aci Acoustical Consultants Inc.
5031-210 Street
Edmonton, Alberta, Canada T6M 0A8
Phone: (780) 414-6373
www.aciacoustical.com

Environmental Noise Monitoring

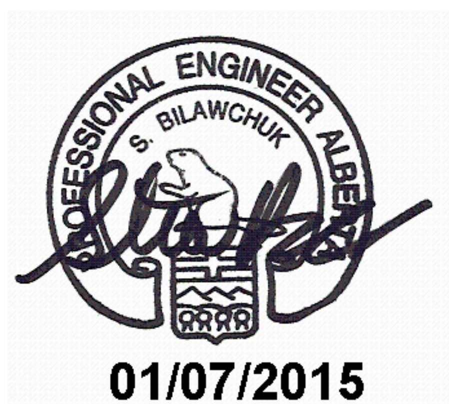
For

Southeast Stoney Trail in Calgary, Alberta

Prepared for:

Alberta Transportation

Prepared by:
S. Bilawchuk, M.Sc., P.Eng.
aci Acoustical Consultants Inc.
Edmonton, Alberta
APEGA Permit to Practice #P7735



aci Project #: 14-036
January 07, 2015

Executive Summary

aci Acoustical Consultants Inc., of Edmonton AB, was retained by Alberta Transportation to conduct an environmental noise assessment for the Southeast section of Stoney Trail (SEST) in Calgary, Alberta. The purpose of the work was to conduct 24-hour environmental noise monitorings at various locations adjacent to the roadway and to generate a computer noise model with current and future traffic conditions and compare the results to the Alberta Transportation noise guidelines. The information contained within this report details the results of the 24-hour noise monitorings conducted at 18 locations along SEST. The data was also used as a calibration tool for a computer noise model of the study area. The site work was conducted for aci from June to August, 2014 by S. Bilawchuk, M.Sc., P.Eng. and Patrick Froment, B.Ed., B.Sc., CET.

The noise monitoring results indicated that the dominant noise sources were associated with vehicle traffic on SEST and Deerfoot Trail. The monitored noise levels ranged from 50.9 - 76.1 dBA $L_{eq}24$. The 1/3 octave band frequency data show the typical trend of low frequency noise (near 63 – 80 Hz) resulting from engines and exhaust, as well as mid-high frequency noise (near 1,000 Hz) resulting from tire noise.

Table of Contents

1.0 Introduction 1
2.0 Location Description 1
2.1. Roadways 1
2.2. Adjacent Development 2
2.3. Topography 7
3.0 Measurement Methods 8
4.0 Results and Discussion 14
4.1. Noise Monitorings 14
5.0 Conclusion 21
6.0 References 22
Appendix I. MEASUREMENT EQUIPMENT USED 52
Appendix II. THE ASSESSMENT OF ENVIRONMENTAL NOISE (GENERAL) 70
Appendix III. SOUND LEVELS OF FAMILIAR NOISE SOURCES 82
Appendix IV. WEATHER DATA 84

List of Tables

Table 1. Noise Monitoring Results 14

List of Figures

Figure 1a. Northern Study Area ... 23
Figure 1b. Southern Study Area ... 24
Figure 2. Noise Monitor at Location 1 ... 25
Figure 3. Noise Monitor at Location 2 ... 25
Figure 4. Noise Monitor at Location 3 ... 26
Figure 5. Noise Monitor at Location 4 ... 26
Figure 6. Noise Monitor at Location 5 ... 27
Figure 7. Noise Monitor at Location 6 ... 27
Figure 8. Noise Monitor at Location 7 ... 28
Figure 9. Noise Monitor at Location 8 ... 28
Figure 10. Noise Monitor at Location 9 ... 29
Figure 11. Noise Monitor at Location 10 ... 29
Figure 12. Noise Monitor at Location 11 ... 30
Figure 13. Noise Monitor at Location 12 ... 30
Figure 14. Noise Monitor at Location 13 ... 31
Figure 15. Noise Monitor at Location 14 ... 31
Figure 16. Noise Monitor at Location 15 ... 32
Figure 17. Noise Monitor at Location 16 ... 32
Figure 18. Noise Monitor at Location 17 ... 33
Figure 19. Noise Monitor at Location 18 ... 33
Figure 20. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 1 ... 34
Figure 21. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 1 ... 34
Figure 22. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 2 ... 35
Figure 23. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 2 ... 35
Figure 24. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 3 ... 36
Figure 25. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 3 ... 36
Figure 26. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 4 ... 37
Figure 27. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 4 ... 37
Figure 28. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 5 ... 38
Figure 29. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 5 ... 38

Figure 30. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 6 39
Figure 31. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 6............................ 39
Figure 32. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 7 40
Figure 33. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 7............................ 40
Figure 34. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 8 41
Figure 35. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 8............................ 41
Figure 36. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 9 42
Figure 37. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 9............................ 42
Figure 38. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 10 43
Figure 39. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 10.......................... 43
Figure 40. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 11 44
Figure 41. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 11.......................... 44
Figure 42. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 12 45
Figure 43. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 12.......................... 45
Figure 44. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 13 46
Figure 45. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 13.......................... 46
Figure 46. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 14 47
Figure 47. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 14.......................... 47
Figure 48. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 15 48
Figure 49. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 15.......................... 48
Figure 50. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 16 49
Figure 51. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 16.......................... 49
Figure 52. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 17 50
Figure 53. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 17.......................... 50
Figure 54. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 18 51
Figure 55. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 18.......................... 51

1.0 Introduction

aci Acoustical Consultants Inc., of Edmonton AB, was retained by Alberta Transportation to conduct an environmental noise assessment for the Southeast section of Stoney Trail (SEST) in Calgary, Alberta. The purpose of the work was to conduct 24-hour environmental noise monitorings at various locations adjacent to the roadway and to generate a computer noise model with current and future traffic conditions and compare the results to the Alberta Transportation noise guidelines. The information contained within this report details the results of the 24-hour noise monitorings conducted at 18 locations along SEST. The data was also used as a calibration tool for a computer noise model of the study area. The site work was conducted for aci from June to August, 2014 by S. Bilawchuk, M.Sc., P.Eng. and Patrick Froment, B.Ed., B.Sc., CET.

2.0 Location Description

2.1. Roadways

The study area for SEST starts just north of the interchange at 17 Avenue SE and spans to the south and then west until the interchange at Macleod Trail SE, as indicated in Figures 1a & 1b. Throughout the entire span (approximately 25 km), SEST is a twinned road with mostly 3-lanes in each direction. The posted speed limit throughout is 100 km/hr. The study area also encompasses Deerfoot Trail from McKenzie Town Blvd SE down to Cranston Avenue SE / Seton Blvd SE (approximately 4 km). Currently, there are grade separated interchanges or fly-overs at the following locations:

- 17 Avenue SE
- Peigan Trail SE
- CN Rail Line South of Peigan Trail SE (flyover)
- 61 Avenue SE (flyover)
- Glenmore Trail SE
- CP Rail Line North of 114 Avenue SE (flyover)
- 114 Avenue SE
- Interchange at Highway 22X
- 52 Street SE
- Deerfoot Trail
- McKenzie Lake Blvd SE / Cranston Blvd SE
- Sun Valley Blvd SE / Chaparrel Blvd SE
- Macleod Trail SE
- McKenzie Lake Blvd SE / McKenzie Towne Blvd SE
- Cranston Avenue SE / Seton Blvd SE

There is also a future interchange proposed at 130 Avenue SE. The earth work has been largely completed, however, the timeline for completion of the interchange has not been determined. As such, it has not been included in the noise study.

2.2. Adjacent Development

Starting from the northeast portion of the study area, there is single family and multi-family residential development backing directly onto the Transportation and Utility Corridor (TUC) to the northwest of the interchange between SEST and 17 Avenue SE. Most of the residents have direct line-of-sight to SEST and the interchange. There is commercial development and open field to the northeast, southeast, and southwest of the interchange.

In between 17 Avenue SE and Peigan Trail SE, there is open field and commercial/industrial development to the east and west of SEST, with acreage style residential lots further to the east (the closest resident is approximately 650 m to the east of SEST).

In between Peigan Trail SE and Glenmore Trail SE is open field and commercial/industrial development on both sides of SEST for at least 1,000 m to the east and west. There are two residential receptors to the east of SEST in this region, with the closest being approximately 530 m to the east of SEST.

In between Glenmore Trail SE and 114 Avenue SE is open field and commercial/industrial development on both sides of SEST for at least 1,000 m to the east and west There are a few acreage style residential lots to the southeast of the interchange between Glenmore Trail SE and SEST (east of 84 Street SE) with the closest houses approximately 600 m from SEST. There is also a residential subdivision located to the northeast of the interchange between 114 Avenue SE and SEST. The closest houses are approximately 600 m east of SEST.

In between 114 Avenue SE and 130 Avenue SE is largely open field and marshland with sparse commercial/industrial development. There are some acreage style residential lots to the east, with the closest being approximately 470 m from SEST.

In between 130 Avenue SE and Highway 22X there is single family residential development to the west of SEST. Some of the residential structures have line-of-sight to SEST over top of their backyard fences, however, there is also an earth berm (approximately 3 m tall) that spans north-south in between SEST and the residential property lines which blocks the line-of-sight in the backyard space for most residents. Further to the south and west of SEST is an open natural reserved area with no development. To the east of SEST are acreage style residential lots with the closest house approximately 250 m east of SEST. These houses have direct line-of-sight to SEST.

In between Highway 22X and 52 Street SE is single family residential development on the north and south of SEST. There is line-of-sight to SEST over top of the fences. To the north of SEST (Copperfield neighbourhood), the fence consists largely of 2.74 m (9 ft) plastic solid screen fencing with 1.83 m (6 ft) plastic solid screen fencing for the houses backing onto the interchange between 52 Street SE and SEST. For the residents immediately northeast of the interchange, the elevations are such that they have direct line-of-sight to the interchange, with no acoustical screening provided by the rear fence. To the south of SEST (Mahogany neighbourhood), the fence consists of a 2.44 m (8 ft) solid screen wood fence throughout.

In between 52 Street SE and Deerfoot Trail is single family residential development to the north (Elgin and Inverness neighbourhoods) and south (Auburn Bay neighbourhood) of SEST. There is also a multi-family area to the northeast of the interchange between Deerfoot Trail and SEST. Immediately northwest of the interchange between 52 Street SE and SEST is green space with residential development further to the northwest. Some of the residential lots that back onto the green space have chainlink fences. Moving further west (still north of SEST), the residential lots have 1.83 m wooden fences at the south property line until near the interchange at Deerfoot Trail. There is also an earth berm (approximately 5m above residential property grade) that starts approximately 600 m west of 52 Street SE and spans approximately 500 m east of Deerfoot Trail. The berm blocks the line-of-sight between the residential lots and SEST. As the Elgin neighbourhood wraps around to the north, along Deerfoot Trail, the residential lots have either 1.83 m wooden fences or chainlink fences or no fences at all. However, as part of the interchange construction, an earth berm (approximately 7 m tall) has been built in between the residential lots and the westbound -to- northbound ramp. This blocks the line-of-sight to SEST, Deerfoot Trail, and the interchange for most of the residences.

Immediately southwest of the interchange between 52 Street SE and SEST is a dog park with residential development to the south. The closest residential development has a 1.83 m wood fence. There is line-of-sight to SEST and 52 Street SE over top of the fence. There are residential lots along Auburn Glen Drive SE with chainlink fences and direct line-of-sight to SEST. Moving further west, the residential lots backing onto SEST have 2.44 m wooden fences (with line-of-sight to SEST over top of the fence) until the green space indentation area approximately 950 m east of Deerfoot Trail. The residential lots in this area have chainlink fences with line-of-sight to SEST. Moving further west, there is a 2.44 m wooden fence until Autumn Crescent SE where the fence height reduces to 1.83 m. The residents have line-of-sight to SEST, Deerfoot Trail, and the interchange over top of the fences.

In between Deerfoot Trail and McKenzie Lake Blvd SE, to the north of SEST (McKenzie Lake neighbourhood), the area backing onto SEST is comprised of single family residential development. Starting from the area northwest of the interchange between Deerfoot Trail and SEST, the residential lots have 1.83 m wooden fences with line-of-sight to SEST, the interchange between Deerfoot Trail and SEST, and the interchange between McKenzie Lake Blvd SE and SEST (over top of the fence). There is no direct line-of-sight to Deerfoot Trail in this area because of the elevation changes associated with the ramps for the interchange between Deerfoot Trail and SEST.

In between Deerfoot Trail and Cranston Blvd SE, to the south of SEST (Cranston neighbourhood), the area backing onto SEST is comprised of single family residential development in the eastern portion and multi-family residential development in the western portion. In the northeast corner, there are lots with 1.83 m wooden fences, however, many of the houses along Crammond Close SE have no rear fences. Starting with the houses on Cranfield Garden SE, there is a 1.83 m wood fence that spans to the west all the way until Cranston Blvd SE. In all areas, there is line-of-sight to SEST over top of the fences. Also, as part of the construction of the interchange between Deerfoot Trail and SEST, an earth berm (approximately 2 - 4 m tall, depending on the location) has been built spanning from the northeast corner of the Cranston neighbourhood, along the northeast and east sides all the way down to approximately 650 m north of Cranston Avenue SE.

In between McKenzie Lake Blvd SE and Sun Valley Blvd SE, to the north of SEST (Mountain Park neighbourhood), is single family residential development spanning approximately 260 m west of McKenzie Lake Blvd SE. There is a 1.83 m wood fence along the south property line until the southwest corner where the fence changes to chainlink. There is line-of-sight to SEST and McKenzie Lake Blvd SE over top of the wooden fence and direct line-of-sight to SEST through the chainlink fence.

The houses in this area are elevated above SEST by as much as 37 m as SEST drops down in to the Bow River Valley. Further west is recreational area within the Bow River Valley (golf course and public park) with no further residential development.

In between Cranston Blvd SE and Chaparral Blvd SE, to the south of SEST (Cranston neighbourhood), is single family residential development spanning approximately 550 m west of Cranston Blvd SE. There is a 1.52 m (5 ft) wooden fence along the rear property line. As such, there is line-of-sight to SEST and Cranston Blvd over top of the fence. Further west is green space within the Bow River Valley on the east and west sides of the Bow River. Further west is single family residential development (Chaparral neighbourhood) within the Bow River Valley. The north fences are chainlink and the residential lots are "walkout" style. There is direct line-of-sight to SEST for these lots. Further west, up at the top of the Bow River Valley, is single family residential development. The northern most houses have a 1.83 m masonry wall at the north property line that wraps around along Chaparral Blvd SE. These residents have line-of-sight to SEST and Chaparral Blvd SE over top of the wall. There is a cul-de-sac to the east of Chaparral Ridge Circle SE in which the houses have chainlink fences at the rear property lines and direct line-of-sight to SEST.

In between Sun Valley Blvd SE and Macleod Trail SE, to the north of SEST, is single family residential development (Sundance neighbourhood). The majority of the residential lots have chainlink fences along the south property line, however, there is an earth berm (approximately 4 m tall) that starts from the interchange between Sun Valley Blvd SE and SEST and spans to the west until approximately 600 m east of Macleod Trail SE. Further west, and wrapping around to the north along Macleod Trail SE, there are typically no fences and there is no earth berm to the south and west of the residential lots. Some individual lots that "side" onto Macleod Trail SE have 1.83 m wood fences for the backyard portion of the lot. The residences in this area have line-of-sight to Macleod Trail either directly or over top of their fences. As Macleod Trail SE continues further north, there is commercial development on the east and west sides.

In between Chaparral Blvd SE and Macleod Trail SE, to the south of SEST, is single family residential development (Chaparral neighbourhood). There are 1.83 m wood fences along the north property lines for all areas except two green space indentations at which there are only chainlink fences. These areas include along Chaparral Common SE and for two houses in between Chapalina Way SE and Chaparral

Circle SE. All of the residential lots have line-of-sight to SEST over top of the fences. Starting at the northwest portion of the residential development, there is a 2.44 m masonry wall at the rear property lines, along Macleod Trail SE that extends down for approximately 1,000 m south of SEST. To the west of Macleod Trail SE, south of SEST, is green space with residential development more than 1,000 m further to the west

In between SEST and McKenzie Towne Blvd SE, on the east side of Deerfoot Trail, is single family residential development (Inverness neighbourhood). Continuing on from the newly constructed earth berm to the northeast of the interchange at SEST and Deerfoot Trail, there is an existing earth berm in between Deerfoot Trail and the houses to the east, extending north all the way to McKenzie Towne Blvd SE (following along the off ramp). In addition, starting at the southwest portion of Inverness Drive SE, there is a 1.83 m solid fence on top of the berm that extends all the way north to McKenzie Towne Blvd SE. As such, the houses to the east of Deerfoot Trail do not have line-of-sight to Deerfoot Trail, McKenzie Towne Blvd SE, or SEST.

In between SEST and McKenzie Lake Blvd SE, on the west side of Deerfoot Trail, is single family residential development (McKenzie Lake neighbourhood). There is an existing earth berm (approximately 2 - 2.5 m tall, depending on the location) that extends the entire length of this section of Deerfoot Trail with a continuous 5 m tall concrete noise barrier on top, separating Deerfoot Trail from the houses. As such, most of the houses do not have line-of-sight to Deerfoot Trail, McKenzie Lake Blvd SE, or SEST. The northern-most houses, that back onto McKenzie Lake Blvd SE do have line-of-sight to McKenzie Lake Blvd SE over top of the noise barrier because the barrier height is reduced in this location.

In between SEST and Seton Blvd SE, on the east side of Deerfoot Trail (Auburn Bay neighbourhood), is largely single family residential development with a small section of multi-family residential development adjacent to Auburn Bay Common SE. There is an earth berm (approximately 3 - 5 m tall depending on location). As well, noise barriers have recently been modified and added. At the time of the noise monitoring, the barrier installation was still underway with some sections not yet complete. When complete, most of the residents will not have line-of-sight to Deerfoot Trail.

In between SEST and Cranston Avenue SE, on the west side of Deerfoot Trail, is entirely single family residential development (Cranston neighbourhood). In the northeast portion of the residential neighbourhood, there are lots which "front" or "side" onto the adjacent interchange. Further south, the lots have back-alley access with garages in the rear of the house. There are many lots with no backyard fence. On the east side of the back-alley, there is a chainlink fence. However, as part of the construction of the road project, an earth berm (approximately 5m tall) has been built spanning from the northeast corner of the Cranston neighbourhood, along the northeast and east sides all the way down to approximately 650 m north of Cranston Avenue SE. Where the berm ends at the south end, a 2.44 m barrier starts and continues down to approximately 350 m north of Cranston Avenue SE where another earth berm (approximately 2 m tall) starts. This final earth berm extends down to approximately 160 m north of Cranston Avenue SE and then ends. As a result, none of the houses north of this point have line-of-sight to Deerfoot Trail. South of this point, the houses all have chainlink fences and have direct line-of-sight to Cranston Avenue SE but do not have line-of-sight to Deerfoot Trail because of the topography related to the interchange.

2.3. Topography

Topographically, the land surrounding SEST from 17 Avenue SE all the way to McKenzie Lake Blvd SE is generally flat with only small hills and ditches between the roadway and the adjacent residential structures. To the west of McKenzie Lake Blvd SE is the Bow River Valley which drops down approximately 40 m. To the west of the Bow River Valley the land surrounding SEST all the way to Macleod Trail is generally flat with only small changes in elevation. As noted in Section 2.2, there are some areas with existing earth berms and some areas in which new earth berms have been built as part of the SEST project. Detailed elevation contours, in 0.5 m elevation intervals, including the newly constructed earth berms, have been included in the noise model generation for increased accuracy.

Throughout the study area, the ground is generally covered with field grasses and small patches of trees and bushes. There are some sections with marsh-lands and other small bodies of water. The vegetation adjacent to SEST provides a moderate level of sound absorption for the houses nearby.

3.0 Measurement Methods

As part of the study, a total of eighteen (18) 24-hour environmental noise monitorings were conducted throughout the study area. The noise monitoring locations, as indicated in Figures 1a & 1b were selected based on their proximity to SEST and adjacent interchanges as well as adjacent residential receptors. A detailed description of each location is provided below. The measurements were conducted collecting broadband A-weighted as well as 1/3 octave band sound levels. This enabled a detailed analysis of the noise climate. The noise monitorings were 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 significantly affect the normal traffic on the road[1]. In addition, the noise monitorings were conducted in summer time conditions (i.e. no snow cover) with dry road surfaces, no precipitation, and low wind-speeds. Each of the noise monitorings was accompanied by a 24-hour digital audio recording for more detailed post process analysis. Finally, a portable weather monitor was used within the area to obtain local weather conditions. Refer to Appendix I for a detailed description of the measurement equipment used, Appendix II for a description of the acoustical terminology, and Appendix III for a list of common noise sources. All noise measurement instrumentation was calibrated at the start of each measurement and then checked afterwards to ensure that there had been negligible calibration drift over the duration of the measurement period.

Noise Monitor 1

Noise Monitor 1 was located approximately 210 m north of the westbound lanes for 17 Avenue SE and 230 m west of the southbound lanes for SEST as shown in Figure 1a and Figure 2. This put the noise monitor approximately 5 m southwest of the rear property line for the residence at 139 Applestone Park SE. At this location, there was direct line-of-sight to SEST, 17 Avenue SE, and the interchange between the two roads. The noise monitor was started at 10:00 on Monday June 23, 2014 and ran for 24-hours until 10:00 on Tuesday June 24, 2014.

Noise Monitor 2

Noise Monitor 2 was located approximately 1,570 m south of Glenmore Trail SE and 80 m east of the northbound lanes for SEST at the edge of the TUC, as shown in Figure 1a and Figure 3. There were no residences nearby, however, this location was selected to provide a representative sample for the large

[1] There were some instances of single lane closures nearby, however, the traffic flow was observed to be essentially unimpeded. Hence, the noise monitoring data is valid.

span between Noise Monitor 1 and Noise Monitor 3. At this location, there was direct line-of-sight to SEST. The noise monitor was started at 10:00 on Thursday July 03, 2014 and ran for 24-hours until 10:00 on Friday July 04, 2014.

Noise Monitor 3

Noise Monitor 3 was located approximately 2,800 m south of the interchange at 114 Avenue SE and 70 m west of the southbound lanes for SEST, as shown in Figure 1b and Figure 4. This put the noise monitor part way up a hill approximately 90 m east of the nearest residential property line at 220 Copperpond Blvd SE. At this location, there was direct line-of-sight to SEST. The noise monitor was started at 11:00 on Tuesday August 05, 2014 and ran for 24-hours until 11:00 on Wednesday August 06, 2014.

Noise Monitor 4

Noise Monitor 4 was located approximately 50 m south of the eastbound lanes for SEST and 1,800 m east of the northbound lanes for 52 Street SE, as shown in Figure 1b and Figure 5. This put the noise monitor part way up a hill, approximately 38 m north of the nearest residential property line at 340 Marquis Heights SE. At this location, there was direct line-of-sight to SEST and the interchange between SEST and Highway 22x. The noise monitor was started at 00:00 on Wednesday August 06, 2014 and ran for 24-hours until 00:00 on Thursday August 07, 2014.

Noise Monitor 5

Noise Monitor 5 was located approximately 118 m north of the westbound lanes for SEST and 960 m east of the northbound lanes for 52 Street SE, as shown in Figure 1b and Figure 6. This put the noise monitor approximately 1 m south of the fence at the south property line of the residence at 135 Copperfield Common SE. At this location, there was direct line-of-sight to SEST and 52 Street SE as well as the interchange between the two roads. The noise monitor was started at 11:00 on Monday June 23, 2014 and ran for 24-hours until 11:00 on Tuesday June 24, 2014.

Noise Monitor 6

Noise Monitor 6 was located approximately 170 m east of the northbound lanes for 52 Street SE and 135 m north of the westbound lanes for SEST, as shown in Figure 1b and Figure 7. This put the noise monitor approximately 1.5 m southwest of the rear fence of the residence at 258 Copperfield Mews SE and approximately 22 m from the westbound -to- northbound ramp for the adjacent interchange. At this location, there was direct line-of-sight to SEST and the westbound -to- northbound ramp at the adjacent interchange as well as partial line-of-sight to 52 Street. The noise monitor was started at 10:30 on Thursday July 03, 2014 and ran for 24-hours until 10:30 on Friday July 04, 2014.

Noise Monitor 7

Noise Monitor 7 was located approximately 360 m south of the eastbound lanes for SEST and 240 m west of the southbound lanes for 52 Street SE, as shown in Figure 1b and Figure 8. This put the noise monitor approximately 12 m northwest of the NW corner for the property at 188 Auburn Meadows Place SE. At this location, there was direct line-of-sight to SEST and 52 Street SE and the interchange between the two. The noise monitor was started at 05:00 on Wednesday August 06, 2014 and ran for 24-hours until 05:00 on Thursday August 07, 2014.

Noise Monitor 8

Noise Monitor 8 was located approximately 90 m north of the westbound lanes for SEST and 900 m east of the northbound lanes for Deerfoot Trail, as shown in Figure 1b and Figure 9. This put the noise monitor approximately 2 m south of the south property line for the residence at 152 Elgin Point SE. At this location, there was no line-of-sight to SEST due to the berm in between SEST and the residences to the north. The noise monitor was started at 11:30 on Monday June 23, 2014 and ran for 24-hours until 11:30 on Tuesday June 24, 2014.

Noise Monitor 9

Noise Monitor 9 was located approximately 250 m east of the northbound lanes for Deerfoot Trail and 245 m north of the westbound lanes for SEST, as shown in Figure 1b and Figure 10. This put the noise monitor approximately 1 m southwest of the fence-line behind the residence at 209 Elgin Gardens SE approximately 100 m from the westbound -to- northbound ramp for the adjacent interchange. There was no line-of-sight to any of the adjacent roads due to the recently constructed earth berm to the west, southwest, and south of the residential properties northeast of the interchange between Deerfoot Trail and Stoney Trail. The noise monitor was started at 11:00 on Thursday July 03, 2014 and ran for 24-hours until 11:00 on Friday July 04, 2014.

Noise Monitor 10

Noise Monitor 10 was located approximately 700 m south of the eastbound lanes for McKenzie Town Blvd SE and 32 m east of the northbound curb for Deerfoot Trail, as shown in Figure 1b and Figure 11. This put the noise monitor at the top of the earth berm adjacent to Deerfoot Trail, approximately 30 m southwest of the rear property line for the nearest residence at 120 Inverness Drive SE. At this location, there was direct line-of-sight to Deerfoot Trail. The noise monitor was started at 11:15 on Thursday July 03, 2014 and ran for 24-hours until 11:15 on Friday July 04, 2014.

Noise Monitor 11

Noise Monitor 11 was located approximately 1,070 m south of the eastbound lanes for McKenzie Lake Blvd SE and 43 m west of the west curb for southbound Deerfoot Trail, as shown in Figure 1b and Figure 12. This put the noise monitor approximately 5 m north of the north property line for the residence at 223 McKerrell Garden SE and 19 m west of the masonry noise barrier that runs parallel to Deerfoot Trail. At this location, there was no line-of-sight to SEST due to the noise barrier. The noise monitor was started at 13:00 on Wednesday August 05, 2014 and ran for 24-hours until 13:00 on Thursday August 06, 2014.

Noise Monitor 12

Noise Monitor 12 was located approximately 157 m north of the westbound lanes for SEST and 400 m west of the southbound lanes for Deerfoot Trail, as shown in Figure 1b and Figure 13. This put the noise monitor approximately 3 m south of the rear property line for the residence at 92 McKerrell Close SE. At this location, there was direct line-of-sight to SEST to the west of the earth berm that runs parallel to the southbound-to-westbound ramp for the adjacent interchange. Other than the highest ramp (SEST eastbound to Deerfoot Trail northbound) for the adjacent interchange, there is no line-of-sight to the roads further to the east due to the berm. The noise monitor was started at 13:15 on Monday June 23, 2014 and ran for 24-hours until 13:15 on Tuesday June 24, 2014.

Noise Monitor 13

Noise Monitor 13 was located approximately 292 m south of the eastbound lanes for SEST and 280 m west of the southbound lanes for Deerfoot Trail, as shown in Figure 1b and Figure 14. This put the noise monitor on top of an earth berm, approximately 10 m ENE of the north corner of the lot at 262 Crammond Court SE. At this location, there was direct line-of-sight to SEST, Deerfoot Trail, and the interchange between the two. The noise monitor was started at 05:00 on Wednesday August 06, 2014 and ran for 24-hours until 05:00 on Thursday August 07, 2014.

Noise Monitor 14

Noise Monitor 14 was located approximately 75 m west of the southbound lanes for Deerfoot Trail and 790 m north of the westbound lanes for Seton Blvd SE, as shown in Figure 1b and Figure 15. This put the noise monitor at the TUC fence, approximately 9.0 m east of the rear property line for the residence at 90 Cranberry Close SE. At this location, there was no line-of-sight to SEST or Seton Blvd SE due to the earth berm to the east of the noise monitor. The noise monitor was started at 16:00 on Wednesday August 05, 2014 and ran for 24-hours until 16:00 on Thursday August 06, 2014.

Noise Monitor 15

Noise Monitor 15 was located approximately 75 m east of the northbound lanes for Deerfoot Trail and 1,080 m south of the eastbound lanes for SEST, as shown in Figure 1b and Figure 16. This put the noise monitor approximately 16 m west of the nearest residence at 52 Auburn Bay Common SE and approximately 15 m east of the nearest ramp for Deerfoot Trail. At this location, there was no line-of-sight to Deerfoot Trail or SEST due to the noise barrier located approximately 1.5 m west of the noise monitor. The noise monitor was started at 12:00 on Thursday July 03, 2014 and ran for 24-hours until 12:00 on Friday July 04, 2014.

Noise Monitor 16

Noise Monitor 16 was located approximately 130 m north of the westbound lanes for SEST and 250 m west of the southbound lanes for McKenzie Lake Blvd, as shown in Figure 1b and Figure 17. This put the noise monitor approximately 1.0 m southwest of the rear property line of the residence at 62 Mount Gibraltar Heights SE. At this location, there was direct line-of-sight to SEST and McKenzie Lake Blvd as well as the interchange between the two roads. The noise monitor was started at 13:00 on Monday June 23, 2014 and ran for 24-hours until 13:00 on Tuesday June 24, 2014.

Noise Monitor 17

Noise Monitor 17 was located approximately 85 m north of the westbound lanes for SEST and 610 m west of the southbound lanes for Sun Valley Blvd SE, as shown in Figure 1b and Figure 18. This put the noise monitor approximately 87 m east of Sunvista Crescent SE at the south fence-line in an open field area. At this location, there was no line-of-sight to SEST due to the earth berm that runs east-west in between SEST and the houses to the north. The noise monitor was started at 14:00 on Monday June 23, 2014 and ran for 24-hours until 14:00 on Tuesday June 24, 2014.

Noise Monitor 18

Noise Monitor 18 was located approximately 295 m south of the eastbound lanes for SEST and 660 m west of the southbound lanes for Chaparral Blvd SE, as shown in Figure 1b and Figure 19. This put the noise monitor approximately 5 m north of the rear fence-line of the residence at 128 Chaparral Crescent SE. At this location, there was direct line-of-sight to SEST, Chaparral Blvd SE (and the interchange between the two roads) as well as to Macleod Trail SE (and the interchange between SEST and Macleod Trail SE). The noise monitor was started at 22:00 on Wednesday August 05, 2014 and ran for 24-hours until 22:00 on Thursday August 06, 2014.

4.0 Results and Discussion

4.1. Noise Monitorings

The results obtained from the environmental noise monitorings are shown in Table 1 and Figures 20 - 55 (broadband A-weighted L_{eq} sound levels and 1/3 octave band L_{eq} sound levels provided). It should be noted that the data have been adjusted by the removal of non-typical noise events such as loud aircraft flyovers (the noise criteria does not account for aircraft), pedestrians, dogs making noise nearby, abnormally loud vehicle passages, etc. In general, at all locations, the resultant 1/3 octave band L_{eq} sound levels were very similar. All locations show the typical trend of low frequency noise (near 63 – 80 Hz) resulting from engines and exhaust, as well as mid-high frequency noise (near 1,000 Hz) resulting from tire noise. These results confirm that the noise levels being measured by the noise monitors were largely attributed to SEST and Deerfoot Trail in addition to the other major roadways. A more detailed description of the data results and the weather conditions for each noise monitor is provided below. Weather data for the duration of the environmental noise monitorings is presented in Appendix IV.

Table 1. Noise Monitoring Results

Noise Monitor	L_{eq}24 (dBA)	L_{eq}Day (dBA)	L_{eq}Night (dBA)
M1	57.8	58.5	56.4
M2	63.4	64.5	60.4
M3	62.5	63.8	58.6
M4	66.6	67.8	63.4
M5	61.8	62.9	59.1
M6	59.4	61.2	51.8
M7	54.8	55.6	53.1
M8	53.0	54.2	50.0
M9	52.3	53.0	50.9
M10	76.1	77.3	72.8
M11	58.2	59.4	54.6
M12	57.5	58.7	54.2
M13	57.2	58.0	55.6
M14	52.3	52.9	51.3
M15	56.9	57.9	54.4
M16	62.4	63.7	58.5
M17	53.5	54.9	49.0
M18	50.9	50.2	51.9

Noise Monitor 1

The dominant noise source was vehicle traffic on SEST and 17 Avenue SE. Crickets were audible at night-time when traffic noise was at a minimum. There was also higher frequency noise from approximately 05:00 - 08:00 due to birds chirping. The noise from the birds and crickets had a minimal impact on the $L_{eq}24$ dBA results. The weather conditions had a light wind (approximately 10 km/h) from the east and southeast from 10:30 - 15:00, then higher winds (approximately 10 - 30 km/hr) from the southwest and west from 15:00 - 21:00, then low wind (approximately 5 km/hr) from the south and southeast from 21:00 - 08:00 and finally higher winds (approximately 10 - 30 km/hr) from the south and southeast from 08:00 - 10:30. In general, the wind conditions were favourable for noise from SEST and 17 Avenue SE towards the noise monitor.

Noise Monitor 2

The dominant noise source was vehicle traffic on SEST. The weather conditions had a light wind (approximately 10 km/h) from the southwest from 09:30 - 12:00, then higher winds (approximately 20 - 40 km/hr) from the south from 12:00 - 20:00, then low wind (approximately 5 km/hr) from the west from 22:00 - 04:00 and finally light winds (approximately 5 - 20 km/hr) from the northwest from 04:00 - 12:00. The highest winds were from 12:30 - 15:30. During this time, there was some increased low frequency noise, however, the dBA sound levels were not significantly affected. In general, the wind conditions were favourable for noise from SEST towards the noise monitor.

Noise Monitor 3

The dominant noise source was vehicle traffic on SEST. Crickets were audible throughout, particularly during the night-time when traffic noise was at a minimum and resulted in the very high frequency noise at and above 10 kHz. There was also higher frequency noise due to birds chirping. The noise from the birds and crickets had a minimal impact on the $L_{eq}24$ dBA results. The weather conditions had a light wind (approximately 5 - 15 km/h) throughout the entire noise monitoring period and near calm during the night-time. The wind was from the southeast from 11:00 - 03:00, then from the west and northwest from 03:00 - 11:00. During the periods when the noise monitor was upwind from the road, the wind was very light. In general, the given the proximity of the noise monitor relative to SEST, the wind conditions had a neutral effect on the sound propagation from SEST towards the noise monitor.

Noise Monitor 4

The dominant noise source was vehicle traffic on SEST. The weather conditions had a light wind (approximately 5 - 15 km/h) throughout the entire noise monitoring period and near calm from 00:00 - 03:00. The wind was from the west from 03:00 - 09:00, then from the north from 09:00 - 15:00 and then shifted from southerly to northerly for the remainder of the noise monitoring. In general, the given the proximity of the noise monitor relative to SEST, the wind conditions had a neutral effect on the sound propagation from SEST towards the noise monitor.

Noise Monitor 5

The dominant noise source was vehicle traffic on SEST. Crickets were audible during the early evening and night-time. During this time, the noise from the crickets had a slight impact on the dBA results. Thus, the L_{eq}24 dBA results are slightly conservative. The weather conditions had a light wind (approximately 10 km/h) from the east and southeast from 10:30 - 15:00, then higher winds (approximately 10 - 30 km/hr) from the southwest and west from 15:00 - 21:00, then low wind (approximately 5 km/hr) from the south and southeast from 21:00 - 08:00 and finally higher winds (approximately 10 - 30 km/hr) from the south and southeast from 08:00 - 10:30. In general, the wind conditions were favourable for noise from SEST towards the noise monitor.

Noise Monitor 6

The dominant noise source was vehicle traffic on SEST and 52 Street SE. During the day-time, there was a Loader operating nearby with occasional pass-bys relative to the noise monitor. There were numerous brief periods of data removed in which the Loader dominated the noise climate. The remaining data was still more than sufficient to discern the L_{eq}24 dBA sound levels from the area vehicle traffic. The weather conditions had a light wind (approximately 10 km/h) from the southwest from 10:30 - 12:00, then higher winds (approximately 20 - 40 km/hr) from the south from 12:00 - 20:00, then low wind (approximately 5 km/hr) from the west from 22:00 - 04:00 and finally light winds (approximately 5 - 20 km/hr) from the northwest from 04:00 - 12:00. The highest winds were from 12:30 - 15:30. During this time, there was some increased low frequency noise, however, the dBA sound levels were not significantly affected. In general, the wind conditions were favourable for noise from SEST and 52 Street SE towards the noise monitor for most of the time, with the exception of the peak morning traffic period when the wind direction was not favorable for sound transmission from the adjacent road to the noise monitor. As such, the monitored noise levels are likely a bit low by approximately 1 dBA.

Noise Monitor 7

The dominant noise source was vehicle traffic on SEST and 52 Street SE. During the day-time, there was construction noise audible from the south (road paving equipment). The construction equipment resulted in elevated low frequency and some mid-frequency noise along with some high frequency back-up beeper noise during the day-time. In general, however, the construction noise was downwind from the noise monitor (relative to SEST) thus the construction related noise levels were below the noise levels associated with SEST and only had a minimal contribution (perhaps 1 - 2 dBA) during the day-time and no impact during the night-time or during the important morning traffic rush peak. As such, with the construction noise, the L_{eq}24 dBA results are slightly conservative. The weather conditions had a light wind (approximately 5 - 15 km/h) throughout the entire noise monitoring period except during a high-wind period from 00:20 - 02:35. The wind was westerly and northerly from 05:00 - 15:30, then near calm from 15:30 - 19:45 and then northerly from 19:45 - 05:00. Noise monitoring data was removed during the high wind period from 00:20 - 02:35, however, this had a negligible impact on the L_{eq}24 dBA results because this is otherwise a relatively quiet period. Removal of data during this otherwise low noise level time period also results in slightly conservative L_{eq}24 dBA results. During the periods when the noise monitor was upwind from the road, the wind was very light. In general, the wind conditions were favourable for sound propagation from SEST and 52 Street SE towards the noise monitor.

