

BLUESTONE WIND

PRE-CONSTRUCTION SOUND LEVEL IMPACT ASSESSMENT



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TABLE OF CONTENTS

1.0	EXECUTIVE SUMMARY	1-1
2.0	INTRODUCTION	2-1
3.0	PROJECT DESCRIPTION	3-1
4.0	REGULATIONS, GUIDELINES, AND EVALUATION CRITERIA	4-1
4.1	Local Regulations	4-1
4.2	New York State	4-1
4.3	Federal Guidelines	4-2
4.4	World Health Organization Guidelines	4-2
4.5	National Association of Regulatory Utility Commissioners Report	4-3
4.6	Wind Turbine Sound Annoyance and Complaint Studies	4-3
	4.6.1 Audible Sound	4-4
	4.6.2 Infrasound and Low Frequency	4-6
4.7	Ground-Borne Vibration	4-9
4.8	Project Noise Standards and Design Goals	4-12
5.0	WIND TURBINE NOISE	5-1
5.1	Sources of Sound from Wind Turbines	5-1
5.2	Noise Abatement Measures	5-1
	5.2.1 Pre-Construction	5-1
	5.2.2 Construction	5-2
	5.2.3 Operations	5-3
6.0	BASELINE SOUND LEVEL MONITORING PROGRAM	6-1
6.1	Sensitive Receptors	6-1
6.2	Sound Level Measurement Locations	6-1
	6.2.1 Location 1	6-3
	6.2.2 Location 2	6-5
	6.2.2.1 Location 2 – Winter	6-5
	6.2.2.2 Location 2 – Summer	6-6
	6.2.3 Location 3	6-7
	6.2.4 Location 4	6-10
	6.2.5 Location 5	6-11
	6.2.6 Location 6	6-13
	6.2.7 Location 7	6-14
6.3	Sound Level Measurement Instrumentation	6-17
6.4	Meteorological Instrumentation	6-17
	6.4.1 Ground Level Winds	6-17
	6.4.2 Hub Height Winds	6-18
	6.4.3 Precipitation, Temperature, and Relative Humidity	6-18

6.5	Infrasound Monitoring	6-19
7.0	BASELINE SOUND LEVEL MONITORING RESULTS	7-1
7.1	Data Formatting Overview	7-1
7.2	Hub Height Winds	7-2
7.3	Location 1	7-2
	7.3.1 Winter Monitoring	7-2
	7.3.2 Summer Monitoring	7-3
	7.3.3 Spectral Sound Level Data	7-3
7.4	Location 2	7-4
	7.4.1 Winter Monitoring	7-4
	7.4.2 Summer Monitoring	7-4
	7.4.3 Spectral Sound Level Data	7-5
7.5	Location 3	7-5
	7.5.1 Winter Monitoring	7-5
	7.5.2 Summer Monitoring	7-6
	7.5.3 Spectral Sound Level Data	7-6
7.6	Location 4	7-7
	7.6.1 Winter Monitoring	7-7
	7.6.2 Summer Monitoring	7-7
	7.6.3 Spectral Sound Level Data	7-8
7.7	Location 5	7-8
	7.7.1 Winter Monitoring	7-8
	7.7.2 Summer Monitoring	7-9
	7.7.3 Spectral Sound Level Data	7-9
7.8	Location 6	7-10
	7.8.1 Winter Monitoring	7-10
	7.8.2 Summer Monitoring	7-11
	7.8.3 Spectral Sound Level Data	7-11
7.9	Location 7	7-11
	7.9.1 Winter Monitoring	7-12
	7.9.2 Summer Monitoring	7-12
	7.9.3 Spectral Sound Level Data	7-13
8.0	SEASONAL SOUND LEVEL MONITORING SUMMARY	8-1
8.1	Daytime Ambient – Lower Tenth Percentile	8-1
8.2	Nighttime Ambient – Lower Tenth Percentile	8-1
8.3	Daytime Ambient - Average	8-2
8.4	Nighttime Ambient - Average	8-2
8.5	Comparison of Sound Levels to Wind Speed	8-3
	8.5.1 Hub Height Wind Speed	8-3
	8.5.2 Ground Level Wind Speed	8-3
	8.5.3 Wind Speed at 10 meters	8-4

8.6	Temporal Accuracy	8-4
8.7	Infrasound and Low Frequency	8-9
9.0	FUTURE SOUND LEVELS	9-1
9.1	Sound Propagation	9-1
9.2	Equipment and Operating Conditions	9-1
9.2.1	Wind Turbines	9-1
9.2.2	Collection Substation	9-2
9.2.3	Battery Storage	9-3
9.3	Modeling Inputs and Scenarios	9-4
9.3.1	Common Modeling Inputs	9-4
9.3.2	Short-Term Modeling Scenarios - ISO 9613-2	9-5
9.3.3	Long-Term Modeling Scenarios – ISO 9613-2 Annual Sound Level Metrics	9-6
9.4	Modeling Results	9-9
9.4.1	Short-Term – ISO 9613-2 (GE 3.8-137, HH = 131m)	9-9
9.4.2	Short-Term – ISO 9613-2 (Vestas V150-4.2, HH = 130m)	9-10
9.4.3	Short-Term – ISO 9613-2 (Nordex N149/4500, HH = 125m)	9-11
9.4.4	Short-Term – ISO 9613-2 (Senvion M148-4.2, HH = 130m)	9-12
9.4.5	Long-Term – ISO 9613-2 L ₁₀ , L ₅₀ , and Nighttime L _{EQ} Annual Sound Level Results	9-13
9.5	Total Sound Levels - Modeled Combined with Ambient	9-17
9.5.1	Assignment of Ambient Sound Levels to Modeling Locations	9-17
9.5.2	Future Total Sound Levels	9-17
9.6	Infrasound and Low Frequency Sound	9-18
10.0	WIND SHEAR AND TURBULENCE INTENSITY	10-1
11.0	CONSTRUCTION NOISE	11-1
11.1	Area 1 Modeling Results	11-2
11.2	Area 2 Modeling Results	11-3
11.3	Area 3 Modeling Results	11-4
11.4	Construction Noise Conclusions	11-6
12.0	OTHER POTENTIAL COMMUNITY NOISE IMPACTS	12-1
12.1	Hearing Damage	12-1
12.2	Speech Interference	12-1
12.3	Outdoor Public Facilities	12-2
12.4	Structural Damage	12-2
12.5	Ground-Borne Vibration	12-2
12.6	Air-borne Vibration	12-3
12.7	Potential Interference with Technology	12-8
12.8	Amplitude Modulation	12-8
12.9	Tonality	12-11

13.0	EVALUATION	13-1
13.1	Local Laws (Goal #1)	13-1
13.2	World Health Organization—Short-Term (Goals #3; #4; #5)	13-1
13.3	World Health Organization—Long-Term (Goals #6; #7)	13-2
13.4	ANSI S12.9-2005/Part 4 (Goal #8)	13-2
13.5	Tonality (Goal #9)	13-3
13.6	Non-Residential Receptors (Goal #10)	13-4
13.7	NYS DEC Lands (Goal #2)	13-4
13.8	Vibration (Goal #11)	13-4
13.9	Summary of Compliance	13-4
14.0	CONCLUSIONS	14-1

LIST OF APPENDICES

Appendix A	Windscreen Insertion Loss
Appendix B	Certificates of Sound Level Instrument Calibration
Appendix C	SUNY MesoNet Meteorological Data
Appendix D	Detailed Sound Model Input Information
Appendix E	Sound Level Modeling Results—Short-term
Appendix F	Sound Level Modeling Results—Long-term
Appendix G	Total Future Sound Levels
Appendix H	Glossary of Terms

LIST OF FIGURES

Figure 4-1	Low Frequency Average Threshold of Hearing	4-7
Figure 6-1	Baseline Monitoring Locations Locus Map	6-2
Figure 6-2	Location 1, Sound Level Meter, Winter	6-4
Figure 6-3	Location 1, Sound Level Meter, Summer	6-5
Figure 6-4	Location 2 - Winter, Sound Level Meter	6-6
Figure 6-5	Location 2 - Summer, Sound Level Meter	6-7
Figure 6-6	Location 3, Sound Level Meter, Winter	6-8
Figure 6-7	Location 3, Sound Level Meter, Summer	6-8
Figure 6-8	Location 3, Meteorological Tower, Winter	6-9
Figure 6-9	Location 3, Meteorological Tower, Summer	6-9
Figure 6-10	Location 4, Sound Level Meter, Winter	6-10
Figure 6-11	Location 4, Sound Level Meter, Summer	6-11
Figure 6-12	Location 5, Sound Level Meter, Winter	6-12
Figure 6-13	Location 5, Sound Level Meter, Summer	6-12
Figure 6-14	Location 6, Sound Level Meter, Winter	6-13
Figure 6-15	Location 6, Sound Level Meter, Summer	6-14
Figure 6-16	Location 7, Sound Level Meter, Winter	6-15
Figure 6-17	Location 7, Sound Level Meter, Summer	6-15
Figure 6-18	Location 7, Meteorological Tower, Winter	6-16
Figure 6-19	Location 7, Meteorological Tower, Summer	6-16
Figure 7-1	On-Site Hub Height Wind Rose – Winter Ambient [REDACTED]	7-14
Figure 7-2	On-Site Hub Height Wind Rose – Summer Ambient [REDACTED]	7-15
Figure 7-3	Baseline Monitoring Graphical Results – Winter Location 1	7-16
Figure 7-4	Baseline Monitoring Graphical Results – Summer Location 1	7-17
Figure 7-5	Baseline Monitoring Graphical Results – Location 1 Octave Band Sound Pressure Levels	7-18
Figure 7-6	Baseline Monitoring Graphical Results – Location 1 - Third Octave Band Sound Pressure Levels	7-19
Figure 7-7	Baseline Monitoring Graphical Results – Winter Location 2	7-20
Figure 7-8	Baseline Monitoring Graphical Results – Summer Location 2	7-21
Figure 7-9	Baseline Monitoring Graphical Results – Location 2 Octave Band Sound Pressure Levels	7-22
Figure 7-10	Baseline Monitoring Graphical Results – Location 2 - Third Octave Band Sound Pressure Levels	7-23
Figure 7-11	Baseline Monitoring Graphical Results – Winter Location 3	7-24
Figure 7-12	Baseline Monitoring Graphical Results – Summer Location 3	7-25
Figure 7-13	Baseline Monitoring Graphical Results – Location 3 Octave Band Sound Pressure Levels	7-26
Figure 7-14	Baseline Monitoring Graphical Results – Location 3 - Third Octave Band Sound Pressure Levels	7-27
Figure 7-15	Baseline Monitoring Graphical Results – Winter Location 4	7-28

Figure 7-16	Baseline Monitoring Graphical Results – Summer Location 4	7-29
Figure 7-17	Baseline Monitoring Graphical Results – Location 4 Octave Band Sound Pressure Levels	7-30
Figure 7-18	Baseline Monitoring Graphical Results – Location 4 - Third Octave Band Sound Pressure Levels	7-31
Figure 7-19	Baseline Monitoring Graphical Results – Winter Location 5	7-32
Figure 7-20	Baseline Monitoring Graphical Results – Summer Location 5	7-33
Figure 7-21	Baseline Monitoring Graphical Results – Location 5 Octave Band Sound Pressure Levels	7-34
Figure 7-22	Baseline Monitoring Graphical Results – Location 5 - Third Octave Band Sound Pressure Levels	7-35
Figure 7-23	Baseline Monitoring Graphical Results – Winter Location 6	7-36
Figure 7-24	Baseline Monitoring Graphical Results – Summer Location 6	7-37
Figure 7-25	Baseline Monitoring Graphical Results – Location 6 Octave Band Sound Pressure Levels	7-38
Figure 7-26	Baseline Monitoring Graphical Results – Location 6 - Third Octave Band Sound Pressure Levels	7-39
Figure 7-27	Baseline Monitoring Graphical Results – Winter Location 7	7-40
Figure 7-28	Baseline Monitoring Graphical Results – Summer Location 7	7-41
Figure 7-29	Baseline Monitoring Graphical Results – Location 7 Octave Band Sound Pressure Levels	7-42
Figure 7-30	Baseline Monitoring Graphical Results – Location 7 - Third Octave Band Sound Pressure Levels	7-43
Figure 8-1	Monitored L_{90} Compared to Hub Height Wind Speed, Location 3, All Seasons [REDACTED]	8-10
Figure 8-2	Monitored L_{eq} Compared to Hub Height Wind Speed, Location 3, All Seasons [REDACTED]	8-11
Figure 8-3	Monitored L_{90} Compared to Ground Level Wind Speed, Location 3, All Seasons	8-12
Figure 8-4	Regression Analysis of Measured L_{90} Sound Level vs. Normalized Wind Speed – Winter Overall Survey Period [REDACTED]	8-13
Figure 8-5	Regression Analysis of Measured L_{90} Sound Level vs. Normalized Wind Speed – Winter Overall Survey Period – Day [REDACTED]	8-14
Figure 8-6	Regression Analysis of Measured L_{90} Sound Level vs. Normalized Wind Speed – Winter Overall Survey Period – Night [REDACTED]	8-15
Figure 8-7	Regression Analysis of Measured L_{90} Sound Level vs. Normalized Wind Speed – Summer Overall Survey Period [REDACTED]	8-16
Figure 8-8	Regression Analysis of Measured L_{90} Sound Level vs. Normalized Wind Speed – Summer Overall Survey Period – Day [REDACTED]	8-17
Figure 8-9	Regression Analysis of Measured L_{90} Sound Level vs. Normalized Wind Speed – Summer Overall Survey Period – Night [REDACTED]	8-18
Figure 8-10	Baseline Monitoring Graphical Summary – Location 5 One-Third Octave-Band Low Frequency and Infrasound Sound Pressure Levels	8-19
Figure 9-1	Sound Level Modeling Locations	9-24

Figure 9-2	Short-Term Sound Level Modeling Results	9-25
Figure 9-3	Annual LEQ, Night Sound Level Modeling Results	9-26
Figure 10-1	Average Annual Wind Shear Coefficient by Hour [REDACTED]	10-1
Figure 10-2	Annual Average Turbulence Intensity by Hour–Boxes show 90% of data and the whiskers are +5% and -5% outliers [REDACTED]	10-2
Figure 10-3	Annual Average Turbulence Intensity by Hub Height Wind Speed–90% of data is Between High and Low Lines; Center Line is Median [REDACTED]	10-3
Figure 11-1	Representative Construction Areas and Sound Contours	11-5
Figure 12-1	Seismic Station within 50 miles of Project	12-15

LIST OF TABLES

Table ES-1	Summary of Compliance with Sound Standards and Design Goals – Bluestone Wind	ES-4
Table 4-1	Low frequency levels at which annoyance is minimal. [ANSI S12.9-2005/Part 4]	4-8
Table 4-2	Measured interior sound pressure levels for perceptible vibration and rattle in lightweight wall and ceiling structures. [ANSI/ASA S12.2-2008]	4-8
Table 4-3	<i>Equivalent</i> outdoor sound pressure levels for perceptible vibration and rattle in lightweight wall and ceiling structures.	4-9
Table 4-4	Base response one-third octave band RMS velocity ratings for the three biodynamic vibration axes and combined axis (From ANSI S2.71-1983 (R2006))	4-11
Table 4-5	Summary of Ground-Borne Vibration Information	4-12
Table 4-6A	Summary of Measured Sound Standards or Design Goals – Bluestone Wind	4-14
Table 4-6B	Summary of Modeled Design Goals – Bluestone Wind	4-15
Table 6-1	GPS Coordinates – Sound Level Measurement Locations	6-3
Table 8-1	Daytime Ambient L ₉₀ (dBA) Sound Pressure Level Summary	8-1
Table 8-2	Nighttime Ambient L ₉₀ (dBA) Sound Pressure Level Summary	8-2
Table 8-3	Daytime Ambient L _{eq} (dBA) Sound Pressure Level Summary	8-2
Table 8-4	Nighttime Ambient L _{eq} (dBA) Sound Pressure Level Summary	8-3
Table 8-5	Temporal Accuracy Summary – Summer Daytime L90	8-5
Table 8-6	Temporal Accuracy Summary – Summer Nighttime L90	8-5
Table 8-7	Temporal Accuracy Summary – Winter Daytime L90	8-6
Table 8-8	Temporal Accuracy Summary – Winter Nighttime L90	8-6
Table 8-9	Temporal Accuracy Summary – Yearly Daytime L90	8-6
Table 8-10	Temporal Accuracy Summary – Yearly Nighttime L90	8-7
Table 8-11	Temporal Accuracy Summary - Summer Daytime Leq	8-7
Table 8-12	Temporal Accuracy Summary - Summer Nighttime Leq	8-7
Table 8-13	Temporal Accuracy Summary - Winter Daytime Leq	8-8

Table 8-14	Temporal Accuracy Summary - Winter Nighttime Leq	8-8
Table 8-15	Temporal Accuracy Summary - Yearly Daytime Leq	8-8
Table 8-16	Temporal Accuracy Summary - Yearly Nighttime Leq	8-8
Table 9-1	Wind Turbines Analyzed for Sound Level Assessment	9-1
Table 9-2	Wind Turbine Broadband Sound Power Levels vs. Wind Speed [REDACTED]	9-2
Table 9-3	Wind Turbine Maximum Octave Band Sound Power Levels [REDACTED]	9-2
Table 9-4	Collector Substation Transformer Sound Power Levels	9-3
Table 9-5	Battery Storage Facility Components Sound Power Levels	9-4
Table 9-6	Summary of Annual On-Site Hub Height Wind Speeds (2017) [REDACTED]	9-7
Table 9-7	Summary of Annual On-Site Hub Height Wind Speed Statistics (2017) [REDACTED]	9-8
Table 9-8	Summary of L ₁₀ , L ₅₀ Annual Sound Power Levels (dBA) [REDACTED]	9-8
Table 9-9	Summary of L _{EQ} , Night, Year Sound Power Levels (dBA) [REDACTED]	9-9
Table 9-10	Participating and Non-Participating Receptors Modeled at 40 dBA or Greater (GE 3.8-137)	9-10
Table 9-11	Participating and Non-Participating Receptors Modeled at 40 dBA or Greater (Vestas V150-4.2)	9-11
Table 9-12	Participating and Non-Participating Receptors Modeled at 40 dBA or Greater (Nordex N149/4500)	9-12
Table 9-13	Participating and Non-Participating Receptors Modeled 40 dBA or Greater (Senvion M148-4.2)	9-13
Table 9-14	Number of Receptors Modeled at 40 dBA or Greater for L _{EQ} -night-year—GE 3.8-137	9-15
Table 9-15	Number of Receptors Modeled at 40 dBA or Greater for L _{EQ} -night-year—Vestas V150-4.2	9-15
Table 9-16	Number of Receptors Modeled at 40 dBA or Greater for L _{EQ} -night-year—Nordex N149/4500	9-16
Table 9-17	Number of Receptors Modeled at 40 dBA or Greater for L _{EQ} -night-year—Senvion M148-4.2	9-16
Table 9-18	Maximum Wind Turbine Sound Power Levels—Infrasound & LFN	9-20
Table 9-19	Locations Analyzed for Infrasound & LFN	9-21
Table 9-20	Calculated Sound Levels—Infrasound & LFN	9-22
Table 11-1	Sound Levels for Noise Sources Included in Construction Modeling	11-2
Table 11-2	Construction Noise Modeling Results – Area 1 Construction (dBA)	11-3
Table 11-3	Construction Noise Modeling Results – Area 2 Construction (dBA)	11-3
Table 11-4	Construction Noise Modeling Results – Area 3 Construction (dBA)	11-4
Table 12-1	ANSI/ASA S12.2-2008 Section 6 and ANSI S12.9-2005/Part 4 Annex D Low Frequency Criteria Compared with Modeled Sound Levels at Worst-Case Receptors	12-3

Table 12-2	Participating and Non-Participating Receptors Modeled 65 dB or Greater for Low Frequency Criteria (GE 3.8-137)	12-4
Table 12-3	Participating and Non-Participating Receptors Modeled 65 dB or Greater for Low Frequency Criteria (Vestas V150-4.2)	12-4
Table 12-4	Participating and Non-Participating Receptors Modeled 65 dB or Greater for Low Frequency Criteria (Nordex N149/4500)	12-5
Table 12-5	Participating and Non-Participating Receptors Modeled 65 dB or Greater for Low Frequency Criteria (Senvion 4.2M148)	12-5
Table 12-6a	Modeled 65 dB or Greater Receptors IDs – 16 Hz	12-6
Table 12-6b	Modeled 65 dB or Greater Receptors IDs – 31.5 Hz	12-7
Table 12-7	Tonal Analysis & Compliance Evaluation: Modeled Sound Pressure Levels	12-13
Table 13-1	Non-Residential Receptors—Highest Short-Term Sound Levels (1-hour Leq)	13-4
Table 13-2	Summary of Compliance with Sound Standards and Design Goals - Bluestone Wind	13-5

1.0 EXECUTIVE SUMMARY

The proposed Bluestone Wind project will be located in Broome County, NY. The project is expected to be approximately 124 MW using 33 wind turbines and ancillary structures. This report is a noise impact assessment required under section 1001.19 as part of the NY State Article 10 process.

This document contain(s) confidential commercial information, trade secrets, and/or proprietary information and as such is entitled to confidential treatment under Section 87(2) of the New York State Public Officers Law and the Commission's regulations (16 NYCRR 6-1). An un-redacted version of this document has been submitted under separate cover pursuant to 16 NYCRR 6-1.4.

Noise Standards and Design Goals

The project will be located within two towns, both of which have local noise standards. In Sanford, sound levels generated by wind turbines are limited to 50 dBA measured at a non-participating residence. This standard applies day or night. The Town of Windsor has a noise ordinance but has confirmed and agreed to in stipulations that it is not applicable to this facility.

As part of the project, noise design goals were developed based on a literature review of health-based standards, guidelines on sound and annoyance, and previous Siting Board proceedings in order to balance reasonable development and minimize potential impacts from the Facility. These design goals include a 45 dBA nighttime limit at a non-participating residence. This is guided by the World Health Organization's (WHO) eight-hour guideline for sleep disturbance. A nighttime design goal of 55 dBA is established for a participating residence. Another design goal for non-participating residences is to prohibit a "pure tone" in accordance with ANSI S12.9 Part 3/Annex B Section B.1, or impose a 5 dBA penalty to the broadband limit if a pure tone occurs.

Wind turbines produce infrasound but these levels are well below human thresholds of audibility. However, infrasound and low frequency energy can result in airborne vibration within homes if the levels are high enough. American National Standard ANSI S12.9-2005/Part 4 identifies that low frequency sound annoyance is minimal when the 16, 31.5 and 63 Hz octave band sound pressure levels are each less than 65 dB. These levels will be design goals at the exterior of a home to conservatively assess the potential for low frequency annoyance.

An annual nighttime level of 40 dBA ($L_{eq, \text{night, outside}}$) at a non-participating residence is another design goal consistent with the Certificate conditions of Cassadaga Wind (case #14-F-0490). This covers all the eight-hour nighttime periods over the course of an entire year (365 days). This same annual nighttime design goal is 50 dBA at a participating residence.

Other design goals include meeting the NYS DEC Noise Policy at locations on DEC lands, limiting 1-hour sound levels to 55 dBA or less at non-participating property lines, 50 dBA at non-residential receptors (i.e. historic venues, cemeteries, playgrounds), and no perceptible indoor vibrations at non-participating residences.

Existing Condition Sound Monitoring

Consistent with Stipulation 19(b) agreed to by the parties in this proceeding, existing condition sound levels were measured at seven locations in and around the project site during both summer and winter seasons. Sound levels were measured for two weeks collecting both broadband (dBA) and one-third octave band data, as well as ground-level and hub-height wind speeds. Additional infrasound measurements were also collected at one location in each season. All data were processed to remove invalid, intermittent, and seasonal noise in order to calculate the L_{eq} and L_{90} ambient sound levels required in the Article 10 regulations.

Future Sound Modeling

Consistent with Stipulation 19, the expected future sound levels from the project were modeled at all sensitive sound receptors identified in the project area. Sound power levels from four potential wind turbine models under maximum sound power conditions were used in the model, plus a 2 dB manufacturer's uncertainty factor. The first round of modeling estimated the highest 1-hour L_{eq} from the project. This was done using the ISO 9613-2 propagation standard and every wind turbine was assumed to be operating simultaneously at maximum sound level. The second round of modeling also used the ISO 9613-2 propagation standard but included adjustments to the maximum sound power levels using one year of on-site meteorological data to calculate an estimated worst-case (L_{10}), typical (L_{50}), and annual nighttime ($L_{eq, \text{night- outside}}$) sound level at each receptor. Sound levels from construction activities at the most potentially impacted areas were modeled for the major phases of construction.

Conclusions

The detailed analyses presented in this report confirm that the Facility construction and operation has been designed to comply with the noise and vibration design goals and applicable standards. Table ES-1 summarizes each of the eleven design goals and standards, and indicates the compliance status of the project with each one.

As detailed below, two potential wind turbine models meet the annual $L_{eq, \text{night- outside}}$ design goal and two potential wind turbine models do not meet this goal. In addition, a few non-participating locations show modeled 16 Hz levels slightly above the design goal under all four potential wind turbine models, and these locations are addressed through the minimization and mitigation measures identified below. The final analysis will be refined to model only the selected wind turbine model. Therefore, at this stage of permitting,

adverse impacts from noise and vibration from the construction and operation of the Bluestone Wind project have been avoided or mitigated to the maximum extent practicable.

Table ES-1 Summary of Compliance with Sound Standards and Design Goals – Bluestone Wind

#	Municipality or Organization	Sound Level Limit	Assessment Location	Noise descriptor	Period of Time	Participant Status	Comply?
1	Town of Sanford Renewable Energy Systems §1402.5(A)(5)	50 dBA	Exterior wall of the nearest non-participating residence	Not stated (assumed Leq)	Not stated (assumed 1-hour); day or night	Non-participant	Yes
2	Program Policy Assessing and Mitigating Noise Impacts issued by the New York State Department of Environmental Conservation (NYSDEC), Feb. 2001	6 dBA increase over ambient	Areas of human use	L90	Not stated	NYS DEC lands	Yes
3	Design goal (1999 WHO Guidelines)	45 dBA ¹	At residence	Leq	8-hour; nighttime	Non-participant	Yes
4	Design goal (1999 WHO Guidelines)	55 dBA	At residence	Leq	8-hour; nighttime	Participant	Yes
5	Design goal	55 dBA	Property line and lands except wetlands	Leq	1-hour; day or night.	Non-participant	Yes
6	Design goal (Permit condition Case 14-F-0490 (Cassadaga Wind))	40 dBA	At residence	Leq, night, outside	Annual; nighttime	Non-participant	Yes (Vestas; Senvion) No (GE; Nordex)

¹ Subject to a 5 dBA penalty if a prominent tone occurs. See goal 9 for details.

