0.9	0.9	1.2
Monitor 10	44 Andrew Crescent	Boudreau Road	10/04/21 22:00	10/05/21 22:00	57.8	59.2	53.2	58.2	59.5	53.8	0.4	0.3	0.7
Monitor 11	14 Emery Court	St. Albert Trail	5/12/21 22:00	5/13/21 22:00	47.8	49.3	43.1	48.1	49.5	43.9	0.3	0.2	0.7
Monitor 12	14 Emerald Terrace	St. Albert Trail	5/10/21 22:00	5/11/21 22:00	48.1	49.6	42.9	49.4	51.0	43.9	1.3	1.4	1.0
Monitor 13	10 Inverness Crescent	Boudreau Road	10/05/21 0:00	10/06/21 0:00	53.8	55.3	48.0	55.2	56.8	49.3	1.4	1.4	1.2
Monitor 14	71 Arbor Crescent	Northwest Anthony Henday Drive	7/13/21 22:00	7/14/21 22:00	56.7	57.6	54.9	56.9	57.7	54.9	0.1	0.2	0.0
Monitor 15	205 Erin Ridge Drive	Bellerose Drive	6/28/21 22:00	6/29/22 22:00	52.8	54.4	46.8	54.1	55.8	47.7	1.3	1.3	0.9
Monitor 16	38 Lodgepole Crescent	Giroux Road	10/05/21 11:00	10/06/21 11:00	54.5	56.2	48.2	54.9	56.5	48.2	0.3	0.4	0.0
Monitor 17	21 Sylvan Drive	Sir Winston Churchill Avenue	10/05/21 11:00	10/06/21 11:00	53.3	54.9	46.7	54.3	55.9	48.0	1.0	1.0	1.3
Monitor 18	26 Finch Crescent	Hebert Road	10/05/21 11:00	10/06/21 11:00	54.7	56.2	49.3	54.8	56.3	49.6	0.1	0.1	0.3
Maximum					**59.3**	**61.0**	**54.9**	**61.0**	**62.4**	**56.8**	**1.7**	**1.4**	**3.6**
Minimum					**47.8**	**49.3**	**42.9**	**48.1**	**49.5**	**43.9**	**0.1**	**0.1**	**0.0**

6.1.1. St. Albert Trail (Erin Ridge Road to Coal Mine Road)

The lowest L_{eq}24 noise levels measured during the 2021 monitoring period were within this noise monitoring area at 14 Emery Court & 14 Emerald Terrace, respectively. The isolated L_{eq}24 values were 47.8 and 48.1 dBA, respectively, which is well below the PSL of 65 dBA L_{eq}24. This can be attributed to a few factors which include i) the distance between the rear yard and St. Albert Trail ii) the significant berm along the rear property line and iii) the masonry fence along the top of the berm.

The relative difference between the Raw and Isolated data for 14 Emerald Terrace was relatively high, however upon investigating the non-typical noise events (found in Appendix IV) it is apparent that there was a significant amount of human activity in the yard, in addition to a dog barking which would account for the higher Raw values.

If there were no changes to the alignment of St. Albert Trail, it would not be anticipated that the noise levels will exceed the PSL of 65 dBA L_{eq}24 in the near future for this residential area, particularly when considering the currently relative low noise levels. However, because of the relatively significant modifications made to St. Albert Trail between Erin Ridge Road to Coal Mine Road, the projected noise levels, with the modifications to St. Albert Trail, will be further investigated in a separate report.

6.1.2. Boudreau Road (Inglewood Drive to Bellerose Drive)

The isolated measured L_{eq}24 noise levels for residents within this monitoring area were all below 65 dBA and range from 52.4 – 59.3 dBA. The highest L_{eq}24 noise levels measured during the entire 2021 monitoring period were at 9 Evergreen Close, which can be primarily attributed to the proximity of this residential receptor to the intersection of Bellerose Drive and Boudreau Road and to their direct line-of-sight to this intersection from the rear yard. It should also be noted that this monitoring location had a significant number of high noise events, as shown in Appendix IV. The L_{eq}24 noise level of 59.3 dBA is still well below the PSL of 65 dBA, however based on these results and the significant number of high noise events, it is recommended that this be the highest priority area for consideration of noise mitigation, when available.

The three other locations within this area were below 55 dBA. These lower noise levels can be primarily attributed to their increased distance to the road(s) and the masonry fence along their rear property line which provides a significant amount of acoustic mitigation. Assuming there are no significant changes to the future traffic volumes or alignment of Boudreau Road, it would not be anticipated that the noise levels will exceed the PSL of 65 dBA L_{eq}24 in the near future for residents with existing masonry noise barriers along their rear property line.

6.1.3. Boudreau Road (Sturgeon Road to Sir Winston Churchill)

The isolated measured L_{eq}24 noise levels for both residents within this monitoring area were 53.8 dBA and 55.3 dBA, respectively, which is below 65 dBA. These lower noise levels can be primarily attributed to their increased distance to the road(s). The values were lower than anticipated, particularly for 49 Woodcrest Avenue. However, in reviewing the data it appears as though the decrease in elevation actually reduces the direct line-of-sight of the residents to the tires of the vehicles. This correlates with theory, as tire noise is the dominant noise source of a vehicles when they are travelling at speeds of 50 km/hr or higher. In addition, because the westbound traffic is going downhill, there is less strain on the vehicles' engine, once again reducing the overall noise contributions of traffic.

Assuming there are no significant changes to the future traffic volumes or alignment of Boudreau Road, it would not be anticipated that the noise levels will exceed the PSL of 65 dBA L_{eq}24 in the near future for these residential areas.

6.1.4. Boudreau Road (Sir Winston Churchill Avenue to Hebert Road)

The isolated measured L_{eq}24 noise level for the single monitoring location within this monitoring area was 57.1 dBA which is below 65 dBA. These moderate noise levels can be primarily attributed to the proximity of the residential location relative to Boudreau Road. Assuming there are no significant changes to the future traffic volumes or alignment of Boudreau Road, it would not be anticipated that the noise levels will exceed the PSL of 65 dBA L_{eq}24 in the near future for these residential areas.

6.1.5. Boudreau Road (Lodgepole Crescent to Campbell Road)

The isolated measured L_{eq}24 noise levels for both residents within this monitoring area were 57.0 dBA and 57.8 dBA, respectively, which is very consistent and below 65 dBA. These moderate noise levels can be primarily attributed to their proximity to Boudreau Road. In addition, there were a significant number of high noise events at 60 Aspen Crescent, however, as indicated in Appendix IV, this could be primarily attributed to this residence operating a daycare[1]. After isolating the data properly, the values are considered representative of the typical noise climate of the area.

Assuming there are no significant changes to the future traffic volumes or alignment of Boudreau Road, it would not be anticipated that the noise levels will exceed the PSL of 65 dBA L_{eq}24 in the near future for these residential areas.

6.1.6. Giroux Road (Deer Ridge and Lacombe Park)

The isolated measured L_{eq}24 noise levels for both residents within this monitoring area were 54.6 dBA and 57.5 dBA, respectively, which is below 65 dBA. As previously mentioned, the noise monitoring for these two specific locations were primarily to determine the variance in noise levels between the two neighbourhoods. As anticipated, the noise levels were indeed higher for residents within Lacombe Park than for those in Deer Ridge. This can be primarily attributed to the variation in the topography which allows residents within Deer Ridge to be better shielded from traffic due to their yards being elevated relative to Giroux Road.

However, despite these difference in noise levels, assuming there are no significant changes to the future traffic volumes or alignment of Giroux Road, it would not be anticipated that the noise levels will exceed the PSL of 65 dBA L_{eq}24 in the near future for either neighbourhood.

6.1.7. Giroux Road (38 Lodgepole Crescent)

The isolated measured L_{eq}24 noise level for 38 Lodgepole Crescent was 54.5 dBA which is well below 65 dBA. It would be anticipated that these relatively low noise levels can be primarily attributed to the lower traffic volumes along this portion of Giroux Road. Assuming there are no significant changes to the future traffic volumes or alignment of Giroux Road, it would not be anticipated that the noise levels will exceed the PSL of 65 dBA L_{eq}24 in the near future for this residential area.

In addition, as shown in Appendix IV, there were a minimal number of non-typical events, however, a few events were near or above 80 dBA which could certainly cause a disturbance for residents in this area. However, no current form of noise mitigation will reduce the annoyance caused by these events.

[1] It should be noted again that in certain locations, there were very few responses from residents. Thus, in this case, this was the only response along Aspen Crescent.

6.1.8. Northwest Anthony Henday Drive (71 Arbour Crescent)

The isolated measured L_{eq}24 noise level for 71 Arbour Crescent was 56.7 dBA which is well below 65 dBA[1]. It would be anticipated that these moderate noise levels can be primarily attributed to the proximity between the resident and NWAHD. However, in comparison to other monitoring locations conducted in 2021, this location will have relatively steady noise levels throughout the day due to the traffic volumes along NWAHD.

Assuming there are no significant changes to the future traffic volumes or alignment of NWAHD, it would not be anticipated that the noise levels will exceed the PSL of 65 dBA L_{eq}24 in the near future for this residential area.

6.1.9. Bellerose Drive (205 Erin Ridge Drive)

The isolated measured L_{eq}24 noise level for 205 Erin Ridge Drive was 52.8 dBA which is well below 65 dBA. Assuming there are no significant changes to the future traffic volumes or alignment of Bellerose Drive, it would not be anticipated that the noise levels will exceed the PSL of 65 dBA L_{eq}24 in the near future for this residential area.

However, as previously stated, the residential concern at this location was not with the overall noise levels, but with the number of short-term high noise level events. As shown in Appendix IV, there were 49 non-typical events ranging from 57.0 dBA to 87.4 dBA within the 24-hour period. The average noise level of these events is 69.3 dBA which is well above the LeqDay value of 54.4 dBA. As such, these noise monitoring results confirm the resident's annoyance caused by short-term loud bursts of noise from engine exhausts and heavy trucks along Bellerose Drive.

However, no current form of noise mitigation will reduce the annoyance caused by these events. Therefore, it is recommended that enforcement of the bylaws for noise nuisance be investigated further to reduce the impact of these events on residents within this neighbourhood.

6.2. Sir Winston Churchill Avenue (21 Sylvan Drive)

The isolated measured L_{eq}24 noise level for 21 Sylvan Drive was 53.3 dBA which is well below 65 dBA. Assuming there are no significant changes to the future traffic volumes or alignment of Sir Winston

[1] Also the Alberta Transportation permissible sound level.

Churchill Avenue, it would not be anticipated that the noise levels will exceed the PSL of 65 dBA $L_{eq}24$ in the near future for this residential area.

However, as previously stated, the residential concern at this location was not with the overall noise levels, but with the number of short-term high noise level events. As shown in Appendix IV, there were 31 non-typical events ranging from 60.8 dBA to 91.2 dBA within the 24-hour period. The average noise level of these events is 72.3 dBA which is well above the LeqDay value of 54.9 dBA. As such, these noise monitoring results confirm the resident's annoyance caused by short-term loud bursts of noise from engine exhausts and heavy trucks along Sir Winston Churchill Avenue and Cunningham Road.

However, no current form of noise mitigation will reduce the annoyance caused by these events. Therefore, it is recommended that enforcement of the bylaws for noise nuisance be investigated further to reduce the impact of these events on residents within this neighbourhood.

6.3. Hebert Road (26 Finch Crescent)

The isolated measured $L_{eq}24$ noise level for 26 Finch Crescent was 54.7 dBA which is well below 65 dBA. It would be anticipated that these relatively low noise levels can be primarily attributed to the lower traffic volumes along Hebert Road. Assuming there are no significant changes to the future traffic volumes or alignment of Hebert Road, it would not be anticipated that the noise levels will exceed the PSL of 65 dBA $L_{eq}24$ in the near future for this residential area.

6.3.1. General Observations and Comments

As indicated in Table 1, the isolated measured $L_{eq}24$ values were below 65 dBA for all noise monitoring locations and ranged from 47.8 dBA to 59.3 dBA. As anticipated, the dominant noise source was vehicle traffic on all roads. The highest $L_{eq}24$ noise level measured during the 2021 monitoring period was at 9 Evergreen Close. Based on subjective observations made during the setup and takedown, the results were anticipated due to the proximity of the noise monitor to Bellerose Drive and Boudreau Road. In addition, at this location, the noise monitor had direct line-of-sight to the intersection as the rear yard is slightly elevated relative to the roadways.

The lowest $L_{eq}24$ noise levels measured during the 2021 monitoring period were within this noise monitoring area at 14 Emery Court & 14 Emerald Terrace, respectively. The isolated $L_{eq}24$ values were 47.8 and 48.1 dBA, respectively, which is well below the PSL of 65 dBA $L_{eq}24$. This can be attributed to a few factors which include i) the distance between the rear yard and St. Albert Trail ii) the significant berm along the rear property line and iii) the masonry fence along the top of the berm.

At all locations, the 1/3 octave band L_{eq} sound levels (frequency content) are very similar as all locations show the typical trend of low frequency noise (near 63 – 80 Hz) resulting from engines and exhaust, mid-high frequency noise (near 1,000 Hz) resulting from tire noise. These results confirm that the noise contributions at each monitoring location could be largely attributed to the nearby roadways.

Lastly, it was found that that certain locations (9 Evergreen Close and 205 Erin Ridge Drive, specifically) experience a high number of short-term loud bursts of noise from engine exhausts, heavy trucks, etc. Although the total $L_{eq}24$ noise levels for these locations might not be close to the PSL of 65 dBA $L_{eq}24$, the number of short-term high noise level events cause significant annoyance for residents adjacent to the roadways.

6.4. Weather Conditions

As previously mentioned, local weather monitoring stations were used throughout all noise monitoring periods to obtain the wind speed, wind direction, temperature, relative humidity, barometric pressure, and rain fall data in 1-minute sampling periods. All weather data are presented in Appendix V. A brief discussion of each 24-hour period can be found below.

6.4.1. May 10 – 11, 2021

The weather at the start of the monitoring period consisted of a calm conditions with partly sunny skies. The wind remained low (primarily lower than 10 km/hr) before increasing in the afternoon of May 11, 2021. The wind was primarily from a general west direction for the majority of the noise monitoring period which resulted in downwind conditions for the monitoring location. The temperature ranged from 5°C - 16°C and the relative humidity ranged from 27% - 77%. In addition, there was no precipitation.

6.4.2. May 12 – 13, 2021

The weather at the start of the monitoring period was moderate (between 5 – 10 km/hr) and apart from a few short periods, remained moderate throughout. The wind was primarily from a general west direction for the majority of the noise monitoring period which resulted in downwind conditions for the monitoring location. The temperature ranged from 6°C - 21°C and the relative humidity ranged from 19% - 67%. In addition, there was no precipitation.

6.4.3. June 2 – 3, 2021

The weather at the start of the monitoring period was moderate – high (between 5 – 15 km/hr) for the duration of the noise monitoring period, apart from 10:00 to 12:00 on June 3, 2021, where the winds would be considered high[1]. The wind varied in direction but was primarily from the west to southwest, thus resulting in crosswind conditions for most of the noise monitoring locations. The temperature ranged from 15°C - 29°C and the relative humidity ranged from 22% - 58%. In addition, there was no precipitation.

6.4.4. June 28 – 29, 2021

The weather at the start of the monitoring period was low and from the east (below 10 km/hr). At 10:00 on June 29, 2021, the wind increased and remained between 10 – 20 km/hr[1] for the remainder of the monitoring period. The wind also shifted to the south and thus resulted in crosswind conditions for the noise monitoring location. The temperature ranged from 18°C - 36°C[2] and the relative humidity ranged from 24% - 77%. In addition, there was no precipitation.

[1] It should be noted that the weather monitoring station for this time period was placed on the west side of St. Albert adjacent to Ray Gibbon Drive. Thus, it was not shielded by houses and other structures. Therefore, when considering that the noise monitoring was conducted within densely populated areas, the influence of wind would be less significant.

[2] Though the wind speeds were relatively high, this date was selected to best represent night-time periods in which there would be a higher level of short-term loud noise from mufflers, motorcycles, etc.

6.4.5. July 13 – 14, 2021

The weather at the start of the monitoring period was moderate and apart from short duration of high wind speeds, remained moderate for the entire noise monitoring period. The wind direction was from the east and southeast throughout, which resulted in downwind conditions (worst-case) for the noise monitor. The temperature ranged from 17°C - 32°C and the relative humidity ranged from 24% - 66%. In addition, there was no precipitation.

6.4.6. October 4 – 5, 2021

The weather at the start of the monitoring period was moderate and apart from short duration of high wind speeds, remained moderate for the entire noise monitoring period. The wind direction was primarily from the north-northeast, which resulted in downwind conditions (worst-case) for the noise monitor. The temperature ranged from 4°C - 9°C and the relative humidity ranged from 31% - 57%. In addition, there was no precipitation.

6.4.7. October 5 – 6, 2021

The weather was relatively moderate (between 5 - 10 km/hr), apart from a few short duration of high wind speeds, for the entire noise monitoring period. The wind direction was primarily from the west-northwest, which resulted in either downwind or crosswind conditions for all noise monitoring locations. The temperature ranged from 2°C - 11°C and the relative humidity ranged from 42% - 73%. In addition, there was no precipitation.

6.4.8. October 6 – 7, 2021

The weather was relatively moderate to calm (between 0 - 10 km/hr), apart from a few short duration of higher wind speeds, for the entire noise monitoring period. The wind varied in direction but was not strong enough to have a significant impact on the noise propagation from the road to the monitor. The temperature ranged from (-)2°C - 13°C and the relative humidity ranged from 29% - 92%. In addition, there was no precipitation.

7.0 Conclusion

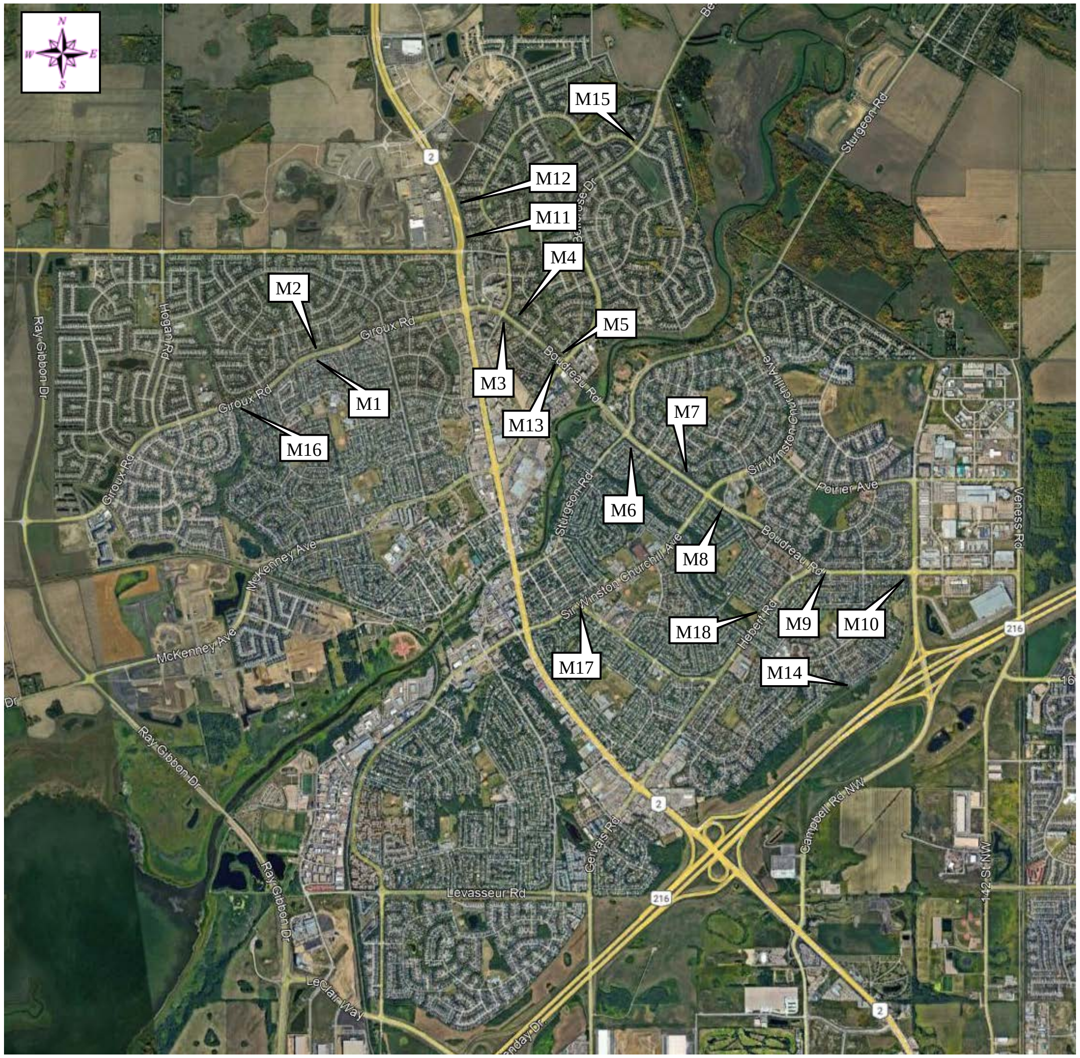
Noise monitoring was conducted throughout the City of St. Albert starting in June 2021 and finishing in October 2021. As part of the noise monitoring program, a total of 18 noise monitorings were conducted at residential locations throughout the City. The monitoring locations were selected based on their proximity to major arterial and collector roadways and represented the various neighbourhoods within the City. Additionally, data collected from Phase 1 of the noise monitoring program and feedback from residents were also utilized to select the specific locations within each monitoring area.

The isolated measured Leq24 values for all residential monitoring locations were below 65 dBA and ranged from 47.8 dBA to 59.3 dBA. As anticipated, the dominant noise source was vehicle traffic on all roads. At all locations, the 1/3 octave band L_{eq} sound levels (frequency content) were very similar as all locations showed the typical trend of low frequency noise (near 63 – 80 Hz) resulting from engines and exhaust, mid-high frequency noise (near 1,000 Hz) resulting from tire noise. These results confirmed that the noise contributions at each monitoring location could be largely attributed to the nearby roadways.

Lastly, it was found that that certain locations experienced a high number of short-term loud bursts of noise from engine exhausts and heavy trucks. Although the total L_{eq}24 noise levels for these locations were not close to the PSL of 65 dBA L_{eq}24, it was determined that the number of short-term high noise level events could cause significant annoyance for residents adjacent to the roadways.

8.0 References

- *City Wide Traffic Monitoring Study,* prepared for the City of St. Albert prepared by GHD Limited, 2018
- City of St. Albert Municipal Engineering Standards, Section 3.9 on Noise Attenuation, 2015
- City of St. Albert Noise Bylaw 31/2006
- 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.



Monitoring Location	Arterial Road	Municipal Address	Isolated Leq24 (dBA)
Monitor 1	Giroux Road	35 Lorraine Crescent	57.5
Monitor 2	Giroux Road	40 Danforth Crescent	54.6
Monitor 3	Boudreau Road	4 Invermere Place	53.5
Monitor 4	Boudreau Road	5 Ellis Court	52.4
Monitor 5	Boudreau Road	9 Evergreen Close	59.3
Monitor 6	Boudreau Road	78 Beaverbrook Crescent	55.3
Monitor 7	Boudreau Road	49 Woodcrest Avenue	53.8
Monitor 8	Boudreau Road	32 Fleetwood Crescent	57.1
Monitor 9	Boudreau Road	60 Aspen Crescent	57.0
Monitor 10	Boudreau Road	44 Andrew Crescent	57.8
Monitor 11	St. Albert Trail	14 Emery Court	47.8
Monitor 12	St. Albert Trail	14 Emerald Terrace	48.1
Monitor 13	Boudreau Road	10 Inverness Crescent	53.8
Monitor 14	Anthony Henday Drive	71 Arbor Crescent	56.7
Monitor 15	Bellerose Drive	205 Erin Ridge Drive	52.8
Monitor 16	Giroux Road	38 Lodgepole Crescent	54.5
Monitor 17	Sir Winston Churchill Avenue	21 Sylvan Drive	53.3
Monitor 18	Hebert Road	26 Finch Crescent	54.7

Figure 1. Study Area & Monitoring Locations

Figure 2. Noise Monitor #1 (35 Lorraine Crescent)

Figure 3. Noise Monitor #2 (40 Danforth Crescent)

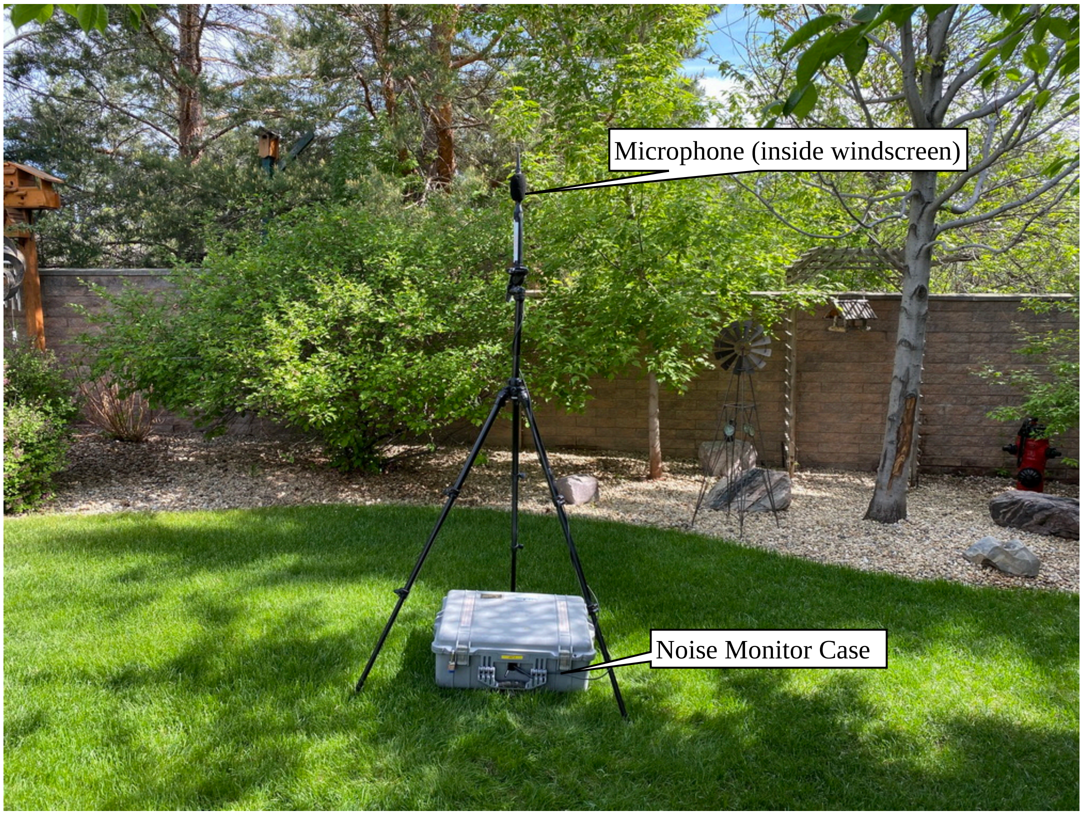


Figure 4. Noise Monitor #3 (4 Invermere Place)

Figure 5. Noise Monitor #4 (5 Ellis Court)

Figure 6. Noise Monitor #5 (9 Evergreen Close)

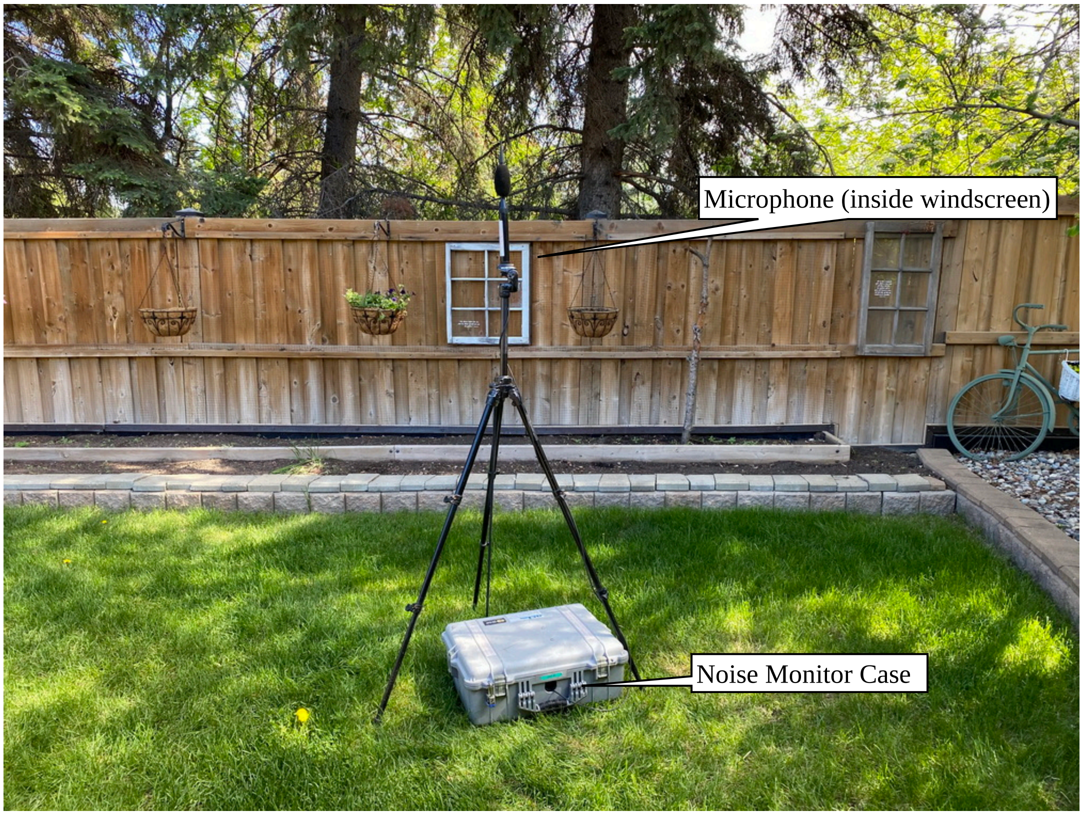


Figure 7. Noise Monitor #6 (78 Beaverbrook Crescent)

Figure 8. Noise Monitor #7 (49 Woodcrest Avenue)

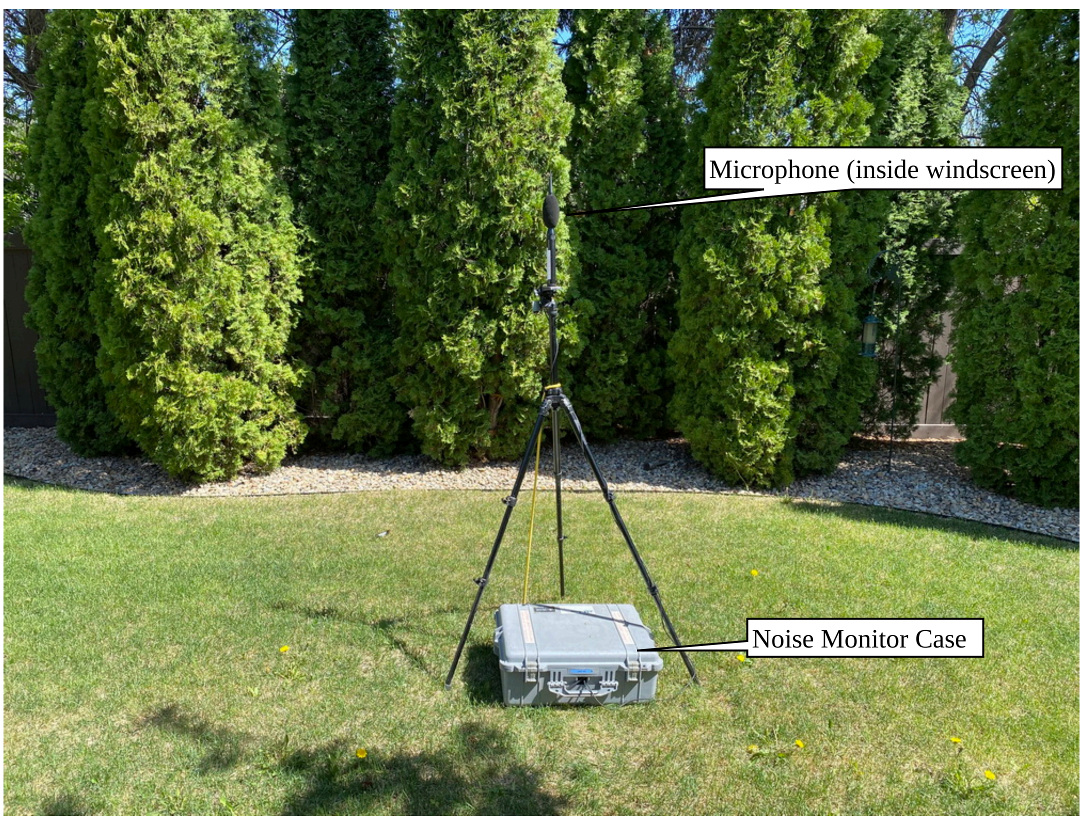


Figure 9. Noise Monitor #8 (32 Fleetwood Crescent)

Figure 10. Noise Monitor #9 (60 Aspen Crescent)

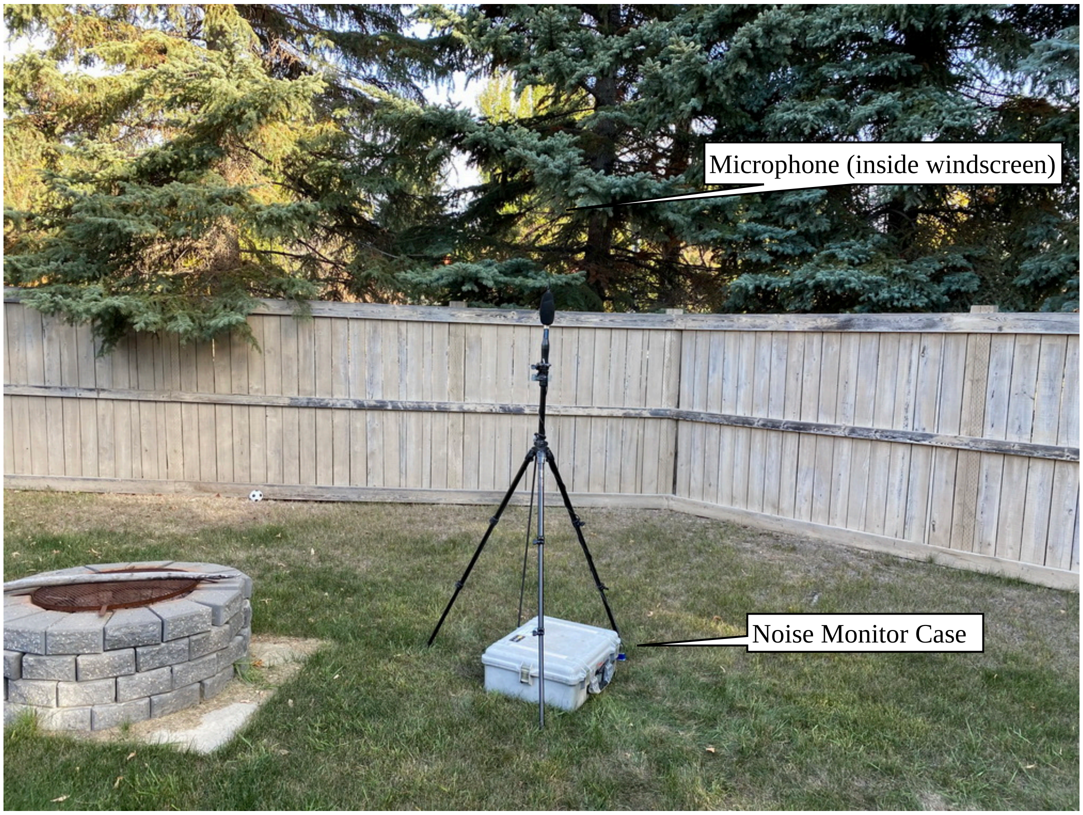


Figure 11. Noise Monitor #10 (44 Andrew Crescent)

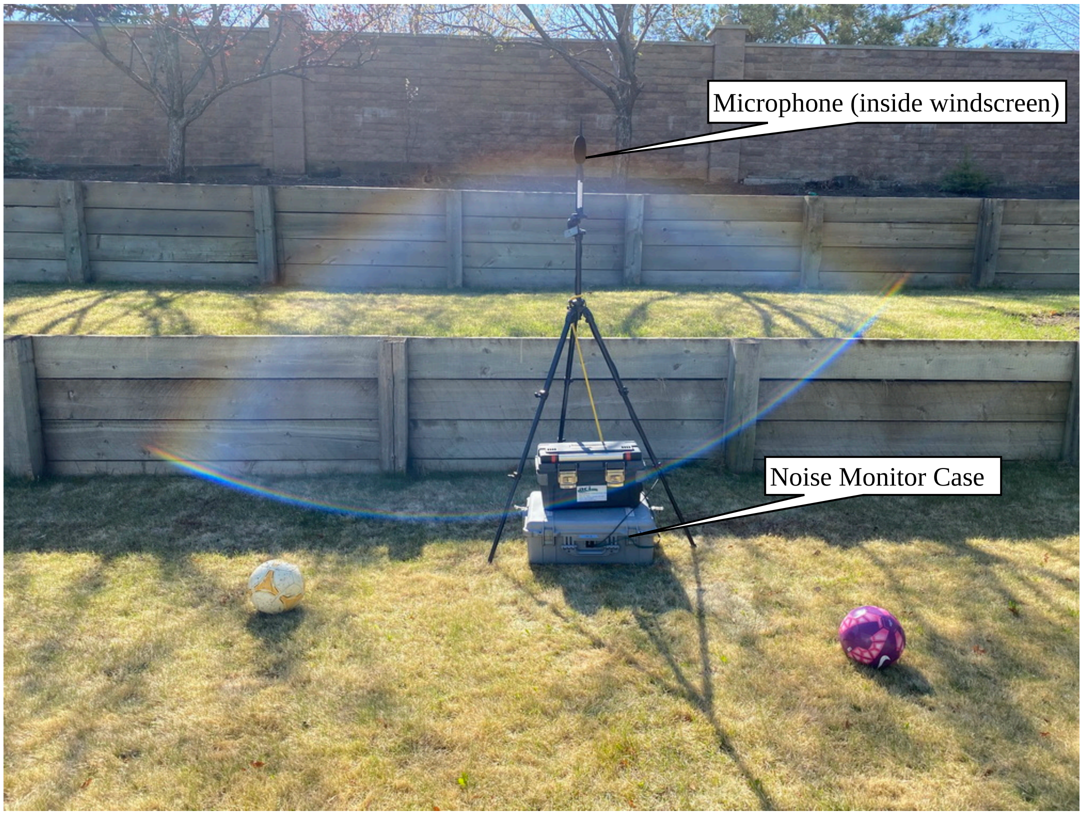


Figure 12. Noise Monitor #11 (14 Emery Court)

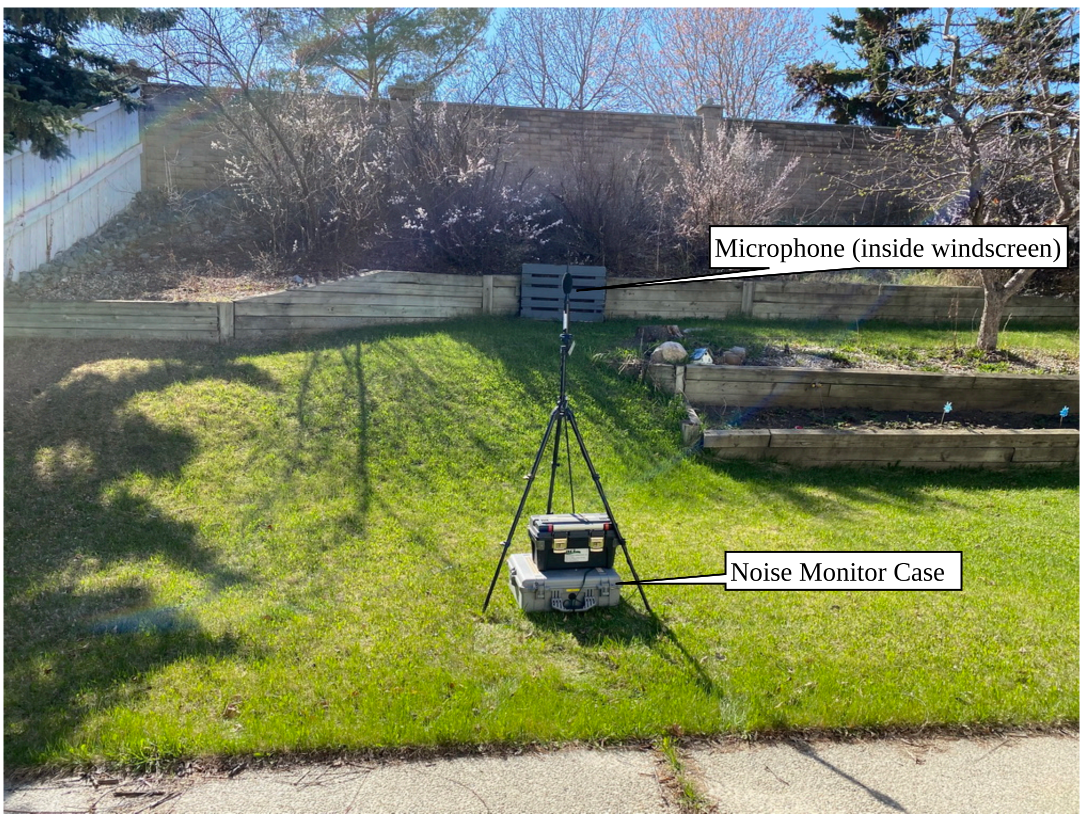


Figure 13. Noise Monitor #12 (14 Emerald Terrace)

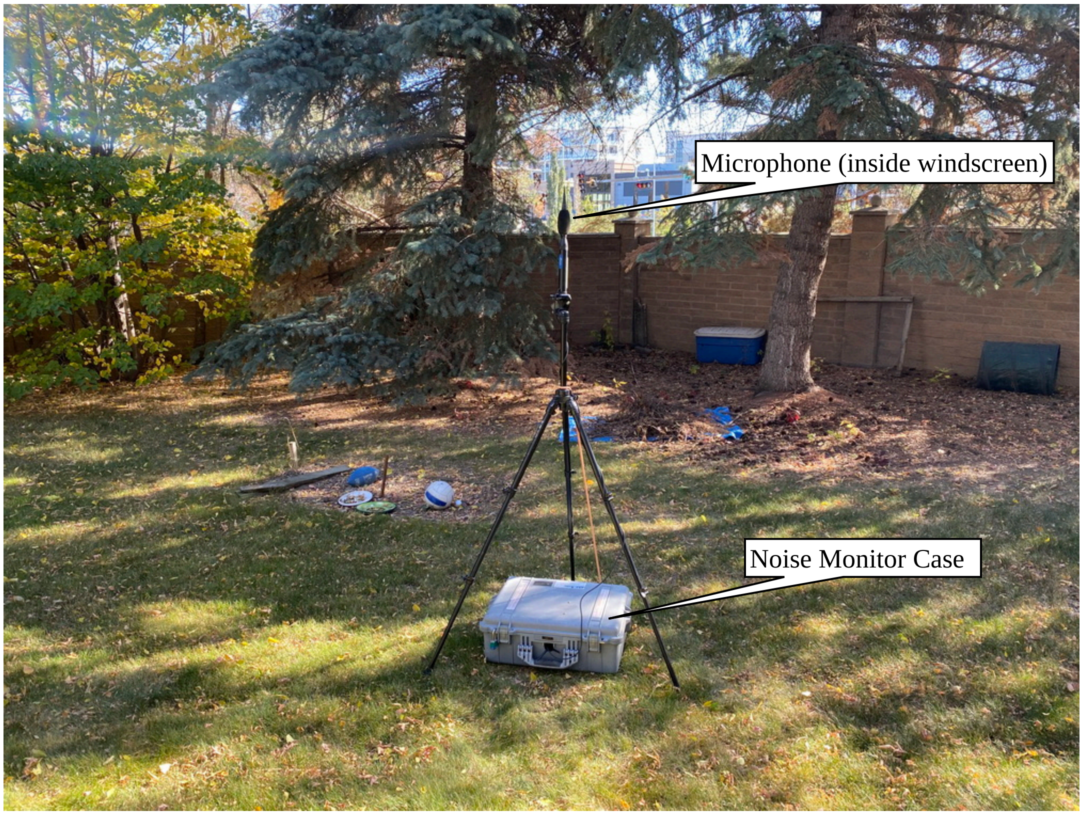


Figure 14. Noise Monitor #13 (10 Inverness Crescent)

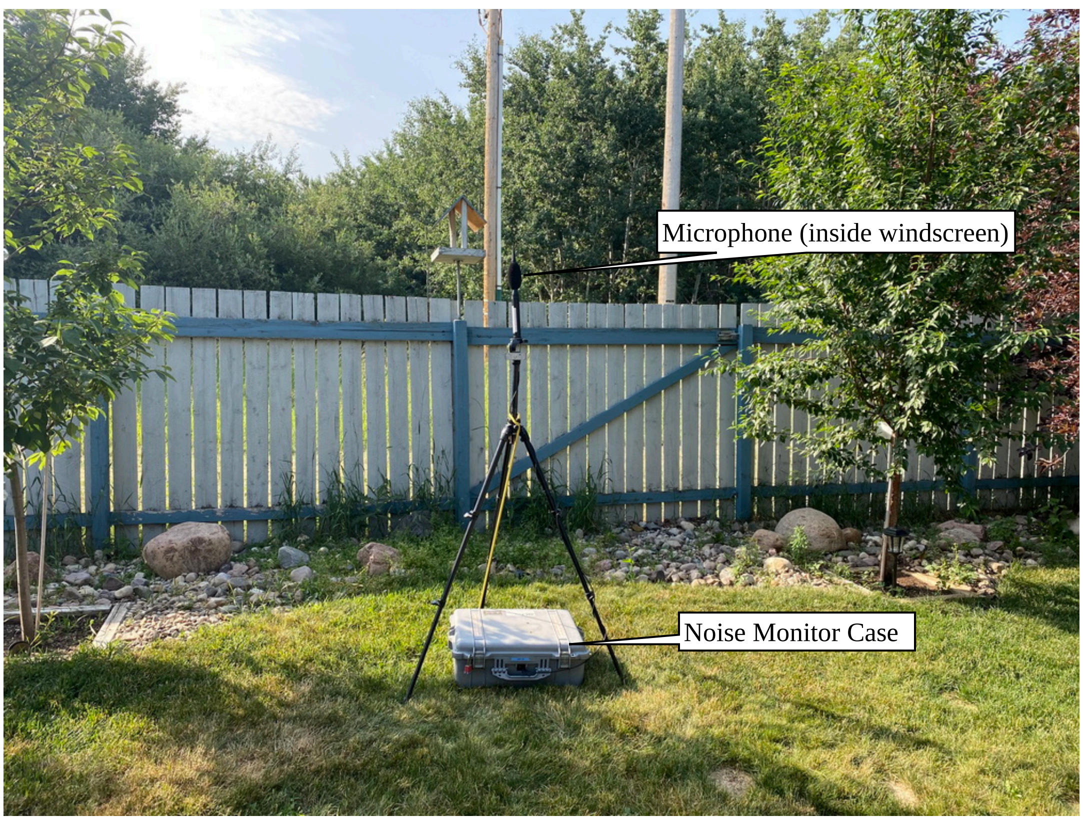


Figure 15. Noise Monitor #14 (71 Arbor Crescent)