Noise Monitor 8

The dominant noise source was vehicle traffic on SEST. Crickets were audible during the early evening and night-time. During this time, the noise from the crickets had a minimal impact on the dBA results. Thus, the L_{eq}24 dBA results are slightly conservative. There was also an increase noise in the 8 kHz and 10 kHz 1/3 octave frequency bands resulting from nearby rodents. The weather conditions had a light wind (approximately 10 km/h) from the east and southeast from 11:30 - 15:00, then higher winds (approximately 10 - 30 km/hr) from the southwest and west from 15:00 - 21:00, then low wind (approximately 5 km/hr) from the south and southeast from 21:00 - 08:00 and finally higher winds (approximately 10 - 30 km/hr) from the south and southeast from 08:00 - 11:30. In general, the wind conditions were favourable for noise from SEST towards the noise monitor.

Noise Monitor 9

The dominant noise source was vehicle traffic on SEST. The weather conditions had a light wind (approximately 10 km/h) from the southwest from 11:00 - 12:00, then higher winds (approximately 20 - 40 km/hr) from the south from 12:00 - 20:00, then low wind (approximately 5 km/hr) from the west from 22:00 - 04:00 and finally light winds (approximately 5 - 20 km/hr) from the northwest from 04:00 - 12:00. The highest winds were from 12:30 - 15:30. During this time, the dBA sound levels were impacted by approximately 1 dBA. Thus the data provided in Table 1 has been modified to remove this time period. In general, the wind conditions were favourable for noise from SEST towards the noise monitor.

Noise Monitor 10

The dominant noise source was vehicle traffic on Deerfoot Trail. The weather conditions had a light wind (approximately 10 km/h) from the southwest from 11:00 - 12:00, then higher winds (approximately 20 - 40 km/hr) from the south from 12:00 - 20:00, then low wind (approximately 5 km/hr) from the west from 22:00 - 04:00 and finally light winds (approximately 5 - 20 km/hr) from the northwest from 04:00 - 12:00. The highest winds were from 12:30 - 15:30. During this time, however, the dBA sound levels were not impacted because of the complete dominance of the vehicle traffic noise. There was some slight increase in low frequency noise. In general, the wind conditions were favourable for noise from Deerfoot Trial towards the noise monitor, however, given the proximity of the noise monitor relative to Deerfoot Trail the weather conditions had a negligible effect.

Noise Monitor 11

The dominant noise source was vehicle traffic on Deerfoot Trail. The weather conditions had a light wind (approximately 5 - 15 km/h) throughout the entire noise monitoring period and near calm during the night-time. The wind was from the southeast from 11:00 - 03:00, then from the west and northwest from 03:00 - 11:00. During the periods when the noise monitor was upwind from the road, the wind was very light. In general, the given the proximity of the noise monitor relative to Deerfoot Trail, the wind conditions had a neutral effect on the sound propagation from Deerfoot Trail towards the noise monitor.

Noise Monitor 12

The dominant noise source was vehicle traffic on SEST and Deerfoot Trail. Crickets were audible during the early evening and night-time. There was also an increase noise in the 8 kHz and 10 kHz 1/3 octave frequency bands resulting from nearby rodents. The noise from the crickets and rodents had a minimal impact on the dBA results. The weather conditions had a light wind (approximately 10 km/h) from the east and southeast from 10:30 - 15:00, then higher winds (approximately 10 - 30 km/hr) from the southwest and west from 15:00 - 21:00, then low wind (approximately 5 km/hr) from the south and southeast from 21:00 - 08:00 and finally higher winds (approximately 10 - 30 km/hr) from the south and southeast from 08:00 - 10:30. In general, the wind conditions were favourable for noise from SEST and Deerfoot Trail towards the noise monitor.

Noise Monitor 13

The dominant noise source was vehicle traffic on SEST and Deerfoot Trail. The weather conditions had a light wind (approximately 5 - 15 km/h) throughout the entire noise monitoring period except during a high-wind period from 00:20 - 02:35. The wind was westerly and northerly from 05:00 - 15:30, then near calm from 15:30 - 19:45 and then northerly from 19:45 - 05:00. Noise monitoring data was removed during the high wind period from 00:20 - 02:35, however, this had a negligible impact on the L_{eq}24 dBA results because this is otherwise a relatively quiet period. Removal of data during this otherwise low noise level time period also results in slightly conservative L_{eq}24 dBA results. In general, the wind conditions were favourable for sound propagation from SEST and Deerfoot Trial towards the noise monitor.

Noise Monitor 14

The dominant noise source was vehicle traffic on Deerfoot Trail. The weather conditions had a light wind (approximately 5 - 15 km/h) throughout the entire noise monitoring period and near calm during the night-time. The wind was from the southeast from 11:00 - 03:00, then from the west and northwest from 03:00 - 11:00. During the periods when the noise monitor was upwind from the road, the wind was very light. In general, the given the proximity of the noise monitor relative to Deerfoot Trail, the wind conditions had a neutral effect on the sound propagation from Deerfoot Trail towards the noise monitor.

Noise Monitor 15

The dominant noise source was vehicle traffic on Deerfoot Trail. The weather conditions had a light wind (approximately 10 km/h) from the southwest from 11:00 - 12:00, then higher winds (approximately 20 - 40 km/hr) from the south from 12:00 - 20:00, then low wind (approximately 5 km/hr) from the west from 22:00 - 04:00 and finally light winds (approximately 5 - 20 km/hr) from the northwest from 04:00 - 12:00. The highest winds were from 12:30 - 15:30. During this time, however, the dBA sound levels were not impacted because of the dominance of the vehicle traffic noise. There was some slight increase in low frequency noise. In general, the wind conditions were favourable for noise from Deerfoot Trial towards the noise monitor, however, given the proximity of the noise monitor relative to Deerfoot Trail the weather conditions had a negligible effect.

Noise Monitor 16

The dominant noise source was vehicle traffic on SEST. Crickets were audible during the early evening and night-time. The noise from the crickets had a minimal impact on the dBA results. The weather conditions had a light wind (approximately 10 km/h) from the east and southeast from 13:00 - 15:00, then higher winds (approximately 10 - 30 km/hr) from the southwest and west from 15:00 - 21:00, then low wind (approximately 5 km/hr) from the south and southeast from 21:00 - 08:00 and finally higher winds (approximately 10 - 30 km/hr) from the south and southeast from 08:00 - 13:00. In general, the wind conditions were favourable for noise from SEST towards the noise monitor.

Noise Monitor 17

The dominant noise source was vehicle traffic on SEST. Crickets were audible during the early evening and night-time. The noise from the crickets had a minimal impact on the dBA results. The weather conditions had a light wind (approximately 10 km/h) from the east and southeast from 14:00 - 15:00, then higher winds (approximately 10 - 30 km/hr) from the southwest and west from 15:00 - 21:00, then low wind (approximately 5 km/hr) from the south and southeast from 21:00 - 08:00 and finally higher winds (approximately 10 - 30 km/hr) from the south and southeast from 08:00 - 13:00. In general, the wind conditions were favourable for noise from SEST towards the noise monitor.

Noise Monitor 18

The dominant noise source was vehicle traffic on SEST. The weather conditions had a light wind (approximately 5 - 15 km/h) throughout the entire noise monitoring period and near calm from 22:00 - 03:00. The wind was from the west from 03:00 - 09:00, then from the north from 09:00 - 15:00 and then shifted from southerly to northerly for the remainder of the noise monitoring. During the morning traffic and afternoon peak periods, the weather conditions were very favorable for sound propagation from SEST towards the noise monitor. During the mid-day-time, however, there were periods with light south wind which resulted in abnormally low noise levels. The favourable weather conditions during the morning and afternoon peak traffic times, however, likely made up for most of the reduced mid-day noise levels, resulting in only a small impact on the $L_{eq}24$ dBA sound level. It is likely that the $L_{eq}24$ dBA sound level is a bit lower than would otherwise be with an entirely northerly wind, by approximately 1 - 2 dBA.

5.0 Conclusion

The noise monitoring results indicated that the dominant noise sources were associated with vehicle traffic on SEST and Deerfoot Trail. The monitored noise levels ranged from 50.9 - 76.1 dBA L_{eq}24. The 1/3 octave band frequency data show the typical trend of low frequency noise (near 63 – 80 Hz) resulting from engines and exhaust, as well as mid-high frequency noise (near 1,000 Hz) resulting from tire noise.

6.0 References

- International Organization for Standardization (ISO), *Standard 1996-1, Acoustics – Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures, 2003*, Geneva Switzerland.
- International Organization for Standardization (ISO), *Standard 9613-1, Acoustics – Attenuation of sound during propagation outdoors – Part 1: Calculation of absorption of sound by the atmosphere, 1993*, Geneva Switzerland.
- International Organization for Standardization (ISO), *Standard 9613-2, Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation, 1996*, Geneva Switzerland.