Table ES-1 Summary of Compliance with Sound Standards and Design Goals – Bluestone Wind (Continued)

#	Municipality or Organization	Sound Level Limit	Assessment Location	Noise descriptor	Period of Time	Participant Status	Comply?
7	Design goal (Permit condition Case 14-F-0490 (Cassadaga Wind))	50 dBA	At residence	Leq, night, outside	Annual; nighttime	Participant	Yes
8	Design goal (Permit condition Case 14-F-0490 (Cassadaga Wind))	65 dB at 16, 31.5, 63 Hz	At residence	Leq	1-hour; day or night	Non-participant	No (16 Hz) Yes (31.5; 63 Hz)
9	Design goal (Permit condition Case 14-F-0490 (Cassadaga Wind))	No pure tone or 5 dBA penalty if a prominent tone occurs	At residence	Leq	1-hour; day or night	Non-participant	Yes
10	Design goal (ANSI/ASA S12.9-2007/Part 5)	50 dBA	Non-residential (historic venues; cemeteries; playgrounds; etc.)	Leq	1-hour	Non-participant	Yes
11	Design goal for vibrations.	Not perceptible indoor vibrations	At residence	See ANSI S 2.71-1983 (R August 6/2012) for details	See ANSI S 2.71-1983 (R August 6/2012) for details	Non-Participant	Yes

2.0 INTRODUCTION

This report is a pre-construction noise impact assessment (PNIA) of the proposed Bluestone Wind required under section 1001.19 as part of the NY State Article 10 process.

The Bluestone Wind Project is a proposed 124-megawatt (MW) project located within the Towns of Windsor and Sanford, Broome County, New York. The proposed Facility consists of the construction and operation of a commercial-scale wind power project, including the installation and operation of up to 33 wind turbines, together with the associated collection lines, access roads, meteorological towers, and operation and maintenance (O&M) building. These turbines and related facilities will be sited within privately-owned leased land within an approximately 5,700-acre Facility Site. To deliver electricity to the New York State power grid, the Applicant proposes to construct a collection substation, and a point of interconnect substation including a battery storage facility, which will interconnect with NYSEG's existing Afton to Stilesville 115 kV transmission line, in the Town of Sanford.

The PNIA was conducted in accordance with the Article 10 regulations and the stipulations among the parties. The report includes the following elements:

- ◆ Project description
- ◆ Discussion of sound level limits, regulations, guidelines, and goals for the project
- ◆ Discussion of human response to wind turbine noise, including annoyance
- ◆ Description of existing condition sound level measurement program
- ◆ Sound level measurement results from two seasons of monitoring
- ◆ Sound level propagation modeling procedures
- ◆ Sound level modeling results
- ◆ Wind shear and turbulence intensity
- ◆ Construction sound level procedures and results
- ◆ Other potential community noise impacts
- ◆ Detailed appendices of model inputs and results tables
- ◆ Glossary of terms

3.0 PROJECT DESCRIPTION

The proposed Bluestone Wind Project (the “Project”) is being developed by Bluestone Wind, LLC (the “Applicant”) an indirect subsidiary of Calpine Wind Holdings, LLC. The Project is a proposed 124-megawatt (MW) project located within the Towns of Windsor and Sanford, Broome County, New York.

The proposed Facility consists of the construction and operation of a commercial-scale wind power project, including the installation and operation of up to 33 wind turbines, together with the associated collection lines, access roads, meteorological (“met”) towers, and one operation and maintenance (O&M) building. These turbines and related facilities will be sited within privately-owned leased land within an approximately 5,700-acre Facility Site.

To deliver electricity to the New York State power grid, the Applicant proposes to construct a collection substation, and a point of interconnect substation including a battery storage facility, which will interconnect with NYSEG’s existing Afton to Stilesville 115 kV transmission line, in the Town of Sanford. The interconnect substation will be the typical three ring break configuration, will not contain any new noise sources, and thus was not included in the noise study. A 10 MW battery storage component is included as part of the project, and will be located adjacent to the collector substation.

The Applicant is considering a range of turbine models for the Facility. For this PNIA, four (4) wind turbine generators (WTGs) were analyzed²:

- ◆ General Electric (GE) 3.8-137; hub height (HH) of 131 meters
- ◆ Vestas V150-4.2; HH = 127 meters
- ◆ Nordex N149/4500; HH = 125 meters
- ◆ Senvion 4.2M148; HH = 130 meters

The collector substation will contain a single 34.5/115 kV step-up transformer rated at up to 222 MVA. 392 discrete receptors were analyzed for the project. These include 97 seasonal residences, 276 year-round residences, 4 public places, and 15 unknown (not verifiable) receptors. All unknown receptors were conservatively assumed to be residences.

² A fifth WTG is also under consideration, the Siemens Gamesa Renewable Energy (SGRE) SG4.2-145; HH = 127 meters. However, no sound power level data were available for this WTG at the time of submission.

4.0 REGULATIONS, GUIDELINES, AND EVALUATION CRITERIA

4.1 Local Regulations

Bluestone Wind is located within the Towns of Sanford and Windsor, Broome County, NY. Broome County does not have any noise regulations applicable to wind turbine operation. In Sanford, Local Law #1-1992 was amended by Local Law #1 of 2017 to add a new Article XIV entitled “Renewable Energy Systems.” Section 1402.5(A)(5) limits sound levels generated by operation of WECS (Wind Energy Conversion Systems) to 50 dBA measured from the exterior wall at a non-participating residence. This standard applies day or night. Neither the metric nor the time period of evaluation is stated in the standard. For purposes of this assessment, a one-hour Leq (day or night) was assumed consistent with NYS DEC solid waste noise limits [Part 360-1.14(p)].

In Windsor, Local Law No. 1 of 2016 amended Chapter 68 “Noise Control.” Section 68-8 contains daytime and nighttime maximum permissible continuous sound levels based on land use (Residential; Business; Commercial). However, Section 68-9(17) states that the provisions of Section 68-8 do not apply to projects under the purview of Article 10. Therefore, the Town of Windsor local limits will not be evaluated for this Project.

4.2 New York State

This project falls under the jurisdiction of the NY State Board on Electric Generation Siting and the Environment “Article 10” regulations. Part 1001.19 “Exhibit 19: Noise and Vibration” contains the required elements of the regulation. These regulations do not list quantitative sound limits applicable to this project, but rather all the factors that must be considered in the noise study. . In a previous proceeding for the siting of a wind project, the Siting Board established standards and design goals at nonparticipating residential receptors as a condition to the operation of the facility. (See Application of Cassadaga Wind LLC, *Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions*, Case No. 14-F-0490, dated January 17, 2018; Conditions 70-73; 80-83).

The NYSDEC has published a guidance document³ for assessing noise impacts (NYSDEC, 2001). This DEC policy states that the US EPA “Protective Noise Levels” guidance found that an annual sound level of 55 dBA L_{dn} was sufficient to protect the public health and welfare, and in most cases, did not create an annoyance. A 55 dBA L_{dn} would be equivalent to a daytime sound level of 55 dBA, and a nighttime sound level of 45 dBA, or a continuous level of approximately 49 dBA. The guidance document states that the addition of any noise source, in a non-industrial setting, should not raise the ambient noise level above a maximum of 65 dBA. This guidance document also states that sound level

³ Program Policy Assessing and Mitigating Noise Impacts issued by the New York State Department of Environmental Conservation (NYSDEC), Feb. 2001

increases from 0-3 dBA should have no appreciable effect on receptors, increases from 3-6 dBA may have potential for adverse noise impact only in cases where the most sensitive of receptors are present, and increases of more than 6 dBA may require a closer analysis of impact potential depending on existing sound levels and the character of surrounding land use and receptors. An increase of 10 dBA deserves consideration of avoidance and mitigation measures in most cases. The DEC policy will be used to evaluate any NYS DEC lands within one mile a wind turbine.

4.3 Federal Guidelines

There are no federal community noise regulations applicable to wind farms.

4.4 World Health Organization Guidelines

A useful guideline for putting sound levels in perspective is the “Guideline for Community Noise” (World Health Organization, Geneva, 1999). Table 4.1 in this document states that daytime and evening outdoor living area sound levels at a residence should not exceed an L_{eq} of 55 dBA to prevent serious annoyance and an L_{eq} of 50 dBA to prevent moderate annoyance from a steady, continuous noise. At night, sound levels at the outside facades of the living spaces should not exceed an L_{eq} of 45 dBA, so that people may sleep with bedroom windows open. The time base for these World Health Organization (WHO) sound levels is 16 hours for daytime and 8 hours for nighttime. In other words, they are not 10-minute averages but over a longer period of time. The 16-hour and 8-hour timeframes are considered short-term time periods.

In 2009 the WHO released another report entitled “Night Noise Guidelines for Europe.” The 2009 WHO report recommends a Night Noise Guideline (NNG) of 40 dBA. However, the 40 dBA guideline is an “ $L_{eq, night, outside}$ ” descriptor, which is NOT the same as a short-term measurement. $L_{eq, night, outside}$ is defined as the A-weighted long-term average sound level determined over all the night periods of a year; in which the night is eight hours (23:00 to 07:00 local time). Thus, the $L_{eq, night, outside}$ is an annual average, and is not an appropriate descriptor to use for evaluating a permit’s compliance criteria. An annual design goal is not a standard and should not be a permit condition given the complexity of measuring sound over the course of 365 nights.

Since $L_{eq, night, outside}$ considers 365 nights of operation, there will be some nights the wind turbines do not operate at all and many others where they will operate at a level below maximum sound level. Therefore, the $L_{eq, night, outside}$ sound level will always be lower than the worst-case (highest) short-term sound level measured on a given night. In other words, the $L_{eq, night, outside}$ guideline of 40 dBA, is not a 10-minute or 1-hour sound level, but is an average annual level.

It is important to note that the 1999 and 2009 WHO guidelines were developed with a focus on transportation sound and were not developed specifically for wind turbines.

4.5 National Association of Regulatory Utility Commissioners Report

The National Association of Regulatory Utility Commissioners (NARUC) Grants & Research Department published a report entitled “Wind Energy & Wind Park Siting and Zoning—Best Practices and Guidance for States” (January 2012). Part of the report presents guidelines for wind power development, including recommended approaches to several critical issues such as noise. The 2012 NARUC study concluded that, for long-term mean sound levels, a planning guideline of 40 dBA is an ideal design goal, and 45 dBA is an appropriate regulatory limit outside a residence at night. The report does not provide a recommendation for an annual average.

Details behind the sound level recommendations in the 2012 NARUC report are found in an October 2011 NARUC report.⁴ It is important to note that the 40 dBA and 45 dBA targets listed above are long-term mean sound levels, from data collected over a period of “several weeks.” In other words, these are not short-term maximum sound levels and are not directly comparable to the short term or annual average design goals established for this Facility. For example, the NARUC modeling methodology does not add the wind turbine manufacturer uncertainty, or “K” factor, which is typically 2 dBA. Therefore, a NARUC modeled result of 45 dBA would be the same as a 47 dBA modeled result when the “K” factor is included. This modeling study incorporates the “K” factor in the model.

According to the report, these sound levels were based on experience with wind turbine project operation and sound monitoring and were intended to minimize adverse reaction and sleep disturbance. Of course, the report notes that these levels do not mean the project sound will be inaudible or completely insignificant, only that its noise would generally be low enough that it would probably not be considered objectionable by the vast majority of neighbors. Another reason these numerical values cannot be compared with the proposed design goals for the Facility are that the NARUC report notes that the L₉₀ statistical measure should be used to determine sound levels from wind turbines instead of the L_{eq} as the L₉₀ captures the consistently present sound level during relatively quiet periods between identifiable noise events like car passbys or planes flying overhead. However, the L_{eq} is used to evaluate project sound levels since the design goals and criteria are stated in terms of an L_{eq}.

4.6 Wind Turbine Sound Annoyance and Complaint Studies

The frequency range 20 – 20,000 Hertz (Hz) is commonly described as the range of “audible” noise. The frequency range of low frequency sound is generally from 20 Hz to 200 Hz, and the range below 20 Hz is often described as “infrasound”.

⁴ Assessing Sound Emissions from Proposed Wind Farms & Measuring the Performance of Completed Projects, NARUC, prepared by Hessler Associates, Inc., October 2011.

4.6.1 Audible Sound

Several studies of human response to wind turbine sound were conducted in Europe in the early 2000s. Pedersen and Waye performed a cross-sectional study in Sweden in 2000.⁵ A dose-response relationship between calculated A-weighted sound levels from wind turbines and noise annoyance was found. Noise annoyance was related to other subjective factors such as attitude and sensitivity. Attitude towards the visual aspect of wind turbines was strongly correlated to annoyance. In other words, if an individual did not like the way a wind turbine appeared, they were more likely to be annoyed by the turbine as compared with being annoyed by the sound generated by a turbine.

Another detailed field study was conducted in the Netherlands in 2007 through the use of calculated sound levels and a questionnaire.⁶ A dose-response relationship between A-weighted sound levels and reported perception and annoyance was found. However, the study found that high turbine visibility enhances negative response, and having wind turbines visible from a dwelling significantly increases the risk of annoyance. Annoyance was strongly correlated with a negative attitude toward the visual impact of wind turbines on the landscape. The study also found that people who benefit economically from wind turbines have a significantly decreased risk of annoyance, even at the same sound levels. From that same study, it was found that of all sound sources that might disturb sleep in rural areas, 70% were not disturbed, 12% were disturbed by people/animals, 12% were disturbed by traffic/mechanical sounds, and 6% were disturbed by wind turbines.⁷

Observations of neighbors' reactions to newly operational wind farms suggest that it is not necessary to rigidly impose a maximum noise level of 40 dBA in order to avoid complaints. The NARUC document recommends 40 dBA as an *ideal* design goal, if it can reasonably be achieved, but 45 dBA as an appropriate regulatory limit. Adverse reactions to wind turbine noise between 40 and 45 dBA is still quite low, at roughly 2 percent of wind-park neighbors, even in rural environments with low background levels.⁸

⁵ *Perception and annoyance due to wind turbine noise—a dose-response relationship*, E. Pedersen and K.P. Waye, Goteborg University, Sweden, J. Acoust. Soc. Am. 116(6), December 2004.

⁶ *Response to noise from modern wind farms in The Netherlands*, E. Pedersen et al, J. Acoust. Soc. Am. 126(2), August 2009.

⁷ *Impact of wind turbine sound on annoyance, self-reported sleep disturbance and psychological distress*, RH Bakker et al, Sci Total Environ, 2012.

⁸ Wind Energy & Wind Park Siting and Zoning Best Practices and Guidance for States, NARUC, prepared by National Regulatory Research Institute, January 2012.

In 2014 McCunney et al did a detailed literature search and concluded that “Annoyance associated with living near wind turbines is a complex phenomenon related to personal factors. Noise from turbines plays a minor role in comparison with other factors in leading people to report annoyance in the context of wind turbines.”⁹

Health Canada, in collaboration with Statistics Canada, conducted one of the most extensive studies to understand the impacts of wind turbine noise to-date.¹⁰ A cross-section epidemiological study was carried out in 2013 in the provinces of Ontario and Prince Edward Island (PEI) on randomly selected participants living near and far from operating wind turbines. Calculated outdoor wind turbine sound levels were up to 46 dBA. Note that these sound levels represent typical worst-case long term (one year) average sound levels.

Many peer-reviewed publications have been written based on the Health Canada research, including an analysis of annoyance. For example, Michaud et al report annoyance toward several wind turbine features increased with increasing sound levels, including the following noise, blinking lights, shadow flicker, visual impacts, and vibrations. In the entire study, approximately 7% reported a high level of annoyance from wind turbine noise. In the homes within the 40-46 dBA wind turbine noise area, approximately 13% reported a high level of annoyance. Annoyance was significantly higher in Ontario versus PEI at comparable sound levels.¹¹

Another publication from the Health Canada study found that the association between wind turbine noise levels and annoyance was found to be rather weak ($R^2 = 9\%$). The R^2 improved after considering annoyance due to other wind turbine related features such as visibility, blinking lights on the nacelle, the perception of vibrations during wind turbine operation, and physical safety.¹² This is consistent with the Pedersen research.

In 2015, the U.S. Department of Energy funded Lawrence Berkeley National Laboratory (LBNL) to lead a 4-year project collecting data from a broad-based and representative sample of individuals living near U.S. wind power projects.¹³ The aim was to broaden the

⁹ *Wind Turbines and Health: A Critical Review of the Scientific Literature*, R. McCunney et al, Journal of Occupational and Environmental Medicine, 56(11), November 2014.

¹⁰ Health Canada website: <http://www.hc-sc.gc.ca/ewh-semt/noise-bruit/turbine-eoliennes/summary-resume-eng.php>

¹¹ *Exposure to wind turbine noise: Perceptual responses and reported health effects*, D. Michaud et al, J. Acoust. Soc. Am. 139(3), March 2016.

¹² *Personal and situational variables associated with wind turbine noise annoyance*, D. Michaud et al, J. Acoust. Soc. Am. 139(3), March 2016.

¹³ *National Survey of Attitudes of Wind Power Project Neighbors: Summary of Results*, B. Hoen et al, US Department of Energy, Lawrence Berkeley National Laboratory, January 2018.

understanding of how U.S. communities are reacting to the deployment of wind turbines, and to provide insights to those communities considering wind projects. Results of this work are now available as presentations or manuscripts, and are in the process of being submitted for peer reviewed publication in scientific journals.

Survey data were collected from 1,705 residents across 24 states who were living within 5 miles of 250 U.S. wind power projects. A 50-question multi-mode (phone, mail, and internet) survey was distributed to each homeowner in the sample, eliciting information on attitudes, stress reactions, perceived fairness of the process, relationship to the project, attitudes, and demographic information. Regarding attitude toward the wind project, 8% responded either very negative or negative, while the remaining 92% were neutral or positive. For just the respondents within 0.5 mile of a wind turbine, 25% were very negative or negative, and 75% were neutral or positive. Regarding annoyance, 5.6% of all respondents reported being somewhat, moderately, or very annoyed by the wind project. For the respondents within 0.5 mile of a wind turbine, 30% reported being somewhat, moderately, or very annoyed by the wind project.

Another portion of the LBNL study included modeled sound levels at more than 500 respondent's homes near 15 existing wind projects. The results found that modeled sound levels alone are not a good predictor of annoyance. Prediction of annoyance was improved by including other variables in the model such as visibility of wind turbines, support or opposition to the project, compensation from the project, and when they moved into the area. Higher background sound levels appear to mask turbine sound and thus produce less annoyance.

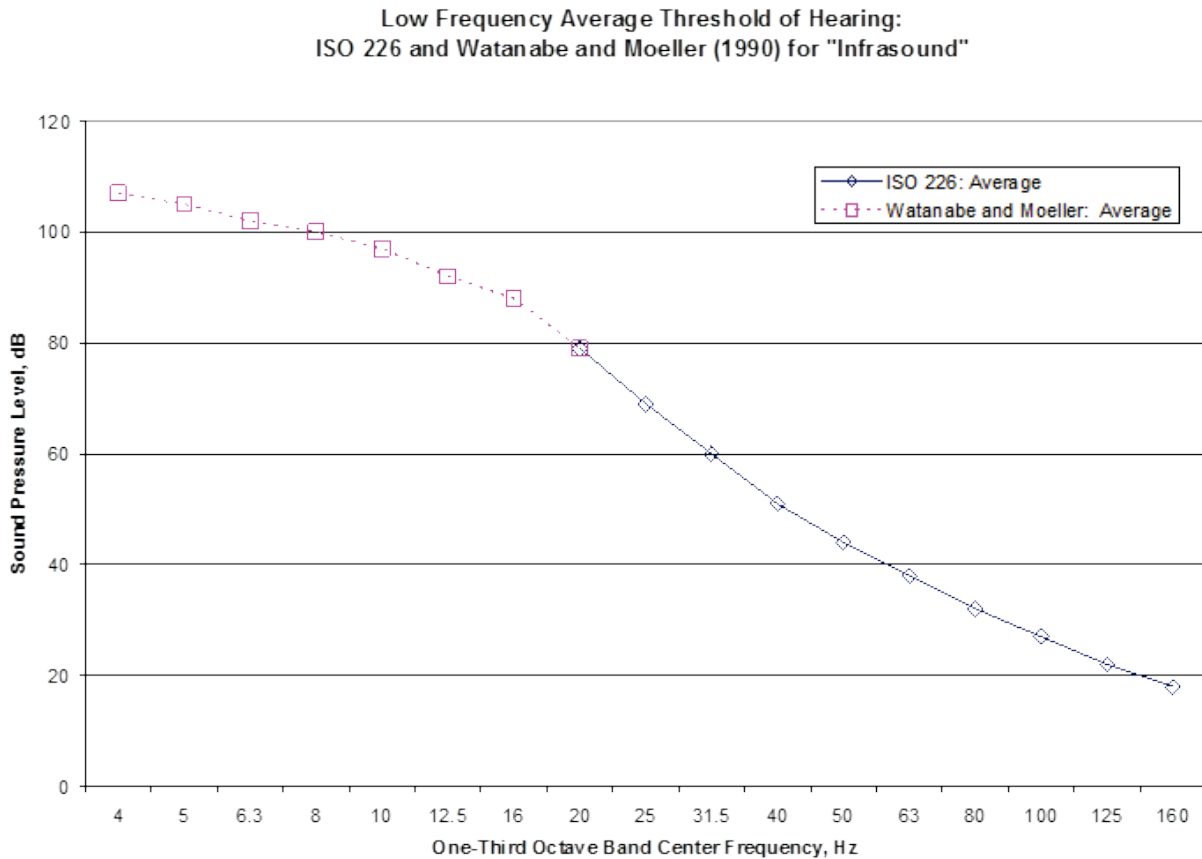
4.6.2 *Infrasound and Low Frequency*

The frequency range of low frequency sound is generally from 20 Hz to 200 Hz, and the range below 20 Hz is often described as "*infrasound*". However, audibility can extend to frequencies below 20 Hz if the energy is high enough. Since there is no sharp change in hearing at 20 Hz, the division between "low-frequency sound" and "infrasound" should only be considered "practical and conventional." The threshold of hearing is standardized for frequencies down to 20 Hz.¹⁴ Based on extensive research and data, Watanabe and Moeller have proposed normal hearing thresholds for frequencies below 20 Hz.¹⁵ Figure 4-1 shows these sound levels as a function of frequency.

¹⁴ Acoustics - Normal equal-loudness-level contours, International Standard ISO 226:2003, International Organization for Standardization, Geneva, Switzerland, (2003).

¹⁵ T. Watanabe, and H. Moeller, "Low Frequency Hearing Thresholds in Pressure Field and in Free Field", J. Low Frequency Noise and Vibration, 9(3), 106-115, (1990).

Figure 4-1 Low Frequency Average Threshold of Hearing



The results of Epsilon Associates, Inc. research indicate that there is no audible infrasound either outside or inside homes at 1,000 feet from a wind turbine. Sound levels meet the ANSI standard for low frequency noise in bedrooms, classrooms, and hospitals, meet the ANSI standard for thresholds of annoyance from low frequency noise, and there should be no window rattles or perceptible airborne induced vibration of light-weight walls or ceilings within homes. In homes there may be slightly audible low frequency noise beginning at around 50 Hz (depending on other sources of low frequency noise); however, the levels are below criteria and recommendations for low frequency noise within homes. ¹⁶

Annex D in the American National Standard ANSI S12.9-2005/Part 4¹⁷ identifies that low frequency sound annoyance is minimal when the 16, 31.5 and 63 Hz octave band sound pressure levels are each less than 65 dB. According to the standard, annoyance to sounds

¹⁶ *Low frequency noise and infrasound from wind turbines*, R. O’Neal et al, Noise Control Engineering J., 59(2), 2011.

¹⁷ American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound – Part 4: Noise Assessment and Prediction of Long-term Community Response, American National Standards Institute ANSI S12.9-2005/Part 4, Acoustical Society of America, New York, (2005).

with strong low frequency content is virtually only an indoor issue. Table 4-1 summarizes these levels.

Section 6 of the American National Standard ANSI/ASA S12.2-2008¹⁸ discusses criteria for evaluating indoor low frequency room noise. These criteria assess the potential to cause perceptible airborne induced vibration and rattles. Outdoor low frequency sounds that are high enough can cause building walls to vibrate and windows to rattle. Window rattles are not low frequency noise, but may be caused by low frequency noise. ANSI/ASA S12.2 presents limiting levels at low frequencies (16, 31.5, 63 Hz) for assessing (a) the probability of *clearly* perceptible acoustically induced vibration and rattles in lightweight wall and ceiling constructions, and (b) the probability of *moderately* perceptible acoustically induced vibration in similar constructions. See Table 4-2 below. Research has found that reduction of sound from outside to inside at these low frequencies is modest but not zero. Typical reductions with windows open are 3 dB, 6 dB, and 9 dB at 16, 31.5, and 63 Hz respectively.¹⁹ Table 4-3 summarizes the equivalent outdoor sound levels with this level of attenuation included.

As noted in the 2011 NARUC report, “the widespread belief that wind turbines produce elevated or even harmful levels of low frequency and infrasonic sound is utterly untrue as proven repeatedly and independently by numerous investigators.”

Table 4-1 Low frequency levels at which annoyance is minimal. [ANSI S12.9-2005/Part 4]

Condition	Octave-band center frequency (Hz)		
	16	31.5	63
Minimal annoyance levels	65 dB	65 dB	65 dB

Table 4-2 Measured interior sound pressure levels for perceptible vibration and rattle in lightweight wall and ceiling structures. [ANSI/ASA S12.2-2008]

Condition	Octave-band center frequency (Hz)		
	16	31.5	63
Clearly perceptible vibration and rattles likely	75 dB	75 dB	80 dB
Moderately perceptible vibration and rattles likely	65 dB	65 dB	70 dB

18 American National Standard Criteria for Evaluating Room Noise, American National Standards Institute ANSI/ASA S12.2-2008, Acoustical Society of America, New York, (2008).