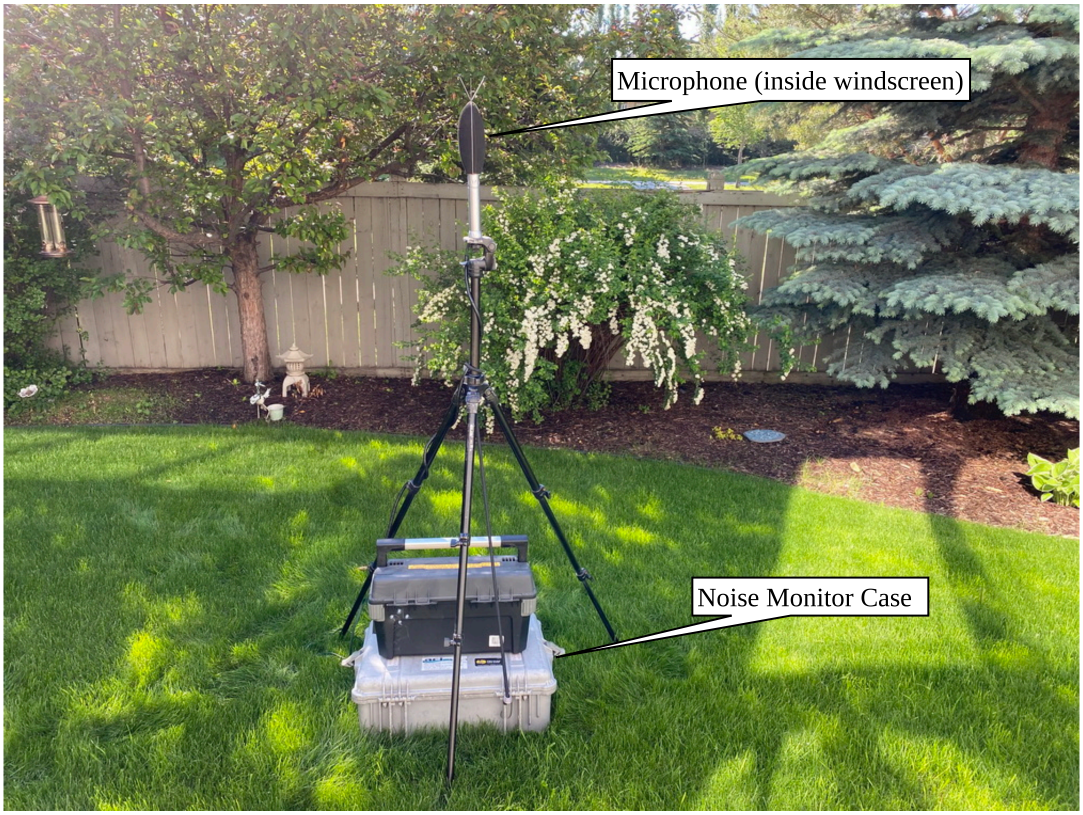


Figure 16. Noise Monitor #15 (205 Erin Ridge Drive)

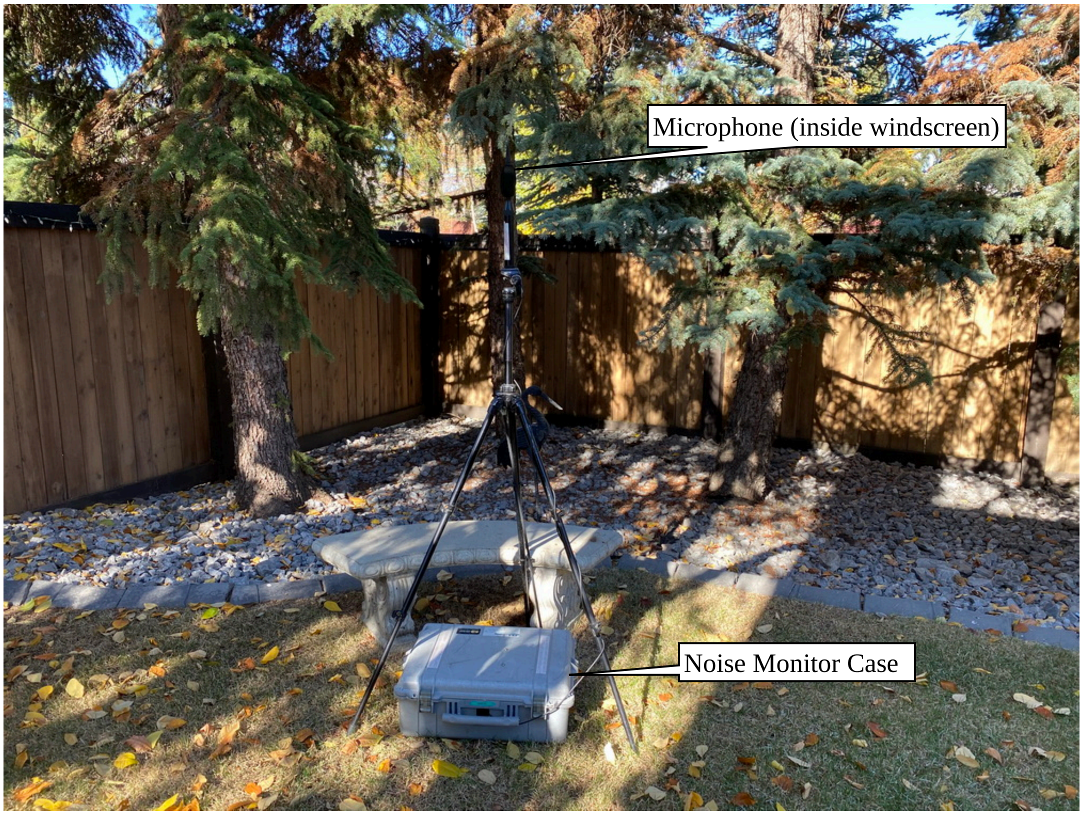


Figure 17. Noise Monitor #16 (38 Lodgepole Crescent)

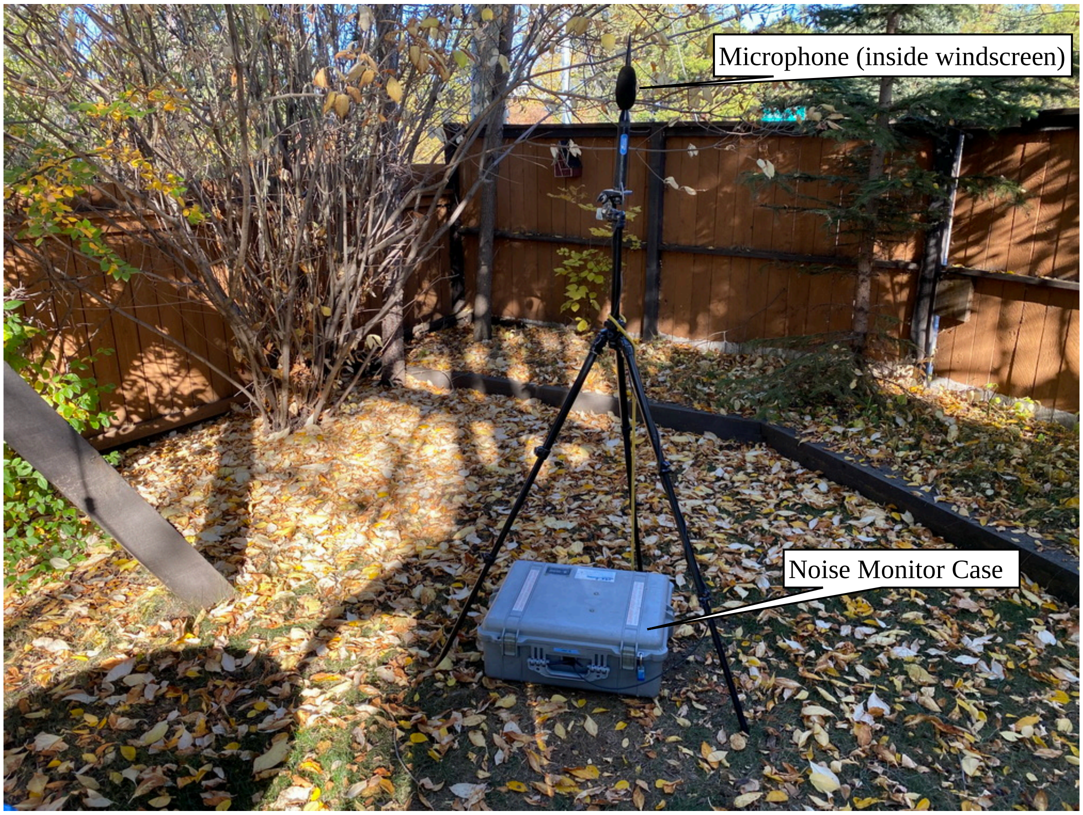


Figure 18. Noise Monitor #17 (21 Sylvan Drive)

Figure 19. Noise Monitor #18 (26 Finch Crescent)

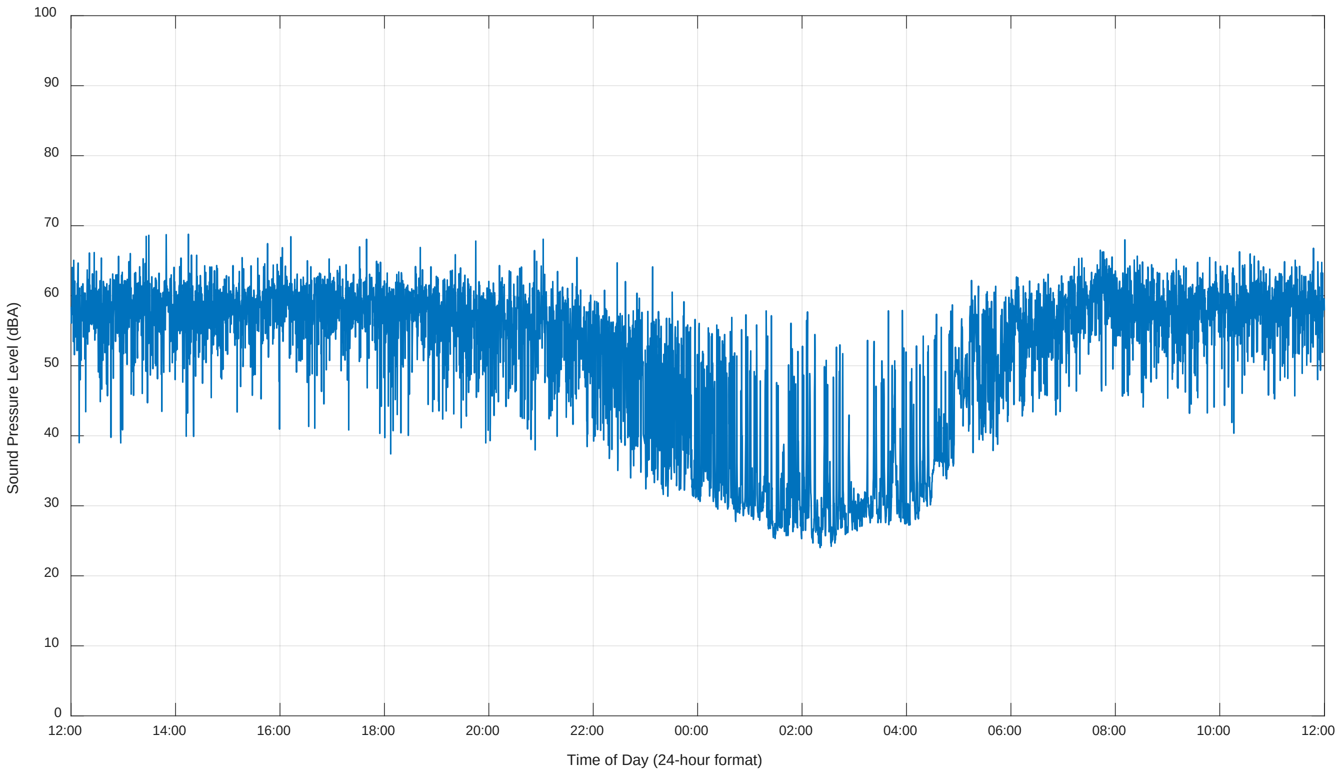


Figure 20. Noise Monitor #1 – 15-Second L_{eq}24 Sound Levels

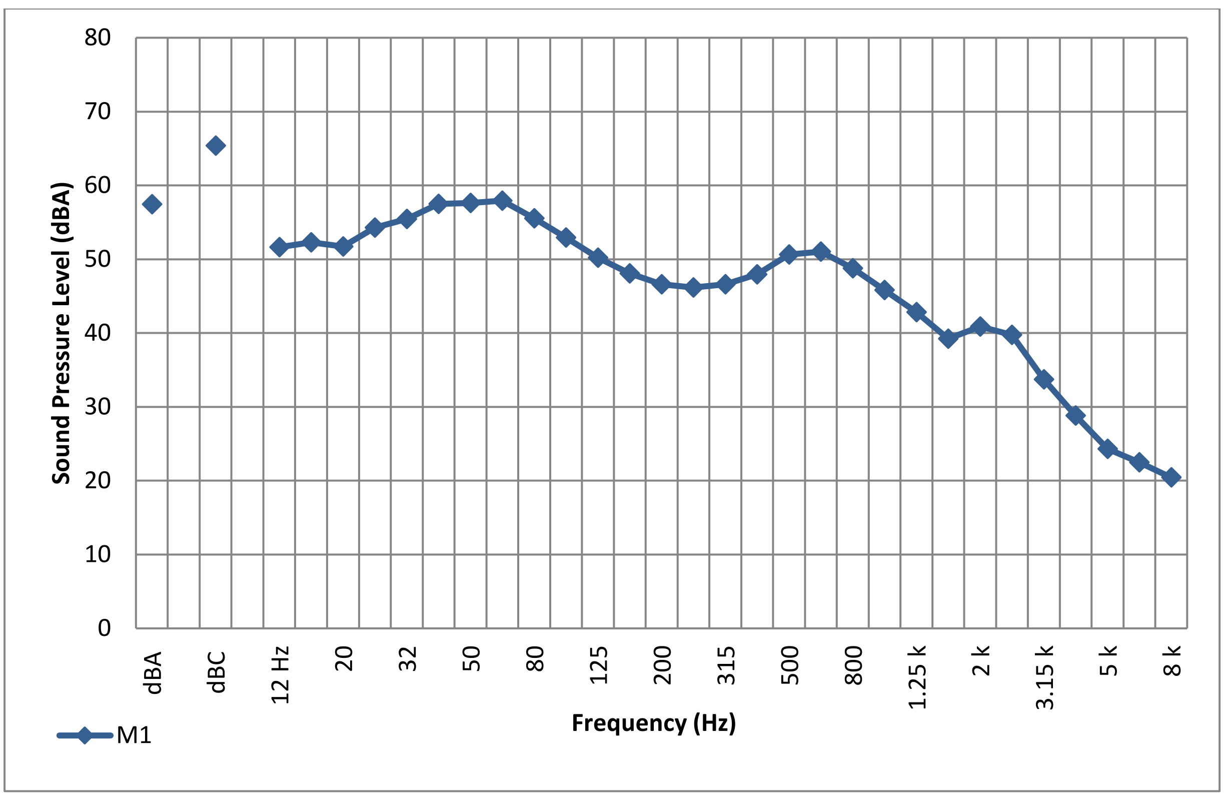


Figure 21. Noise Monitor #1 – 24-Hour 1/3 Octave Band L_{eq} Sound Levels

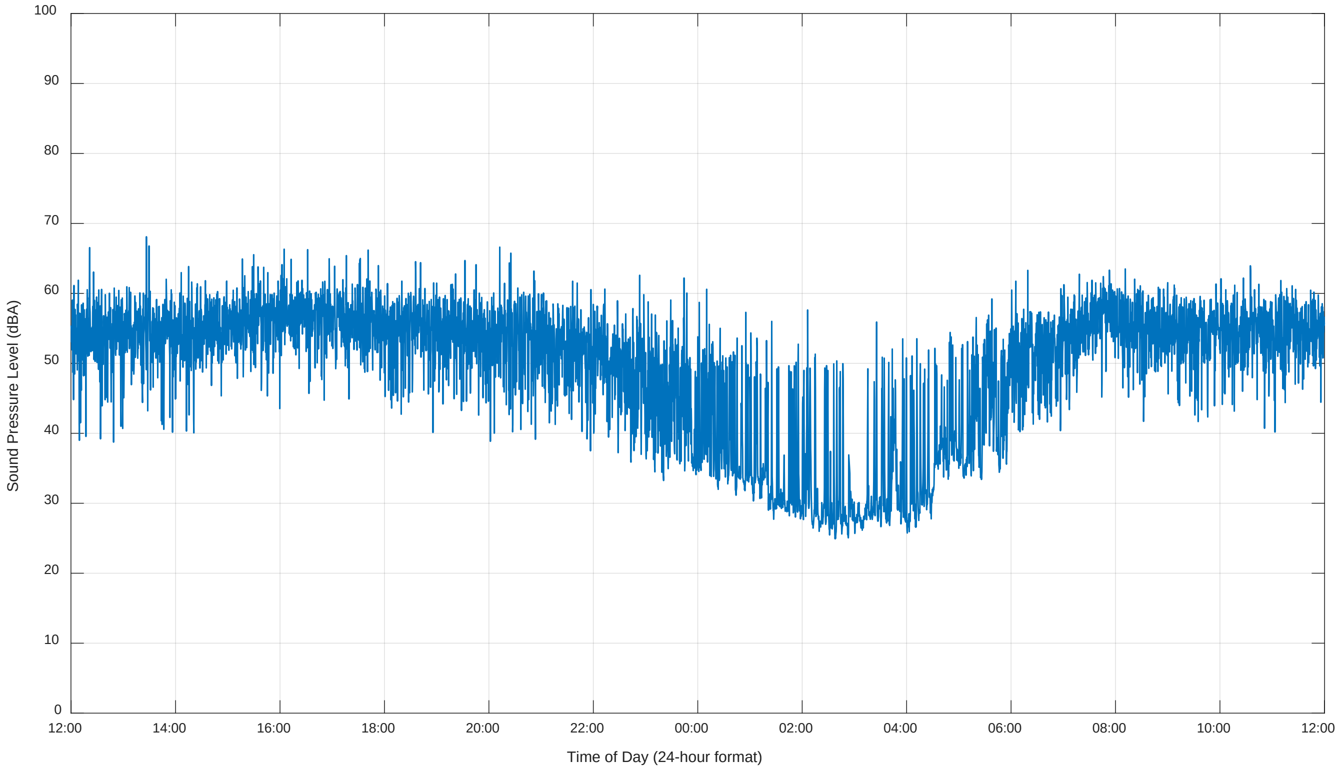


Figure 22. Noise Monitor #2 – 15-Second L_{eq}24 Sound Levels

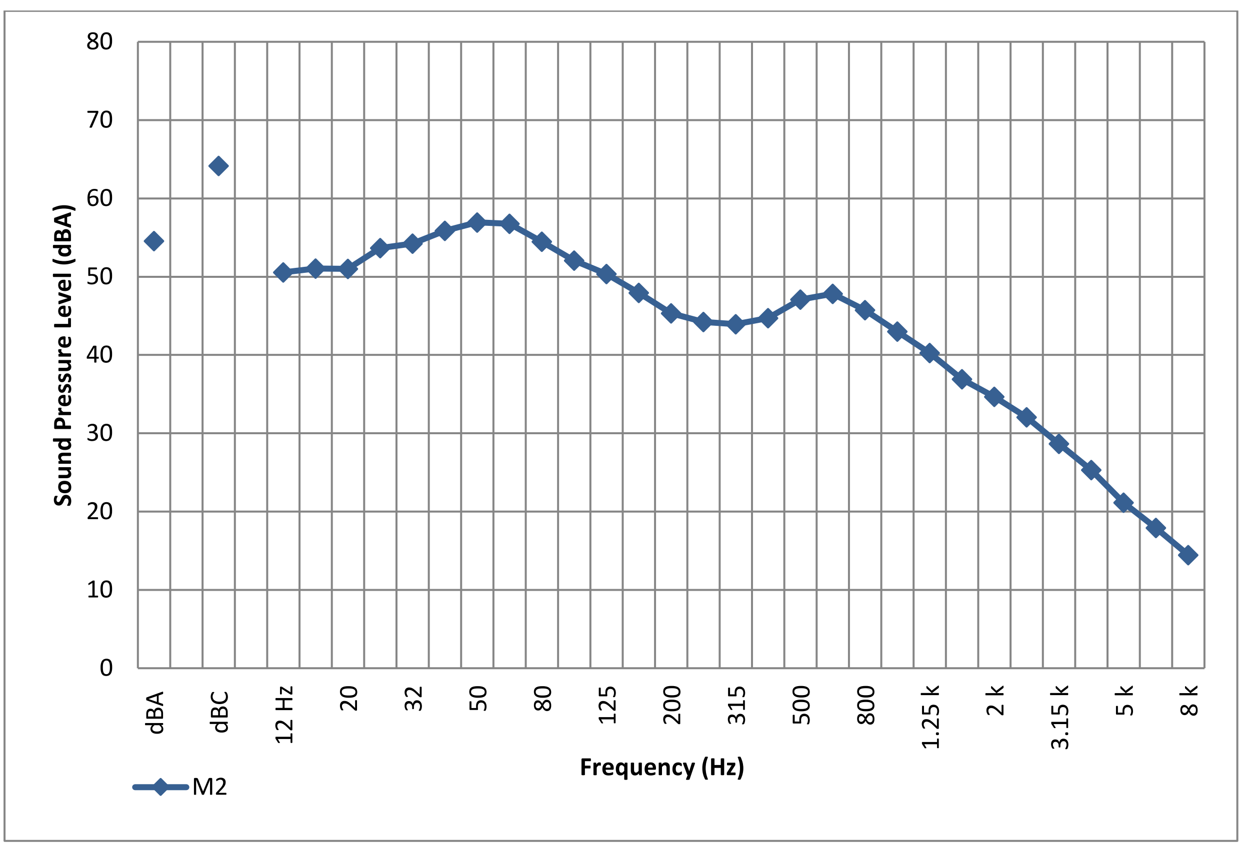


Figure 23. Noise Monitor #2 – 24-Hour 1/3 Octave Band L_{eq} Sound Levels

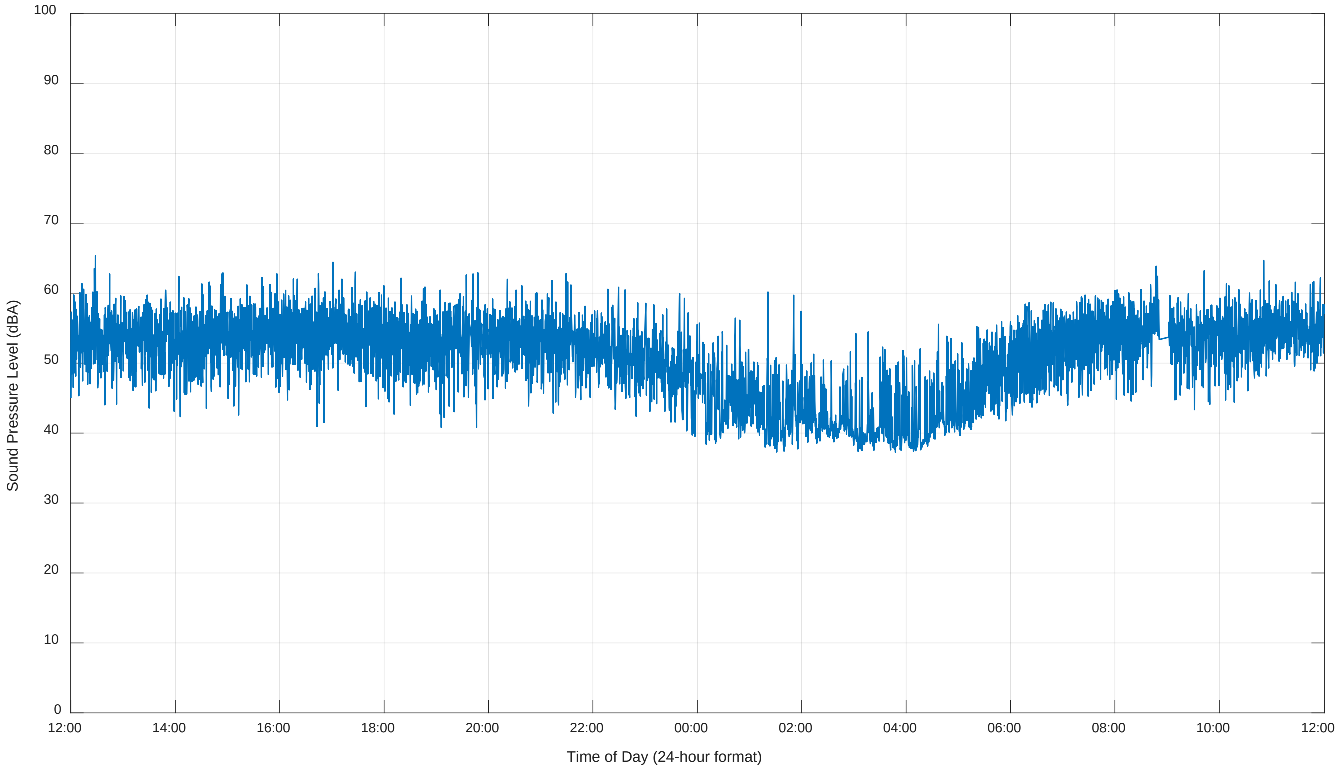


Figure 24. Noise Monitor #3 – 15-Second L_{eq}24 Sound Levels

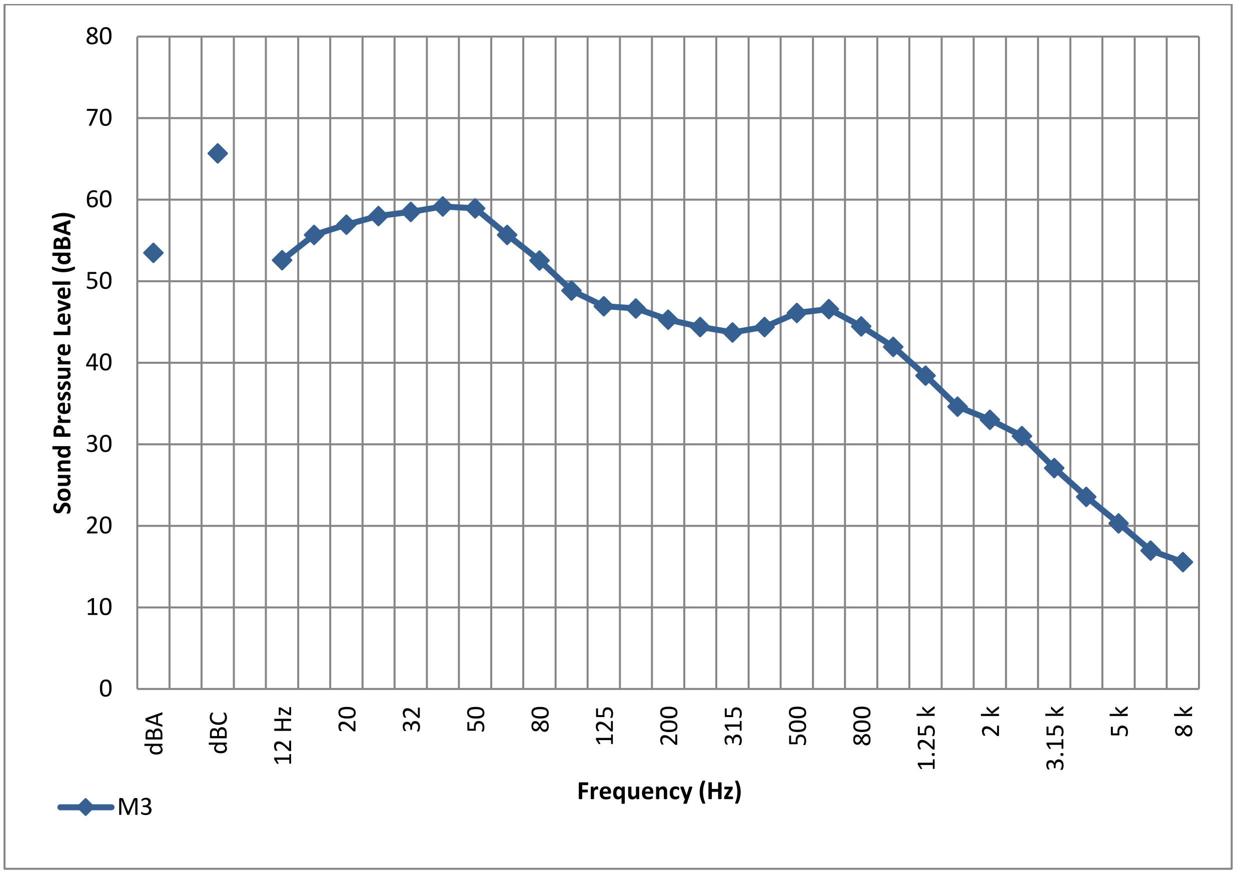


Figure 25. Noise Monitor #3 – 24-Hour 1/3 Octave Band L_{eq} Sound Levels

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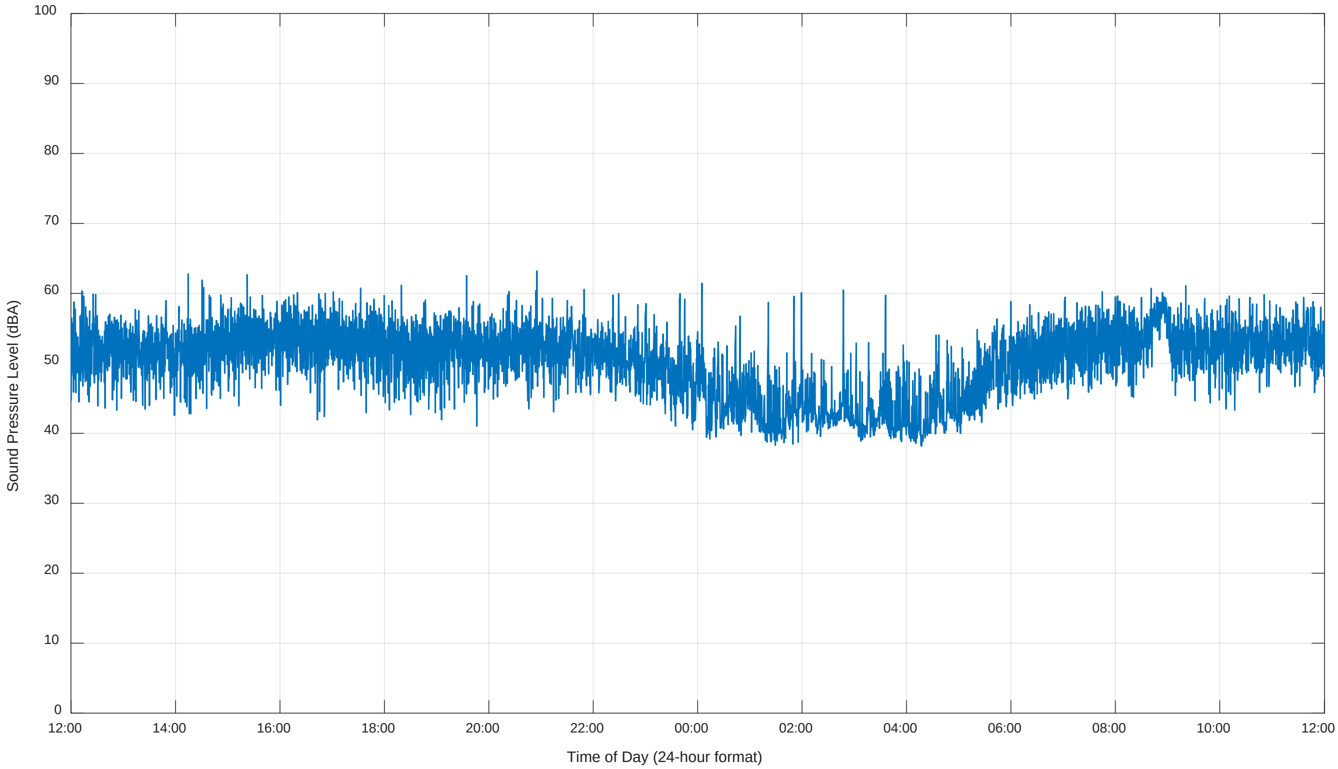

Figure 26. Noise Monitor #4 – 15-Second L_{eq}24 Sound Levels

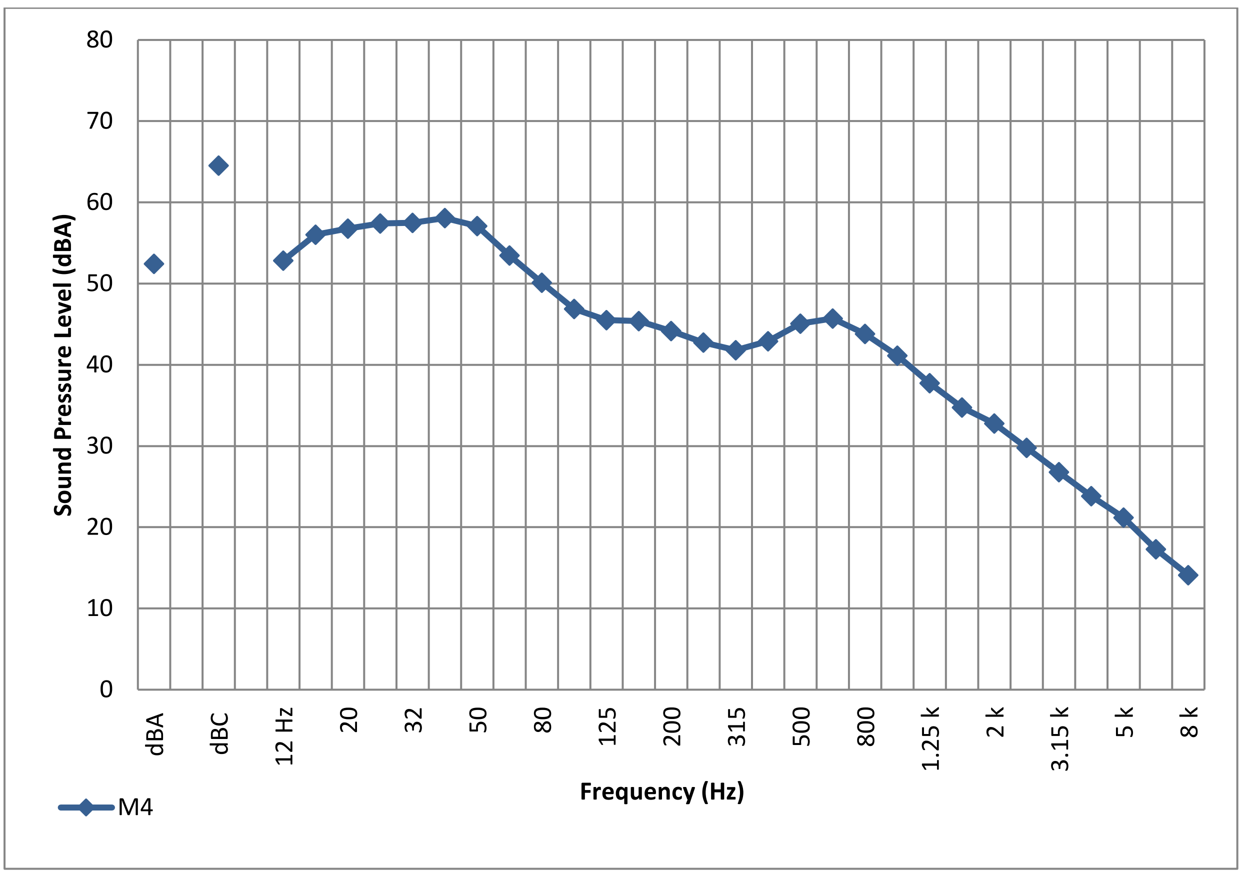

Figure 27. Noise Monitor #4 – 24-Hour 1/3 Octave Band L_{eq} Sound Levels

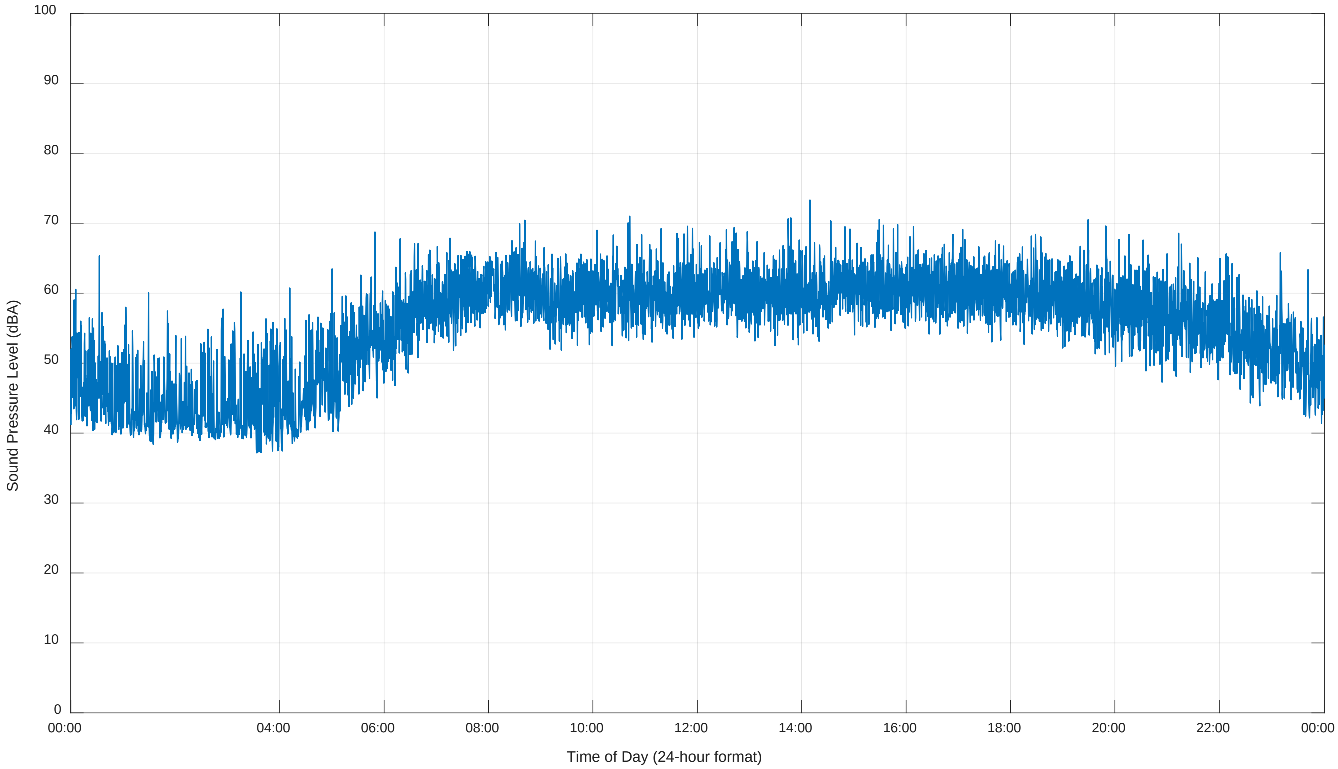

Figure 28. Noise Monitor #5 – 15-Second L_{eq}24 Sound Levels

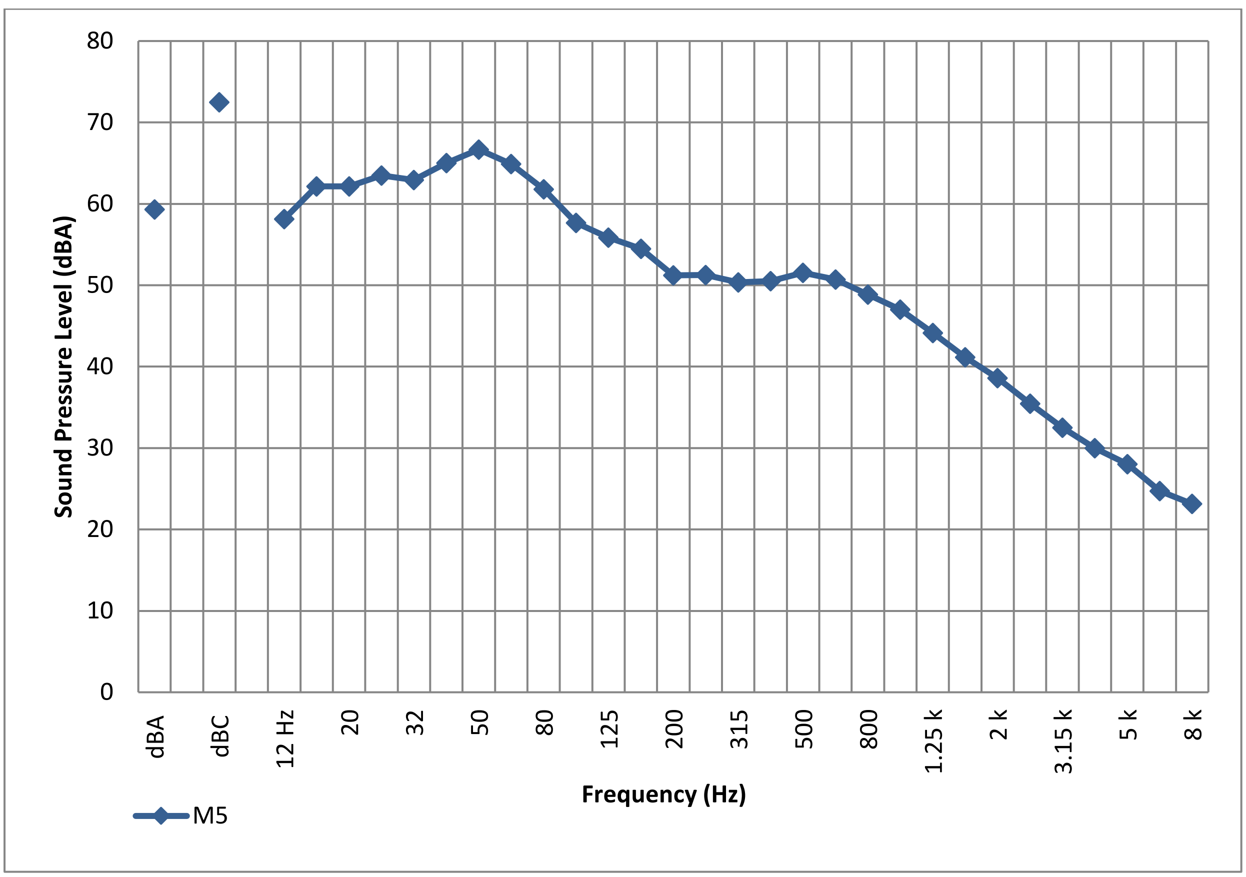

Figure 29. Noise Monitor #5 – 24-Hour 1/3 Octave Band L_{eq} Sound Levels

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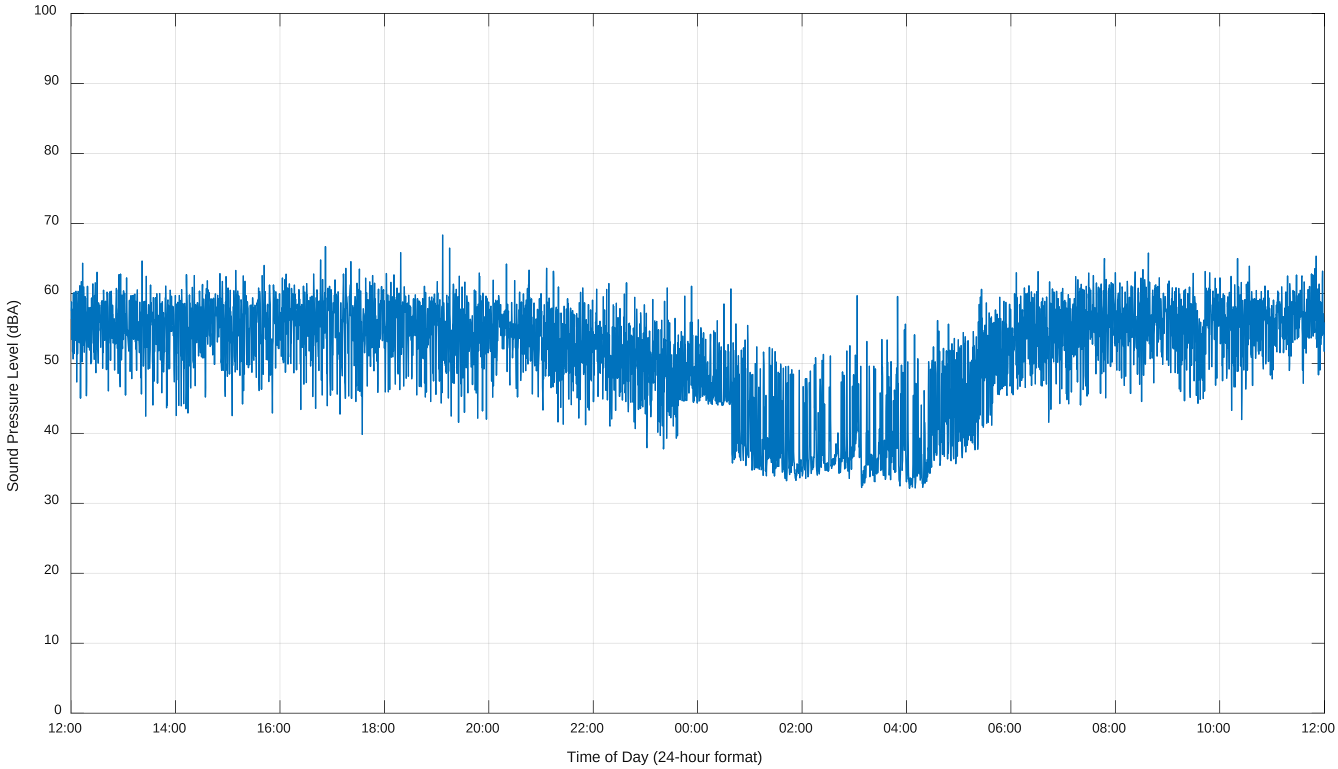