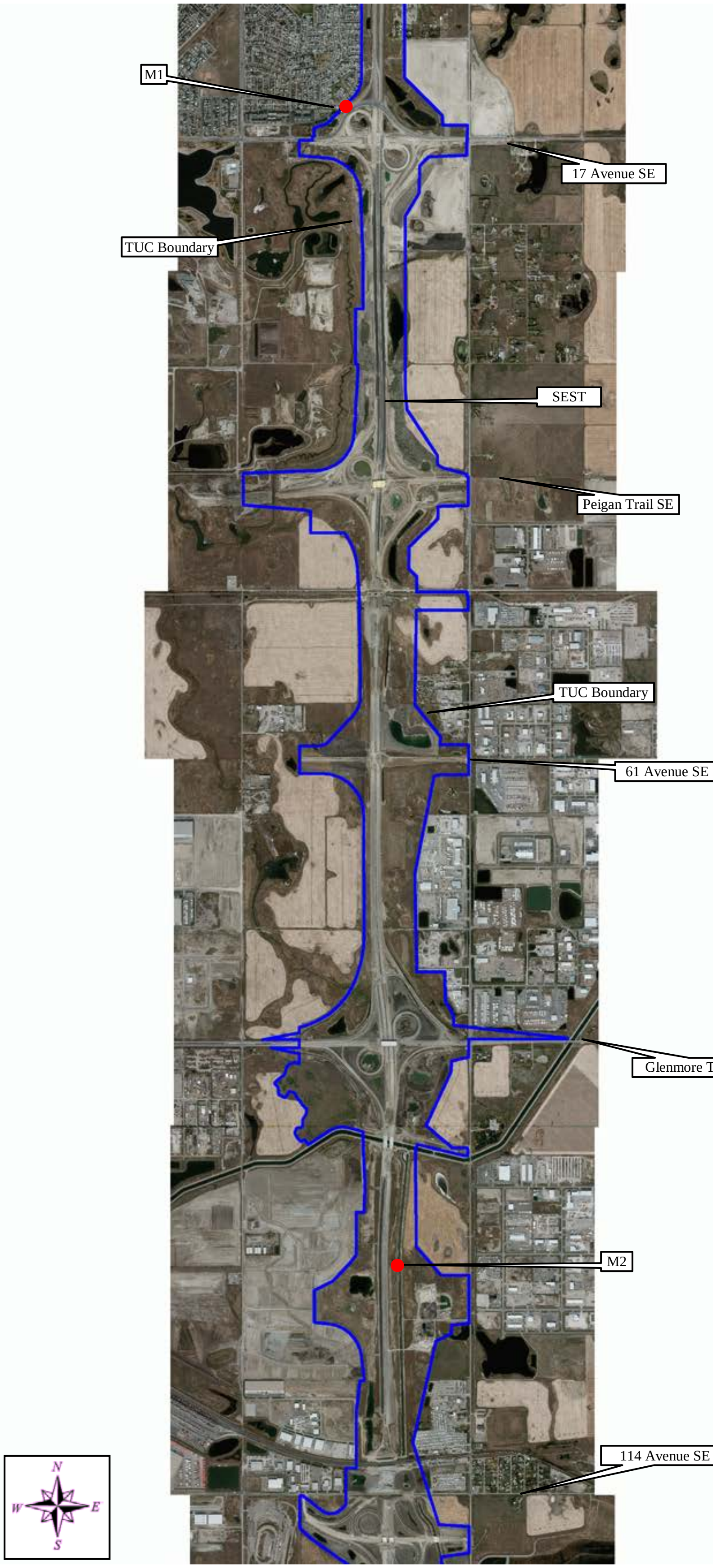


Figure 1a. Northern Study Area

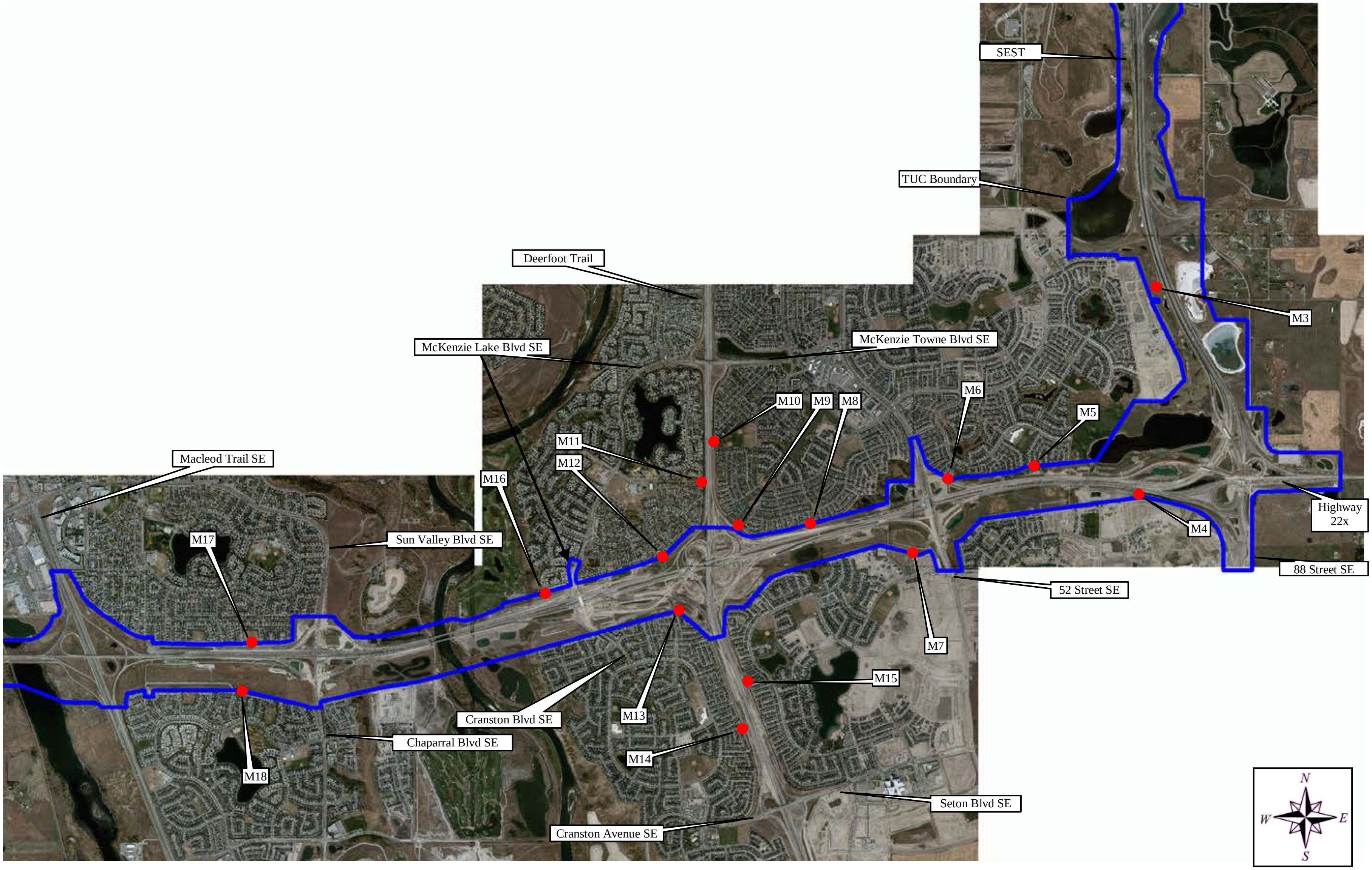


Figure 1b. Southern Study Area

acoustical consultants inc

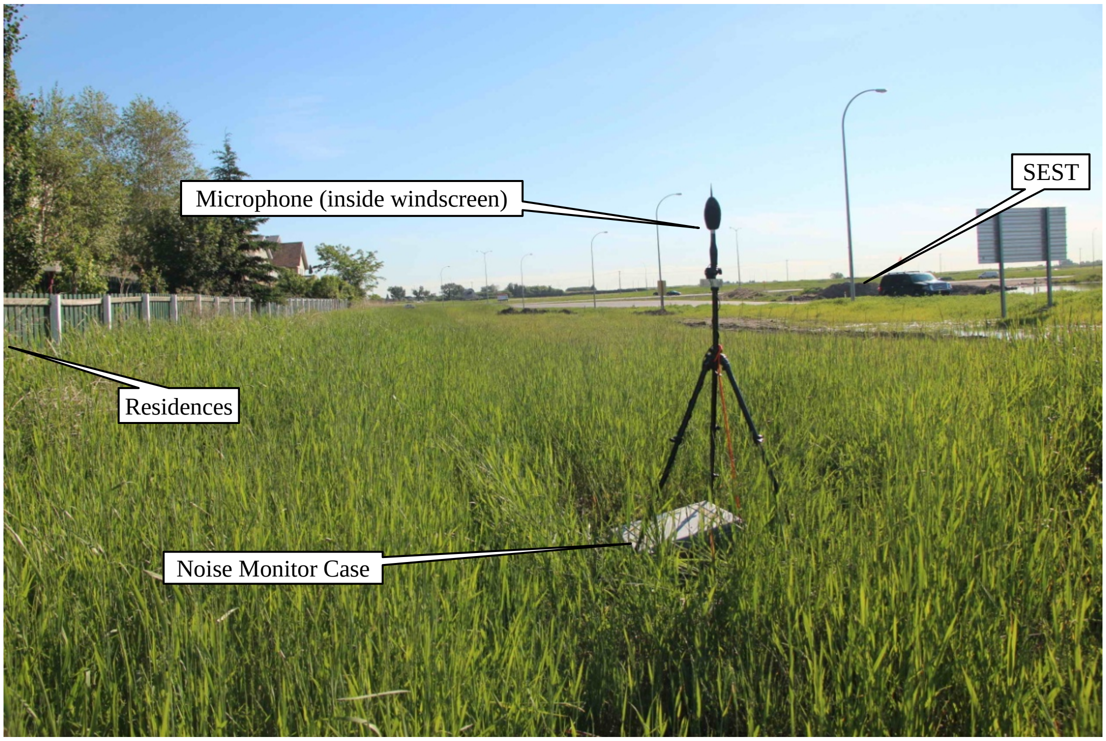


Figure 2. Noise Monitor at Location 1

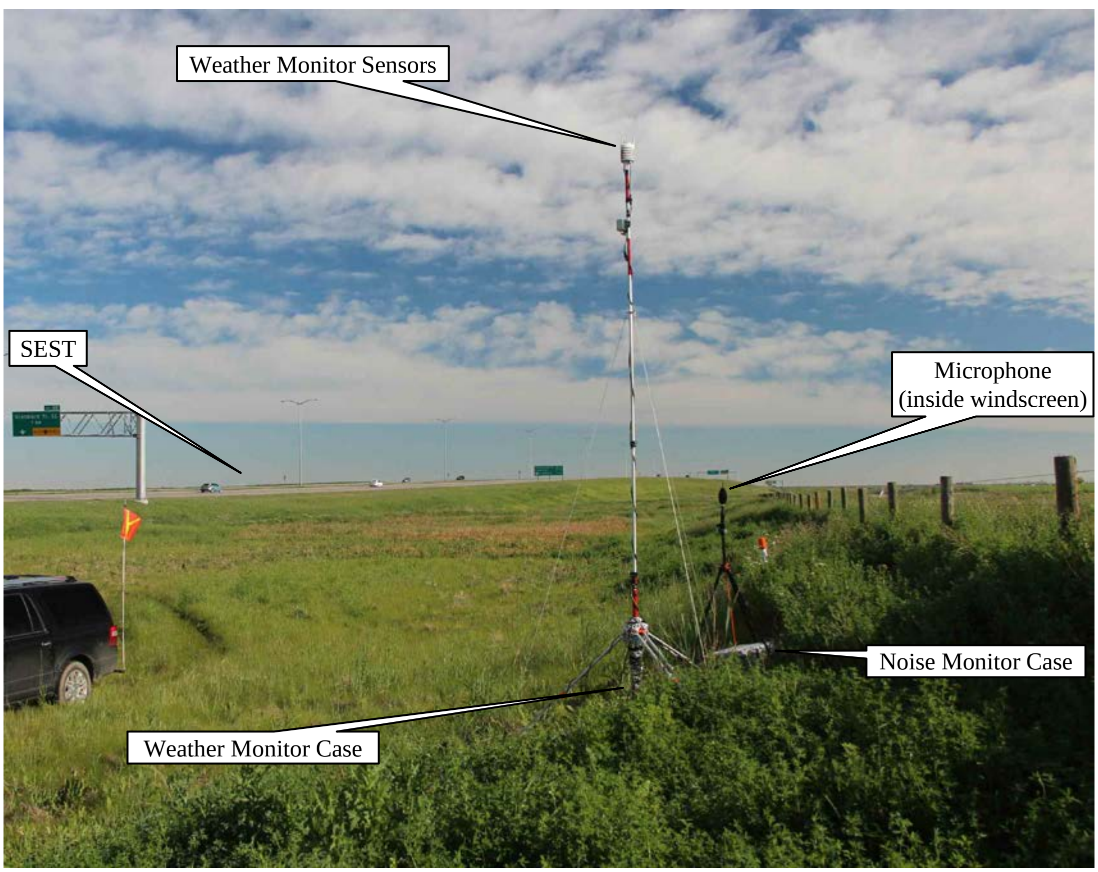


Figure 3. Noise Monitor at Location 2

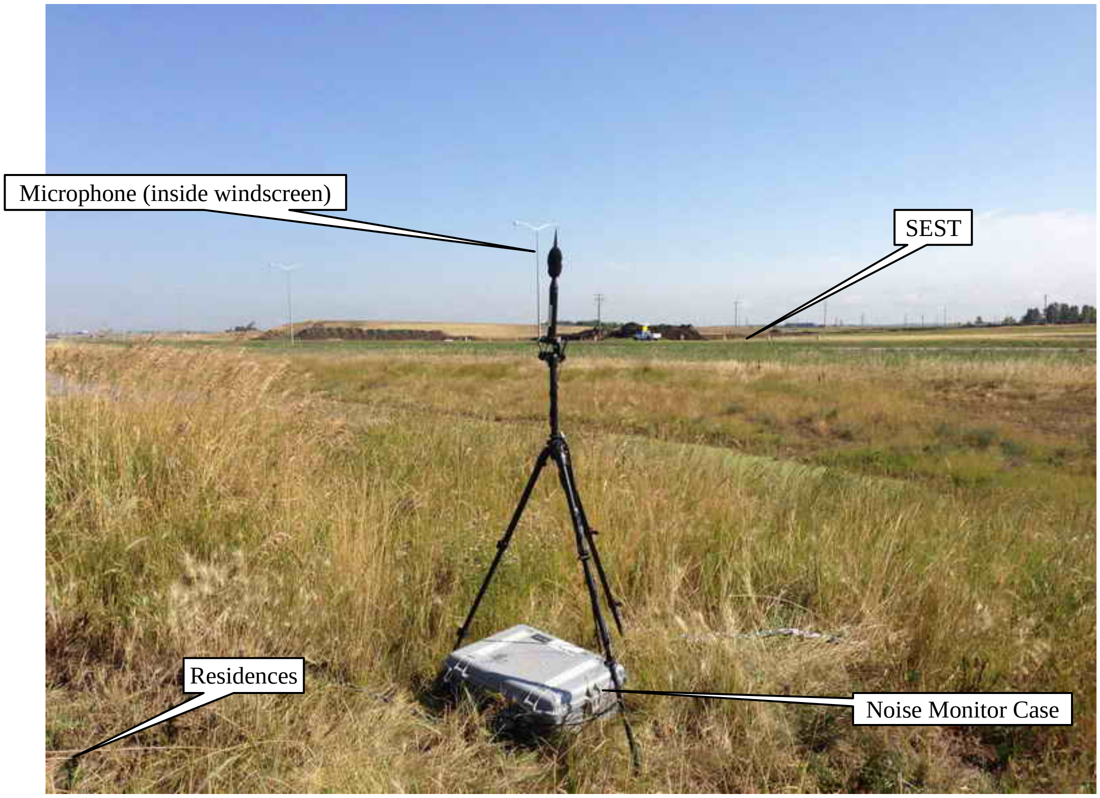


Figure 4. Noise Monitor at Location 3

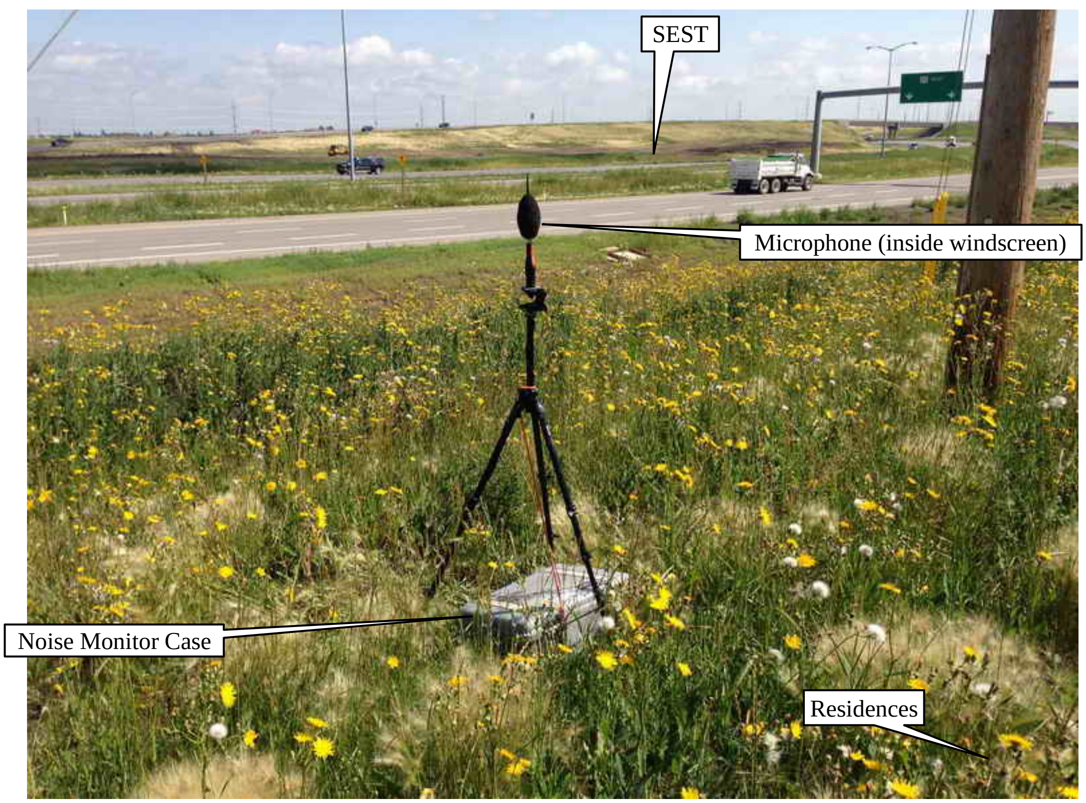


Figure 5. Noise Monitor at Location 4

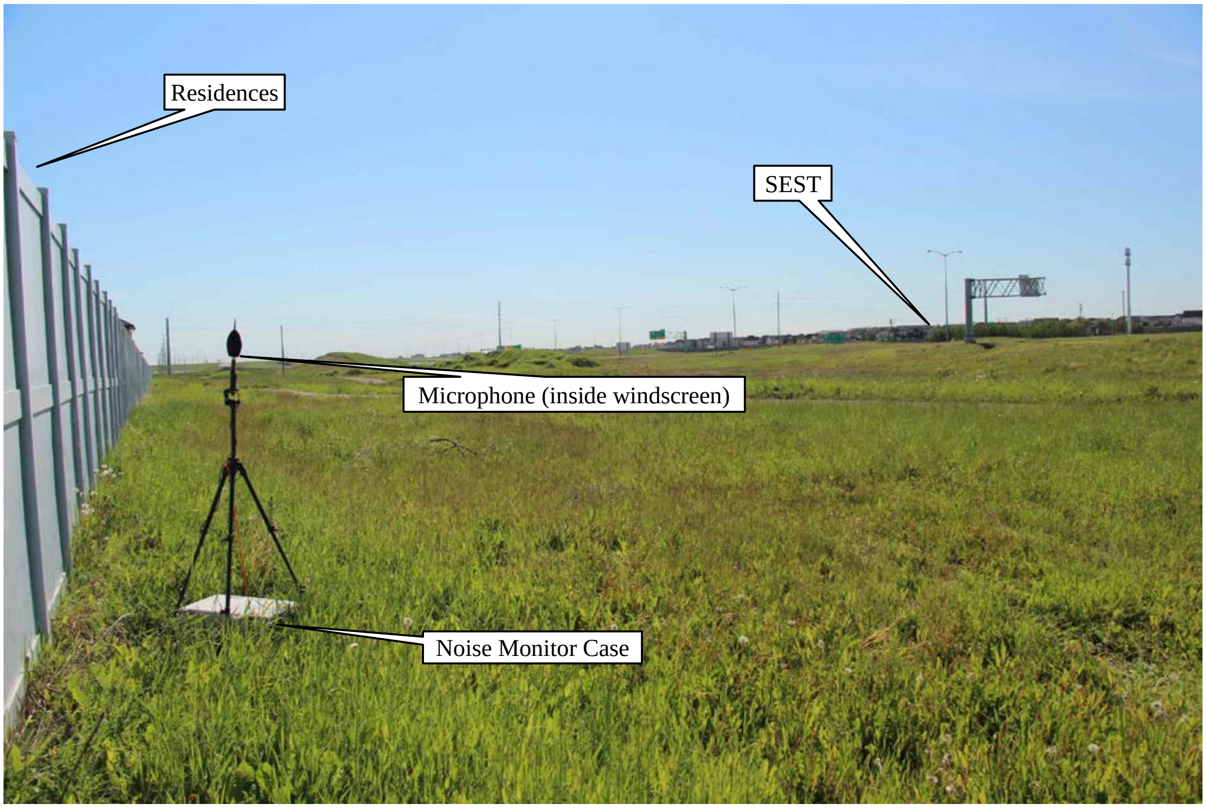


Figure 6. Noise Monitor at Location 5

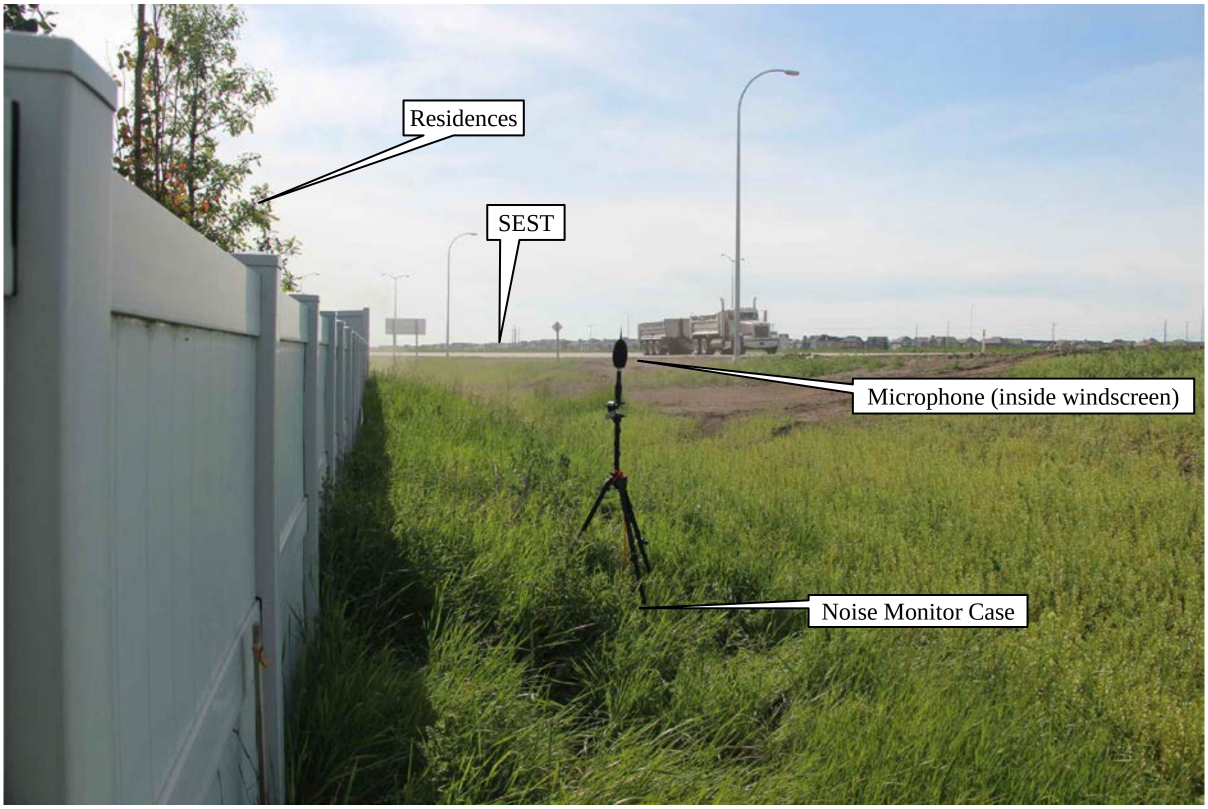


Figure 7. Noise Monitor at Location 6

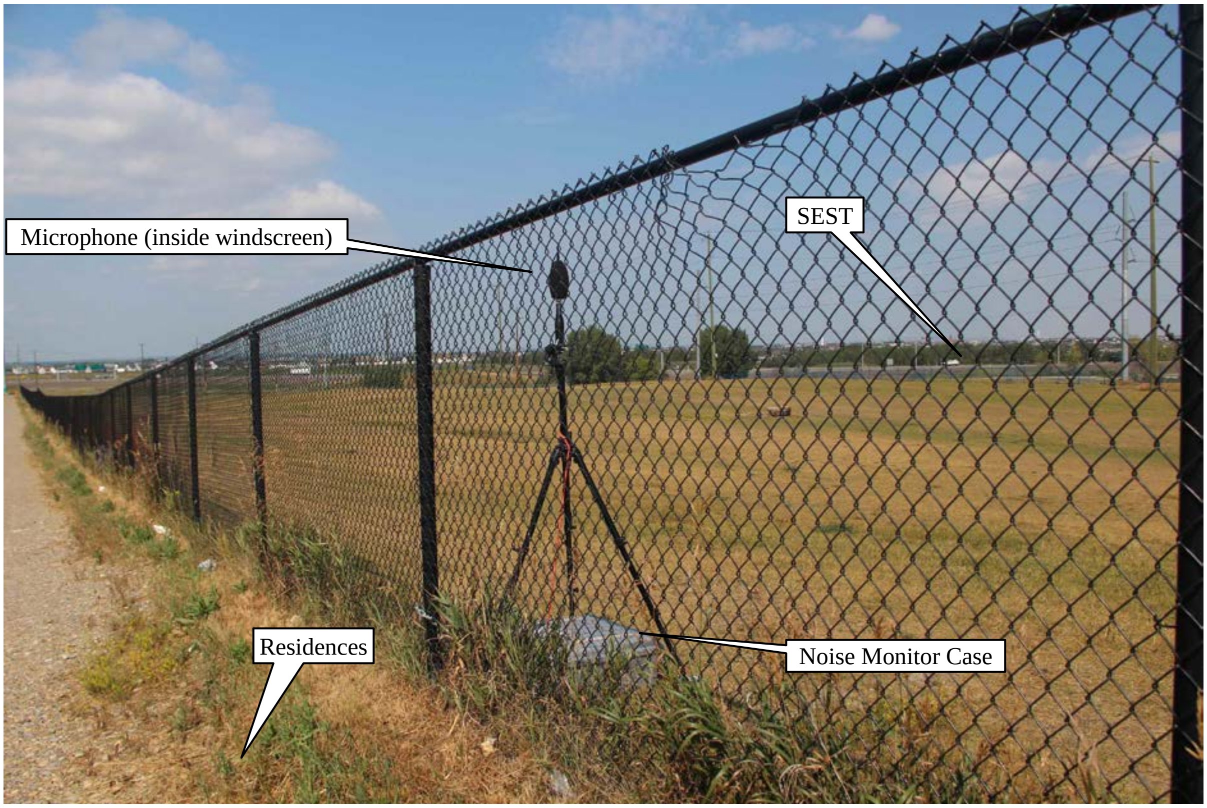


Figure 8. Noise Monitor at Location 7

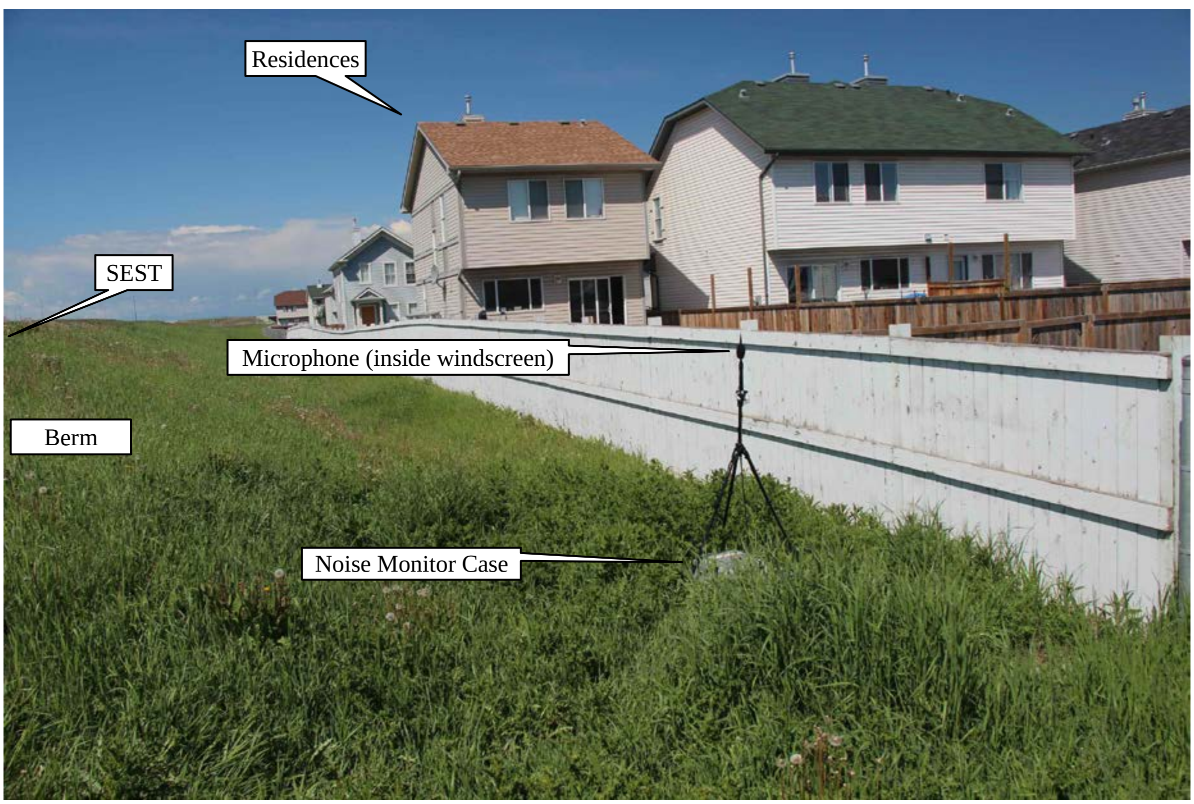


Figure 9. Noise Monitor at Location 8

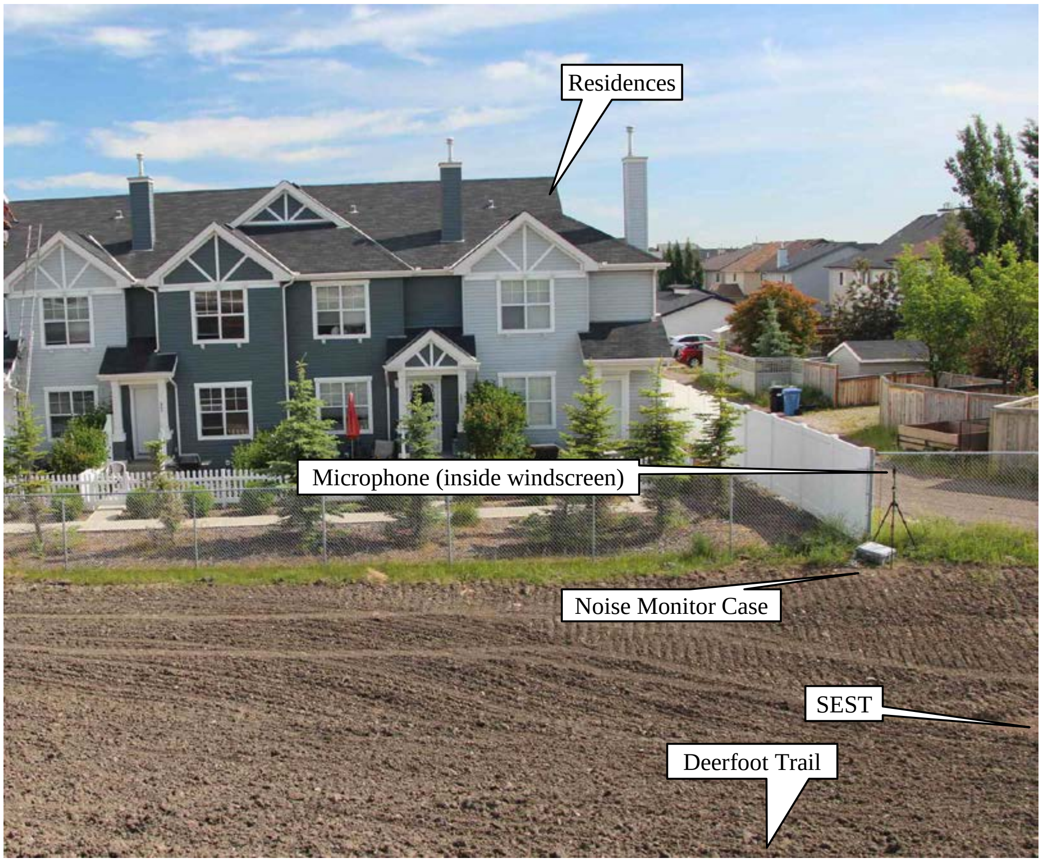


Figure 10. Noise Monitor at Location 9

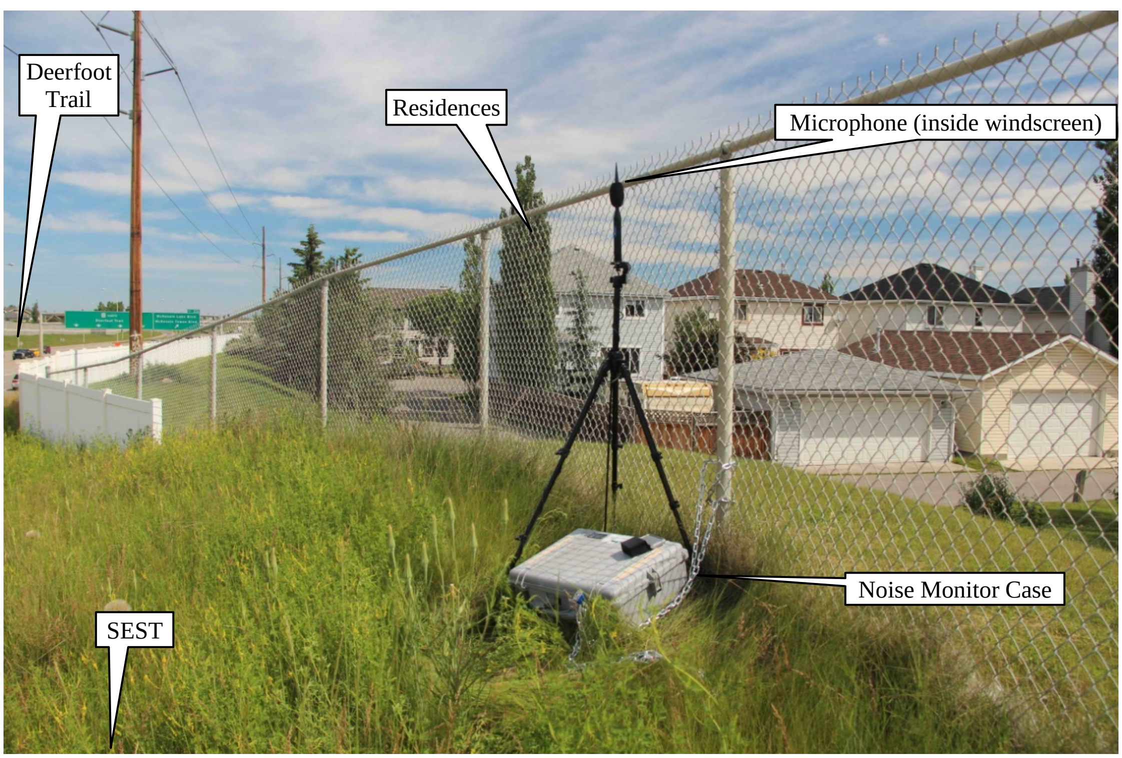


Figure 11. Noise Monitor at Location 10

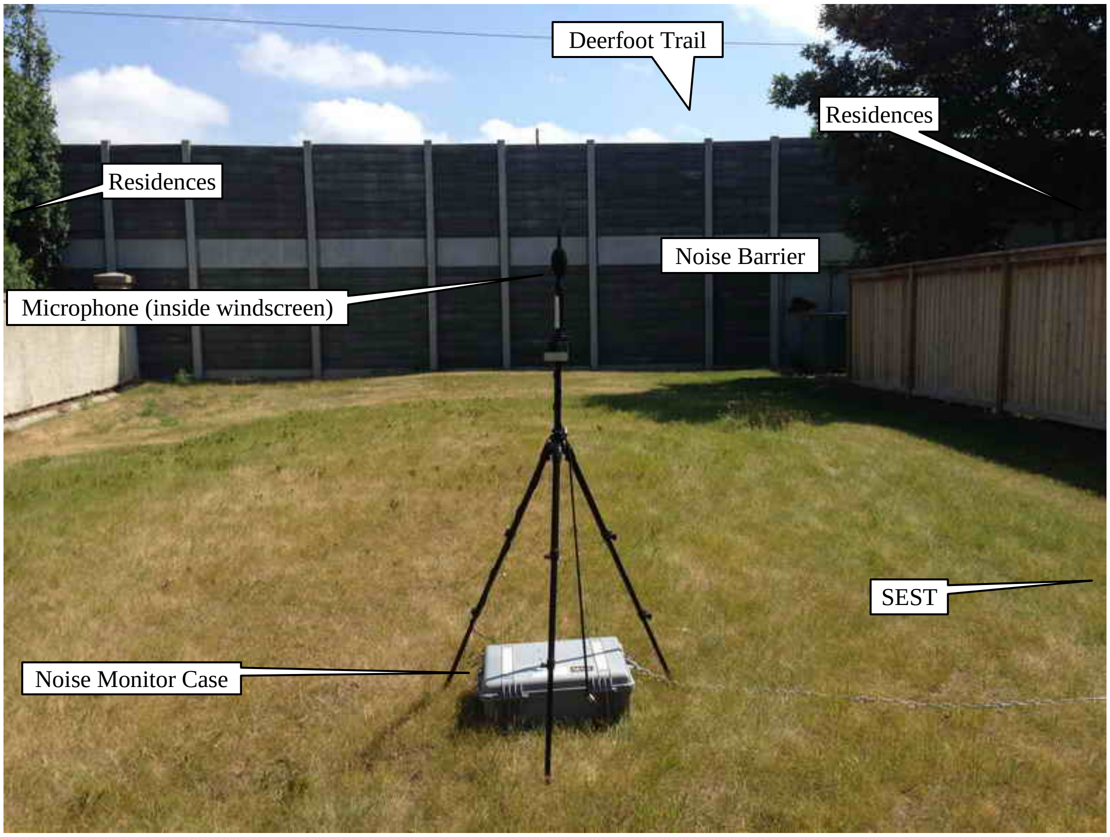


Figure 12. Noise Monitor at Location 11

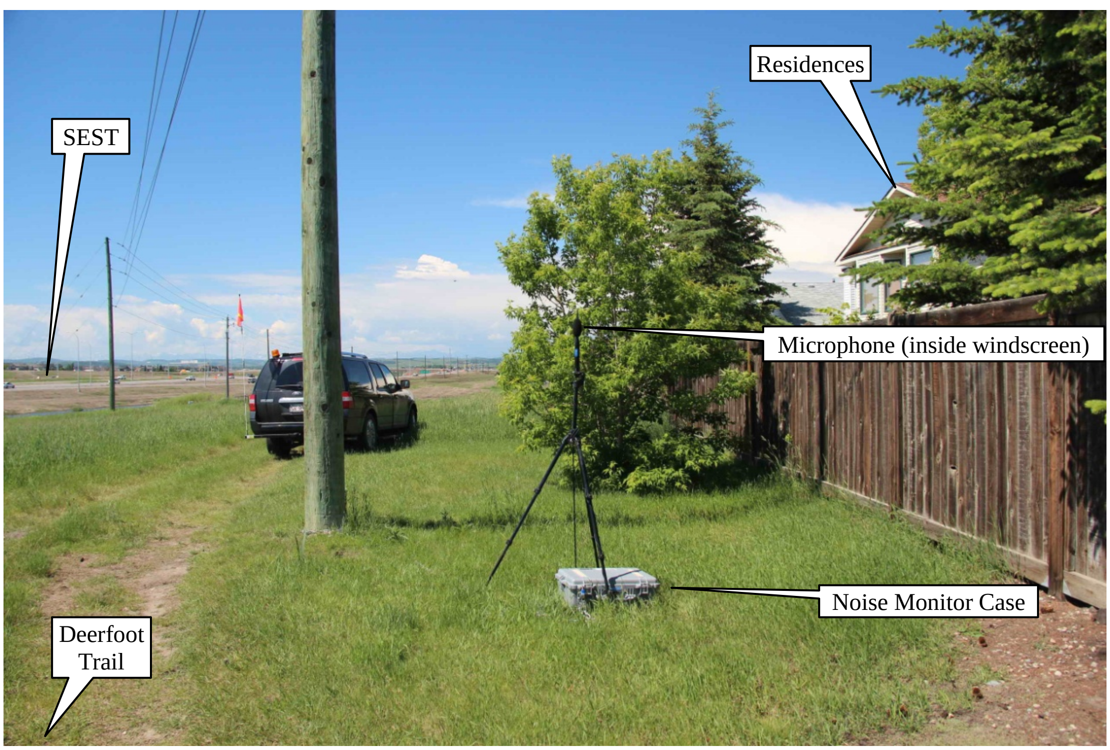


Figure 13. Noise Monitor at Location 12

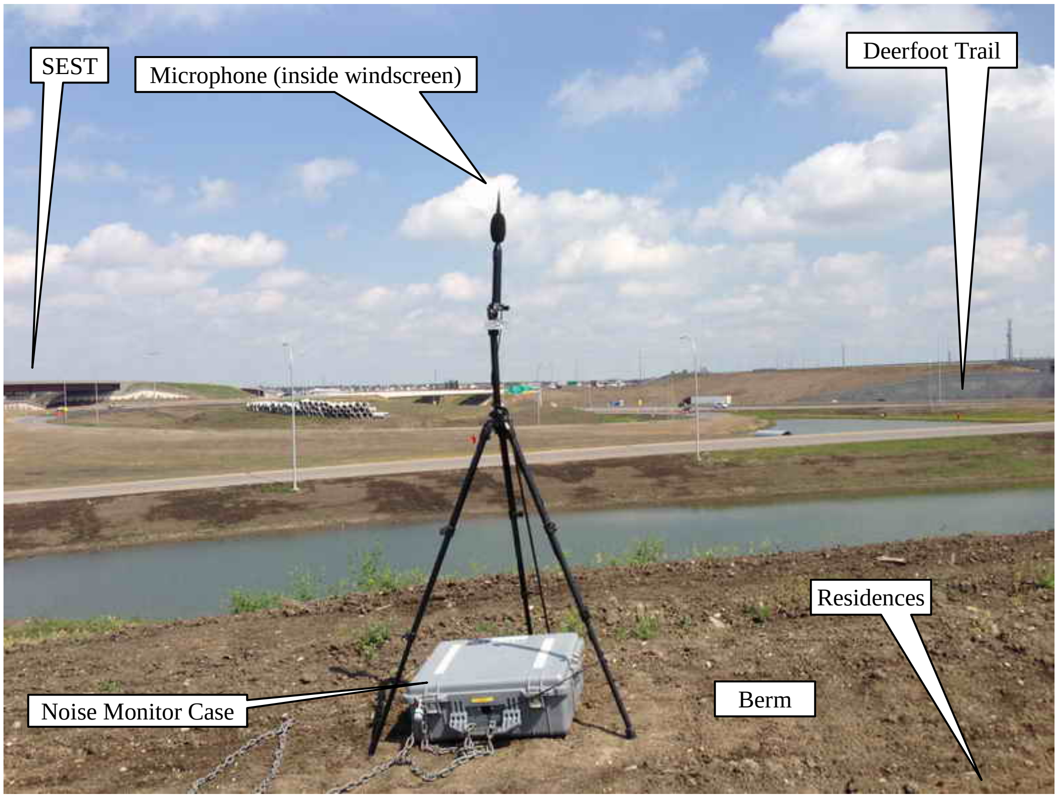


Figure 14. Noise Monitor at Location 13

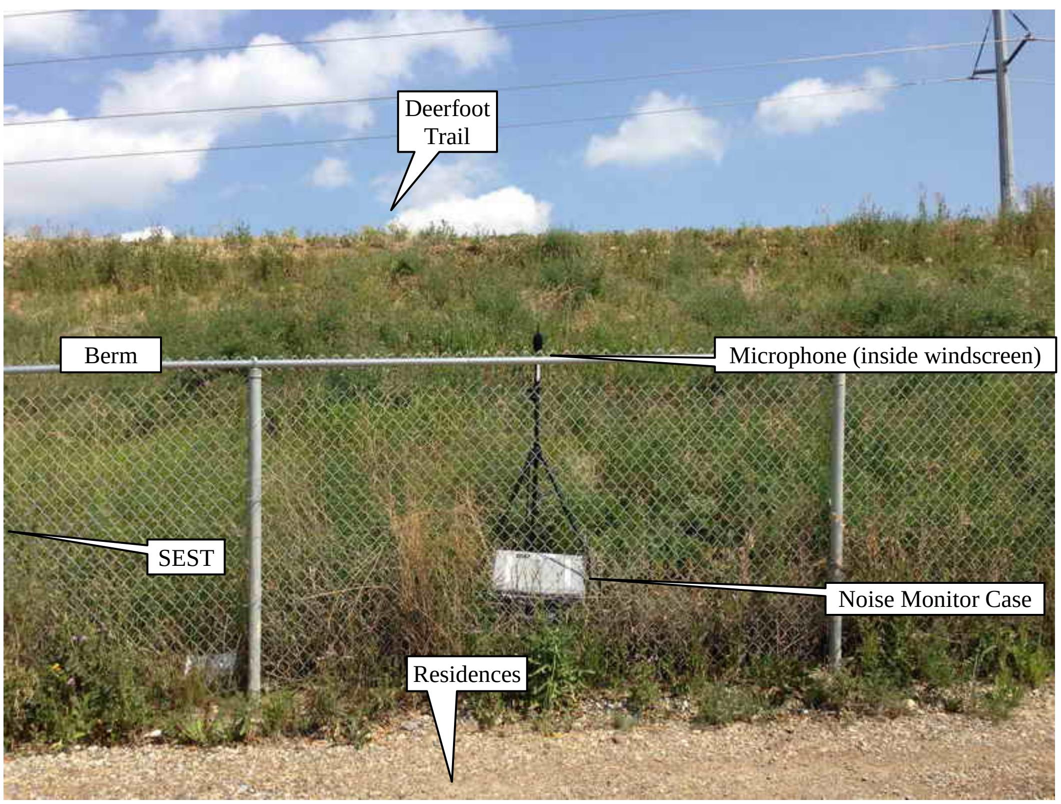


Figure 15. Noise Monitor at Location 14

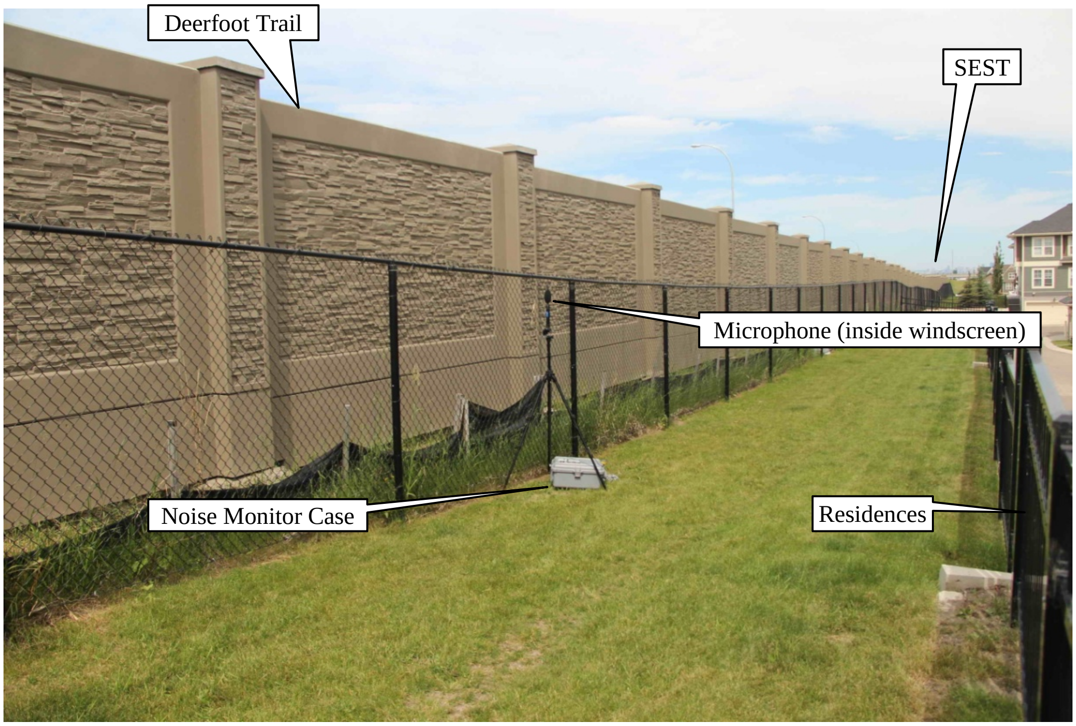


Figure 16. Noise Monitor at Location 15

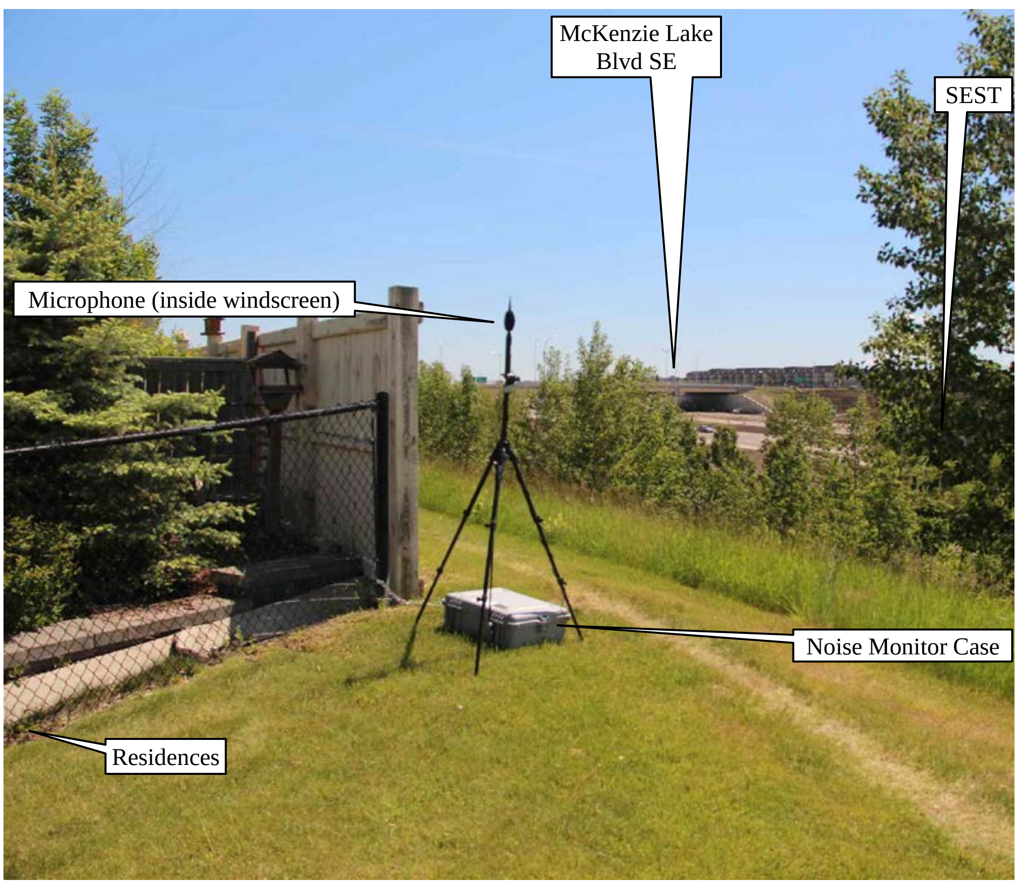


Figure 17. Noise Monitor at Location 16

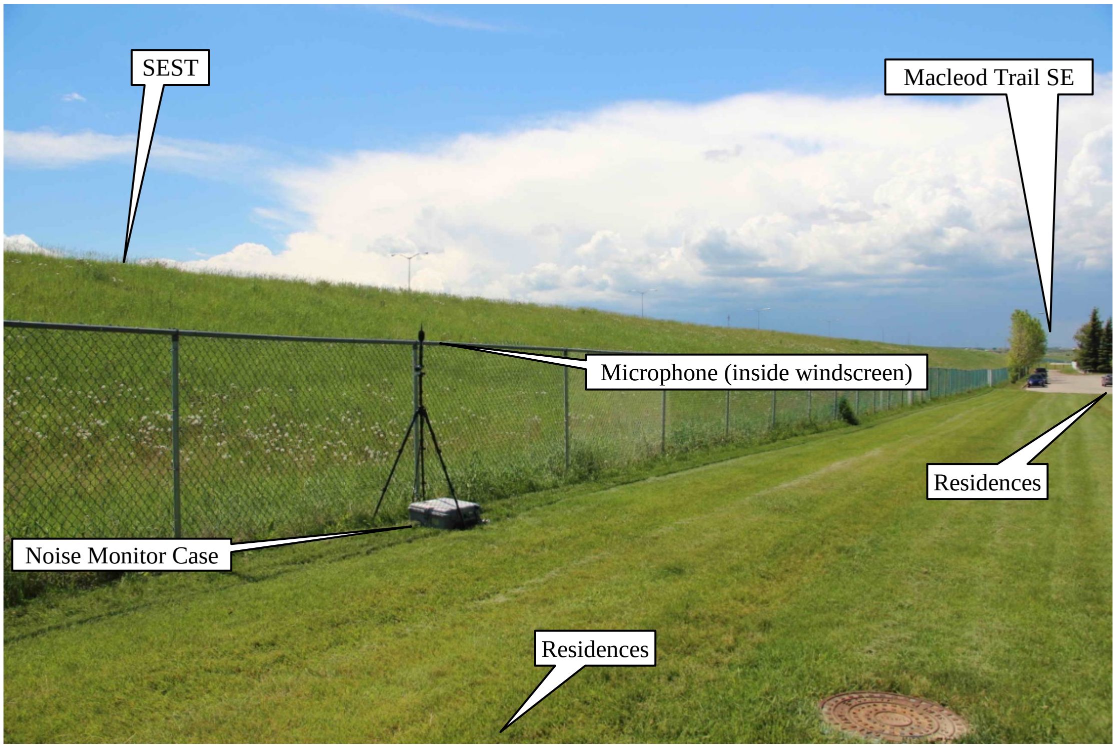


Figure 18. Noise Monitor at Location 17

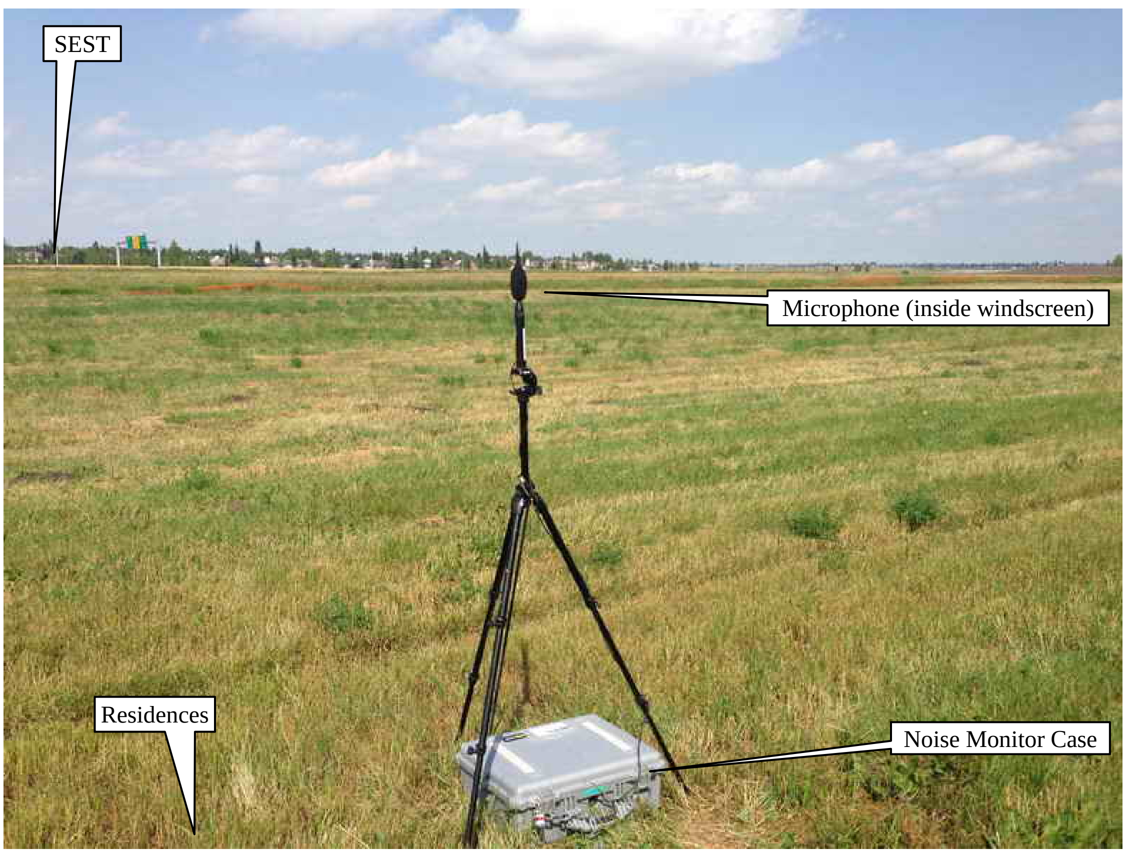


Figure 19. Noise Monitor at Location 18

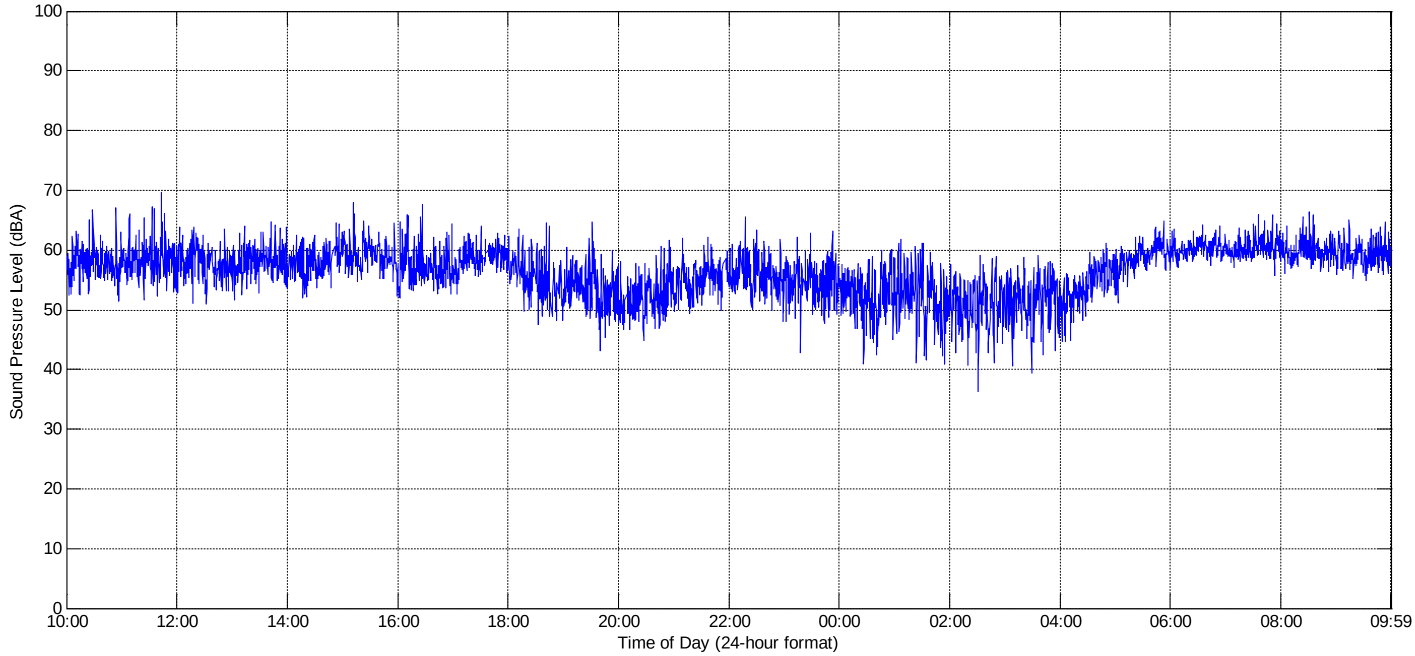


Figure 20. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 1

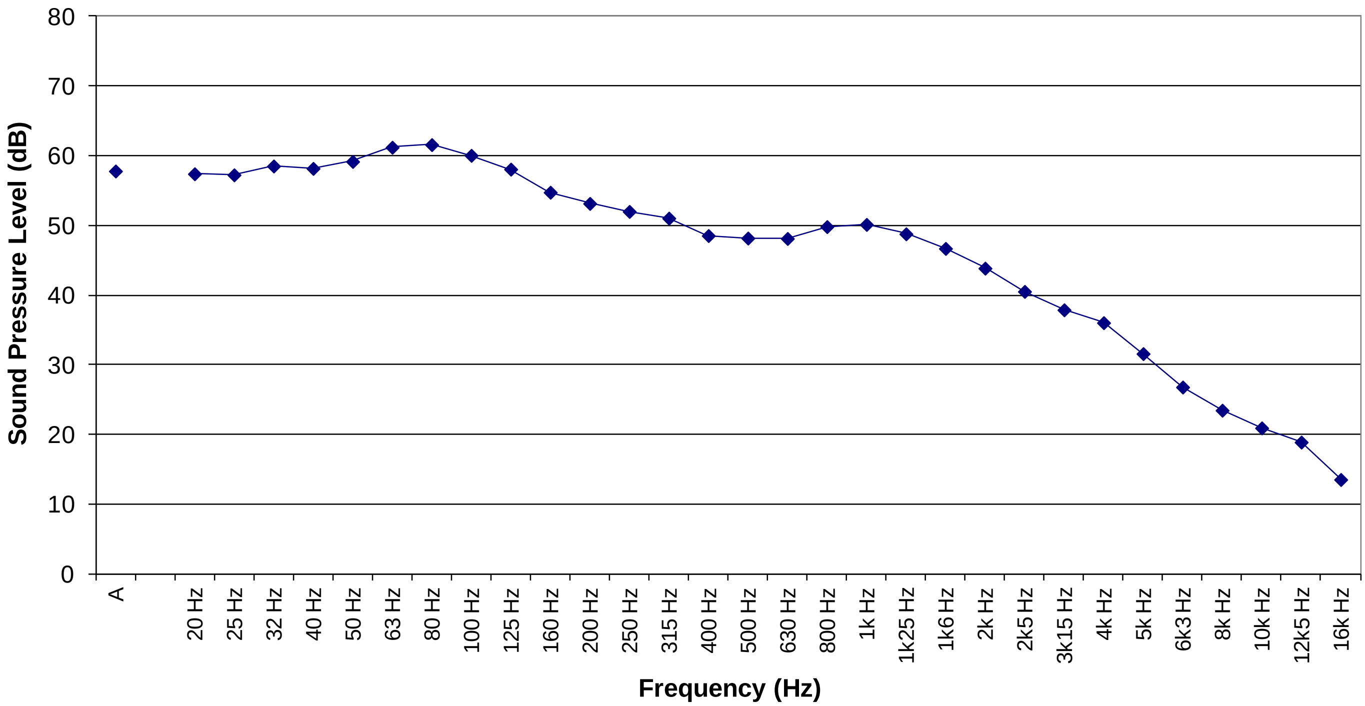


Figure 21. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 1

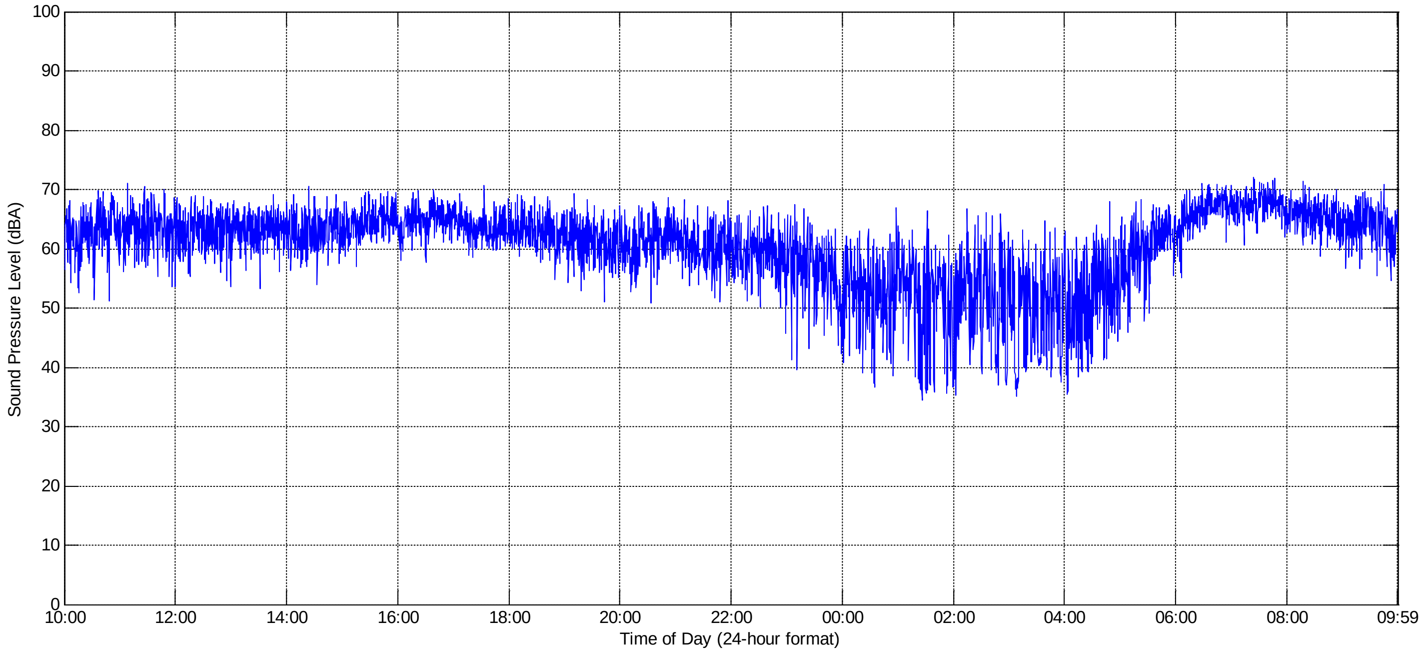


Figure 22. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 2

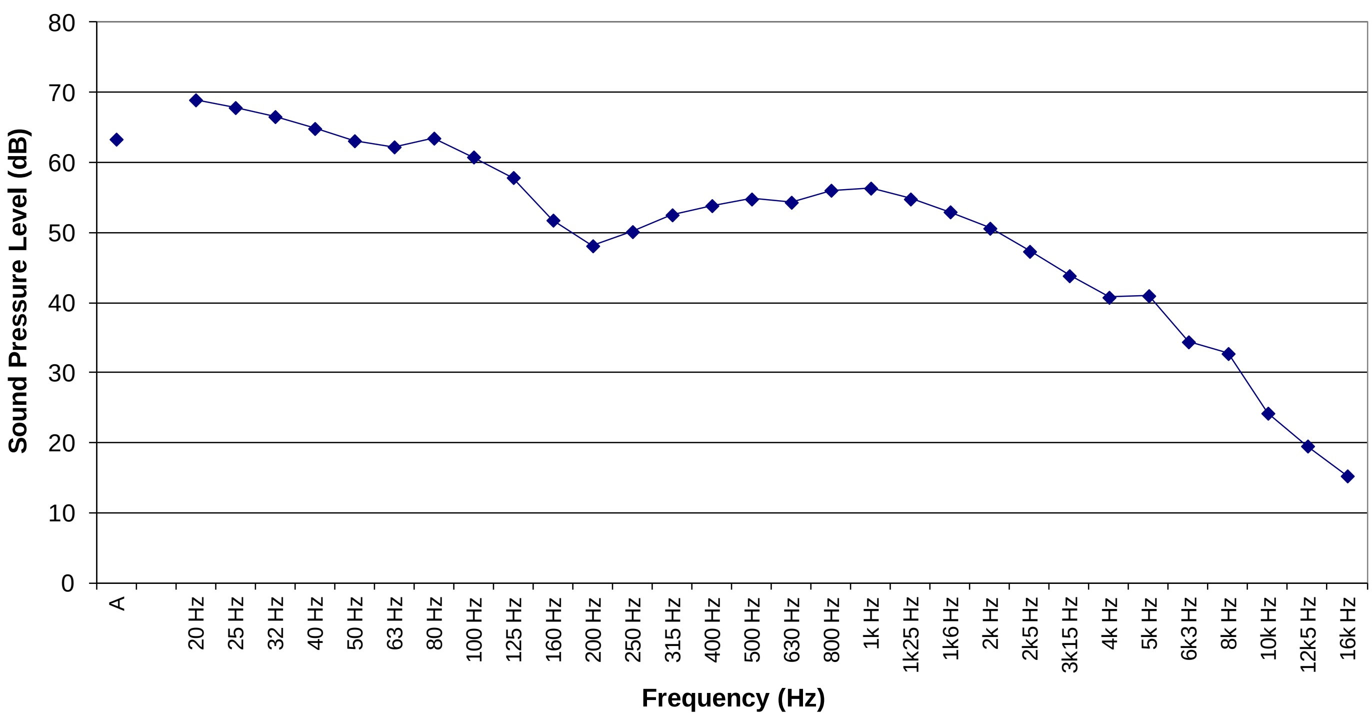


Figure 23. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 2

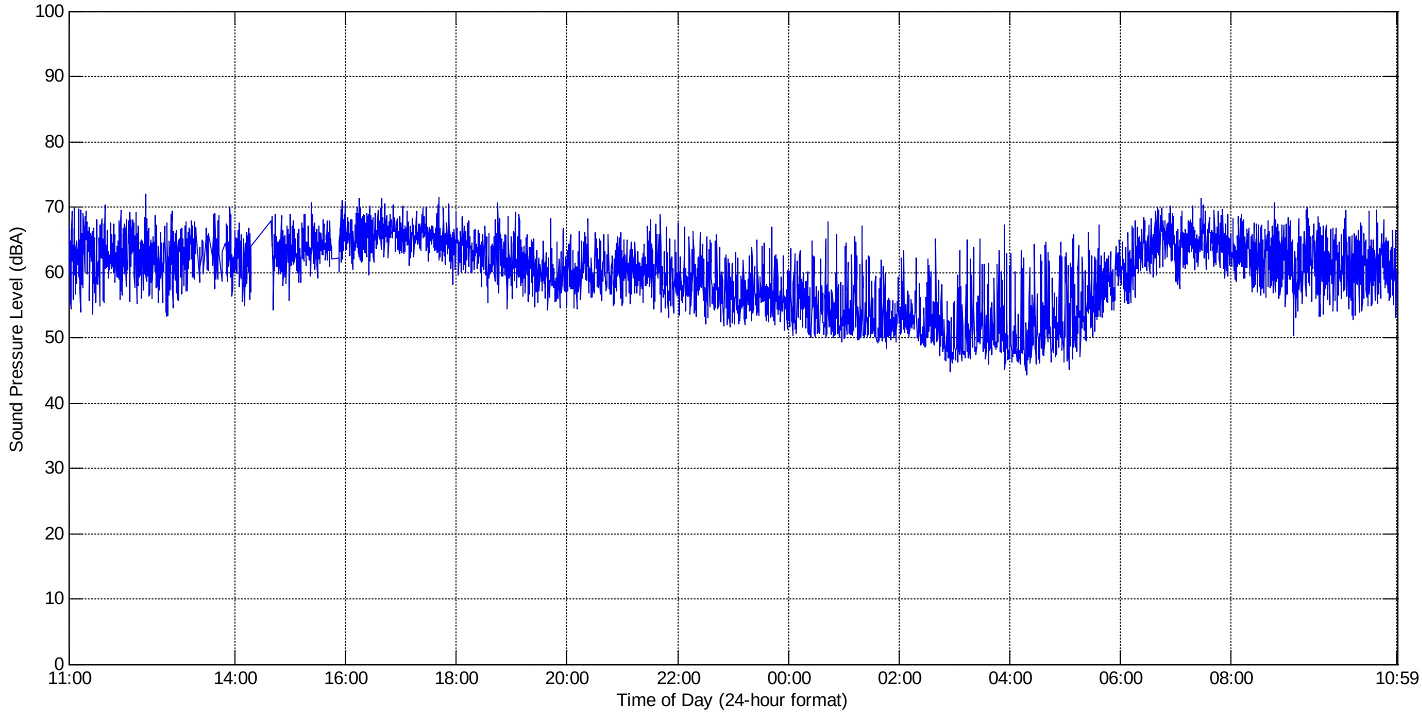


Figure 24. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 3

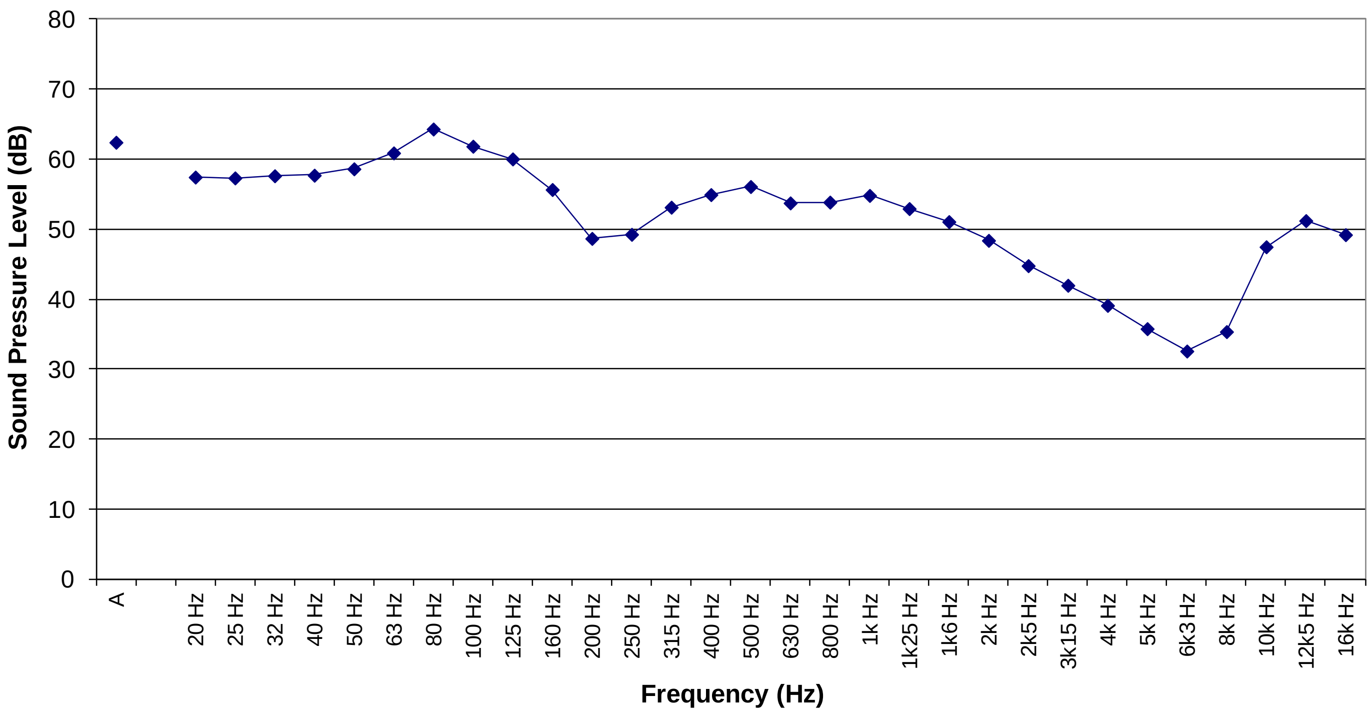


Figure 25. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 3

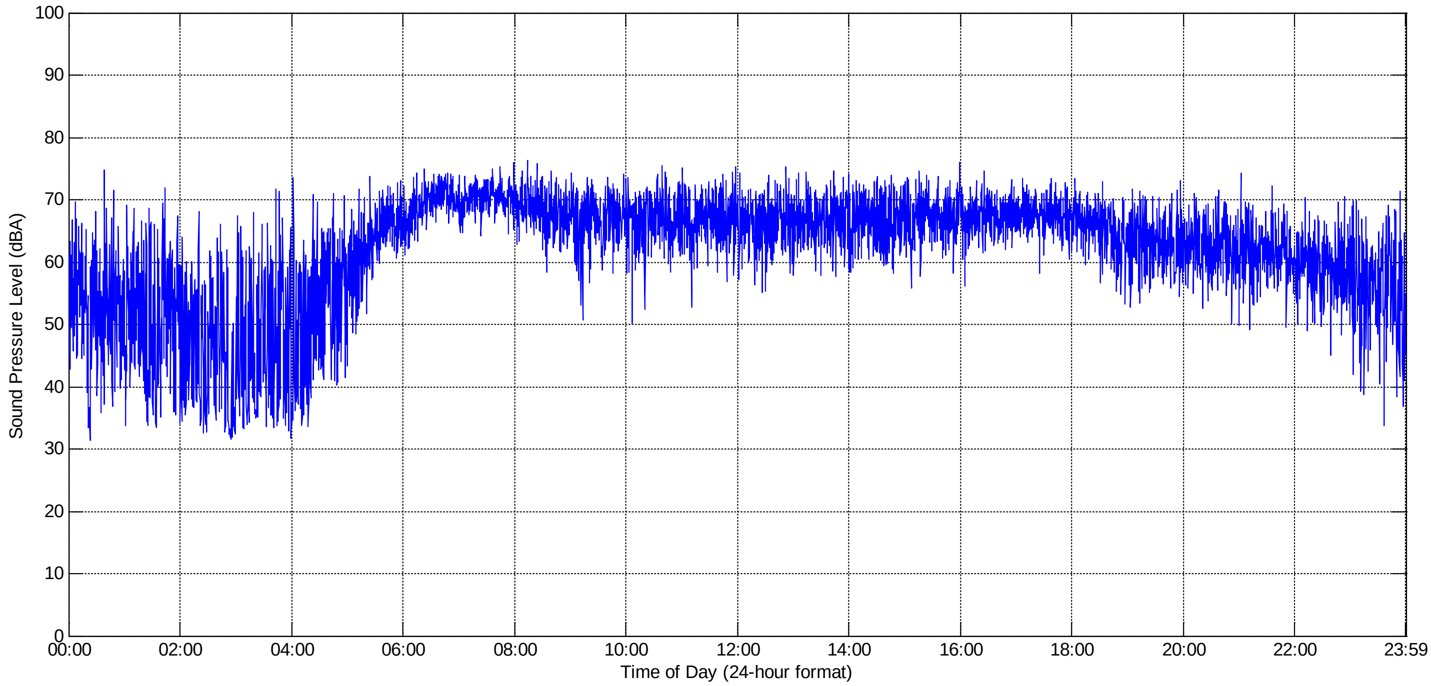


Figure 26. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 4

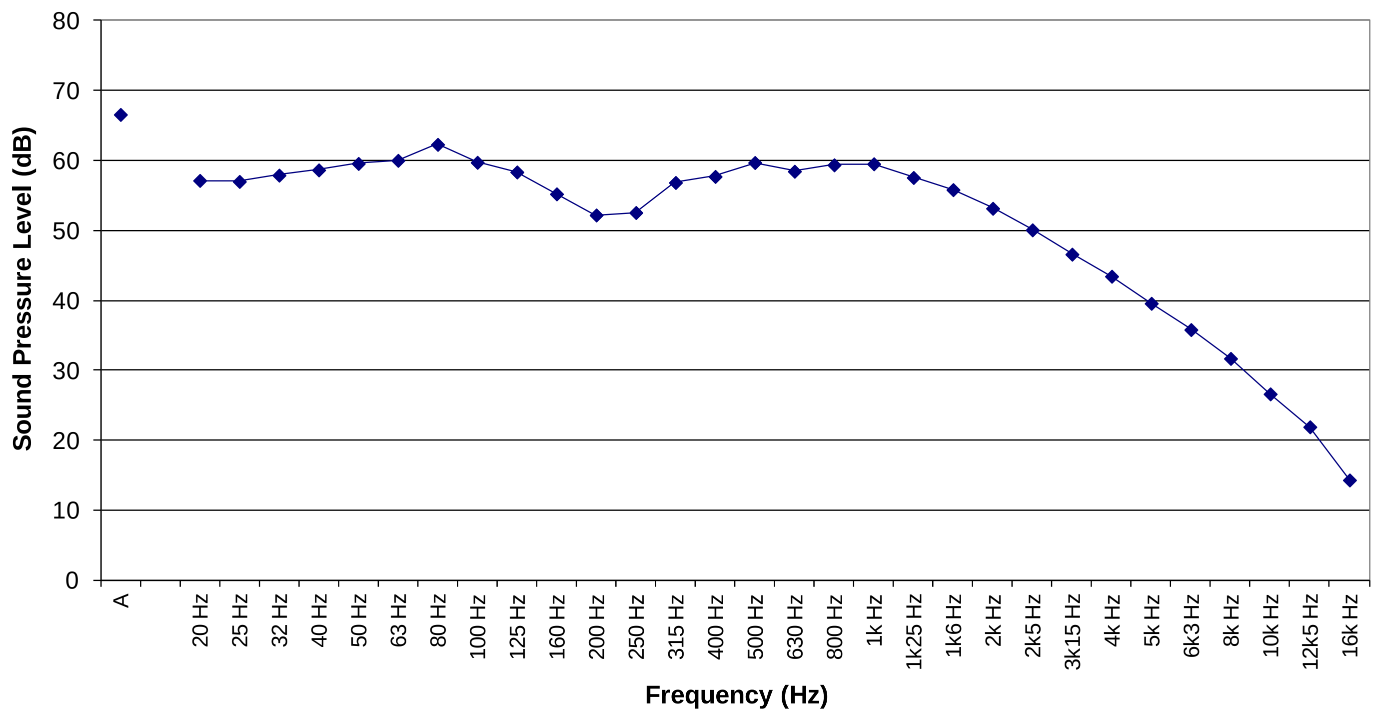


Figure 27. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 4

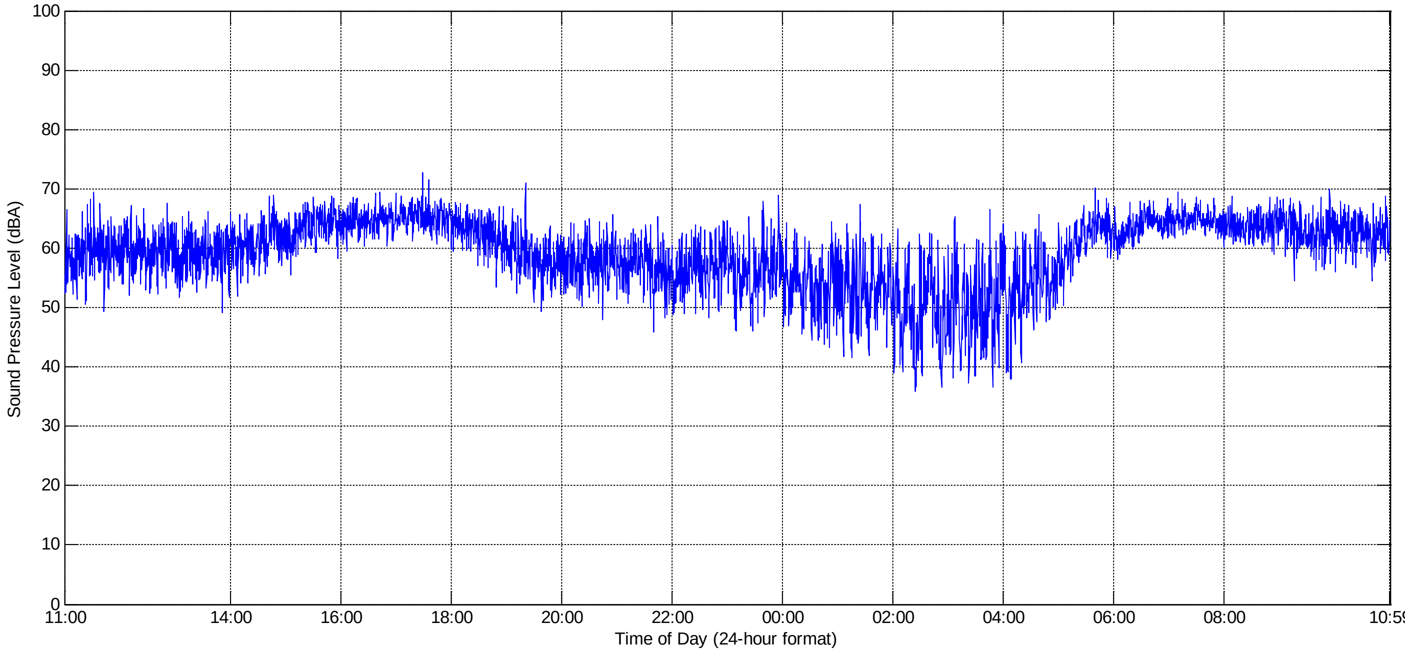


Figure 28. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 5

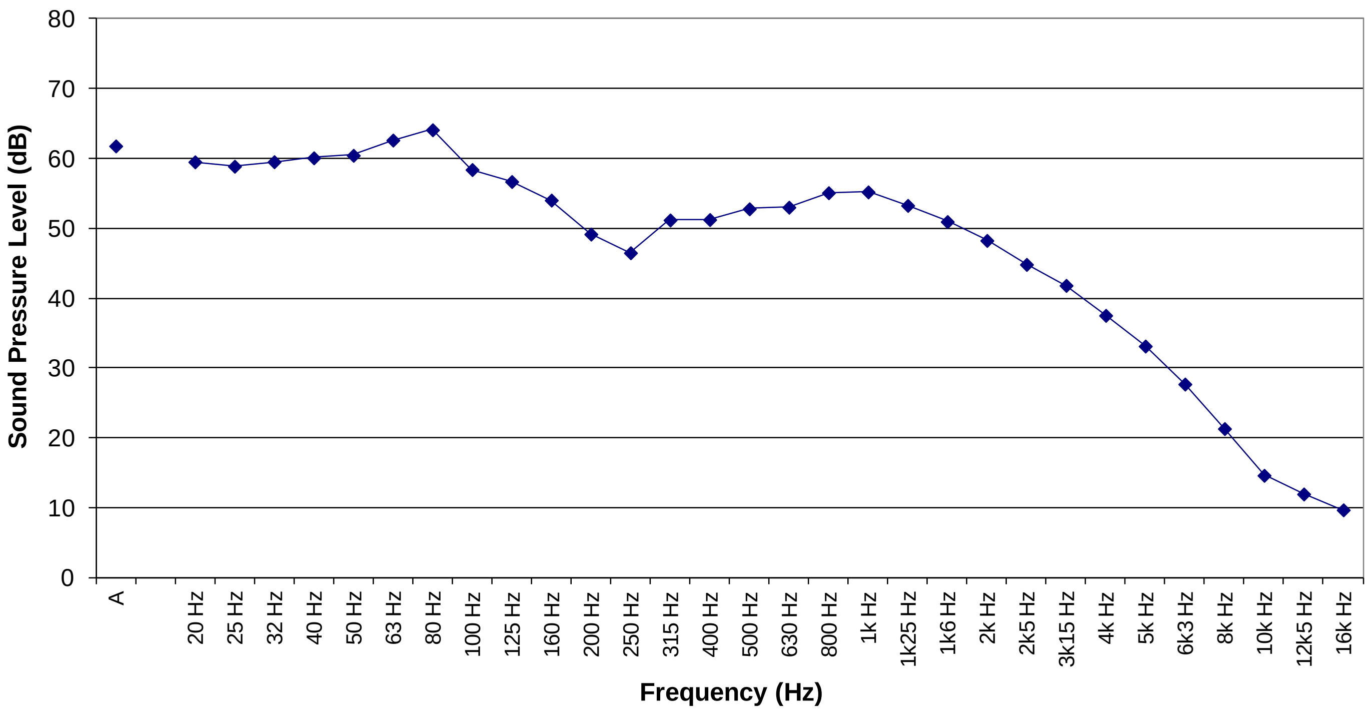


Figure 29. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 5

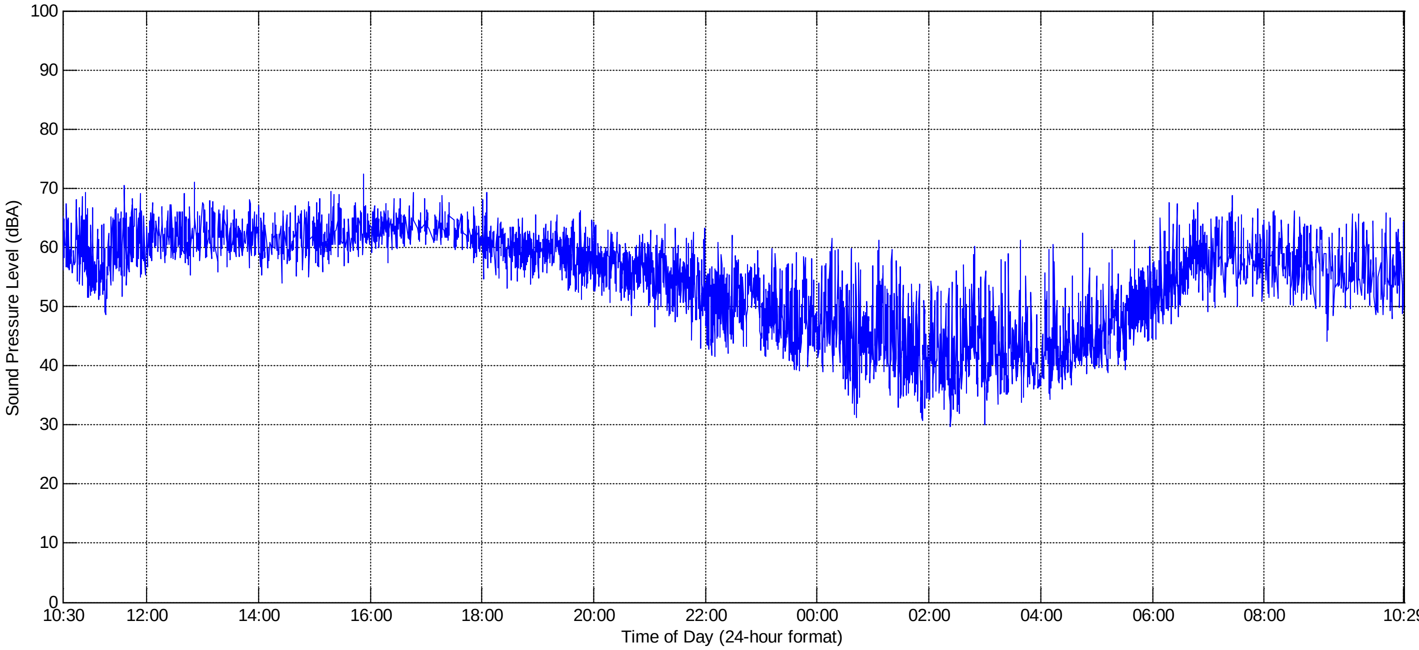


Figure 30. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 6

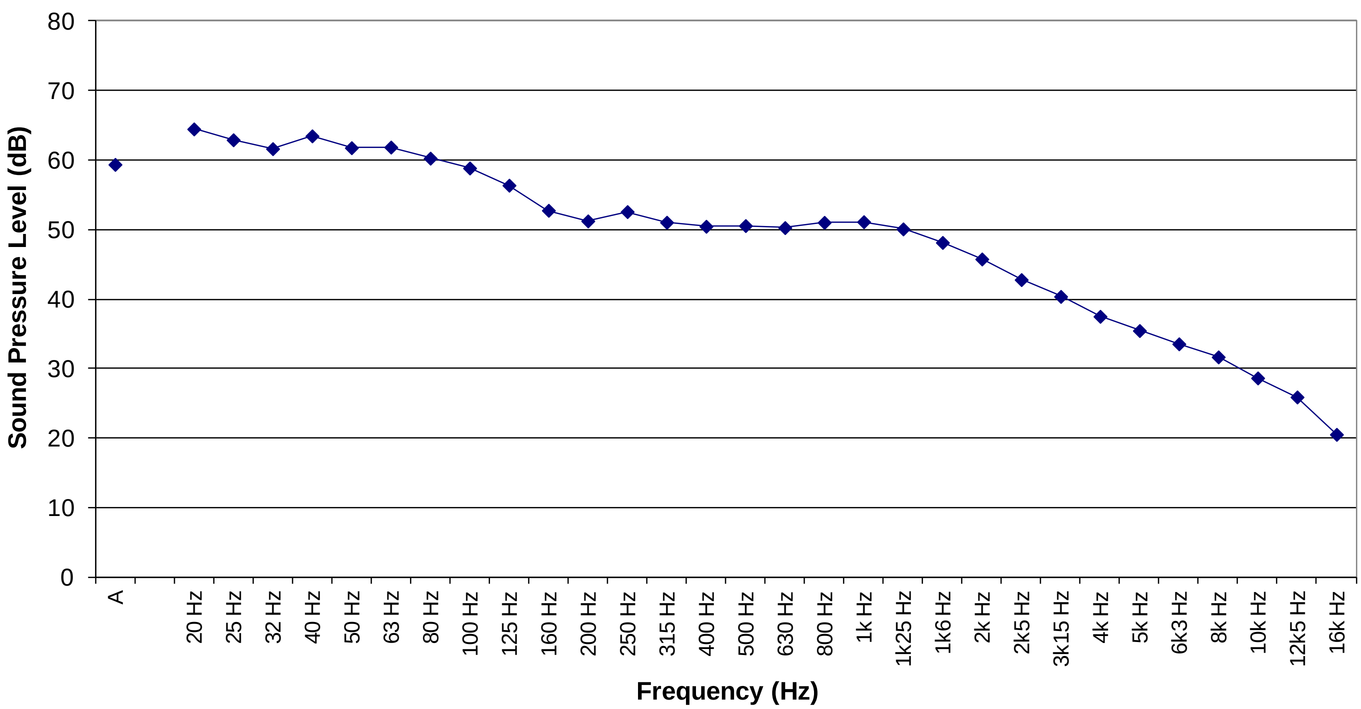


Figure 31. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 6

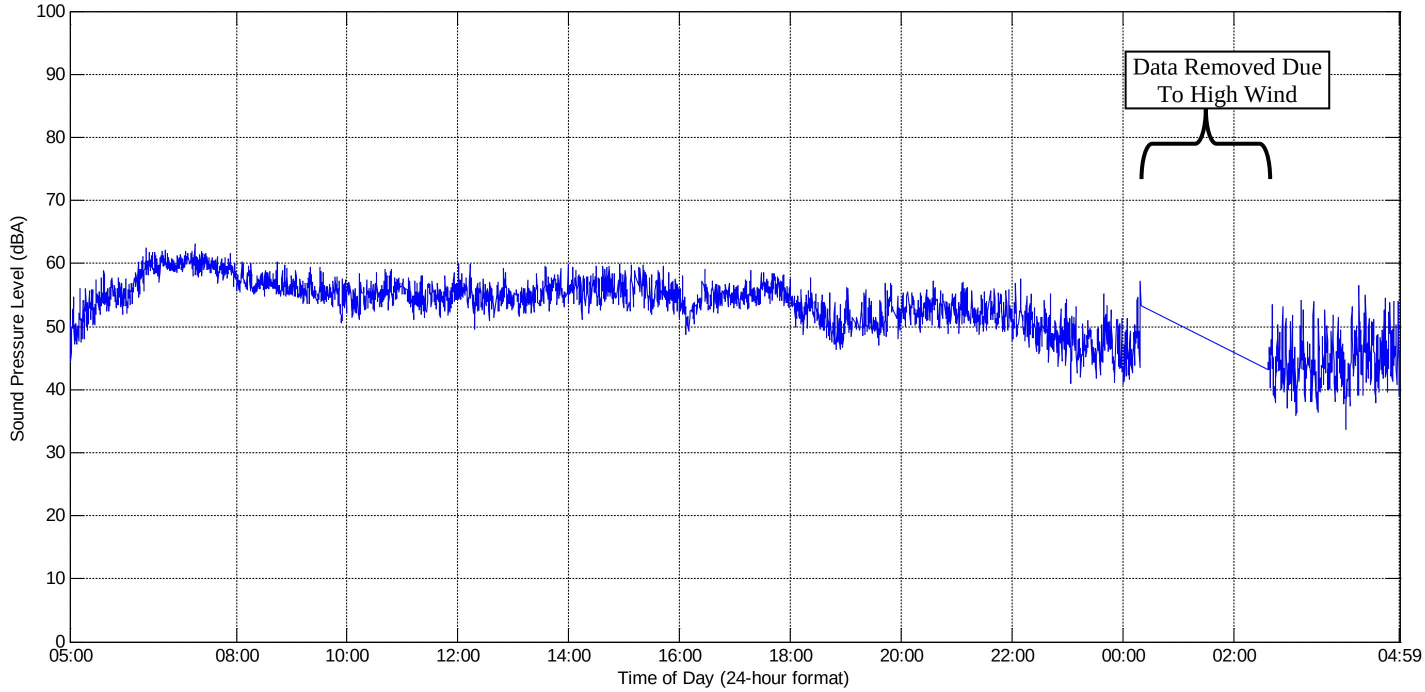


Figure 32. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 7

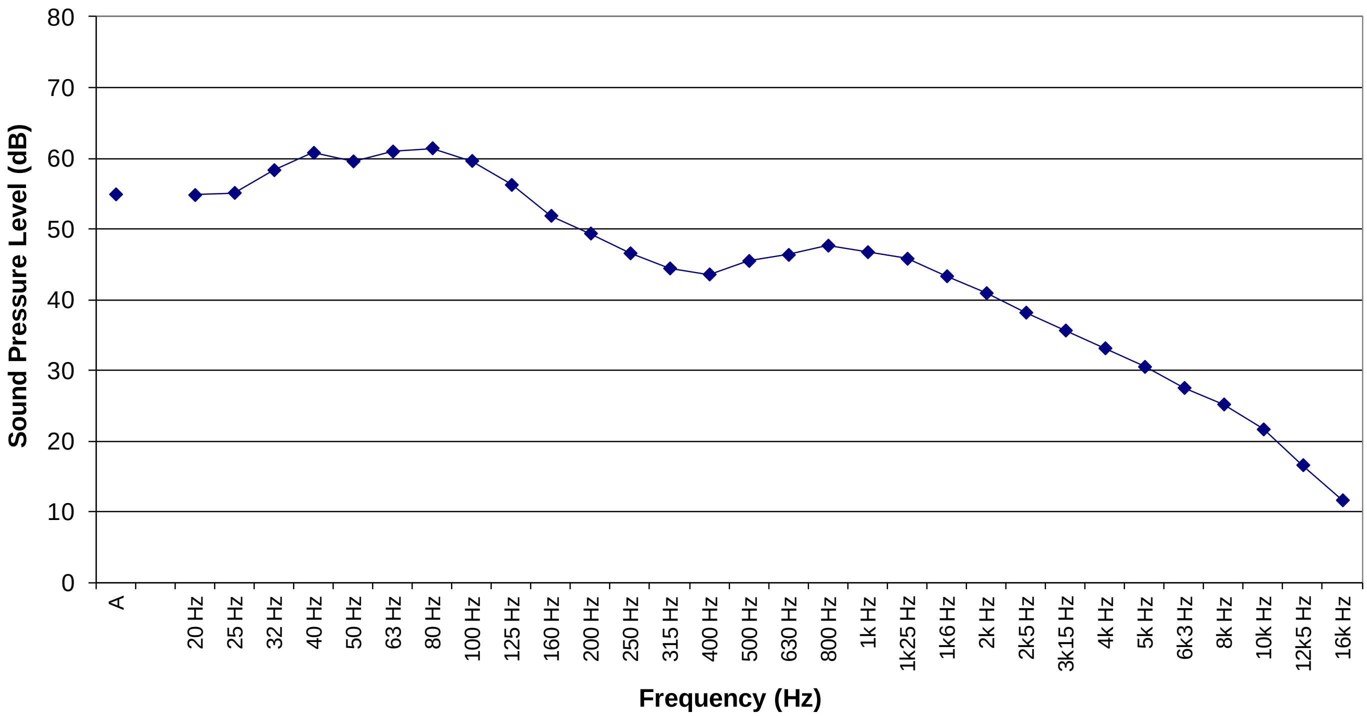


Figure 33. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 7

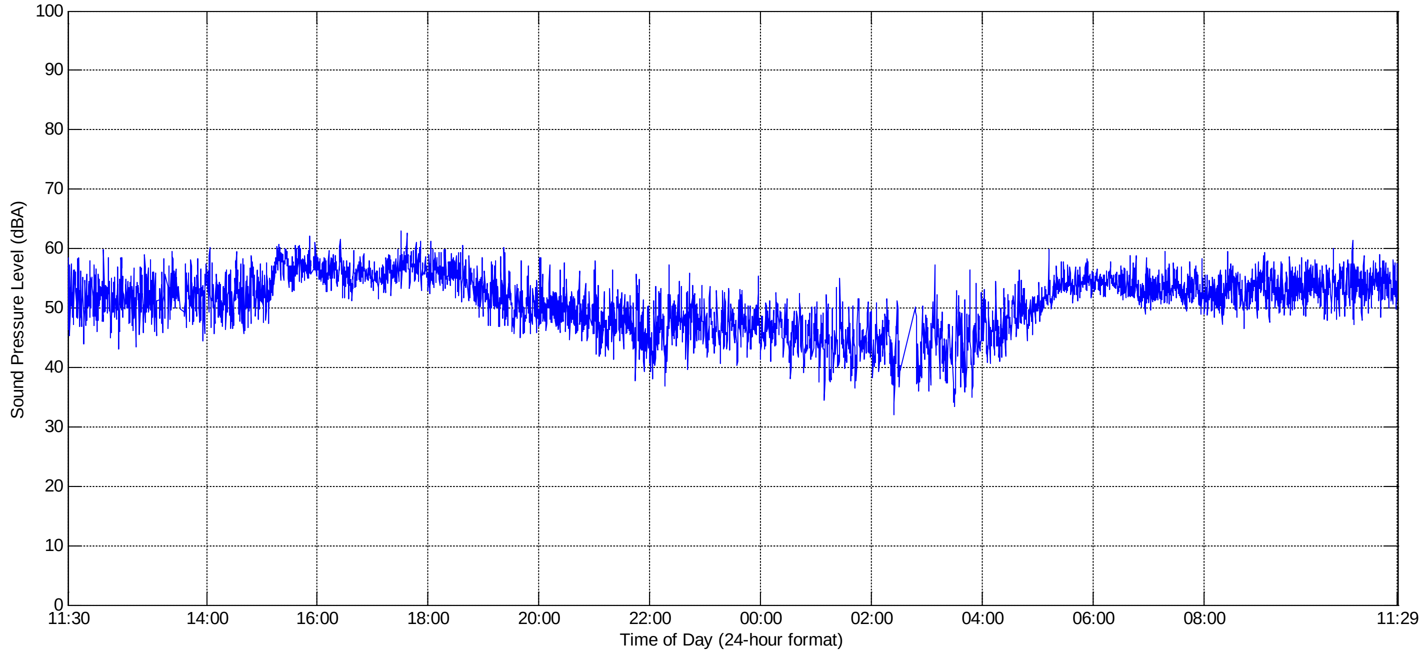


Figure 34. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 8

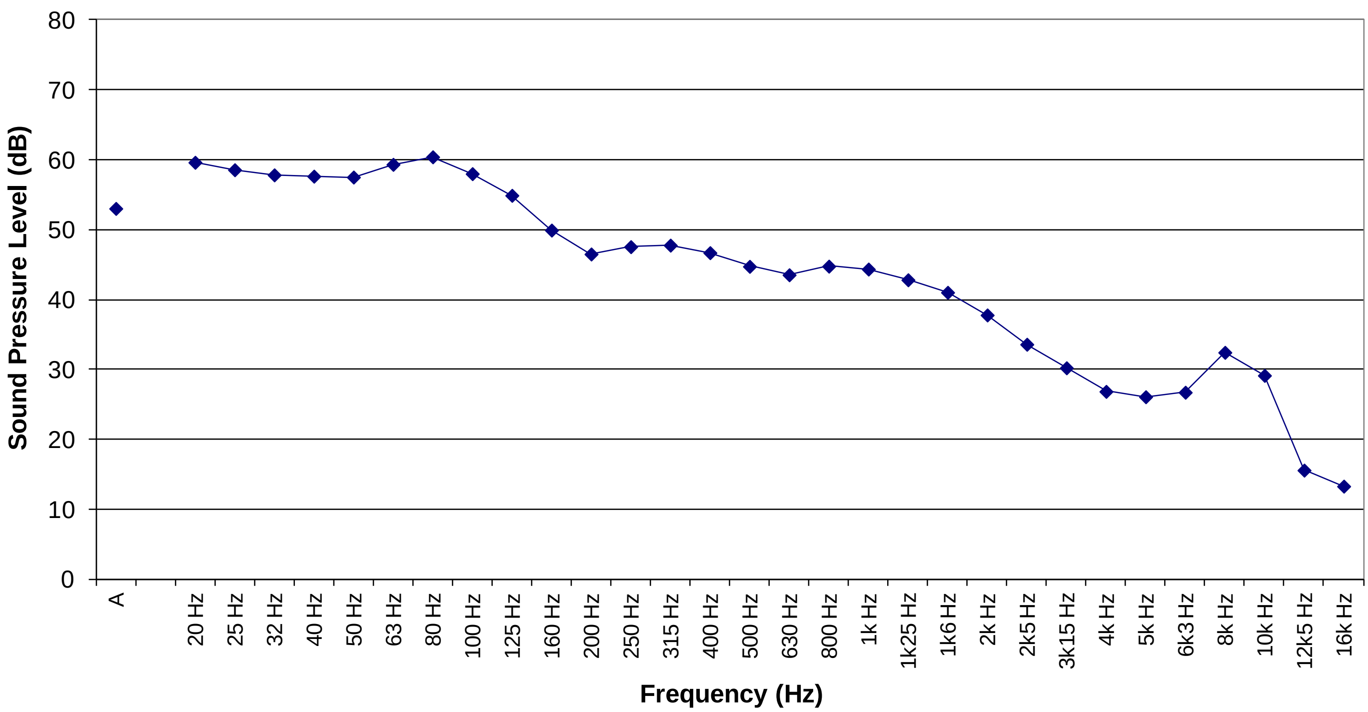


Figure 35. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 8

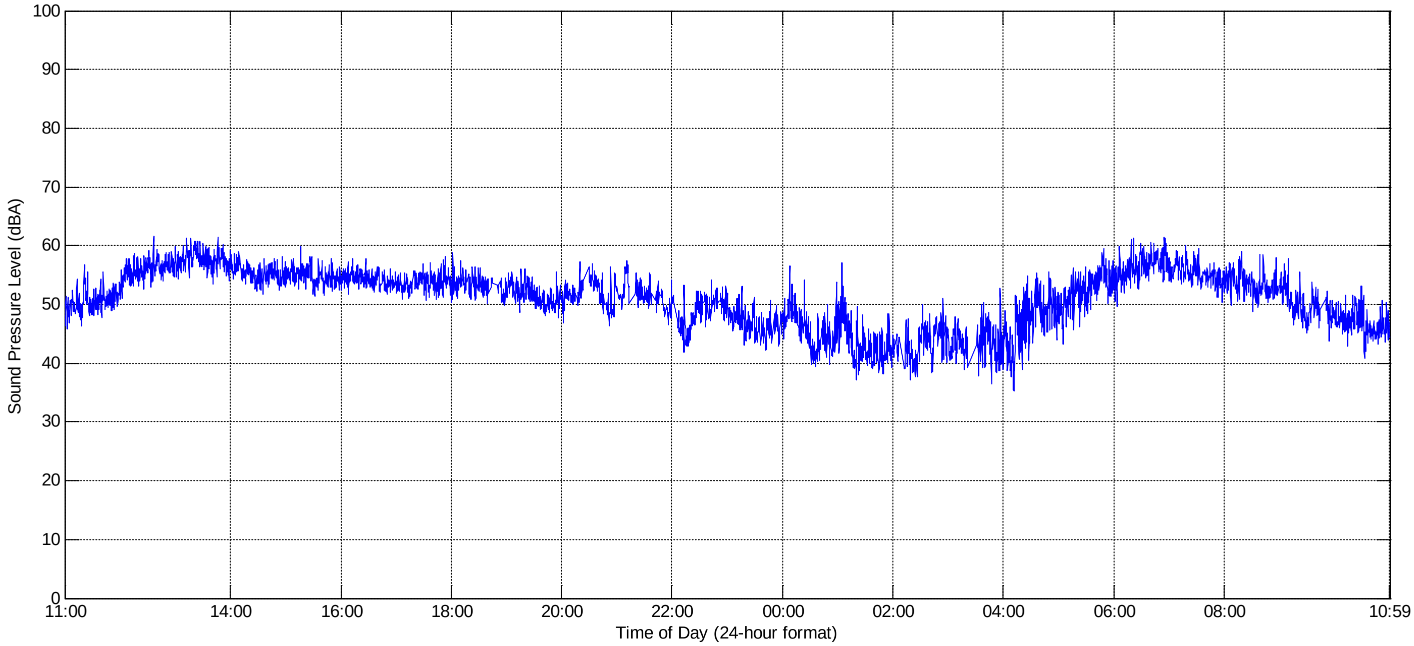


Figure 36. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 9

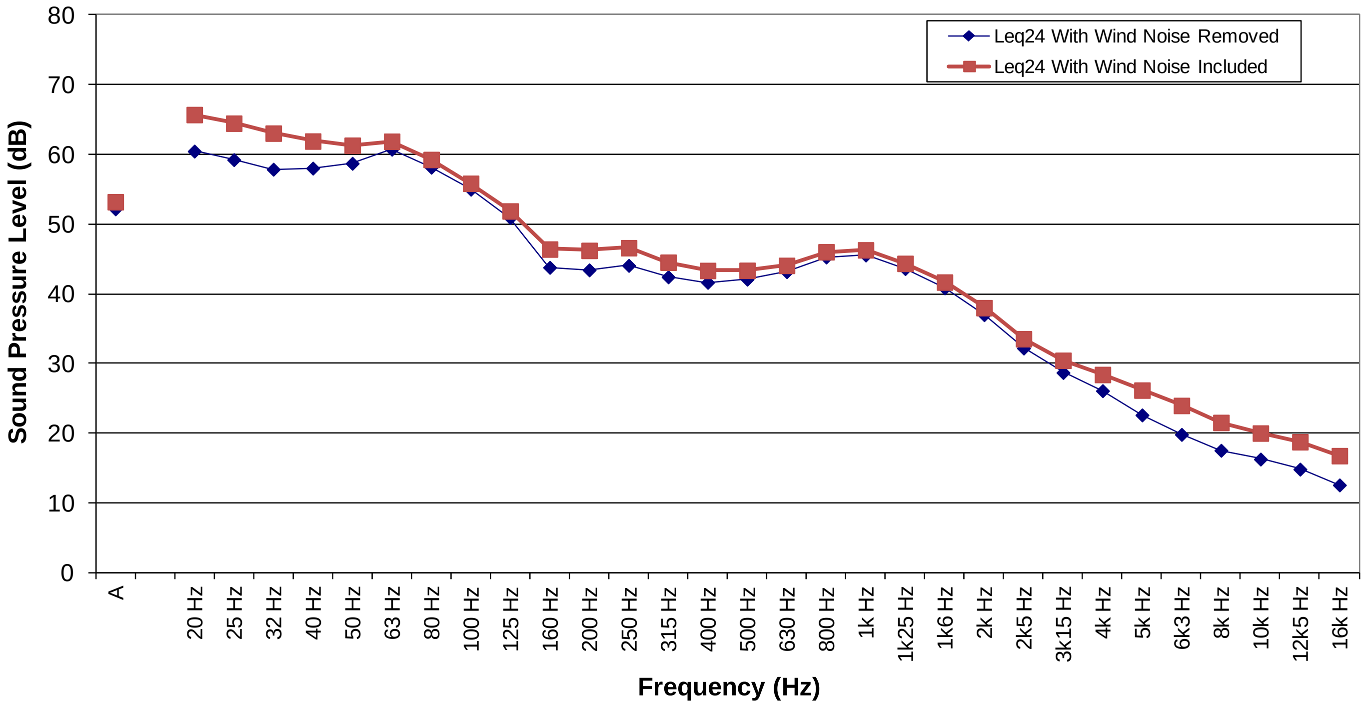


Figure 37. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 9