19 Low frequency noise and infrasound from wind turbines, R. O’Neal et al, Noise Control Engineering J., 59(2), 2011.

Table 4-3 *Equivalent outdoor sound pressure levels for perceptible vibration and rattle in lightweight wall and ceiling structures.*

Condition	Octave-band center frequency (Hz)		
	16	31.5	63
Clearly perceptible vibration and rattles likely	78 dB	81 dB	89 dB
Moderately perceptible vibration and rattles likely	68 dB	71 dB	79 dB

4.7 Ground-Borne Vibration

While not studied nearly as extensively as airborne vibration, the potential for wind turbines to create adverse ground-borne vibration has been investigated. Measurement of ground borne vibration associated with wind turbine operations can be detectable with instruments but is below the threshold of perception, even within a wind farm.

Gastmeier & Howe measured vibration at a residence 325 meters (1,066 feet) from several 1.8 MW wind turbines and found vibration levels were well below the perception limits found in ISO 2631-2 (“Evaluation of human exposure to whole-body vibration Part 2”).²⁰

The Massachusetts Department of Environmental Protection (MA DEP) and the Massachusetts Department of Public Health commissioned an expert panel who found that seismic motion from wind turbines is so small that it is difficult to induce any physical or structural response.²¹ Two reports cited in the MA DEP review (Styles 2005²²; Schofield 2010²³) indicate that at 100 meters from a wind turbine the maximum motion that is induced is 120 nanometers (at about 1 Hz). A nanometer is 10^{-9} meter. So this is 1.2×10^{-7} meter of ground displacement. Extremely sensitive measuring devices have been used to detect this slight motion. To put the motion in perspective, the diameter of a human hair is on the order of 10^{-6} meter. The Schofield measurements were conducted on a Vestas V-47 with a maximum rotational rate of 29 rpm (blade pass frequency of 1.47 Hz).

Ground-borne vibration measurements were made by Epsilon from Siemens 2.3 and GE 1.5sle wind turbines in Texas.²⁴ The maximum ground-borne vibration RMS particle

²⁰ *Recent Studies of Infrasound from Industrial Sources*, W. Gastmeier & B. Howe, Canadian Acoustics, 36(3), 2008.

²¹ *Wind Turbine Health Impact Study: Review of Independent Expert Panel*, Massachusetts Department of Environmental Protection and Massachusetts Department of Public Health, January 2012.

²² *Microseismic and Infrasound Monitoring of Low Frequency Noise and Vibration from Windfarms*, P. Styles et al, Keele University, 18 July 2005.

²³ *Seismic Measurements at the Stateline Wind Project*, R. Schofield, University of Oregon, 2010.

²⁴ *A Study of Low Frequency Noise and Infrasound from Wind Turbines*, Epsilon Associates, Inc., prepared for NextEra Energy Resources, LLC, July 2009.

velocities were 0.071 mm/second (0.71×10^{-4} meters/second) in the 8 Hz one-third octave band. This was measured 1,000 feet downwind from a GE 1.5sle WTG under maximum power output and high wind at the ground. The background ground-borne vibration RMS particle velocity at the same location was 0.085 mm/sec. Both of these measurements meet ANSI S2.71-1983²⁵ recommendations for perceptible vibration in residences during night time hours of 1.0×10^{-4} meters/second at 8 Hz. Soil conditions were soft earth representative of an active agricultural use. No perceptible vibration was felt from operation of the wind turbines. The GE 1.5sle has a maximum rotation rate of 20 rpm (blade pass frequency of 1 Hz), and the Siemens 2.3 has a maximum rotation rate of 15.4 rpm (blade pass frequency of 0.77 Hz).

ANSI S2.71-1983 presents recommendations for magnitudes of ground-borne vibration which humans will perceive and possibly react to within buildings. A basic rating is given in Table 1 of the standard for the most stringent conditions, which correspond to the approximate threshold of perception of the most sensitive humans. From the base rating, multiplication factors should be applied according to the location of the receiver; for continuous sources of vibration in residences at nighttime, the multiplication factor is 1.0 – 1.4. For spaces in which the occupants may be sitting, standing, or lying at various times, the standard recommends using a combined axis rating which is obtained from the most stringent rating for each axis. Measurements in each of the 3 axes should be compared to the combined axis rating. Table 4-4 presents the base response velocity ratings for the combined axis. The velocity ratings are for root-mean-square (RMS) values.

²⁵ *Guide to the Evaluation of Human Exposure to Vibration in Buildings*, ANSI/ASA S2.71-1983 (R August 6, 2012).

Table 4-4 Base response one-third octave band RMS velocity ratings for the three biodynamic vibration axes and combined axis (From ANSI S2.71-1983 (R2006))

One-Third Octave band center frequency, Hz	Velocity (RMS), m/s		
	z axis	x, y axis	Combined axis
1	1.6×10^{-3}	5.7×10^{-4}	5.7×10^{-4}
1.25	1.1×10^{-3}	4.6×10^{-4}	4.6×10^{-4}
1.6	8.0×10^{-4}	3.6×10^{-4}	3.6×10^{-4}
2	5.6×10^{-4}	2.9×10^{-4}	2.9×10^{-4}
2.5	4.0×10^{-4}	2.9×10^{-4}	2.4×10^{-4}
3.15	2.9×10^{-4}	2.9×10^{-4}	2.1×10^{-4}
4	2.0×10^{-4}	2.9×10^{-4}	1.7×10^{-4}
5	1.6×10^{-4}	2.9×10^{-4}	1.4×10^{-4}
6.3	1.3×10^{-4}	2.9×10^{-4}	1.2×10^{-4}
8	1.0×10^{-4}	2.9×10^{-4}	1.0×10^{-4}
10	1.0×10^{-4}	2.9×10^{-4}	1.0×10^{-4}
12.5	1.0×10^{-4}	2.9×10^{-4}	1.0×10^{-4}
16	1.0×10^{-4}	2.9×10^{-4}	1.0×10^{-4}
20	1.0×10^{-4}	2.9×10^{-4}	1.0×10^{-4}
25	1.0×10^{-4}	2.9×10^{-4}	1.0×10^{-4}
31.5	1.0×10^{-4}	2.9×10^{-4}	1.0×10^{-4}
40	1.0×10^{-4}	2.9×10^{-4}	1.0×10^{-4}
50	1.0×10^{-4}	2.9×10^{-4}	1.0×10^{-4}
63	1.0×10^{-4}	2.9×10^{-4}	1.0×10^{-4}
80	1.0×10^{-4}	2.9×10^{-4}	1.0×10^{-4}

Finally, the Ministry for the Environment, Climate and Energy of the Federal State of Baden-Wuerttemberg, Germany published a detailed study on infrasound and vibration from wind turbines.²⁶ The results found that vibration velocity levels from a 2.4 MW Nordex N117 wind turbine at distances of less than 300 meters (~1,000 feet) were less than 0.1×10^{-4} meters/sec. Therefore, ground-borne vibration can be detected by instruments but is no different than the ever-present background vibration and not a concern.

The information from some of the references cited above is summarized in Table 4-5 below. No information is publicly available about the soil type, foundation, or vibration isolation characteristics of the cited examples. The maximum frequency of rotation for the GE 3.8-137 wind turbine is 13.6 rpm. The maximum frequency of rotation for the Vestas V150-4.2 wind turbine is 12.0 rpm. The maximum frequency of rotation for the Nordex N149/4500 wind turbine is 12.25 rpm. The maximum frequency of rotation for the Senvion 4.2M148 wind turbine is 10.5 rpm. With regard to the mass of rotation, a single blade for the GE 3.8-137 weighs 40,124 pounds, a single blade for the Vestas V150-4.2 weighs 38,005 pounds, a single blade for the Nordex N149/4500 weighs 43,872 pounds, and a single blade for the Senvion 4.2M148 weighs 46,297 pounds. Blade weights for the other wind turbines in Table 4-5 were not available.

Table 4-5 Summary of Ground-Borne Vibration Information

Reference	Power output of WTGs	Distance to vibration measurements	Frequency of rotation
Gastmeier & Howe (2008)	1.8 MW	1,066 feet	17 rpm
MA DEP/Styles et al (2005)	450 kW	328 feet	33 rpm
MA DEP/Schofield (2010)	660 kW	80 feet	29 rpm
Epsilon/NextEra (2009)	1.5 MW	1,000 feet	20 rpm
Epsilon/NextEra (2009)	2.3 MW	1,000 feet	15.4 rpm
LUBW Ministry for Environment	2.4 MW	1,000 feet	13.2 rpm

4.8 Project Noise Standards and Design Goals

As noted in the NARUC 2012 report, a balance must be struck between avoiding or minimizing potential impacts from wind turbine generated sound while not imposing regulatory standards which are so stringent that they do not afford additional benefits but instead are prohibitive to project viability. Regulatory limits for other power generation and

²⁶ Low-frequency sound noise incl. infrasound from wind turbines and other sources, LUBW Ministry for the Environment, Climate and Energy of the Federal State of Baden-Wuerttemberg, Germany, November 2016.

mechanical processes never seek inaudibility but rather to limit noise from a source to a reasonably acceptable level. The project noise standards and design goals have been grouped into ones that can reasonably be verified through post-construction sound level measurements (see Table 4-6A), and those that are evaluated through the use of detailed computer modeling (see Table 4-6B). The eleven standards and design goals for this project are described in more detail below.

The project will be located within two towns, both of which have local noise standards. In Sanford, the local wind law states a 50 dBA standard measured at a non-participating residence. This standard applies day or night (Goal #1). The Town of Windsor has a noise ordinance but has confirmed and stipulated that it is not applicable to this facility because the project is proceeding under PSL Article 10.

As part of the project, noise design goals were developed based on a literature review in order to balance reasonable development and minimize annoyance to the community. These include a 45 dBA Leq nighttime limit at a non-participating residence (Goal #3). This is based on the World Health Organization's (WHO) eight-hour guideline to minimize sleep disturbance. A nighttime design goal of 55 dBA is established for a participating residence and is also based on the WHO guideline (Goal #4). Another design goal for non-participating residences is to prohibit a "pure tone" in accordance with ANSI S12.9 Part 3/Annex B Section B.1, or impose a 5 dBA penalty to the broadband limit if a pure tone occurs (Goal #9).

Wind turbines produce infrasound but these levels are well below human thresholds of audibility. However, infrasound and low frequency energy can result in airborne vibration within homes if the levels are high enough. American National Standard ANSI S12.9-2005/Part 4 identifies that low frequency sound annoyance is minimal when the 16, 31.5 and 63 Hz octave band sound pressure levels are each 65 dB or less (Goal #8).

An annual nighttime level of 40 dBA ($L_{eq, \text{night, outside}}$) at a non-participating residence is another design goal as put forth by the WHO (Goal #6). This covers all the eight-hour nighttime periods over the course of an entire year (365 days). This same annual nighttime design goal is 50 dBA at a participating residence (Goal #7).

As discussed in Section 4.4, the WHO notes daytime and evening outdoor living area sound levels at a residence should not exceed an L_{eq} of 55 dBA to prevent serious annoyance and an L_{eq} of 50 dBA to prevent moderate annoyance from a steady, continuous noise. Since a property line is not a "living area", or even an area where people routinely spend extended time, limiting 1-hour sound levels to 55 dBA or less at non-participating property lines is a reasonable design goal (Goal #5). Other design goals include meeting the NYS DEC Noise Policy at locations on DEC lands (Goal #2), and 50 dBA at non-residential receptors (Goal #10).

Since ground-borne vibration from a wind farm is not a demonstrated issue to people in their homes, ground-borne vibration has a design goal but will only be analyzed through the post-construction complaint resolution program, if necessary (Goal #11).

Table 4-6A Summary of Measured Sound Standards or Design Goals – Bluestone Wind

#	Municipality or Organization	Sound Level Limit	Assessment Location	Noise descriptor	Period of Time	Participant Status
1	Town of Sanford Renewable Energy Systems §1402.5(A)(5)	50 dBA	Exterior wall of the nearest non-participating residence	Not stated (assumed Leq)	Not stated (assumed 1-hour); day or night	Non-participant
3	Design goal (1999 WHO Guidelines)	45 dBA	At residence	Leq	8-hour; nighttime	Non-participant
4	Design goal (1999 WHO Guidelines)	55 dBA	At residence	Leq	8-hour; nighttime	Participant
8	Design goal (Permit condition Case 14-F-0490 (Cassadaga Wind))	65 dB at 16, 31.5, 63 Hz	At residence	Leq	1-hour; day or night	Non-participant
9	Design goal (Permit condition Case 14-F-0490 (Cassadaga Wind))	No pure tone or 5 dBA penalty if a prominent tone occurs	At residence	Leq	1-hour; day or night	Non-participant

Table 4-6B Summary of Modeled Design Goals – Bluestone Wind

#	Municipality or Organization	Sound Level Limit	Assessment Location	Noise descriptor	Period of Time	Participant Status
2	Program Policy Assessing and Mitigating Noise Impacts issued by the New York State Department of Environmental Conservation (NYSDEC), Feb. 2001	6 dBA increase over ambient	Areas of human use	L90	Not stated	NYS DEC lands
5	Design goal	55 dBA	Property line and lands except wet-lands	Leq	1-hour; day or night	Non-participant
6	Design goal (Permit condition Case 14-F-0490 (Cassadaga Wind))	40 dBA	At residence	Leq, night, outside	Annual; nighttime	Non-participant
7	Design goal (Permit condition Case 14-F-0490 (Cassadaga Wind))	50 dBA	At residence	Leq, night, outside	Annual; nighttime	Participant
10	Design goal (ANSI/ASA S12.9-2007/Part 5)	50 dBA	Non-residential (historic venues; cemeteries; playgrounds; etc.)	Leq	1-hour	Non-participant
11	Design goal for vibrations.	Not perceptible indoor vibrations	At residence	See ANSI S 2.71-1983 (R August 6/2012) for details	See ANSI S 2.71-1983 (R August 6/2012) for details	Non-Participant

5.0 WIND TURBINE NOISE

5.1 Sources of Sound from Wind Turbines

A wind turbine produces noise mechanically and aerodynamically. Mechanical noise sources include the gearbox, generator, yaw drives, cooling fans, and auxiliary equipment such as hydraulics. Advances in gearboxes and yaw systems have decreased these noise sources over the years. Direct drive systems, such as those proposed for the turbines under consideration for this Facility, will improve this even more. In addition, utility scale wind turbines are usually insulated to prevent mechanical noise from proliferating outside the nacelle or tower.

Aerodynamic sound is generated due to complex fluid-structure interactions occurring on the blades. Of these mechanisms, the most persistent and often strongest source of aerodynamic sound from modern wind turbines is the trailing edge noise. As a turbine blade rotates through a changing wind stream, the aerodynamics change, leading to differences in the boundary layer and thus to differences in the trailing edge noise. Also, the direction in which the blade is pointing changes as it rotates, leading to differences in the directivity of the noise from the trailing edge. This noise source leads to what some people call the “whooshing” sound.²⁷

Most modern turbines use pitch control for a variety of reasons. One of the reasons is that at higher wind speeds, when the control system has the greatest impact, the pitch controlled turbine is quieter than a comparable stall-regulated turbine. In other words, once sound levels have reached their maximum level, typically at around wind speeds of 8-10 m/s at hub height, sound levels do not continue to increase even when wind speeds increase beyond 8-10 m/s. The wind turbines proposed for this project use pitch control.

5.2 Noise Abatement Measures

Noise from wind turbines can be reduced using either factory-installed technology, proper siting, or possibly through energy reduction measures after construction. Given the large distances between wind turbines and sensitive receptors in this project, noise abatement measures should not be necessary.

5.2.1 Pre-Construction

Modern utility-scale wind turbines are all horizontal axis, upwind, 3-blade designs. The upwind design means the rotor and blades always face into the wind. The older downwind

²⁷ *Wind Turbine Health Impact Study: Review of Independent Expert Panel*, Massachusetts Department of Environmental Protection and Massachusetts Department of Public Health, January 2012.

design is obsolete and could cause some noise issues due to the blades passing through the wake created by the wind hitting the tower.

Proper siting is another way to minimize and abate noise during the design of the project. Adequate setbacks between wind turbines and sensitive receptors will ensure the project meets noise design goals. There are many different factors that go into the design of a wind turbine layout including wake effects between turbines, maximizing energy production based on the wind regime, environmental and regulatory setback requirements for other conditions (wetlands, etc.), access road configuration, and landowner property preferences. A project must also be of sufficient scale such that it is economically viable so that simply increasing a wind turbine setback from a sensitive receptor must take into consideration the ripple effect it could have on the other project design constraints.

The design of the wind turbine blades has an impact on sound levels. Blade manufacturers are researching and testing ways to reduce sound levels from various tip shapes. In addition, there are low noise trailing edge (LNTE) or serrated trailing edge (STE) options available for some wind turbine models (terminology depends on the manufacturer but the intent is the same). These are essentially metal sawtooth serrations that can be affixed to the edge of a blade to reduce blade trailing edge noise. General Electric estimates that the LNTE option reduces sound levels 2-4 dBA as compared to unserrated blades.²⁸

5.2.2 Construction

Noise due to construction is an unavoidable outcome of construction. The heavy civil and site work will last approximately 6-9 months. Due to the large distances between construction activity and sensitive receptors, noise from construction is not expected to result in impacts. However, the Complaint Resolution Plan provided with this Application contains the procedures to be followed in the event of a noise complaint during construction. Nonetheless construction noise will be minimized through the use of best management practices (BMP) such as those listed below.

- ◆ Blasting is likely at this site. Blasting will be limited to daytime hours and conducted in accordance with the Bluestone Wind Preliminary Blasting Plan included elsewhere in the Article 10 Application.
- ◆ Pile driving is possible at this site. If pile driving is required, it will be limited to daytime hours.
- ◆ Utilizing construction equipment fitted with exhaust systems and mufflers that have the lowest associated noise whenever those features are available.

²⁸ *Wind Turbine Blade Noise Mitigation Technologies*, B. Petitjean et al., presented at Fourth International Meeting on Wind Turbine Noise, Rome, Italy, 2011.

- ◆ Maintaining equipment and surface irregularities on construction sites to prevent unnecessary noise.
- ◆ Configuring, to the extent feasible, the construction in a manner that keeps loud equipment and activities as far as possible from noise-sensitive locations.
- ◆ Using back-up alarms with a minimum increment above the background noise level to satisfy the performance requirements of the current revisions of Standard Automotive Engineering (SAE) J994 and OSHA requirements.
- ◆ Develop a staging plan that establishes equipment and material staging areas away from sensitive receptors when feasible.
- ◆ Contractors shall use approved haul routes to minimize noise at residential and other sensitive noise receptor sites on the mainland.

5.2.3 *Operations*

The Complaint Resolution Plan provided with this Application contains the procedures to be followed in the event of a noise complaint during operations. The noise emitted by a wind turbine is predominantly determined by the aerodynamic broadband noise of the rotor blades, which is directly dependent on the circumferential or blade tip speed. Blade noise increases with increasing wind speed until rated electrical power is reached. The sound power level can be lowered by reducing the rotor speed through blade pitch adjustments, thus lowering and limiting the tip speed. The rated electrical power level is reduced accordingly through earlier blade pitching. Therefore, there is some loss in energy yield because of the reduction in power level.

Most modern wind turbine manufacturers offer an option called noise-reduced operating mode (NRO = Noise-Reduced Operation). With the aid of the control system the turbine can be switched to noise-reduced mode, based on pre-determined parameters such as the time of day, wind direction, wind speed, etc. NRO can be implemented on an “as needed” basis through the use of software programming.

Due to the inherent size of wind turbines, typical barrier structures are not practical to reduce sound. Sound barriers are used as needed around a substation if the transformer is identified as a sound source requiring noise control. At a noise-sensitive receptor, interior sound levels can be reduced through the use of better doors, windows, and/or insulation.

6.0 BASELINE SOUND LEVEL MONITORING PROGRAM

To characterize the existing soundscape of the Project area, an ambient (baseline) monitoring program was conducted in accordance with the NYS Article 10 Exhibit 19 requirements and Stipulation 19(b). This section outlines the structure of the ambient program.

Details of the winter monitoring program were presented in the “Sound Level Measurement Protocol—Winter Season” and was attached to the Facility’s Preliminary Scoping Statement, dated February 17, 2017. Between the time of the ambient measurement programs and this NIA, the Project Area was reconfigured and shifted to the east. The ambient measurement locations are still representative of the general vicinity of the Project.

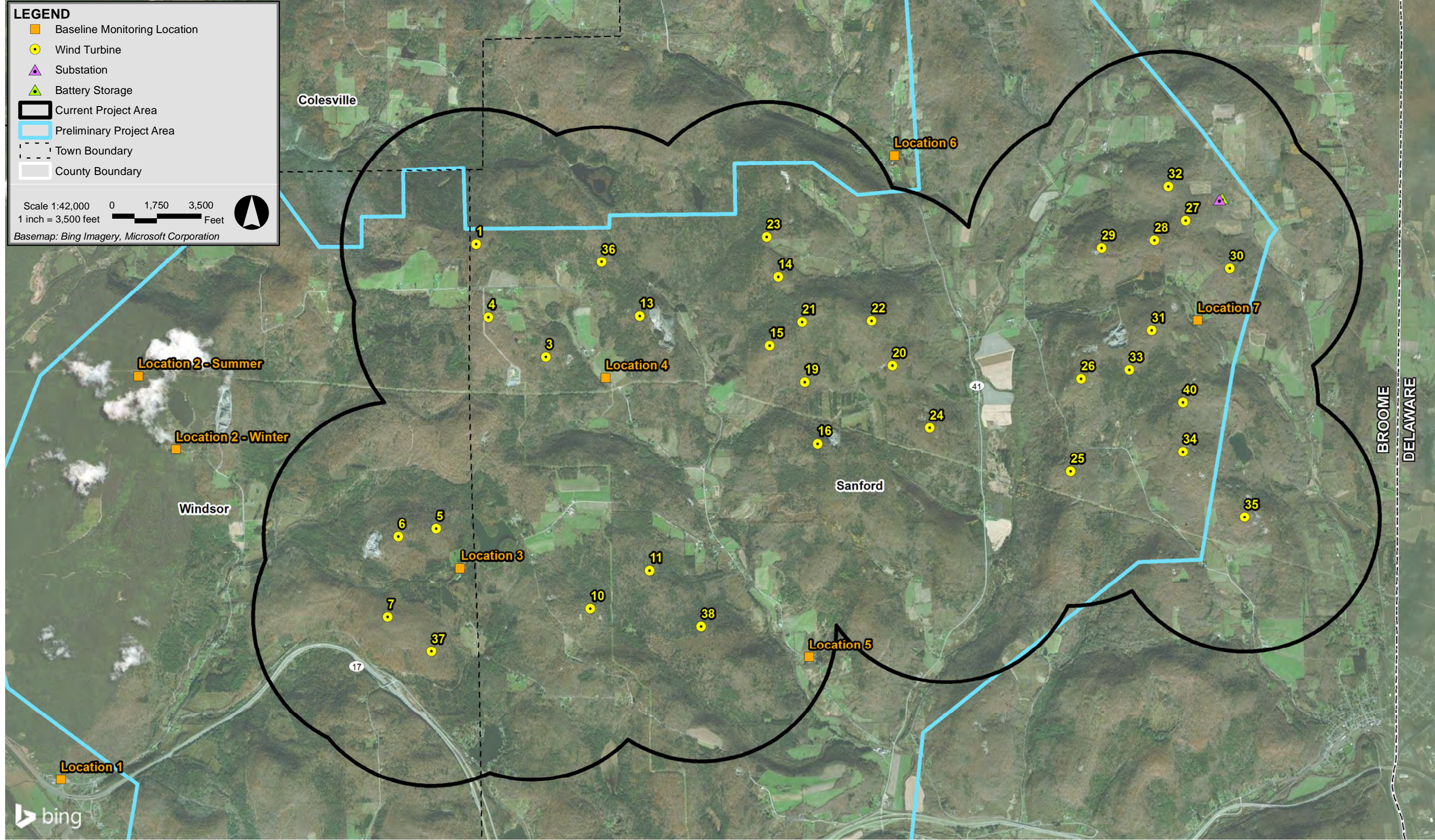
6.1 Sensitive Receptors

All residences [including participating, non-participating, full-time and seasonal], outdoor public facilities and areas, hospitals, schools, care centers, libraries, places of worship, cemeteries, public parks, public campgrounds, summer camps (e.g. YMCA Camp Tuscarora), and any historic resources listed or eligible for listing on the State or National Register of Historic Places and Federal and State lands, if any within one mile of a wind turbine or project-related substation were included as sensitive receptors. Seasonal receptors included cabins and hunting camps identified by property tax codes and any other seasonal residence known to have septic systems or running water. These are shown in Figure 9-1 in accordance with Stipulation 19(a).

6.2 Sound Level Measurement Locations

In accordance with ANSI S12.9-1992/Part 2 (R2013), the deterministic spatial sampling technique was used to select measurement locations. In other words, sound monitoring locations were selected to be representative of nearby residences in various directions from the wind project. For example, Location 1 represents those receptors near I-86/Old Route 17 which carries 8,000-10,000 vehicles/day, while the remaining locations represent rural residential areas with about 500 vehicles/day or less. Thus, the selected locations are representative of potentially impacted receptors. The program was intended to measure total ambient sound in the area which includes all noise sources.

Two sound level measurement programs were conducted; winter and summer. The measurement locations remained generally consistent between the two programs with the exception of one location for which there was a change in property permissions. Therefore, a different, but nearby, measurement location was utilized in the summer program. Figure 6-1 shows the measurement locations for both measurement programs and identifies the one location that was changed between the seasons overlaid upon an aerial photograph. Each sound level monitoring location is described in the following subsections. The



Bluestone Wind Broome County, New York

coordinates for the sound level measurement locations are listed in Table 6-1, which are slightly adjusted from the field-measured Global Positioning System (GPS) points for refined accuracy.

The NYS DOT website was checked for Annual Average Daily Traffic (AADT) counts in the vicinity of the sound level meters (SLM). The section of Interstate 86 (I-86; State Route 17) immediately south of the Project had an AADT ranging from 8,294 to 10,834 vehicles in 2015, Route 41 in the eastern portion of the Project Area had an AADT ranging from 524 to 714 vehicles in 2015, and Route 233 in the western portion of the Project Area had an AADT of 562 in 2015.²⁹ Other roads in the Project Area generally carry less traffic than these roads.