Figure 30. Noise Monitor #6 – 15-Second L_{eq}24 Sound Levels

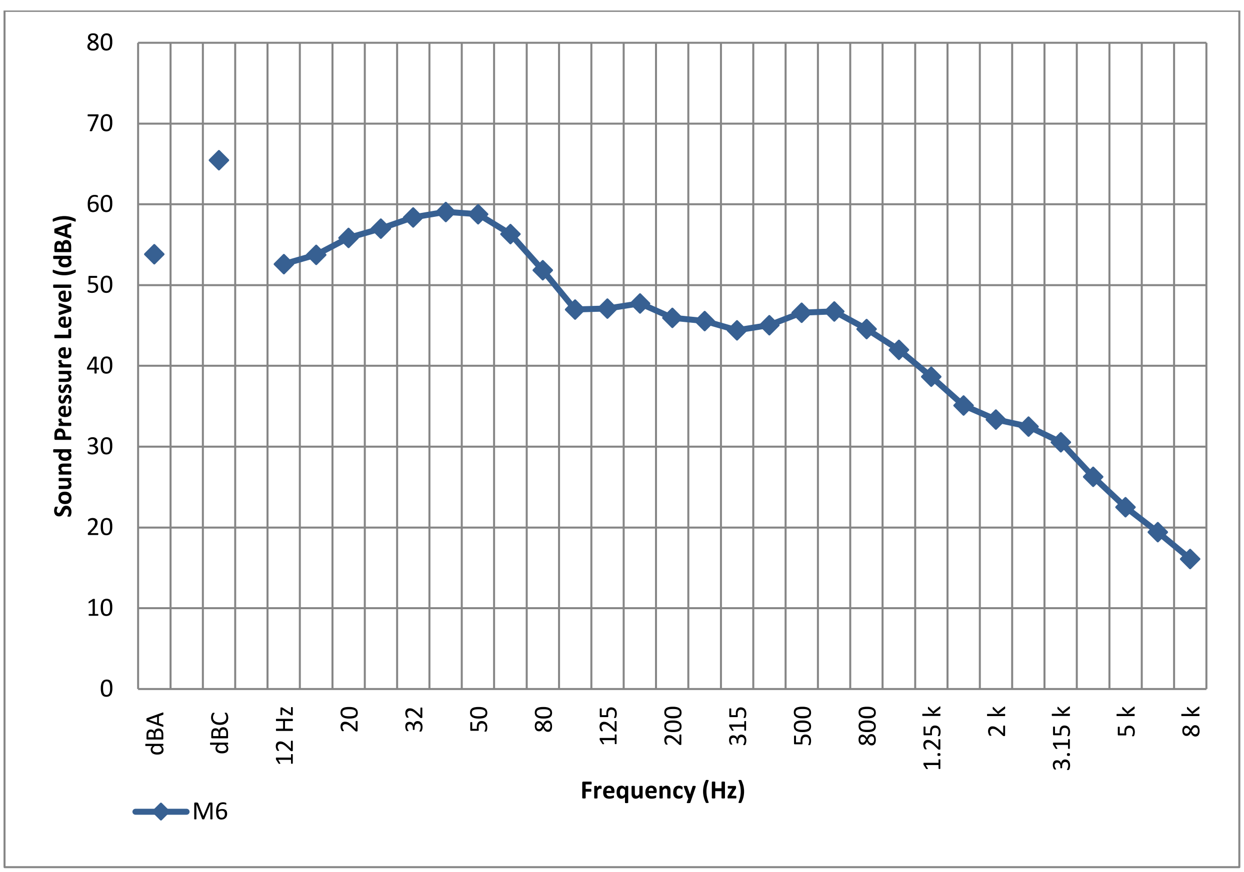

Figure 31. Noise Monitor #6 – 24-Hour 1/3 Octave Band L_{eq} Sound Levels

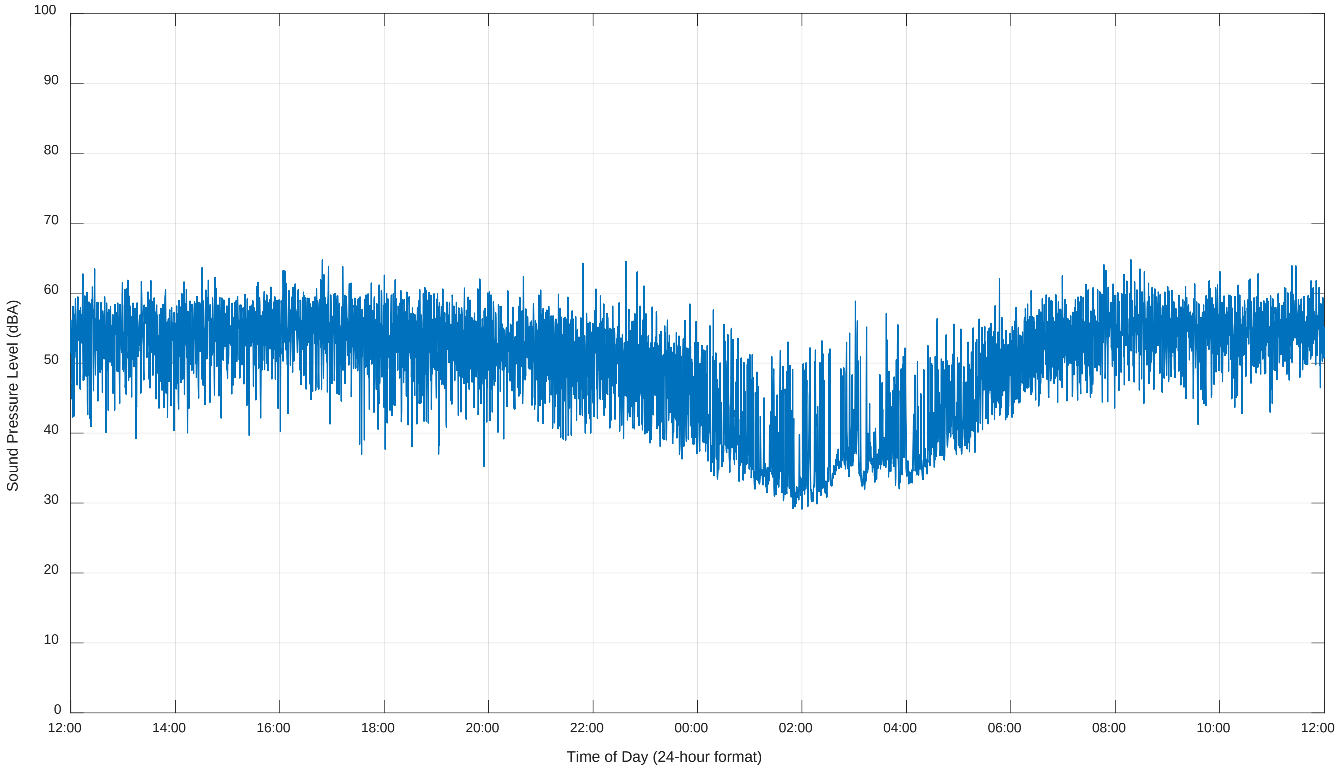

Figure 32. Noise Monitor #7 – 15-Second L_{eq}24 Sound Levels

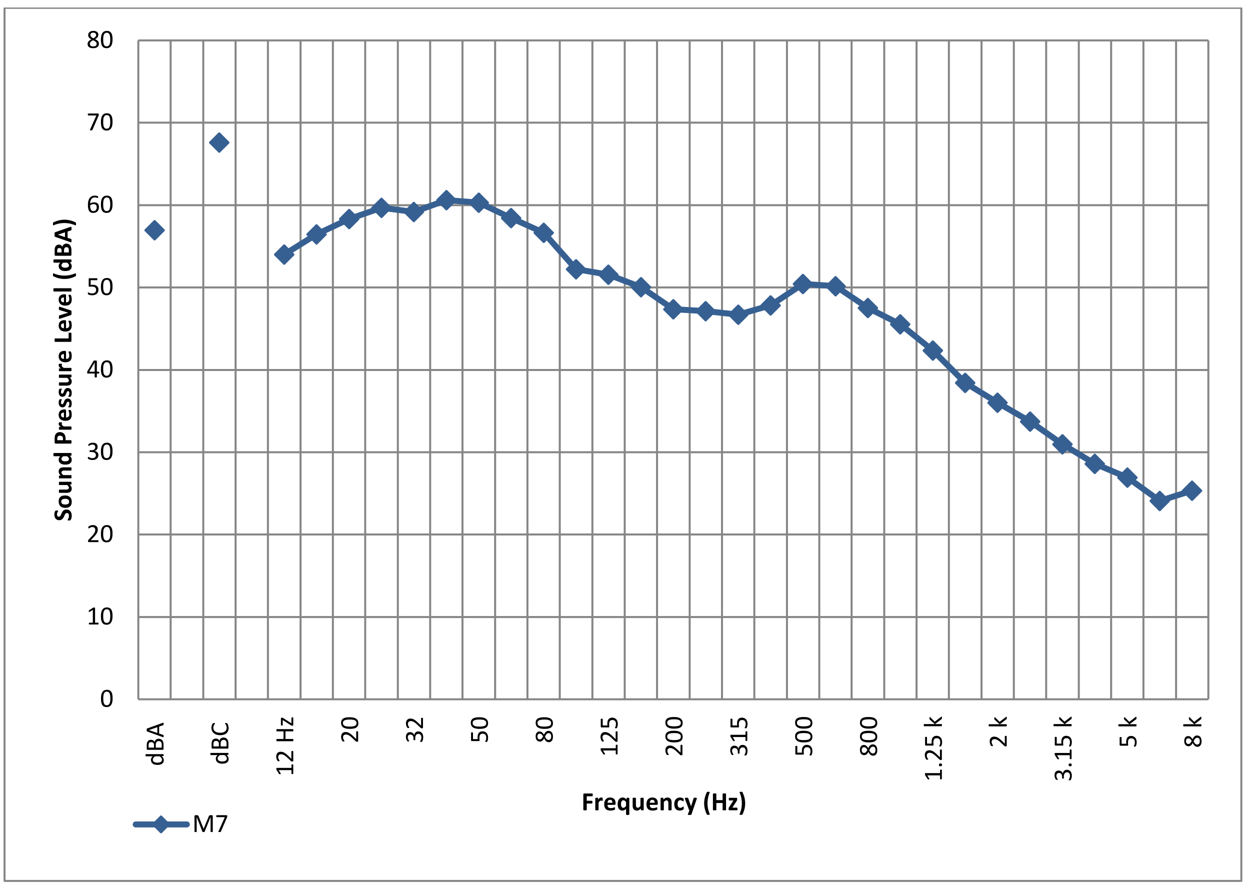

Figure 33. Noise Monitor #7 – 24-Hour 1/3 Octave Band L_{eq} Sound Levels

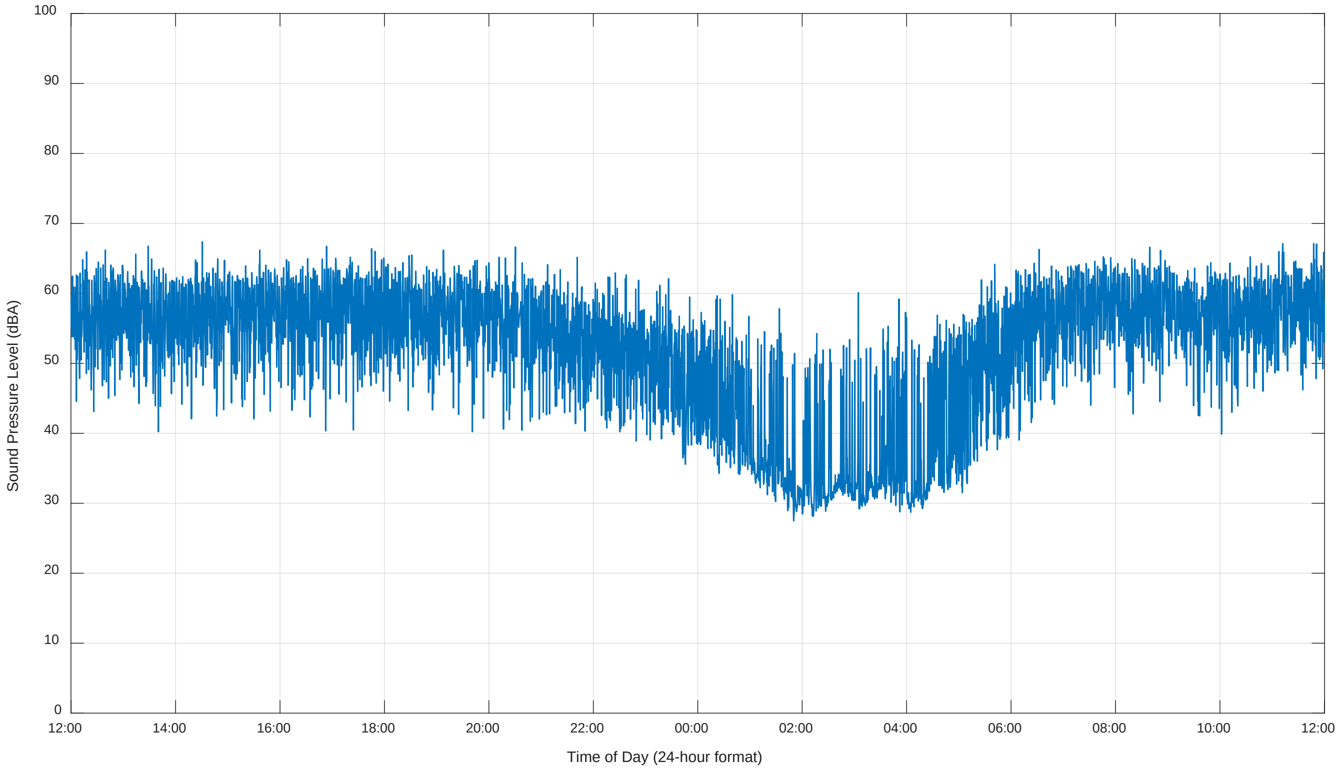

Figure 34. Noise Monitor #8 – 15-Second L_{eq}24 Sound Levels

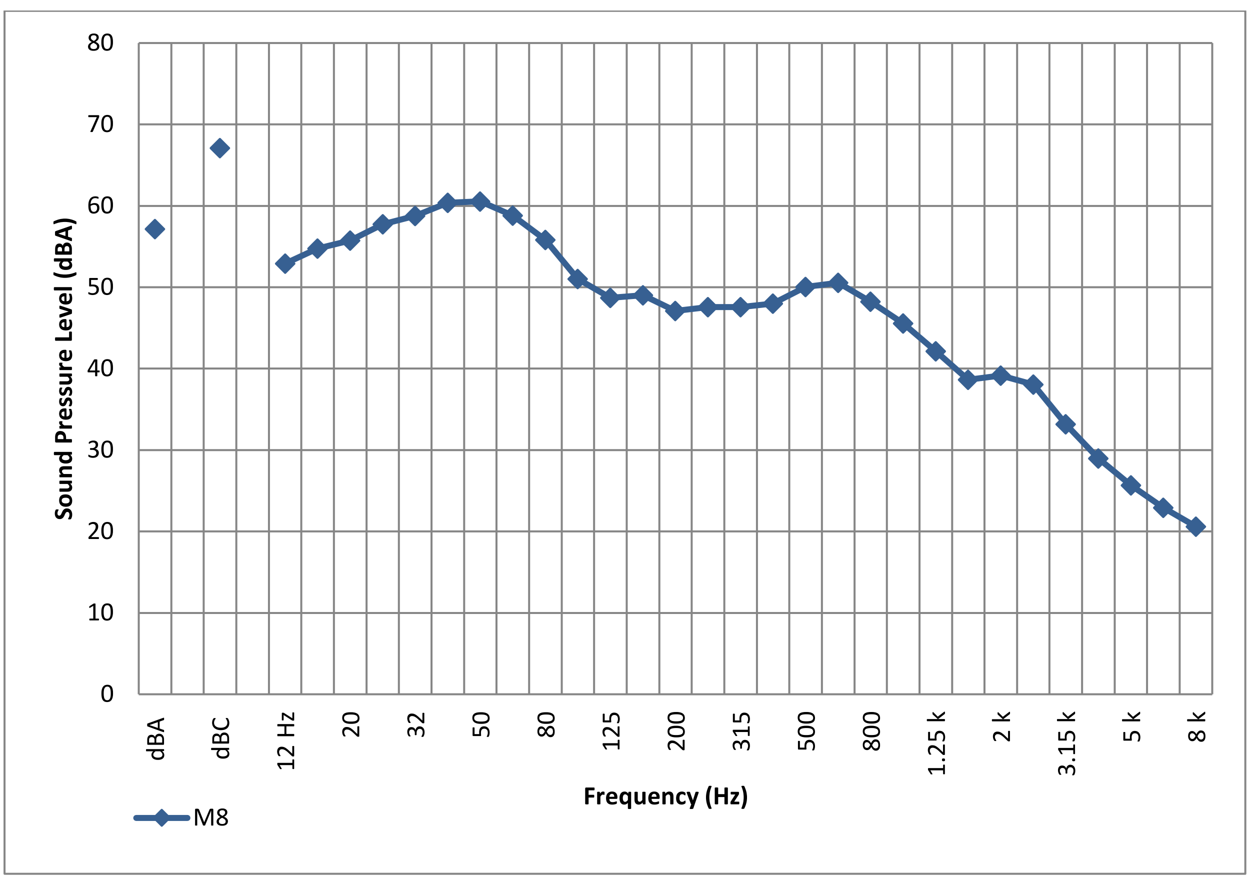

Figure 35. Noise Monitor #8 – 24-Hour 1/3 Octave Band L_{eq} Sound Levels

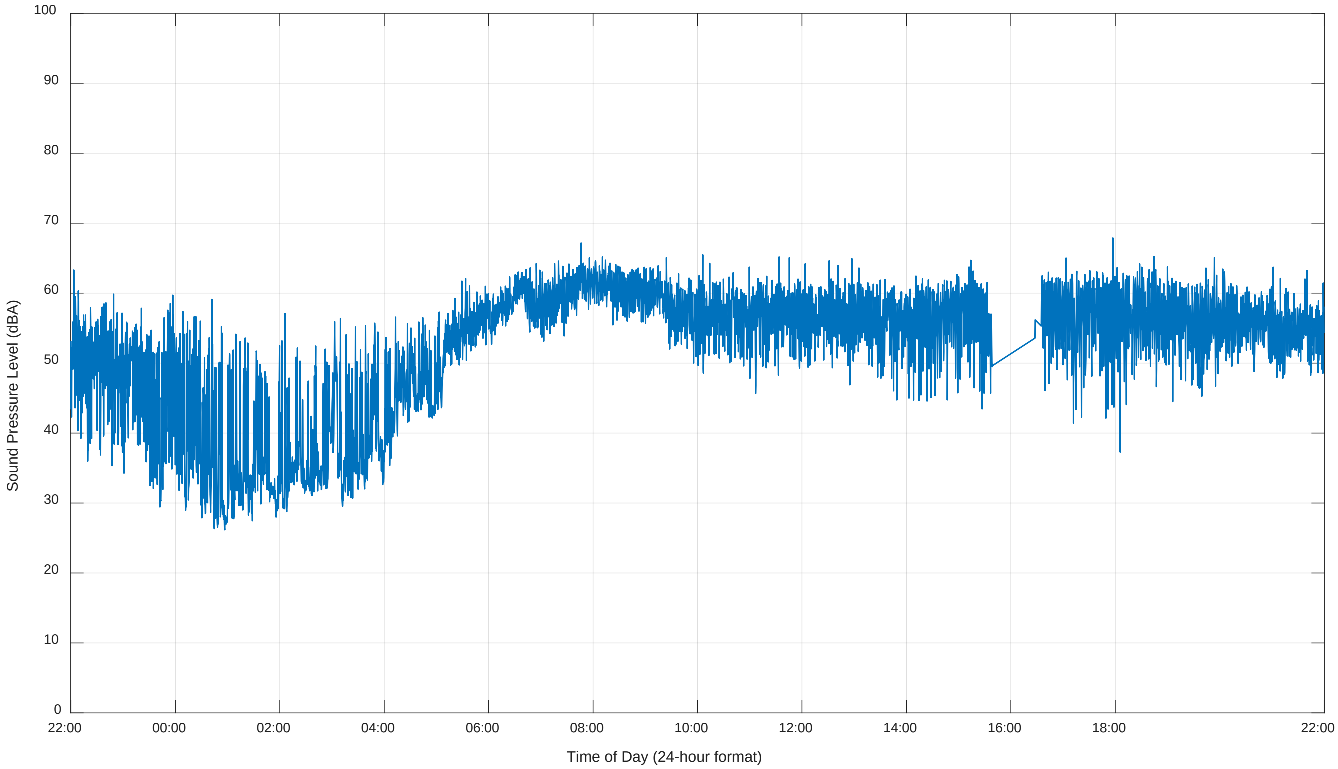

Figure 36. Noise Monitor #9 – 15-Second L_{eq}24 Sound Levels

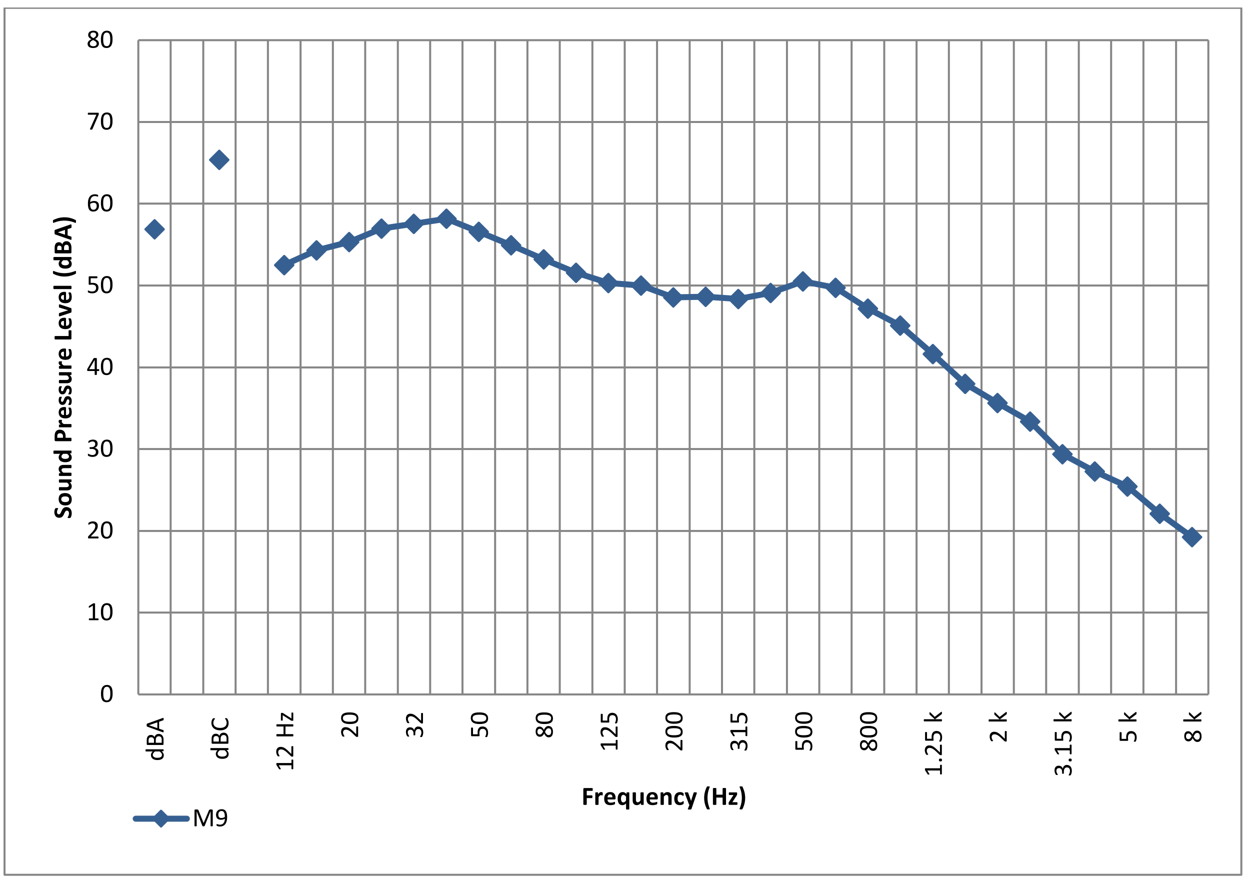

Figure 37. Noise Monitor #9 – 24-Hour 1/3 Octave Band L_{eq} Sound Levels

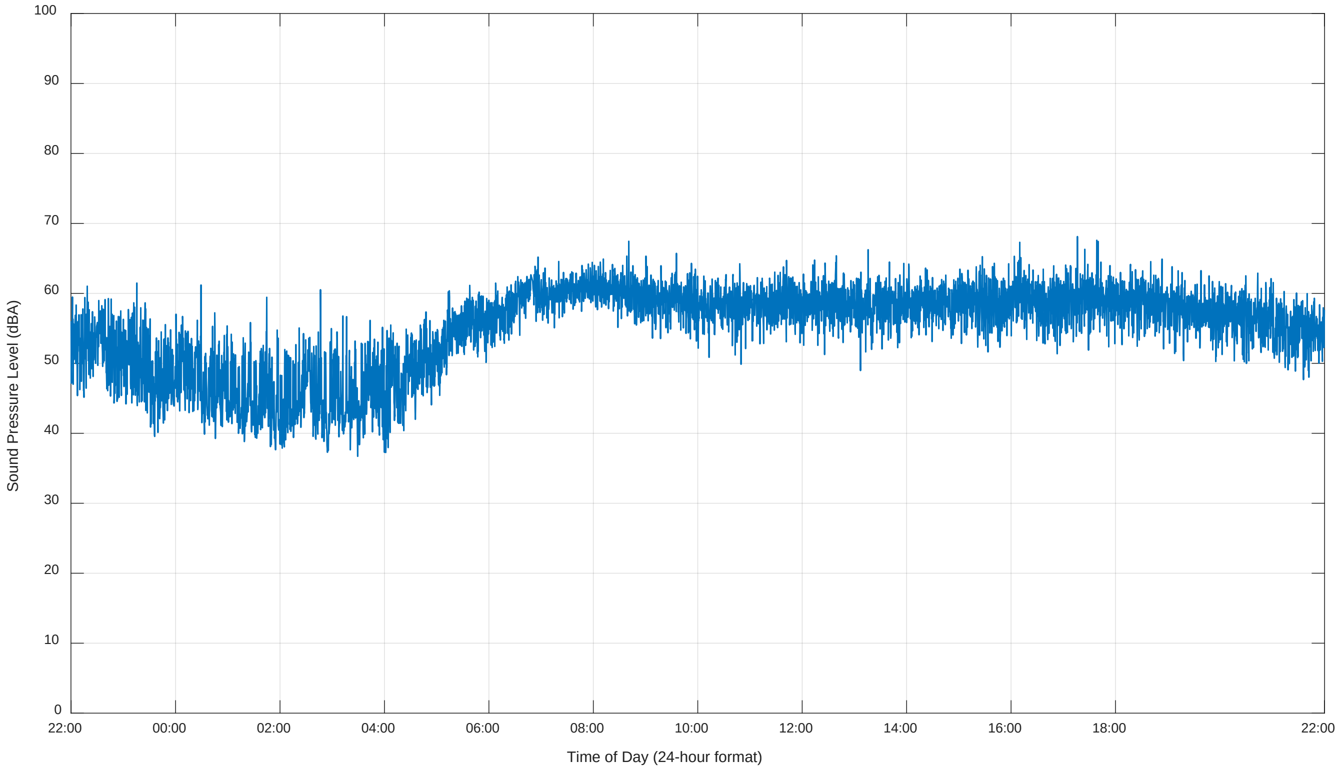

Figure 38. Noise Monitor #10 – 15-Second L_{eq}24 Sound Levels

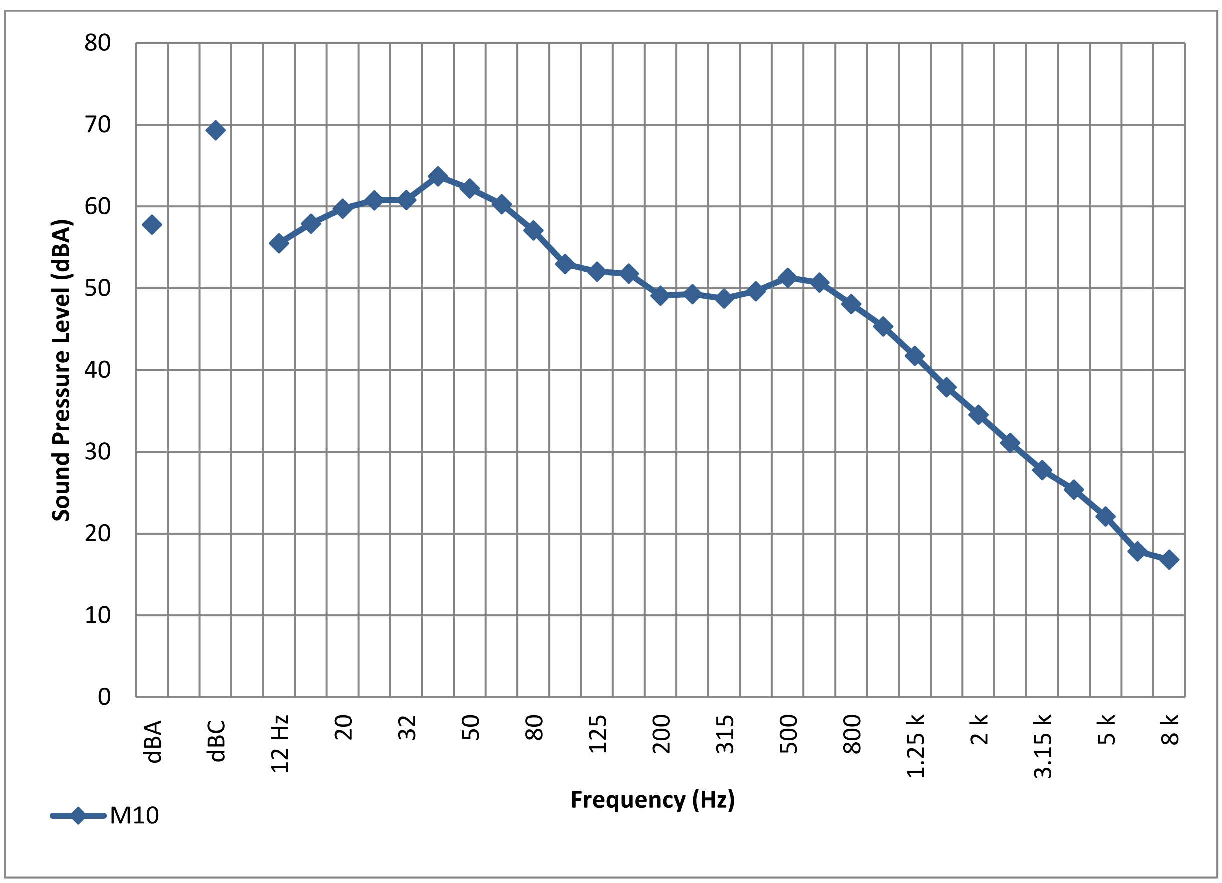

Figure 39. Noise Monitor #10 – 24-Hour 1/3 Octave Band L_{eq} Sound Levels

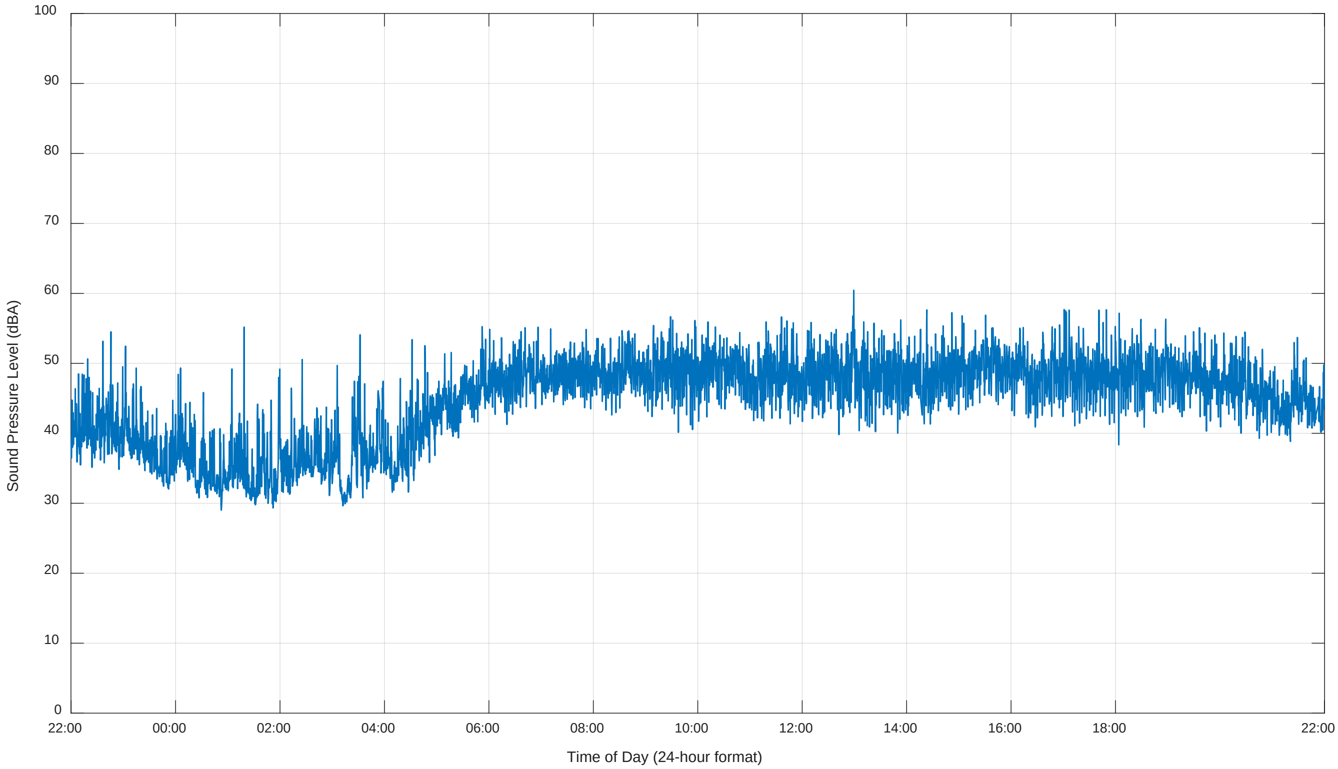

Figure 40. Noise Monitor #11 – 15-Second L_{eq}24 Sound Levels

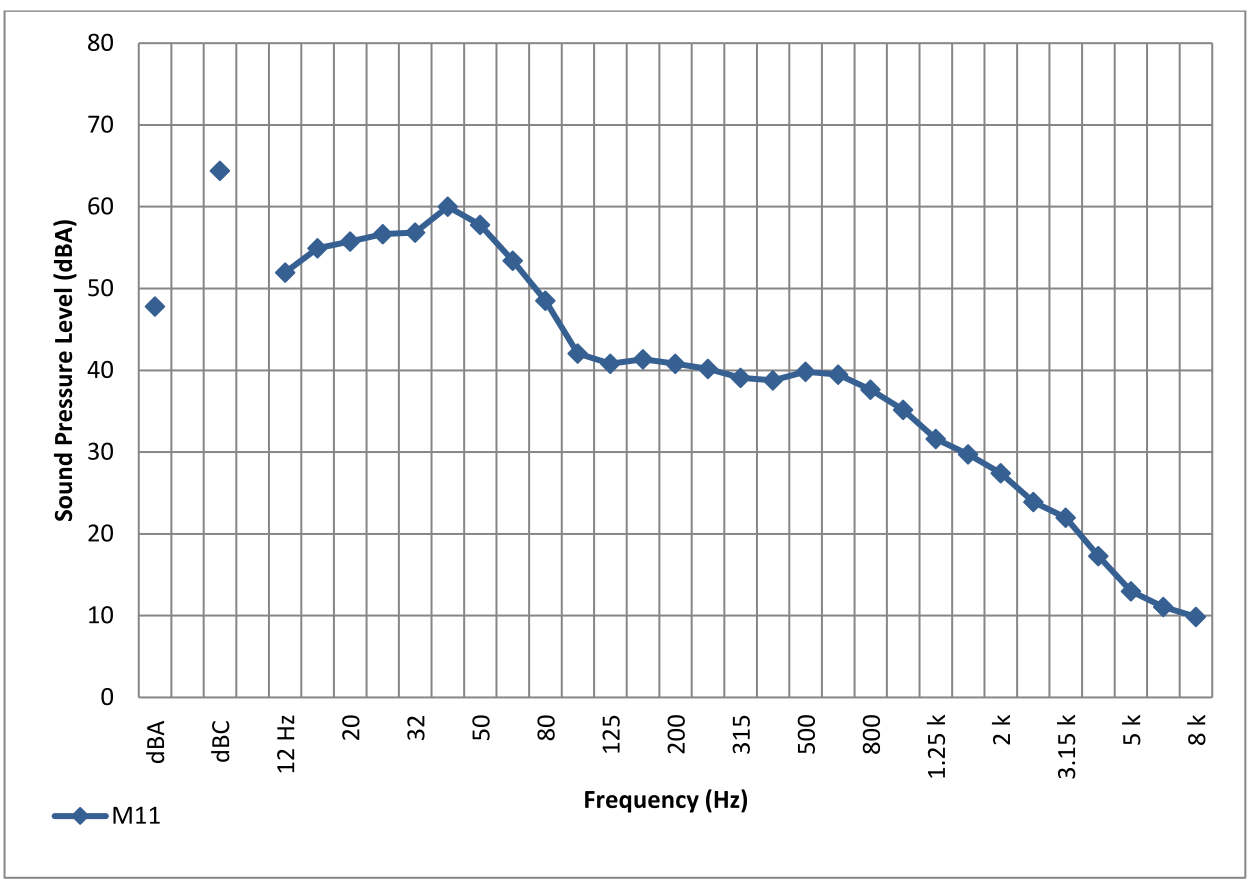

Figure 41. Noise Monitor #11 – 24-Hour 1/3 Octave Band L_{eq} Sound Levels

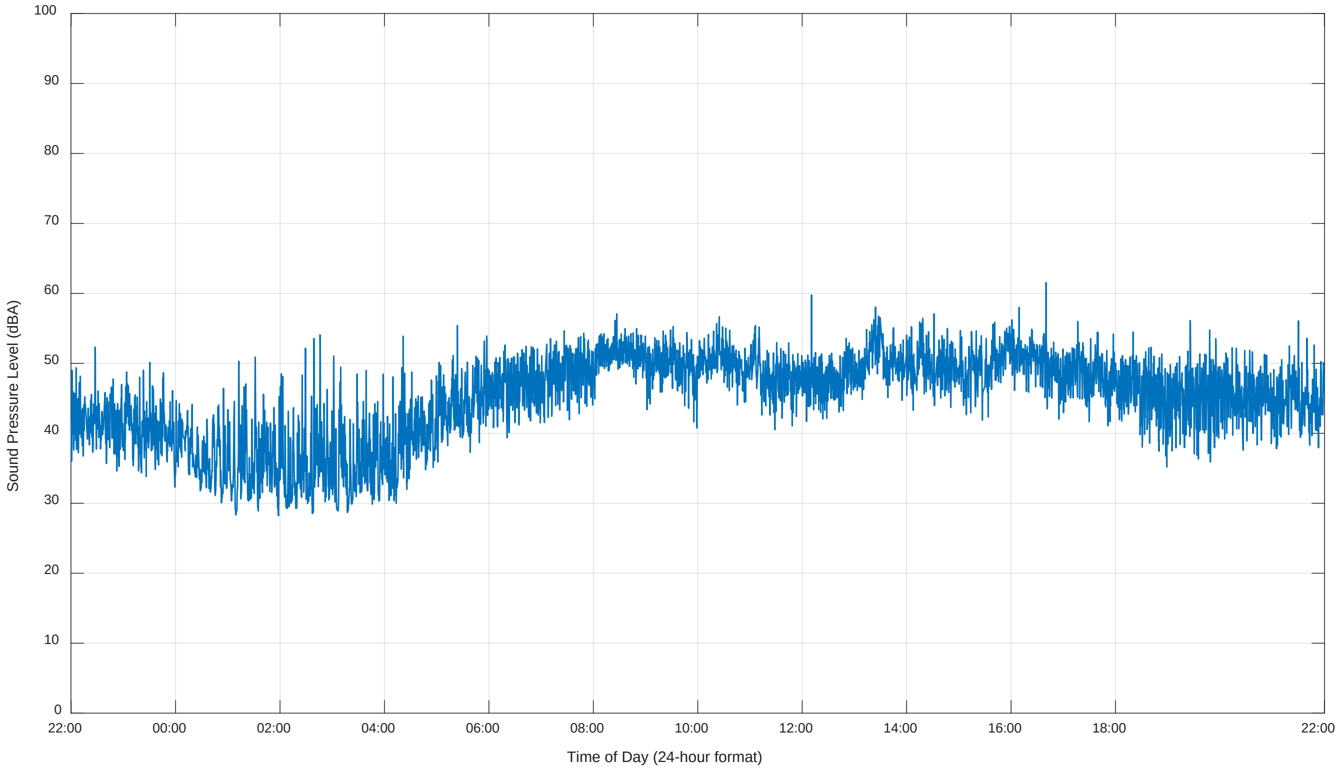

Figure 42. Noise Monitor #12 – 15-Second L_{eq}24 Sound Levels

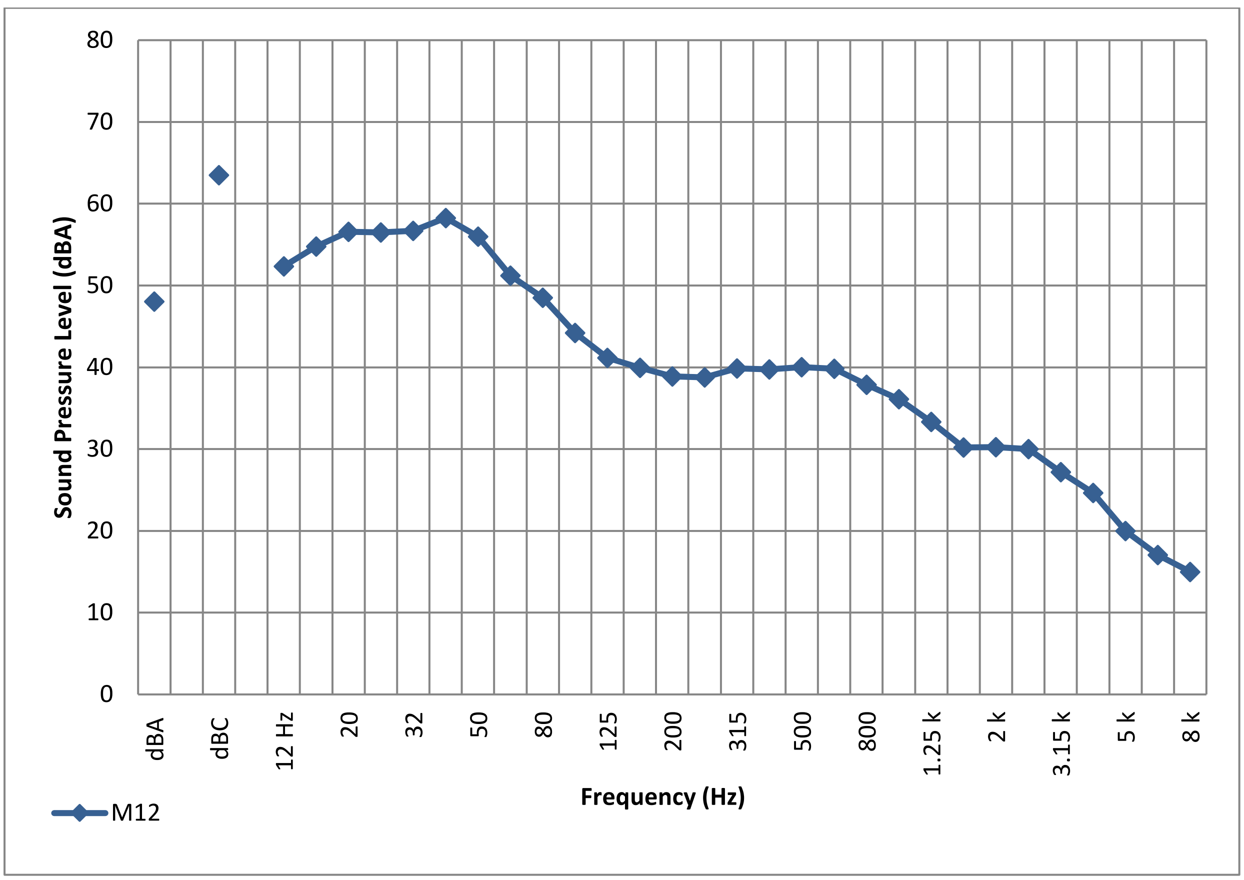

Figure 43. Noise Monitor #12 – 24-Hour 1/3 Octave Band L_{eq} Sound Levels

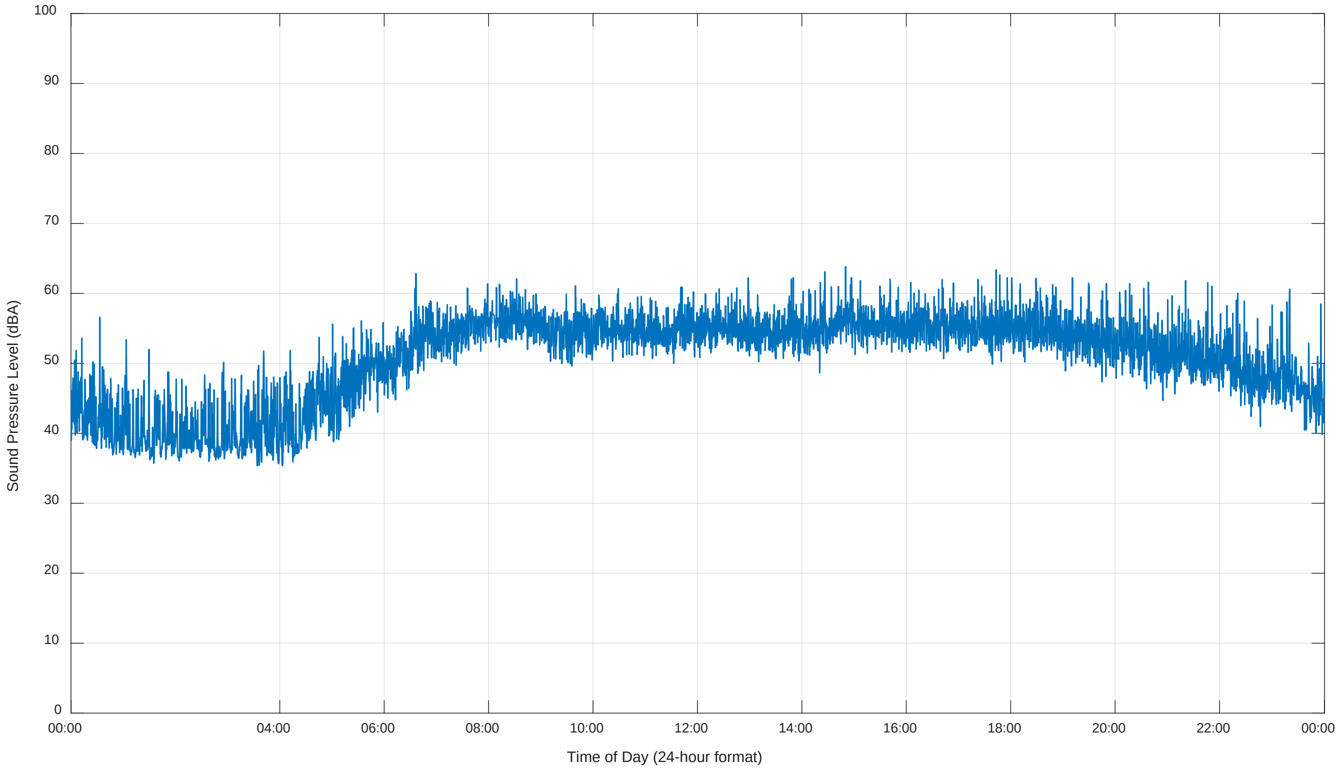

Figure 44. Noise Monitor #13 – 15-Second L_{eq}24 Sound Levels

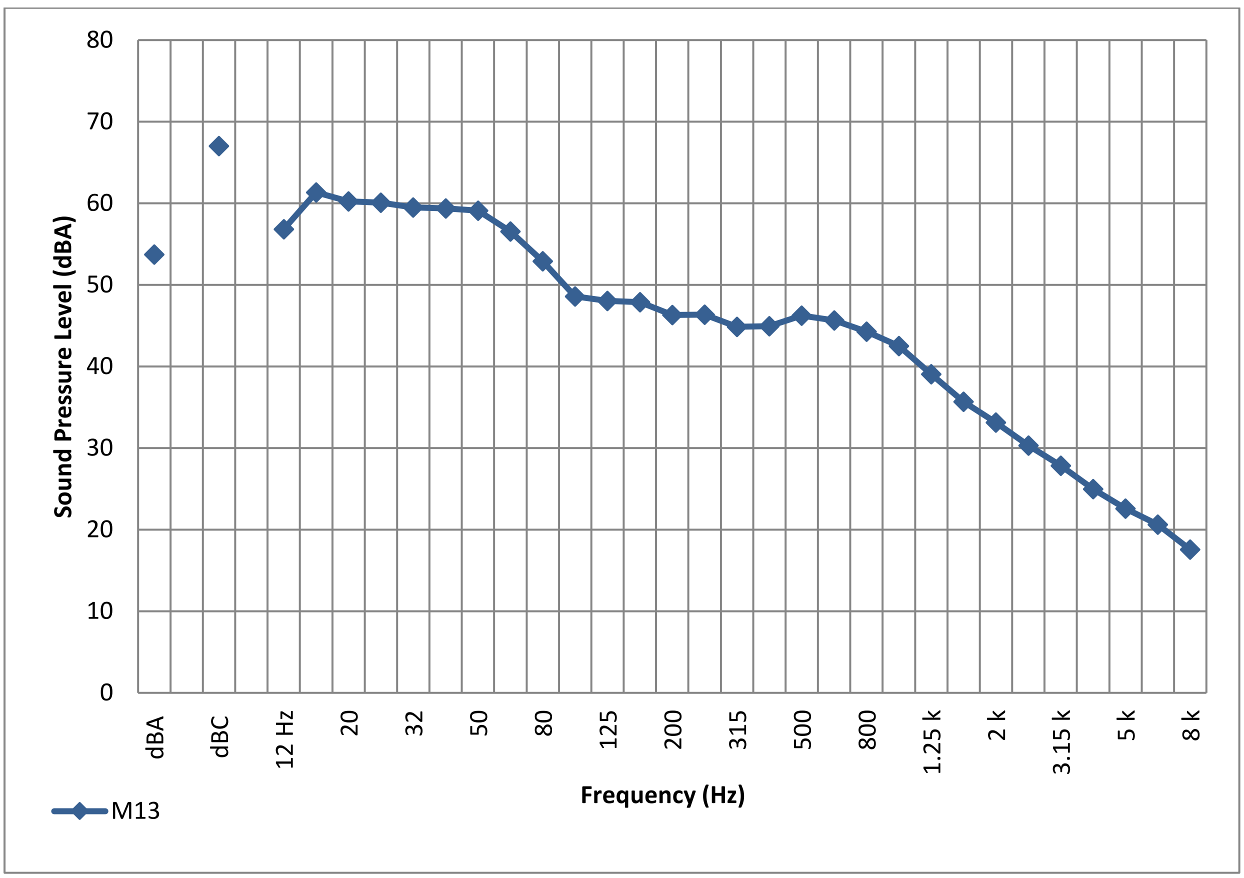

Figure 45. Noise Monitor #13 – 24-Hour 1/3 Octave Band L_{eq} Sound Levels

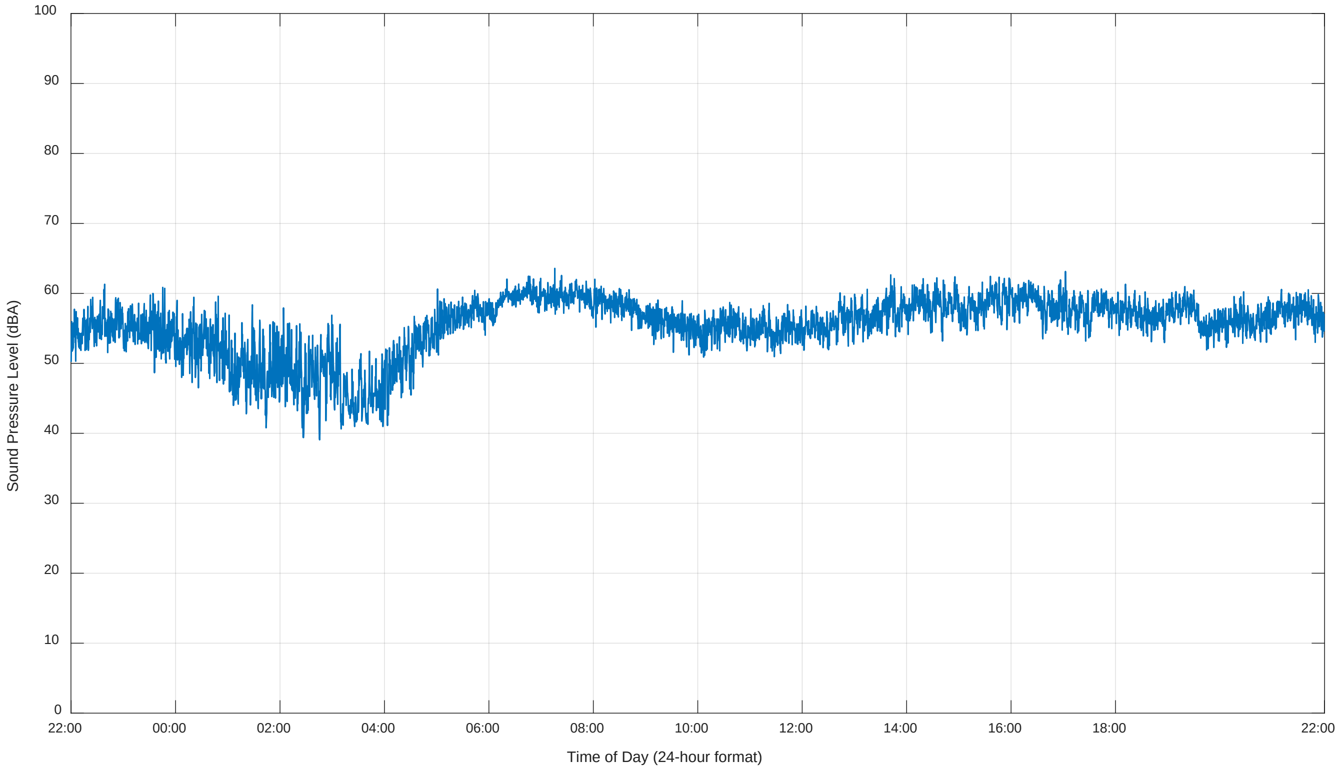

Figure 46. Noise Monitor #14 – 15-Second L_{eq}24 Sound Levels

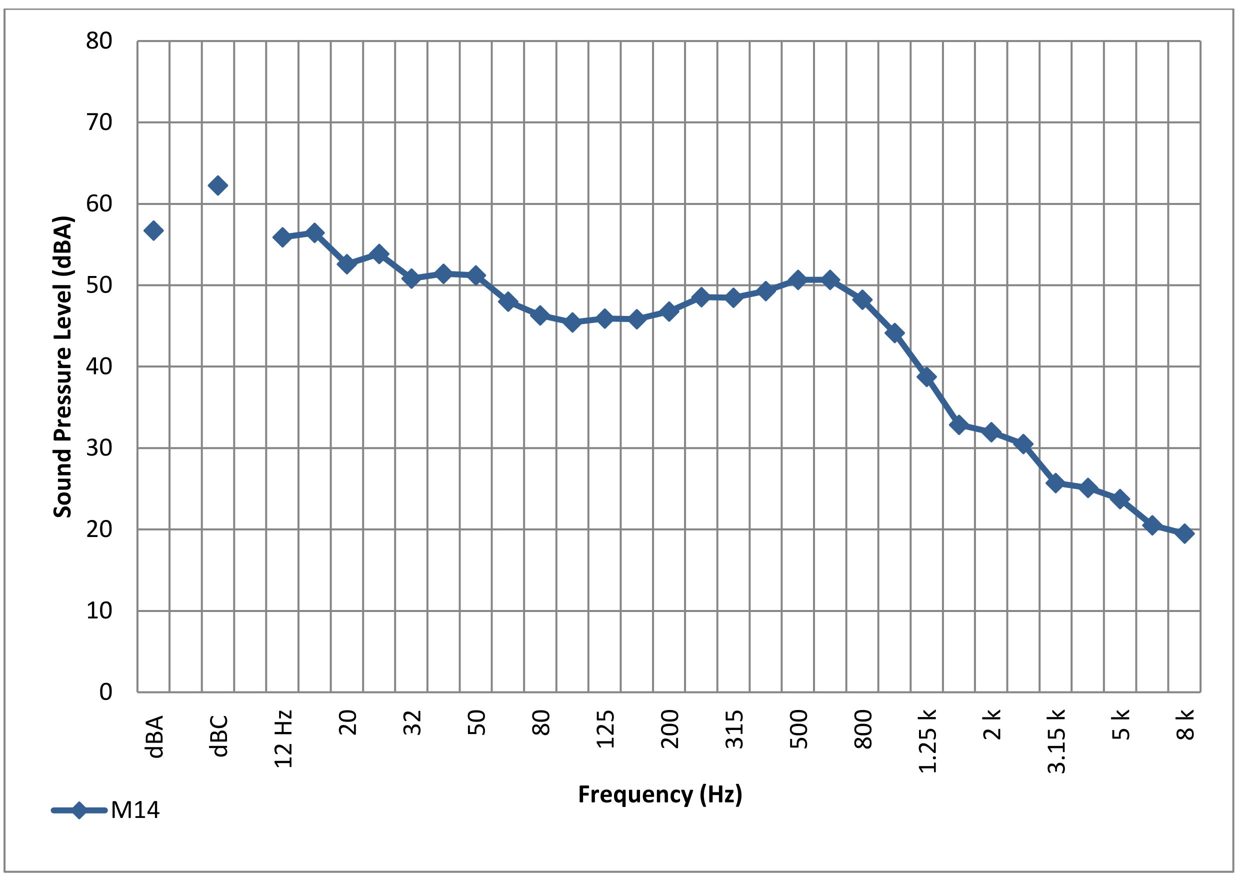

Figure 47. Noise Monitor #14 – 24-Hour 1/3 Octave Band L_{eq} Sound Levels

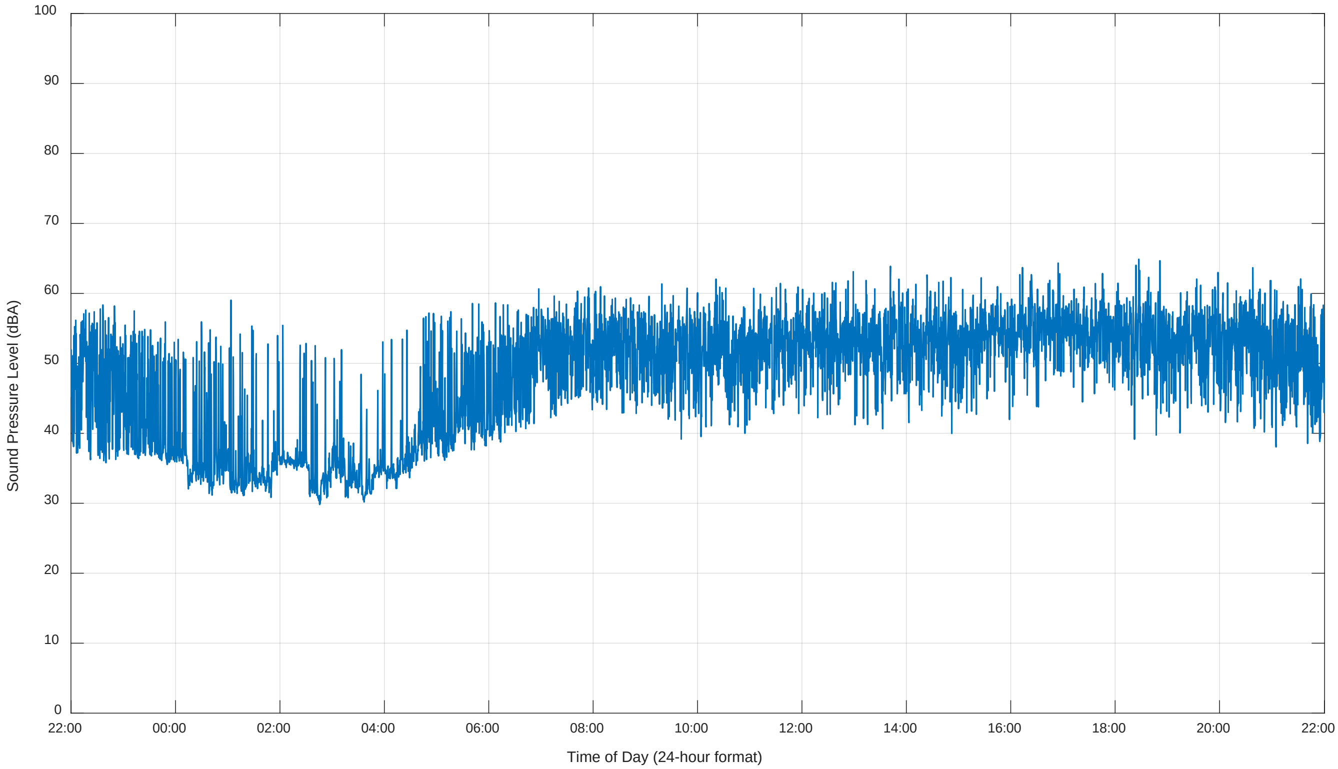

Figure 48. Noise Monitor #15 – 15-Second L_{eq}24 Sound Levels

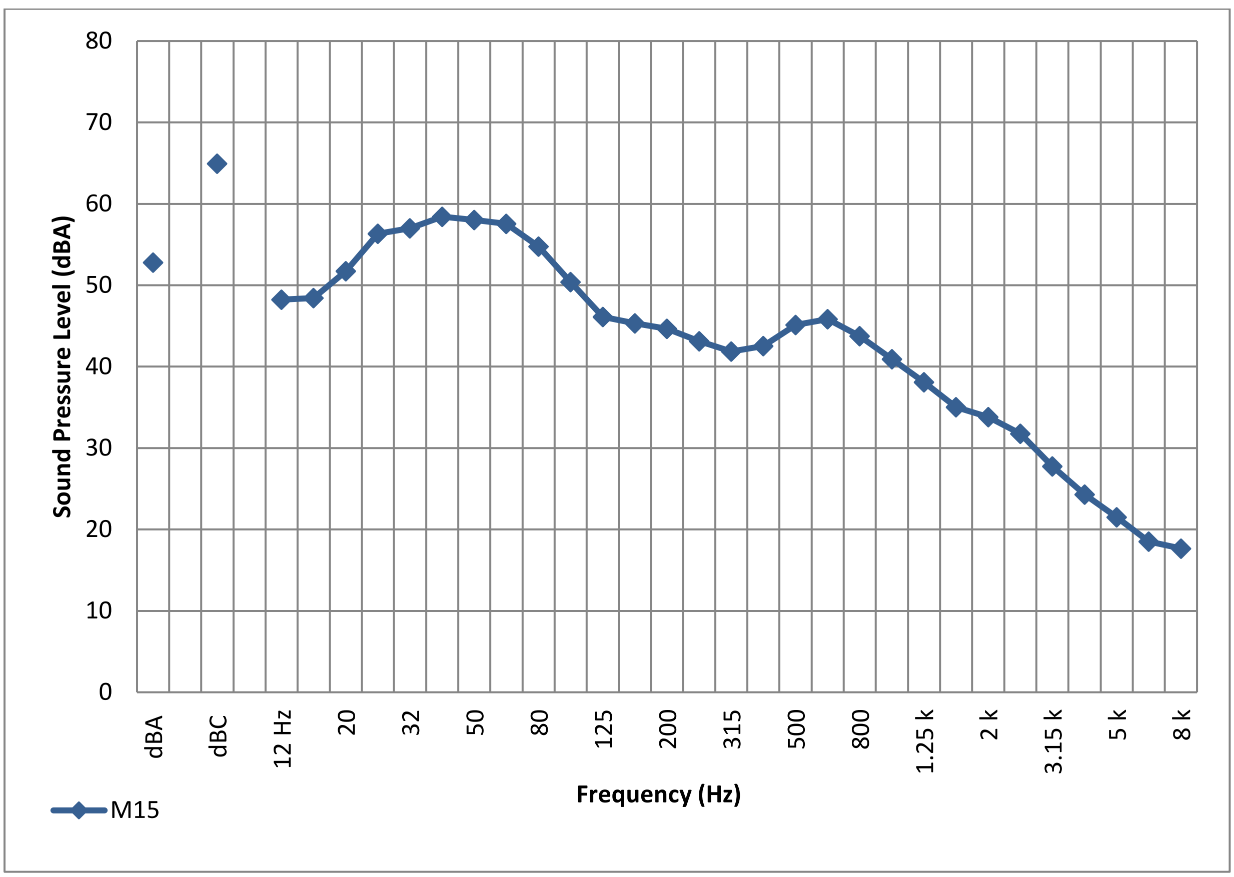

Figure 49. Noise Monitor #15 – 24-Hour 1/3 Octave Band L_{eq} Sound Levels

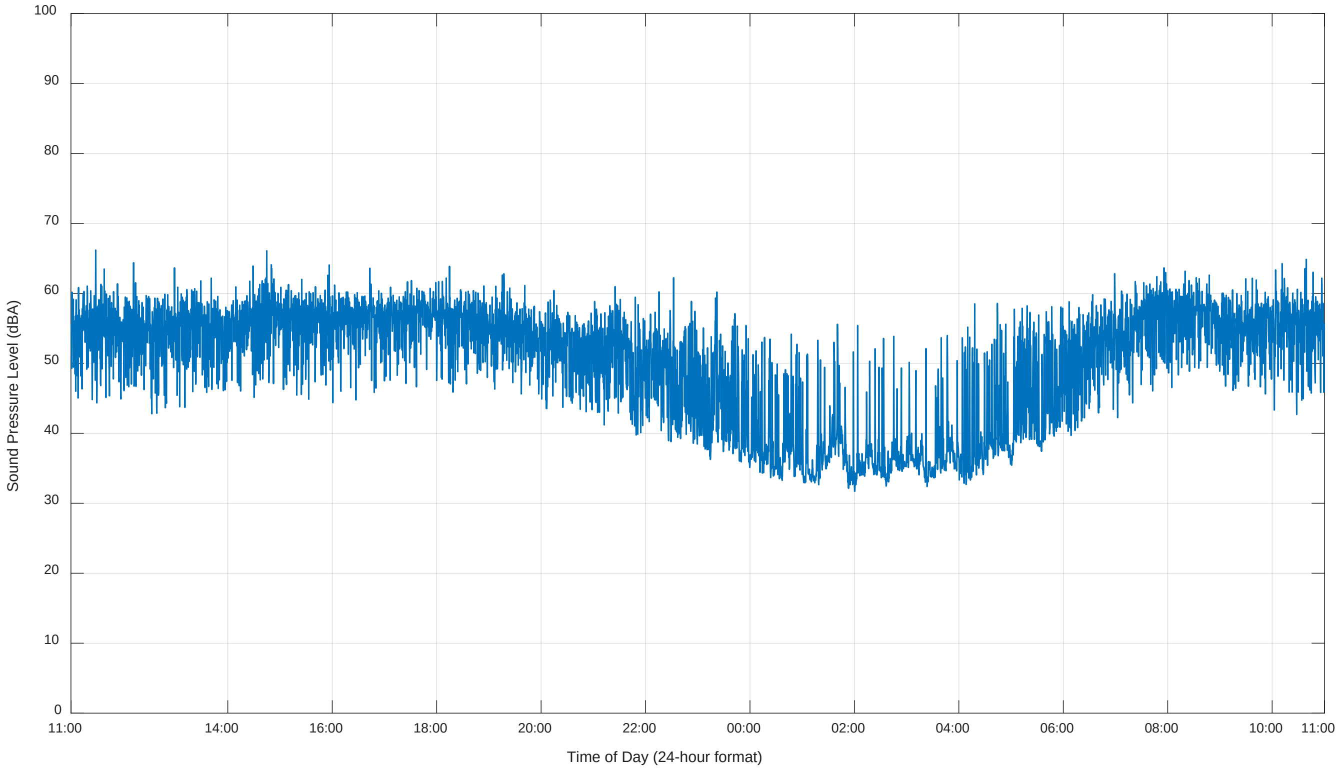

Figure 50. Noise Monitor #16 – 15-Second L_{eq}24 Sound Levels

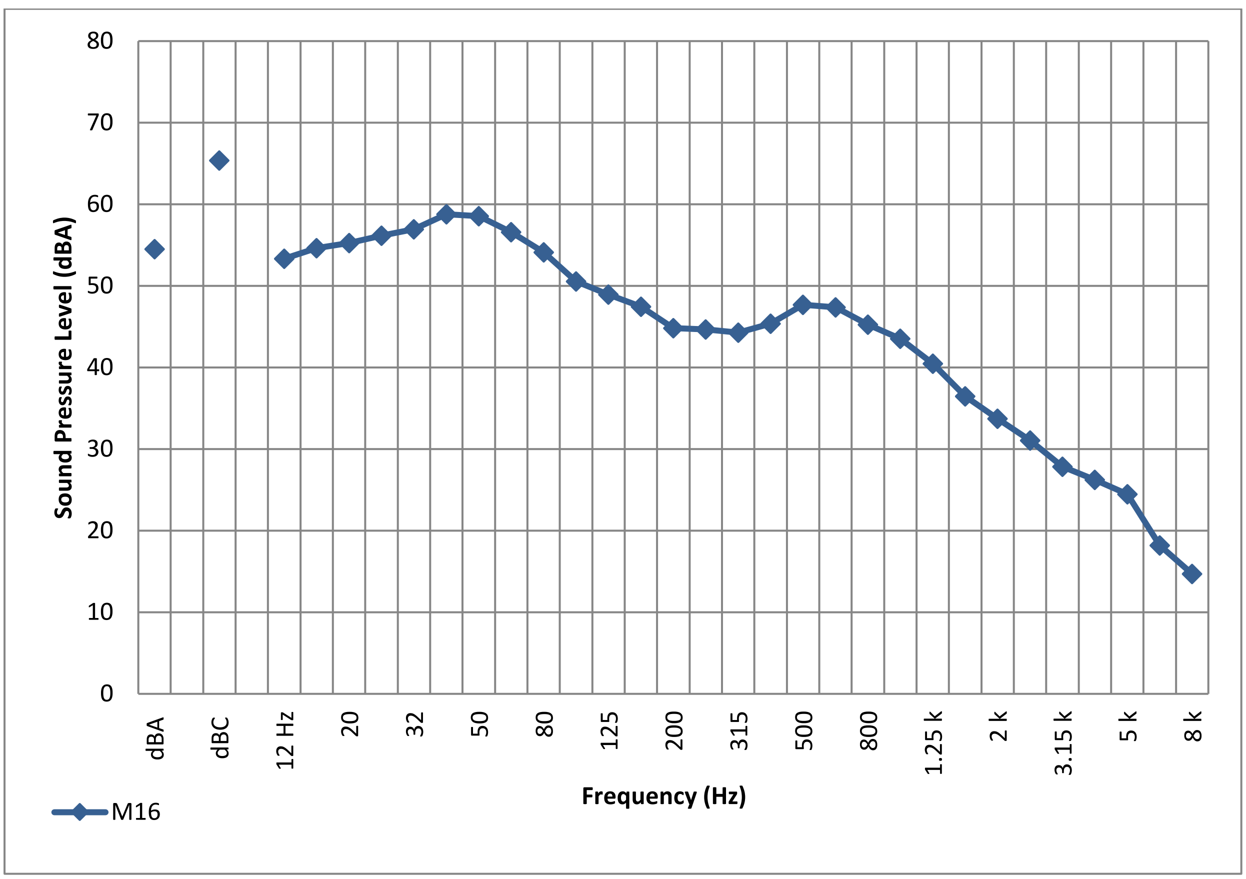

Figure 51. Noise Monitor #16 – 24-Hour 1/3 Octave Band L_{eq} Sound Levels

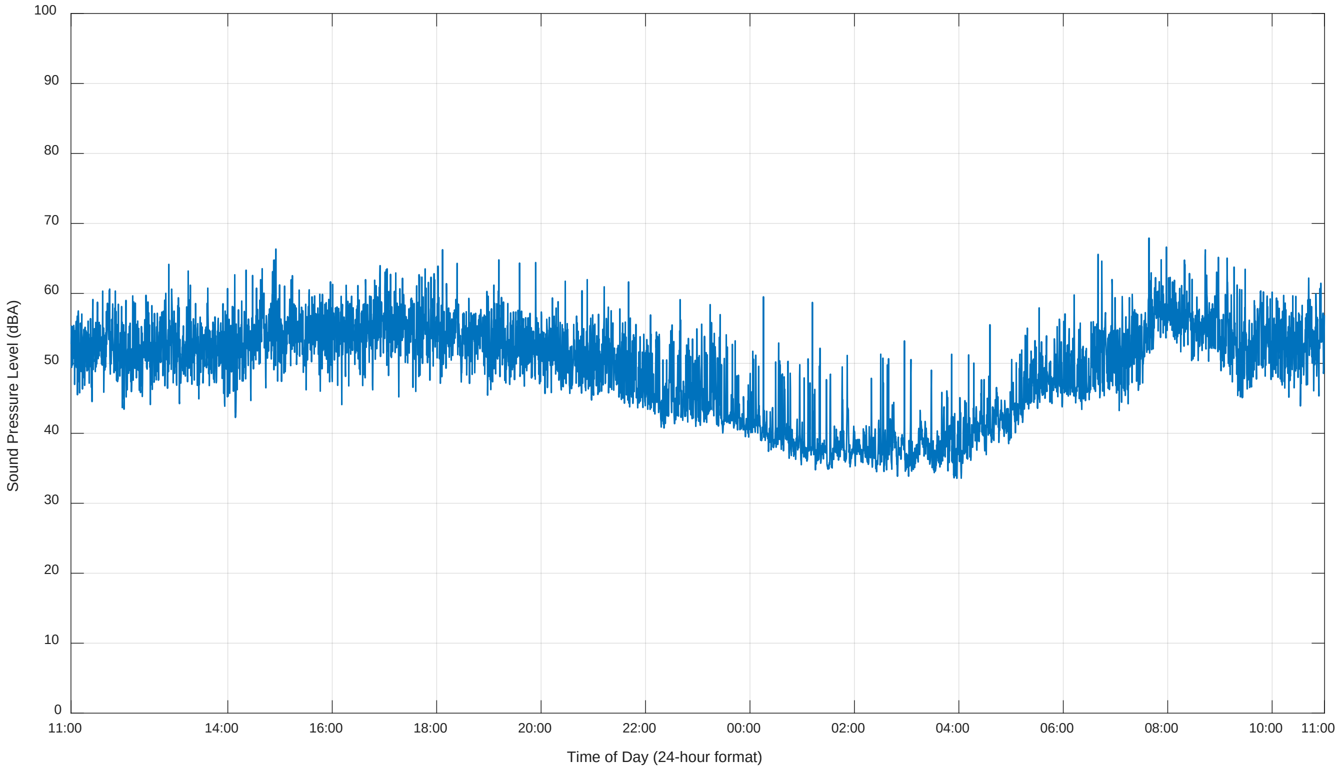

Figure 52. Noise Monitor #17 – 15-Second L_{eq}24 Sound Levels

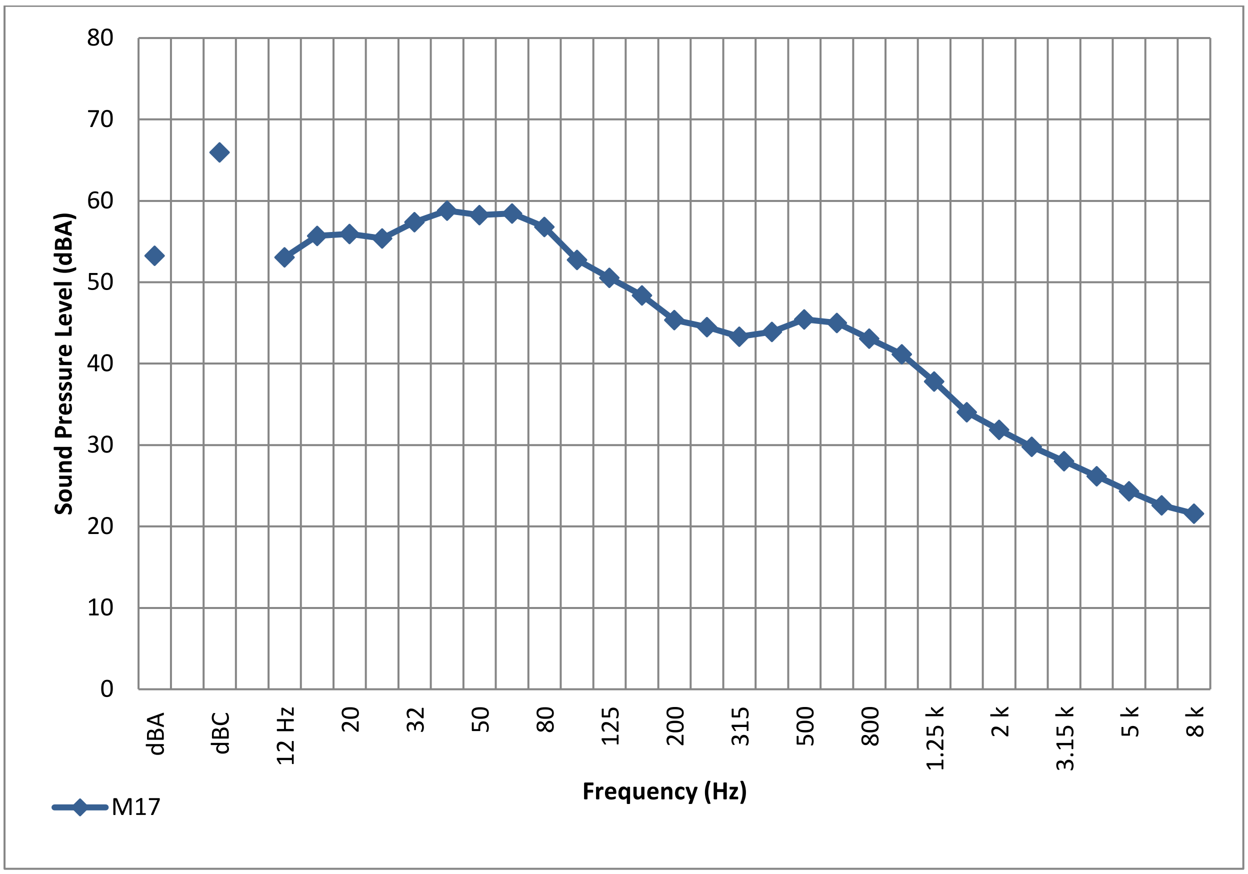

Figure 53. Noise Monitor #17 – 24-Hour 1/3 Octave Band L_{eq} Sound Levels

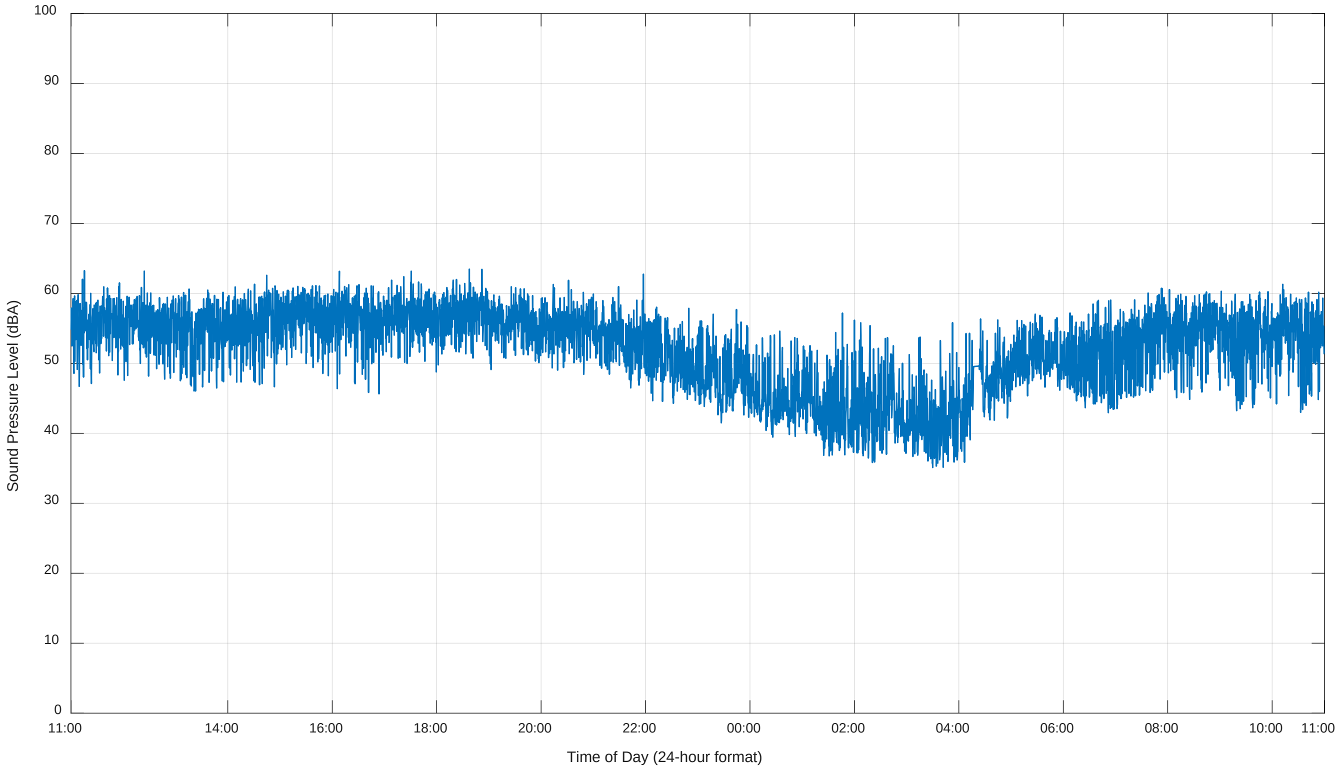

Figure 54. Noise Monitor #18 – 15-Second L_{eq}24 Sound Levels

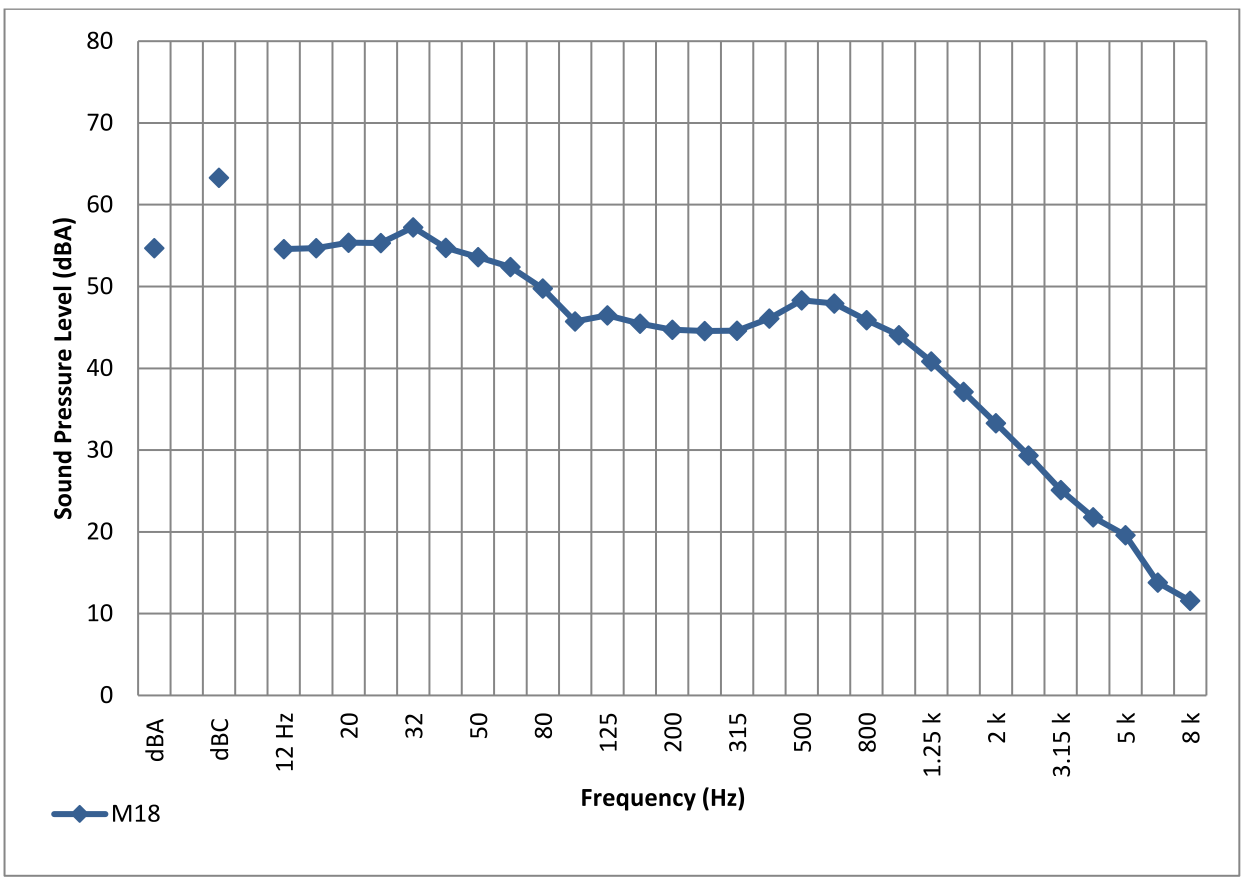

Figure 55. Noise Monitor #18 – 24-Hour 1/3 Octave Band L_{eq} Sound Levels

Appendix I MEASUREMENT EQUIPMENT USED

Brüel and Kjær 2250/2270

The environmental noise monitoring equipment used consisted of a Brüel and Kjær Type 2250/2270 Precision Integrating Sound Level Meter enclosed in an environmental case, a tripod, a weather protective microphone hood, and in certain cases an external battery. The system acquired data in 15-second L_{eq} samples using 1/3 octave band frequency analysis and overall A-weighted and C-weighted sound levels. The sound level meter conforms to Type 1, ANSI S1.4, ANSI S1.43, IEC 61672-1, IEC 60651, IEC 60804 and DIN 45657. The 1/3 octave filters conform to S1.11 – Type 0-C, and IEC 61260 – Class 0. The calibrator conforms to IEC 942 and ANSI S1.40. The sound level meter, pre-amplifier and microphone were certified on May 19, 2021 / April 07, 2021 / April 07, 2021 / March 04, 2021 / March 04, 2021 / April 07, 2021 / August 26, 2021 / April 07, 2021 / April 07, 2021 and the calibrator (type B&K 4231) was certified on March 03, 2021 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 8 kHz sample rate for more detailed post-processing analysis. Refer to the next section in the Appendix for a detailed description of the various acoustical descriptive terms used.

Weather Monitor

The 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.

Record of Calibration Results

Description	Date	Time	Pre / Post	Calibration Level	Calibrator Model	Serial Number
Monitor #1	02-Jun-21	10:20	Pre	93.9 dBA	B&K 4231	2575493
Monitor #1	04-Jun-21	12:20	Post	93.8 dBA	B&K 4231	2575493