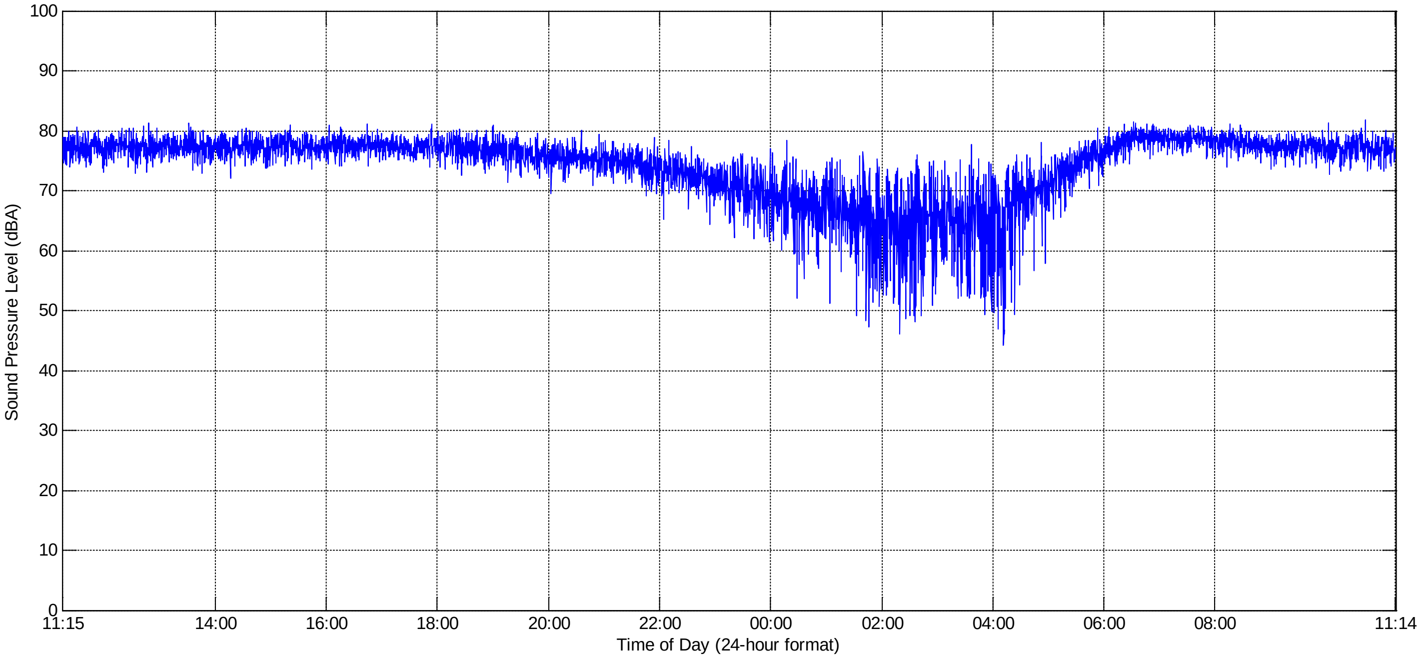


Figure 38. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 10

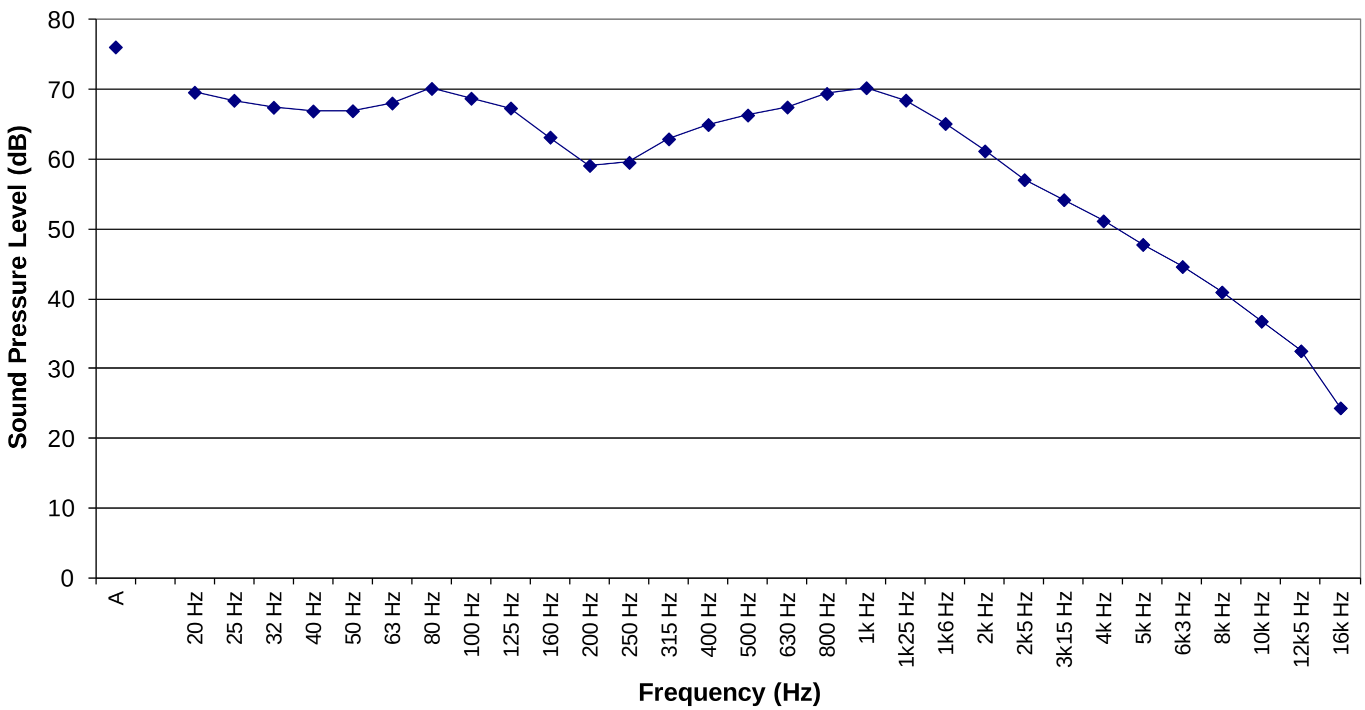


Figure 39. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 10

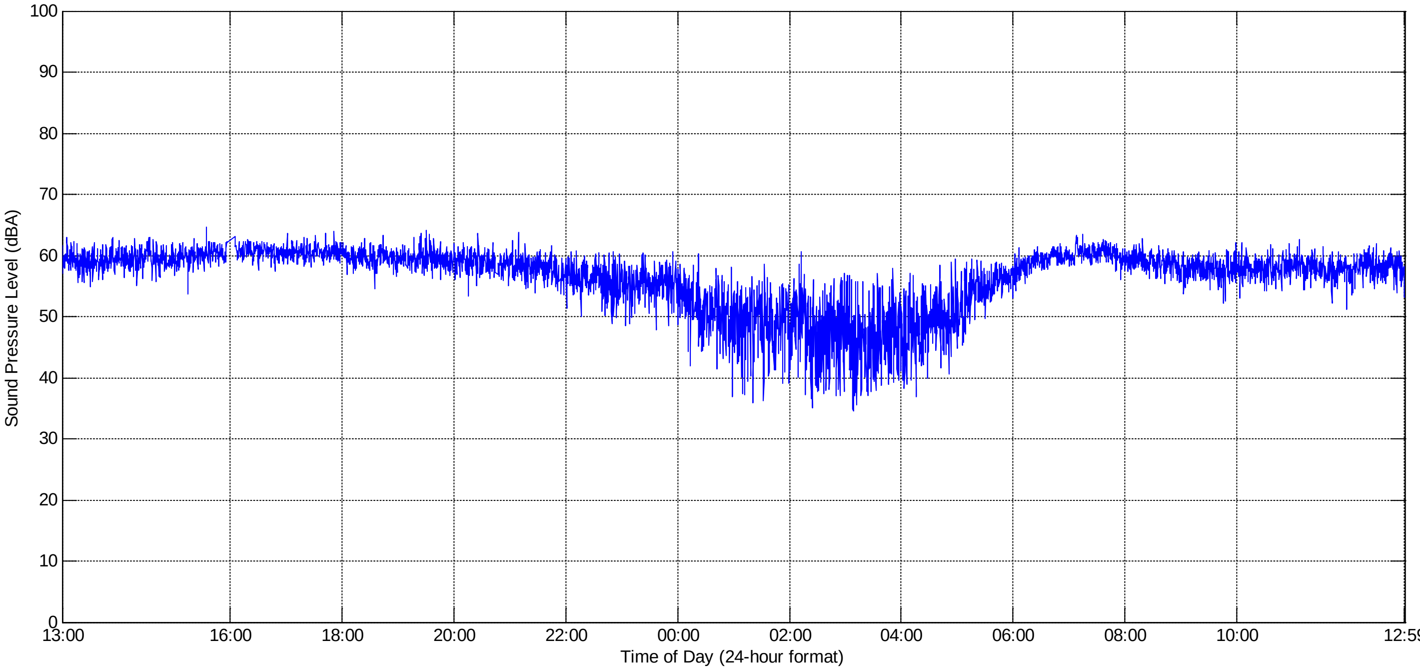


Figure 40. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 11

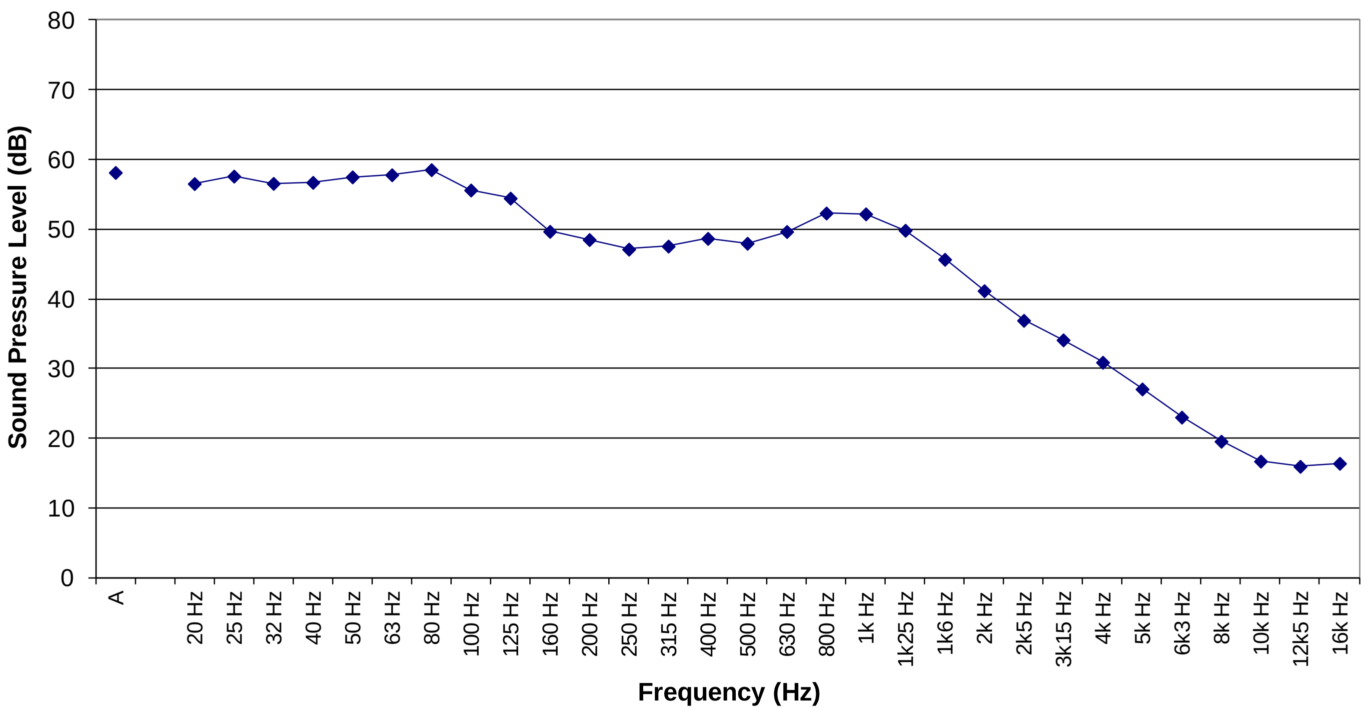


Figure 41. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 11

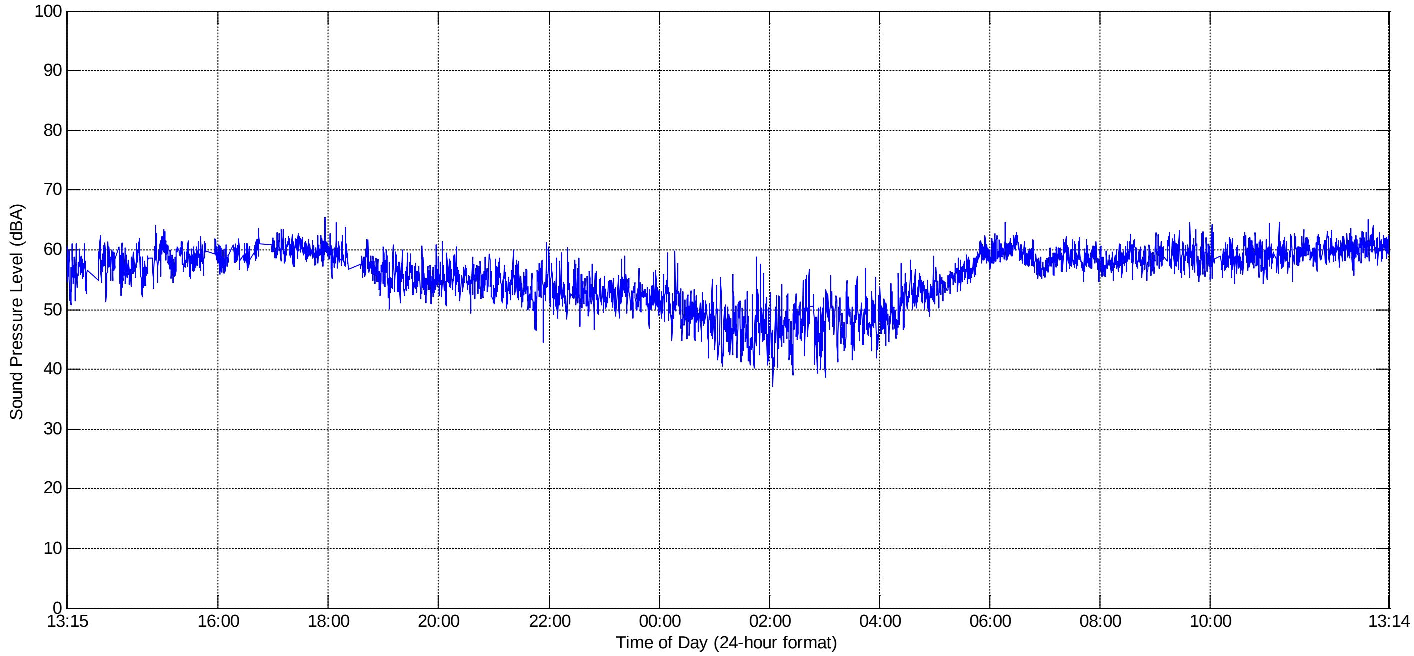


Figure 42. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 12

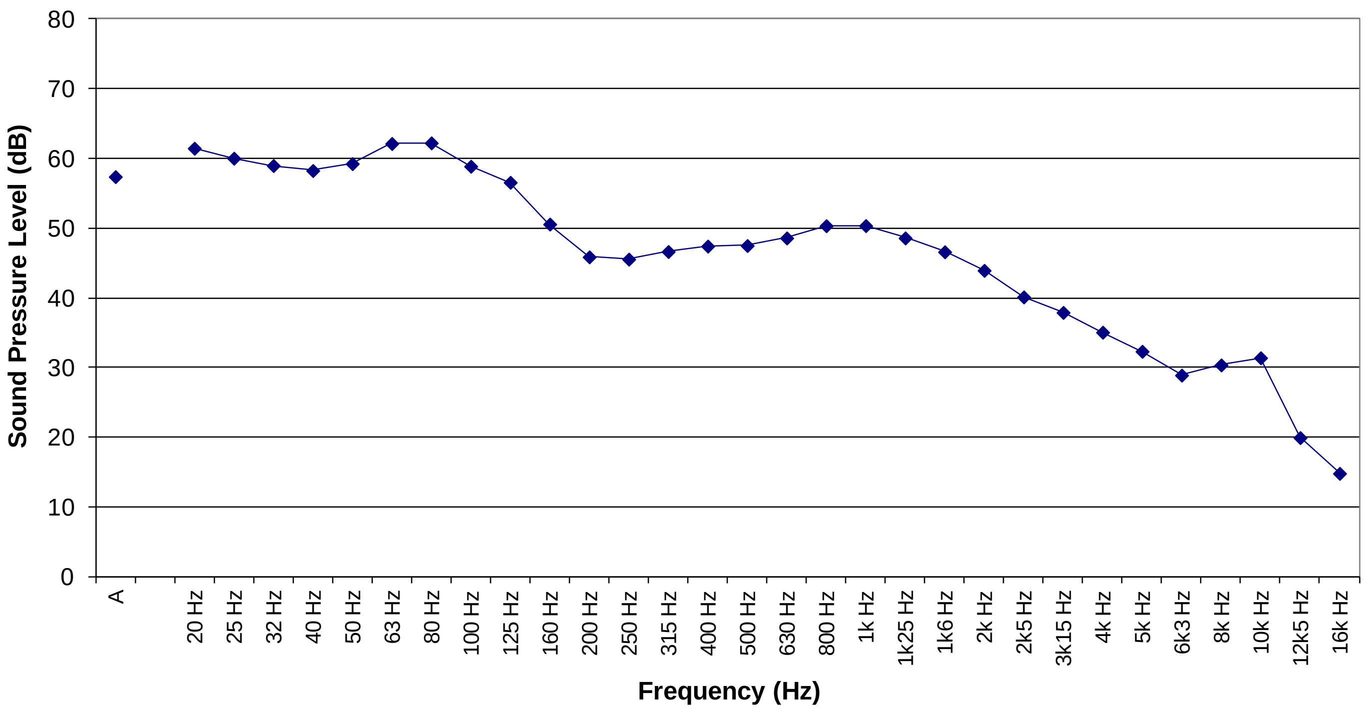


Figure 43. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 12

acoustical consultants inc

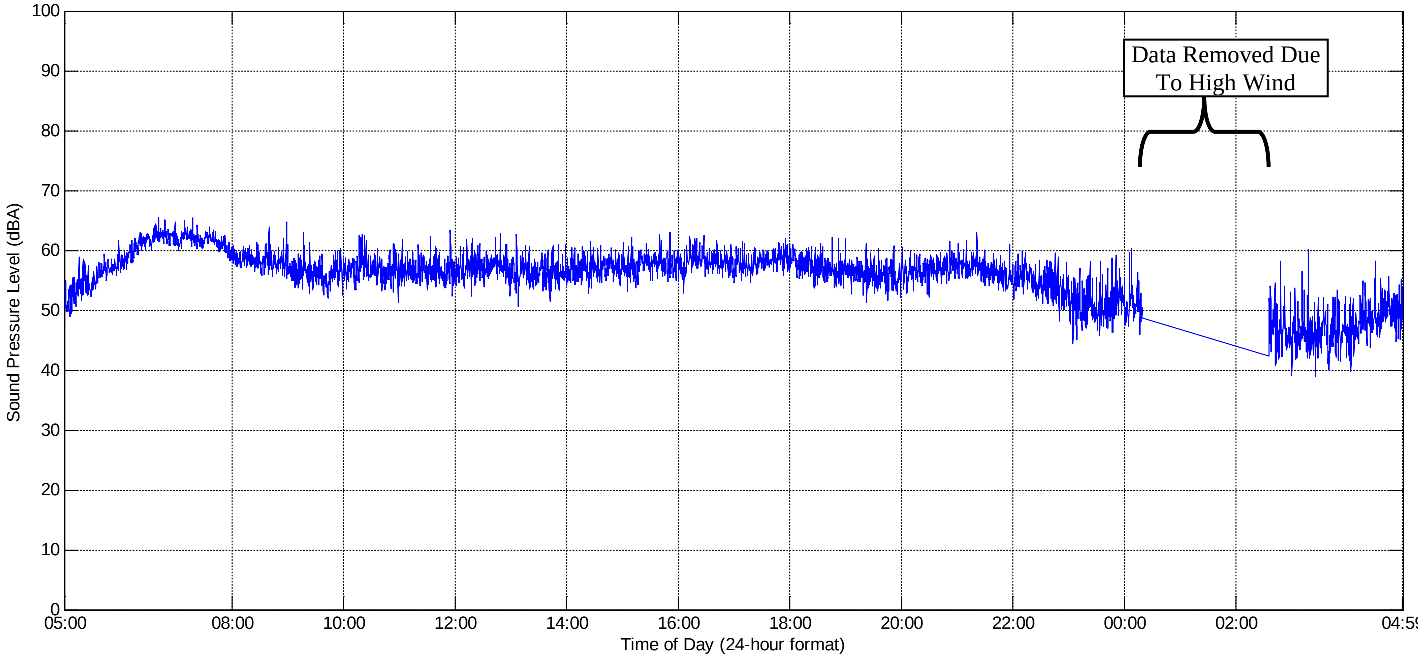


Figure 44. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 13

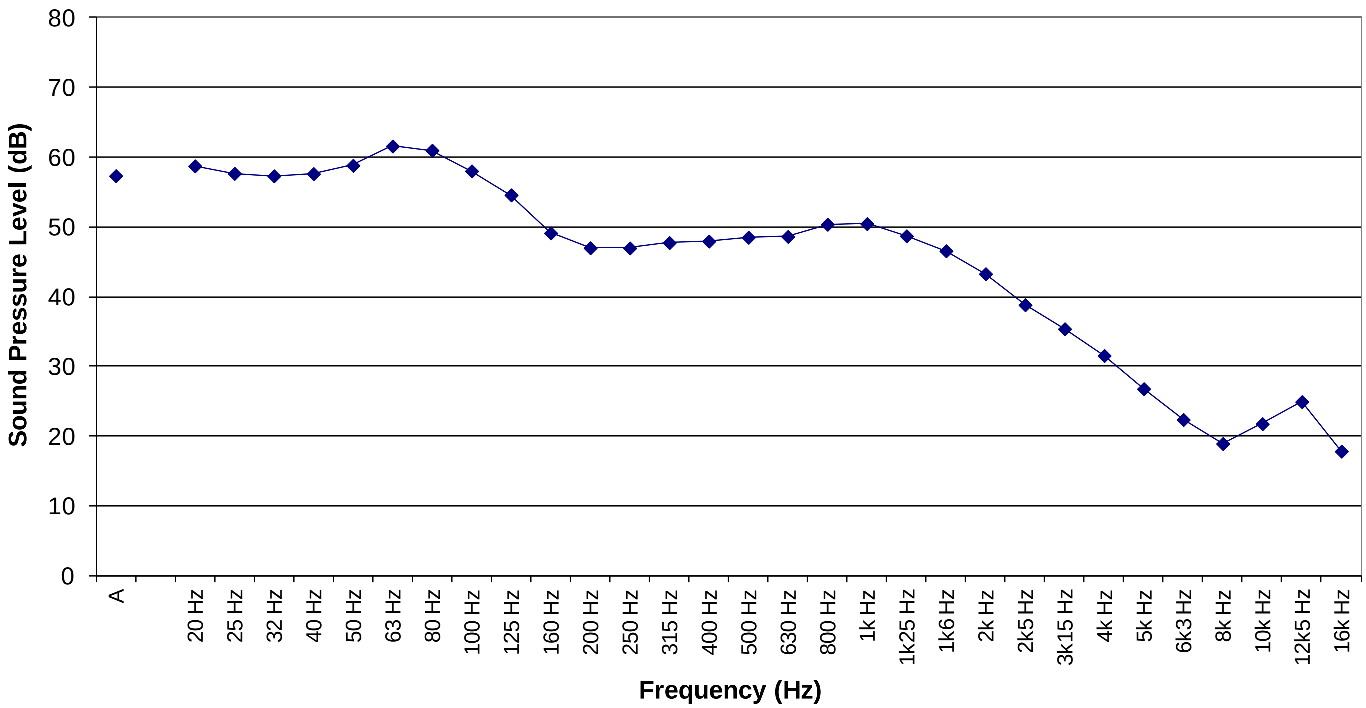


Figure 45. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 13

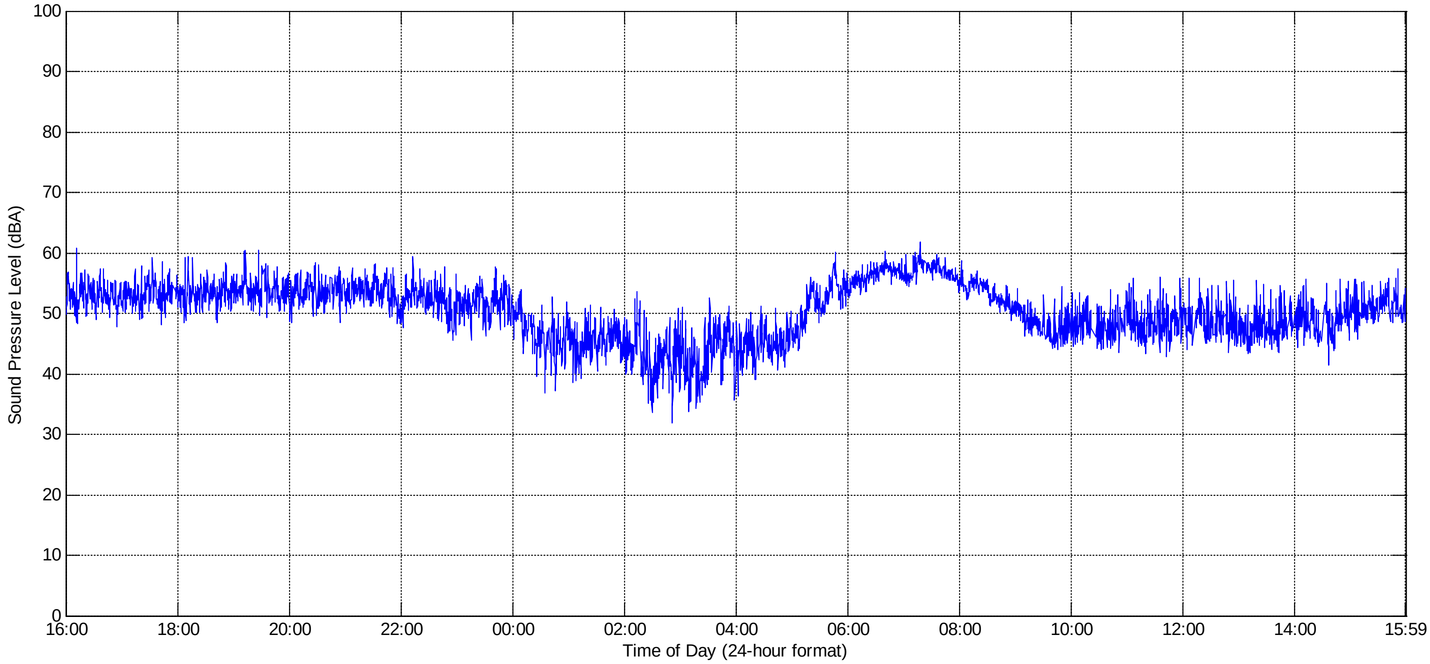


Figure 46. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 14

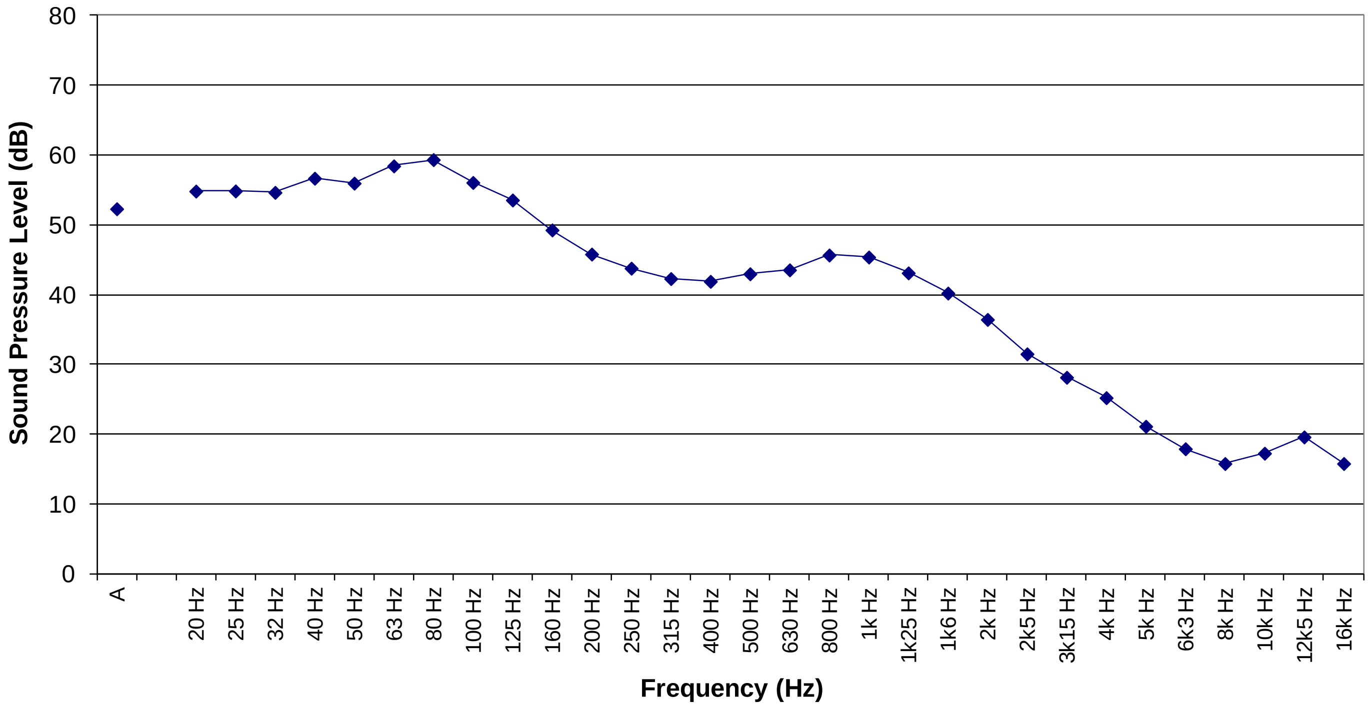


Figure 47. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 14

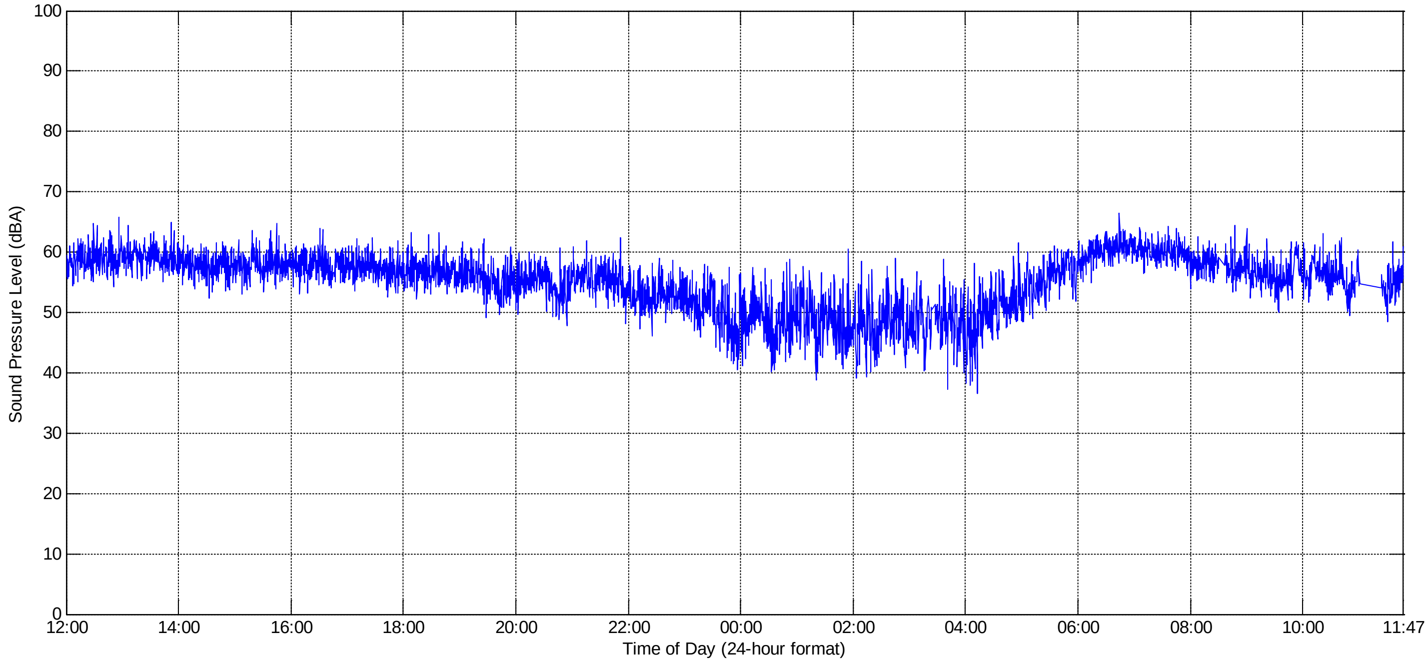


Figure 48. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 15

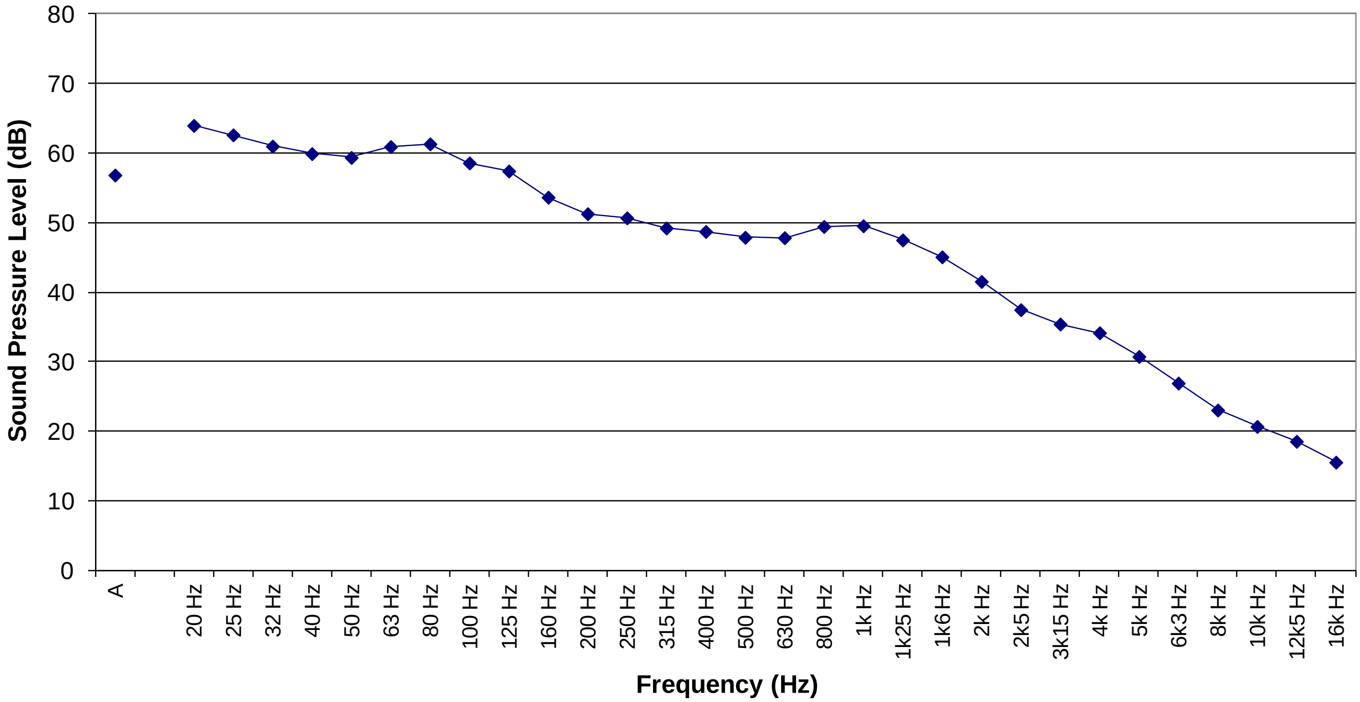


Figure 49. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 15

acoustical consultants inc

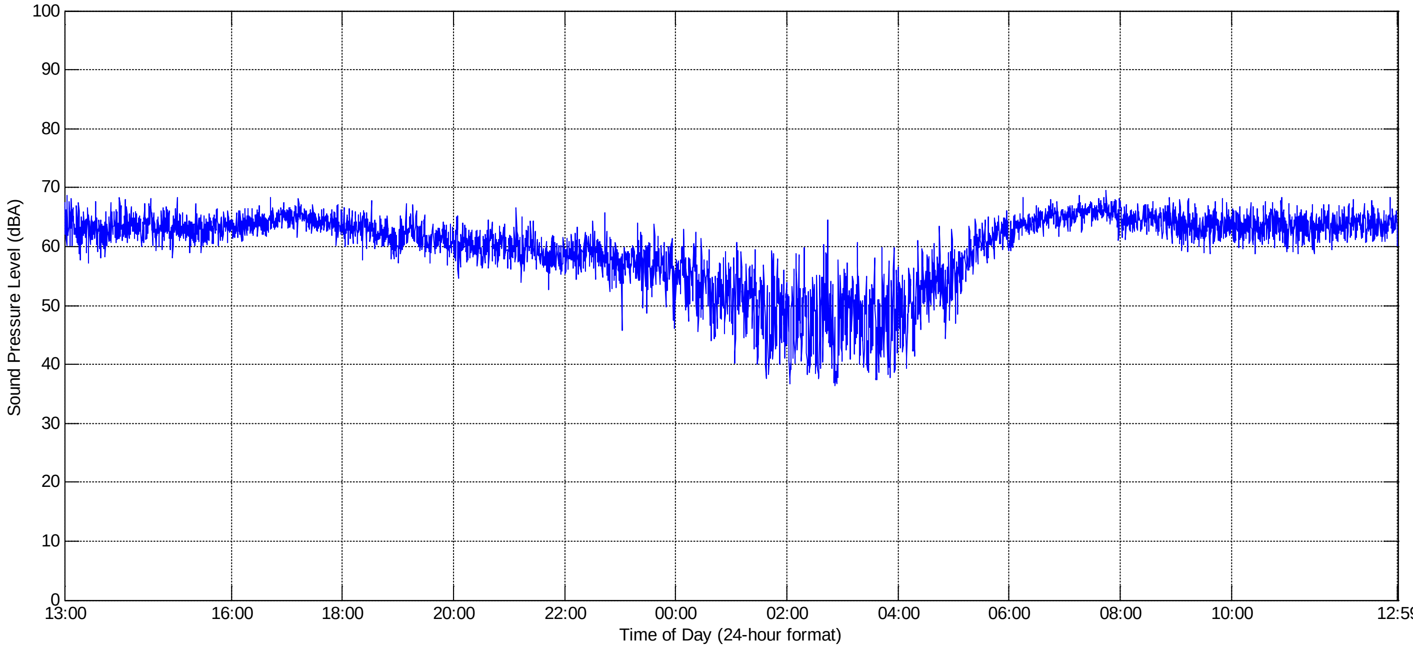


Figure 50. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 16

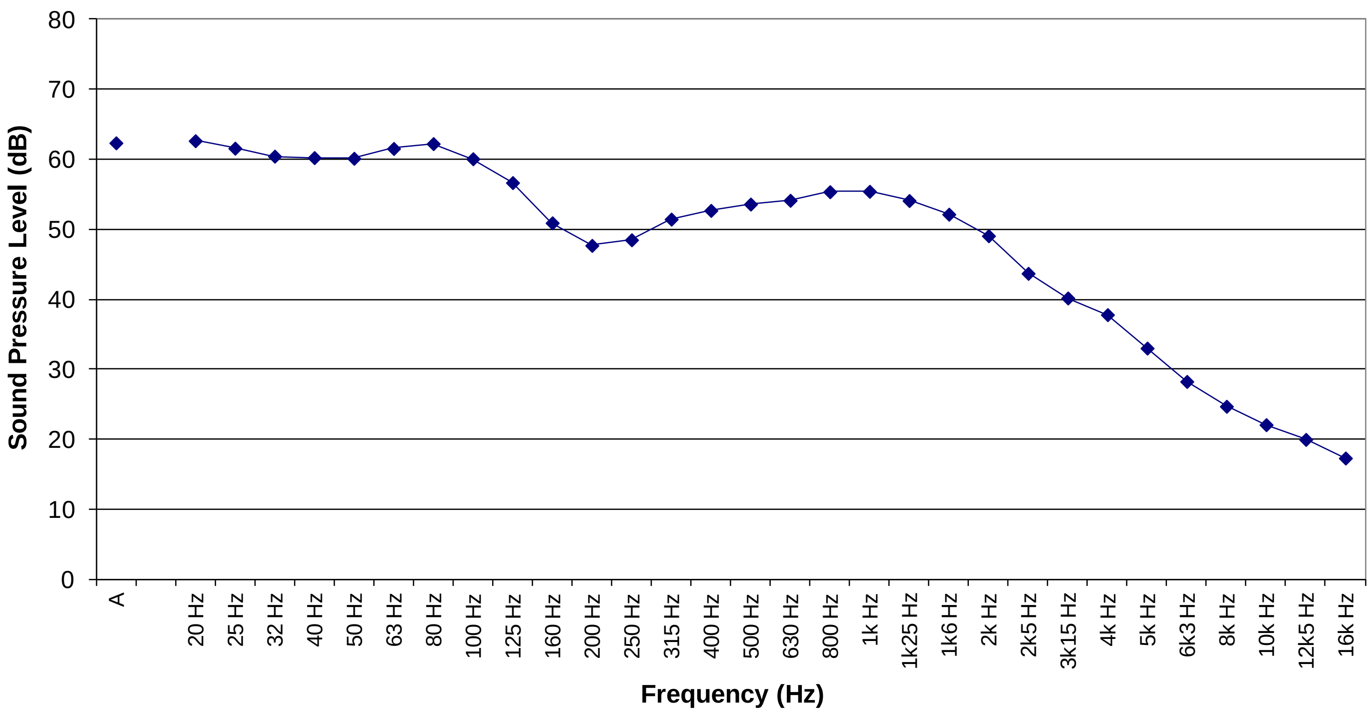


Figure 51. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 16

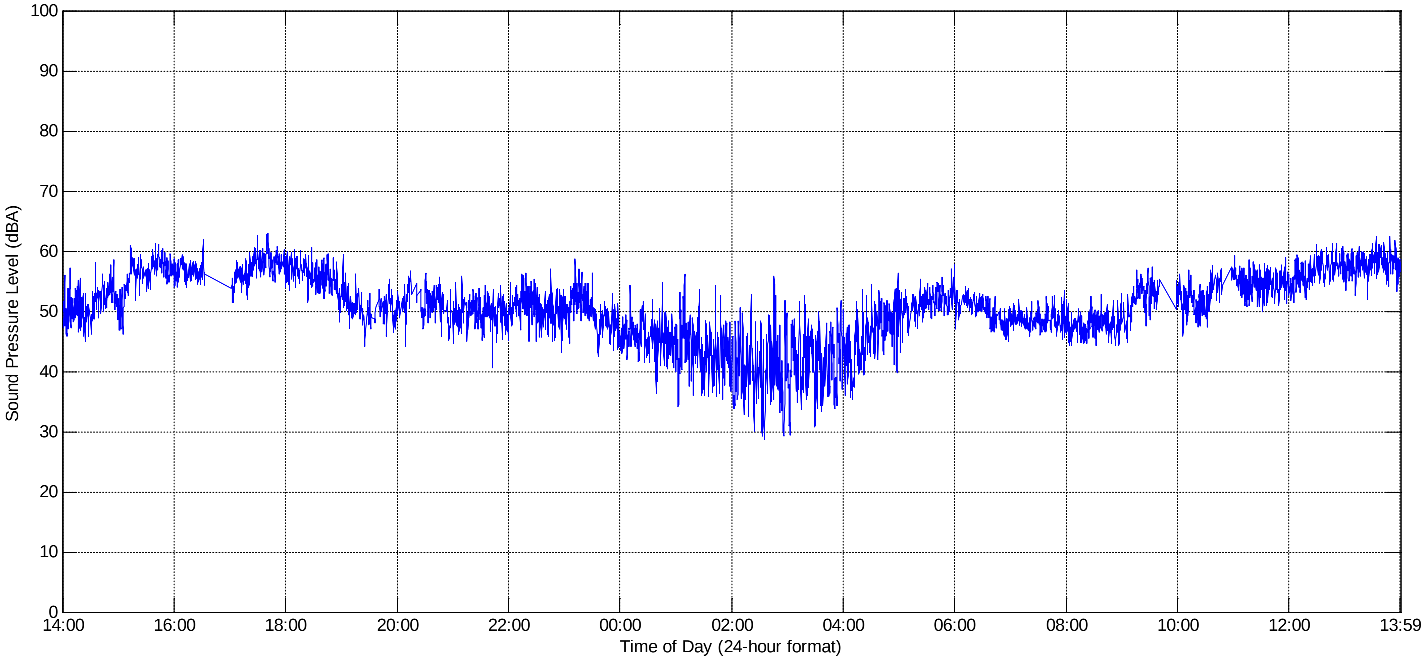


Figure 52. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 17

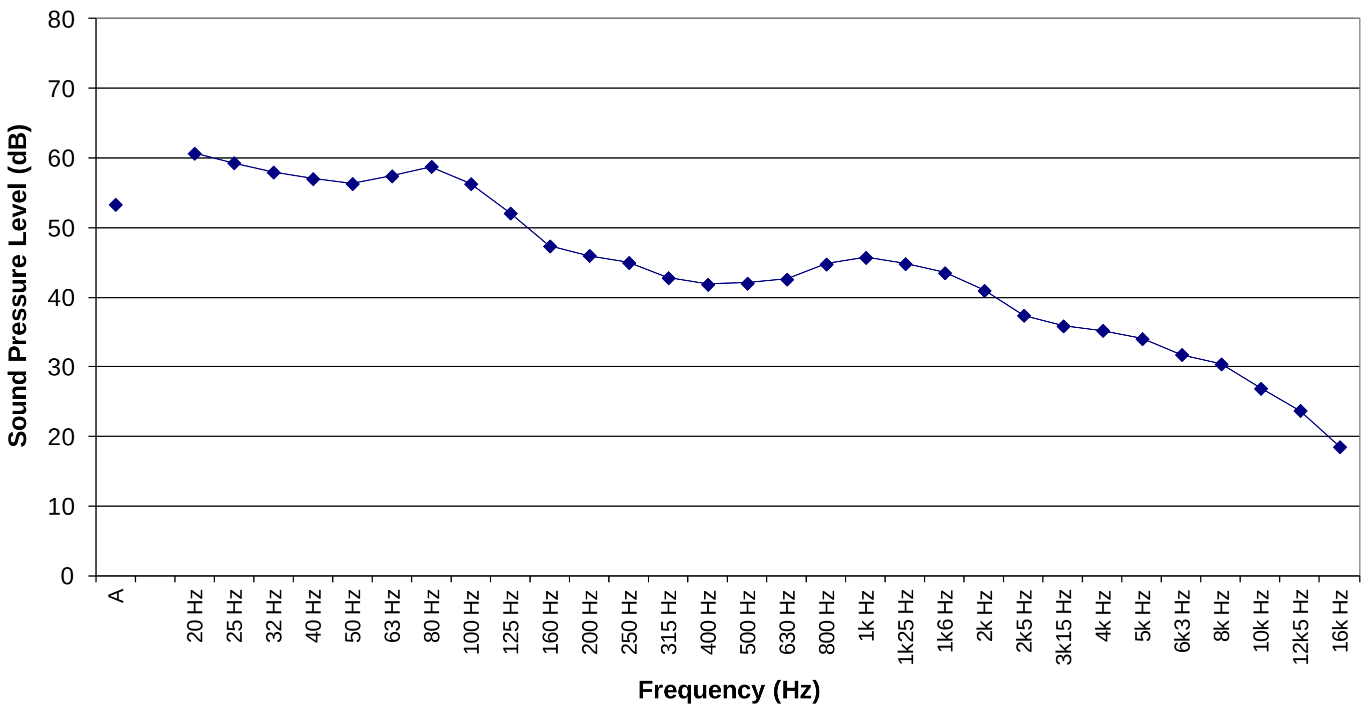


Figure 53. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 17

acoustical consultants inc

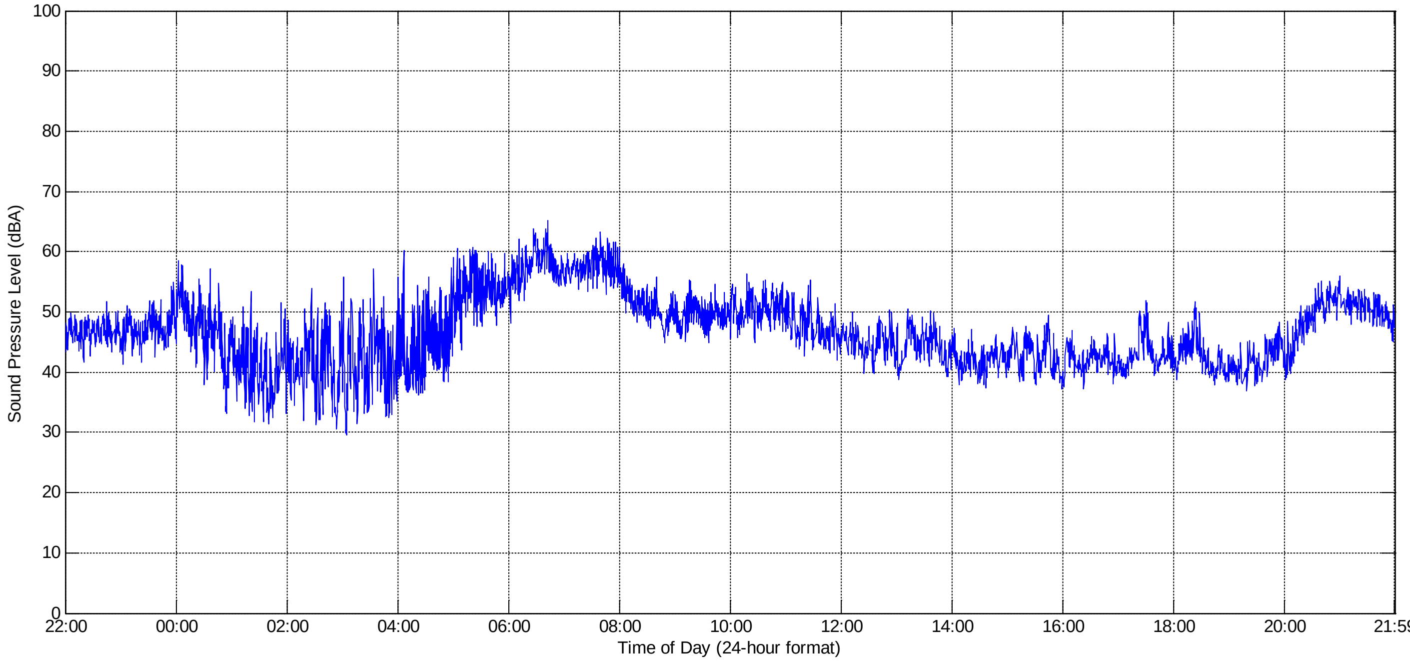


Figure 54. 24-Hour Broadband A-Weighted L_{eq} Sound Levels at Noise Monitor Location 18

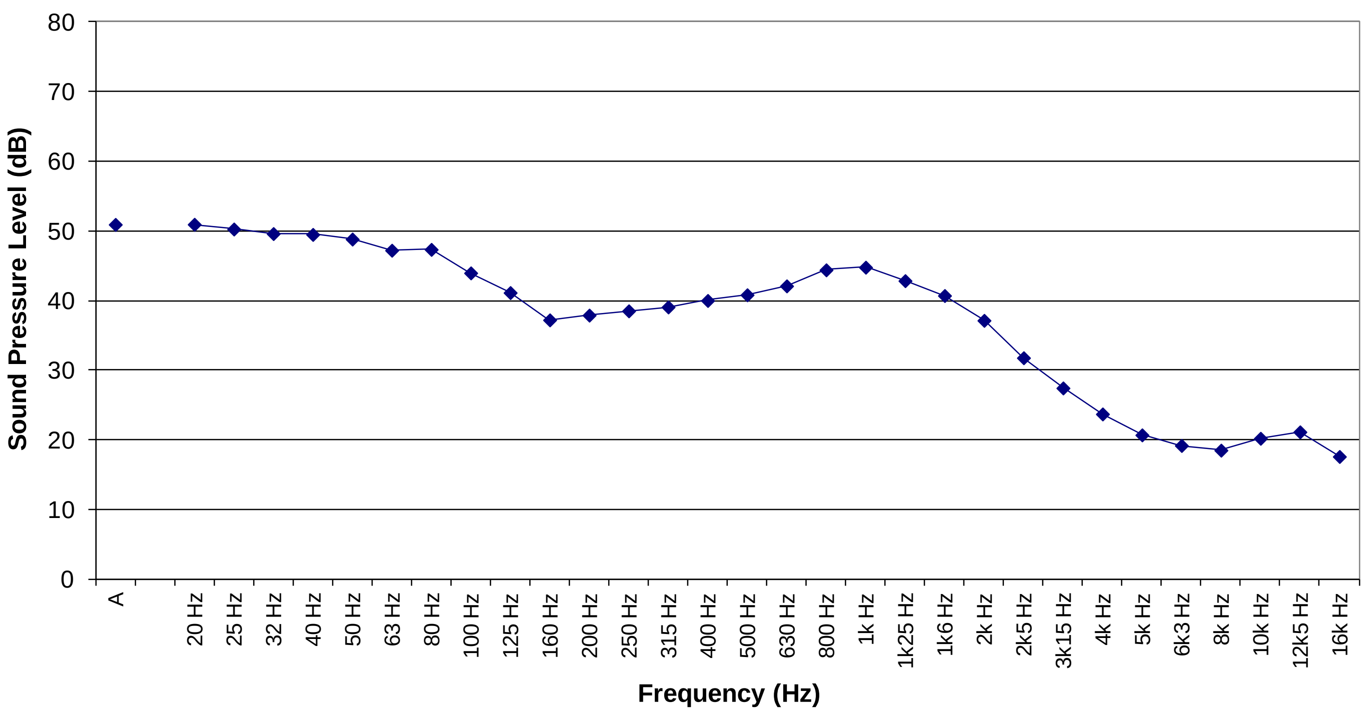


Figure 55. 24-Hour 1/3 Octave Band L_{eq} Sound Levels at Noise Monitor Location 18

Appendix I. MEASUREMENT EQUIPMENT USED

Noise Monitors

The environmental noise monitoring equipment used consisted of Brüel and Kjær Type 2250/2270 Precision Integrating Sound Level Meters enclosed in environmental cases with tripods and weather protective microphone hoods. The systems acquired data in 15-second L_{eq} samples using 1/3 octave band frequency analysis and overall A-weighted and C-weighted sound levels. The sound level meters conform to Type 1, ANSI S1.4, ANSI S1.43, IEC 61672-1, IEC 60651, IEC 60804 and DIN 45657. The 1/3 octave filters conform to S1.11 – Type 0-C, and IEC 61260 – Class 0. The calibrator conforms to IEC 942 and ANSI S1.40. The sound level meters, pre-amplifiers and microphones were certified on June 27, 2013 / December 11, 2012 / December 11, 2012 / October 2, 2012 / October 2, 2012 / October 2, 2012 / October 1, 2012 / April 30, 2014 / April 30, 2014 and the calibrators (type B&K 4231) were certified on November 07, 2013 by a NIST NVLAP Accredited Calibration Laboratory for all requirements of ISO 17025: 1999 and relevant requirements of ISO 9002:1994, ISO 9001:2000 and ANSI/NCSL Z540: 1994 Part 1. 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 with a WXT520 Self-Aspirating Radiation Shield Sensor Unit, a Weather MicroServer 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 temperature, relative humidity, rain rate and total rain accumulation.

Record of Calibration Results