Table 6-1 GPS Coordinates – Sound Level Measurement Locations

Location	Latitude	Longitude
Location 1	42.05627°	-75.61497°
Location 2 – Winter	42.09161°	-75.59784°
Location 2 – Summer	42.09951°	-75.60313°
Location 3	42.07848°	-75.55710°
Location 4	42.09877°	-75.53576°
Location 5	42.06845°	-75.50690°
Location 6	42.12226°	-75.49370°
Location 7	42.10409°	-75.45022°

6.2.1 Location 1

One continuous programmable, unattended sound level meter was placed near Old Route 17 in the Town of Windsor, New York. The meter was placed approximately 15 meters north of the road and is representative of existing sound levels along Old Route 17 and in near proximity to I-86. Refer to Figures 6-2 and 6-3 for a photo of the monitoring setup during the winter and summer³⁰ seasons, respectively.

²⁹ <https://www.dot.ny.gov/tdv>. Accessed in May 2018.

³⁰ Sound level meter placement at the precise winter location during the summer season was not physically possible due to overgrown vegetation; however, a representative location was selected.

The meter continuously measured and stored broadband (A-weighted) and one-third octave band sound level statistics during the winter season from 10:00 a.m. Thursday, March 2 until 4:20 p.m. Friday, March 17, 2017 for a total of 2,040³¹ 10-minute measurement periods, and from 10:20 a.m. Thursday, August 10 until 12:30 p.m. Thursday, August 24, 2017 for a total of 2,022 10-minute measurement periods during the summer season.

Upon the mid-term check on the equipment during the winter season, the extension cable from the microphone to the SLM was declared to be faulty and required replacement. Therefore, the meter did not measure sound levels for 158 10-minute periods while no extension cable was present in the setup. The sound data collected during the first week of the program with the original extension cable were reviewed and appear to be unaffected by the cable.

Figure 6-2 Location 1, Sound Level Meter, Winter



³¹ There was a total of 158 10-minute periods when the SLM was not collecting data due to an extension cable replacement during the mid-term check.

Figure 6-3 Location 1, Sound Level Meter, Summer



6.2.2 Location 2

Measurement Location 2 was selected to be representative of the northwestern vicinity of the Project. Permission had been granted at a residential property along Ostrander Road in the Town of Windsor, NY for the first monitoring season (winter). Permission was not granted several months later to monitor at the property for the summer monitoring program; therefore, an alternate location was selected for the summer to be similarly representative of the northwestern vicinity of the Project.

6.2.2.1 Location 2 – Winter

One continuous programmable, unattended sound level meter was placed at the Weaver residence on Ostrander Road in the Town of Windsor, NY. The meter was placed approximately 20 meters southwest of the road in an open field. This location is representative of existing sound levels in the northwestern vicinity of the Project along Ostrander Road. Refer to Figure 6-4 for the monitoring setup during the winter season.

The meter continuously measured and stored broadband (A-weighted) and one-third octave band sound level statistics during the winter season from 11:20 a.m. Thursday, March 2 until 9:40 a.m. Friday, March 17, 2017 for a total of 2,143 10-minute measurement periods.

Figure 6-4 Location 2 - Winter, Sound Level Meter

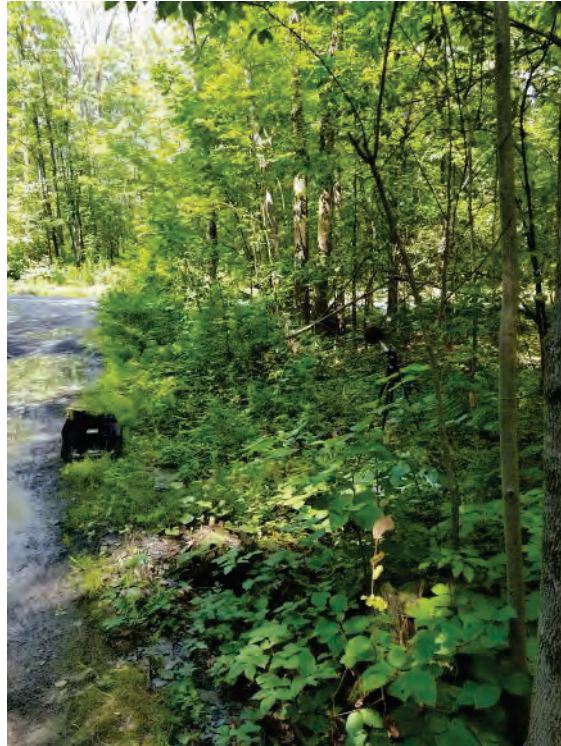


6.2.2.2 Location 2 – Summer

One continuous programmable, unattended sound level meter was placed at the Goodspeed residence on Cresson Hill Road in the Town of Windsor, NY. The meter was placed approximately 15 meters south of the road. This location is representative of existing sound levels in the northwestern vicinity of the Project. Refer to Figure 6-4 for the monitoring setup during the summer season.

The meter continuously measured and stored broadband (A-weighted) and one-third octave band sound level statistics during the summer season from 2:40 p.m. Wednesday, August 9 until 10:00 a.m. Thursday, August 24, 2017 for a total of 2,121 10-minute measurement periods.

Figure 6-5 Location 2 - Summer, Sound Level Meter



6.2.3 Location 3

One continuous programmable, unattended sound level meter was placed at the Sky Lake Camp property on Sky Lake Road in the Town of Windsor, NY. The meter was placed approximately 25 meters south of Sky Lake Road. This location is representative of receptors in the west-central area of the Project. Refer to Figures 6-6 and 6-7 for a photo of the monitoring setup during the winter and summer seasons, respectively.

The meter continuously measured and stored broadband (A-weighted) and one-third octave band sound level statistics during the winter season from 12:30 p.m. Thursday, March 2 until 10:40 a.m. Friday, March 17, 2017 for a total of 2,143 10-minute measurement periods and from 4:50 p.m. Wednesday, August 9 until 10:40 a.m. Thursday, August 24, 2017 for a total of 2,115 10-minute measurement periods during the summer season. In addition to sound data collection, continuous ground-level wind speed and direction were made at this location during both monitoring programs. During the summer program, temperature, relative humidity, and precipitation measurement data were also collected. The meteorological equipment setup is shown in Figure 6-8 and 6-9 for the respective seasons.

Figure 6-6 Location 3, Sound Level Meter, Winter



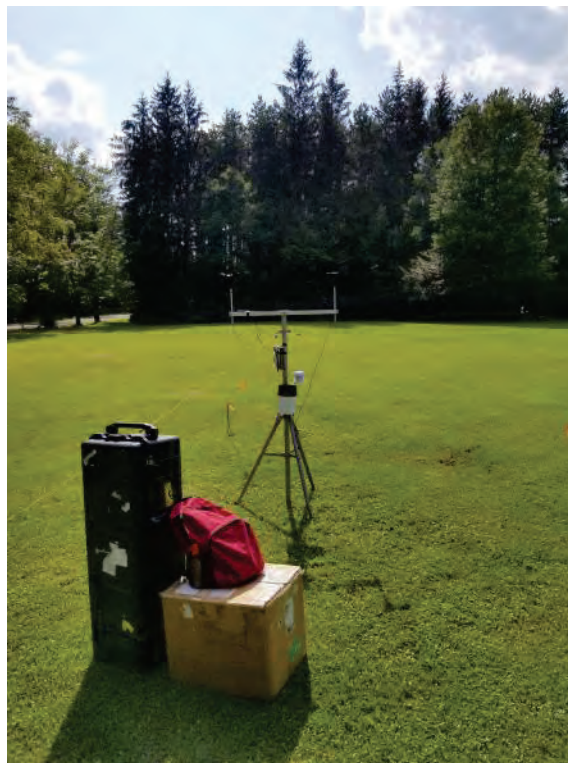
Figure 6-7 Location 3, Sound Level Meter, Summer



Figure 6-8 Location 3, Meteorological Tower, Winter



Figure 6-9 Location 3, Meteorological Tower, Summer



6.2.4 Location 4

One continuous programmable, unattended sound level meter was placed on Pazzelli Road in the Town of Sanford, NY. The meter was placed approximately 15 meters southwest of Pazzelli Road in a field. This location is representative of receptors in the central vicinity of the Project Area. Refer to Figures 6-10 and 6-11 for a photo of the monitoring setup during the winter and summer seasons, respectively.

The meter continuously measured and stored broadband (A-weighted) and one-third octave band sound level statistics during the winter season from 12:50 p.m. Friday, March 3 until 3:00 p.m. Friday, March 17, 2017 for a total of 1,795 10-minute measurement periods and from 5:30 p.m. Wednesday, August 9 until 11:00 a.m. Thursday, August 24, 2017 for a total of 2,115 10-minute measurement periods during the summer season.

Upon the mid-term check during the winter season, the 7-inch windscreen was found on the ground near the SLM. A review of the sound levels from the first week of the program indicate that the windscreen was displaced for most, if not all, of the monitoring duration, rendering those periods (788) invalid. The windscreen was replaced by Epsilon personnel; however when the location was checked several hours later, the windscreen was missing, likely due to high winds. The meter began collecting sound level data with a replacement windscreen on the microphone at 3:10 p.m. on March 10, 2017.

Figure 6-10 Location 4, Sound Level Meter, Winter



Figure 6-11 Location 4, Sound Level Meter, Summer



6.2.5 Location 5

One continuous programmable, unattended sound level meter was placed along the eastern side of Farnham Road in the Town of Sanford, NY. The meter was positioned approximately 15 meters from Farnham Road. This location is representative of receptors in the southeast area of the Project. Refer to Figures 6-12 and 6-13 for a photo of the monitoring setup during the winter and summer seasons, respectively.

The meter continuously measured and stored broadband (A-weighted) and one-third octave band sound level statistics during the winter season from 5:30 p.m. Thursday, March 2 until 12:20 p.m. Friday, March 17, 2017 for a total of 2,127 10-minute measurement periods and from 11:20 a.m. Thursday, August 10 until 1:20 p.m. Thursday, August 24, 2017 for a total of 2,025 10-minute measurement periods during the summer season.

Figure 6-12 Location 5, Sound Level Meter, Winter



Figure 6-13 Location 5, Sound Level Meter, Summer



6.2.6 Location 6

One continuous programmable, unattended sound level meter was placed along Mooney Pond Road, to the east of Parker Road in the Town of Sanford, NY. The meter was positioned approximately 15 meters east of Parker Road. This location is representative of receptors in the northern area of the Project. Refer to Figures 6-14 and 6-15 for a photo of the monitoring setup during the winter and summer³² seasons, respectively.

The meter continuously measured and stored broadband (A-weighted) and one-third octave band sound level statistics during the winter season from 6:30 p.m. Thursday, March 2 until 2:10 p.m. Friday, March 17, 2017 for a total of 2,129 10-minute measurement periods and from 11:50 a.m. Thursday, August 10 until 2:00 p.m. Thursday, August 24, 2017 for a total of 2,018 10-minute measurement periods during the summer season.

Figure 6-14 Location 6, Sound Level Meter, Winter



³² Sound level meter placement at the precise winter location during the summer season was not physically possible due to overgrown vegetation; however, a representative location was selected.

Figure 6-15 Location 6, Sound Level Meter, Summer



6.2.7 Location 7

One continuous programmable, unattended sound level meter was placed along Loomis Hill Road, in the Town of Sanford, NY. The meter was positioned approximately 15 meters southwest of Loomis Hill Road. This location is representative of receptors within the eastern portion of the Project Area. Refer to Figures 6-16 and 6-17 for a photo of the monitoring setup during the winter and summer seasons, respectively.

The meter continuously measured and stored broadband (A-weighted) and one-third octave band sound level statistics during the winter season from 2:50 p.m. Thursday, March 2 until 1:00 p.m. Friday, March 17, 2017 for a total of 2,143 10-minute measurement periods, and from 6:40 p.m. Wednesday, August 9 until 11:40 a.m. Thursday, August 24, 2017 for a total of 2,108 10-minute measurement periods during the summer season. In addition to sound data collection, continuous ground-level wind speed measurements were made at this location during both monitoring programs utilizing equipment shown in Figures 6-18 and 6-19 for the respective seasons.

Figure 6-16 Location 7, Sound Level Meter, Winter



Figure 6-17 Location 7, Sound Level Meter, Summer



Figure 6-18 Location 7, Meteorological Tower, Winter



Figure 6-19 Location 7, Meteorological Tower, Summer



6.3 Sound Level Measurement Instrumentation

Each of the monitoring locations utilized either a Larson Davis (LD) model 831³³ sound level meter (SLM) to measure both A-weighted (dBA) and one-third octave bands from 20 Hz to 10,000 Hz. Each instrument was equipped with a LD PRM831 preamplifier and a PCB 377B20 or 377C20 half-inch microphone, or a Norsonic model Nor140³⁴ SLM equipped with a Norsonic Nor1209 preamplifier and a G.R.A.S. 40AN half-inch microphone along with an environmental protection kit. The kit included an untreated ACO 7-inch diameter 20 ppi (pores per inch) open cell foam windscreen to reduce wind-induced noise over the microphone. Windscreen insertion loss data by one-third octave band is found in Table B.2 of ANSI/ASA S12.9-2016/Part 7.³⁵ This shows windscreen insertion loss of 0.1 dB or less in the low frequency and infrasound range, less than 1.0 dB from 200 Hz to 4000 Hz, and up to 2 dB from 5000 Hz to 10,000 Hz. A summary of these insertion losses is included in this report as Appendix A. Each microphone was tripod-mounted at a height of approximately four feet (1.2 meters) above ground level in accordance with ANSI S12.9-1992/Part 2 (R2013). Horizontal microphone placements near roadways were in accordance with ANSI S12.9-1992/Part 2 (R2013) for open land.

The LD831 and Nor140 meters meet Type 1 ANSI/ASA S1.4, ANSI S1.43-1997 (R2007), and IEC 61672 Class 1 standards for sound level meters and were calibrated and certified as accurate to standards set by the National Institute of Standards and Technology. The octave band filters for all instrumentation meet ANSI S1.11-2004 (R2009). These calibrations were conducted by an independent laboratory within 12 months of field placement and certificates of calibration are provided in Appendix B. All measurement equipment was calibrated in the field before and after the surveys with the manufacturer's acoustical calibrator which meets the standards of IEC 60942-2003 Class 1L and ANSI/ASA S1.40-2006 (R2016).

6.4 Meteorological Instrumentation

6.4.1 Ground Level Winds

Wind speed can have a strong influence on ambient sound levels. In order to understand how the existing sound levels are influenced by wind speed, HOBO H21-002 micro-

³³ Noise floor specified in manufacturer's manual with use of PRM831 preamplifier and 377B02 microphone for A-weighted sound pressure levels is 18 dB at a 0 dB gain and 17 at a 20 dB gain. Noise floor specified for Z-weighted sound pressure levels is 23 dB at a 0 dB gain and 21 at a 20 dB gain.

³⁴ Noise floor specified in manufacturer's manual A-weighted sound pressure levels is 25 dB with self-noise of the SLM at 15 dB. Preamplifier and microphone are not stated.

³⁵ Quantities and Procedures for Description and Measurement of Environmental Sound, Part 7: Measurement of Low-frequency Noise and Infrasound Outdoors and in the Presence of Wind and Indoors in Occupied Spaces, ANSI/ASA S12.9-2016/Part 7, American National Standards Institute, Inc., 2016.

weather stations (manufactured by Onset Computer Corporation) with tripods and data loggers were used to record continuous wind speed data at Locations 3 and 7 during both seasons. The wind instruments have a measurement range of 0 to 44 m/s (99 mph) or 0 to 45 m/s (100 mph) and an accuracy of +/- 0.5 m/s (1.1 mph) or +/- 1.1 m/s (2.4 mph). The starting threshold is 0.5 m/s (1.1 mph) or ≤ 1.0 m/s (2.2 mph). The wind direction measurement range is 0 to 358 degrees (2-degree dead band) or 0 to 355 degrees (5-degree dead band), with an accuracy of +/- 5 degrees.

6.4.2 *Hub Height Winds*

Hub height wind speeds during the ambient programs were calculated based on measurements from an on-site 60-meter meteorological tower. The wind speed sensor mounted at 59 meters was used to extrapolate wind speeds up to the 130 meter hub height by Bluestone Wind meteorologists and provided to Epsilon.

6.4.3 *Precipitation, Temperature, and Relative Humidity*

Meteorological data from the New York State Mesonet system was used for both the winter and summer measurements. The New York State Mesonet consists of 125 state-of-the-art environmental monitoring stations and serves as the foundation of an Early Warning Severe Weather Detection network for the entire State of New York. The New York State Mesonet was developed by research scientists at the State University of New York (SUNY) at Albany's Atmospheric Sciences Research Center, and Department of Atmospheric and Environmental Sciences. Mesonet sites are distributed statewide with every county across New York having at least one or more sites. The Mesonet collects measurements of a number of surface and atmospheric variables, such as temperature, relative humidity, wind speed and direction, surface pressure, soil moisture, soil temperature, solar radiation, and precipitation amounts for rainfall and snow accumulation. These data are archived and available to the public.

The Deposit Mesonet station is located approximately 4 miles from the closest Bluestone measurement location. This location began operation on August 23, 2016. As this is the closest Mesonet station, and has elevation comparable to the Project site, this location was selected as a source of precipitation, relative humidity, and temperature data for both the winter and summer measurements.

The SUNY Mesonet data from Deposit are provided in Appendix C of this report.

One hour of data was missing from the SUNY Mesonet data during the winter monitoring program. National Weather Service data from Binghamton was used during this period. This station is approximately 25 miles west of the Bluestone site.

6.5 Infrasonic Monitoring

Infrasound was measured during both seasons at Location 5, using the Norsonic Nor140 SLM equipped with a Norsonic Nor1209 preamplifier, a G.R.A.S. 40AN half-inch microphone. The G.R.A.S. 40AN microphone is designed to measure audible frequencies as well as infrasound frequencies down to 1 Hz (+/- 1 dB) and 0.5 Hz (+/- 2 dB). The infrasound SLM utilized the same environmental protection kit as the other SLMs with an ACO 7-inch diameter windscreen to reduce wind-induced noise over the microphone that was tripod-mounted approximately 4 feet above ground level. The infrasound meter collected continuous broadband and one-third octave-band ambient sound pressure level data. The meter logged data every 10 minutes with statistical data for the following parameters: L_{eq} , L_{10} , L_{50} , L_{90} , L_{max} , and L_{min} . A one-second time history data collection using the "fast" response setting was also implemented.

7.0 BASELINE SOUND LEVEL MONITORING RESULTS

This chapter discusses the results from the detailed ambient (baseline) monitoring program outlined in the previous chapter. Specifically, the logic for data validity, hub-height wind speed data during monitoring, and sound level result descriptions for the monitoring locations are explained.

7.1 Data Formatting Overview

Sound level data were collected at 10-minute intervals³⁶ at seven strategically selected locations around the proposed wind energy Project during a winter and a summer season. Monitoring periods that experienced elevated ground-level wind speeds or precipitation were excluded from the data analysis per Method #1 in ANSI S12.18-1994. According to this standard, “No sound level measurement shall be made when the average wind velocity exceeds 5 m/s when measured at a height of 2 ± 0.2 m above the ground”. In addition, “Measurement during precipitation [...] is highly discouraged”. Precipitation events identified at the SUNY MesoNet station in Deposit, NY defined periods for which sound level data were excluded from the analysis for the both the winter and summer measurement programs.

The sound level equipment used in ambient monitoring have specifications regarding operative ranges under certain air conditions, e.g., temperature and relative humidity.^{37,38} Data from the Deposit MesoNet station were additionally referenced for the range exceedances during all measurement timeframes. Sound levels during these exceedances were excluded from further processing.

As per Stipulation 19(b)(9), seasonal noise shall be removed from the ambient sound level measurements regardless of season. A high-frequency natural sound (HFNS) filter was therefore applied to the measured one-third octave-band data from which a broadband sound level was calculated for both the summer and winter monitoring seasons. This technique removes all sound energy above the 1,250 Hertz frequency band. The methodology for the filtration process is as specified in ANSI/ASA S12.100-2014 and the

³⁶ It should be noted that all sound level instrumentation data, ground level meteorological instrumentation data, on-site meteorological tower data, and National Weather Service data records were all time-correlated for appropriate alignment of 10-minute periods. Daylight Savings Time adjustments were also made for the winter 2017 monitoring period, specifically.

³⁷ Periods measured outside the temperature range of 14°F to 122°F were considered invalid due to the Larson Davis Model 831 and Norsonic Nor140 SLM specifications.

³⁸ Periods measured outside the relative humidity range of 1 to 99% were considered invalid based on microphone specifications. The accuracy of sound levels measured with a Larson Davis Model 831 SLM outside the relative humidity range of 25% to 90% is unknown; however, the data are not considered invalid and are included in the data summaries. The same is relevant for sound levels measured with a Norsonic Nor140 SLM outside the range of 5% to 90% relative humidity.

sound pressure levels presented in this report using this methodology are indicated as ANS-weighted levels (presented in dBA). The calculated broadband ANS-weighted (dBA) average L_{eq} and L_{90} ambient sound levels are presented for the winter and summer seasons for each location in following subsections.

As per the Exhibit 19 regulations 1001.19(f)(1) daytime is defined as the period from 7 a.m. to 10 p.m. Respectively, nighttime is defined as the period from 10 p.m. to 7 a.m. (1001.19(f)(2)).

7.2 Hub Height Winds

Wind speed data from a 60-meter on-site tower and extrapolated hub height wind speeds were provided to Epsilon for the ambient monitoring periods. Extrapolated hub height wind speed and wind direction data are displayed as wind roses for the winter and summer monitoring seasons in Figures 7-1, and 7-2 [REDACTED], respectively. These data are used for a comparison of hub height wind speeds (relevant to wind turbine operation) versus ambient sound levels in Chapter 8 of this report. Hub height wind speeds that produce the maximum sound power levels vary by wind turbine manufacturer, which is reflected in the binning of the wind speeds in Figures 7-1 and 7-2.

7.3 Location 1

Sound levels at Location 1 were influenced by vehicular traffic on Old Route 17 and Interstate 86, occasional rattling from a nearby sign, machinery noise from an auto body shop, birds, and occasional aircraft. Sound level-versus-time graphs are provided in this section. This includes L_{eq} and L_{90} sound pressure levels and ground-level wind speeds measured at Location 3. Data that were excluded from further analysis and calculations due to ground-level winds exceeding 5 m/s or due to precipitation and instrumentation operative exceedances as recorded at the Deposit MesoNet station are identified in the figures.

7.3.1 *Winter Monitoring*

The ranges of measured A-weighted sound levels during the winter season are summarized below and presented graphically in Figure 7-3. A total of 636 10-minute periods were excluded from the winter season. The resulting dataset includes a total of 1398 10-minute periods of valid data.

- ◆ The valid steady-state level (L_{90}) measurements ranged from 22 to 58 dBA;
- ◆ The valid equivalent level (L_{eq}) measurements ranged from 25 to 69 dBA.

The ranges of calculated ANS-weighted sound levels during the winter season are summarized below.

- ◆ The valid, calculated steady-state (L_{90}) ANS-weighted broadband sound levels ranged from 21 to 57 dBA;
- ◆ The valid, calculated equivalent (L_{eq}) ANS-weighted broadband sound levels ranged from 24 to 65 dBA.

7.3.2 Summer Monitoring

The ranges of measured A-weighted sound levels during the summer season are summarized below and presented graphically in Figure 7-4. A total of 113 10-minute periods were excluded from the summer season. The resulting dataset includes a total of 1909 10-minute periods of valid data.

- ◆ The valid steady-state level (L_{90}) measurements ranged from 38 to 61 dBA;
- ◆ The valid equivalent level (L_{eq}) measurements ranged from 48 to 66 dBA.

The ranges of calculated ANS-weighted sound levels during the summer season are summarized below.

- ◆ The valid, calculated steady-state (L_{90}) ANS-weighted broadband sound levels ranged from 23 to 59 dBA;
- ◆ The valid, calculated equivalent (L_{eq}) ANS-weighted broadband sound levels ranged from 34 to 65 dBA.

7.3.3 Spectral Sound Level Data

In addition to broadband sound levels, spectral sound level data were measured during each 10-minute period at Location 1 for both the winter and summer measurement periods. Using only valid measurement periods, octave-band and one-third octave-band data are summarized in Figures 7-5 and 7-6, respectively, as logarithmic averages of the equivalent (L_{eq}) sound levels; separated by daytime and nighttime. Octave-band levels are displayed from 31.5 Hz to 16,000 Hz in Figure 7-5 for both L_{eq} and L_{90} . The one-third octave-band data in Figure 7-6 span the audible frequencies from 20 Hz to 10,000 Hz and were analyzed for prominent discrete tones³⁹. The logarithmically averaged one-third octave-

³⁹ Prominent discrete tones as defined by the ANSI S12.9 Part 3 standard. The lowest frequency in the Annex B.1 tone test is 25 Hz. 20 Hz data are presented for informational purposes.

band ambient sound levels demonstrate no existing tones in the winter season. Pure tones were present at the 5,000 Hz frequency for the summer season, likely due to bird and insect activity.

7.4 Location 2

Placement of the Location 2 monitor changed between the winter and summer measurement programs due to change of permission. Sound levels at the Winter Location 2 monitor were influenced by wind, birds, vegetation rustle, occasional trains, and distant traffic. Sound levels at the Summer Location 2 monitor were influenced by birds, owls, insects, and distant vehicles. Sound level-versus-time graphs are provided in this section. This includes L_{eq} and L_{90} sound pressure levels and measured ground-level wind speeds at Location 3. Data that were excluded from further analysis and calculations due to ground-level winds exceeding 5 m/s or due to precipitation and instrumentation operative exceedances as recorded at the Deposit MesoNet station are identified in the figures.

7.4.1 *Winter Monitoring*

The ranges of measured A-weighted sound levels during the winter season are summarized below and presented graphically in Figure 7-7. A total of 601 10-minute periods were excluded from the winter season. The resulting dataset includes a total of 1,536 10-minute periods of valid data.

- ◆ The valid steady-state level (L_{90}) measurements ranged from 17 to 50 dBA;
- ◆ The valid equivalent level (L_{eq}) measurements ranged from 18 to 64 dBA.

The ranges of calculated ANS-weighted sound levels during the winter season are summarized below.