Monitor #2	02-Jun-21	10:05	Pre	93.9 dBA	B&K 4231	2575493
Monitor #2	04-Jun-21	12:15	Post	93.8 dBA	B&K 4231	2575493
Monitor #3	02-Jun-21	10:40	Pre	93.9 dBA	B&K 4231	2575493
Monitor #3	04-Jun-21	12:05	Post	93.8 dBA	B&K 4231	2575493
Monitor #4	02-Jun-21	10:50	Pre	93.9 dBA	B&K 4231	2575493
Monitor #4	04-Jun-21	11:50	Post	93.9 dBA	B&K 4231	2575493
Monitor #5	04-Oct-21	11:20	Pre	93.9 dBA	B&K 4231	2642956
Monitor #5	06-Oct-21	11:40	Post	93.9 dBA	B&K 4231	2642956
Monitor #6	02-Jun-21	11:15	Pre	93.9 dBA	B&K 4231	2575493
Monitor #6	04-Jun-21	11:35	Post	93.8 dBA	B&K 4231	2575493
Monitor #7	02-Jun-21	11:35	Pre	93.9 dBA	B&K 4231	2575493
Monitor #7	04-Jun-21	11:25	Post	93.9 dBA	B&K 4231	2575493
Monitor #8	02-Jun-21	11:55	Pre	93.9 dBA	B&K 4231	2575493
Monitor #8	04-Jun-21	11:15	Post	93.8 dBA	B&K 4231	2575493
Monitor #9	06-Oct-21	10:45	Pre	93.9 dBA	B&K 4231	2575493
Monitor #9	08-Oct-21	10:30	Post	93.8 dBA	B&K 4231	2575493
Monitor #10	04-Oct-21	10:15	Pre	93.9 dBA	B&K 4231	2575493
Monitor #10	06-Oct-21	10:25	Post	93.8 dBA	B&K 4231	2575493
Monitor #11	10-May-21	16:30	Pre	93.9 dBA	B&K 4231	2575493
Monitor #11	14-May-21	15:10	Post	93.9 dBA	B&K 4231	2575493
Monitor #12	10-May-21	16:50	Pre	93.9 dBA	B&K 4231	2575493
Monitor #12	14-May-21	15:10	Post	93.9 dBA	B&K 4231	2575493
Monitor #13	04-Oct-21	11:45	Pre	93.9 dBA	B&K 4231	2575493
Monitor #13	06-Oct-21	11:55	Post	93.9 dBA	B&K 4231	2575493
Monitor #14	13-Jul-21	9:15	Pre	93.9 dBA	B&K 4231	2575493
Monitor #14	16-Jul-21	10:05	Post	93.8 dBA	B&K 4231	2575493
Monitor #15	21-Jun-21	9:40	Pre	93.9 dBA	B&K 4231	2642956
Monitor #15	29-Jun-21	10:35	Post	93.8 dBA	B&K 4231	2642956
Monitor #16	04-Oct-21	12:30	Pre	93.9 dBA	B&K 4231	2575493
Monitor #16	06-Oct-21	12:10	Post	93.8 dBA	B&K 4231	2575493
Monitor #17	04-Oct-21	11:05	Pre	93.9 dBA	B&K 4231	2575493
Monitor #17	06-Oct-21	11:20	Post	93.8 dBA	B&K 4231	2575493
Monitor #18	04-Oct-21	10:35	Pre	93.9 dBA	B&K 4231	2575493
Monitor #18	06-Oct-21	11:05	Post	93.8 dBA	B&K 4231	2575493

B&K 2250 Unit #1 SLM Calibration Certificate

CALIBRATED BY TRANSCAT

CERTIFICATE OF CALIBRATION

Customer: ACI ACOUSTICAL CONSULTANTS INC
5031-210 STREET NW
EDMONTON, AB T6M 0A8

PO Number: BILAWCHUK-CC

ANAB ACCREDITED ISO/IEC 17025 CALIBRATION LABORATORY
ANAB AC-2489.07
ilac-MRA

Certificate/SO Number: 17-Q1Y7V-20-1 Revision 0

Manufacturer: Bruel & Kjaer
Model Number: 2250
Description: Sound Level Meter
Serial Number: 2488495
ID: Unit #1

As-Found: In Tolerance
As-Left: In Tolerance

Issue Date: May 19, 2021
Calibration Date: May 19, 2021

Calibrated To: Manufacturer Specification
Calibration Procedure: 1-AC28548-3

Transcat Calibration Laboratories have been audited and found in compliance with ISO/IEC 17025:2017. Accredited calibrations performed within the Lab Scope of Accreditation are indicated by the presence of the Accrediting Body Logo and Certificate Number. Any measurements on an accredited calibration not covered by the Lab Scope of Accreditation are listed in the notes section of the certificate. SCC, NRC, CLAS or ANAB do not guarantee the accuracy of an individual calibration by accredited laboratories.

Transcat calibrations, as applicable, are performed in compliance with the requirements of the Transcat Quality Manual QAC-P01-000, the customer Purchase Order and/or Quality Agreement requirements, ISO 9001:2015, ANSI/NCSL Z540.1-1994 (R2002), and ISO 10012:2003, as applicable. When specified contractually, the requirements of ISO TS16949:2009, 10CFR21, 10CFR50 App. B, ASME NQA-1:2012, and ANSI/NCSL Z540.3-2006 (R2013) are also covered.

Complete records of work performed are maintained by Transcat and are available for inspection. Laboratory standards used in the performance of this calibration are listed on this certificate.

Transcat documents the traceability of measurements to the SI units through the National Institute of Standards and Technology(NIST), or the National Research Council of Canada (NRC), or other national measurement institutes (NMI) that are signatories to the CIPM Mutual Recognition Arrangement, or accepted fundamental and/or natural physical constants, or by the use of specified methods, consensus standards or ratio type measurements. Documentation supporting traceability information is available for review upon written request at a Transcat facility. The measured quantity and the measurement uncertainty are required for further dissemination of traceability.