Description	Date	Time	Pre / Post	Calibration Level	Calibrator Model	Serial Number
M1	June 23 2014	8:45	Pre	93.9 dBA	B&K 4231	2594693
M1	June 24 2014	15:00	Post	93.9 dBA	B&K 4231	2594693
M2	July 03 2014	9:20	Pre	93.9 dBA	B&K 4231	2594693
M2	July 04 2014	12:15	Post	93.9 dBA	B&K 4231	2594693
M3	August 05 2014	10:30	Pre	93.9 dBA	B&K 4231	2656414
M3	August 07 2014	13:00	Post	93.7 dBA	B&K 4231	2594693
M4	August 05 2014	12:00	Pre	93.9 dBA	B&K 4231	2656414
M4	August 07 2014	12:30	Post	93.7 dBA	B&K 4231	2594693
M5	June 23 2014	10:45	Pre	93.9 dBA	B&K 4231	2594693
M5	June 24 2014	11:10	Post	93.9 dBA	B&K 4231	2594693
M6	July 03 2014	10:00	Pre	93.9 dBA	B&K 4231	2594693
M6	July 04 2014	10:45	Post	94.0 dBA	B&K 4231	2594693
M7	August 05 2014	11:30	Pre	93.9 dBA	B&K 4231	2656414
M7	August 07 2014	12:00	Post	93.7 dBA	B&K 4231	2594693
M8	June 23 2014	11:15	Pre	93.9 dBA	B&K 4231	2594693
M8	June 24 2014	11:40	Post	93.8 dBA	B&K 4231	2594693
M9	July 03 2014	10:30	Pre	93.9 dBA	B&K 4231	2594693
M9	July 04 2014	11:00	Post	93.9 dBA	B&K 4231	2594693
M10	July 03 2014	11:00	Pre	93.9 dBA	B&K 4231	2594693
M10	July 04 2014	11:15	Post	93.8 dBA	B&K 4231	2594693
M11	August 05 2014	12:55	Pre	93.9 dBA	B&K 4231	2656414
M11	August 07 2014	10:30	Post	93.7 dBA	B&K 4231	2594693
M12	June 23 2014	12:00	Pre	93.9 dBA	B&K 4231	2594693
M12	June 24 2014	14:00	Post	93.8 dBA	B&K 4231	2594693
M13	August 05 2014	13:35	Pre	93.9 dBA	B&K 4231	2656414
M13	August 07 2014	10:45	Post	93.7 dBA	B&K 4231	2594693
M14	August 05 2014	14:25	Pre	93.9 dBA	B&K 4231	2656414
M14	August 07 2014	11:15	Post	93.8 dBA	B&K 4231	2594693
M15	July 03 2014	11:45	Pre	93.9 dBA	B&K 4231	2594693
M15	July 04 2014	12:00	Post	93.8 dBA	B&K 4231	2594693
M16	June 23 2014	12:30	Pre	93.9 dBA	B&K 4231	2594693
M16	June 24 2014	13:00	Post	93.8 dBA	B&K 4231	2594693
M17	June 23 2014	13:30	Pre	93.9 dBA	B&K 4231	2594693
M17	June 24 2014	14:15	Post	93.8 dBA	B&K 4231	2594693
M18	August 05 2014	15:15	Pre	93.9 dBA	B&K 4231	2656414
M18	August 07 2014	10:00	Post	93.9 dBA	B&K 4231	2594693

B&K 2250 Unit #1 SLM Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY

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

NVLAP®

NVLAP Lab Code: 200625-0

Calibration Certificate No.29118

Instrument: **Sound Level Meter**
Model: **2250**
Manufacturer: **Brüel and Kjær**
Serial number: **2488495**
Tested with: **Microphone 4189 s/n 2471133**
Preamplifier ZC0032 s/n 3271
Type (class): **1**

Date Calibrated: **6/28/2013** *Cal Due:*

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

Contains non-accredited tests: __Yes X No
Calibration service: __ Basic X Standard

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

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/22/2012
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	25747	Jul 2, 2012	Scantek, Inc./ NVLAP	Jul 2, 2013
DS-360-SRS	Function Generator	61646	Nov 20, 2012	ACR Env./ A2LA	Nov 20, 2014
34401A-Agilent Technologies	Digital Voltmeter	MY41022043	Nov 20, 2012	ACR Env. / A2LA	Nov 20, 2013
DPI 141-Druck	Pressure Indicator	790/00-04	Nov 21, 2012	ACR Env./ A2LA	Nov 21, 2014
HMP233-Vaisala Oyj	Humidity & Temp.	V3820001	Sep 6, 2012	ACR Env./ A2LA	Mar 6, 2014
PC Program 1019 Norsonic	Calibration software	v.5.2	Validated Mar 2011	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Dec 14, 2012	Scantek, Inc./ NVLAP	Dec 14, 2013

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

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
23.9 °C	98.895 kPa	55.6 %RH

Calibrated by:	Valentin Buzduga	**Authorized signatory:**	Mariana Buzduga
Signature		Signature	
Date	6/28/2013	Date	6/28/2013

Document stored Z:\Calibration Lab\SLM 2013\BNK2250_2488495_M1.doc