- ◆ The valid, calculated steady-state (L_{90}) ANS-weighted broadband sound levels ranged from 14 to 48 dBA;
- ◆ The valid, calculated equivalent (L_{eq}) ANS-weighted broadband sound levels ranged from 16 to 63 dBA.

7.4.2 *Summer Monitoring*

The ranges of measured A-weighted sound levels during the summer season are summarized below and presented graphically in Figure 7-8. A total of 173 10-minute periods were excluded from the summer season. The resulting dataset includes a total of 1,948 10-minute periods of valid data.

- ◆ The valid steady-state level (L_{90}) measurements ranged from 24 to 67 dBA;
- ◆ The valid equivalent level (L_{eq}) measurements ranged from 27 to 72 dBA.

The ranges of calculated ANS-weighted sound levels during the summer season are summarized below.

- ◆ The valid, calculated steady-state (L_{90}) ANS-weighted broadband sound levels ranged from 12 to 61 dBA;
- ◆ The valid, calculated equivalent (L_{eq}) ANS-weighted broadband sound levels ranged from 15 to 66 dBA.

7.4.3 Spectral Sound Level Data

In addition to broadband sound levels, spectral sound level data were measured during each 10-minute period at Location 2. Using only valid measurement periods, octave-band and one-third octave-band data are summarized in Figures 7-9 and 7-10, respectively, as logarithmic averages of the equivalent (L_{eq}) sound levels; separated by daytime and nighttime. Octave-band levels are displayed from 31.5 Hz to 16,000 Hz in Figure 7-9 for both L_{eq} and L_{90} . The one-third octave-band data in Figure 7-10 span the audible frequencies from 20 Hz to 10,000 Hz and were analyzed for prominent discrete tones⁴⁰. The logarithmically averaged one-third octave-band ambient sound levels demonstrate no existing tones for the winter season. A pure tone exists at 5,000 Hz for the summer season, likely due to insect activity.

7.5 Location 3

Sound levels at Location 3 were influenced by rustling vegetation, overhead planes, audible wind, birds, insects, faint Interstate 86 traffic, and the occasional car on William Law Road. Sound level-versus-time graphs are provided in this section. This includes L_{eq} and L_{90} sound pressure levels and measured ground-level wind speeds that were measured at this location. Data that were excluded from further analysis and calculations due to ground-level winds exceeding 5 m/s or due to precipitation and instrumentation operative exceedances as recorded at the Deposit MesoNet station are identified in the figures.

7.5.1 Winter Monitoring

The ranges of measured A-weighted sound levels during the winter season are summarized below and presented graphically in Figure 7-11. A total of 594 10-minute periods were excluded from the winter season. The resulting dataset includes a total of 1,543 10-minute periods of valid data.

- ◆ The valid steady-state level (L_{90}) measurements ranged from 17 to 53 dBA;

⁴⁰ Prominent discrete tones as defined by the ANSI S12.9 Part 3 standard. The lowest frequency in the Annex B.1 tone test is 25 Hz. 20 Hz data are presented for informational purposes.

- ◆ The valid equivalent level (L_{eq}) measurements ranged from 19 to 65 dBA.

The ranges of calculated ANS-weighted sound levels during the winter season are summarized below.

- ◆ The valid, calculated steady-state (L_{90}) ANS-weighted broadband sound levels ranged from 13 to 52 dBA;
- ◆ The valid, calculated equivalent (L_{eq}) ANS-weighted broadband sound levels ranged from 17 to 60 dBA.

7.5.2 Summer Monitoring

The ranges of measured A-weighted sound levels during the summer season are summarized below and presented graphically in Figure 7-12. A total of 158 10-minute periods were excluded from the summer season. The resulting dataset includes a total of 1,957 10-minute periods of valid data.

- ◆ The valid steady-state level (L_{90}) measurements ranged from 20 to 63 dBA;
- ◆ The valid equivalent level (L_{eq}) measurements ranged from 22 to 79 dBA.

The ranges of calculated ANS-weighted sound levels during the summer season are summarized below.

- ◆ The valid, calculated steady-state (L_{90}) ANS-weighted broadband sound levels ranged from 14 to 62 dBA;
- ◆ The valid, calculated equivalent (L_{eq}) ANS-weighted broadband sound levels ranged from 18 to 78 dBA.

7.5.3 Spectral Sound Level Data

In addition to broadband sound levels, spectral sound level data were measured during each 10-minute period at Location 3. Using only valid measurement periods, octave-band and one-third octave-band data are summarized in Figures 7-13 and 7-14, respectively, as logarithmic averages of the equivalent (L_{eq}) sound levels; separated by daytime and nighttime. Octave-band levels are displayed from 31.5 Hz to 16,000 Hz in Figure 7-13 for both L_{eq} and L_{90} . The one-third octave-band data in Figure 7-14 span the audible frequencies from 20 Hz to 10,000 Hz and were analyzed for prominent discrete tones⁴¹. The logarithmically averaged one-third octave-band ambient sound levels demonstrate no existing tones.

⁴¹ Prominent discrete tones as defined by the ANSI S12.9 Part 3 standard. The lowest frequency in the Annex B.1 tone test is 25 Hz. 20 Hz data are presented for informational purposes.

7.6 Location 4

Sound levels at the Location 4 monitor were influenced by wind, occasional vehicle traffic on Pazzelli Road, overhead planes, rustling vegetation, birds, faint stream noise, and occasional farm animals. Sound level-versus-time graphs are provided in this section. This includes L_{eq} and L_{90} sound pressure levels and measured ground-level wind speeds that were measured at Location 3. Data that were excluded from further analysis and calculations due to ground-level winds exceeding 5 m/s or due to precipitation and instrumentation operative exceedances as recorded at the Deposit MesoNet station are identified in the figures.

7.6.1 *Winter Monitoring*

The ranges of measured A-weighted sound levels during the winter season are summarized below and presented graphically in Figure 7-15. A total of 366 10-minute periods were excluded from the winter season. The resulting dataset includes a total of 635 10-minute periods of valid data. The winter data at this location were truncated as there were technical issues during the first week of measurements.

- ◆ The valid steady-state level (L_{90}) measurements ranged from 18 to 48 dBA;
- ◆ The valid equivalent level (L_{eq}) measurements ranged from 18 to 58 dBA.

The ranges of calculated ANS-weighted sound levels during the winter season are summarized below.

- ◆ The valid, calculated steady-state (L_{90}) ANS-weighted broadband sound levels ranged from 14 to 47 dBA;
- ◆ The valid, calculated equivalent (L_{eq}) ANS-weighted broadband sound levels ranged from 16 to 58 dBA.

7.6.2 *Summer Monitoring*

The ranges of measured A-weighted sound levels during the summer season are summarized below and presented graphically in Figure 7-16. A total of 162 10-minute periods were excluded from the summer season. The resulting dataset includes a total of 1,951 10-minute periods of valid data.

- ◆ The valid steady-state level (L_{90}) measurements ranged from 23 to 60 dBA;
- ◆ The valid equivalent level (L_{eq}) measurements ranged from 24 to 69 dBA.

The ranges of calculated ANS-weighted sound levels during the summer season are summarized below.

- ◆ The valid, calculated steady-state (L_{90}) ANS-weighted broadband sound levels ranged from 12 to 51 dBA;
- ◆ The valid, calculated equivalent (L_{eq}) ANS-weighted broadband sound levels ranged from 14 to 69 dBA.

7.6.3 Spectral Sound Level Data

In addition to broadband sound levels, spectral sound level data were measured during each 10-minute period at Location 4. Using only valid measurement periods, octave-band and one-third octave-band data are summarized in Figures 7-17 and 7-18, respectively, as logarithmic averages of the equivalent (L_{eq}) sound levels; separated by daytime and nighttime. Octave-band levels are displayed from 31.5 Hz to 16,000 Hz in Figure 7-17 for both L_{eq} and L_{90} . The one-third octave-band data in Figure 7-18 span the audible frequencies from 20 Hz to 10,000 Hz and were analyzed for prominent discrete tones⁴². The logarithmically averaged one-third octave-band ambient sound levels demonstrate no existing tones for the winter season. Pure tones are present in the summer data at the 5,000 Hz and 10,000 Hz frequencies, likely due to insect or bird activity.

7.7 Location 5

Sound levels at the Winter Location 5 monitor were influenced by distant traffic noise from Interstate 86, occasional aircraft, stream noise⁴³, bird, insects, and vehicles along Farnham Road. Sound level-versus-time graphs are provided in this section. This includes L_{eq} and L_{90} sound pressure levels and measured ground-level wind speeds that were measured at Location 3. Data that were excluded from further analysis and calculations due to ground-level winds exceeding 5 m/s or due to precipitation and instrumentation operative exceedances as recorded at the Deposit Mesonet station are identified in the figures.

7.7.1 Winter Monitoring

The ranges of measured A-weighted sound levels during the winter season are summarized below and presented graphically in Figure 7-19. A total of 578 10-minute periods were

⁴² Prominent discrete tones as defined by the ANSI S12.9 Part 3 standard. The lowest frequency in the Annex B.1 tone test is 25 Hz. 20 Hz data are presented for informational purposes.

⁴³ The measurement Protocol states that the microphone was to be placed 15 meters (~ 50 feet) from the centerline of the nearest traffic lane, and if this was not possible or practical that the microphone setback from the road would be comparable to the setback of a sensitive receptor. Specific microphone placement at this location was designed to avoid stream noise as much as possible while following the Protocol and with the limitation of the parcel boundary.

excluded from the winter season. The resulting dataset includes a total of 1,543 10-minute periods of valid data.

- ◆ The valid steady-state level (L_{90}) measurements ranged from 21 to 55 dBA;
- ◆ The valid equivalent level (L_{eq}) measurements ranged from 21 to 64 dBA.

The ranges of calculated ANS-weighted sound levels during the winter season are summarized below.

- ◆ The valid, calculated steady-state (L_{90}) ANS-weighted broadband sound levels ranged from 17 to 54 dBA;
- ◆ The valid, calculated equivalent (L_{eq}) ANS-weighted broadband sound levels ranged from 20 to 63 dBA.

7.7.2 Summer Monitoring

The ranges of measured A-weighted sound levels during the summer season are summarized below and presented graphically in Figure 7-20. A total of 166 10-minute periods were excluded from the summer season. The resulting dataset includes a total of 1,859 10-minute periods of valid data.

- ◆ The valid steady-state level (L_{90}) measurements ranged from 25 to 64 dBA;
- ◆ The valid equivalent level (L_{eq}) measurements ranged from 30 to 69 dBA.

The ranges of calculated ANS-weighted sound levels during the summer season are summarized below.

- ◆ The valid, calculated steady-state (L_{90}) ANS-weighted broadband sound levels ranged from 17 to 60 dBA;
- ◆ The valid, calculated equivalent (L_{eq}) ANS-weighted broadband sound levels ranged from 19 to 67 dBA.

7.7.3 Spectral Sound Level Data

In addition to broadband sound levels, spectral sound level data were measured during each 10-minute period at Location 5. Using only valid measurement periods, octave-band and one-third octave-band data are summarized in Figures 7-21 and 7-22, respectively, as logarithmic averages of the equivalent (L_{eq}) winter and summer sound levels; separated by daytime and nighttime. Octave-band levels are displayed from 31.5 Hz to 16,000 Hz in Figure 7-21 for both L_{eq} and L_{90} . The one-third octave-band data in Figure 7-22 span the audible frequencies from 20 Hz to 10,000 Hz and were analyzed for prominent discrete

tones⁴⁴. The logarithmically averaged one-third octave-band ambient sound levels demonstrate no existing tones for the winter monitoring period. A pure tone was present at 5,000 Hz during the summer program, likely due to insect activity.

7.8 Location 6

Sound levels at the Location 6 monitor were influenced by occasional traffic from Route 41 to the west, wind, rustling vegetation, stream noise⁴⁵, insects, birds and a neighborhood dog barking. Sound level-versus-time graphs are provided in this section. This includes L_{eq} and L_{90} sound pressure levels and measured ground-level wind speeds that were measured at Location 7. Data that were excluded from further analysis and calculations due to ground-level winds exceeding 5 m/s or due to precipitation and instrumentation operative exceedances as recorded at the Deposit MesoNet station are identified in the figures.

7.8.1 Winter Monitoring

The ranges of measured A-weighted sound levels during the winter season are summarized below and presented graphically in Figure 7-23. A total of 694 10-minute periods were excluded from the winter season. The resulting dataset includes a total of 1,429 10-minute periods of valid data.

- ◆ The valid steady-state level (L_{90}) measurements ranged from 25 to 55 dBA;
- ◆ The valid equivalent level (L_{eq}) measurements ranged from 27 to 69 dBA.

The ranges of calculated ANS-weighted sound levels during the winter season are summarized below.

- ◆ The valid, calculated steady-state (L_{90}) ANS-weighted broadband sound levels ranged from 23 to 53 dBA;
- ◆ The valid, calculated equivalent (L_{eq}) ANS-weighted broadband sound levels ranged from 26 to 66 dBA.

⁴⁴ Prominent discrete tones as defined by the ANSI S12.9 Part 3 standard. The lowest frequency in the Annex B.1 tone test is 25 Hz. 20 Hz data are presented for informational purposes.

⁴⁵ The measurement Protocol states that the microphone was to be placed 15 meters (~50 feet) from the centerline of the nearest traffic lane, and if this was not possible or practical that the microphone setback from the road would be comparable to the setback of a sensitive receptor. Specific microphone placement at this location was designed to avoid stream noise as much as possible while following the Protocol and with the limitation of the parcel boundary.

7.8.2 Summer Monitoring

The ranges of measured A-weighted sound levels during the summer season are summarized below and presented graphically in Figure 7-24. A total of 72 10-minute periods were excluded from the summer season. The resulting dataset includes a total of 1,946 10-minute periods of valid data.

- ◆ The valid steady-state level (L_{90}) measurements ranged from 32 to 62 dBA;
- ◆ The valid equivalent level (L_{eq}) measurements ranged from 34 to 74 dBA.

The ranges of calculated ANS-weighted sound levels during the summer season are summarized below.

- ◆ The valid, calculated steady-state (L_{90}) ANS-weighted broadband sound levels ranged from 25 to 60 dBA;
- ◆ The valid, calculated equivalent (L_{eq}) ANS-weighted broadband sound levels ranged from 27 to 73 dBA.

7.8.3 Spectral Sound Level Data

In addition to broadband sound levels, spectral sound level data were measured during each 10-minute period at Location 6. Using only valid measurement periods, octave-band and one-third octave-band data are summarized in Figures 7-25 and 7-26, respectively, as logarithmic averages of the equivalent (L_{eq}) winter sound levels; separated by daytime and nighttime. Octave-band levels are displayed from 31.5 Hz to 16,000 Hz in Figure 7-25 for both L_{eq} and L_{90} . The one-third octave-band data in Figure 7-26 span the audible frequencies from 20 Hz to 10,000 Hz and were analyzed for prominent discrete tones⁴⁶. The logarithmically averaged one-third octave-band ambient sound levels demonstrate no existing tones for the winter season. Pure tones exist at the 5,000 Hz and 8,000 Hz frequencies for the summer season likely due to birds and insect activity.

7.9 Location 7

Sound levels at the Winter Location 7 monitor were influenced by wind noise, vegetation rustle, birds, sounds from nearby residences, and insects. Sound level-versus-time graphs are provided in this section. This includes L_{eq} and L_{90} sound pressure levels and measured ground-level wind speeds that were measured at this location. Data that were excluded

⁴⁶ Prominent discrete tones as defined by the ANSI S12.9 Part 3 standard. The lowest frequency in the Annex B.1 tone test is 25 Hz. 20 Hz data are presented for informational purposes.

from further analysis and calculations due to ground-level winds exceeding 5 m/s or due to precipitation and instrumentation operative exceedances as recorded at the Deposit MesoNet station are identified in the figures.

7.9.1 Winter Monitoring

The ranges of measured A-weighted sound levels during the winter season are summarized below and presented graphically in Figure 7-27. A total of 713 10-minute periods were excluded from the winter season. The resulting dataset includes a total of 1,424 10-minute periods of valid data.

- ◆ The valid steady-state level (L_{90}) measurements ranged from 19 to 50 dBA;
- ◆ The valid equivalent level (L_{eq}) measurements ranged from 19 to 66 dBA.

The ranges of calculated ANS-weighted sound levels during the winter season are summarized below.

- ◆ The valid, calculated steady-state (L_{90}) ANS-weighted broadband sound levels ranged from 15 to 50 dBA;
- ◆ The valid, calculated equivalent (L_{eq}) ANS-weighted broadband sound levels ranged from 17 to 64 dBA.

7.9.2 Summer Monitoring

The ranges of measured A-weighted sound levels during the summer season are summarized below and presented graphically in Figure 7-28. A total of 73 10-minute periods were excluded from the summer season. The resulting dataset includes a total of 2,035 10-minute periods of valid data.

- ◆ The valid steady-state level (L_{90}) measurements ranged from 20 to 62 dBA;
- ◆ The valid equivalent level (L_{eq}) measurements ranged from 23 to 77 dBA.

The ranges of calculated ANS-weighted sound levels during the summer season are summarized below.

- ◆ The valid, calculated steady-state (L_{90}) ANS-weighted broadband sound levels ranged from 10 to 61 dBA;
- ◆ The valid, calculated equivalent (L_{eq}) ANS-weighted broadband sound levels ranged from 12 to 76 dBA.

7.9.3 Spectral Sound Level Data

In addition to broadband sound levels, spectral sound level data were measured during each 10-minute period at Location 7. Using only valid measurement periods, octave-band and one-third octave-band data are summarized in Figures 7-29 and 7-30, respectively, as logarithmic averages of the equivalent (L_{eq}) winter and summer sound levels; separated by daytime and nighttime. Octave-band levels are displayed from 31.5 Hz to 16,000 Hz in Figure 7-29 for both L_{eq} and L_{90} . The one-third octave-band data in Figure 7-30 span the audible frequencies from 20 Hz to 10,000 Hz and were analyzed for prominent discrete tones⁴⁷. The logarithmically averaged one-third octave-band ambient sound levels demonstrate no existing tones during the winter season. A pure tone was present at 5,000 Hz during the summer season, likely due to insect activity.

⁴⁷ Prominent discrete tones as defined by the ANSI S12.9 Part 3 standard. The lowest frequency in the Annex B.1 tone test is 25 Hz. 20 Hz data are presented for informational purposes.

Figure 7-1 On-Site Hub Height Wind Rose – Winter Ambient [REDACTED]

Figure 7-2 On-Site Hub Height Wind Rose – Summer Ambient [REDACTED]

Figure 7-3: Baseline Monitoring Graphical Results - Location 1 (Winter)
 10-Minute Ambient Sound Level Data

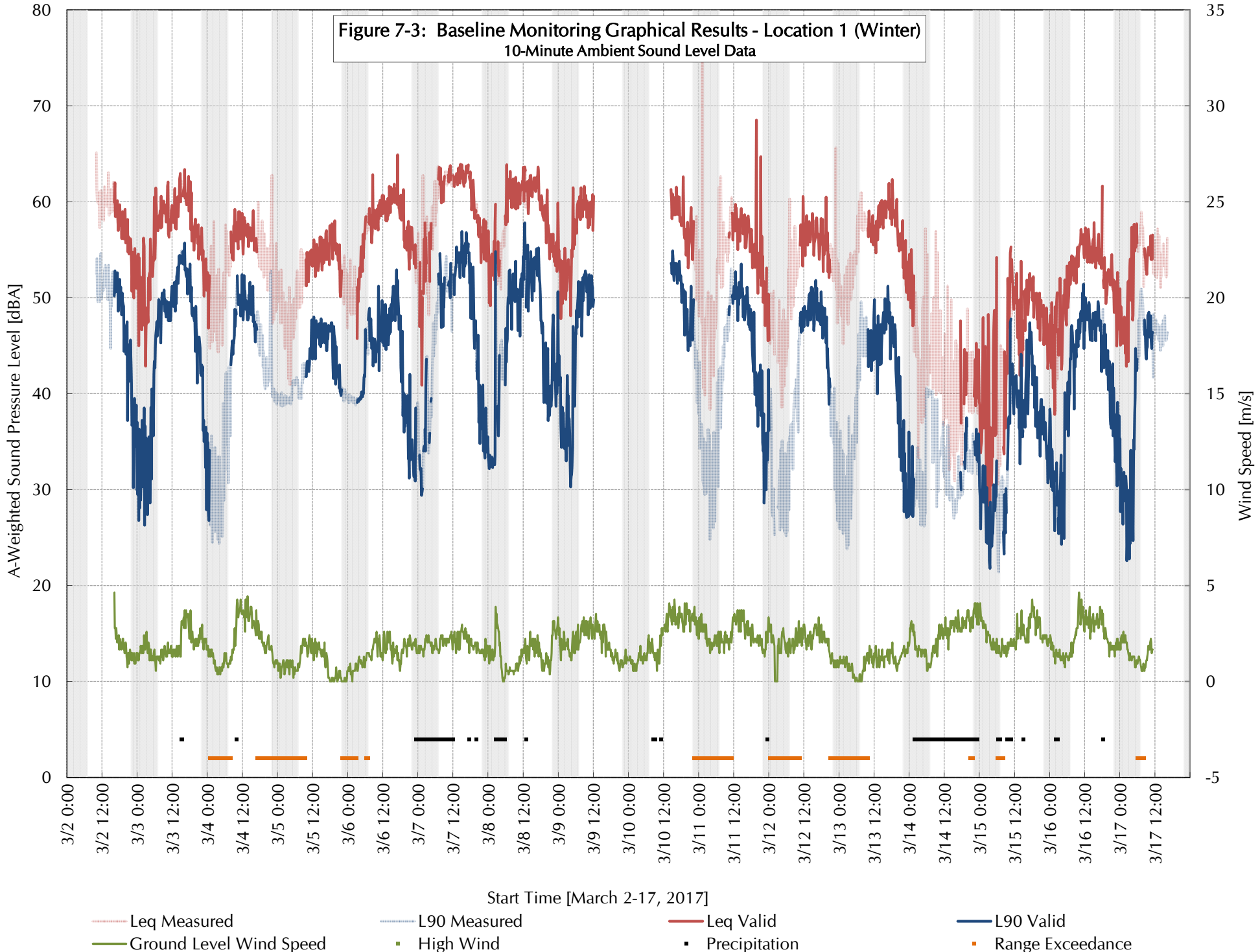


Figure 7-4: Baseline Monitoring Graphical Results - Location 1 (Summer)
 10-Minute Ambient Sound Level Data

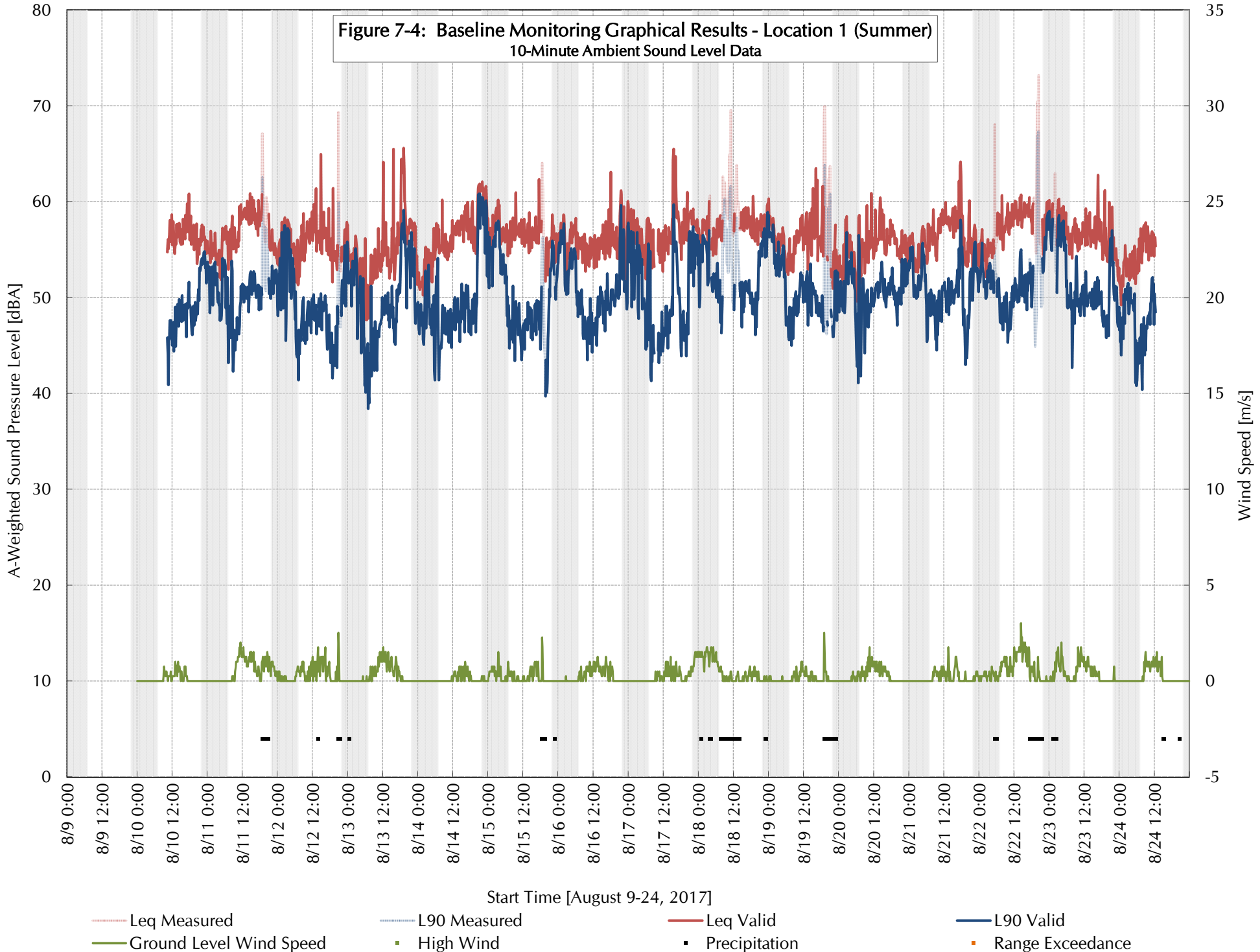
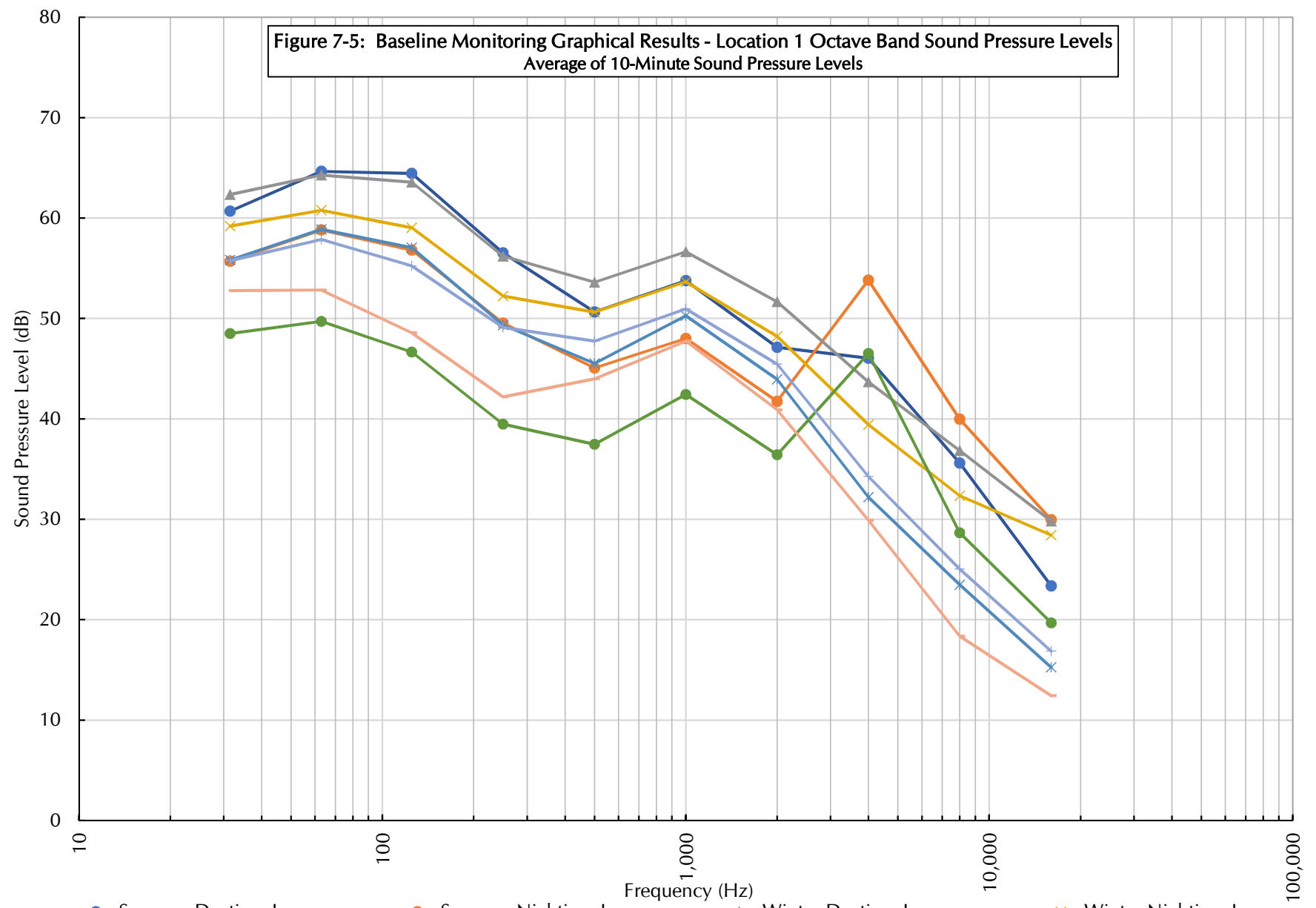