Uncertainties are reported with a coverage factor k=2, providing a level of confidence of approximately 95%. All calibrations have been performed using processes having a TUR of 4:1 or better (3:1 for mass calibrations), unless otherwise noted. The Test Uncertainty Ratio (TUR) is calculated in accordance with NCSL International RP-18. For mass calibrations: Conventional mass referenced to 8.0 g/cm³.

The results in this report relate only to the item calibrated or tested. Recorded calibration data is valid at the time of calibration within the stated uncertainties at the environmental conditions noted. The determination of compliance to the specification is specific to the model/serial no./ID no. referenced above based on the tolerances shown; these tolerances are either the original equipment manufacturers(OEM's) warranted specifications or the client's requested specifications. Any number of factors can cause a unit to drift out of tolerance at any time following its calibration. Limitations on the uses of this instrument are detailed in the OEM's operating instructions. This certificate may not be reproduced except in full, without the written approval of Transcat. Additional information, if applicable may be included on separate report(s).

Date Received: May 12, 2021
Service Level : R9

Certificate - Page 1 of 7

Customer Number: 9-330269-000
OPS-F20-014R8 04/01/21 FP001R9 4/9/2021

B&K 2270 Unit #2 SLM Calibration Certificate

CALIBRATED BY TRANSCAT

CERTIFICATE OF CALIBRATION

Customer: ACI ACCOUSTICAL CONSULTANTS IN
5031-210 STREET NW
EDMONTON, AB T6M 0A8

PO Number: BILAWCHUK

ANAB ACCREDITED ISO/IEC 17025 CALIBRATION LABORATORY
ANAB AC-2489.07

Certificate/SO Number: 17-Q1X3X-100-1 Revision 0

Manufacturer: Bruel & Kjaer
Model Number: 2270
Description: Sound Level Meter
Serial Number: 3002718/2850742
ID: UNIT 2

As-Found: In Tolerance
As-Left: In Tolerance

Issue Date: Apr 07, 2021
Calibration Date: Apr 07, 2021

Calibrated To: Manufacturer Specification
Calibration Procedure: 1-AC28548-3

Transcat Calibration Laboratories have been audited and found in compliance with ISO/IEC 17025:2017. Accredited calibrations performed within the Lab?s Scope of Accreditation are indicated by the presence of the Accrediting Body?s Logo and Certificate Number. Any measurements on an accredited calibration not covered by that Lab?s Scope of Accreditation are listed in the notes section of the certificate. SCC, NRC, CLAS or ANAB do not guarantee the accuracy of an individual calibration by accredited laboratories.

Transcat calibrations, as applicable, are performed in compliance with the requirements of the Transcat Quality Manual QAC-P01-000, the customer?s Purchase Order and/or Quality Agreement requirements, ISO 9001:2015, ANSI/NCSL Z540.1-1994 (R2002) or NQA-1, as applicable. Complete records of work performed are maintained by Transcat and are available for inspection. Laboratory standards used in the performance of this calibration are listed on this certificate.

Transcat documents the traceability of measurements to the SI units through the National Institute of Standards and Technology(NIST), or the National Research Council of Canada (NRC), or other national measurement institutes (NMI) that are signatories to the CIPM Mutual Recognition Arrangement, or accepted fundamental and/or natural physical constants, or by the use of specified methods, consensus standards or ratio type measurements. Documentation supporting traceability information is available for review upon written request at a Transcat facility. The measured quantity and the measurement uncertainty are required for further dissemination of traceability.

A binary decision rule, utilizing simple acceptance, and simple rejection criteria is used for the determination of compliance, unless otherwise superseded by the client?s Decision Rule. When Calibration Tolerance compliance statements are present, they are reported without factoring in the effects of uncertainty and comply with the guidelines established by ASME B89.7.3.1-2001(R2019) as follows:
-The acceptance zone is defined as: less than or equal to the high calibration tolerance limit, and/or greater than or equal to the low calibration tolerance limit. The rejection zones are defined as greater than the high calibration tolerance limit and/or less than the low calibration tolerance limit.
-Single measurement results in the acceptance zone are be identified as in-tolerance. Single measurement results in the rejection zone are identified as out-of-tolerance (OOT).
-When all measurement results are in the acceptance zone for repeated measurements, for the same characteristic, the test is identified as in-tolerance. For repeated characteristic measurements, a single measurement result in the rejection zone, will cause the test to be identified as out-of-tolerance (OOT).

Uncertainties are reported with a coverage factor k=2, providing a level of confidence of approximately 95%. All calibrations have been performed using processes having a TUR of 4:1 or better (3:1 for mass calibrations), unless otherwise noted. The Test Uncertainty Ratio (TUR) is calculated in accordance with NCSL International RP-18. For mass calibrations: Conventional mass referenced to 8.0 g/cm³.

The results in this report relate only to the item calibrated or tested. Recorded calibration data is valid at the time of calibration within the stated uncertainties at the environmental conditions noted. The determination of compliance to the specification is specific to the model/serial no./ID no. referenced above based on the tolerances shown; these tolerances are either the original equipment manufacturers(OEM?s) warranted specifications or the client?s requested specifications. This certificate may not be reproduced except in full, without the written approval of Transcat. Additional information, if applicable may be included on separate report(s).

Date Received: March 19, 2021
Service Level : R9

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Customer Number: 9-330269-000
OPS-F20-014R8 04/01/21 FP014R0 4/2/2021

B&K 4231 Unit #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® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.46080

Instrument:	**Acoustical Calibrator**	*Date Calibrated:* **3/3/2021** *Cal Due:*		
Model:	**4231**	*Status:*	**Received**	**Sent**
Manufacturer:	**Brüel and Kjær**	*In tolerance:*	**X**	**X**
Serial number:	**2575493**	*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, Alberta, CANADA T6M 0A8**		
Tel/Fax:	**780-414-6373 / 780-414-6376**			

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	31052	Oct 31, 2020	Scantek, Inc./ NVLAP	Oct 31, 2021
DS-360-SRS	Function Generator	33584	Oct 23, 2019	ACR Env./ A2LA	Oct 23, 2021
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Feb 4, 2021	ACR Env. / A2LA	Feb 4, 2022
HM30-Thommen	Meteo Station	1040170/39633	Dec 7, 2020	ACR Env./ A2LA	Dec 7, 2021
140-Norsonic	Real Time Analyzer	1406423	Nov 3, 2020	Scantek / NVLAP	Nov 3, 2021
PC Program 1018 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
4134-Brüel&Kjær	Microphone	173368	Oct 26, 2020	Scantek, Inc. / NVLAP	Oct 26, 2021
1203-Norsonic	Preamplifier	14059	March 3, 2020	Scantek, Inc./ NVLAP	March 3, 2021

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

Calibrated by:	Lydon Dawkins	**Authorized signatory:**	William D. Gallagher
Signature	*Lydon Dawkins*	Signature	*William D. Gallagher*
Date	3/3/2021	Date	3/5/2021

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B&K 2270 Unit #3 SLM Calibration Certificates

CALIBRATED BY TRANSCAT

CERTIFICATE OF CALIBRATION

Customer: ACI ACCOUSTICAL CONSULTANTS IN
5031-210 STREET NW
EDMONTON, AB T6M 0A8

PO Number: BILAWCHUK

ANAB ACCREDITED ISO/IEC 17025 CALIBRATION LABORATORY
ANAB AC-2489.07
ilac-MRA

Certificate/SO Number: 17-Q1X3X-80-1 Revision 0

Manufacturer: Bruel & Kjaer
Model Number: 2270
Description: Sound Level Meter
Serial Number: 3002730/2850741
ID: UNIT 3

As-Found: In Tolerance
As-Left: In Tolerance

Issue Date: Apr 07, 2021
Calibration Date: Apr 07, 2021

Calibrated To: Manufacturer Specification
Calibration Procedure: 1-AC28548-3

Transcat Calibration Laboratories have been audited and found in compliance with ISO/IEC 17025:2017. Accredited calibrations performed within the Lab?s Scope of Accreditation are indicated by the presence of the Accrediting Body?s Logo and Certificate Number. Any measurements on an accredited calibration not covered by that Lab?s Scope of Accreditation are listed in the notes section of the certificate. SCC, NRC, CLAS or ANAB do not guarantee the accuracy of an individual calibration by accredited laboratories.

Transcat calibrations, as applicable, are performed in compliance with the requirements of the Transcat Quality Manual QAC-P01-000, the customer?s Purchase Order and/or Quality Agreement requirements, ISO 9001:2015, ANSI/NCSL Z540.1-1994 (R2002) or NQA-1, as applicable. Complete records of work performed are maintained by Transcat and are available for inspection. Laboratory standards used in the performance of this calibration are listed on this certificate.

Transcat documents the traceability of measurements to the SI units through the National Institute of Standards and Technology(NIST), or the National Research Council of Canada (NRC), or other national measurement institutes (NMI) that are signatories to the CIPM Mutual Recognition Arrangement, or accepted fundamental and/or natural physical constants, or by the use of specified methods, consensus standards or ratio type measurements. Documentation supporting traceability information is available for review upon written request at a Transcat facility. The measured quantity and the measurement uncertainty are required for further dissemination of traceability.

A binary decision rule, utilizing simple acceptance, and simple rejection criteria is used for the determination of compliance, unless otherwise superseded by the client?s Decision Rule. When Calibration Tolerance compliance statements are present, they are reported without factoring in the effects of uncertainty and comply with the guidelines established by ASME B89.7.3.1-2001 (R2019) as follows:
-The acceptance zone is defined as: less than or equal to the high calibration tolerance limit, and/or greater than or equal to the low calibration tolerance limit. The rejection zones are defined as greater than the high calibration tolerance limit and/or less than the low calibration tolerance limit.
-Single measurement results in the acceptance zone are be identified as in-tolerance. Single measurement results in the rejection zone are identified as out-of-tolerance (OOT).
-When all measurement results are in the acceptance zone for repeated measurements, for the same characteristic, the test is identified as in-tolerance. For repeated characteristic measurements, a single measurement result in the rejection zone, will cause the test to be identified as out-of-tolerance (OOT).

Uncertainties are reported with a coverage factor k=2, providing a level of confidence of approximately 95%. All calibrations have been performed using processes having a TUR of 4:1 or better (3:1 for mass calibrations), unless otherwise noted. The Test Uncertainty Ratio (TUR) is calculated in accordance with NCSL International RP-18. For mass calibrations: Conventional mass referenced to 8.0 g/cm³.

The results in this report relate only to the item calibrated or tested. Recorded calibration data is valid at the time of calibration within the stated uncertainties at the environmental conditions noted. The determination of compliance to the specification is specific to the model/serial no./ID no. referenced above based on the tolerances shown; these tolerances are either the original equipment manufacturers (OEM?s) warranted specifications or the client?s requested specifications. This certificate may not be reproduced except in full, without the written approval of Transcat. Additional information, if applicable may be included on separate report(s).

Date Received: March 19, 2021
Service Level : R9

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Customer Number: 9-330269-000
OPS-F20-014R8 04/01/21 FP014R0 4/2/2021

B&K 4231 Unit #4 Calibrator Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2017, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.46832

Instrument:	**Acoustical Calibrator**	*Date Calibrated:* **8/26/2021** *Cal Due:*		
Model:	**4231**	*Status:*	**Received**	**Sent**
Manufacturer:	**Brüel and Kjær**	*In tolerance:*	**X**	**X**
Serial number:	**2642956**	*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, Alberta, CANADA T6M 0A8**		
Tel/Fax:	**780-414-6373 / 780-414-6376**			

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	31052	Oct 31, 2020	Scantek, Inc./ NVLAP	Oct 31, 2021
DS-360-SRS	Function Generator	33584	Oct 23, 2019	ACR Env./ A2LA	Oct 23, 2021
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Feb 4, 2021	ACR Env. / A2LA	Feb 4, 2022
HM30-Thommen	Meteo Station	1040170/39633	Dec 7, 2020	ACR Env./ A2LA	Dec 7, 2021
140-Norsonic	Real Time Analyzer	1406423	Nov 3, 2020	Scantek / NVLAP	Nov 3, 2021
PC Program 1018 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
4134-Brüel&Kjær	Microphone	173368	Oct 26, 2020	Scantek, Inc. / NVLAP	Oct 26, 2021
1203-Norsonic	Preamplifier	14059	March 3, 2021	Scantek, Inc./ NVLAP	March 3, 2022

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

Calibrated by:	Lydon Dawkins	**Authorized signatory:**	William Gallagher
Signature	Lydon Dawkins	Signature	William Gallagher
Date	8/26/2021	Date	8/27/2021

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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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 MRA signatory)

NVLAP®
CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.46081

Instrument: **Sound Level Meter**
Model: **2250**
Manufacturer: **Brüel and Kjær**
Serial number: **2722894**
Tested with: **Microphone 4189 s/n 271977**
Preamplifier ZC0032 s/n 13895
Type (class): **1**
Customer: **ACI Acoustical Consultants Inc.**
Tel/Fax: **780-414-6373 / 780-414-6376**

Date Calibrated: **3/4/2021** *Cal Due:*

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

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

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

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31052	Oct 31, 2020	Scantek, Inc./ NVLAP	Oct 31, 2021
DS-360-SRS	Function Generator	33584	Oct 23, 2019	ACR Env./ A2LA	Oct 23, 2021
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Feb 4, 2021	ACR Env. / A2LA	Feb 4, 2022
HM30-Thommen	Meteo Station	1040170/39633	Dec 7, 2020	ACR Env./ A2LA	Dec 7, 2021
PC Program 1019 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Oct 26, 2020	Scantek, Inc./ NVLAP	Oct 26, 2021

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 (%)
22.8	99.52	44.9

Calibrated by:	Lydon Dawkins	**Authorized signatory:**	William D. Gallagher
Signature	Lydon Dawkins	Signature	William D. Gallagher
Date	3/4/2021	Date	3/5/2021

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B&K 2250 Unit #5 Microphone Calibration Certificate

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

NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.46082

Instrument: **Microphone**
Model: **4189**
Manufacturer: **Brüel & Kjær**
Serial number: **271977**
Composed of:

Date Calibrated: **3/4/2021** *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: **780-414-6373/780-414-6376**
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. 2/25/2015

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31052	Oct 31, 2020	Scantek, Inc./ NVLAP	Oct 31, 2021
DS-360-SRS	Function Generator	33584	Oct 23, 2019	ACR Env./ A2LA	Oct 23, 2021
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Feb 4, 2021	ACR Env. / A2LA	Feb 4, 2022
HM30-Thommen	Meteo Station	1040170/39633	Dec 7, 2020	ACR Env./ A2LA	Dec 7, 2021
PC Program 1017 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1253-Norsonic	Calibrator	28326	Oct 26, 2020	Scantek, Inc./ NVLAP	Oct 26, 2021
1203-Norsonic	Preamplifier	14059	March 3, 2021	Scantek, Inc./ NVLAP	March 3, 2022
4180-Brüel&Kjær	Microphone	2246115	Oct 1, 2019	DPLA / DANAK	Oct 1, 2021

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

Calibrated by:	Lydon Dawkins	**Authorized signatory:**	William D. Gallagher
Signature	Lydon Dawkins	Signature	William D Gallagher
Date	3/4/2021	Date	3/5/2021

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B&K 2250 Unit #6 SLM Calibration Certificate

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

NVLAP®
CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.46083

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

Date Calibrated: **3/4/2021** *Cal Due:*

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

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

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

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31052	Oct 31, 2020	Scantek, Inc./ NVLAP	Oct 31, 2021
DS-360-SRS	Function Generator	33584	Oct 23, 2019	ACR Env./ A2LA	Oct 23, 2021
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Feb 4, 2021	ACR Env. / A2LA	Feb 4, 2022
HM30-Thommen	Meteo Station	1040170/39633	Dec 7, 2020	ACR Env./ A2LA	Dec 7, 2021
PC Program 1019 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Oct 26, 2020	Scantek, Inc./ NVLAP	Oct 26, 2021

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

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
22.9	99.66	42.5

Calibrated by:	Lydon Dawkins	**Authorized signatory:**	William D. Gallagher
Signature	Lydon Dawkins	Signature	William D. Gallagher
Date	3/4/2021	Date	3/5/2021

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B&K 2250 Unit #6 Microphone Calibration Certificate

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

NVLAP®
CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.46084

Instrument: **Microphone**
Model: **4189**
Manufacturer: **Brüel & Kjær**
Serial number: **2650730**
Composed of:

Date Calibrated: **3/4/2021** *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: **780-414-6373/780-414-6376**
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. 2/25/2015

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31052	Oct 31, 2020	Scantek, Inc./ NVLAP	Oct 31, 2021
DS-360-SRS	Function Generator	33584	Oct 23, 2019	ACR Env./ A2LA	Oct 23, 2021
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Feb 4, 2021	ACR Env. / A2LA	Feb 4, 2022
HM30-Thommen	Meteo Station	1040170/39633	Dec 7, 2020	ACR Env./ A2LA	Dec 7, 2021
PC Program 1017 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1253-Norsonic	Calibrator	28326	Oct 26, 2020	Scantek, Inc./ NVLAP	Oct 26, 2021
1203-Norsonic	Preamplifier	14059	March 3, 2021	Scantek, Inc./ NVLAP	March 3, 2022
4180-Brüel&Kjær	Microphone	2246115	Oct 1, 2019	DPLA / DANAK	Oct 1, 2021

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

Calibrated by:	Lydon Dawkins	Authorized signatory:	William D. Gallagher
Signature	Lydon Dawkins	Signature	William D Gallagher
Date	3/4/2021	Date	3/5/2021

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B&K 4231 Unit #6 Calibrator Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2017, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.46833

Instrument: **Acoustical Calibrator**
Model: **4231**
Manufacturer: **Brüel and Kjær**
Serial number: **2656414**
Class (IEC 60942): **1**
Barometer type:
Barometer s/n:
Customer: **ACI Acoustical Consultants Inc.**
Tel/Fax: **780-414-6373 / 780-414-6376**

Date Calibrated: **8/26/2021** *Cal Due:*

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

Contains non-accredited tests: __Yes _X_ No

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

Tested in accordance with the following procedures and standards:
Calibration of 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	31052	Oct 31, 2020	Scantek, Inc./ NVLAP	Oct 31, 2021
DS-360-SRS	Function Generator	33584	Oct 23, 2019	ACR Env./ A2LA	Oct 23, 2021
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Feb 4, 2021	ACR Env. / A2LA	Feb 4, 2022
HM30-Thommen	Meteo Station	1040170/39633	Dec 7, 2020	ACR Env./ A2LA	Dec 7, 2021
140-Norsonic	Real Time Analyzer	1406423	Nov 3, 2020	Scantek / NVLAP	Nov 3, 2021
PC Program 1018 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
4134-Brüel&Kjær	Microphone	173368	Oct 26, 2020	Scantek, Inc. / NVLAP	Oct 26, 2021
1203-Norsonic	Preamplifier	14059	March 3, 2021	Scantek, Inc./ NVLAP	March 3, 2022

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

Calibrated by:	Lydon Dawkins	Authorized signatory:	William Gallagher
Signature	Lydon Dawkins	Signature	William Gallagher
Date	8/26/2021	Date	8/27/2021

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

CALIBRATED BY TRANSCAT

CERTIFICATE OF CALIBRATION

Customer: ACI ACCOUSTICAL CONSULTANTS IN
5031-210 STREET NW
EDMONTON, AB T6M 0A8

PO Number: BILAWCHUK

ANAB ACCREDITED ISO/IEC 17025 CALIBRATION LABORATORY
ANAB AC-2489.07

ilac-MRA

Certificate/SO Number: 17-Q1X3X-20-1 Revision 0

Manufacturer: Bruel & Kjaer
Model Number: 2250
Description: Sound Level Meter
Serial Number: 2722859/2710791
ID: UNIT #7

As-Found: In Tolerance
As-Left: In Tolerance

Issue Date: Apr 07, 2021
Calibration Date: Apr 07, 2021

Calibrated To: Manufacturer Specification
Calibration Procedure: 1-AC28548-3

Transcat Calibration Laboratories have been audited and found in compliance with ISO/IEC 17025:2017. Accredited calibrations performed within the Lab?s Scope of Accreditation are indicated by the presence of the Accrediting Body?s Logo and Certificate Number. Any measurements on an accredited calibration not covered by that Lab?s Scope of Accreditation are listed in the notes section of the certificate. SCC, NRC, CLAS or ANAB do not guarantee the accuracy of an individual calibration by accredited laboratories.

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A binary decision rule, utilizing simple acceptance, and simple rejection criteria is used for the determination of compliance, unless otherwise superseded by the client?s Decision Rule. When Calibration Tolerance compliance statements are present, they are reported without factoring in the effects of uncertainty and comply with the guidelines established by ASME B89.7.3.1-2001(R2019) as follows:
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Uncertainties are reported with a coverage factor k=2, providing a level of confidence of approximately 95%. All calibrations have been performed using processes having a TUR of 4:1 or better (3:1 for mass calibrations), unless otherwise noted. The Test Uncertainty Ratio (TUR) is calculated in accordance with NCSL International RP-18. For mass calibrations: Conventional mass referenced to 8.0 g/cm³.

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Date Received: March 19, 2021
Service Level : R9

Certificate - Page 1 of 7

Customer Number: 9-330269-000
OPS-F20-014R8 04/01/21 FP014R0 4/2/2021

B&K 2250 Unit #8 SLM Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2017, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®
CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.46829

Instrument: **Sound Level Meter**
Model: **2250**
Manufacturer: **Brüel and Kjær**
Serial number: **3028218**
Tested with: **Microphone 4189 s/n 2851039**
Preamplifier ZC0032 s/n 20742
Type (class): **1**
Customer: **ACI Acoustical Consultants Inc.**
Tel/Fax: **780-414-6373 / 780-414-6376**

Date Calibrated: **8/26/2021** *Cal Due:*

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

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

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

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31052	Oct 31, 2020	Scantek, Inc./ NVLAP	Oct 31, 2021
DS-360-SRS	Function Generator	33584	Oct 23, 2019	ACR Env./ A2LA	Oct 23, 2021
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Feb 4, 2021	ACR Env. / A2LA	Feb 4, 2022
HM30-Thommen	Meteo Station	1040170/39633	Dec 7, 2020	ACR Env./ A2LA	Dec 7, 2021
PC Program 1019 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Oct 26, 2020	Scantek, Inc./ NVLAP	Oct 26, 2021

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 (%)
22.1	100.31	40.9

Calibrated by:	Lydon Dawkins	**Authorized signatory:**	William Gallagher
Signature	Lydon Dawkins	Signature	William Gallagher
Date	8/26/2021	Date	8/27/2021

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Page 1 of 2

B&K 2250 Unit #8 Microphone Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2017, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP® CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.46830

Instrument: **Microphone**
Model: **4189**
Manufacturer: **Brüel & Kjær**
Serial number: **2851039**
Composed of:

Date Calibrated: **8/24/2021** *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: **780-414-6373/780-414-6376**

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. 2/25/2015

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31052	Oct 31, 2020	Scantek, Inc./ NVLAP	Oct 31, 2021
DS-360-SRS	Function Generator	33584	Oct 23, 2019	ACR Env./ A2LA	Oct 23, 2021
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Feb 4, 2021	ACR Env. / A2LA	Feb 4, 2022
HM30-Thommen	Meteo Station	1040170/39633	Dec 7, 2020	ACR Env./ A2LA	Dec 7, 2021
PC Program 1017 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1253-Norsonic	Calibrator	28326	Oct 26, 2020	Scantek, Inc./ NVLAP	Oct 26, 2021
1203-Norsonic	Preamplifier	14059	March 3, 2021	Scantek, Inc./ NVLAP	March 3, 2022
4180-Brüel&Kjær	Microphone	2246115	Oct 1, 2019	DPLA / DANAK	Oct 1, 2021

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

Calibrated by:	Lydon Dawkins	**Authorized signatory:**	William Gallagher
Signature	Lydon Dawkins	Signature	William D Gallagher
Date	8/24/2021	Date	8/27/2021

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This Calibration Certificate or Test Reports shall not be used to claim product certification, approval or endorsement by NVLAP, NIST, or any agency of the federal government.
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B&K 2250 Unit #9 SLM Calibration Certificate

CALIBRATED BY TRANSCAT

CERTIFICATE OF CALIBRATION

Customer: ACI ACCOUSTICAL CONSULTANTS IN
5031-210 STREET NW
EDMONTON, AB T6M 0A8

PO Number: BILAWCHUK

ANAB ACCREDITED ISO/IEC 17025 CALIBRATION LABORATORY
ANAB AC-2489.07

Certificate/SO Number: 17-Q1X3X-40-1 Revision 0

Manufacturer: Bruel & Kjaer
Model Number: 2250
Description: Sound Level Meter
Serial Number: 3027810/3195885
ID: UNIT 9

As-Found: In Tolerance
As-Left: In Tolerance

Issue Date: Apr 07, 2021
Calibration Date: Apr 07, 2021

Calibrated To: Manufacturer Specification
Calibration Procedure: 1-AC28548-3

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Date Received: March 19, 2021
Service Level : R9

Certificate - Page 1 of 7

Customer Number: 9-330269-000
OPS-F20-014R8 04/01/21 FP014R0 4/2/2021

B&K 2250 Unit #10 SLM Calibration Certificate

CALIBRATED BY TRANSCAT

CERTIFICATE OF CALIBRATION

Customer: ACI ACCOUSTICAL CONSULTANTS IN
5031-210 STREET NW
EDMONTON, AB T6M 0A8

PO Number: BILAWCHUK

ANAB ACCREDITED ISO/IEC 17025 CALIBRATION LABORATORY
ANAB AC-2489.07

ilac-MRA

Certificate/SO Number: 17-Q1X3X-60-1 Revision 0

Manufacturer: Bruel & Kjaer
Model Number: 2250
Description: Sound Level Meter
Serial Number: 3007542/2978664
ID: UNIT #10

As-Found: In Tolerance
As-Left: In Tolerance

Issue Date: Apr 07, 2021
Calibration Date: Apr 07, 2021

Calibrated To: Manufacturer Specification
Calibration Procedure: 1-AC28548-3

Transcat Calibration Laboratories have been audited and found in compliance with ISO/IEC 17025:2017. Accredited calibrations performed within the Lab?s Scope of Accreditation are indicated by the presence of the Accrediting Body?s Logo and Certificate Number. Any measurements on an accredited calibration not covered by that Lab?s Scope of Accreditation are listed in the notes section of the certificate. SCC, NRC, CLAS or ANAB do not guarantee the accuracy of an individual calibration by accredited laboratories.

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Date Received: March 19, 2021
Service Level : R9

Certificate - Page 1 of 7

Customer Number: 9-330269-000
OPS-F20-014R8 04/01/21 FP014R0 4/2/2021

Appendix II THE ASSESSMENT OF ENVIRONMENTAL NOISE (GENERAL)

Sound Pressure Level

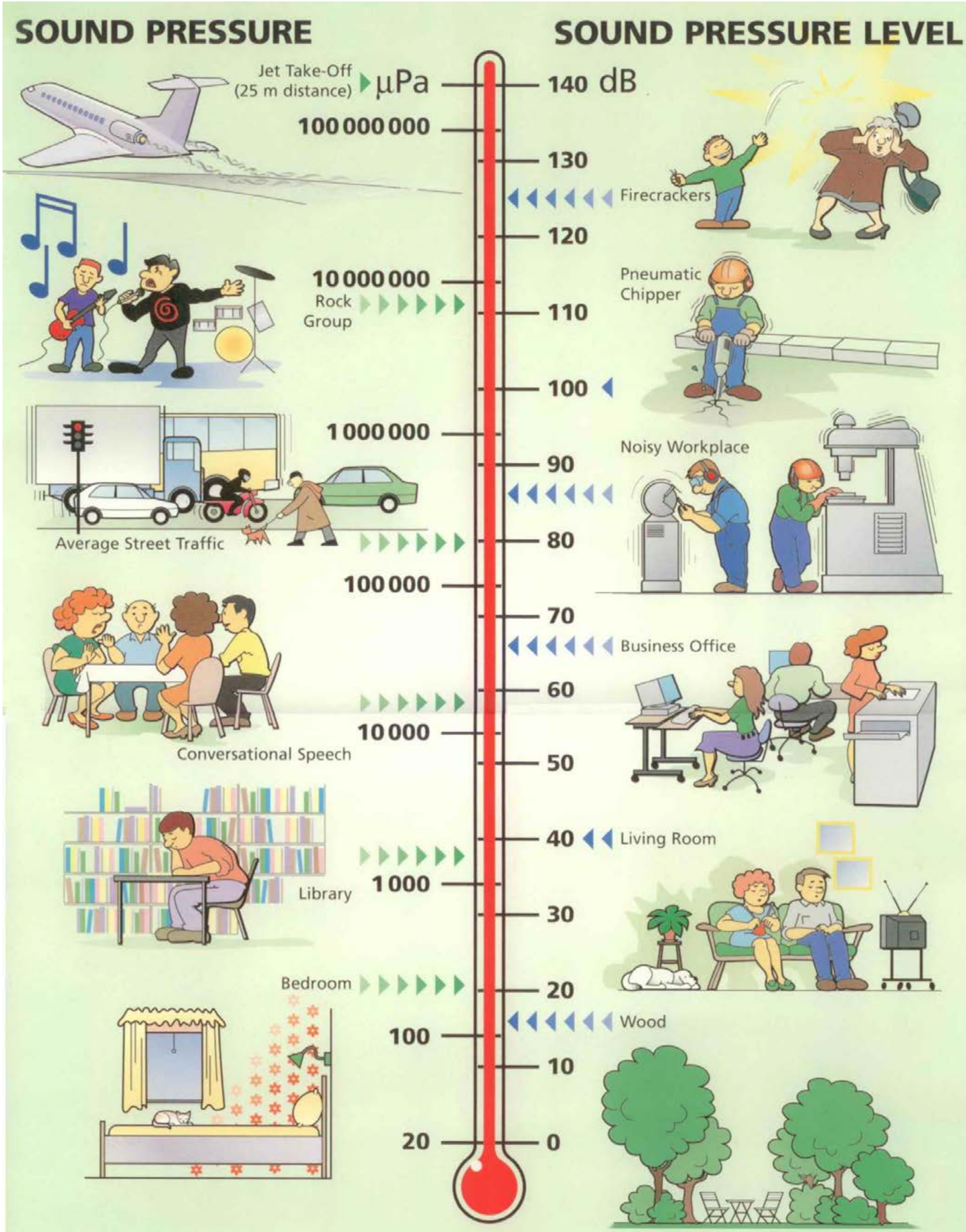
Sound pressure is initially measured in Pascal's (Pa). Humans can hear several orders of magnitude in sound pressure levels, so a more convenient scale is used. This scale is known as the decibel (dB) scale, named after Alexander Graham Bell (telephone guy). It is a base 10 logarithmic scale. When we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



acoustical consultants inc

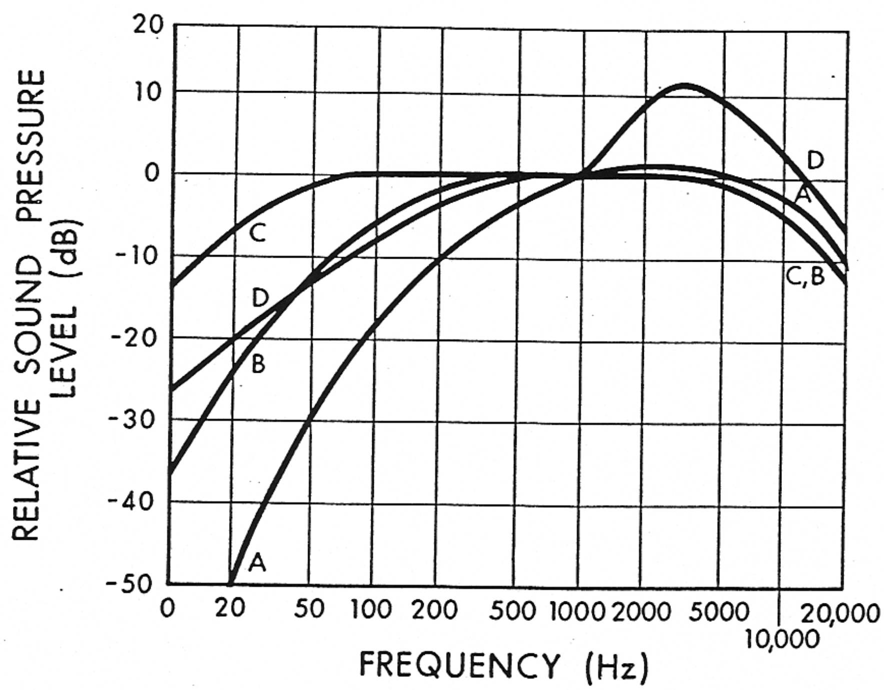
Frequency

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

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

	Whole Octave			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.

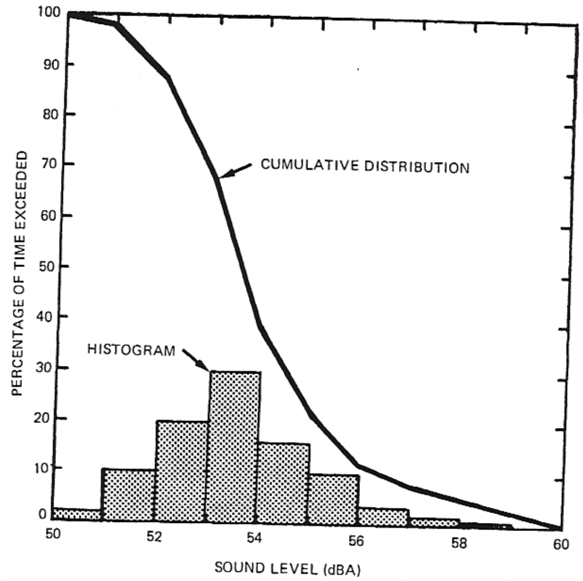


Figure 16.6 Statistically processed community noise showing histogram and cumulative distribution of A weighted sound levels.

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

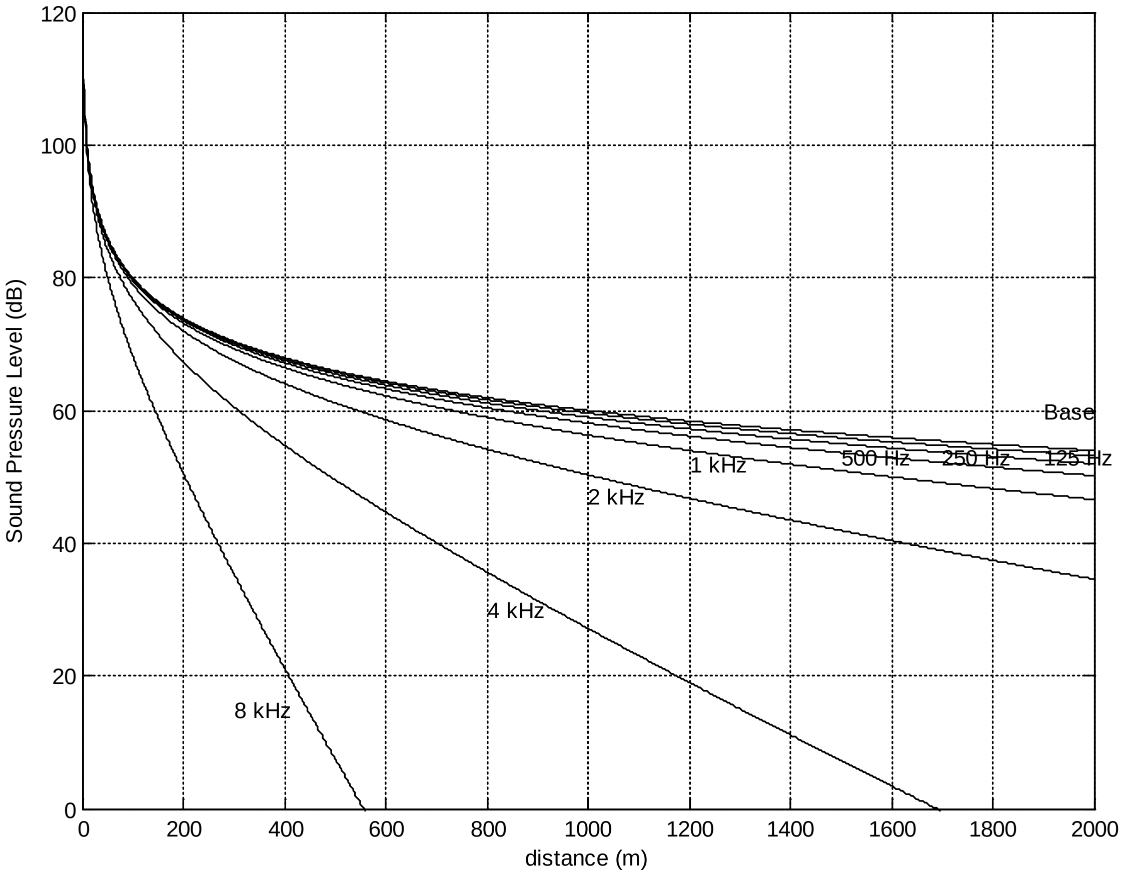
As sound transmits through a medium, there is an attenuation (or dissipation of acoustic energy) which can be attributed to three mechanisms:

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

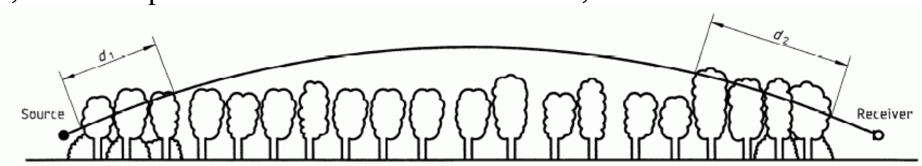
- Can be an effective absorber due to large area covered
- Only effective at low height above ground. Does not affect sound transmitted direct from source to receiver if there is line of sight.
- Typically less absorption than atmospheric absorption when there is line of sight.
- Approximate rule of 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	Nominal midband frequency							
m	63 Hz	125	250	500	1 000	2 000	4 000	8 000
$10 \leq d_f \leq 20$	Attenuation, dB: 0	0	1	1	1	1	2	3
$20 \leq d_f \leq 200$	Attenuation, dB/m: 0,02	0,03	0,04	0,05	0,06	0,08	0,09	0,12

Tree/Foliage attenuation from ISO 9613-2:1996

Bodies of Water

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

Snow

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

Appendix III SOUND LEVELS OF FAMILIAR NOISE SOURCES

Used with Permission Obtained from the Alberta Energy Regulator 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 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	Leq (dBA)	Duration (min)	Reason
6/02/21 12:11	6/02/21 12:11	76.6	0.50	Loud Vehicle Pass-by
6/02/21 14:37	6/02/21 14:38	70.3	1.00	Loud Vehicle Pass-by
6/02/21 17:41	6/02/21 17:41	66.6	0.75	Loud Vehicle Pass-by
6/02/21 19:16	6/02/21 19:17	74.3	1.00	Emergency Sirens
6/02/21 21:21	6/02/21 21:21	66.3	0.50	Loud Vehicle Pass-by
6/02/21 22:57	6/02/21 22:59	73.4	1.50	Emergency Sirens
6/02/21 23:47	6/02/21 23:47	63.4	0.50	Loud Vehicle Pass-by
6/03/21 0:10	6/03/21 0:10	61.2	0.75	Loud Vehicle Pass-by
6/03/21 0:55	6/03/21 0:55	69.2	0.25	Loud Vehicle Pass-by
6/03/21 2:53	6/03/21 2:54	60.4	0.50	Loud Vehicle Pass-by
6/03/21 3:25	6/03/21 3:25	59.1	0.50	Loud Vehicle Pass-by
6/03/21 5:19	6/03/21 5:20	64.2	1.00	Excessive Bird Noise
6/03/21 6:05	6/03/21 6:05	63.6	0.50	Excessive Bird Noise
6/03/21 6:19	6/03/21 6:19	86.9	0.25	Excessive Bird Noise
6/03/21 7:00	6/03/21 7:02	73.9	1.25	Emergency Sirens
	Total Time of Data Removed		**10.75**	

Data Removal Noise Monitoring Location #2

Start Time	End Time	Leq (dBA)	Duration (min)	Reason
6/02/21 12:11	6/02/21 12:11	64.9	0.50	Loud Vehicle Pass-by
6/02/21 13:49	6/02/21 13:50	63.8	0.75	Aircraft Flyover
6/02/21 14:37	6/02/21 14:37	67.9	0.50	Loud Vehicle Pass-by
6/02/21 19:16	6/02/21 19:17	73.0	1.00	Emergency Sirens
6/02/21 21:21	6/02/21 21:22	66.4	0.75	Loud Vehicle Pass-by
6/02/21 22:58	6/02/21 22:59	72.0	1.25	Emergency Sirens
6/02/21 23:08	6/02/21 23:08	63.7	0.50	Loud Vehicle Pass-by
6/03/21 2:53	6/03/21 2:54	59.1	1.00	Loud Vehicle Pass-by
6/03/21 7:01	6/03/21 7:02	71.7	1.25	Emergency Sirens
6/03/21 10:22	6/03/21 10:23	63.4	0.75	Aircraft Flyover
	Total Time of Data Removed		**8.25**	

Data Removal Noise Monitoring Location #3

Start Time	End Time	Leq (dBA)	Duration (min)	Reason
6/02/21 13:16	6/02/21 13:16	70.9	0.75	Emergency Sirens
6/02/21 19:38	6/02/21 19:40	70.7	2.00	Human Activity
6/02/21 20:55	6/02/21 20:55	83.3	0.25	Loud Vehicle Pass-by
6/02/21 21:29	6/02/21 21:29	85.0	0.25	Loud Vehicle Pass-by
6/02/21 21:35	6/02/21 21:36	62.8	1.00	Emergency Sirens
6/02/21 21:49	6/02/21 21:49	75.3	0.25	Loud Vehicle Pass-by
6/02/21 22:00	6/02/21 22:01	67.7	0.50	Emergency Sirens
6/02/21 22:39	6/02/21 22:40	65.4	0.50	Loud Vehicle Pass-by
6/02/21 22:59	6/02/21 23:00	74.2	1.00	Emergency Sirens
6/03/21 0:04	6/03/21 0:05	58.1	1.25	Loud Vehicle Pass-by
6/03/21 2:47	6/03/21 2:48	57.6	1.00	Loud Vehicle Pass-by
6/03/21 3:35	6/03/21 3:37	54.3	1.25	Loud Vehicle Pass-by
6/03/21 6:21	6/03/21 6:22	59.9	0.50	Loud Vehicle Pass-by
6/03/21 7:02	6/03/21 7:03	57.9	0.75	Emergency Sirens
6/03/21 8:51	6/03/21 9:02	60.7	10.75	Low Frequency Noise with Sirens
6/03/21 9:21	6/03/21 9:21	79.9	0.25	Loud Vehicle Pass-by
6/03/21 9:48	6/03/21 9:49	63.8	0.75	Loud Vehicle Pass-by
	Total Time of Data Removed		**23.00**	

Data Removal Noise Monitoring Location #4

Start Time	End Time	Leq (dBA)	Duration (min)	Reason
6/02/21 13:16	6/02/21 13:17	67.5	1.00	Emergency Sirens
6/02/21 21:29	6/02/21 21:30	64.9	1.25	Loud Vehicle Pass-by
6/02/21 21:35	6/02/21 21:36	64.3	1.00	Loud Vehicle Pass-by
6/02/21 22:00	6/02/21 22:01	63.0	0.75	Loud Vehicle Pass-by
6/02/21 22:39	6/02/21 22:40	59.7	1.00	Loud Vehicle Pass-by
6/02/21 23:00	6/02/21 23:00	73.4	0.75	Emergency Sirens
6/03/21 8:49	6/03/21 8:49	80.2	0.25	Machinery Noise
6/03/21 9:48	6/03/21 9:49	60.6	0.75	Loud Vehicle Pass-by
	Total Time of Data Removed		**6.75**	

Data Removal Noise Monitoring Location #5

Start Time	End Time	Leq (dBA)	Duration (min)	Reason
10/05/21 1:47	10/05/21 1:48	64.7	0.75	Loud Vehicle Pass-by
10/05/21 3:06	10/05/21 3:06	60.6	0.50	Aircraft Flyover
10/05/21 5:03	10/05/21 5:04	78.0	0.25	Loud Vehicle Pass-by
10/05/21 6:20	10/05/21 6:20	69.6	0.50	Loud Vehicle Pass-by
10/05/21 6:21	10/05/21 6:22	83.4	0.25	Loud Vehicle Pass-by
10/05/21 6:36	10/05/21 6:36	85.4	0.25	Loud Vehicle Pass-by
10/05/21 7:58	10/05/21 7:59	69.6	1.00	Loud Vehicle Pass-by
10/05/21 8:04	10/05/21 8:06	75.7	1.75	Emergency Sirens
10/05/21 8:10	10/05/21 8:11	75.9	1.00	Emergency Sirens
10/05/21 8:12	10/05/21 8:13	77.9	1.25	Emergency Sirens
10/05/21 8:16	10/05/21 8:16	84.7	0.25	Loud Vehicle Pass-by
10/05/21 9:39	10/05/21 9:40	69.0	0.75	Loud Vehicle Pass-by
10/05/21 9:51	10/05/21 9:51	82.3	0.25	Loud Vehicle Pass-by
10/05/21 10:06	10/05/21 10:08	74.5	1.25	Emergency Sirens
10/05/21 12:18	10/05/21 12:18	80.8	0.25	Loud Vehicle Pass-by
10/05/21 13:24	10/05/21 13:24	82.9	0.25	Loud Vehicle Pass-by
10/05/21 13:51	10/05/21 13:52	80.3	0.50	Emergency Sirens
10/05/21 14:06	10/05/21 14:07	70.6	0.50	Loud Vehicle Pass-by
10/05/21 14:07	10/05/21 14:08	84.5	0.25	Loud Vehicle Pass-by
10/05/21 14:19	10/05/21 14:19	72.5	0.50	Loud Vehicle Pass-by
10/05/21 14:41	10/05/21 14:41	85.7	0.25	Loud Vehicle Pass-by
10/05/21 15:02	10/05/21 15:02	77.3	0.75	Emergency Sirens
10/05/21 15:36	10/05/21 15:36	74.0	0.50	Loud Vehicle Pass-by
10/05/21 15:52	10/05/21 15:52	85.4	0.25	Loud Vehicle Pass-by
10/05/21 16:32	10/05/21 16:33	72.2	0.75	Loud Vehicle Pass-by
10/05/21 17:12	10/05/21 17:12	72.2	0.50	Loud Vehicle Pass-by
10/05/21 17:20	10/05/21 17:20	91.2	0.25	Loud Vehicle Pass-by
10/05/21 17:37	10/05/21 17:38	68.0	0.50	Loud Vehicle Pass-by
10/05/21 17:55	10/05/21 17:55	91.2	0.25	Loud Vehicle Pass-by
10/05/21 18:00	10/05/21 18:01	69.9	0.50	Loud Vehicle Pass-by
10/05/21 18:21	10/05/21 18:22	68.9	1.00	Loud Vehicle Pass-by
10/05/21 18:28	10/05/21 18:28	87.3	0.25	Loud Vehicle Pass-by
10/05/21 18:42	10/05/21 18:43	69.8	0.50	Loud Vehicle Pass-by
10/05/21 18:49	10/05/21 18:50	70.1	0.50	Loud Vehicle Pass-by
10/05/21 21:20	10/05/21 21:20	69.0	0.50	Loud Vehicle Pass-by
10/05/21 21:23	10/05/21 21:23	85.7	0.25	Loud Vehicle Pass-by
10/05/21 21:46	10/05/21 21:46	77.6	0.25	Loud Vehicle Pass-by
10/05/21 21:50	10/05/21 21:51	80.3	0.25	Loud Vehicle Pass-by
10/05/21 22:13	10/05/21 22:14	80.5	1.00	Loud Vehicle Pass-by
10/05/21 22:18	10/05/21 22:19	69.0	0.50	Loud Vehicle Pass-by
10/05/21 22:58	10/05/21 22:58	67.8	0.50	Loud Vehicle Pass-by
10/05/21 23:00	10/05/21 23:00	68.0	0.50	Loud Vehicle Pass-by
10/05/21 23:17	10/05/21 23:17	83.6	0.25	Loud Vehicle Pass-by
10/05/21 23:19	10/05/21 23:20	66.7	0.75	Aircraft Flyover
10/05/21 23:35	10/05/21 23:35	70.1	0.50	Loud Vehicle Pass-by
10/05/21 23:55	10/05/21 23:56	64.8	0.50	Loud Vehicle Pass-by
	Total Time of Data Removed		**24.75**	