Page 1 of 2

B&K 2250 Unit #1 Microphone Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY

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

NVLAP®

NVLAP Lab Code: 200625-0

Calibration Certificate No.29119

Instrument: **Microphone**
Model: **4189**
Manufacturer: **Brüel & Kjær**
Serial number: **2471133**
Composed of:

Date Calibrated: **6/27/2013** *Cal Due:*

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

Contains non-accredited tests: __Yes _X_ No

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

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

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	25747	Jul 2, 2012	Scantek, Inc./ NVLAP	Jul 2, 2013
DS-360-SRS	Function Generator	61646	Nov 20, 2012	ACR Env./ A2LA	Nov 20, 2014
34401A-Agilent Technologies	Digital Voltmeter	MY41022043	Nov 20, 2012	ACR Env. / A2LA	Nov 20, 2013
DPI 141-Druck	Pressure Indicator	790/00-04	Nov 21, 2012	ACR Env./ A2LA	Nov 21, 2014
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Sep 6, 2012	ACR Env./ A2LA	Mar 6, 2014
PC Program 1017 Norsonic	Calibration software	v.5.2	Validated Mar 2011	Scantek, Inc.	-
1253-Norsonic	Calibrator	28326	Dec 14, 2012	Scantek, Inc./ NVLAP	Dec 14, 2013
1203-Norsonic	Preamplifier	14059	Jan 4, 2013	Scantek, Inc./ NVLAP	Jan 4, 2014
4180-Brüel&Kjær	Microphone	2246115	Nov 21, 2011	NPL-UK / UKAS	Nov 21, 2013

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

Calibrated by:	Valentin Buzduga	**Authorized signatory:**	Mariana Buzduga
Signature		Signature	
Date	6/27/2013	Date	6/28/2013

Document stored as: Z:\Calibration Lab\Mic 2013\B&K4189_2471133_M1.doc Page 1 of 2

B&K 2270 Unit #2 Calibration Certificates

MANUFACTURER'S CERTIFICATE OF CONFORMANCE

We certify that Brüel & Kjær **-2270--D00-** Serial No. **3002718** has been tested and passed all production tests, confirming compliance with the manufacturer's published specification at the date of the test.

The final test has been performed using calibrated equipment, traceable to National or International Standards or by ratio measurements.

Brüel & Kjær is certified under ISO 9001:2008 assuring that all test data is retained on file and is available for inspection upon request.

Nærum 11-dec-2012

Torben Bjørn
Vice President, Operations

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

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

Brüel & Kjær

Prepolarized Free-field 1/2" Microphone Type 4189

Bruel & Kjær — Calibration Chart

Serial No:	2850742	
Open-circuit Sensitivity*, S_0:	*-26.0*	dB re 1V/Pa
Equivalent to:	*50.4*	mV/Pa
Uncertainty, 95 % confidence level	0.2	dB
Capacitance:	*13.4*	pF
Valid At:		
Temperature:	23	°C
Ambient Static Pressure:	101.3	kPa
Relative Humidity:	50	%
Frequency:	251.2	Hz
Polarization Voltage, external:	0	V

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

IEC 61094-4: Type WS 2 F

Environmental Calibration Conditions:
99.7 kPa 22 °C 47 % RH

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

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

B&K 2270 Unit #3 Calibration Certificates

MANUFACTURER'S CERTIFICATE OF CONFORMANCE

We certify that Brüel & Kjær **-2270--D00-** Serial No. **3002730** has been tested and passed all production tests, confirming compliance with the manufacturer's published specification at the date of the test.

The final test has been performed using calibrated equipment, traceable to National or International Standards or by ratio measurements.

Brüel & Kjær is certified under ISO 9001:2008 assuring that all test data is retained on file and is available for inspection upon request.