Figure 7-5: Baseline Monitoring Graphical Results - Location 1 Octave Band Sound Pressure Levels
Average of 10-Minute Sound Pressure Levels



- Summer Daytime Leq
- Summer Nighttime Leq
- ▲ Winter Daytime Leq
- × Winter Nighttime Leq
- × Summer Daytime L90
- Summer Nighttime L90
- × Winter Daytime L90
- Winter Nighttime L90

Figure 7-6: Baseline Monitoring Graphical Results - Location 1-Third Octave Band Sound Pressure Levels
Average of 10-Minute Sound Pressure Levels

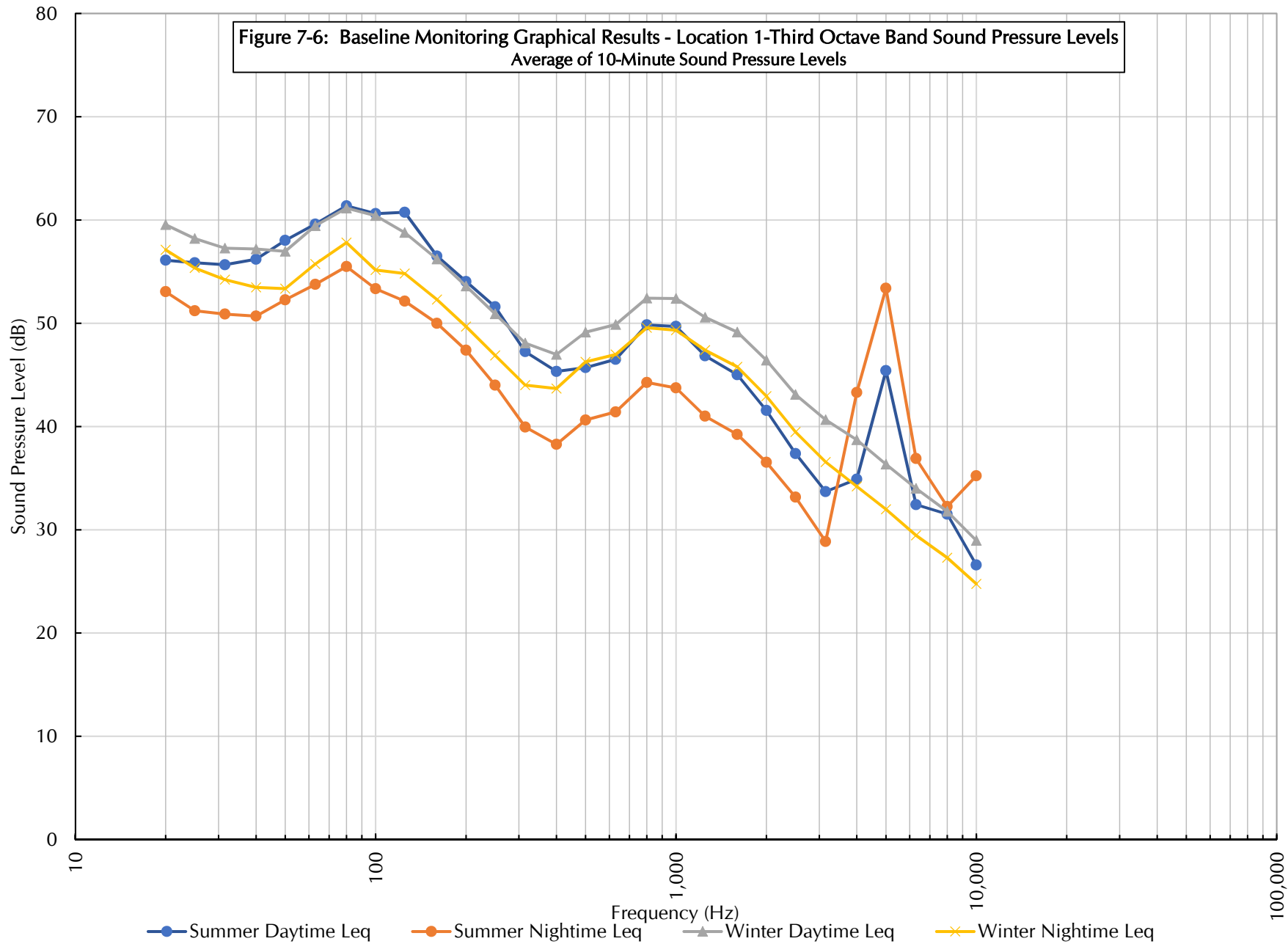


Figure 7-7: Baseline Monitoring Graphical Results - Location 2 (Winter)
 10-Minute Ambient Sound Level Data

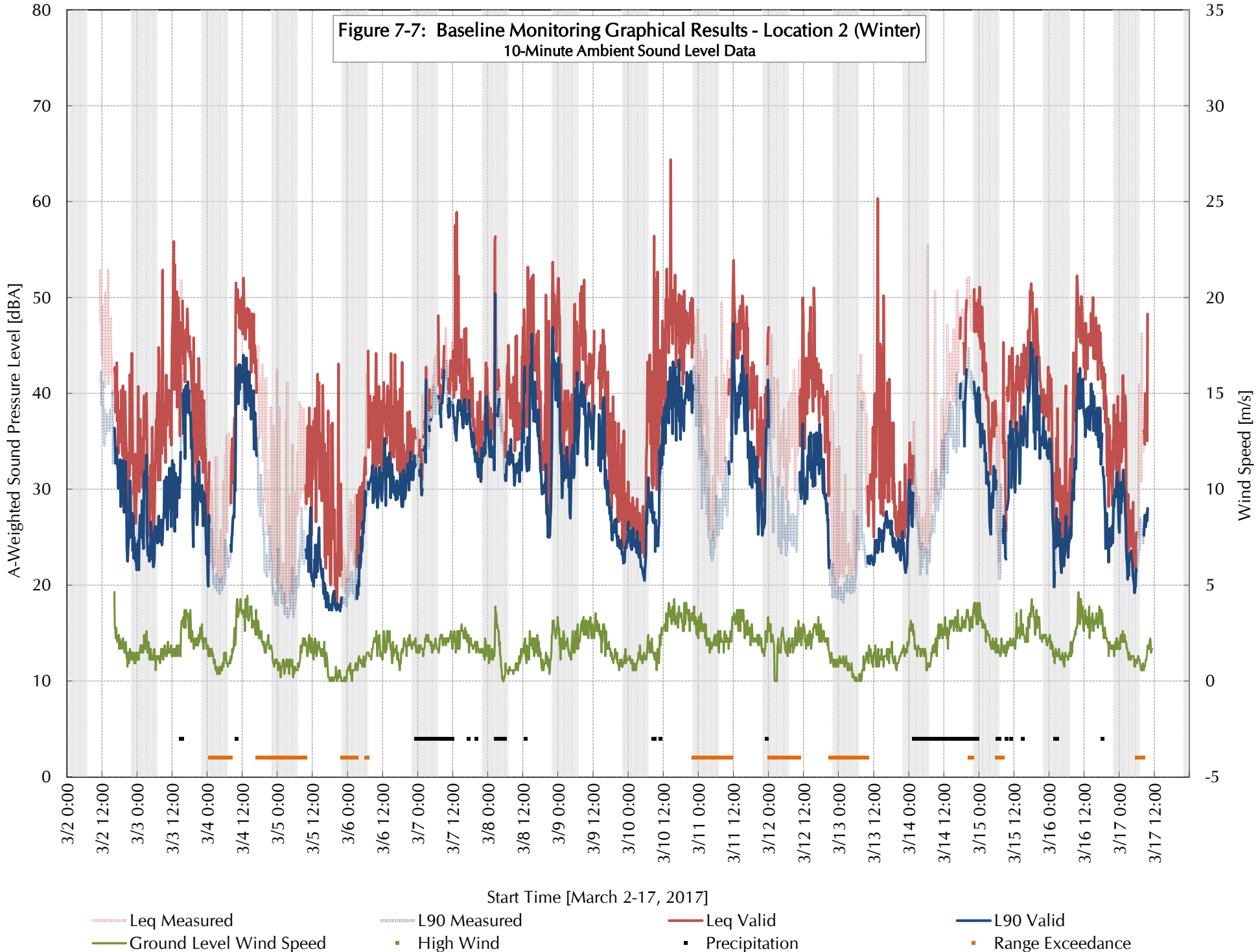


Figure 7-8: Baseline Monitoring Graphical Results - Location 2 (Summer)
10-Minute Ambient Sound Level Data

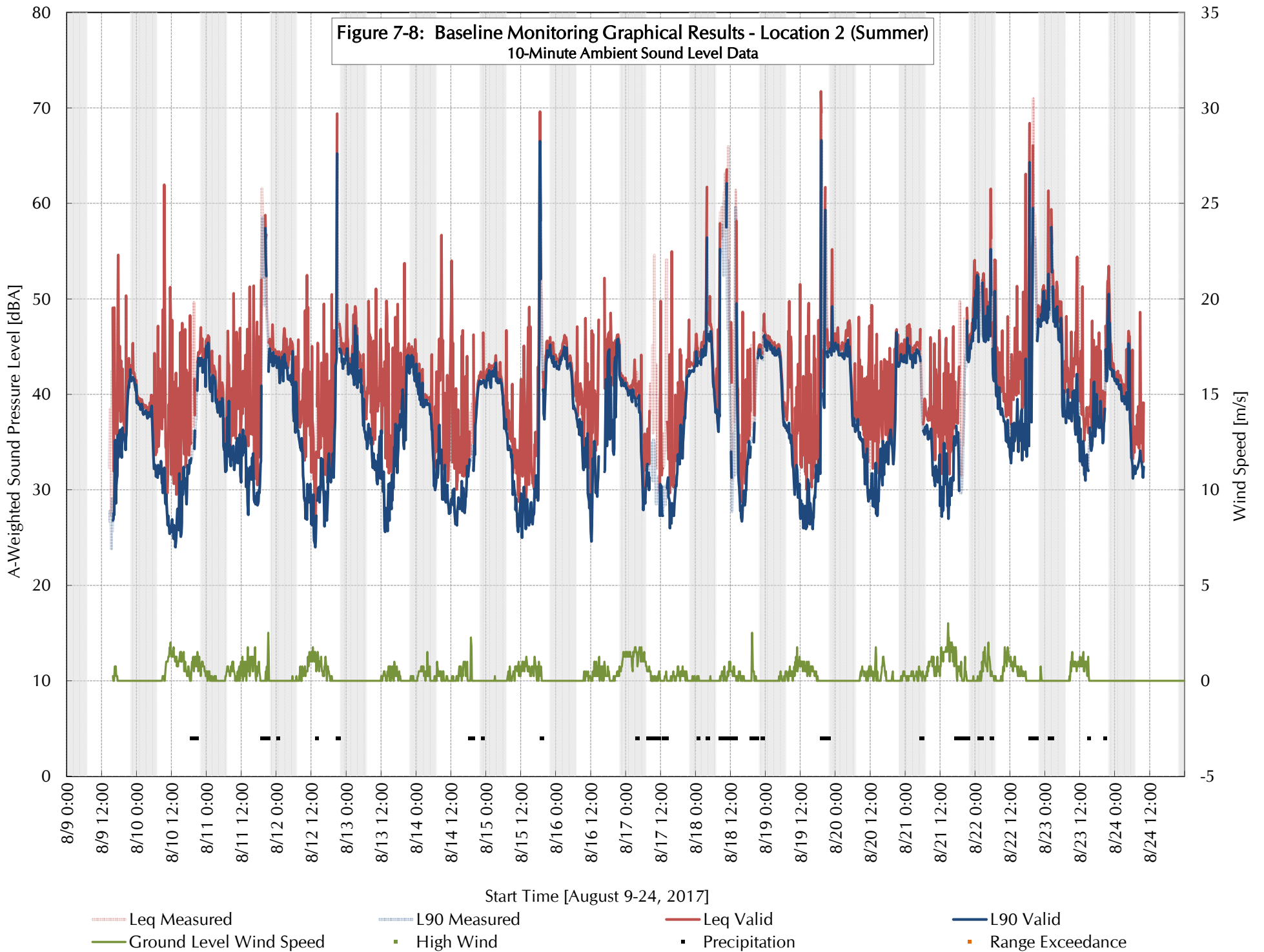
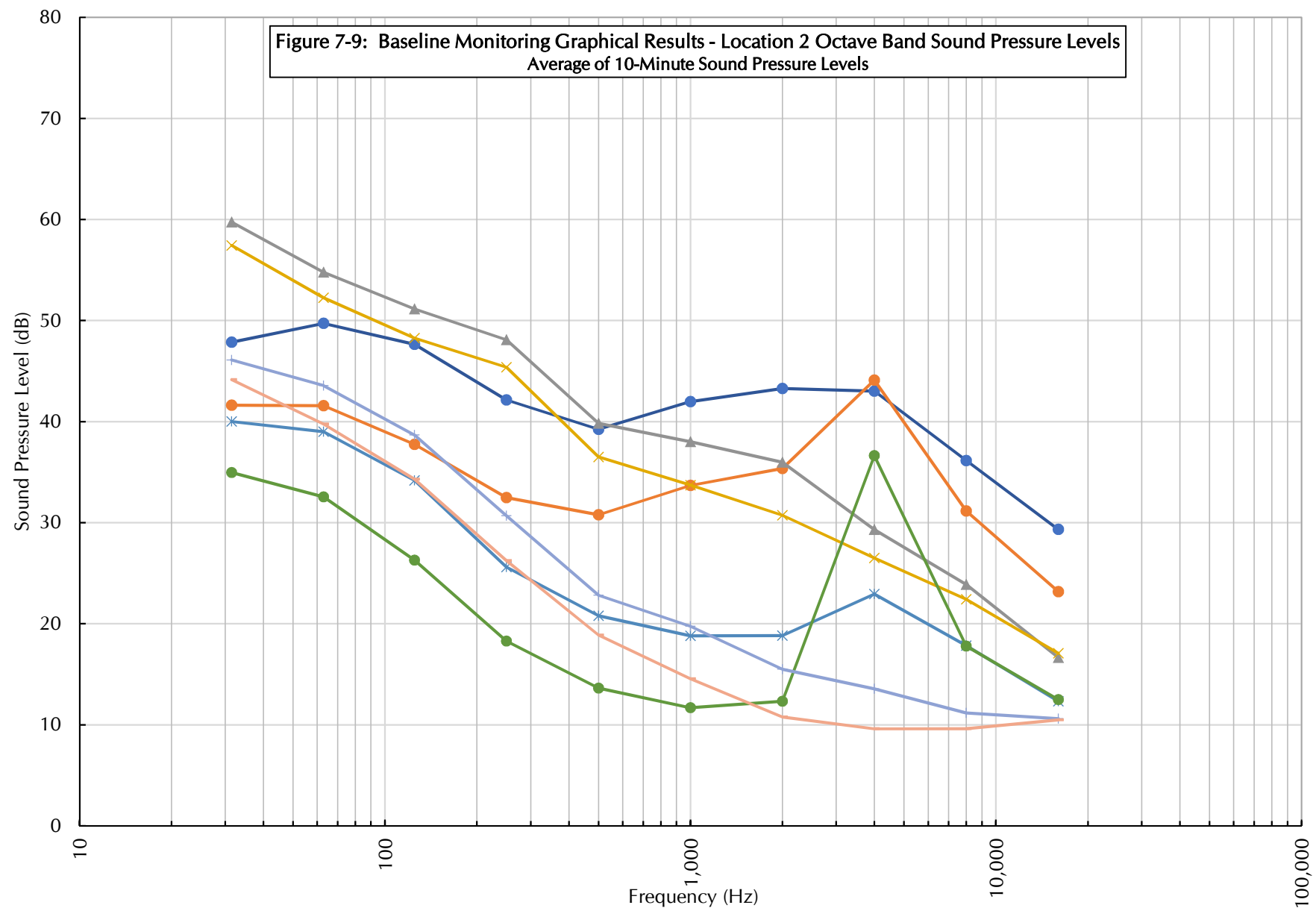


Figure 7-9: Baseline Monitoring Graphical Results - Location 2 Octave Band Sound Pressure Levels
 Average of 10-Minute Sound Pressure Levels



- Summer Daytime Leq
- Summer Nighttime Leq
- ▲ Winter Daytime Leq
- × Winter Nighttime Leq
- × Summer Daytime L90
- Summer Nighttime L90
- ▲ Winter Daytime L90
- × Winter Nighttime L90

Figure 7-10: Baseline Monitoring Graphical Results - Location 2-Third Octave Band Sound Pressure Levels
Average of 10-Minute Sound Pressure Levels

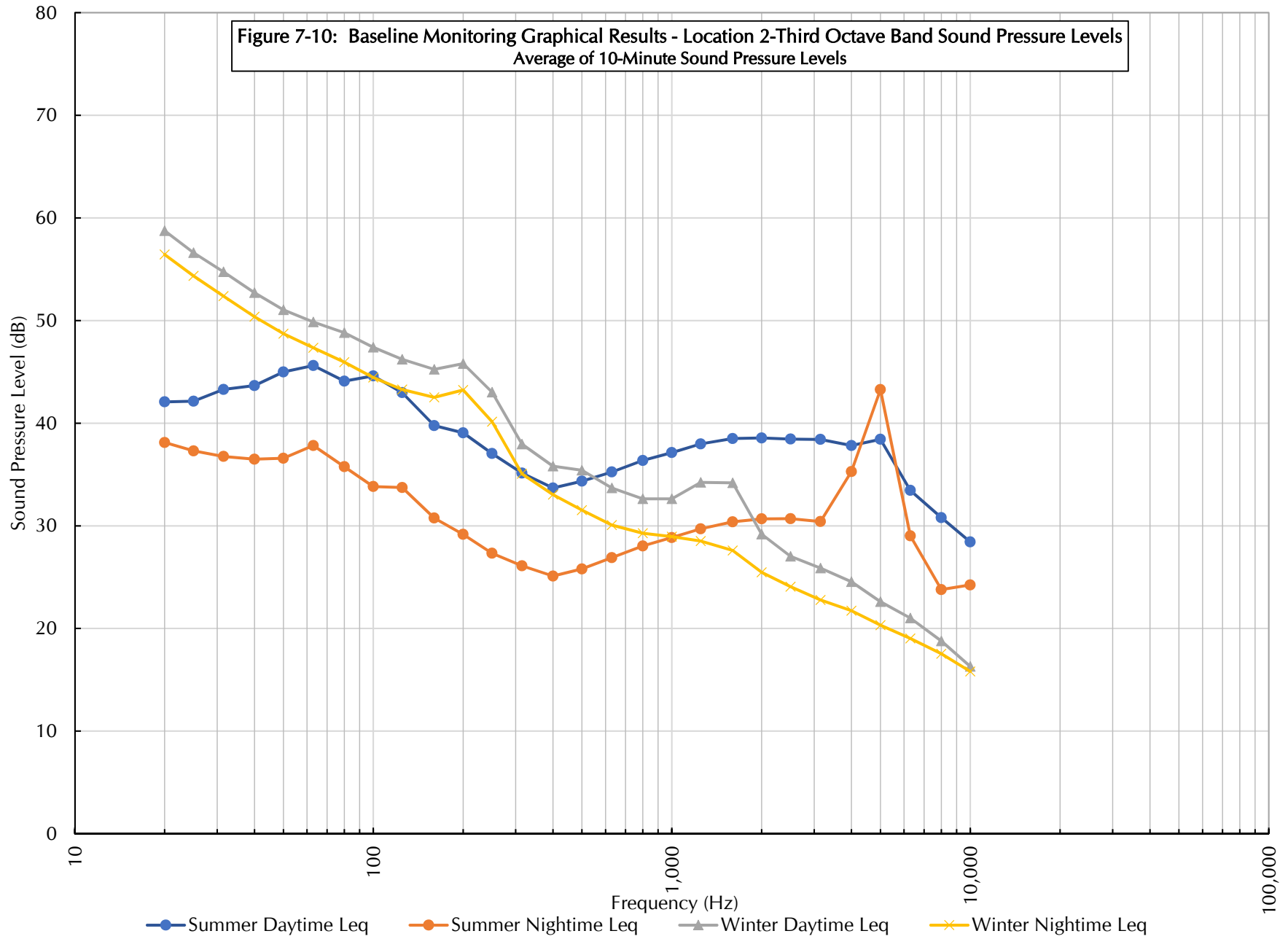


Figure 7-11: Baseline Monitoring Graphical Results - Location 3 (Winter)
 10-Minute Ambient Sound Level Data

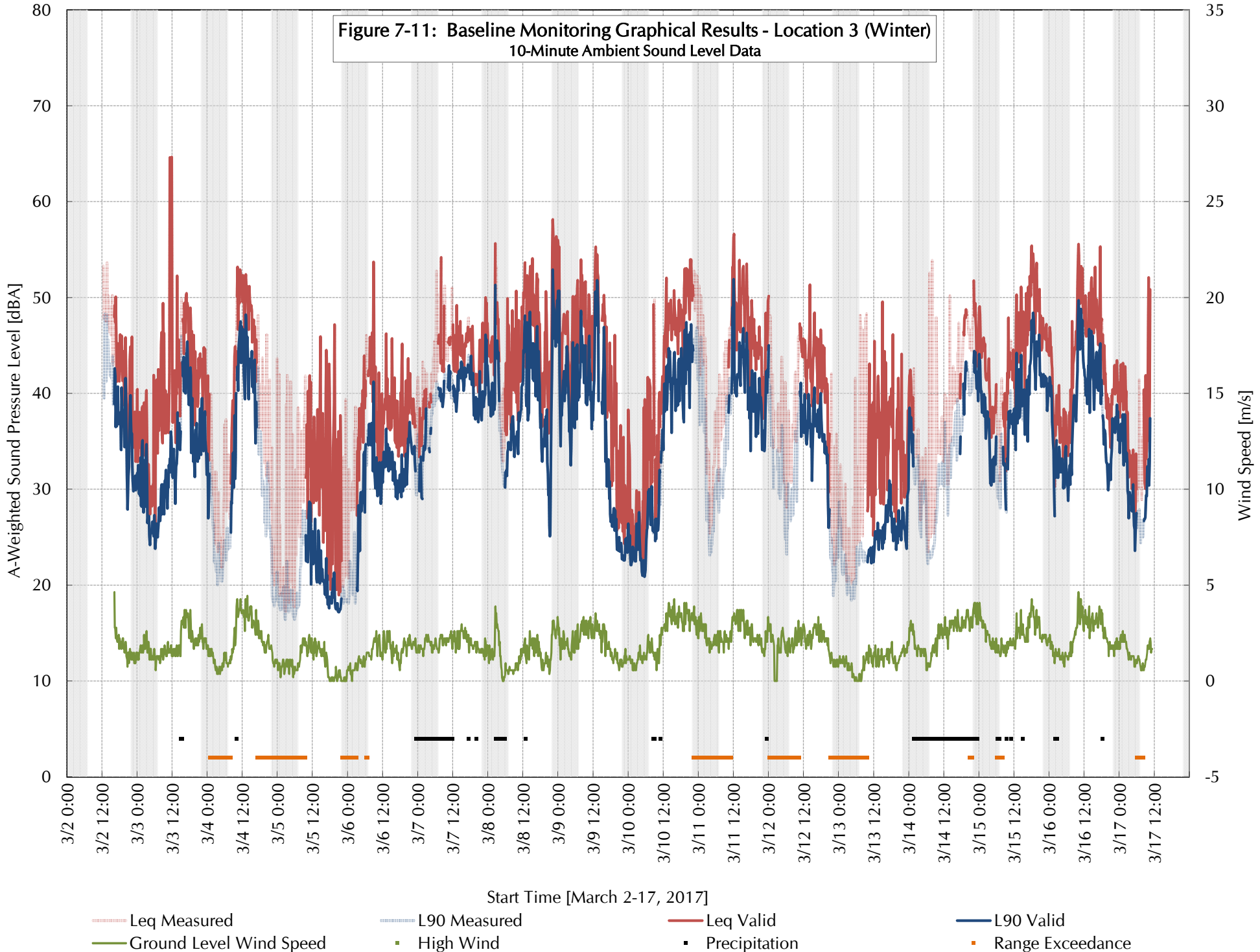


Figure 7-12: Baseline Monitoring Graphical Results - Location 3 (Summer)
 10-Minute Ambient Sound Level Data