Data Removal Noise Monitoring Location #6

Start Time	End Time	Leq (dBA)	Duration (min)	Reason
6/02/21 13:05	6/02/21 13:06	70.4	1.25	Emergency Sirens
6/02/21 13:17	6/02/21 13:18	71.7	1.00	Loud Vehicle Pass-by
6/02/21 15:49	6/02/21 15:50	71.4	1.25	Emergency Sirens
6/02/21 17:12	6/02/21 17:13	63.8	1.00	Emergency Sirens
6/02/21 20:57	6/02/21 20:57	71.0	0.50	Loud Vehicle Pass-by
6/02/21 22:01	6/02/21 22:02	65.8	0.75	Emergency Sirens
6/03/21 1:43	6/03/21 1:44	57.6	0.50	Loud Vehicle Pass-by
6/03/21 3:01	6/03/21 3:01	87.7	0.25	Loud Vehicle Pass-by
6/03/21 5:49	6/03/21 5:49	64.3	0.50	Loud Vehicle Pass-by
6/03/21 7:00	6/03/21 7:00	74.0	0.25	Loud Vehicle Pass-by
6/03/21 9:54	6/03/21 9:54	65.4	0.50	Loud Vehicle Pass-by
6/03/21 10:22	6/03/21 10:22	63.2	0.50	Aircraft Flyover
6/03/21 10:53	6/03/21 10:54	66.9	0.50	Loud Vehicle Pass-by
	Total Time of Data Removed		**8.75**	

Data Removal Noise Monitoring Location #7

Start Time	End Time	Leq (dBA)	Duration (min)	Reason
6/02/21 13:18	6/02/21 13:18	64.5	0.75	Emergency Sirens
6/02/21 13:24	6/02/21 13:26	71.1	1.50	Loud Vehicle Pass-by
6/02/21 15:19	6/02/21 15:20	62.8	0.75	Loud Vehicle Pass-by
6/02/21 15:50	6/02/21 15:50	69.3	0.50	Emergency Sirens
6/02/21 17:12	6/02/21 17:13	68.2	0.50	Emergency Sirens
6/02/21 20:19	6/02/21 20:20	71.5	0.50	Loud Vehicle Pass-by
6/02/21 20:29	6/02/21 20:30	62.6	0.75	Loud Vehicle Pass-by
6/02/21 20:46	6/02/21 20:46	62.0	0.50	Loud Vehicle Pass-by
6/02/21 22:02	6/02/21 22:02	62.0	0.50	Emergency Sirens
6/03/21 0:22	6/03/21 0:22	78.0	0.25	Loud Vehicle Pass-by
6/03/21 7:00	6/03/21 7:00	61.8	0.50	Loud Vehicle Pass-by
6/03/21 10:10	6/03/21 10:11	76.4	0.25	Loud Vehicle Pass-by
6/03/21 10:22	6/03/21 10:22	78.5	0.25	Aircraft Flyover
6/03/21 10:50	6/03/21 10:50	77.6	0.25	Loud Vehicle Pass-by
6/03/21 10:54	6/03/21 10:54	87.2	0.25	Loud Vehicle Pass-by
	Total Time of Data Removed		**8.00**	

Data Removal Noise Monitoring Location #8

Start Time	End Time	Leq (dBA)	Duration (min)	Reason
6/02/21 13:18	6/02/21 13:19	70.9	0.75	Emergency Sirens
6/02/21 15:51	6/02/21 15:51	75.2	0.50	Emergency Sirens
6/02/21 15:52	6/02/21 15:53	64.7	1.00	Emergency Sirens
6/02/21 17:13	6/02/21 17:13	71.2	0.50	Emergency Sirens
6/02/21 18:28	6/02/21 18:29	64.9	0.75	Loud Vehicle Pass-by
6/02/21 19:09	6/02/21 19:10	65.9	0.50	Dog Barking
6/02/21 19:47	6/02/21 19:47	65.4	0.50	Human Activity
6/02/21 19:50	6/02/21 19:50	65.2	0.50	Human Activity
6/02/21 19:57	6/02/21 19:58	65.8	1.00	Dog Barking
6/02/21 20:35	6/02/21 20:36	65.5	1.50	Dog Barking
6/02/21 20:46	6/02/21 20:47	65.6	1.25	Dog Barking
6/02/21 22:02	6/02/21 22:03	68.3	0.75	Emergency Sirens
6/02/21 22:17	6/02/21 22:18	63.3	0.75	Loud Vehicle Pass-by
6/02/21 23:46	6/02/21 23:47	58.0	1.75	Loud Vehicle Pass-by
6/03/21 1:45	6/03/21 1:46	54.7	1.25	Loud Vehicle Pass-by
6/03/21 3:01	6/03/21 3:03	54.7	1.50	Loud Vehicle Pass-by
6/03/21 5:27	6/03/21 5:28	63.5	0.50	Loud Vehicle Pass-by
6/03/21 5:46	6/03/21 5:46	67.5	0.50	Loud Vehicle Pass-by
6/03/21 5:50	6/03/21 5:51	83.2	0.25	Loud Vehicle Pass-by
6/03/21 6:24	6/03/21 6:25	64.3	0.50	Loud Vehicle Pass-by
6/03/21 7:49	6/03/21 7:49	87.4	0.25	Loud Vehicle Pass-by
	Total Time of Data Removed		**16.75**	

Data Removal Noise Monitoring Location #9

Start Time	End Time	Leq (dBA)	Duration (min)	Reason
10/06/21 22:55	10/06/21 22:56	59.7	1.00	Human Activity
10/06/21 23:06	10/06/21 23:07	73.0	0.25	Human Activity
10/06/21 23:09	10/06/21 23:10	72.9	1.25	Dog Barking
10/07/21 5:31	10/07/21 5:31	63.0	0.50	Loud Vehicle Pass-by
10/07/21 6:12	10/07/21 6:13	64.6	0.50	Loud Vehicle Pass-by
10/07/21 6:26	10/07/21 6:27	63.0	0.75	Loud Vehicle Pass-by
10/07/21 6:56	10/07/21 6:57	65.0	0.50	Loud Vehicle Pass-by
10/07/21 8:42	10/07/21 8:42	64.6	0.50	Loud Vehicle Pass-by
10/07/21 9:33	10/07/21 9:33	73.8	0.50	Emergency Sirens
10/07/21 15:04	10/07/21 15:05	63.3	0.75	Loud Vehicle Pass-by
10/07/21 15:39	10/07/21 16:27	63.7	48.75	Children Outside
10/07/21 16:28	10/07/21 16:34	61.4	6.50	Human Activity
10/07/21 16:55	10/07/21 16:55	83.3	0.25	Loud Vehicle Pass-by
10/07/21 17:13	10/07/21 17:14	70.1	1.50	Excessive Bird Noise
10/07/21 17:15	10/07/21 17:15	70.0	0.50	Excessive Bird Noise
10/07/21 17:17	10/07/21 17:17	64.5	0.50	Excessive Bird Noise
10/07/21 17:29	10/07/21 17:29	64.7	0.50	Dog Barking
10/07/21 18:18	10/07/21 18:19	65.1	0.75	Loud Vehicle Pass-by
10/07/21 19:12	10/07/21 19:13	69.4	0.75	Loud Vehicle Pass-by
10/07/21 19:51	10/07/21 19:52	69.2	0.50	Loud Vehicle Pass-by
10/07/21 21:49	10/07/21 21:49	69.3	0.50	Loud Vehicle Pass-by
	Total Time of Data Removed		**67.5**	

Data Removal Noise Monitoring Location #10

Start Time	End Time	Leq (dBA)	Duration (min)	Reason
10/04/21 22:03	10/04/21 22:04	61.9	0.75	Loud Vehicle Pass-by
10/04/21 22:29	10/04/21 22:30	64.3	0.25	Loud Vehicle Pass-by
10/04/21 23:44	10/04/21 23:44	83.5	0.25	Loud Vehicle Pass-by
10/04/21 23:45	10/04/21 23:45	75.9	1.25	Loud Vehicle Pass-by
10/05/21 0:23	10/05/21 0:24	67.0	0.25	Emergency Sirens
10/05/21 1:22	10/05/21 1:23	79.1	0.25	Loud Vehicle Pass-by
10/05/21 1:56	10/05/21 1:56	72.1	0.25	Loud Vehicle Pass-by
10/05/21 6:29	10/05/21 6:29	88.5	0.25	Loud Vehicle Pass-by
10/05/21 6:34	10/05/21 6:34	90.9	1.75	Loud Vehicle Pass-by
10/05/21 6:48	10/05/21 6:50	64.4	1.00	Train Pass-by
10/05/21 8:01	10/05/21 8:02	74.2	0.50	Emergency Sirens
10/05/21 13:20	10/05/21 13:20	65.9	0.25	Loud Vehicle Pass-by
10/05/21 13:29	10/05/21 13:30	85.7	0.25	Loud Vehicle Pass-by
10/05/21 14:29	10/05/21 14:29	84.3	0.25	Loud Vehicle Pass-by
10/05/21 14:54	10/05/21 14:54	84.9	0.50	Loud Vehicle Pass-by
10/05/21 15:09	10/05/21 15:09	71.0	1.00	Loud Vehicle Pass-by
10/05/21 17:47	10/05/21 17:48	68.0	0.50	Loud Vehicle Pass-by
10/05/21 18:14	10/05/21 18:14	65.0	0.25	Loud Vehicle Pass-by
10/05/21 18:19	10/05/21 18:19	85.6	0.50	Loud Vehicle Pass-by
10/05/21 18:21	10/05/21 18:22	65.1	0.25	Loud Vehicle Pass-by
10/05/21 18:30	10/05/21 18:31	79.6	0.25	Loud Vehicle Pass-by
10/05/21 19:45	10/05/21 19:46	84.9	0.50	Loud Vehicle Pass-by
10/05/21 20:12	10/05/21 20:13	67.1	0.25	Loud Vehicle Pass-by
10/05/21 20:42	10/05/21 20:42	87.7	0.25	Loud Vehicle Pass-by
10/05/21 20:59	10/05/21 20:59	84.1	0.50	Loud Vehicle Pass-by
10/05/21 21:02	10/05/21 21:02	63.5	0.25	Loud Vehicle Pass-by
10/05/21 21:11	10/05/21 21:12	84.1	0.25	Loud Vehicle Pass-by
10/05/21 21:20	10/05/21 21:20	79.0	0.25	Loud Vehicle Pass-by
10/05/21 21:52	10/05/21 21:52	77.6	0.75	Loud Vehicle Pass-by
10/05/21 21:55	10/05/21 21:56	60.6	1.00	Loud Vehicle Pass-by
10/05/21 21:56	10/05/21 21:57	61.9	0.00	Loud Vehicle Pass-by
	Total Time of Data Removed		**14.75**	

Data Removal Noise Monitoring Location #11

Start Time	End Time	Leq (dBA)	Duration (min)	Reason
5/12/21 22:40	5/12/21 22:41	50.3	0.50	Loud Vehicle Pass-by
5/12/21 23:13	5/12/21 23:14	48.3	0.75	Loud Vehicle Pass-by
5/12/21 23:57	5/12/21 23:57	49.5	0.50	Loud Vehicle Pass-by
5/13/21 0:37	5/13/21 0:38	47.3	0.50	Loud Vehicle Pass-by
5/13/21 3:53	5/13/21 3:54	51.4	1.25	Loud Vehicle Pass-by
5/13/21 5:58	5/13/21 5:59	54.0	0.75	Loud Vehicle Pass-by
5/13/21 6:43	5/13/21 6:44	58.8	1.00	Emergency Sirens
5/13/21 6:57	5/13/21 6:58	57.3	1.50	Excessive Bird Noise
5/13/21 7:17	5/13/21 7:17	77.1	0.25	Loud Vehicle Pass-by
5/13/21 10:28	5/13/21 10:29	58.5	0.50	Loud Vehicle Pass-by
5/13/21 12:21	5/13/21 12:22	57.9	0.75	Loud Vehicle Pass-by
5/13/21 14:16	5/13/21 14:17	57.0	1.25	Excessive Bird Noise
5/13/21 16:41	5/13/21 16:42	59.6	1.25	Loud Vehicle Pass-by
5/13/21 20:28	5/13/21 20:28	61.0	0.50	Loud Vehicle Pass-by
5/13/21 21:51	5/13/21 21:53	54.6	2.00	Aircraft Flyover
	Total Time of Data Removed		**13.25**	

Data Removal Noise Monitoring Location #12

Start Time	End Time	Leq (dBA)	Duration (min)	Reason
5/10/21 22:16	5/10/21 22:18	50.1	2.25	Loud Vehicle Pass-by
5/10/21 22:37	5/10/21 22:38	45.9	1.50	Loud Vehicle Pass-by
5/10/21 22:38	5/10/21 22:38	0.0	0.00	Loud Vehicle Pass-by
5/11/21 0:08	5/11/21 0:10	49.3	2.00	Emergency Sirens
5/11/21 0:11	5/11/21 0:13	61.2	1.75	Emergency Sirens
5/11/21 0:20	5/11/21 0:22	48.4	1.75	Aircraft Flyover
5/11/21 4:03	5/11/21 4:04	52.0	0.50	Loud Vehicle Pass-by
5/11/21 7:04	5/11/21 7:06	53.6	1.75	Excessive Bird Noise
5/11/21 9:24	5/11/21 9:25	56.5	1.00	Human Activity
5/11/21 10:49	5/11/21 10:50	53.6	1.00	Human Activity
5/11/21 11:02	5/11/21 11:03	56.1	1.00	Dog Barking
5/11/21 11:08	5/11/21 11:09	56.1	1.00	Dog Barking
5/11/21 11:10	5/11/21 11:11	55.6	0.75	Dog Barking
5/11/21 11:44	5/11/21 11:45	57.3	0.50	Loud Vehicle Pass-by
5/11/21 13:15	5/11/21 13:16	56.3	1.25	Dog Barking
5/11/21 13:18	5/11/21 13:19	58.2	0.75	Human Activity
5/11/21 13:29	5/11/21 13:32	61.5	2.50	Human Activity
5/11/21 13:34	5/11/21 13:35	61.4	0.75	Emergency Sirens
5/11/21 13:42	5/11/21 13:43	56.2	1.00	Human Activity
5/11/21 13:46	5/11/21 13:46	59.6	0.50	Human Activity
5/11/21 13:47	5/11/21 13:49	62.4	1.75	Human Activity
5/11/21 13:57	5/11/21 13:59	58.2	2.00	Dog Barking
5/11/21 14:03	5/11/21 14:05	65.1	1.50	Human Activity
5/11/21 14:09	5/11/21 14:11	64.3	2.75	Human Activity
5/11/21 14:33	5/11/21 14:35	57.8	2.25	Dog Barking
5/11/21 14:57	5/11/21 14:58	57.8	0.50	Human Activity
5/11/21 15:09	5/11/21 15:10	54.9	1.00	Human Activity
5/11/21 15:17	5/11/21 15:17	59.0	0.75	Human Activity
5/11/21 15:27	5/11/21 15:30	55.6	2.25	Dog Barking
5/11/21 15:36	5/11/21 15:37	55.0	1.00	Dog Barking
5/11/21 15:43	5/11/21 15:43	57.8	0.50	Dog Barking
5/11/21 16:43	5/11/21 16:44	56.6	0.50	Loud Vehicle Pass-by
5/11/21 18:17	5/11/21 18:17	55.8	0.50	Loud Vehicle Pass-by
5/11/21 18:26	5/11/21 18:27	54.3	1.00	Loud Vehicle Pass-by
5/11/21 19:15	5/11/21 19:16	59.6	1.25	Emergency Sirens
5/11/21 20:15	5/11/21 20:17	57.9	1.50	Emergency Sirens
5/11/21 20:25	5/11/21 20:26	53.2	0.75	Loud Vehicle Pass-by
5/11/21 20:57	5/11/21 20:58	54.1	1.00	Dog Barking
5/11/21 21:13	5/11/21 21:14	56.8	1.25	Emergency Sirens
5/11/21 21:27	5/11/21 21:28	58.2	0.75	Human Activity
	Total Time of Data Removed		**48.25**	

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Data Removal Noise Monitoring Location #13

Start Time	End Time	Leq (dBA)	Duration (min)	Reason
10/05/21 1:47	10/05/21 1:48	55.6	1.00	Loud Vehicle Pass-by
10/05/21 3:06	10/05/21 3:08	54.9	1.50	Aircraft Flyover
10/05/21 5:04	10/05/21 5:04	55.7	0.50	Loud Vehicle Pass-by
10/05/21 5:49	10/05/21 5:51	54.8	1.50	Loud Vehicle Pass-by
10/05/21 6:19	10/05/21 6:19	75.8	0.25	Loud Vehicle Pass-by
10/05/21 6:20	10/05/21 6:21	57.8	1.00	Loud Vehicle Pass-by
10/05/21 6:22	10/05/21 6:22	79.3	0.25	Loud Vehicle Pass-by
10/05/21 6:36	10/05/21 6:36	0.0	0.00	Loud Vehicle Pass-by
10/05/21 8:04	10/05/21 8:06	70.3	1.75	Emergency Sirens
10/05/21 8:11	10/05/21 8:12	71.2	1.00	Emergency Sirens
10/05/21 8:12	10/05/21 8:13	73.7	0.75	Loud Vehicle Pass-by
10/05/21 8:40	10/05/21 8:41	61.4	1.25	Loud Vehicle Pass-by
10/05/21 9:19	10/05/21 9:21	62.6	1.25	Aircraft Flyover
10/05/21 9:49	10/05/21 9:50	77.2	0.25	Loud Vehicle Pass-by
10/05/21 9:52	10/05/21 9:52	73.0	0.25	Loud Vehicle Pass-by
10/05/21 9:58	10/05/21 9:59	59.0	0.50	Loud Vehicle Pass-by
10/05/21 10:07	10/05/21 10:08	69.3	1.75	Emergency Sirens
10/05/21 10:24	10/05/21 10:24	61.1	0.50	Loud Vehicle Pass-by
10/05/21 11:19	10/05/21 11:19	59.5	0.50	Loud Vehicle Pass-by
10/05/21 11:35	10/05/21 11:35	77.8	0.25	Loud Vehicle Pass-by
10/05/21 11:37	10/05/21 11:37	82.7	0.25	Loud Vehicle Pass-by
10/05/21 11:45	10/05/21 11:45	61.3	0.50	Loud Vehicle Pass-by
10/05/21 12:18	10/05/21 12:19	62.8	0.75	Loud Vehicle Pass-by
10/05/21 12:33	10/05/21 12:34	60.3	1.25	Loud Vehicle Pass-by
10/05/21 12:47	10/05/21 12:47	76.2	0.25	Loud Vehicle Pass-by
10/05/21 13:25	10/05/21 13:25	60.3	0.75	Loud Vehicle Pass-by
10/05/21 13:35	10/05/21 13:35	59.8	0.50	Loud Vehicle Pass-by
10/05/21 13:52	10/05/21 13:52	74.8	0.50	Emergency Sirens
10/05/21 14:07	10/05/21 14:07	79.0	0.25	Loud Vehicle Pass-by
10/05/21 14:19	10/05/21 14:20	63.4	0.50	Loud Vehicle Pass-by
10/05/21 15:02	10/05/21 15:03	74.1	0.75	Emergency Sirens
10/05/21 15:27	10/05/21 15:28	62.0	0.50	Loud Vehicle Pass-by
10/05/21 15:36	10/05/21 15:36	65.3	0.50	Loud Vehicle Pass-by
10/05/21 15:52	10/05/21 15:53	62.3	0.50	Loud Vehicle Pass-by
10/05/21 16:27	10/05/21 16:27	76.6	0.25	Loud Vehicle Pass-by
10/05/21 16:33	10/05/21 16:33	79.6	0.25	Loud Vehicle Pass-by
10/05/21 17:08	10/05/21 17:08	75.7	0.25	Loud Vehicle Pass-by
10/05/21 17:12	10/05/21 17:13	62.1	1.00	Loud Vehicle Pass-by
10/05/21 17:20	10/05/21 17:21	67.6	0.50	Loud Vehicle Pass-by
10/05/21 18:24	10/05/21 18:25	66.0	0.75	Loud Vehicle Pass-by
10/05/21 18:43	10/05/21 18:43	62.8	0.50	Loud Vehicle Pass-by
10/05/21 22:14	10/05/21 22:14	71.2	0.50	Loud Vehicle Pass-by
10/05/21 22:59	10/05/21 22:59	78.2	0.25	Loud Vehicle Pass-by
10/05/21 23:35	10/05/21 23:36	63.5	0.50	Loud Vehicle Pass-by
	Total Time of Data Removed		**28.50**	

Data Removal Noise Monitoring Location #14

Start Time	End Time	Leq (dBA)	Duration (min)	Reason
7/13/21 22:01	7/13/21 22:02	57.1	1.00	Loud Vehicle Pass-by
7/13/21 22:36	7/13/21 22:37	61.0	0.50	Loud Vehicle Pass-by
7/13/21 22:46	7/13/21 22:47	60.2	0.50	Loud Vehicle Pass-by
7/13/21 23:18	7/13/21 23:19	60.2	1.00	Loud Vehicle Pass-by
7/14/21 7:56	7/14/21 7:57	62.4	1.00	Loud Vehicle Pass-by
7/14/21 8:58	7/14/21 9:00	59.2	1.50	Loud Vehicle Pass-by
7/14/21 9:44	7/14/21 9:44	59.4	0.50	Loud Vehicle Pass-by
7/14/21 10:21	7/14/21 10:21	59.3	0.50	Dog Barking
7/14/21 12:22	7/14/21 12:23	61.2	0.75	Loud Vehicle Pass-by
7/14/21 13:36	7/14/21 13:36	61.7	0.75	Loud Vehicle Pass-by
7/14/21 14:11	7/14/21 14:12	62.6	0.75	Loud Vehicle Pass-by
7/14/21 14:33	7/14/21 14:34	62.6	1.00	Loud Vehicle Pass-by
7/14/21 16:13	7/14/21 16:13	72.0	0.25	Loud Vehicle Pass-by
7/14/21 16:15	7/14/21 16:16	64.2	0.50	Loud Vehicle Pass-by
7/14/21 18:38	7/14/21 18:38	60.5	0.50	Loud Vehicle Pass-by
7/14/21 18:52	7/14/21 18:53	61.4	1.00	Loud Vehicle Pass-by
7/14/21 19:10	7/14/21 19:10	60.6	0.75	Loud Vehicle Pass-by
7/14/21 20:32	7/14/21 20:34	67.1	2.25	Dog Barking
7/14/21 20:43	7/14/21 20:43	59.9	0.75	Loud Vehicle Pass-by
7/14/21 21:07	7/14/21 21:08	59.9	0.75	Loud Vehicle Pass-by
7/14/21 21:44	7/14/21 21:44	62.2	0.50	Loud Vehicle Pass-by
	Total Time of Data Removed		**17.00**	

Data Removal Noise Monitoring Location #15

Start Time	End Time	Leq (dBA)	Duration (min)	Reason
6/28/21 22:00	6/28/21 22:01	60.1	0.50	Loud Vehicle Pass-by
6/28/21 22:50	6/28/21 22:51	74.2	0.25	Loud Vehicle Pass-by
6/28/21 22:57	6/28/21 22:58	61.3	0.50	Loud Vehicle Pass-by
6/28/21 23:34	6/28/21 23:34	86.0	0.25	Loud Vehicle Pass-by
6/29/21 0:55	6/29/21 0:56	77.8	0.25	Loud Vehicle Pass-by
6/29/21 4:19	6/29/21 4:20	57.9	0.75	Loud Vehicle Pass-by
6/29/21 5:34	6/29/21 5:35	57.0	0.50	Human Activity
6/29/21 6:29	6/29/21 6:30	62.0	0.75	Loud Vehicle Pass-by
6/29/21 7:04	6/29/21 7:04	62.6	0.50	Loud Vehicle Pass-by
6/29/21 7:19	6/29/21 7:19	81.5	0.25	Loud Vehicle Pass-by
6/29/21 7:22	6/29/21 7:22	61.0	0.50	Loud Vehicle Pass-by
6/29/21 7:32	6/29/21 7:33	61.8	0.50	Loud Vehicle Pass-by
6/29/21 7:36	6/29/21 7:37	59.6	0.50	Loud Vehicle Pass-by
6/29/21 7:52	6/29/21 7:52	71.3	0.25	Loud Vehicle Pass-by
6/29/21 7:58	6/29/21 7:58	59.6	0.50	Loud Vehicle Pass-by
6/29/21 8:16	6/29/21 8:17	83.8	0.25	Loud Vehicle Pass-by
6/29/21 8:26	6/29/21 8:26	61.2	0.50	Loud Vehicle Pass-by
6/29/21 8:41	6/29/21 8:42	60.9	0.50	Loud Vehicle Pass-by
6/29/21 9:16	6/29/21 9:17	62.1	0.50	Loud Vehicle Pass-by
6/29/21 9:22	6/29/21 9:23	64.5	0.75	Loud Vehicle Pass-by
6/29/21 9:26	6/29/21 9:27	83.7	0.25	Loud Vehicle Pass-by
6/29/21 9:33	6/29/21 9:34	61.3	0.75	Human Activity
6/29/21 9:51	6/29/21 9:51	74.0	0.25	Loud Vehicle Pass-by
6/29/21 10:01	6/29/21 10:02	60.3	0.50	Loud Vehicle Pass-by
6/29/21 10:20	6/29/21 10:20	78.6	0.25	Loud Vehicle Pass-by
6/29/21 11:09	6/29/21 11:09	76.2	0.25	Loud Vehicle Pass-by
6/29/21 11:26	6/29/21 11:27	67.1	1.00	Loud Vehicle Pass-by
6/29/21 11:39	6/29/21 11:40	62.2	0.75	Loud Vehicle Pass-by
6/29/21 12:46	6/29/21 12:46	61.8	0.50	Loud Vehicle Pass-by
6/29/21 13:06	6/29/21 13:06	86.8	0.25	Loud Vehicle Pass-by
6/29/21 13:47	6/29/21 13:48	69.9	1.25	Loud Vehicle Pass-by
6/29/21 14:21	6/29/21 14:22	70.5	0.50	Loud Vehicle Pass-by
6/29/21 14:45	6/29/21 14:45	78.8	0.25	Human Activity
6/29/21 14:47	6/29/21 14:48	64.0	1.25	Loud Vehicle Pass-by
6/29/21 14:55	6/29/21 14:55	65.7	0.50	Loud Vehicle Pass-by
6/29/21 15:11	6/29/21 15:11	72.1	0.50	Loud Vehicle Pass-by
6/29/21 15:32	6/29/21 15:32	65.6	0.50	Loud Vehicle Pass-by
6/29/21 15:56	6/29/21 15:56	78.9	0.25	Loud Vehicle Pass-by
6/29/21 15:57	6/29/21 15:58	65.6	0.50	Loud Vehicle Pass-by
6/29/21 16:24	6/29/21 16:25	64.4	1.00	Loud Vehicle Pass-by
6/29/21 16:36	6/29/21 16:37	64.8	0.50	Loud Vehicle Pass-by
6/29/21 17:15	6/29/21 17:16	82.5	0.25	Loud Vehicle Pass-by
6/29/21 17:26	6/29/21 17:27	87.4	0.25	Loud Vehicle Pass-by
6/29/21 18:08	6/29/21 18:08	85.1	0.25	Loud Vehicle Pass-by
6/29/21 18:41	6/29/21 18:42	70.4	1.00	Loud Vehicle Pass-by
6/29/21 19:03	6/29/21 19:04	64.5	0.50	Loud Vehicle Pass-by
6/29/21 20:11	6/29/21 20:12	70.3	0.50	Loud Vehicle Pass-by
6/29/21 20:27	6/29/21 20:28	65.8	0.50	Loud Vehicle Pass-by
6/29/21 20:33	6/29/21 20:33	70.4	0.75	Loud Vehicle Pass-by
	Total Time of Data Removed		**25.00**	

Data Removal Noise Monitoring Location #16

Start Time	End Time	Leq (dBA)	Duration (min)	Reason
10/05/21 14:05	10/05/21 14:06	73.5	1.00	Loud Vehicle Pass-by
10/05/21 19:56	10/05/21 19:57	63.1	0.75	Loud Vehicle Pass-by
10/05/21 19:58	10/05/21 19:59	66.0	0.50	Loud Vehicle Pass-by
10/05/21 20:49	10/05/21 20:50	79.1	0.25	Loud Vehicle Pass-by
10/06/21 8:48	10/06/21 8:48	84.1	0.25	Loud Vehicle Pass-by
10/06/21 10:08	10/06/21 10:09	65.9	0.75	Loud Vehicle Pass-by
10/06/21 10:31	10/06/21 10:31	88.0	0.25	Loud Vehicle Pass-by
10/06/21 10:41	10/06/21 10:41	88.1	0.25	Loud Vehicle Pass-by
	Total Time of Data Removed		**4**	

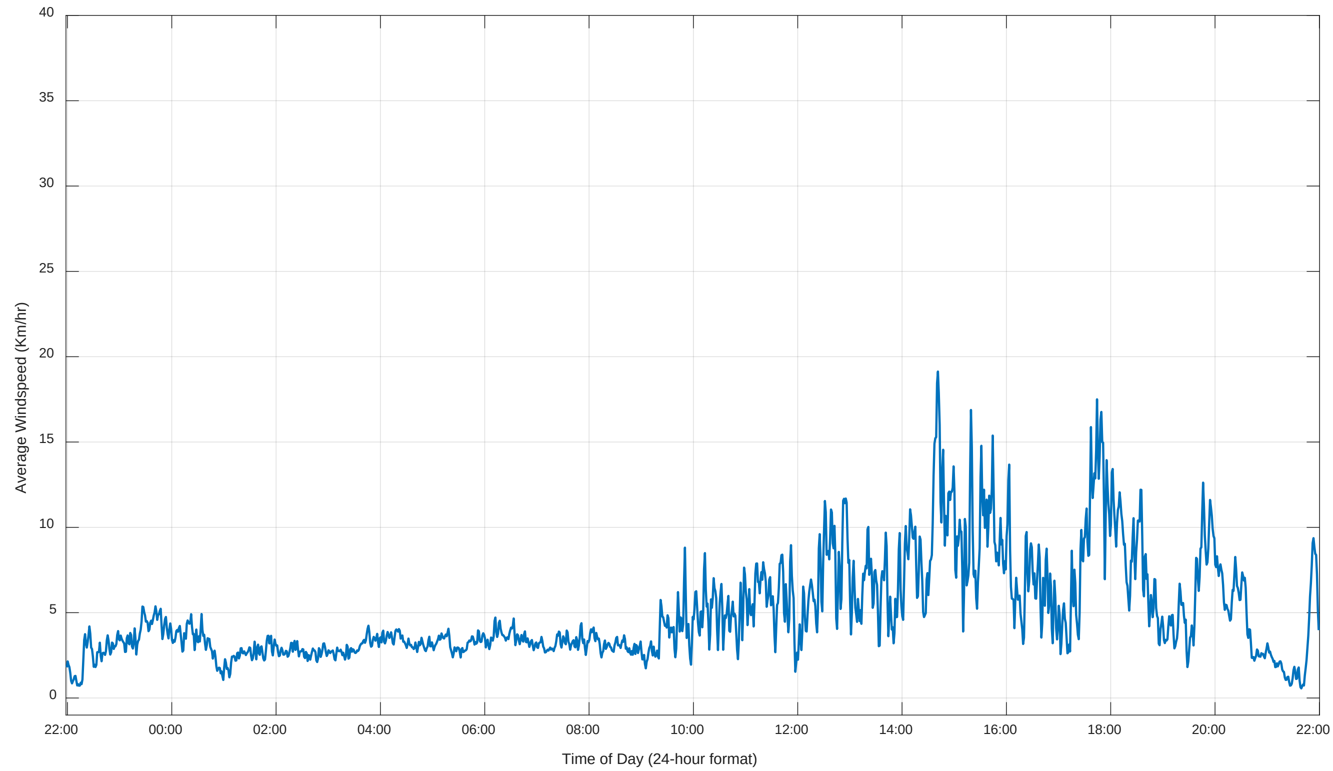
Data Removal Noise Monitoring Location #17

Start Time	End Time	Leq (dBA)	Duration (min)	Reason
10/05/21 11:14	10/05/21 11:14	61.6	0.75	Loud Vehicle Pass-by
10/05/21 11:22	10/05/21 11:23	65.8	0.50	Loud Vehicle Pass-by
10/05/21 11:41	10/05/21 11:41	90.8	0.25	Loud Vehicle Pass-by
10/05/21 11:48	10/05/21 11:49	68.8	0.75	Loud Vehicle Pass-by
10/05/21 12:12	10/05/21 12:12	86.2	0.25	Loud Vehicle Pass-by
10/05/21 12:32	10/05/21 12:32	65.8	0.50	Loud Vehicle Pass-by
10/05/21 12:55	10/05/21 12:57	64.0	1.25	Loud Vehicle Pass-by
10/05/21 14:02	10/05/21 14:03	68.9	0.75	Aircraft Flyover
10/05/21 14:40	10/05/21 14:40	67.0	0.50	Loud Vehicle Pass-by
10/05/21 14:44	10/05/21 14:44	91.2	0.25	Loud Vehicle Pass-by
10/05/21 14:56	10/05/21 14:56	65.3	0.50	Loud Vehicle Pass-by
10/05/21 15:03	10/05/21 15:04	62.2	0.75	Loud Vehicle Pass-by
10/05/21 15:09	10/05/21 15:10	65.7	0.75	Loud Vehicle Pass-by
10/05/21 15:17	10/05/21 15:18	85.1	0.25	Loud Vehicle Pass-by
10/05/21 15:37	10/05/21 15:37	62.2	0.50	Loud Vehicle Pass-by
10/05/21 15:56	10/05/21 15:56	65.9	0.50	Loud Vehicle Pass-by
10/05/21 17:10	10/05/21 17:10	90.9	0.25	Loud Vehicle Pass-by
10/05/21 17:21	10/05/21 17:21	82.1	0.25	Loud Vehicle Pass-by
10/05/21 18:27	10/05/21 18:28	68.2	0.75	Loud Vehicle Pass-by
10/05/21 18:52	10/05/21 18:52	85.8	0.25	Loud Vehicle Pass-by
10/05/21 19:09	10/05/21 19:10	71.1	0.75	Emergency Sirens
10/05/21 19:55	10/05/21 19:56	84.4	0.25	Loud Vehicle Pass-by
10/05/21 20:36	10/05/21 20:37	64.0	0.75	Loud Vehicle Pass-by
10/05/21 21:30	10/05/21 21:31	83.1	0.25	Loud Vehicle Pass-by
10/05/21 21:50	10/05/21 21:50	66.1	0.75	Loud Vehicle Pass-by
10/05/21 22:11	10/05/21 22:12	90.6	0.25	Loud Vehicle Pass-by
10/05/21 22:52	10/05/21 22:53	63.1	0.75	Loud Vehicle Pass-by
10/06/21 5:41	10/06/21 5:43	60.8	1.75	Loud Vehicle Pass-by
10/06/21 6:17	10/06/21 6:17	64.4	0.50	Loud Vehicle Pass-by
10/06/21 7:48	10/06/21 7:48	65.2	0.50	Loud Vehicle Pass-by
10/06/21 10:50	10/06/21 10:51	63.7	0.50	Loud Vehicle Pass-by
	Total Time of Data Removed		**17.50**	

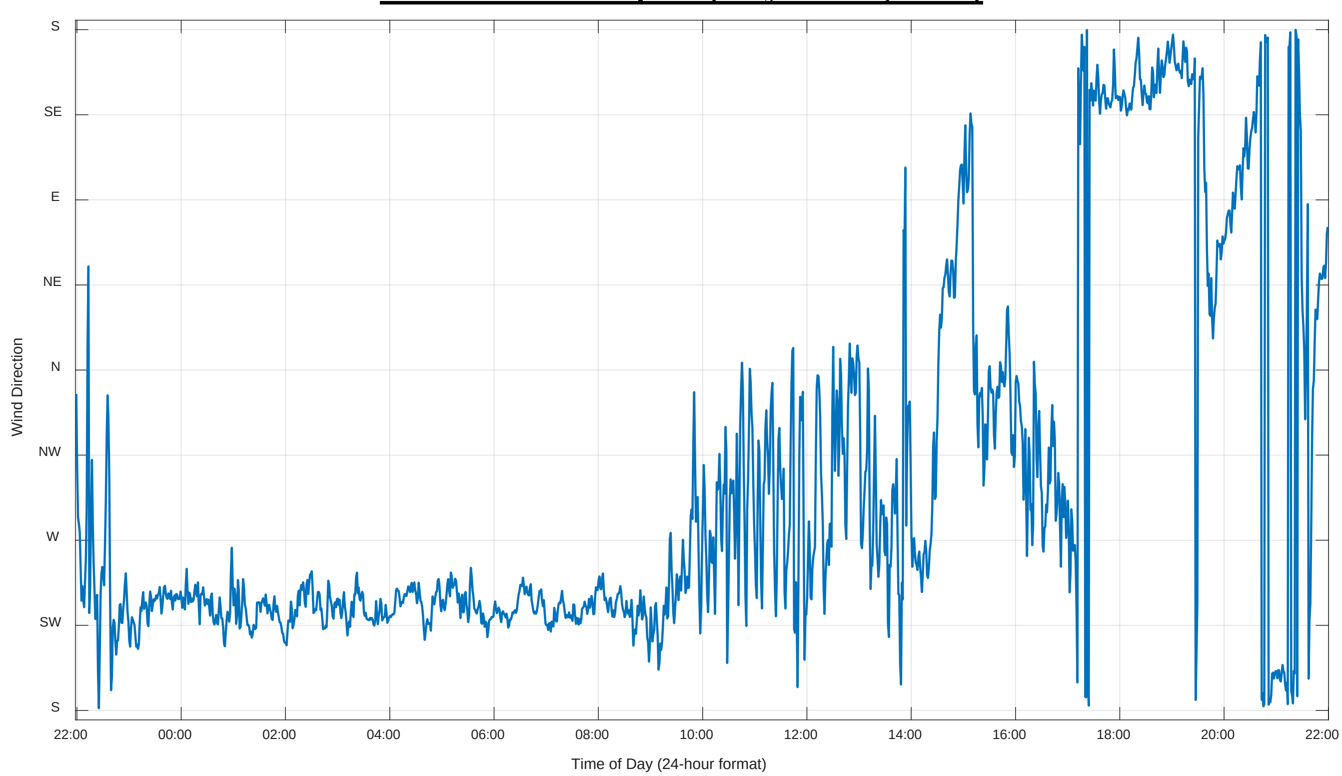
Data Removal Noise Monitoring Location #18

Start Time	End Time	Leq (dBA)	Duration (min)	Reason
10/05/21 13:28	10/05/21 13:28	62.7	0.50	Loud Vehicle Pass-by
10/05/21 14:20	10/05/21 14:21	63.7	0.50	Loud Vehicle Pass-by
10/05/21 17:24	10/05/21 17:25	65.9	1.00	Loud Vehicle Pass-by
10/05/21 20:11	10/05/21 20:11	82.5	0.25	Loud Vehicle Pass-by
10/05/21 23:39	10/05/21 23:39	76.2	0.25	Loud Vehicle Pass-by
10/06/21 4:17	10/06/21 4:23	57.5	6.00	Train Pass-by
	Total Time of Data Removed		**8.5**	

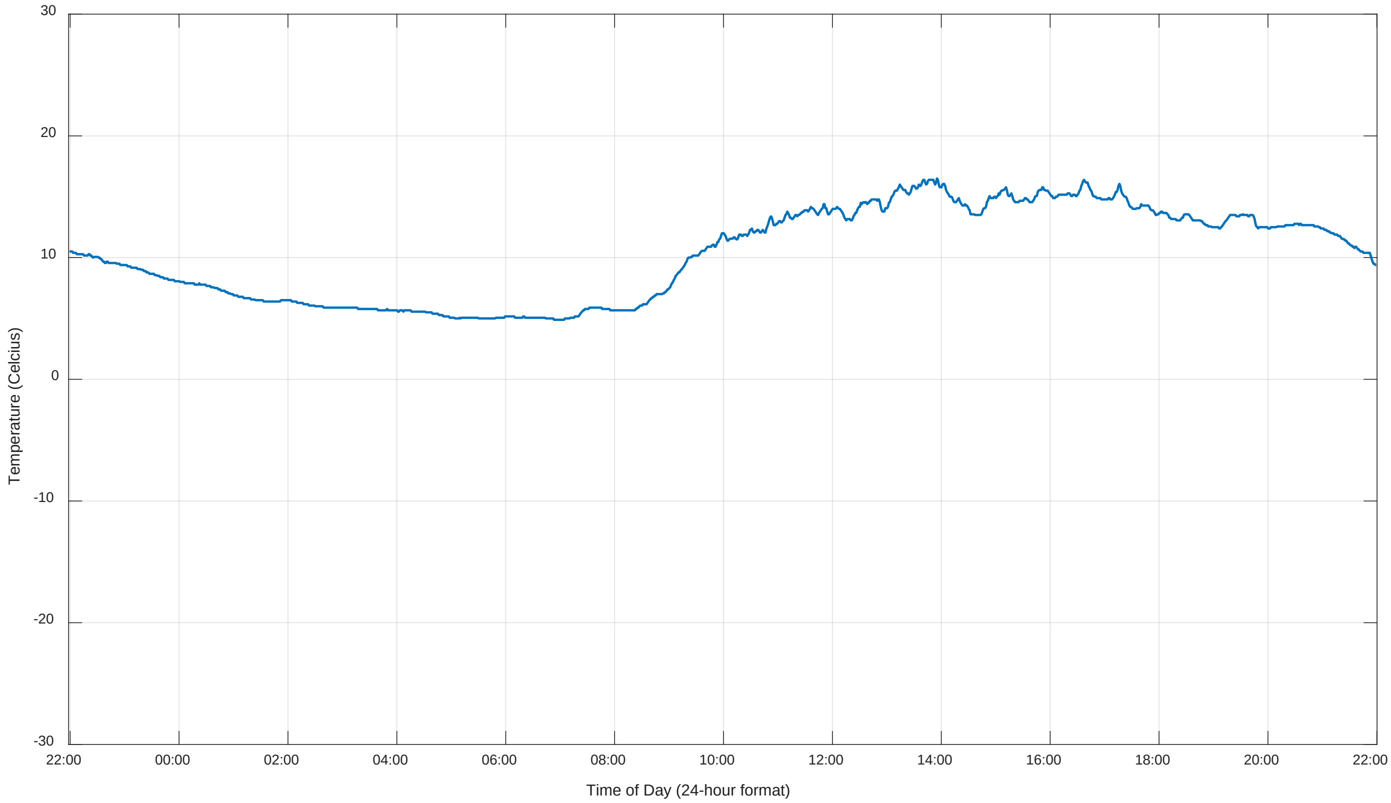
Appendix V WEATHER DATA



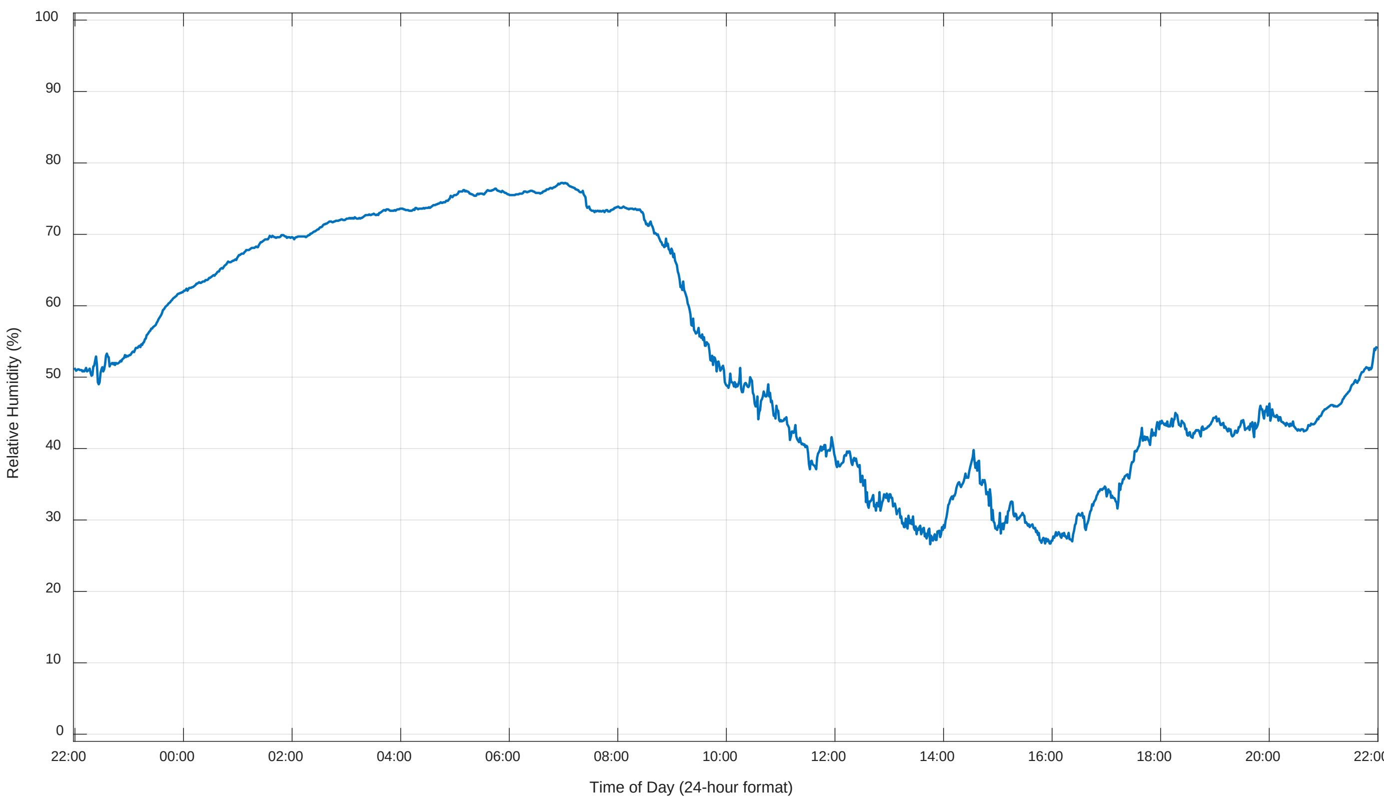
Monitored Wind Speed (May 10 – 11, 2021)