Nærum 11-dec-2012

Torben Bjørn
Vice President, Operations

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

BA 0238-18

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

Brüel & Kjær

Bruel & Kjær

Prepolarized Free-field 1/2" Microphone Type 4189

Calibration Chart

Serial No:	2850741	
Open-circuit Sensitivity*, S_0:	-26.0	dB re 1V/Pa
Equivalent to:	49.8	mV/Pa
Uncertainty, 95 % confidence level	0.2	dB
Capacitance:	14.1	pF
Valid At:		
Temperature:	23	°C
Ambient Static Pressure:	101.3	kPa
Relative Humidity:	50	%
Frequency:	251.2	Hz
Polarization Voltage, external:	0	V

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

IEC 61094-4: Type WS 2 F

Environmental Calibration Conditions:
99.7 kPa 22 °C 47 % RH

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

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

acoustical consultants inc

B&K 4231 Unit #3 Calibrator Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY

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

NVLAP Lab Code: 200625-0

Calibration Certificate No.30003

Instrument:	**Acoustical Calibrator**	*Date Calibrated:* **11/7/2013** *Cal Due:*		
Model:	**4231**	*Status:*	**Received**	**Sent**
Manufacturer:	**Brüel and Kjær**	*In tolerance:*	X	X
Serial number:	**2594693**	*Out of tolerance:*		
Class (IEC 60942):	**1**	*See comments:*		
Barometer type:		*Contains non-accredited tests:* __Yes _X_ No		
Barometer s/n:				

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

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

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	25747	Jul 2, 2013	Scantek, Inc./ NVLAP	Jul 2, 2014
DS-360-SRS	Function Generator	61646	Nov 20, 2012	ACR Env./ A2LA	Nov 20, 2014
34401A-Agilent Technologies	Digital Voltmeter	MY41022043	Nov 20, 2012	ACR Env. / A2LA	Nov 20, 2013
DPI 141-Druck	Pressure Indicator	790/00-04	Nov 21, 2012	ACR Env./ A2LA	Nov 21, 2014
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Sep 6, 2012	ACR Env./ A2LA	Mar 6, 2014
8903A-HP	Audio Analyzer	2514A05691	Dec 1, 2010	ACR Env./ A2LA	Dec 1, 2013
PC Program 1018 Norsonic	Calibration software	v.5.2	Validated March 2011	Scantek, Inc.	-
4134-Brüel&Kjær	Microphone	906763	Nov 23, 2011	NPL-UK / UKAS	Nov 23, 2013
1203-Norsonic	Preamplifier	14059	Jan 4, 2013	Scantek, Inc./ NVLAP	Jan 4, 2014

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

Calibrated by:	Valentin Buzduga	**Authorized signatory:**	Mariana Buzduga
Signature		Signature	
Date	11/07/2013	Date	11/07/2013

Document stored as: Z:\Calibration Lab\Cal 2013\BNK4231_2594693_M1.doc Page 1 of 2

B&K 2270 Unit #4 SLM Calibration Certificate

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

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.27282

Instrument:	**Sound Level Meter**	*Date Calibrated:* **10/2/2012**	*Cal Due:*
Model:	**2270**	*Status:*	**Received** / **Sent**
Manufacturer:	**Brüel and Kjær**	*In tolerance:*	X / X
Serial number:	**2644639**	*Out of tolerance:*	
Tested with:	**Microphone 4189 s/n 2643219** **Preamplifier ZC0032 s/n 8255**	*See comments:*	
		Contains non-accredited tests: __Yes X No	
Type (class):	**1**	*Calibration service:* __ Basic X Standard	
Customer:	**ACI Acoustical Consultants Inc.**	*Address:*	**5031 - 210 Street, Edmonton**
Tel/Fax:	**780-414-6373 / -6376**		**Alberta, CANADA T6M 0A8**

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/22/2012
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	25747	Jul 2, 2012	Scantek, Inc./ NVLAP	Jul 2, 2013
DS-360-SRS	Function Generator	61646	Nov 16, 2011	ACR Env./ A2LA	Nov 16, 2013
34401A-Agilent Technologies	Digital Voltmeter	MY41022043	Dec 9, 2011	ACR Env. / A2LA	Dec 9, 2012
DPI 141-Druck	Pressure Indicator	790/00-04	Dec 13, 2010	ACR Env./ A2LA	Dec 13, 2012
HMP233-Vaisala Oyj	Humidity & Temp.	V3820001	Sep 6, 2012	ACR Env./ A2LA	Mar 6, 2014
PC Program 1019 Norsonic	Calibration software	v.5.2	Validated Mar 2011	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Dec 13, 2011	Scantek, Inc./ NVLAP	Dec 13, 2012

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

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
24 °C	100.067 kPa	49.4 %RH

Calibrated by:	Valentin Buzduga	**Authorized signatory:**	Mariana Buzduga
Signature		Signature	
Date	10/02/2012	Date	10/02/2012

Document stored Z:\Calibration Lab\SLM 2012\BNK2270_2644639_M1.doc Page 1 of 2

B&K 2270 Unit #4 Microphone Calibration Certificate

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

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.27283

Instrument:	**Microphone**	*Date Calibrated:* **10/1/2012** *Cal Due:*		
Model:	**4189**	*Status:*	**Received**	**Sent**
Manufacturer:	**Brüel & Kjær**	*In tolerance:*	X	X
Serial number:	**2643219**	*Out of tolerance:*		
Composed of:		*See comments:*		
		Contains non-accredited tests: __Yes _X_ No		
Customer:	**ACI Acoustical Consultants Inc.**	*Address:*	**5031 - 210 Street, Edmonton Alberta, CANADA T6M 0A8**	
Tel/Fax:	**780-414-6373 / -6376**			

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

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	25747	Jul 2, 2012	Scantek, Inc./ NVLAP	Jul 2, 2013
DS-360-SRS	Function Generator	61646	Nov 16, 2011	ACR Env./ A2LA	Nov 16, 2013
34401A-Agilent Technologies	Digital Voltmeter	MY41022043	Dec 9, 2011	ACR Env. / A2LA	Dec 9, 2012
DPI 141-Druck	Pressure Indicator	790/00-04	Dec 13, 2010	ACR Env./ A2LA	Dec 13, 2012
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Sep 6, 2012	ACR Env./ A2LA	Mar 6, 2014
PC Program 1017 Norsonic	Calibration software	v.5.2	Validated Mar 2011	Scantek, Inc.	-
1253-Norsonic	Calibrator	28326	Dec 13, 2011	Scantek, Inc./ NVLAP	Dec 13, 2012
1203-Norsonic	Preamplifier	14059	Jan 3, 2012	Scantek, Inc./ NVLAP	Jan 3, 2013
4180-Brüel&Kjær	Microphone	2246115	Nov 21, 2011	NPL-UK / UKAS	Nov 21, 2013

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

Calibrated by:	Valentin Buzduga	**Authorized signatory:**	Mariana Buzduga
Signature		Signature	
Date	10/02/2012	Date	10/2/2012

Document stored as: Z:\Calibration Lab\Mic 2012\B&K4189_2643219_M1.doc Page 1 of 2

B&K 2250 Unit #5 SLM Calibration Certificate

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

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.27284

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

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

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

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

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/22/2012
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	25747	Jul 2, 2012	Scantek, Inc./ NVLAP	Jul 2, 2013
DS-360-SRS	Function Generator	61646	Nov 16, 2011	ACR Env./ A2LA	Nov 16, 2013
34401A-Agilent Technologies	Digital Voltmeter	MY41022043	Dec 9, 2011	ACR Env. / A2LA	Dec 9, 2012
DPI 141-Druck	Pressure Indicator	790/00-04	Dec 13, 2010	ACR Env./ A2LA	Dec 13, 2012
HMP233-Vaisala Oyj	Humidity & Temp.	V3820001	Sep 6, 2012	ACR Env./ A2LA	Mar 6, 2014
PC Program 1019 Norsonic	Calibration software	v.5.2	Validated Mar 2011	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Dec 13, 2011	Scantek, Inc./ NVLAP	Dec 13, 2012

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

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
24.7 °C	100.019 kPa	48.6 %RH

Calibrated by:	Valentin Buzduga	**Authorized signatory:**	Mariana Buzduga
Signature		Signature	
Date	10/02/2012	Date	10/2/2012

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.
Document stored Z:\Calibration Lab\SLM 2012\BNK2250_2722894_M1.doc Page 1 of 2

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 and APLAC signatory)

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.27285

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

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

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	25747	Jul 2, 2012	Scantek, Inc./ NVLAP	Jul 2, 2013
DS-360-SRS	Function Generator	61646	Nov 16, 2011	ACR Env./ A2LA	Nov 16, 2013
34401A-Agilent Technologies	Digital Voltmeter	MY41022043	Dec 9, 2011	ACR Env. / A2LA	Dec 9, 2012
DPI 141-Druck	Pressure Indicator	790/00-04	Dec 13, 2010	ACR Env./ A2LA	Dec 13, 2012
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Sep 6, 2012	ACR Env./ A2LA	Mar 6, 2014
PC Program 1017 Norsonic	Calibration software	v.5.2	Validated Mar 2011	Scantek, Inc.	-
1253-Norsonic	Calibrator	28326	Dec 13, 2011	Scantek, Inc./ NVLAP	Dec 13, 2012
1203-Norsonic	Preamplifier	14059	Jan 3, 2012	Scantek, Inc./ NVLAP	Jan 3, 2013
4180-Brüel&Kjær	Microphone	2246115	Nov 21, 2011	NPL-UK / UKAS	Nov 21, 2013

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

Calibrated by:	Valentin Buzduga	**Authorized signatory:**	Mariana Buzduga
Signature		Signature	
Date	10/01/2012	Date	10/2/2012

Document stored as: Z:\Calibration Lab\Mic 2012\B&K4189_2719777_M1.doc Page 1 of 2

B&K 2250 Unit #6 SLM Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY

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

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.27286

Instrument:	**Sound Level Meter**	*Date Calibrated:* **10/2/2012** *Cal Due:*		
Model:	**2250**	*Status:*	**Received**	**Sent**
Manufacturer:	**Brüel and Kjær**	*In tolerance:*	**X**	**X**
Serial number:	**2661161**	*Out of tolerance:*		
Tested with:	**Microphone 4189 s/n 2650730**	*See comments:*		
	Preamplifier ZC0032 s/n 9935	*Contains non-accredited tests:* __Yes **X** No		
Type (class):	**1**	*Calibration service:* __ Basic **X** Standard		
Customer:	**ACI Acoustical Consultants Inc.**	*Address:*	**5031 - 210 Street, Edmonton**	
Tel/Fax:	**780-414-6373 / -6376**		**Alberta, CANADA T6M 0A8**	

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/22/2012
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	25747	Jul 2, 2012	Scantek, Inc./ NVLAP	Jul 2, 2013
DS-360-SRS	Function Generator	61646	Nov 16, 2011	ACR Env./ A2LA	Nov 16, 2013
34401A-Agilent Technologies	Digital Voltmeter	MY41022043	Dec 9, 2011	ACR Env. / A2LA	Dec 9, 2012
DPI 141-Druck	Pressure Indicator	790/00-04	Dec 13, 2010	ACR Env./ A2LA	Dec 13, 2012
HMP233-Vaisala Oyj	Humidity & Temp.	V3820001	Sep 6, 2012	ACR Env./ A2LA	Mar 6, 2014
PC Program 1019 Norsonic	Calibration software	v.5.2	Validated Mar 2011	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Dec 13, 2011	Scantek, Inc./ NVLAP	Dec 13, 2012

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

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
23.2 °C	99.991 kPa	51.9 %RH

Calibrated by:	Valentin Buzduga	**Authorized signatory:**	Mariana Buzduga
Signature		Signature	
Date	10/02/2012	Date	10/2/2012

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.
Document stored Z:\Calibration Lab\SLM 2012\BNK2250_2661161_M1.doc

Page 1 of 2

B&K 2250 Unit #6 Microphone Calibration Certificate

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

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.27287

Instrument:	**Microphone**	*Date Calibrated:* **10/1/2012** *Cal Due:*		
Model:	**4189**	*Status:*	**Received**	**Sent**
Manufacturer:	**Brüel & Kjær**	*In tolerance:*	X	X
Serial number:	**2650730**	*Out of tolerance:*		
Composed of:		*See comments:*		
		Contains non-accredited tests: __Yes _X_ No		
Customer:	**ACI Acoustical Consultants Inc.**	*Address:*	**5031 - 210 Street, Edmonton Alberta, CANADA T6M 0A8**	
Tel/Fax:	**780-414-6373 / -6376**			

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

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	25747	Jul 2, 2012	Scantek, Inc./ NVLAP	Jul 2, 2013
DS-360-SRS	Function Generator	61646	Nov 16, 2011	ACR Env./ A2LA	Nov 16, 2013
34401A-Agilent Technologies	Digital Voltmeter	MY41022043	Dec 9, 2011	ACR Env. / A2LA	Dec 9, 2012
DPI 141-Druck	Pressure Indicator	790/00-04	Dec 13, 2010	ACR Env./ A2LA	Dec 13, 2012
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Sep 6, 2012	ACR Env./ A2LA	Mar 6, 2014
PC Program 1017 Norsonic	Calibration software	v.5.2	Validated Mar 2011	Scantek, Inc.	-
1253-Norsonic	Calibrator	28326	Dec 13, 2011	Scantek, Inc./ NVLAP	Dec 13, 2012
1203-Norsonic	Preamplifier	14059	Jan 3, 2012	Scantek, Inc./ NVLAP	Jan 3, 2013
4180-Brüel&Kjær	Microphone	2246115	Nov 21, 2011	NPL-UK / UKAS	Nov 21, 2013

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

Calibrated by:	Valentin Buzduga	**Authorized signatory:**	Mariana Buzduga
Signature		Signature	
Date	10/01/2012	Date	10/2/2012

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.
Document stored as: Z:\Calibration Lab\Mic 2012\B&K4189_2650730_M1.doc Page 1 of 2

B&K 4231 Unit #6 Calibrator Calibration Certificate

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

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.30005

Instrument:	**Acoustical Calibrator**	*Date Calibrated:* **11/7/2013** *Cal Due:*			
Model:	**4231**	*Status:*	**Received**	**Sent**	
Manufacturer:	**Brüel and Kjær**	*In tolerance:*	X	X	
Serial number:	**2656414**	*Out of tolerance:*			
Class (IEC 60942):	**1**	*See comments:*			
Barometer type:		*Contains non-accredited tests:* __Yes _X_ No			
Barometer s/n:					

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

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

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	25747	Jul 2, 2013	Scantek, Inc./ NVLAP	Jul 2, 2014
DS-360-SRS	Function Generator	61646	Nov 20, 2012	ACR Env./ A2LA	Nov 20, 2014
34401A-Agilent Technologies	Digital Voltmeter	MY41022043	Nov 20, 2012	ACR Env. / A2LA	Nov 20, 2013
DPI 141-Druck	Pressure Indicator	790/00-04	Nov 21, 2012	ACR Env./ A2LA	Nov 21, 2014
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Sep 6, 2012	ACR Env./ A2LA	Mar 6, 2014
8903A-HP	Audio Analyzer	2514A05691	Dec 1, 2010	ACR Env./ A2LA	Dec 1, 2013
PC Program 1018 Norsonic	Calibration software	v.5.2	Validated March 2011	Scantek, Inc.	-
4134-Brüel&Kjær	Microphone	906763	Nov 23, 2011	NPL-UK / UKAS	Nov 23, 2013
1203-Norsonic	Preamplifier	14059	Jan 4, 2013	Scantek, Inc./ NVLAP	Jan 4, 2014

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

Calibrated by:	Valentin Buzduga	**Authorized signatory:**	Mariana Buzduga
Signature		Signature	
Date	11/07/2013	Date	11/7/2013

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.
Document stored as: Z:\Calibration Lab\Cal 2013\BNK4231_2656414_M1.doc

Page 1 of 2

B&K 2250 Unit #7 SLM Calibration Certificate

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

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.27288

Instrument:	**Sound Level Meter**	*Date Calibrated:* **10/1/2012** *Cal Due:*		
Model:	**2250**	*Status:*	**Received**	**Sent**
Manufacturer:	**Brüel and Kjær**	*In tolerance:*	X	X
Serial number:	**2722859**	*Out of tolerance:*		
Tested with:	**Microphone 4189 s/n 2710791** **Preamplifier ZC0032 s/n 13398**	*See comments:*		
		Contains non-accredited tests: __Yes _X_ No		
Type (class):	**1**	*Calibration service:* __ Basic _X_ Standard		
Customer:	**ACI Acoustical Consultants Inc.**	*Address:* **5031 - 210 Street, Edmonton Alberta, CANADA T6M 0A8**		
Tel/Fax:	**780-414-6373 / -6376**			

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/22/2012
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	25747	Jul 2, 2012	Scantek, Inc./ NVLAP	Jul 2, 2013
DS-360-SRS	Function Generator	61646	Nov 16, 2011	ACR Env./ A2LA	Nov 16, 2013
34401A-Agilent Technologies	Digital Voltmeter	MY41022043	Dec 9, 2011	ACR Env. / A2LA	Dec 9, 2012
DPI 141-Druck	Pressure Indicator	790/00-04	Dec 13, 2010	ACR Env./ A2LA	Dec 13, 2012
HMP233-Vaisala Oyj	Humidity & Temp.	V3820001	Sep 6, 2012	ACR Env./ A2LA	Mar 6, 2014
PC Program 1019 Norsonic	Calibration software	v.5.2	Validated Mar 2011	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Dec 13, 2011	Scantek, Inc./ NVLAP	Dec 13, 2012

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

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
22.7 °C	100.02 kPa	47.4 %RH

Calibrated by:	Valentin Buzduga	**Authorized signatory:**	Mariana Buzduga
Signature		Signature	
Date	10/01/2012	Date	10/2/2012

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.
Document stored Z:\Calibration Lab\SLM 2012\BNK2250_2722859_M1.doc

Page 1 of 2

aci acoustical consultants inc

B&K 2250 Unit #7 Microphone Calibration Certificate

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

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.27289

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

Date Calibrated: **10/1/2012** *Cal Due:*

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

Contains non-accredited tests: __Yes _X_ No

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

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

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	25747	Jul 2, 2012	Scantek, Inc./ NVLAP	Jul 2, 2013
DS-360-SRS	Function Generator	61646	Nov 16, 2011	ACR Env./ A2LA	Nov 16, 2013
34401A-Agilent Technologies	Digital Voltmeter	MY41022043	Dec 9, 2011	ACR Env. / A2LA	Dec 9, 2012
DPI 141-Druck	Pressure Indicator	790/00-04	Dec 13, 2010	ACR Env./ A2LA	Dec 13, 2012
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Sep 6, 2012	ACR Env./ A2LA	Mar 6, 2014
PC Program 1017 Norsonic	Calibration software	v.5.2	Validated Mar 2011	Scantek, Inc.	-
1253-Norsonic	Calibrator	28326	Dec 13, 2011	Scantek, Inc./ NVLAP	Dec 13, 2012
1203-Norsonic	Preamplifier	14059	Jan 3, 2012	Scantek, Inc./ NVLAP	Jan 3, 2013
4180-Brüel&Kjær	Microphone	2246115	Nov 21, 2011	NPL-UK / UKAS	Nov 21, 2013

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

Calibrated by:	Valentin Buzduga	**Authorized signatory:**	Mariana Buzduga
Signature		Signature	
Date	10/01/2012	Date	10/2/2012

Document stored as: Z:\Calibration Lab\Mic 2012\B&K4189_2710791_M1.doc

Page 1 of 2

B&K 2250 Unit #8 SLM Calibration Certificate

MANUFACTURER'S CERTIFICATE OF CONFORMANCE

We certify that Brüel & Kjær **-2250--D00-** Serial No. **3005978** has been tested and passed all production tests, confirming compliance with the manufacturer's published specification at the date of the test.

The final test has been performed using calibrated equipment, traceable to National or International Standards or by ratio measurements.

Brüel & Kjær is certified under ISO 9001:2008 assuring that all test data is retained on file and is available for inspection upon request.

Nærum 30-apr-2014

Torben Bjørn
Vice President, Operations

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

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

Brüel & Kjær

Bruel & Kjær

Prepolarized Free-field 1/2" Microphone Type 4189

Calibration Chart

Serial No: 2851039

Open-circuit Sensitivity*, S_0:	***-25.8***	dB re 1V/Pa
Equivalent to:	***51.6***	mV/Pa
Uncertainty, 95 % confidence level	0.2	dB
Capacitance:	*13.7*	pF
Valid At:		
Temperature:	23	°C
Ambient Static Pressure:	101.3	kPa
Relative Humidity:	50	%
Frequency:	251.2	Hz
Polarization Voltage, external:	0	V

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

IEC 61094-4: Type WS 2 F

Environmental Calibration Conditions:
102.5 kPa 23 °C 46 % RH

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

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

acoustical consultants inc

B&K 2250 Unit #9 SLM Calibration Certificate

MANUFACTURER'S CERTIFICATE OF CONFORMANCE

We certify that Brüel & Kjær **-2250--D00-** Serial No. **3006198** has been tested and passed all production tests, confirming compliance with the manufacturer's published specification at the date of the test.

The final test has been performed using calibrated equipment, traceable to National or International Standards or by ratio measurements.

Brüel & Kjær is certified under ISO 9001:2008 assuring that all test data is retained on file and is available for inspection upon request.

Nærum 30-apr-2014

Torben Bjørn
Vice President, Operations

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

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

Brüel & Kjær

Prepolarized Free-field 1/2" Microphone Type 4189

Bruel & Kjær — Calibration Chart

Serial No:	2906926	
Open-circuit Sensitivity*, S_0:	-25.7	dB re 1V/Pa
Equivalent to:	52.0	mV/Pa
Uncertainty, 95 % confidence level	0.2	dB
Capacitance:	12.7	pF
Valid At:		
Temperature:	23	°C
Ambient Static Pressure:	101.3	kPa
Relative Humidity:	50	%
Frequency:	251.2	Hz
Polarization Voltage, external:	0	V

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

IEC 61094-4: Type WS 2 F

Environmental Calibration Conditions:
99.2 kPa 23 °C 50 % RH

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

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

Appendix II. THE ASSESSMENT OF ENVIRONMENTAL NOISE (GENERAL)

Sound Pressure Level

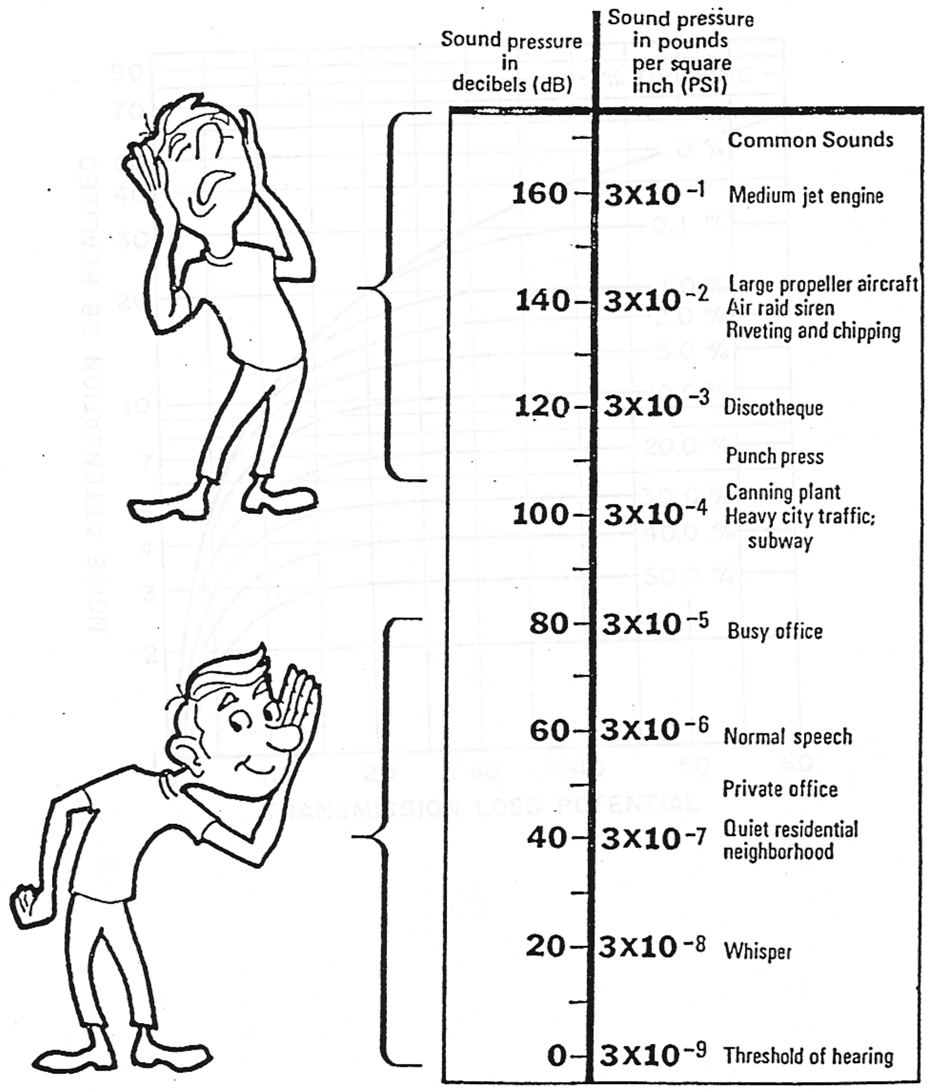
Sound pressure is initially measured in Pascal's (Pa). Humans can hear several orders of magnitude in sound pressure levels, so a more convenient scale is used. This scale is known as the decibel (dB) scale, named after Alexander Graham Bell (telephone guy). It is a base 10 logarithmic scale. When we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

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

Where: SPL = Sound Pressure Level in dB
P_{RMS} = Root Mean Square measured pressure (Pa)
P_{ref} = Reference sound pressure level ($P_{ref} = 2\text{x}10^{-5}$ Pa = 20 μPa)

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

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


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

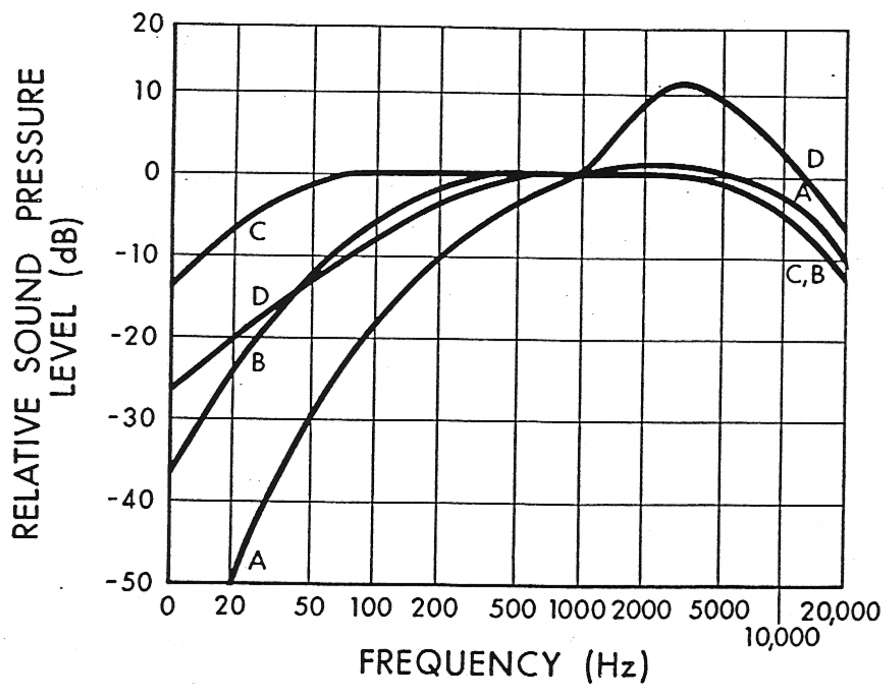
Frequency

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

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

	Whole Octave			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.

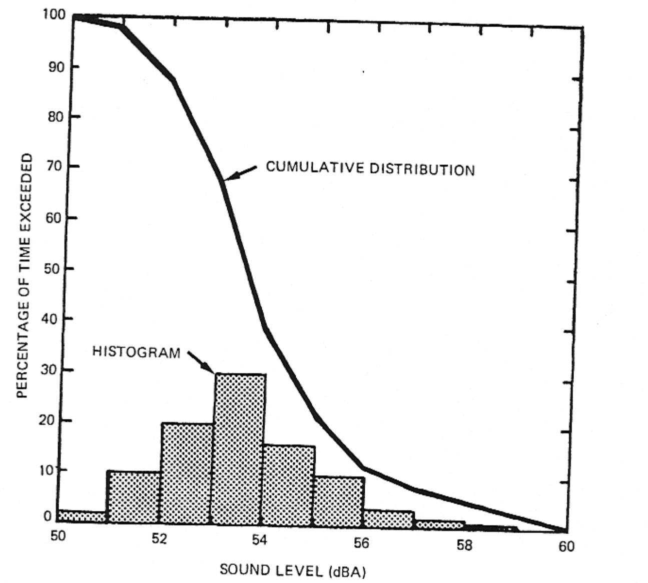


Figure 16.6 Statistically processed community noise showing histogram and cumulative distribution of A weighted sound levels.

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 34 dB at 400m.
- A line source measuring 50 dB at 100m will be 40 dB at 1000m.

Atmospheric Absorption

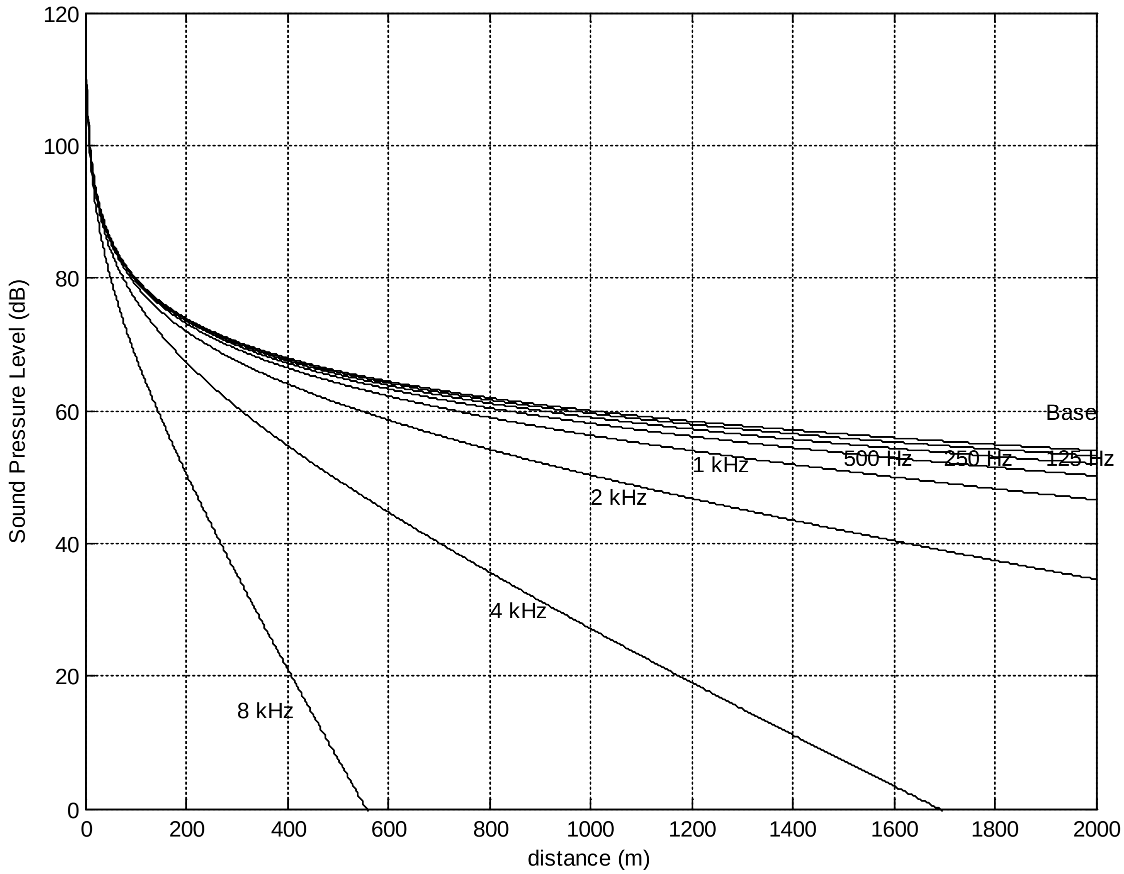
As sound transmits through a medium, there is an attenuation (or dissipation of acoustic energy) which can be attributed to three mechanisms:

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



Atmospheric Absorption at 10^{o}C and 70% RH

Meteorological Effects

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

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

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

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

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

Topographical Effects

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

Topography

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

Grass

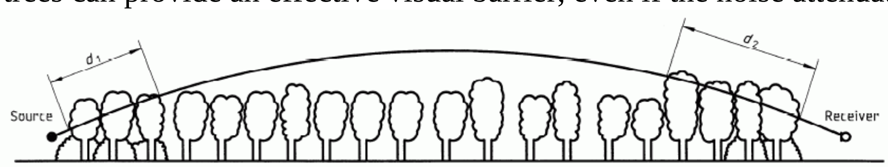
- Can be an effective absorber due to large area covered
- Only effective at low height above ground. Does not affect sound transmitted direct from source to receiver if there is line of sight.
- Typically less absorption than atmospheric absorption when there is line of sight.
- Approximate rule of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

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

Where: A_g is the absorption amount

Trees

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



NOTE — $d_f = d_1 + d_2$

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

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

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

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

Tree/Foliage attenuation from ISO 9613-2:1996

Bodies of Water

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

Snow

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

Appendix III. SOUND LEVELS OF FAMILIAR NOISE SOURCES

Used with Permission Obtained from 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).

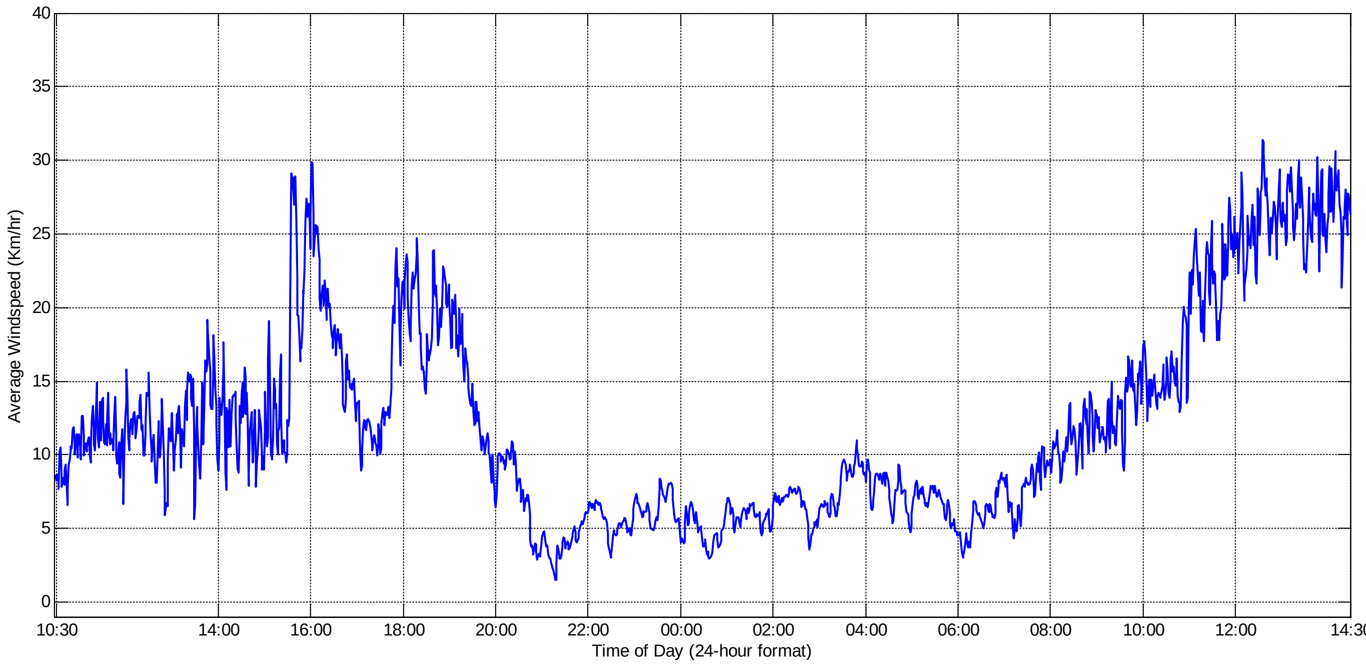
SOUND LEVELS GENERATED BY COMMON APPLIANCES

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

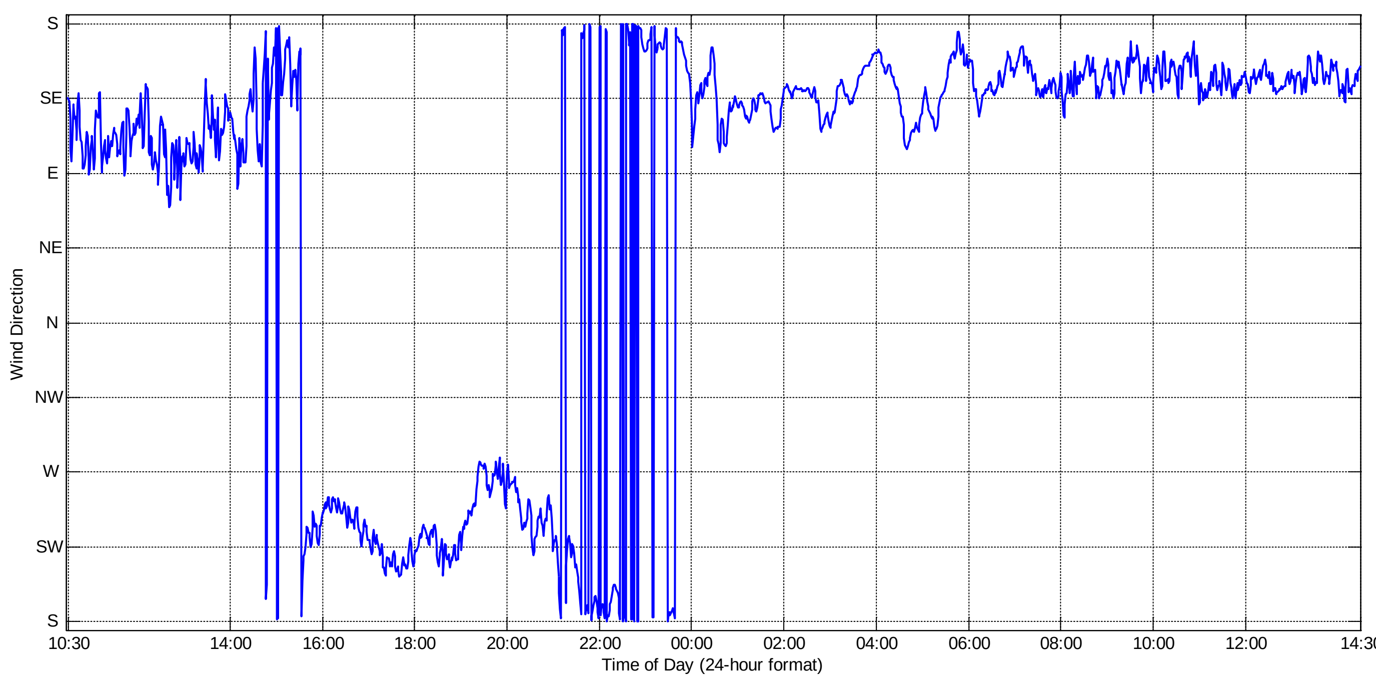
Source[1]	Sound level at 3 feet (dBA)
Freezer	38-45
Refrigerator	34-53
Electric heater	47
Hair clipper	50
Electric toothbrush	48-57
Humidifier	41-54
Clothes dryer	51-65
Air conditioner	50-67
Electric shaver	47-68
Water faucet	62
Hair dryer	58-64
Clothes washer	48-73
Dishwasher	59-71
Electric can opener	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).