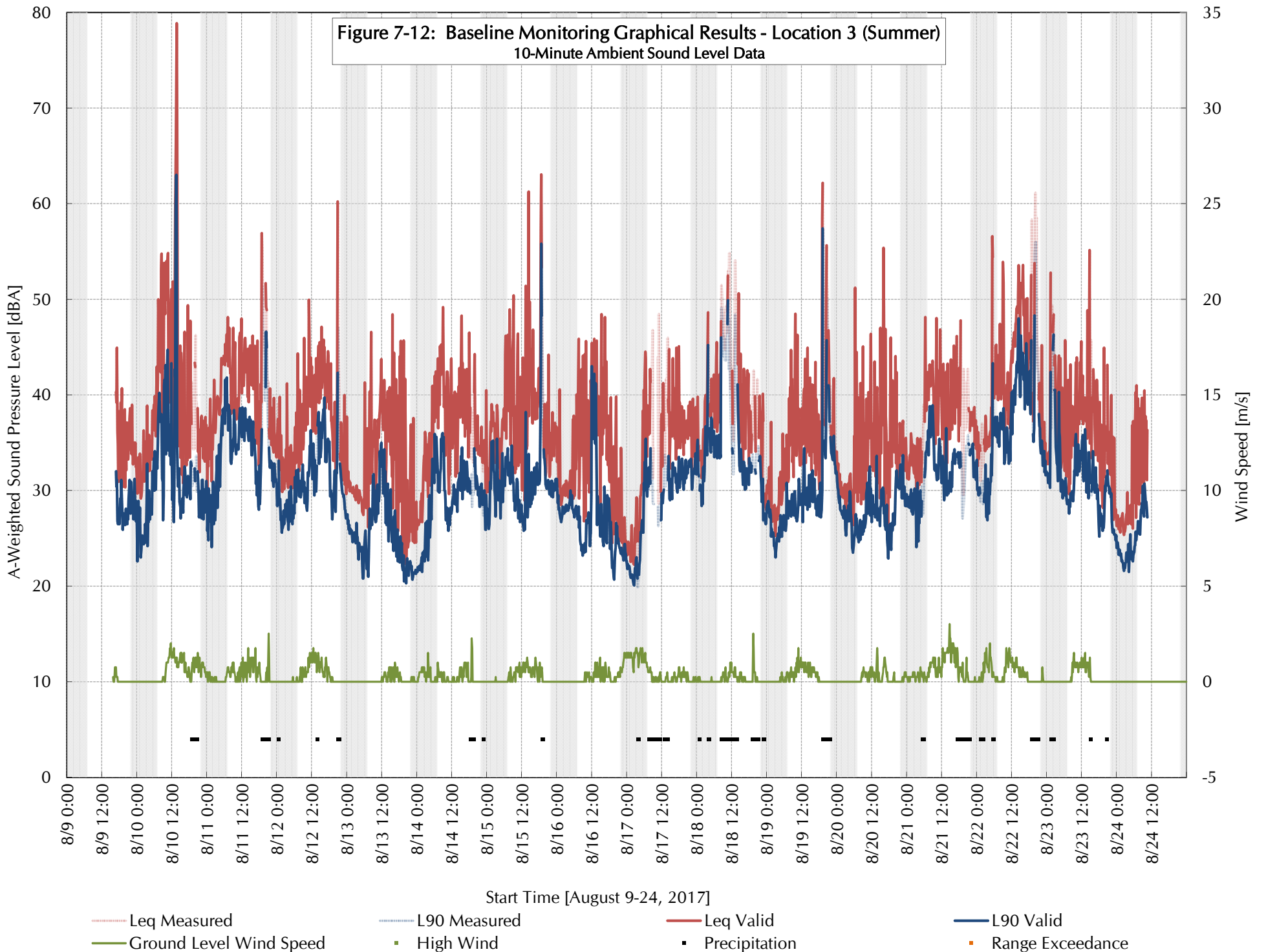
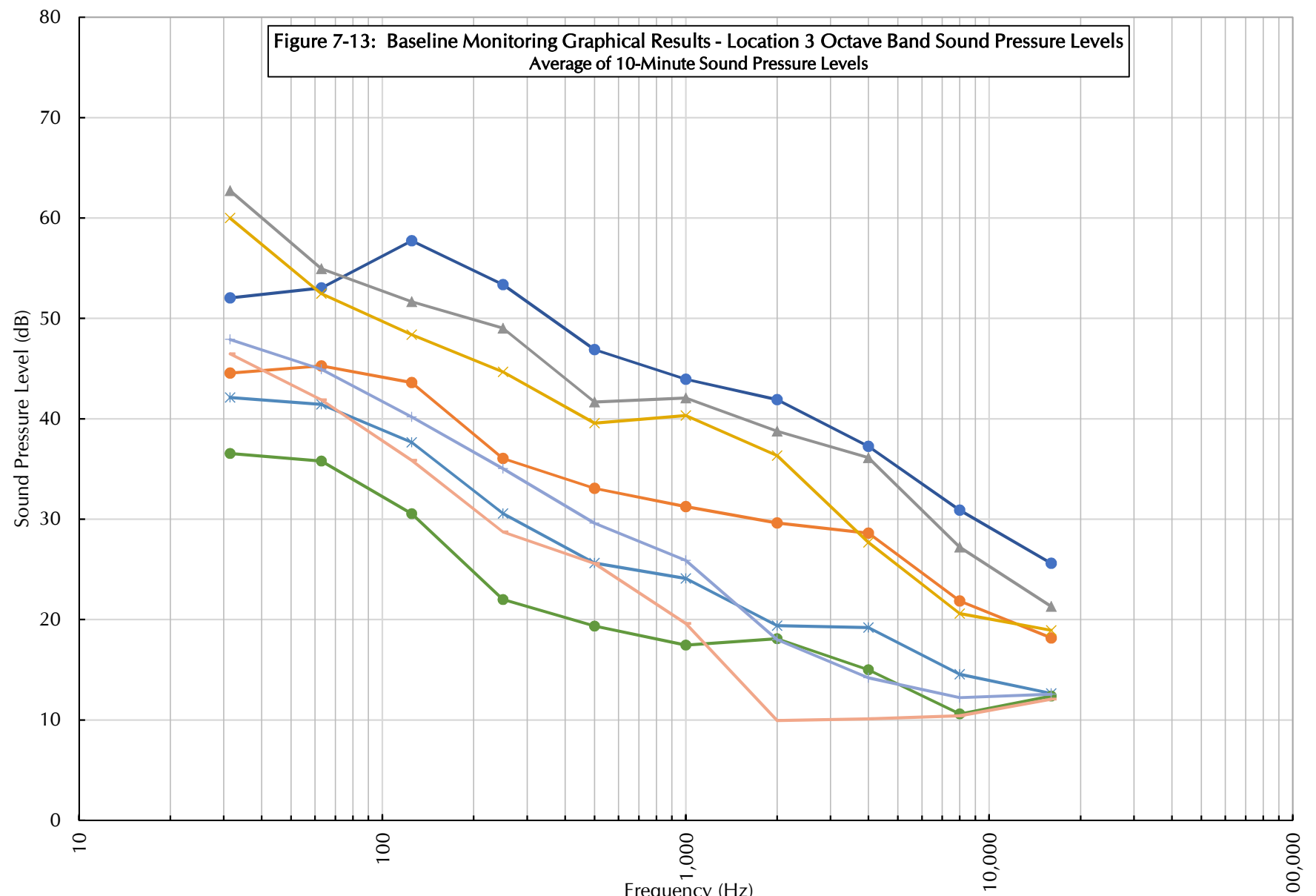


Figure 7-13: Baseline Monitoring Graphical Results - Location 3 Octave Band Sound Pressure Levels
Average of 10-Minute Sound Pressure Levels



- Summer Daytime Leq
- Summer Nighttime Leq
- ▲ Winter Daytime Leq
- ✕ Winter Nighttime Leq
- ✕ Summer Daytime L90
- Summer Nighttime L90
- ▲ Winter Daytime L90
- ✕ Winter Nighttime L90

Figure 7-14: Baseline Monitoring Graphical Results - Location 3-Third Octave Band Sound Pressure Levels
Average of 10-Minute Sound Pressure Levels

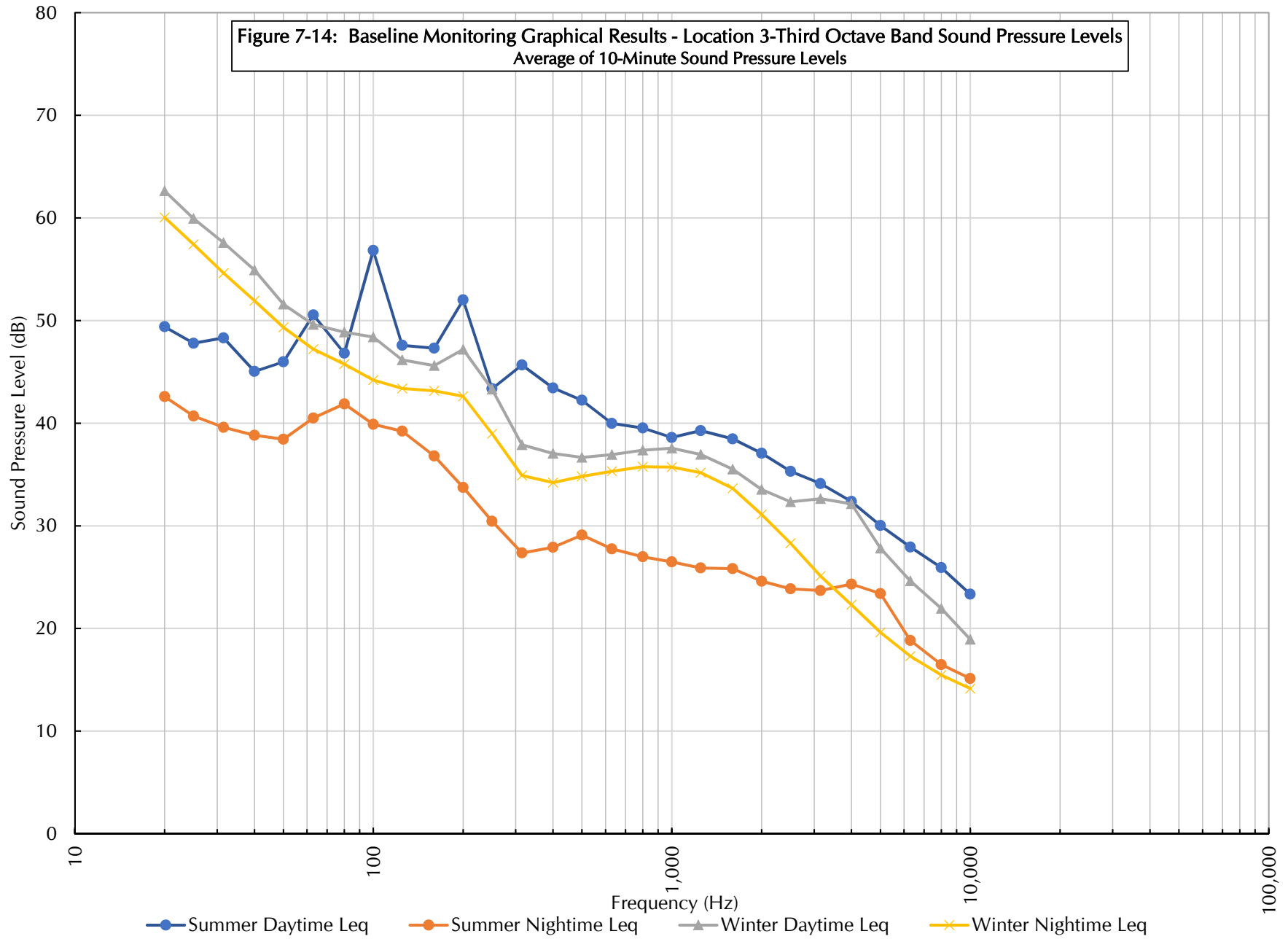


Figure 7-15: Baseline Monitoring Graphical Results - Location 4 (Winter)
10-Minute Ambient Sound Level Data

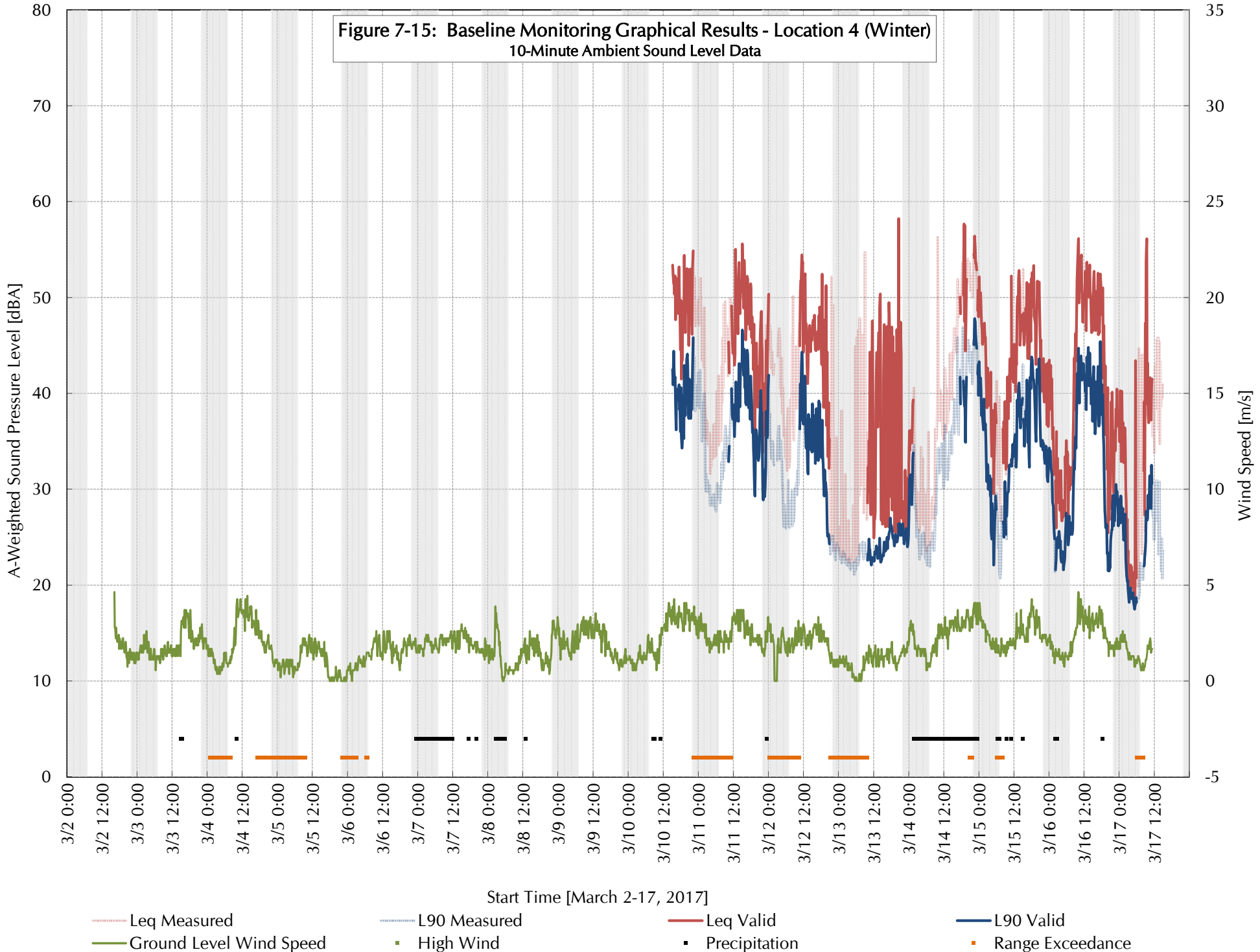


Figure 7-16: Baseline Monitoring Graphical Results - Location 4 (Summer)
 10-Minute Ambient Sound Level Data

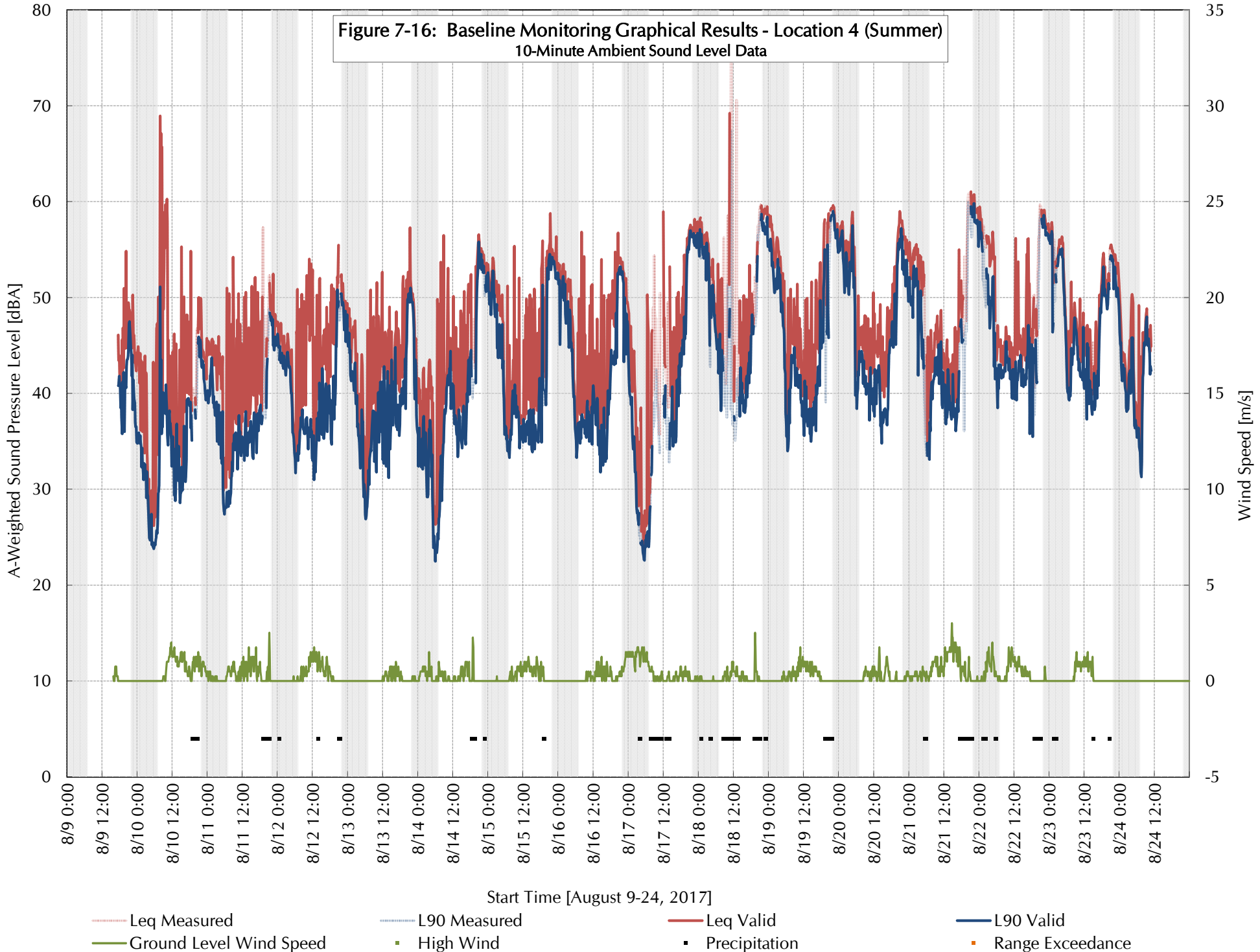
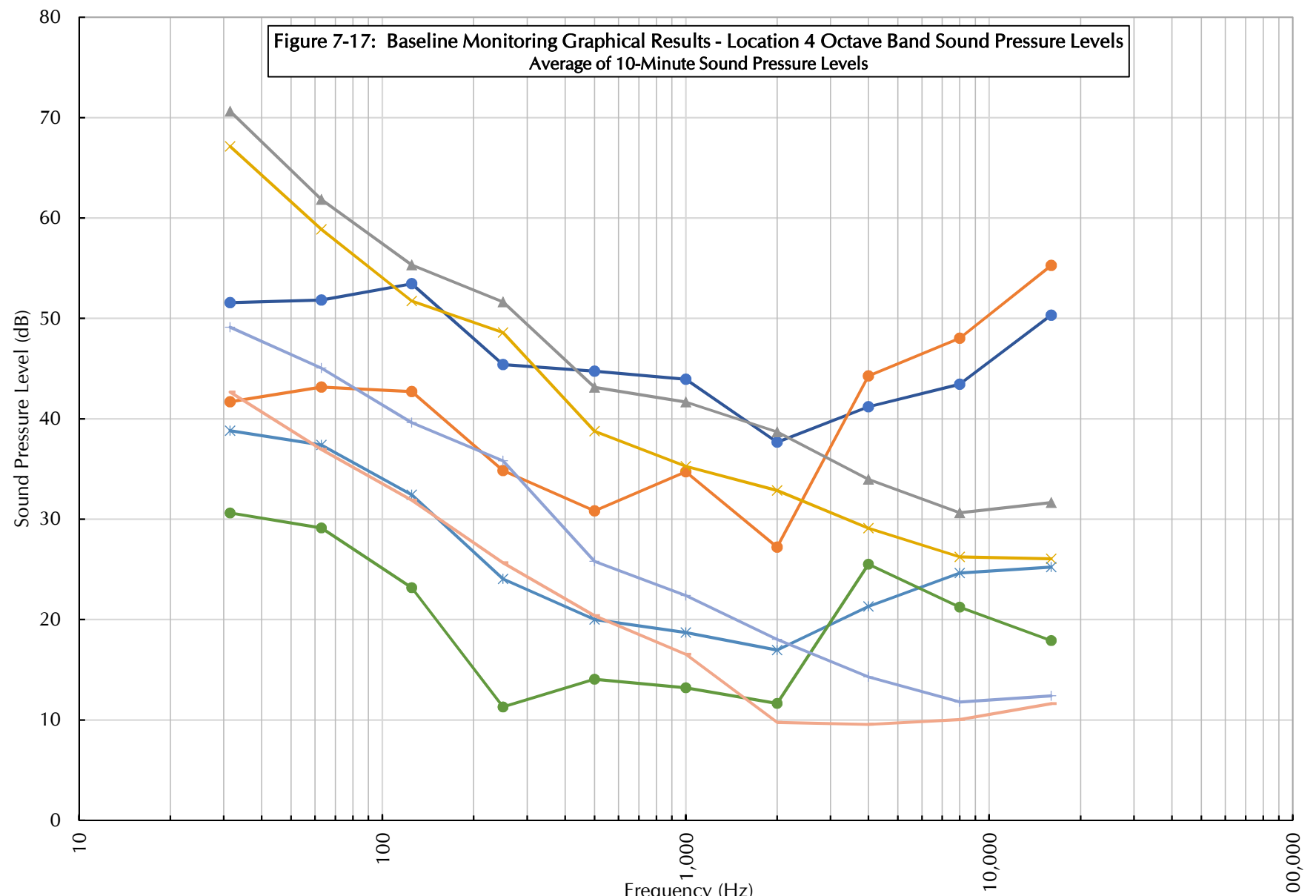


Figure 7-17: Baseline Monitoring Graphical Results - Location 4 Octave Band Sound Pressure Levels
Average of 10-Minute Sound Pressure Levels



- Summer Daytime Leq
- Summer Nighttime Leq
- ▲ Winter Daytime Leq
- ✕ Winter Nighttime Leq
- ✕ Summer Daytime L90
- Summer Nighttime L90
- ✕ Winter Daytime L90
- Winter Nighttime L90

Figure 7-18: Baseline Monitoring Graphical Results - Location 4-Third Octave Band Sound Pressure Levels
Average of 10-Minute Sound Pressure Levels