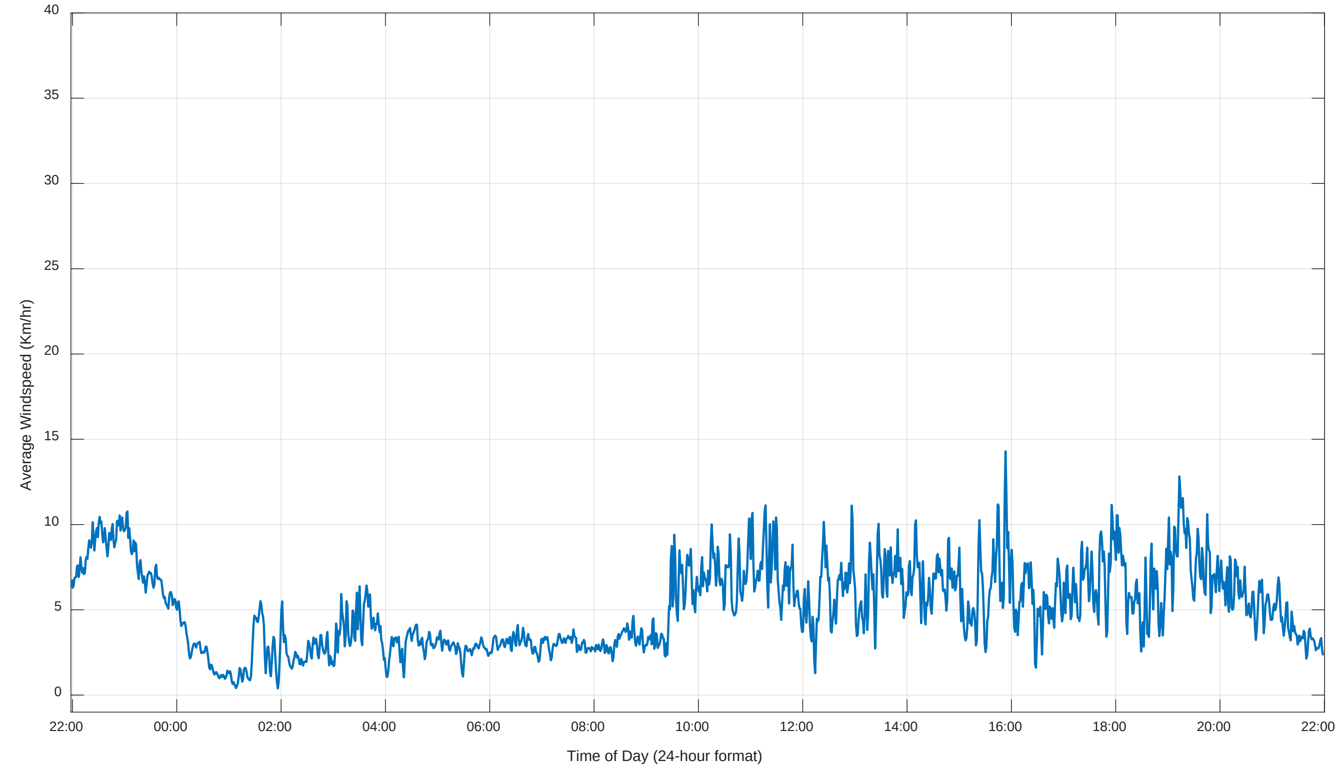
Monitored Wind Direction (May 10 – 11, 2021)



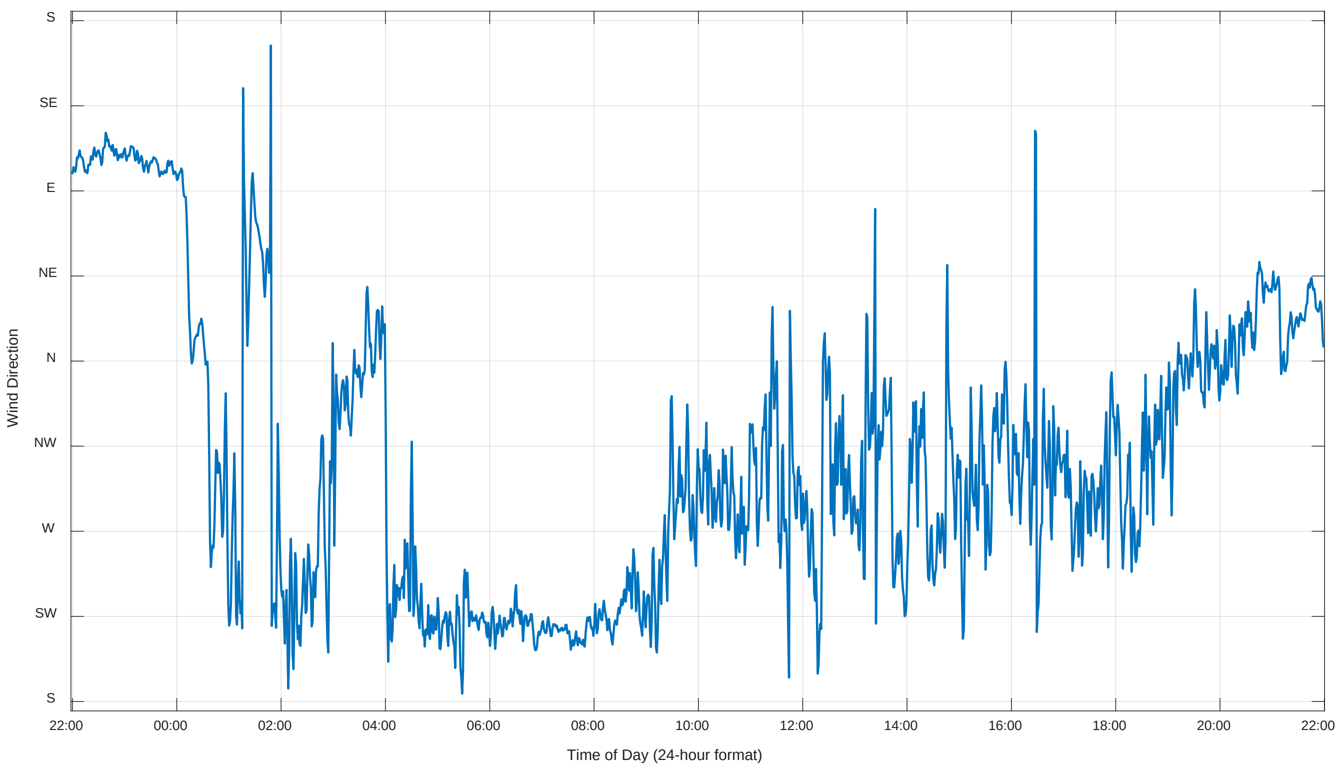
Monitored Temperature (May 10 – 11, 2021)



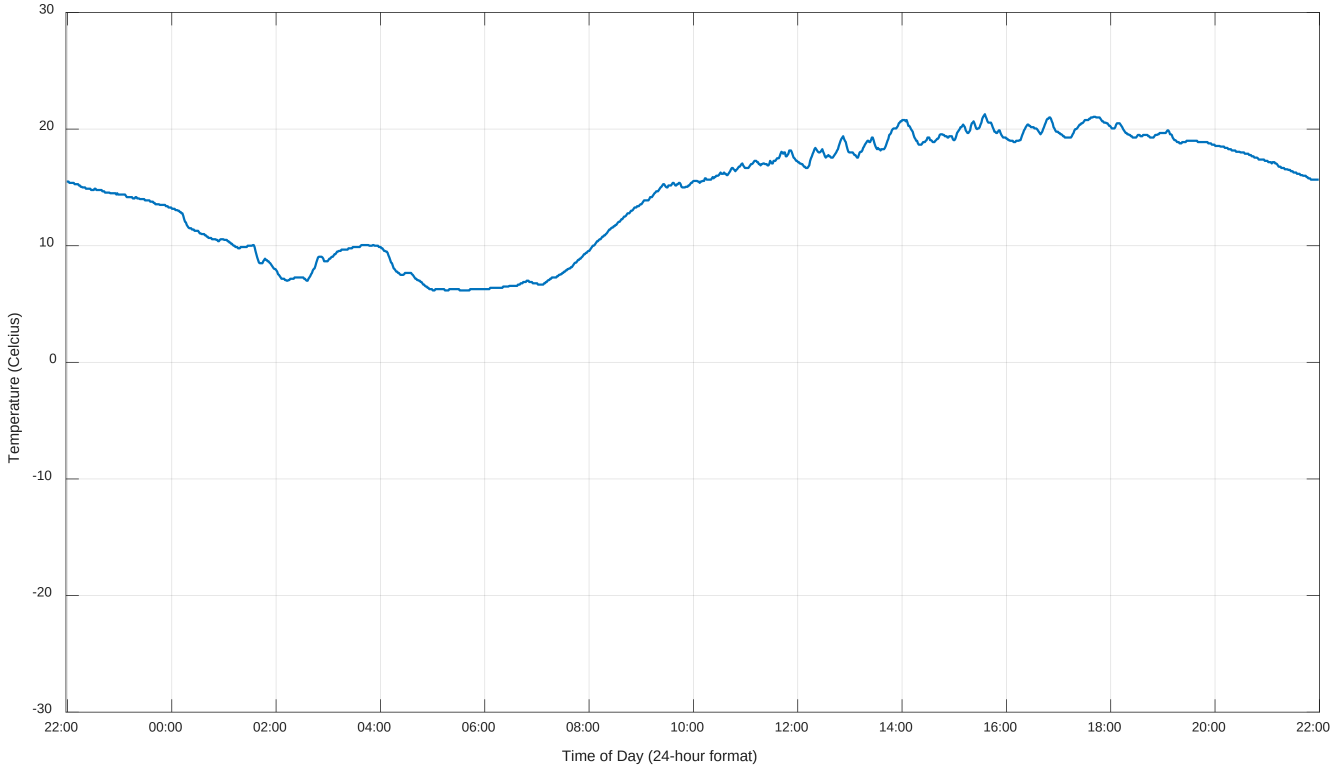
Monitored Humidity (May 10 – 11, 2021)



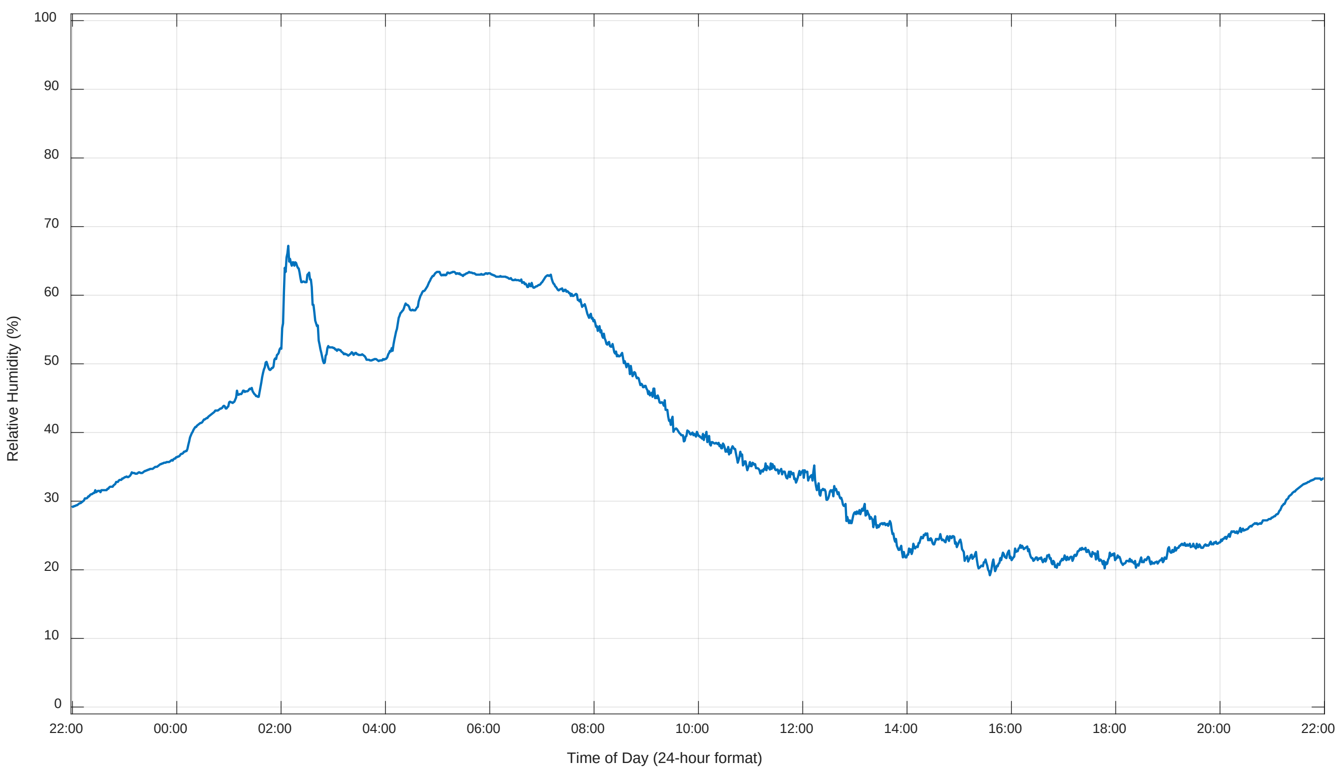
Monitored Wind Speed (May 12 – 13, 2021)



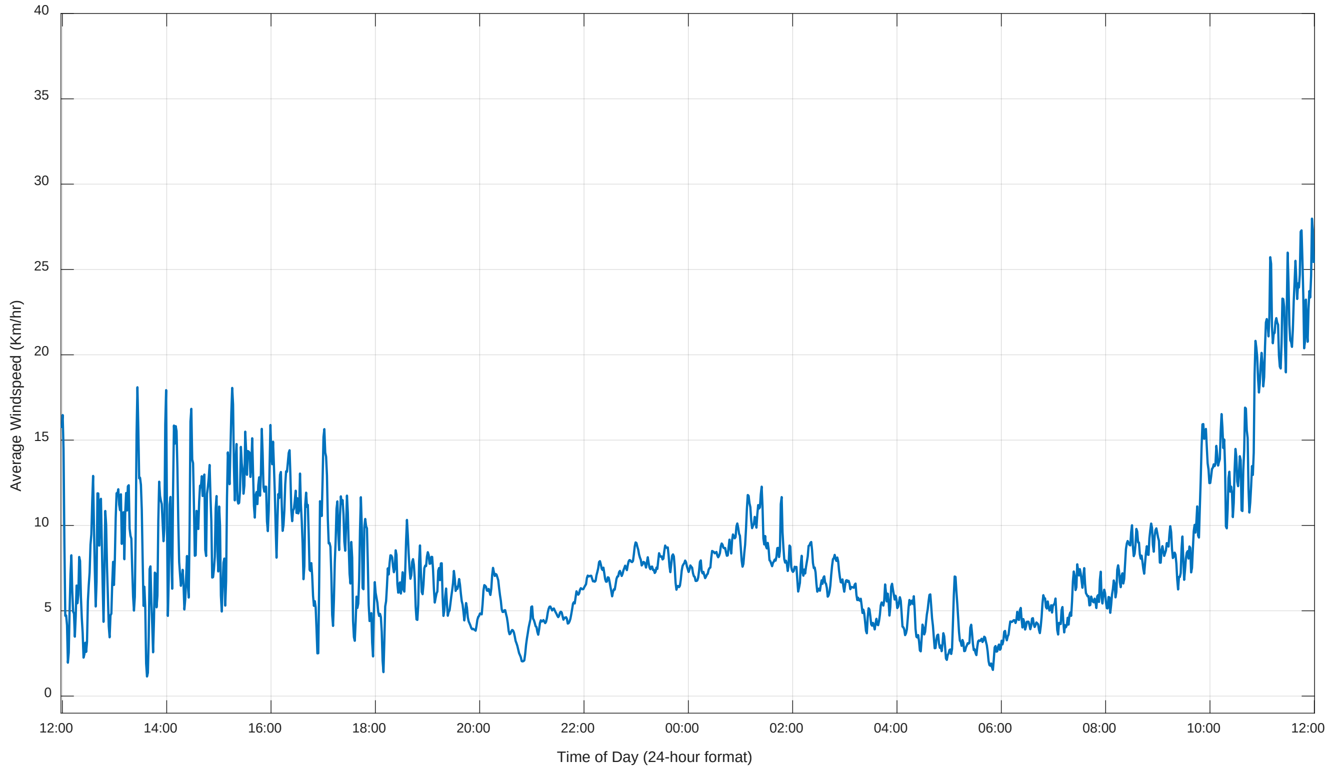
Monitored Wind Direction (May 12 – 13, 2021)



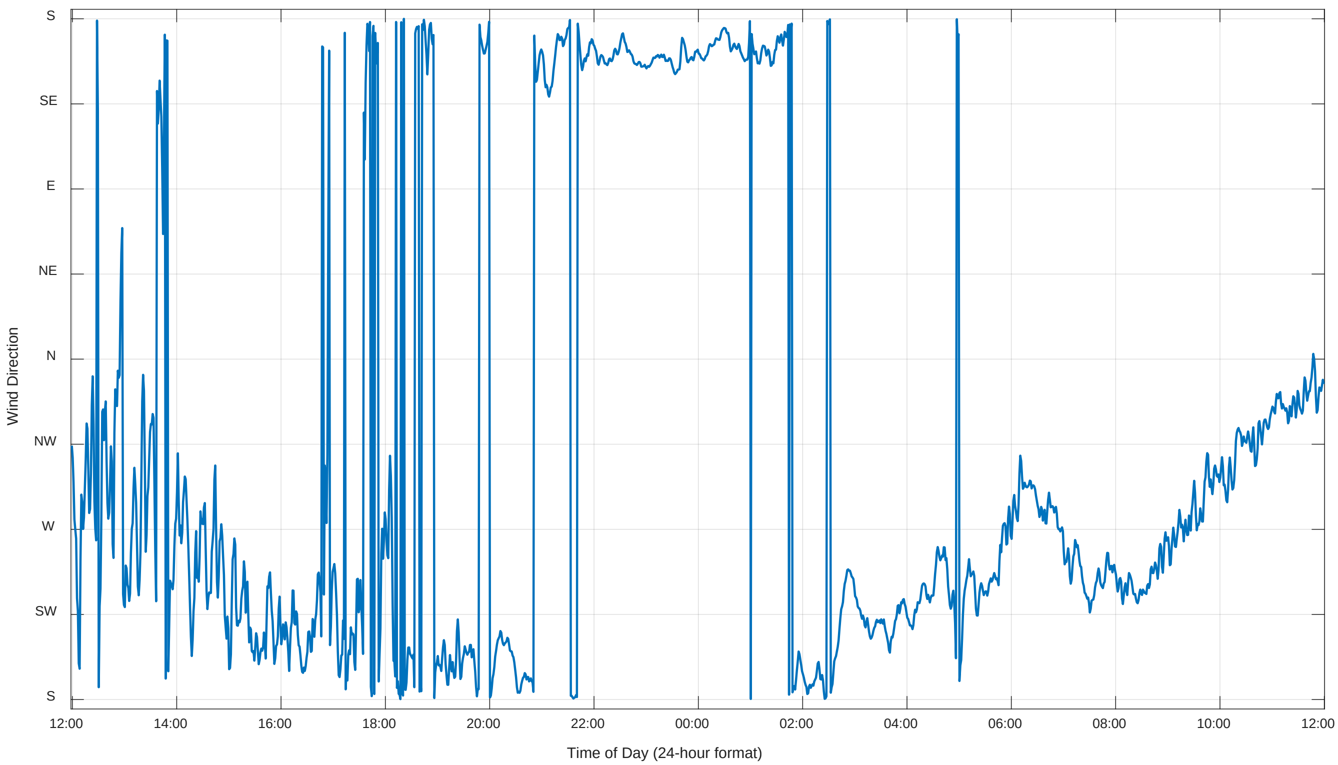
Monitored Temperature (May 12 – 13, 2021)



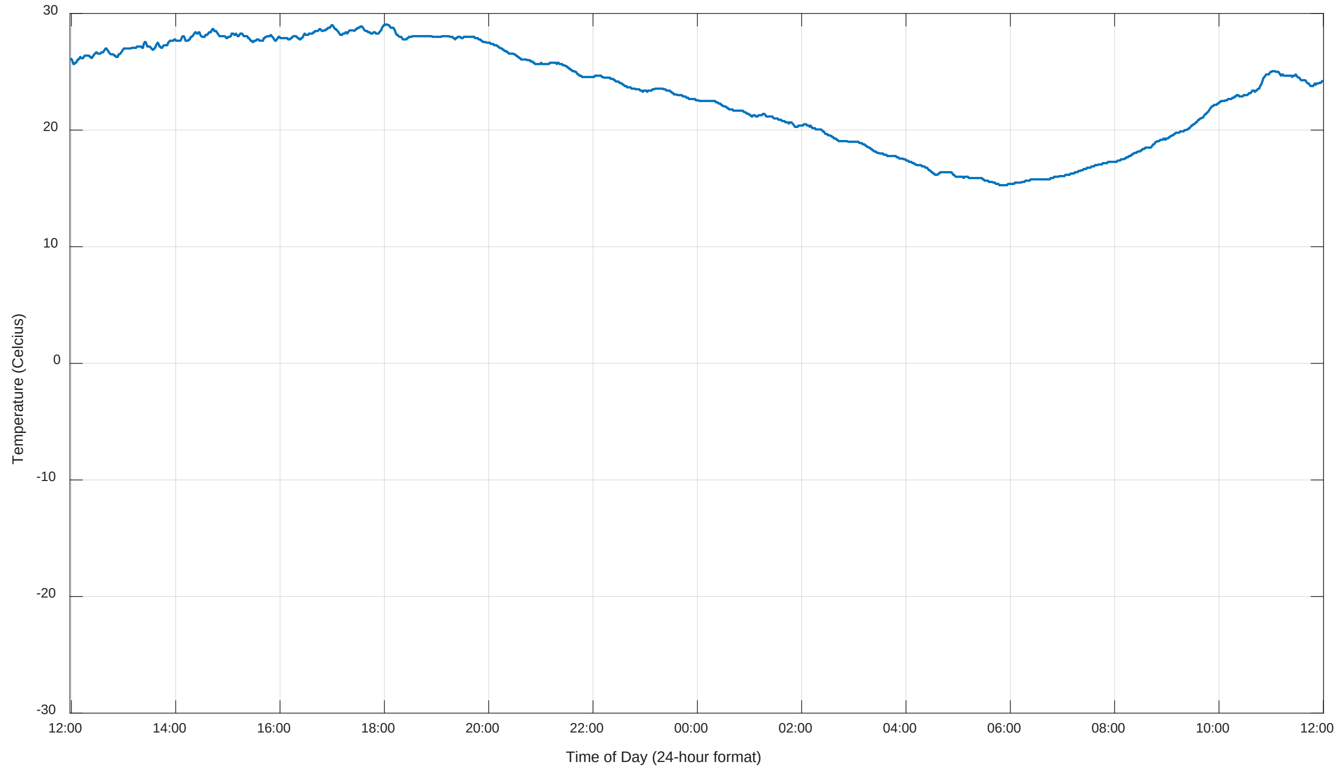
Monitored Humidity (May 12 – 13, 2021)



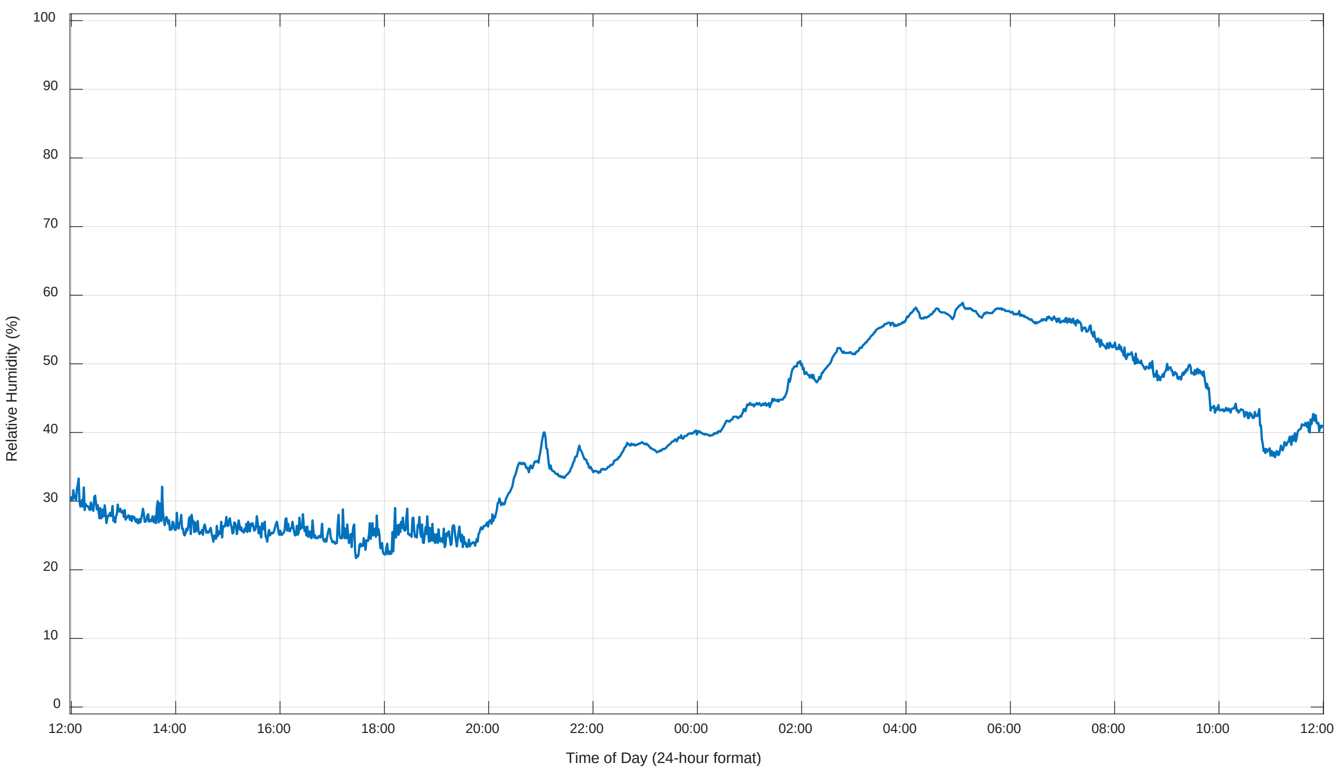
Monitored Wind Speed (June 2 – 3, 2021)



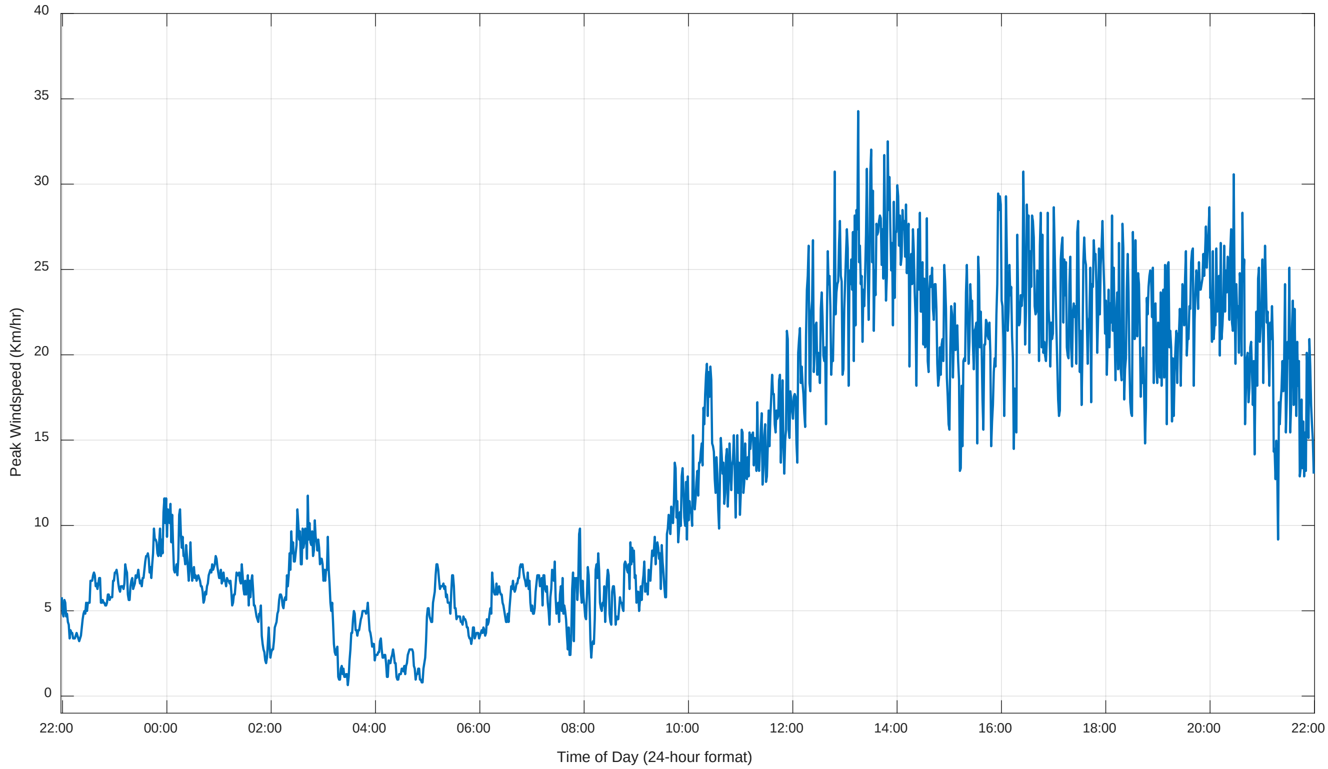
Monitored Wind Direction (June 2 – 3, 2021)



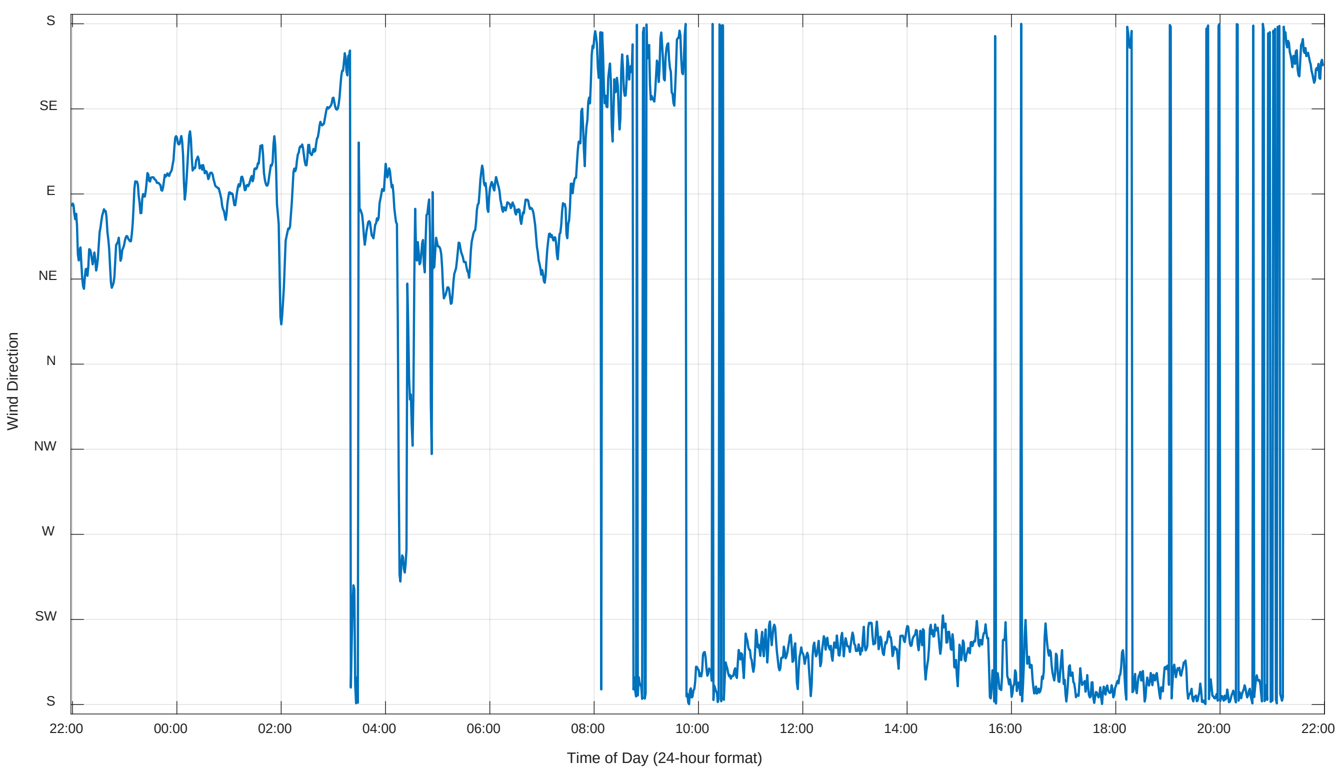
Monitored Temperature (June 2 – 3, 2021)



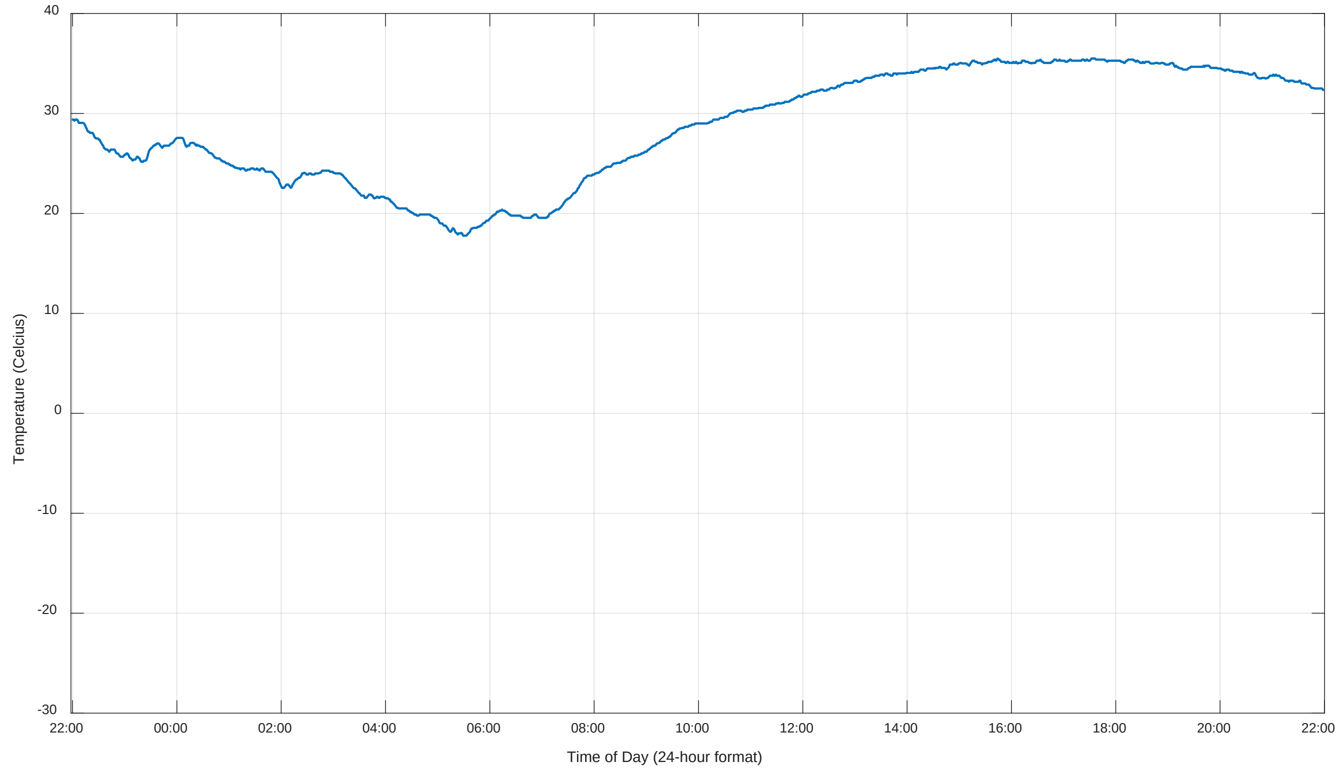
Monitored Humidity (June 2 – 3, 2021)



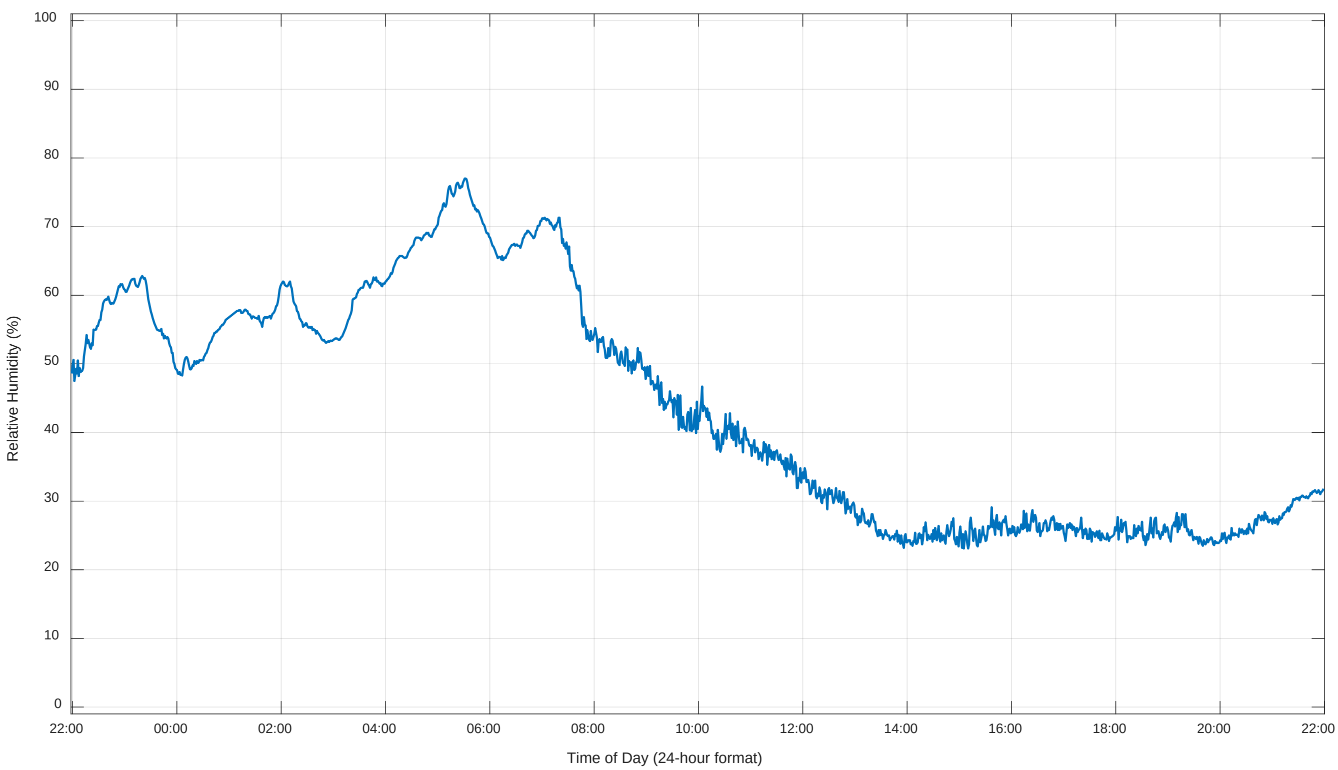
Monitored Wind Speed (June 28 – 29, 2021)



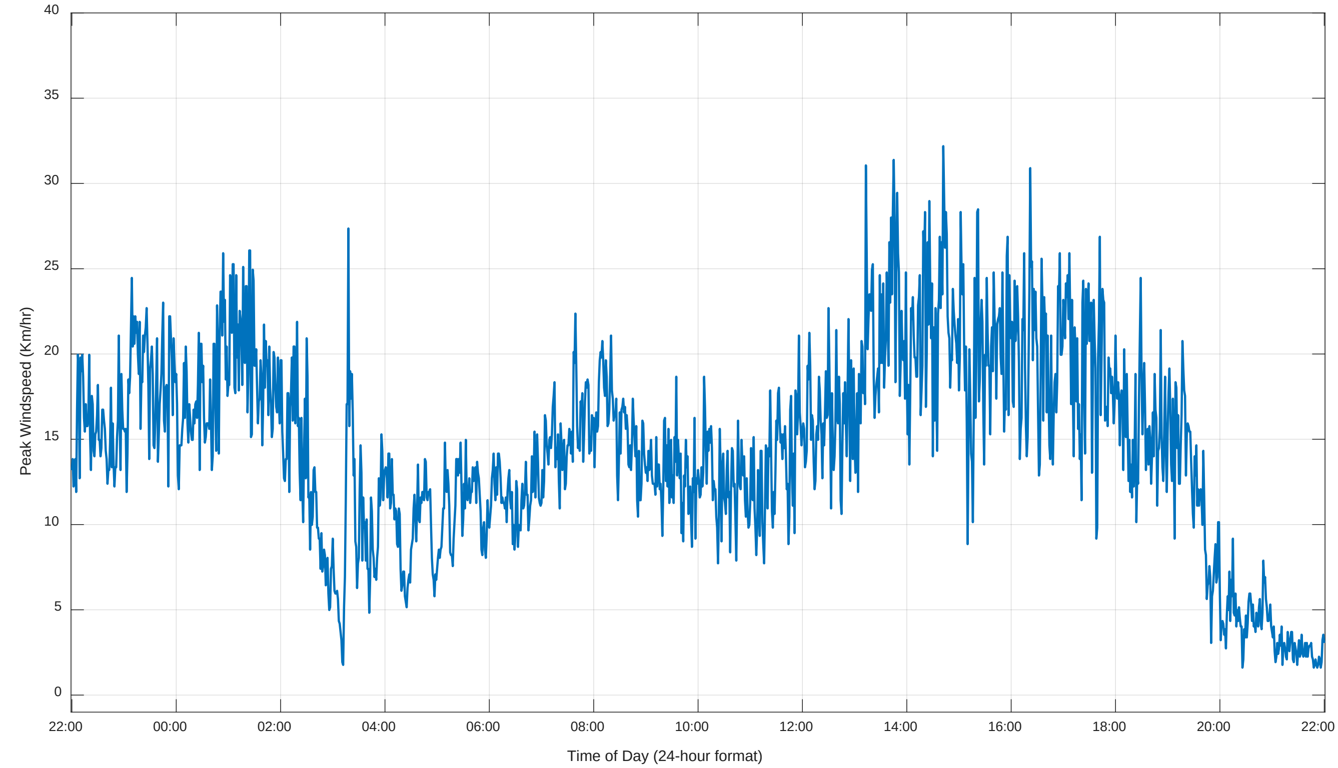
Monitored Wind Direction (June 28 – 29, 2021)



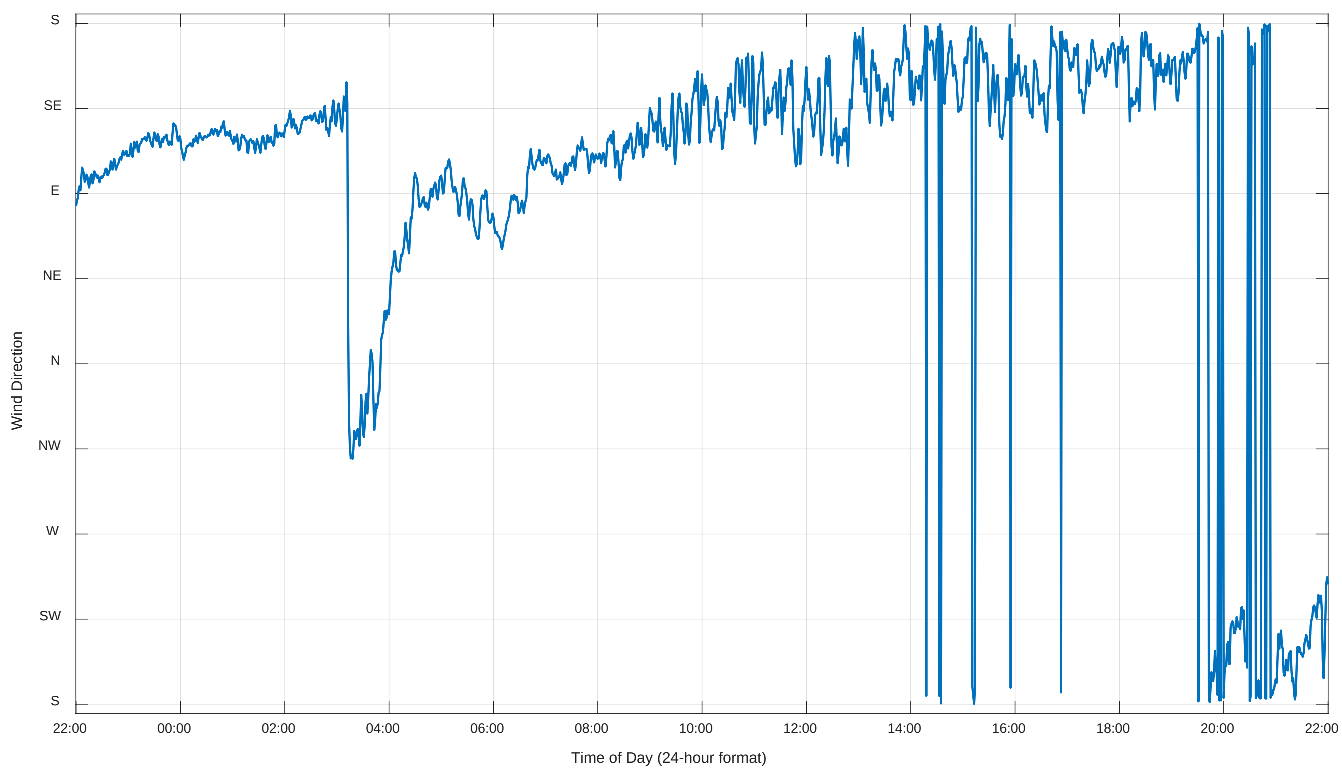
Monitored Temperature (June 28 – 29, 2021)