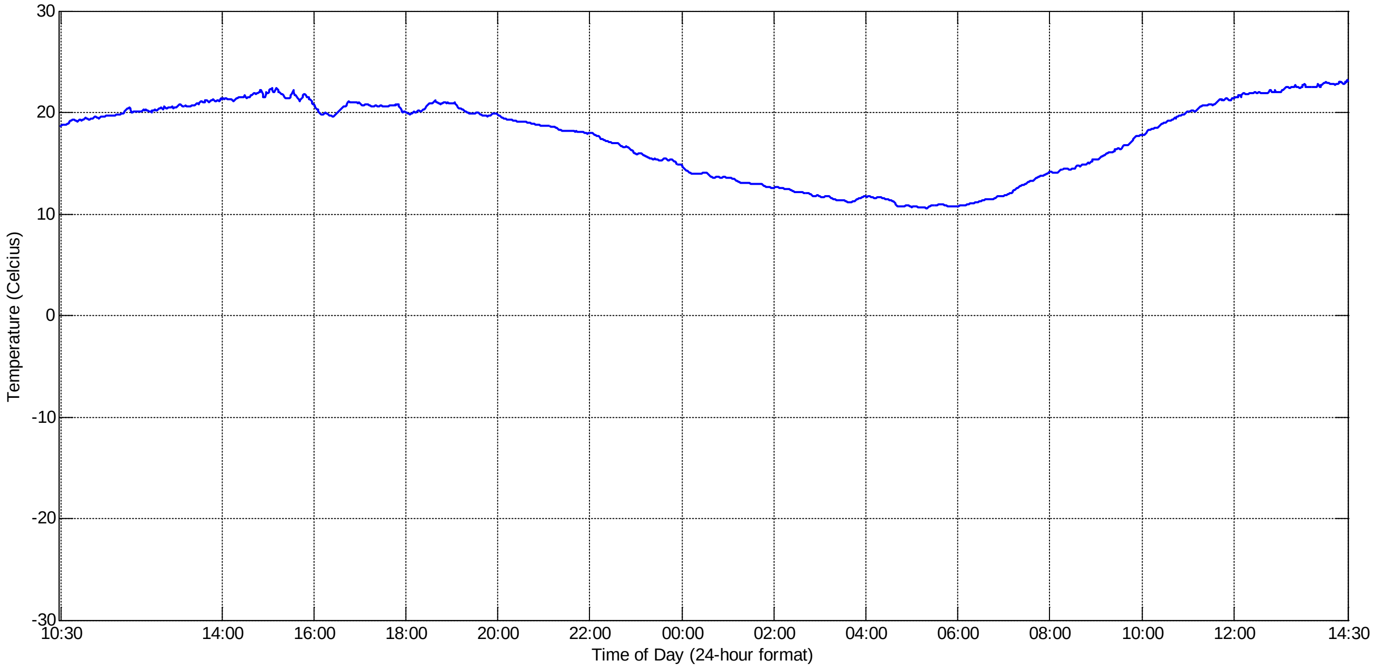
Appendix IV. WEATHER DATA



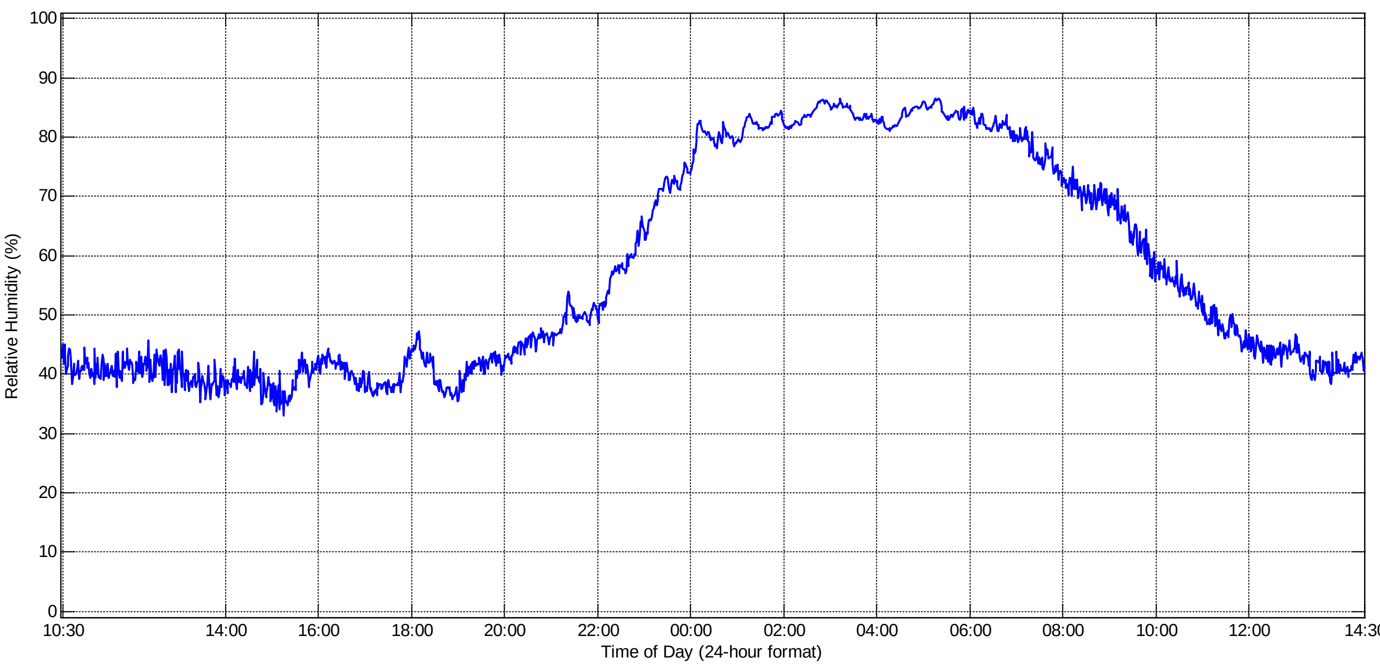
June 23 - 24, 2014 Monitored Wind Speed



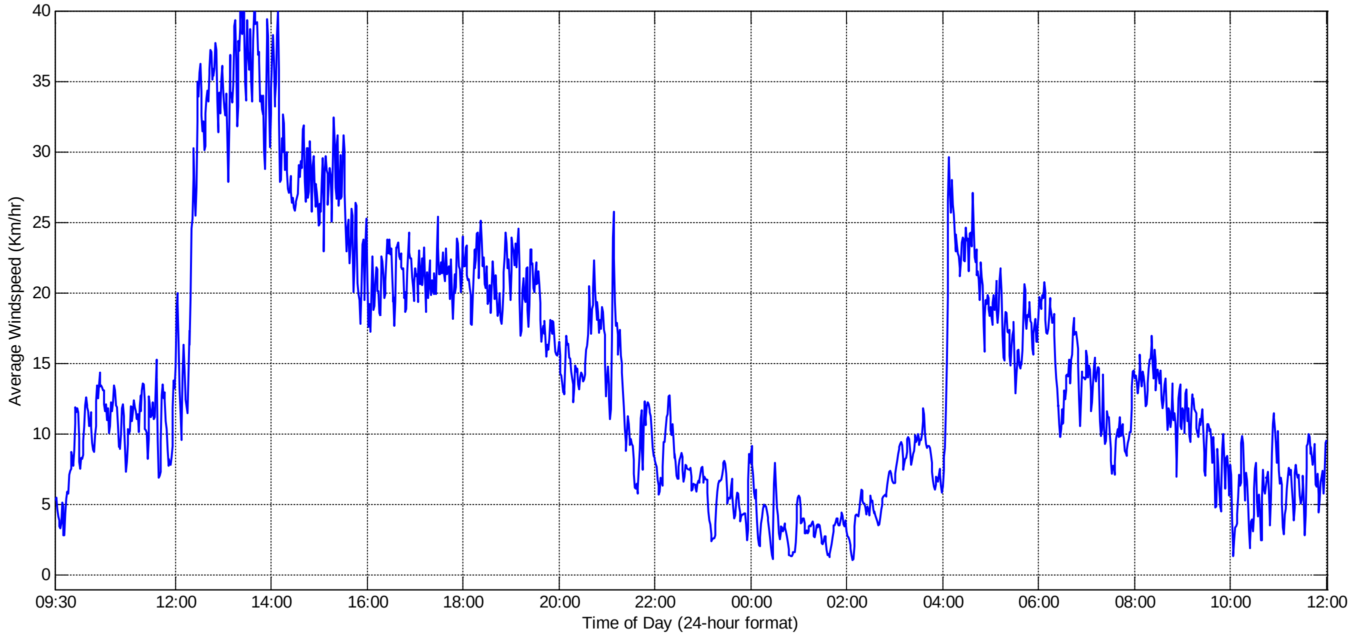
June 23 - 24, 2014 Monitored Wind Direction



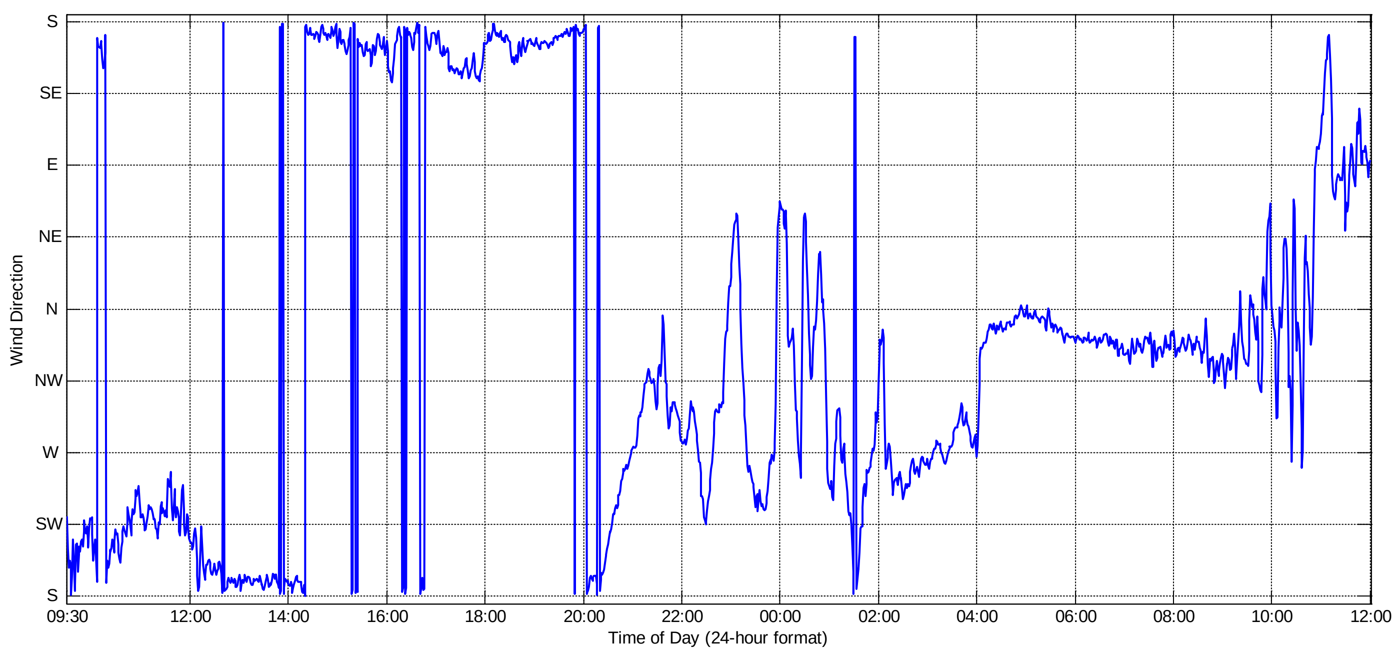
June 23 - 24, 2014 Monitored Temperature



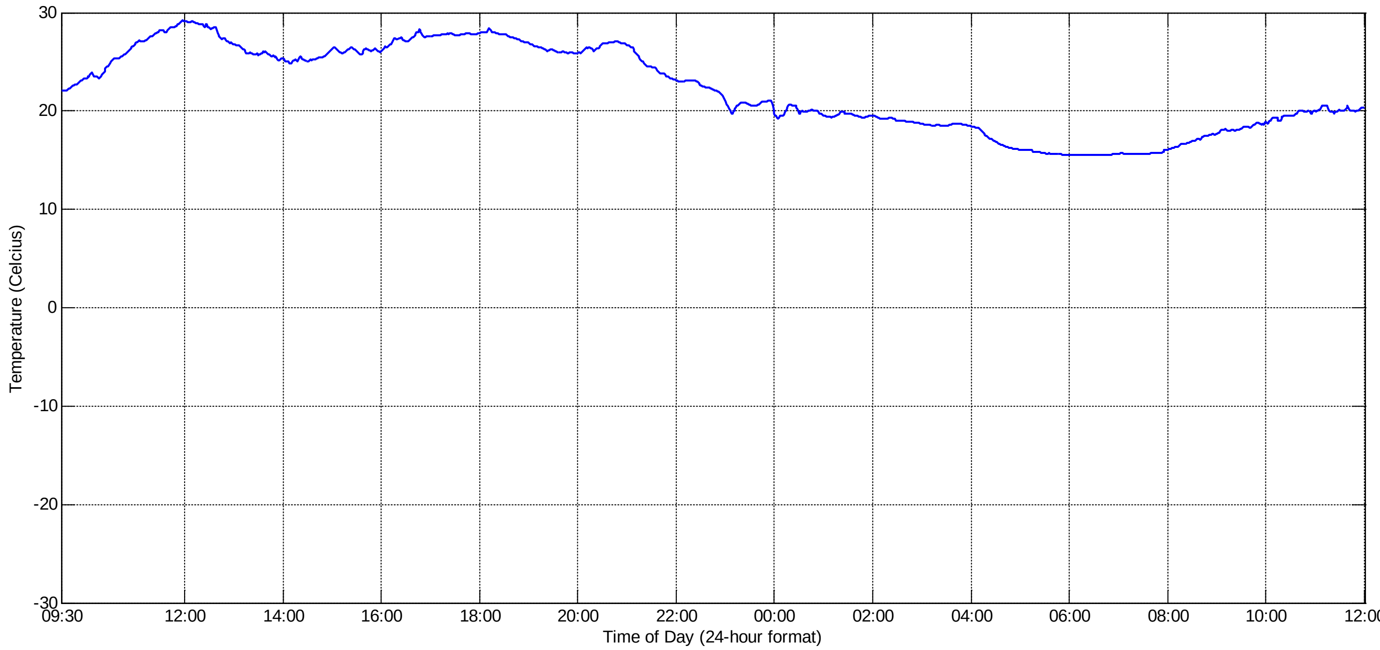
June 23 - 24, 2014 Monitored Relative Humidity



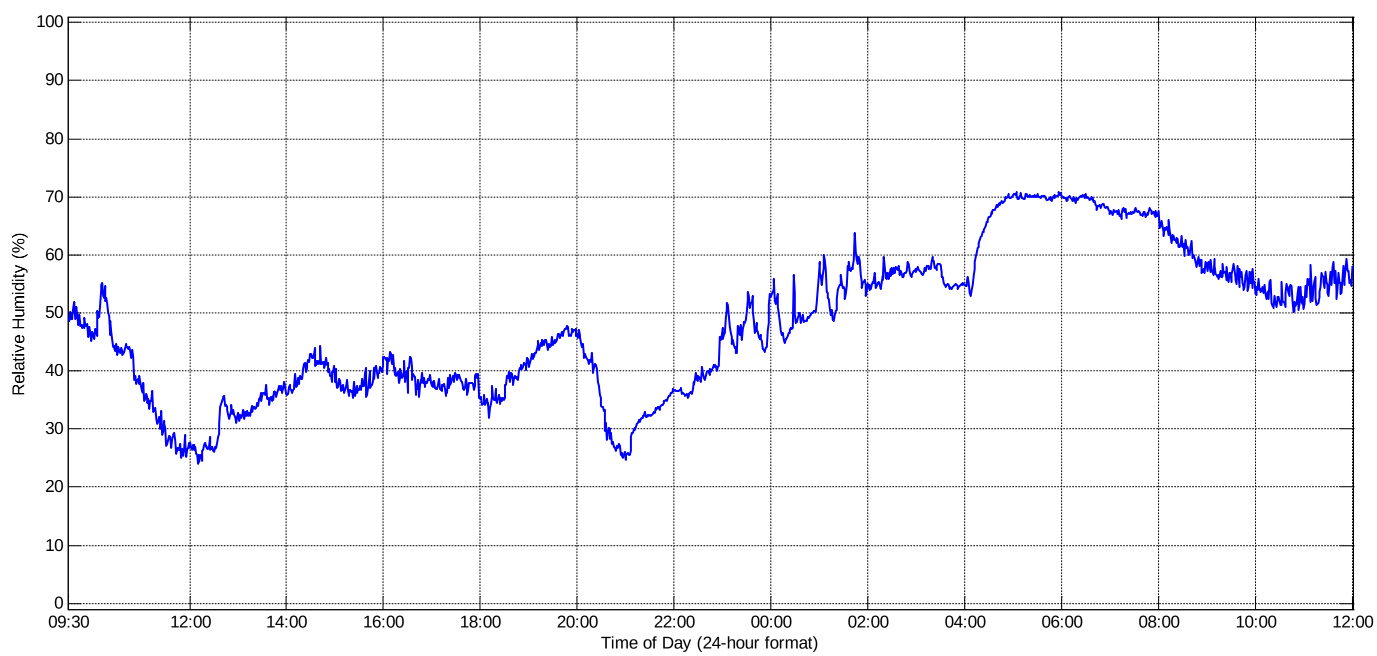
July 03 - 04, 2014 Monitored Wind Speed



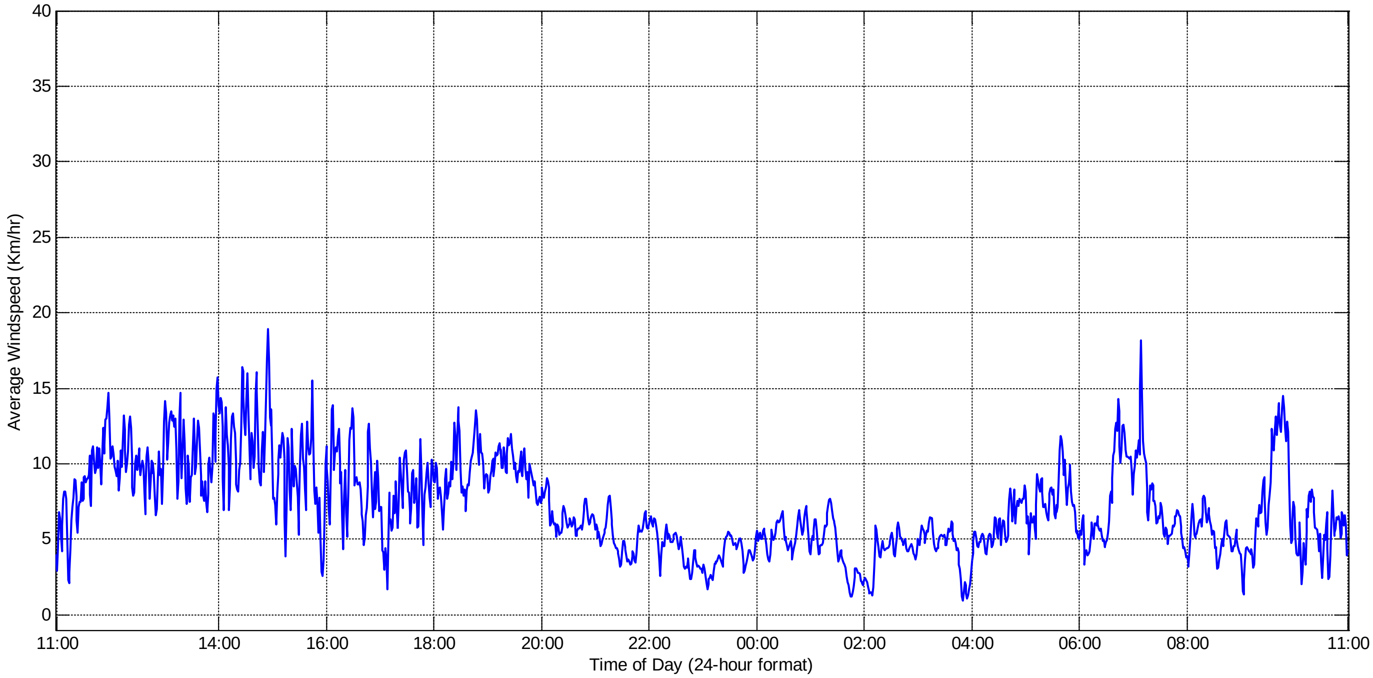
July 03 - 04, 2014 Monitored Wind Direction



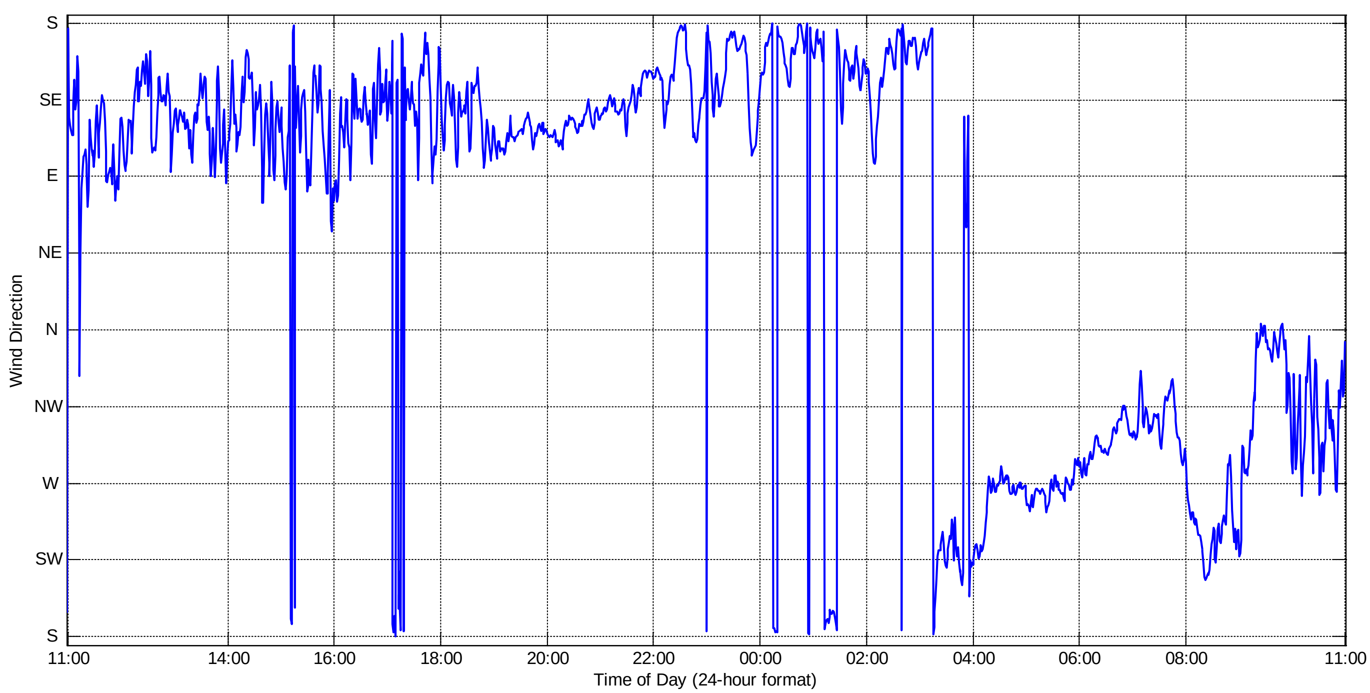
July 03 - 04, 2014 Monitored Temperature



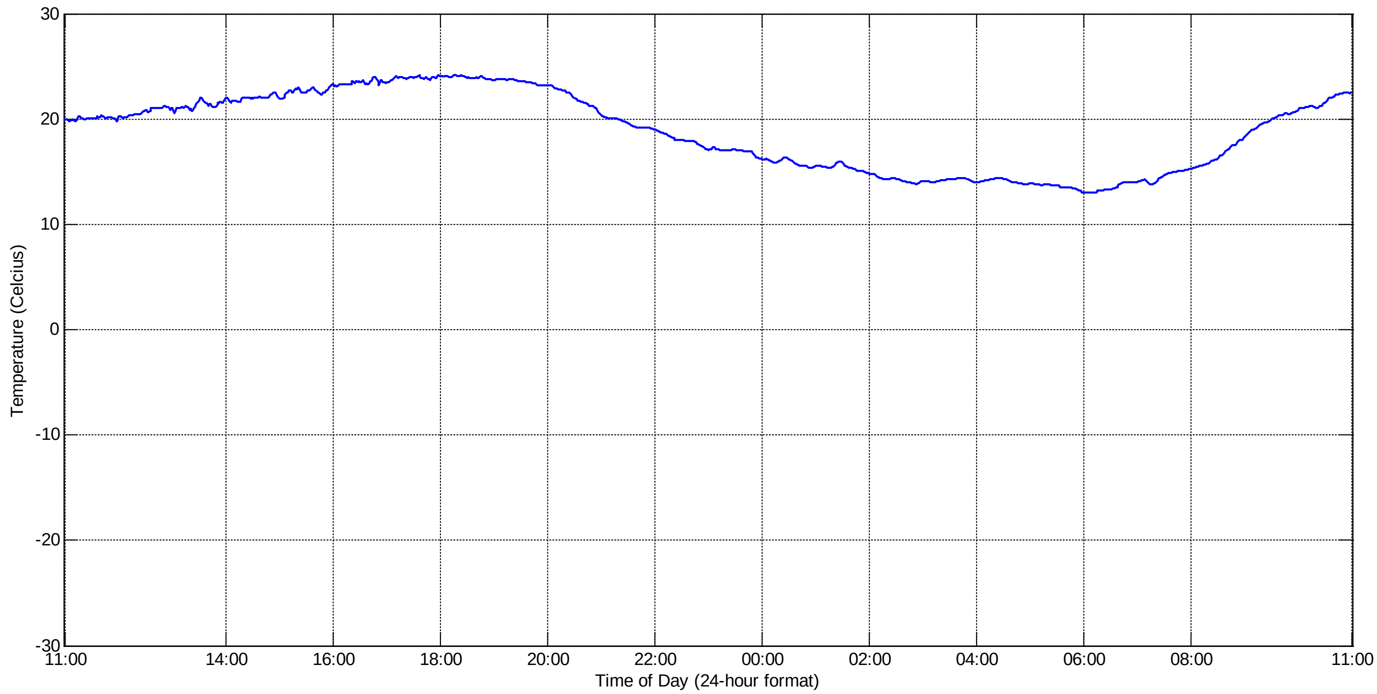
July 03 - 04, 2014 Monitored Relative Humidity



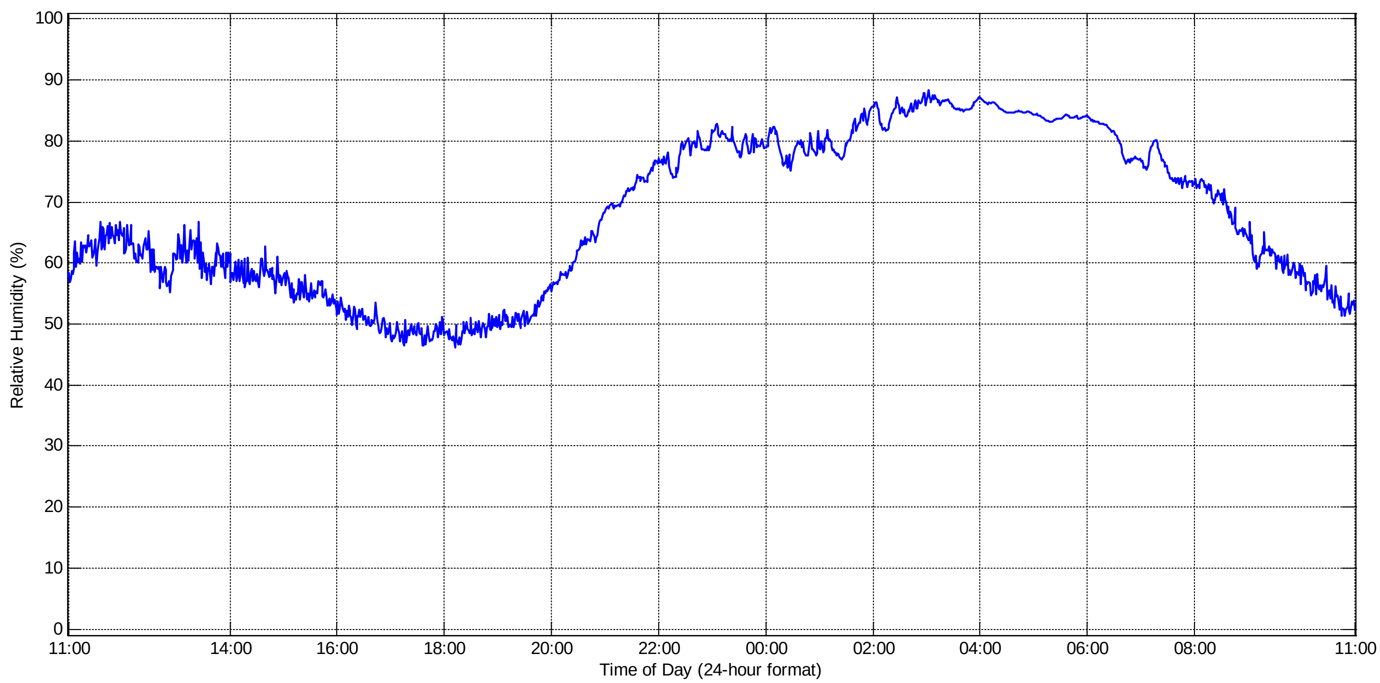
August 05 - 06, 2014 Monitored Wind Speed



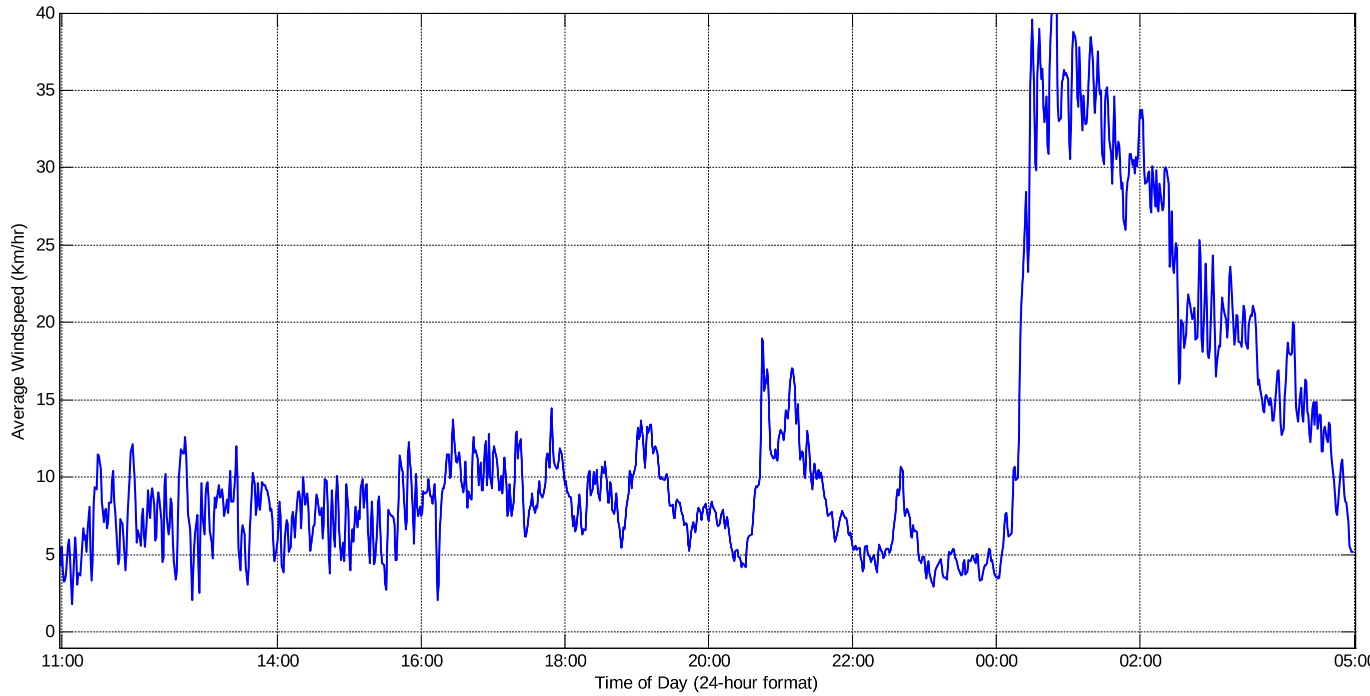
August 05 - 06, 2014 Monitored Wind Direction



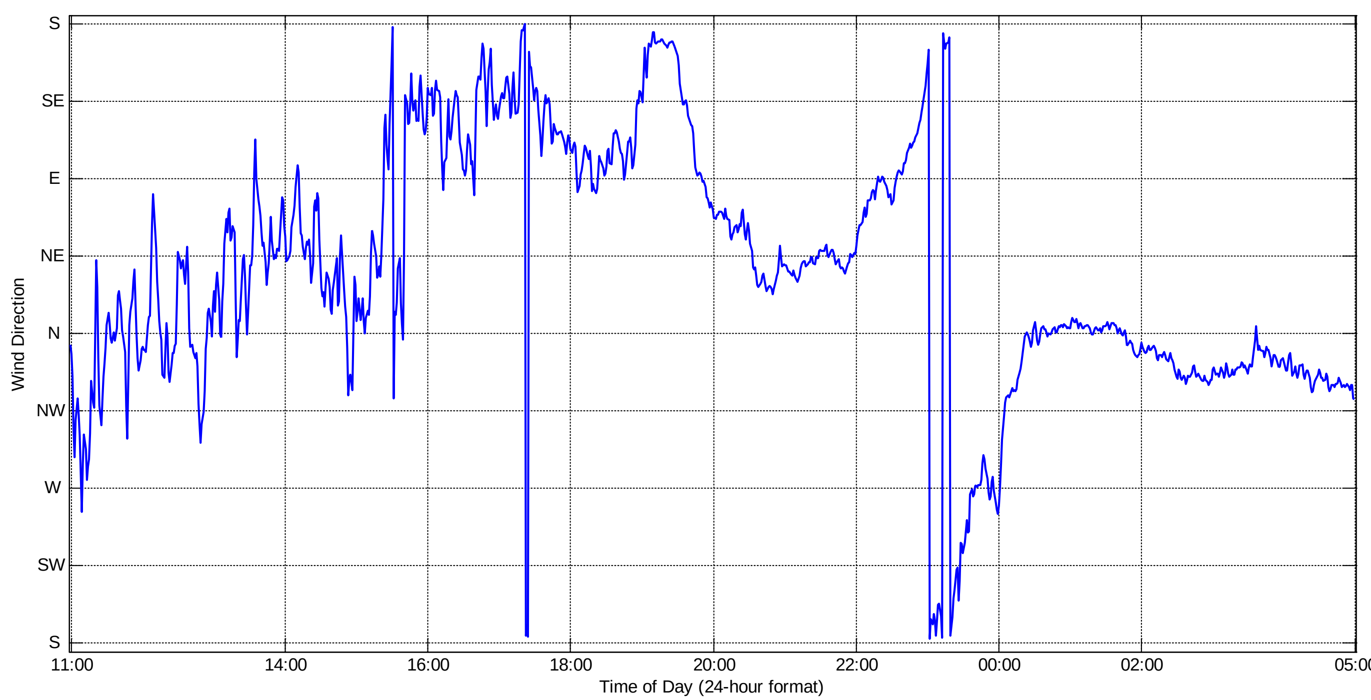
August 05 - 06, 2014 Monitored Temperature



August 05 - 06, 2014 Monitored Relative Humidity

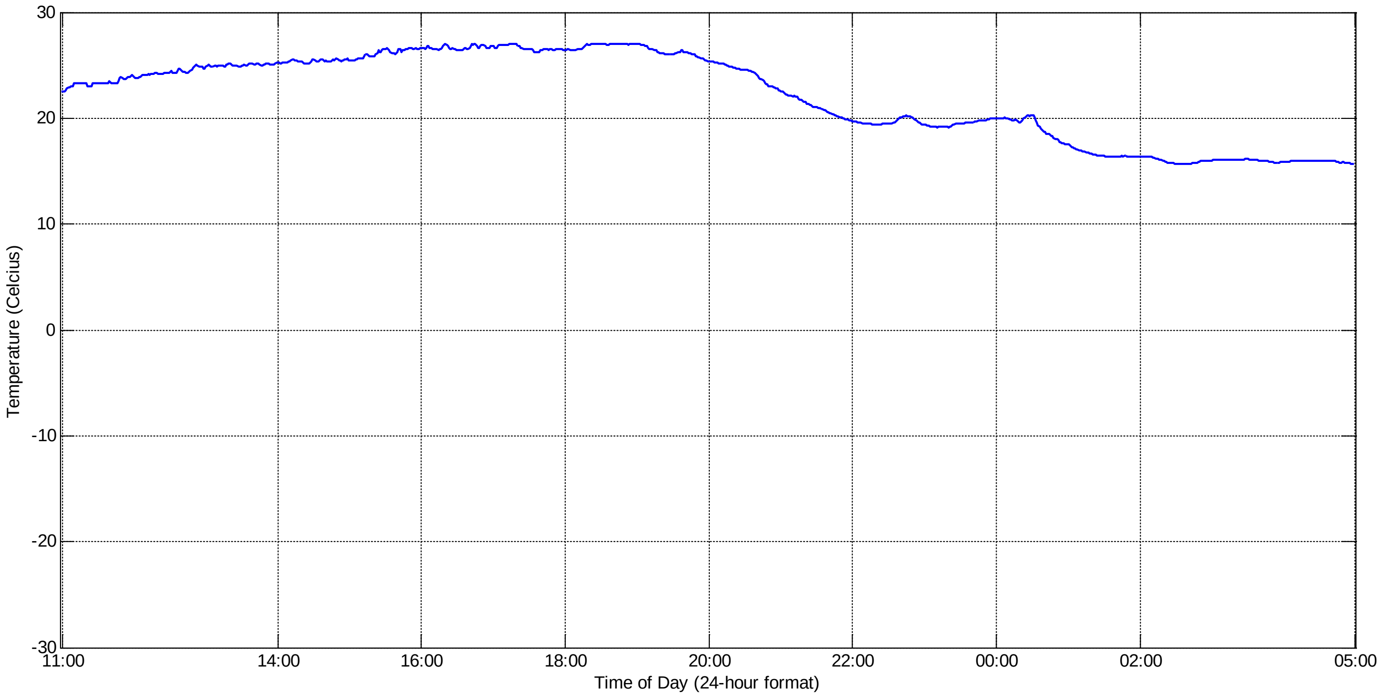


August 06 - 07, 2014 Monitored Wind Speed

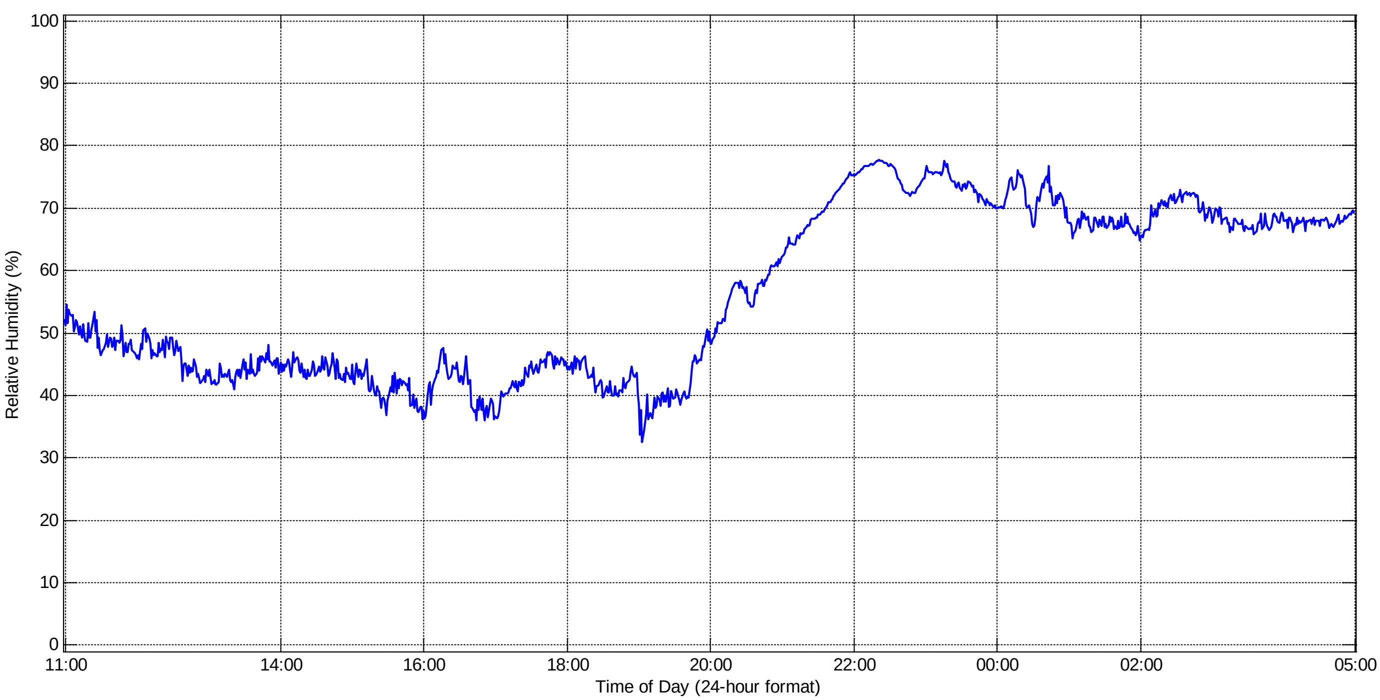


August 06 - 07, 2014 Monitored Wind Direction

acoustical consultants inc



August 06 - 07, 2014 Monitored Temperature



August 06 - 07, 2014 Monitored Relative Humidity