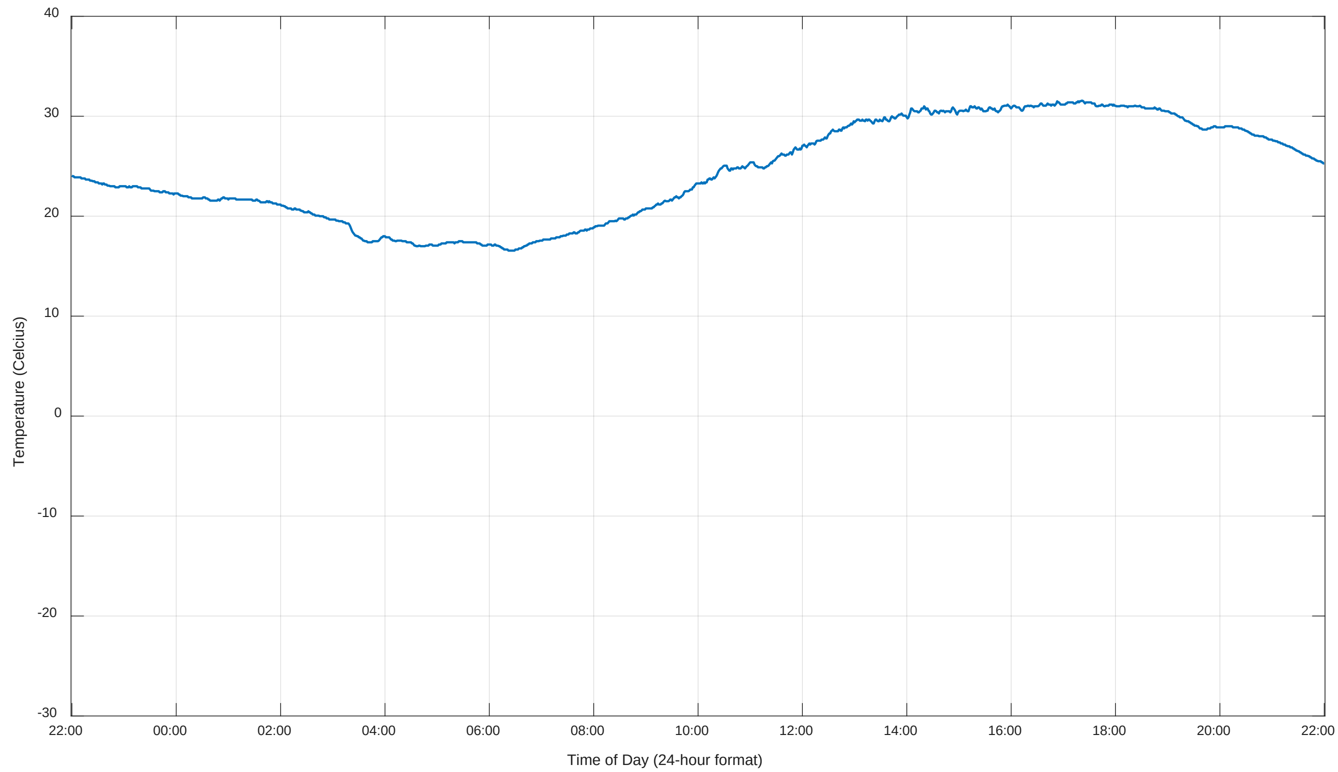
Monitored Humidity (June 28 – 29, 2021)



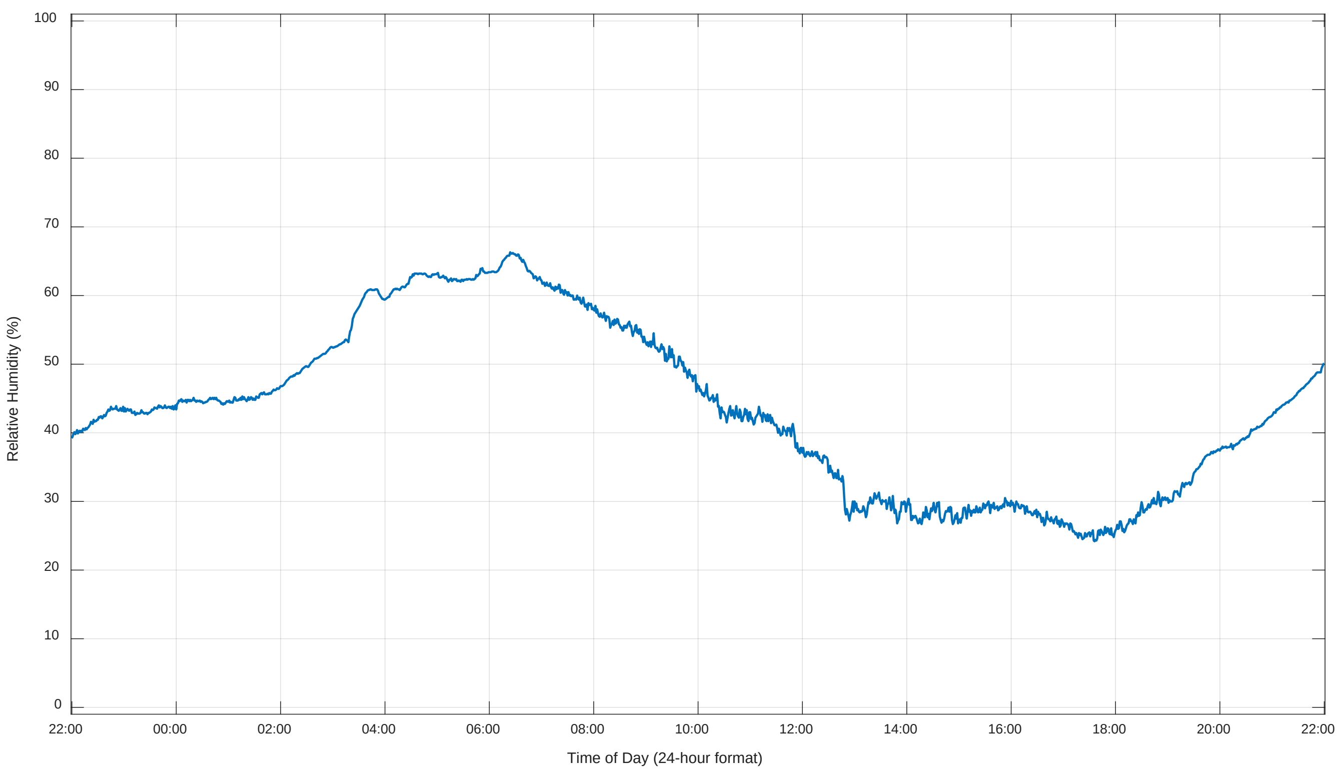
Monitored Wind Speed (July 13 – 14, 2021)



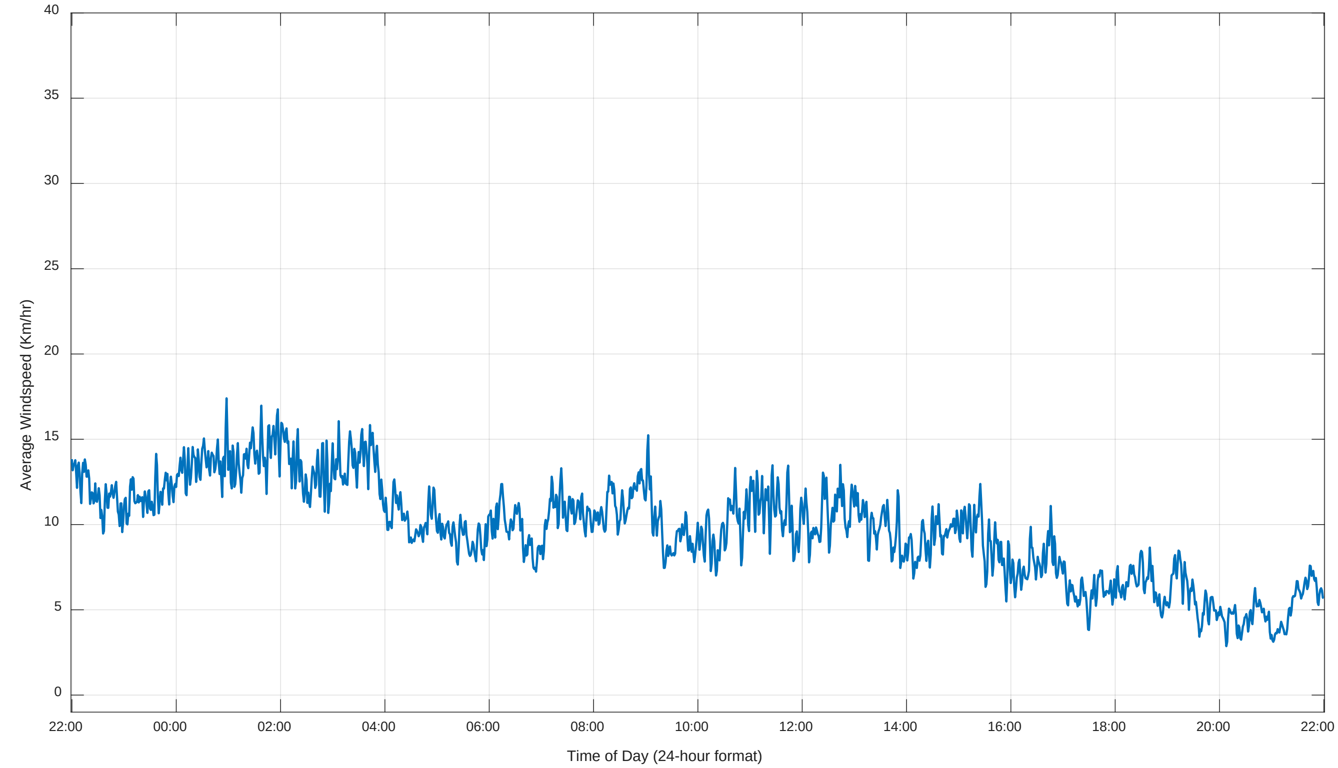
Monitored Wind Direction (July 13 – 14, 2021)



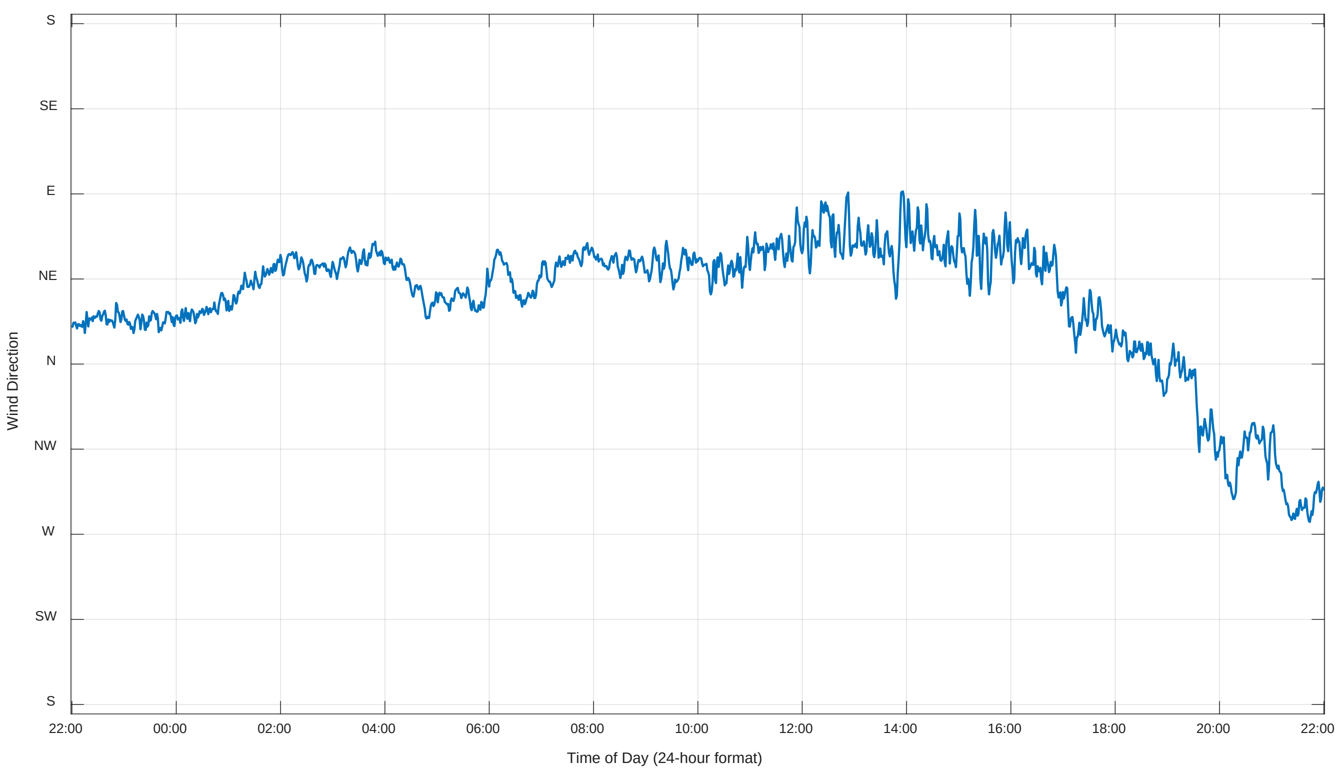
Monitored Temperature (July 13 – 14, 2021)



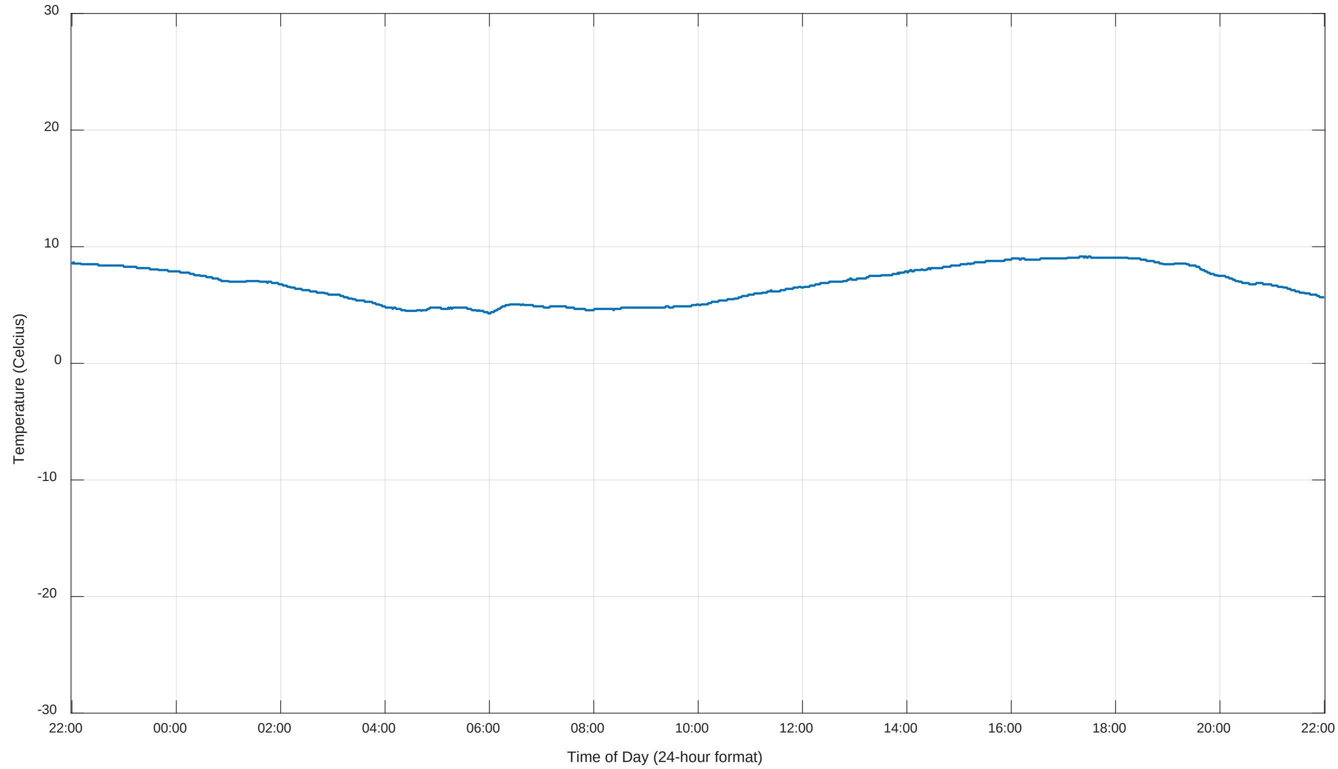
Monitored Humidity (July 13 – 14, 2021)



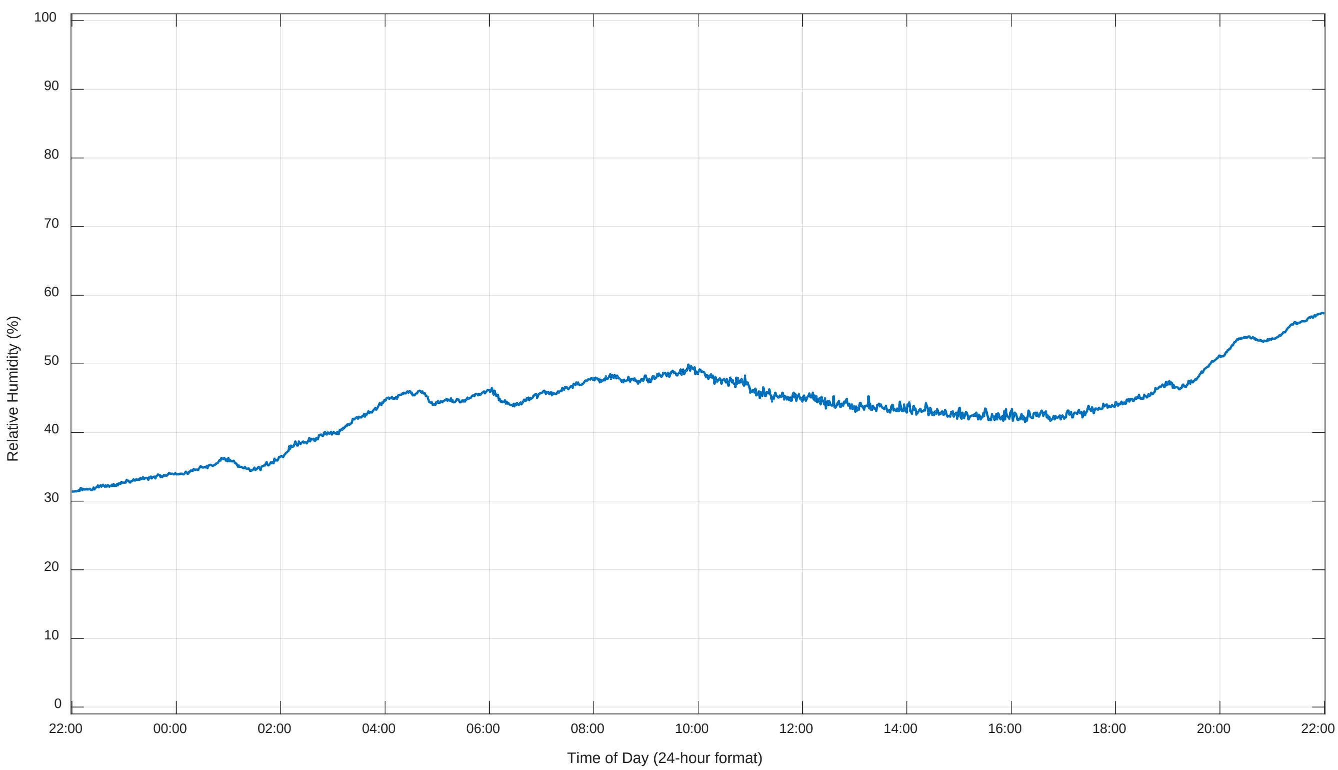
Monitored Wind Speed (October 4 – 5, 2021)



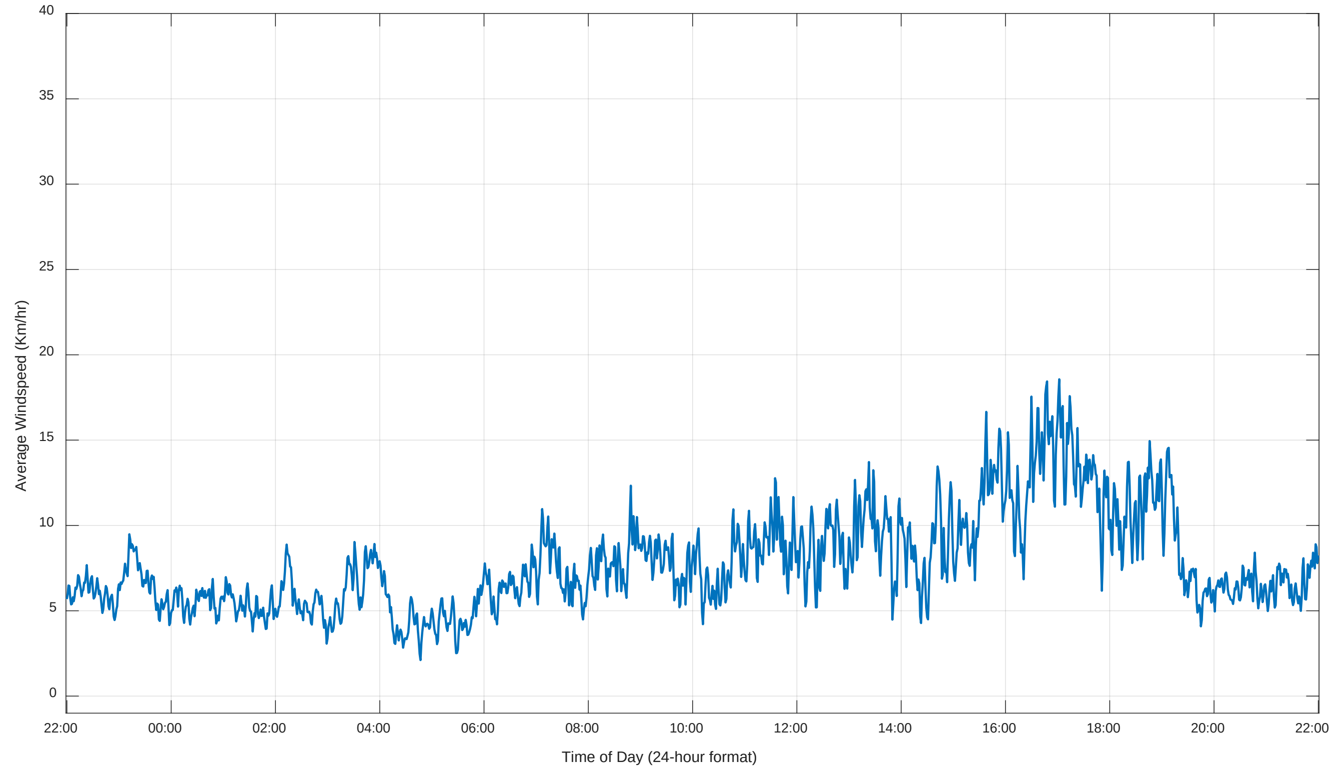
Monitored Wind Direction (October 4 – 5, 2021)



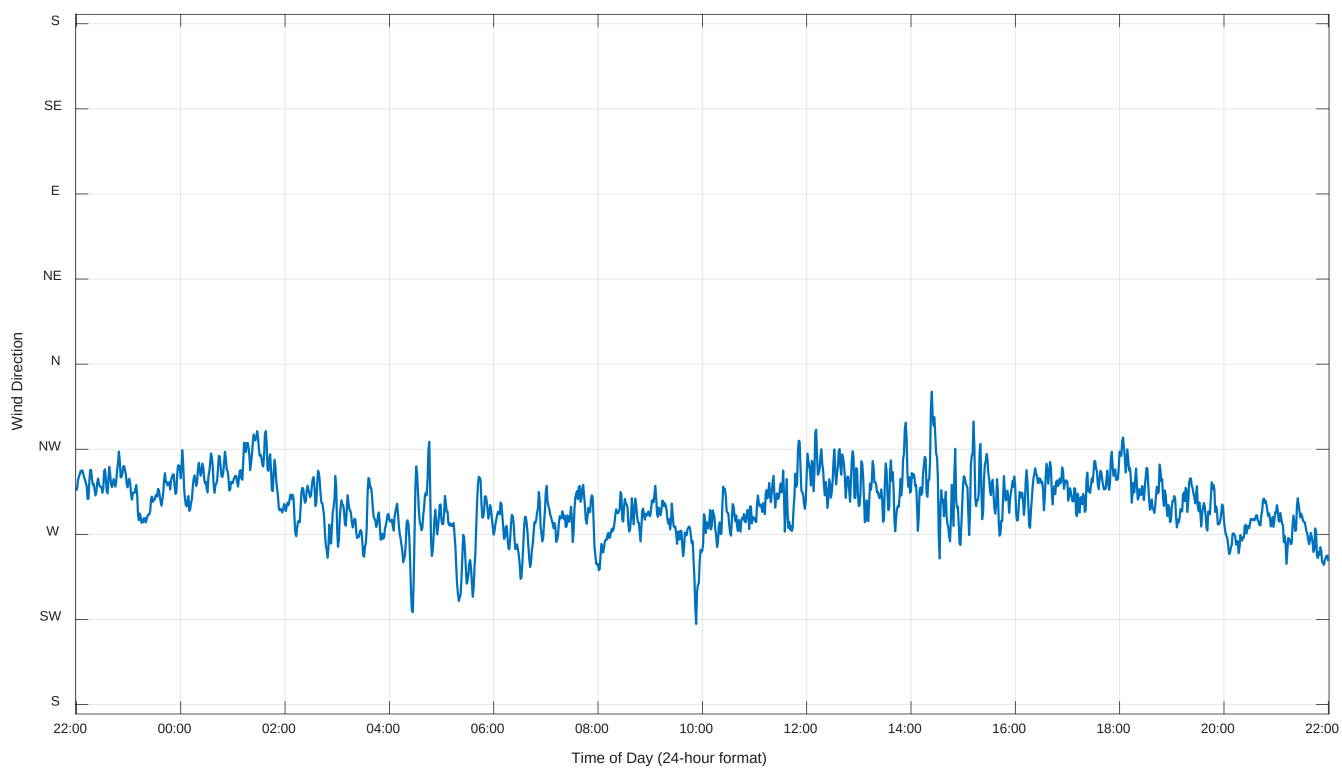
Monitored Temperature (October 4 – 5, 2021)



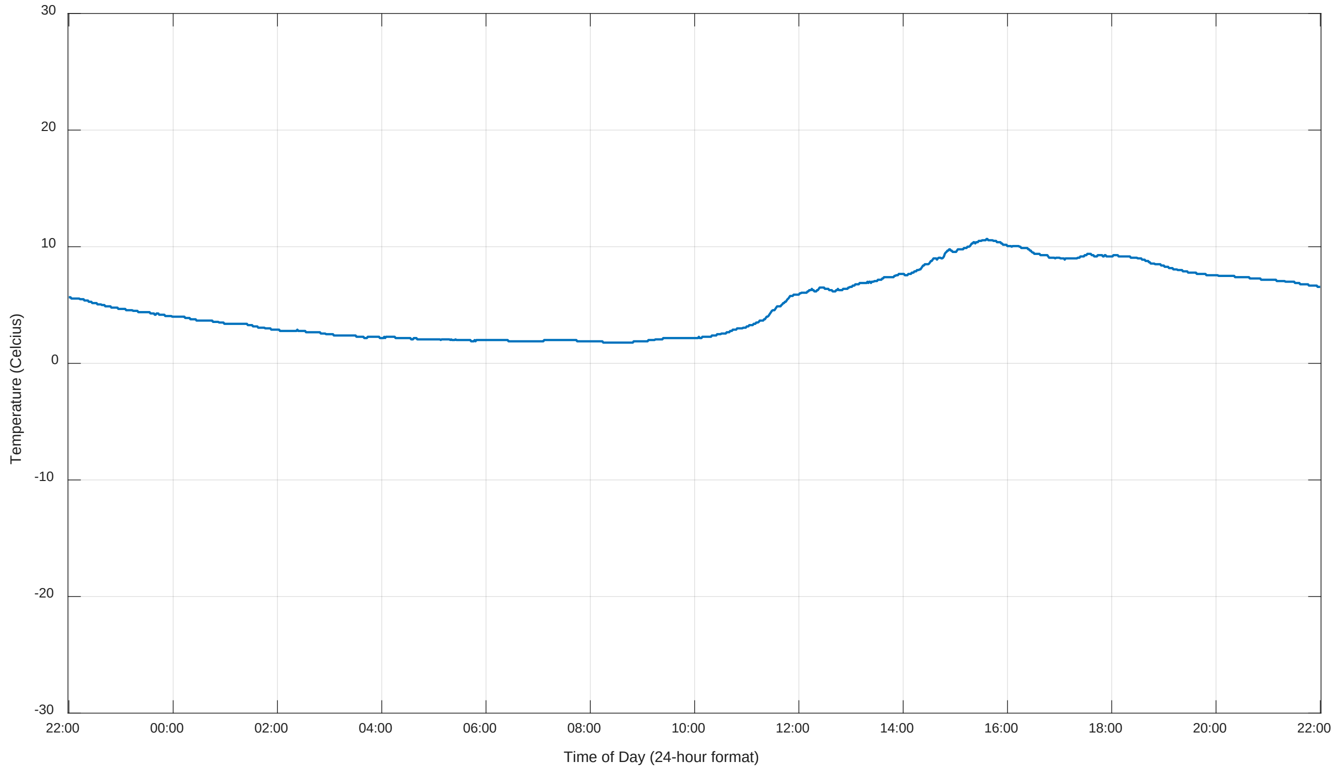
Monitored Humidity (October 4 – 5, 2021)



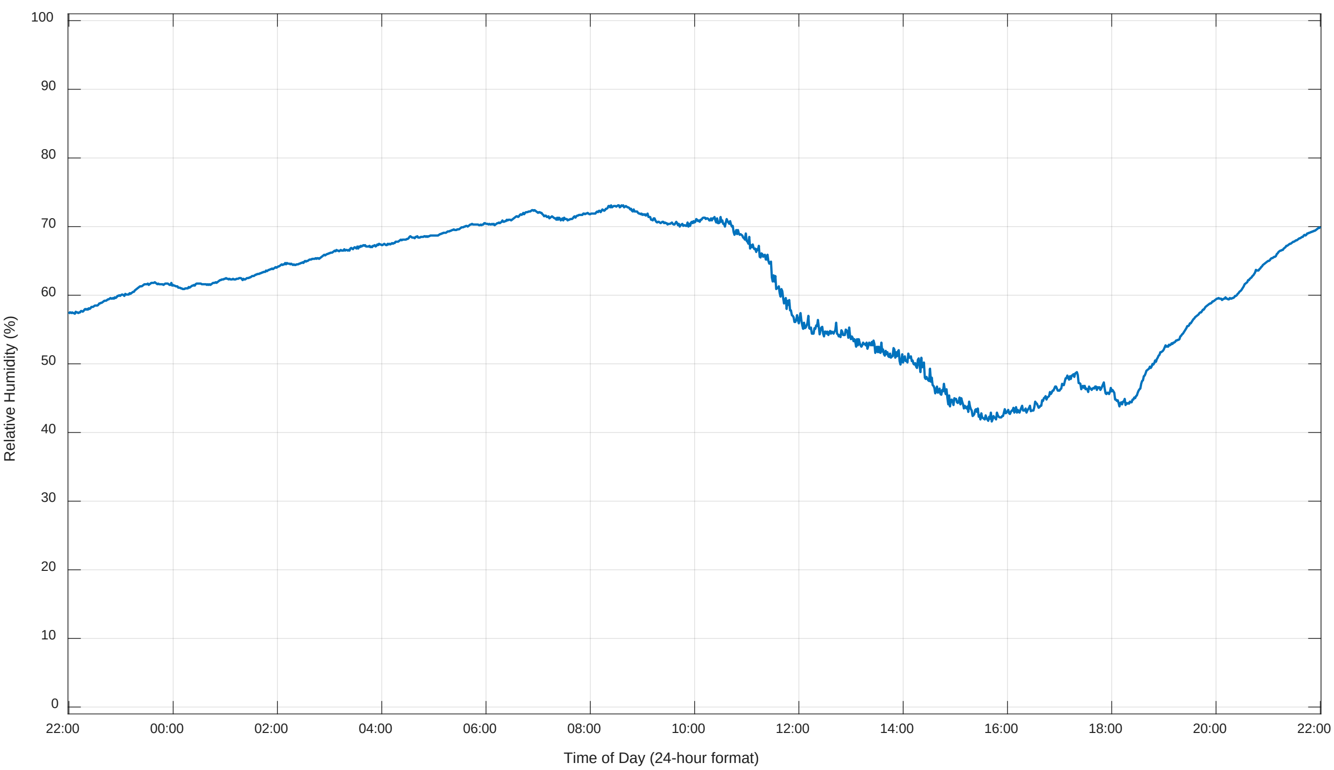
Monitored Wind Speed (October 5 – 6, 2021)



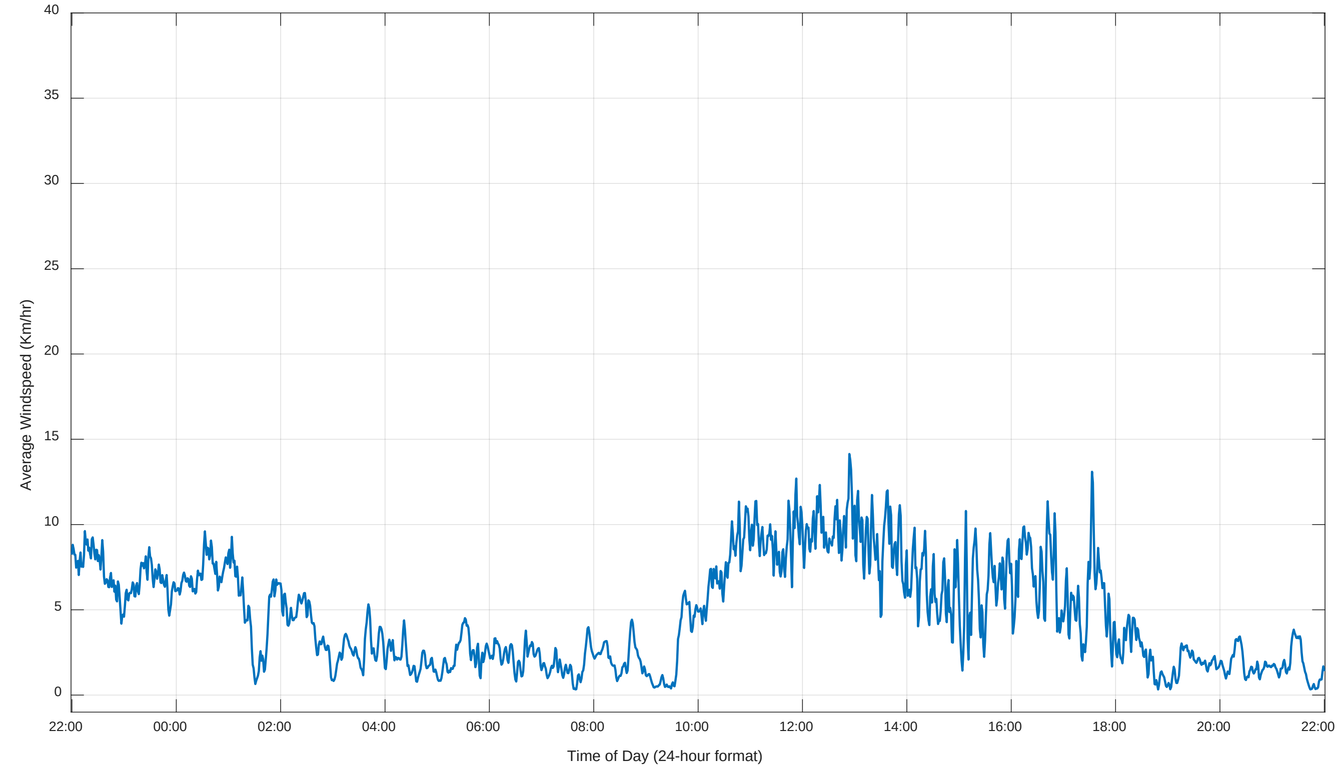
Monitored Wind Direction (October 5 – 6, 2021)



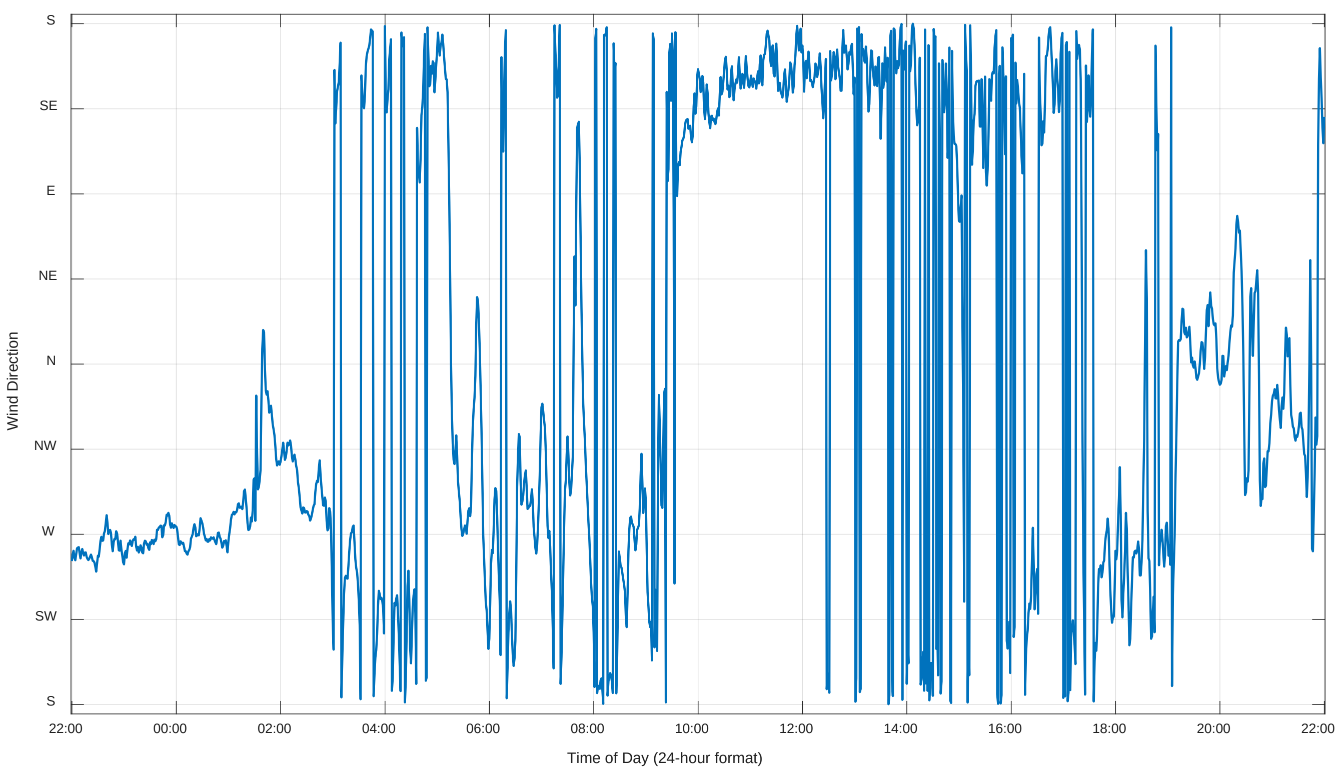
Monitored Temperature (October 5 – 6, 2021)



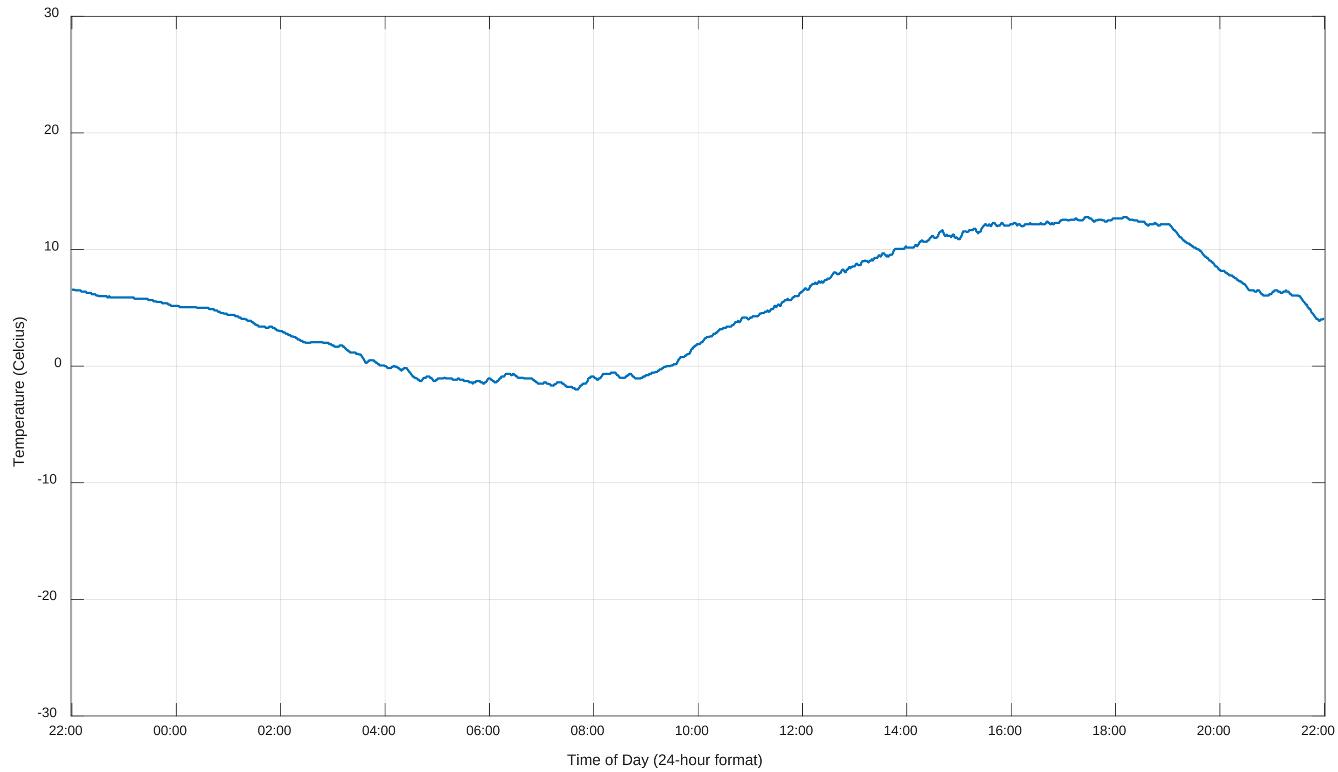
Monitored Humidity (October 5 – 6, 2021)



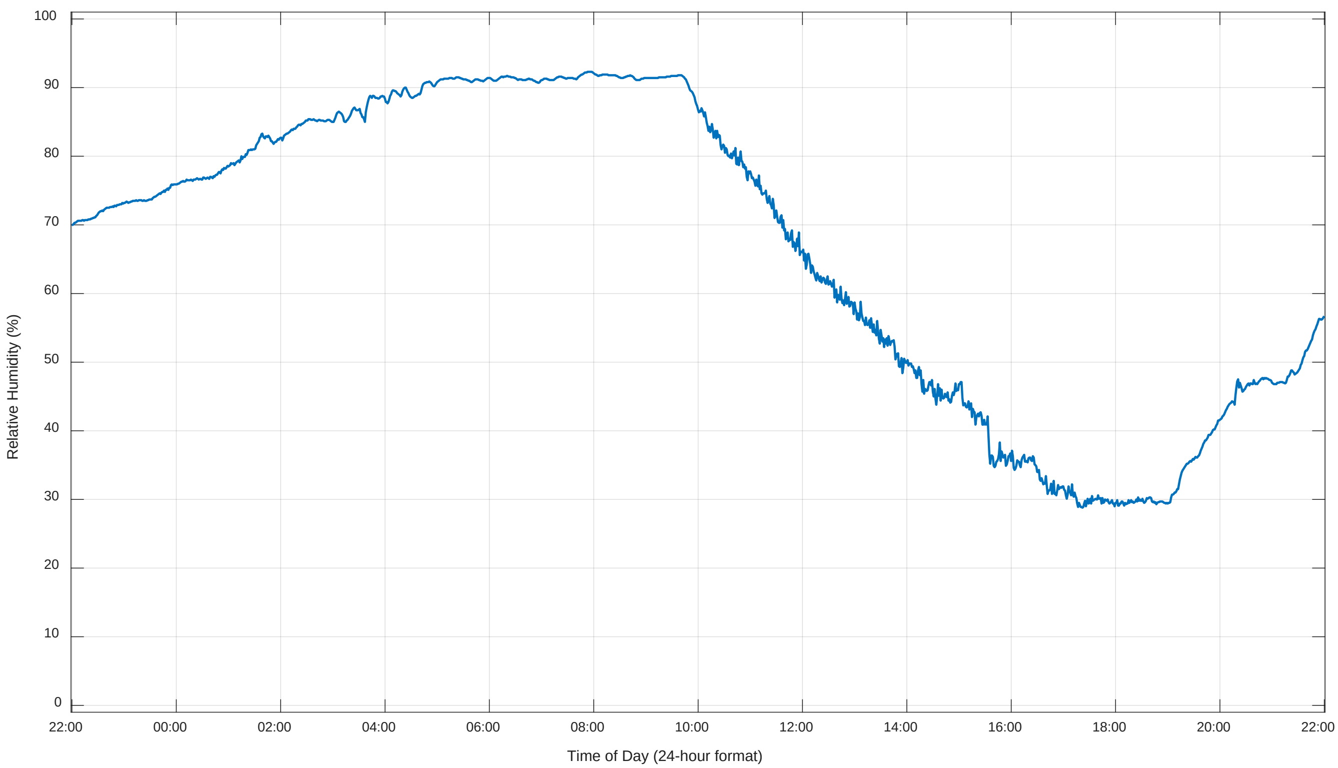
Monitored Wind Speed (October 6 – 7, 2021)



Monitored Wind Direction (October 6 – 7, 2021)



Monitored Temperature (October 6 – 7, 2021)



Monitored Humidity (October 6 – 7, 2021)