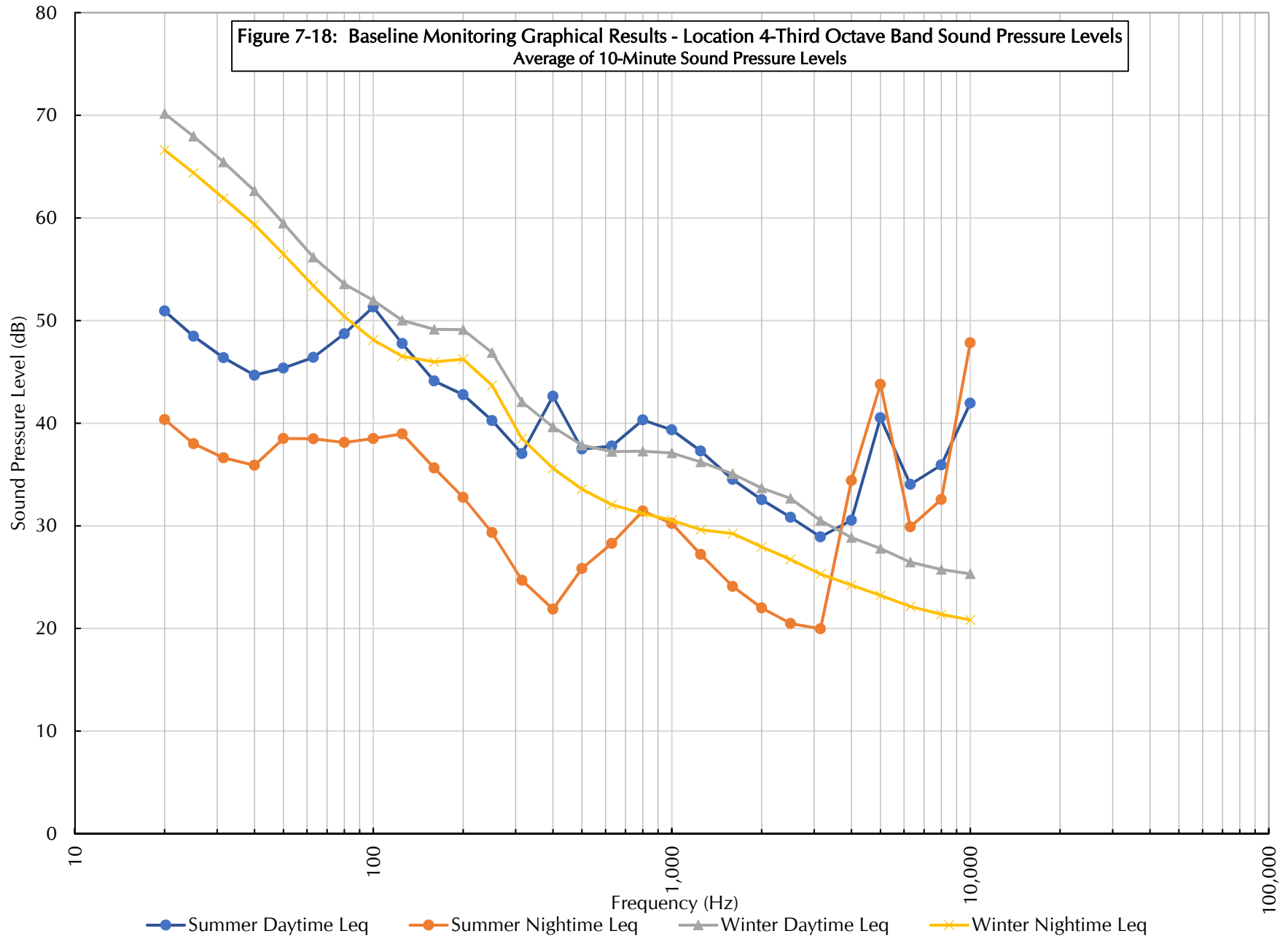
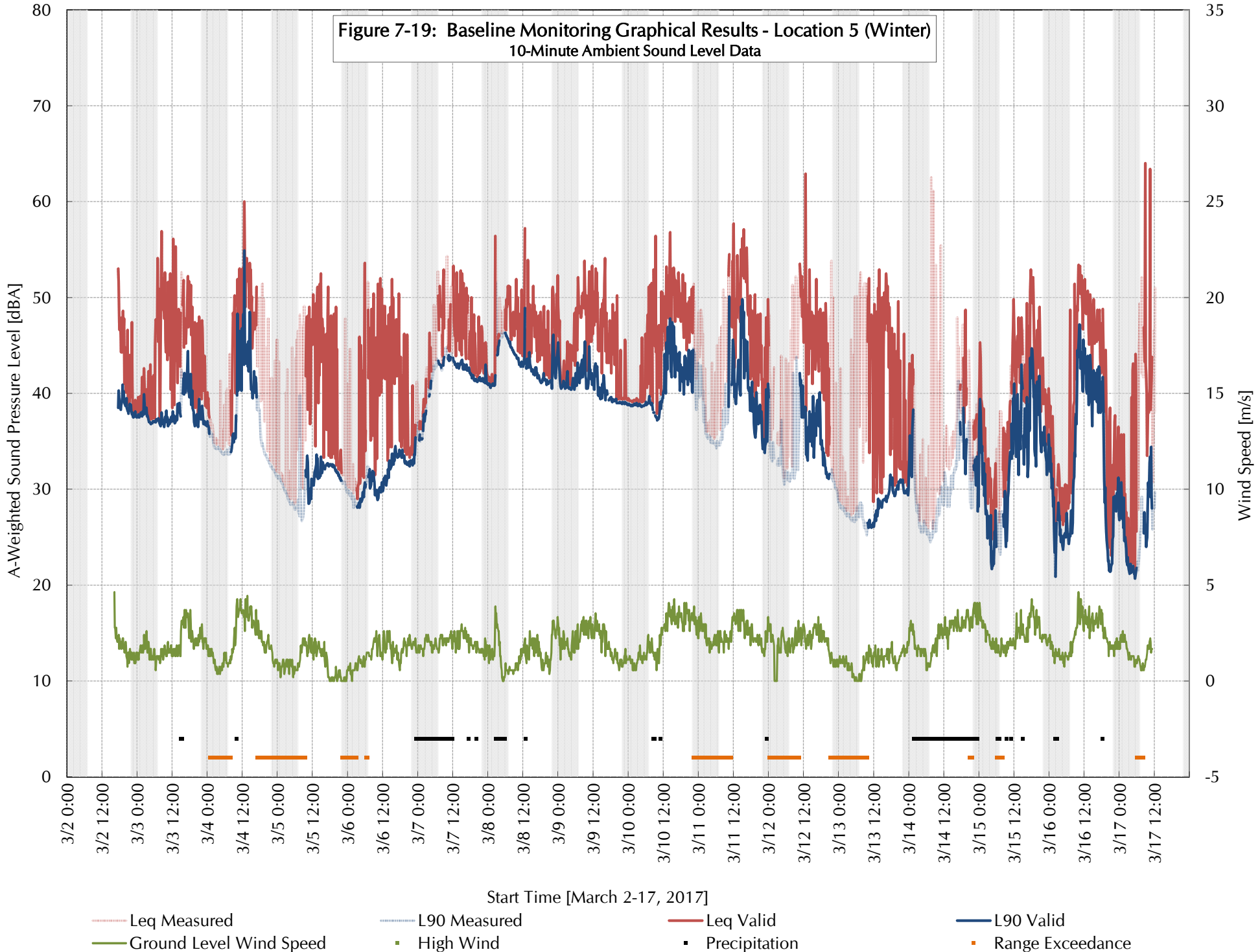


Figure 7-19: Baseline Monitoring Graphical Results - Location 5 (Winter)
 10-Minute Ambient Sound Level Data



⋯ Leq Measured	⋯ L90 Measured	— Leq Valid	— L90 Valid
— Ground Level Wind Speed	■ High Wind	— Precipitation	■ Range Exceedance

Figure 7-20: Baseline Monitoring Graphical Results - Location 5 (Summer)
10-Minute Ambient Sound Level Data

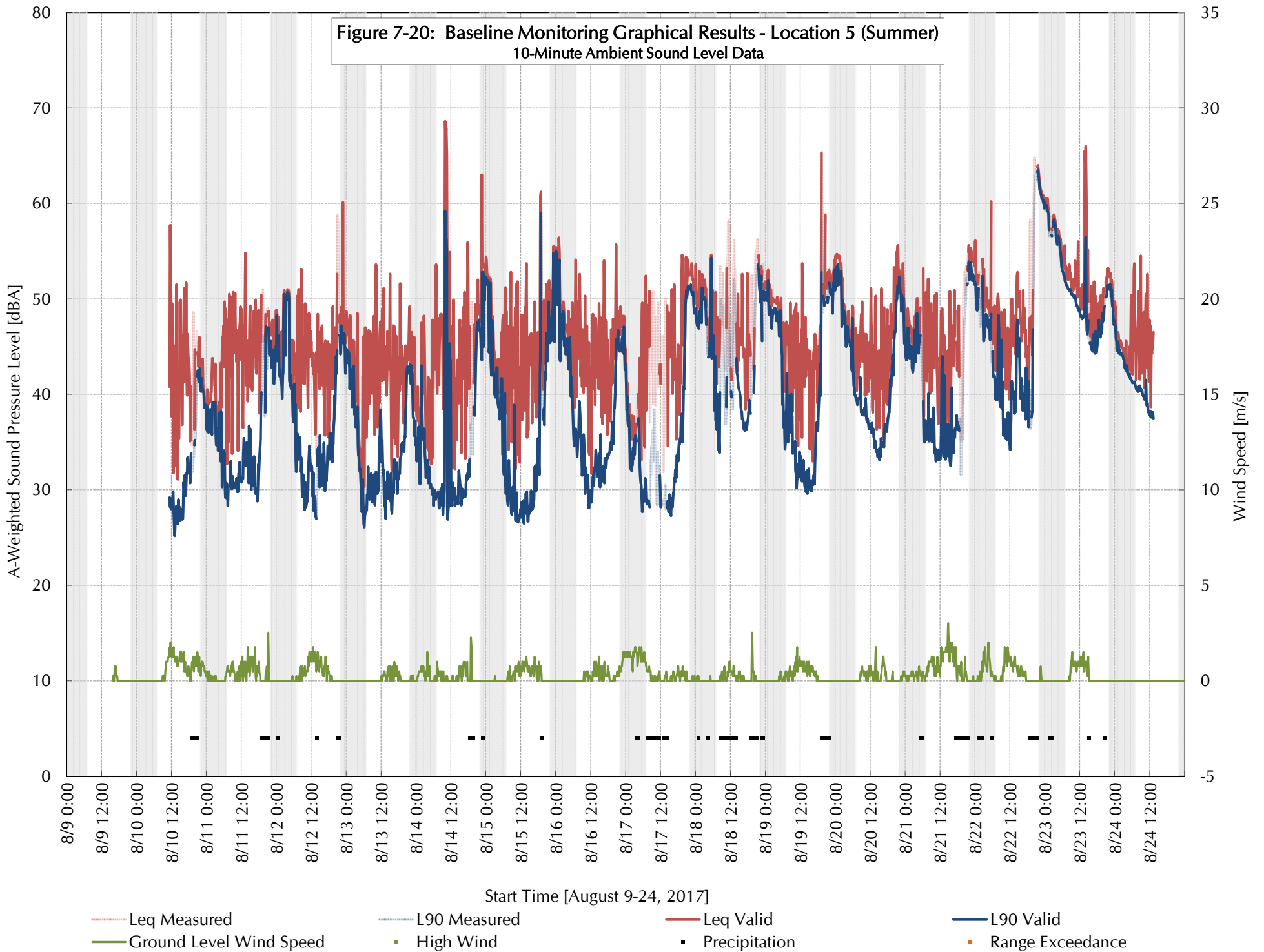
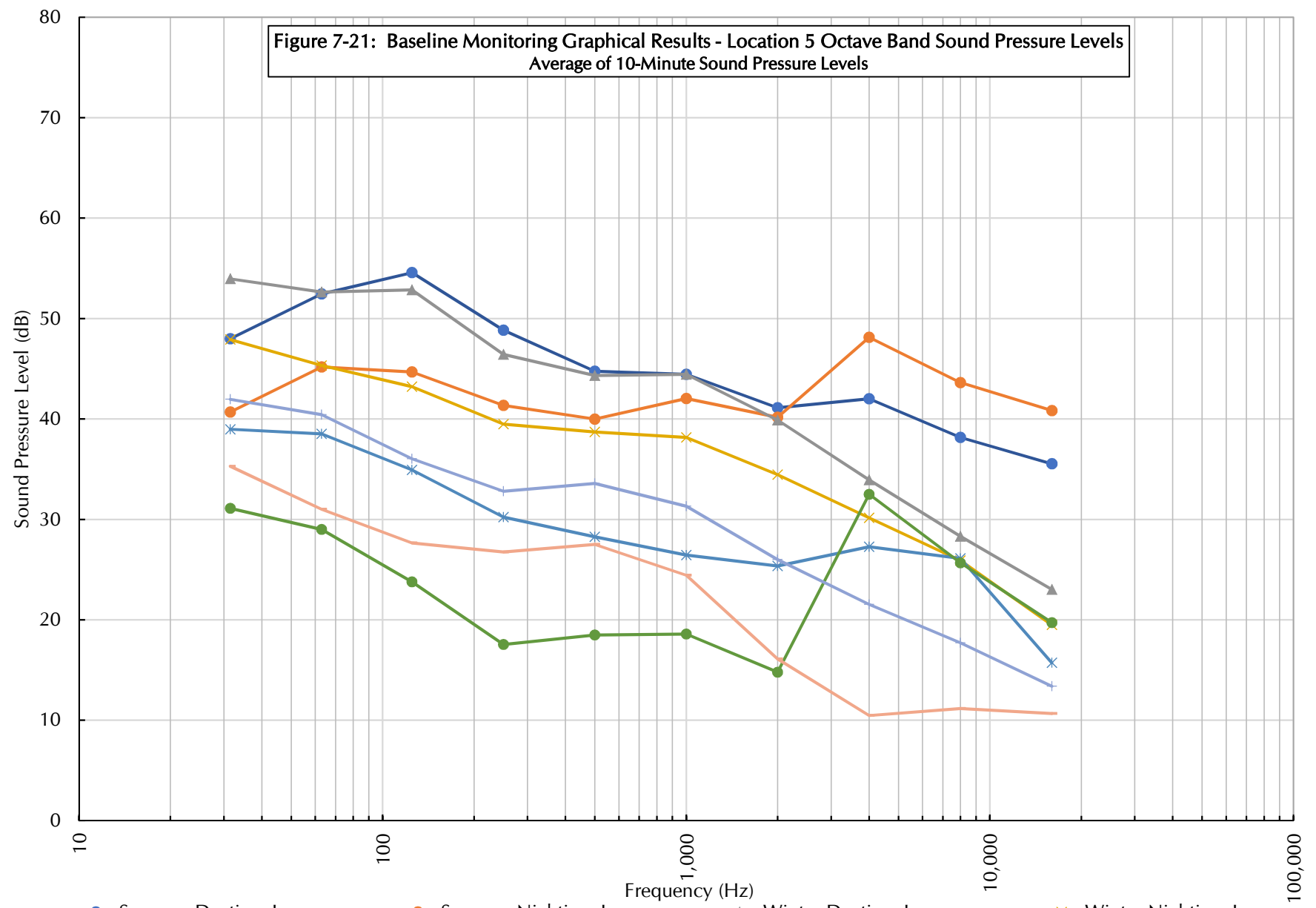


Figure 7-21: Baseline Monitoring Graphical Results - Location 5 Octave Band Sound Pressure Levels
Average of 10-Minute Sound Pressure Levels



- Summer Daytime Leq
- Summer Nighttime Leq
- ▲ Winter Daytime Leq
- ✕ Winter Nighttime Leq
- ✕ Summer Daytime L90
- Summer Nighttime L90
- ▲ Winter Daytime L90
- ✕ Winter Nighttime L90

Figure 7-22: Baseline Monitoring Graphical Results - Location 5-Third Octave Band Sound Pressure Levels
Average of 10-Minute Sound Pressure Levels

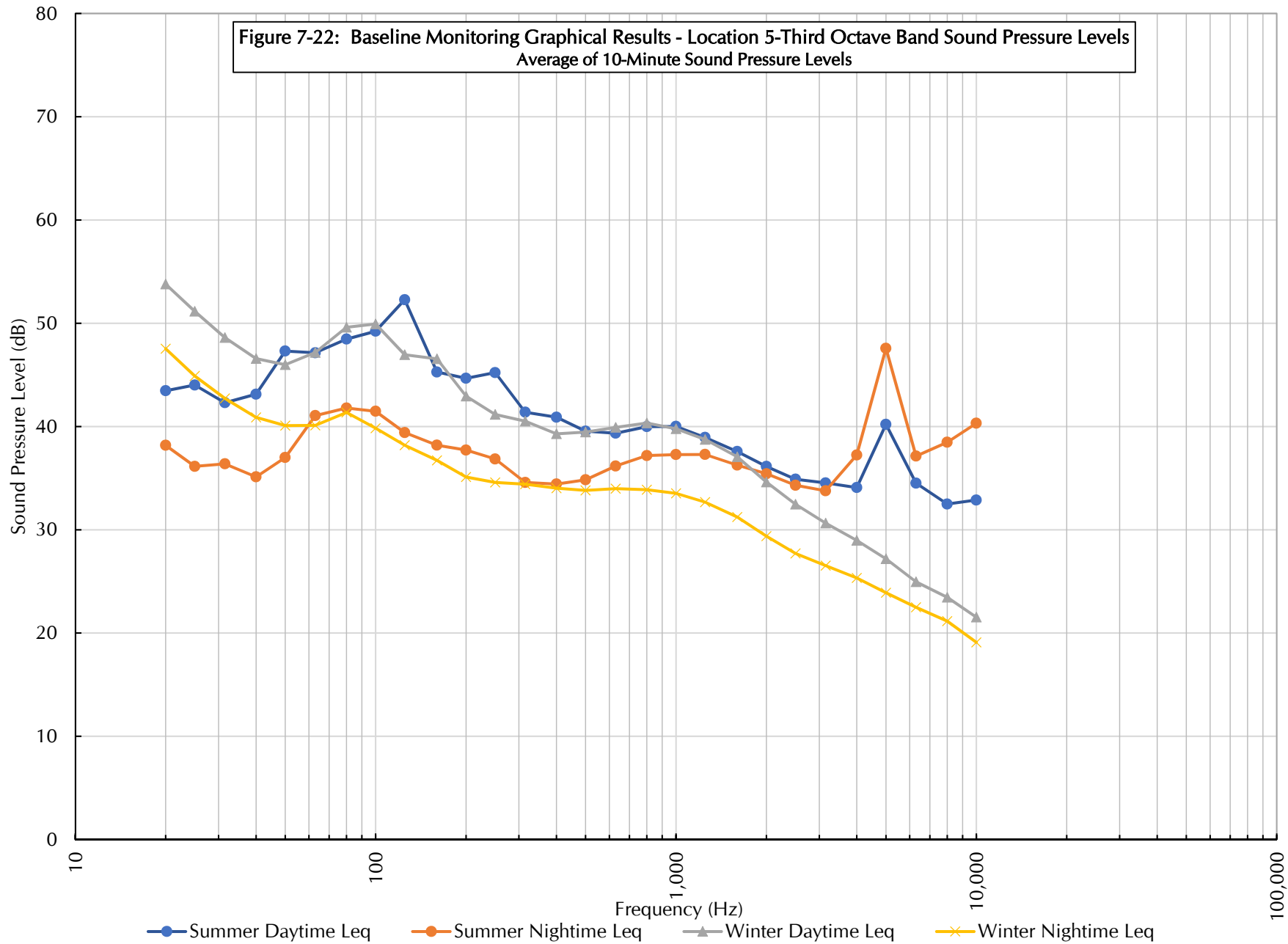


Figure 7-23: Baseline Monitoring Graphical Results - Location 6 (Winter)
 10-Minute Ambient Sound Level Data

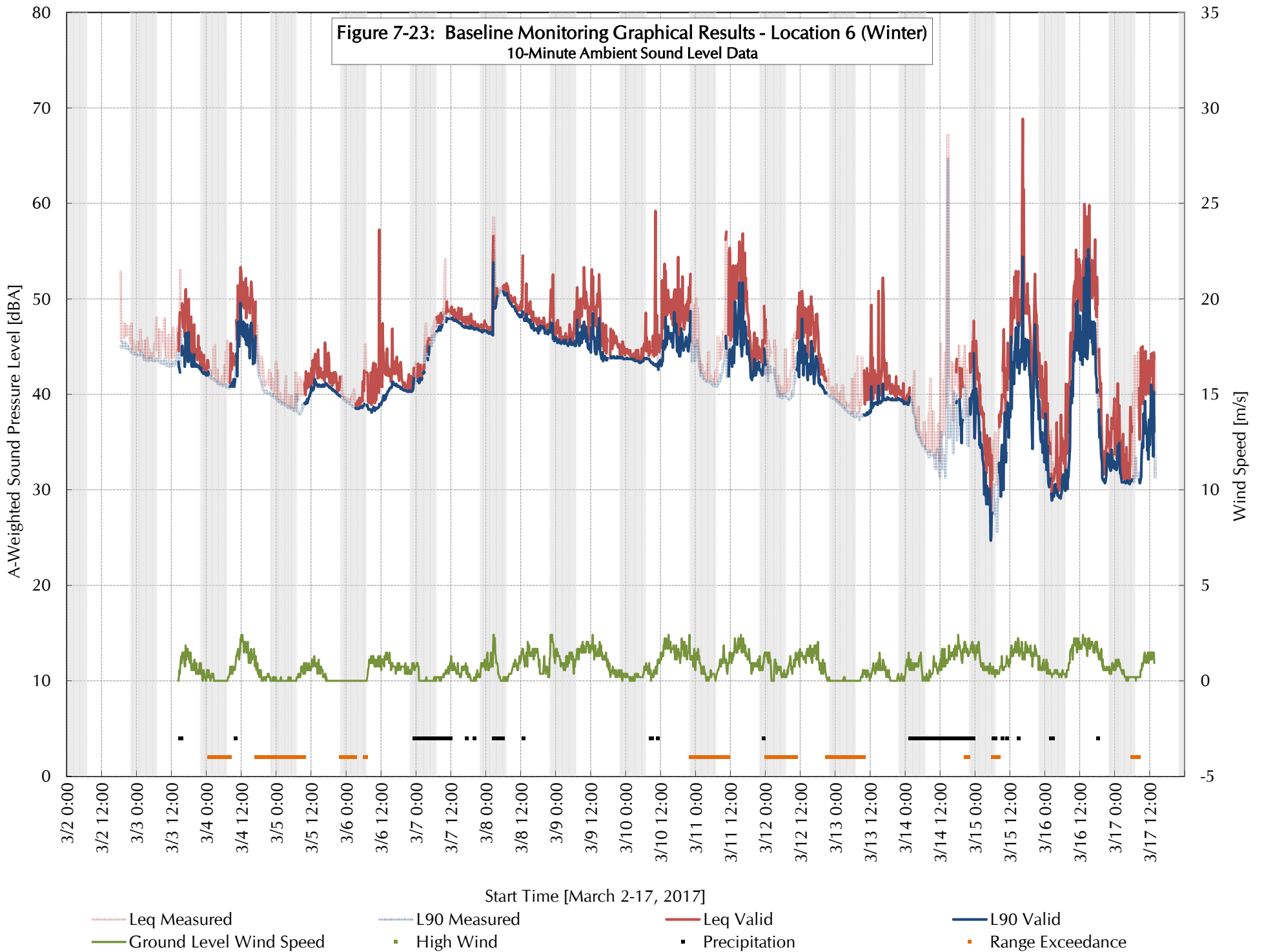
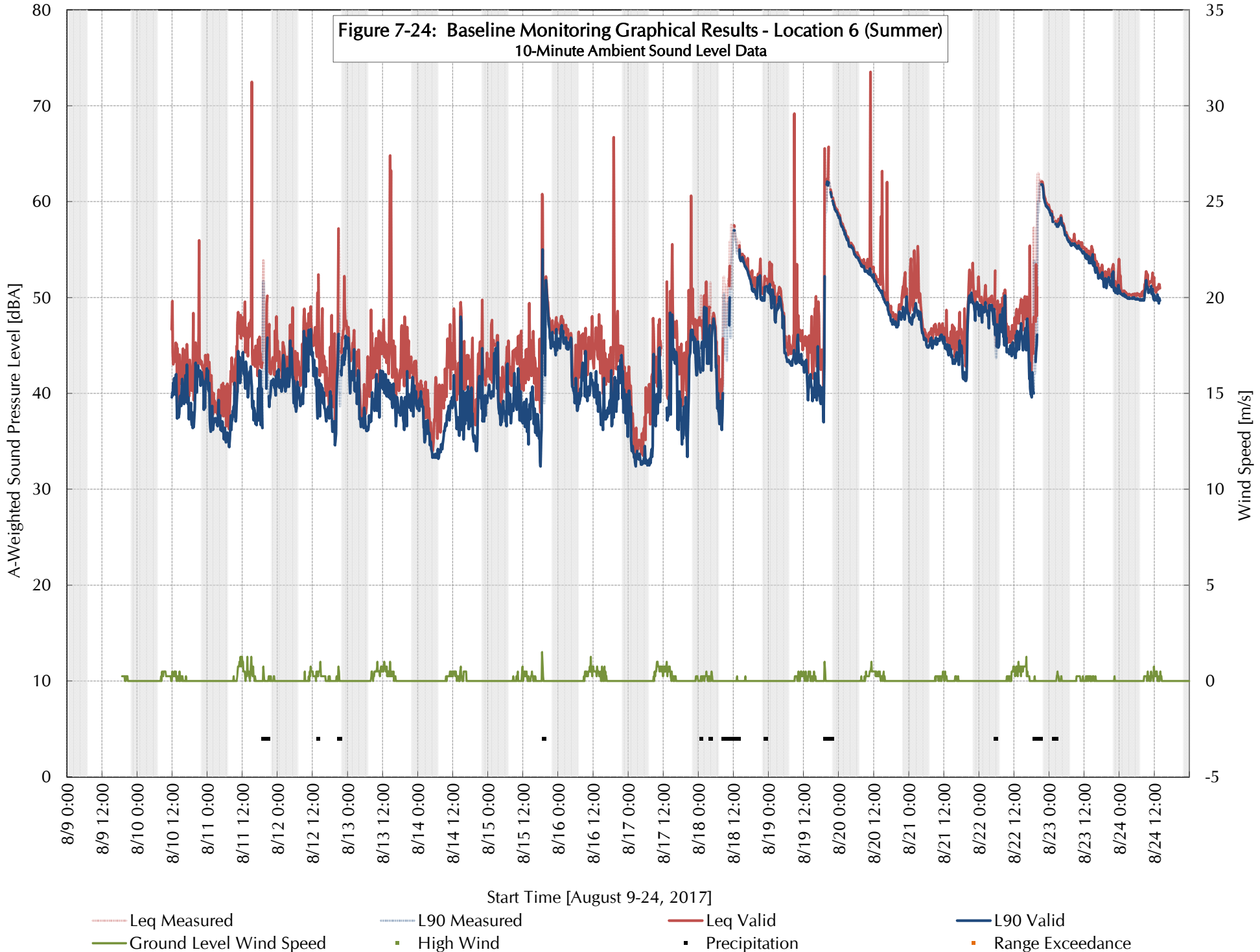
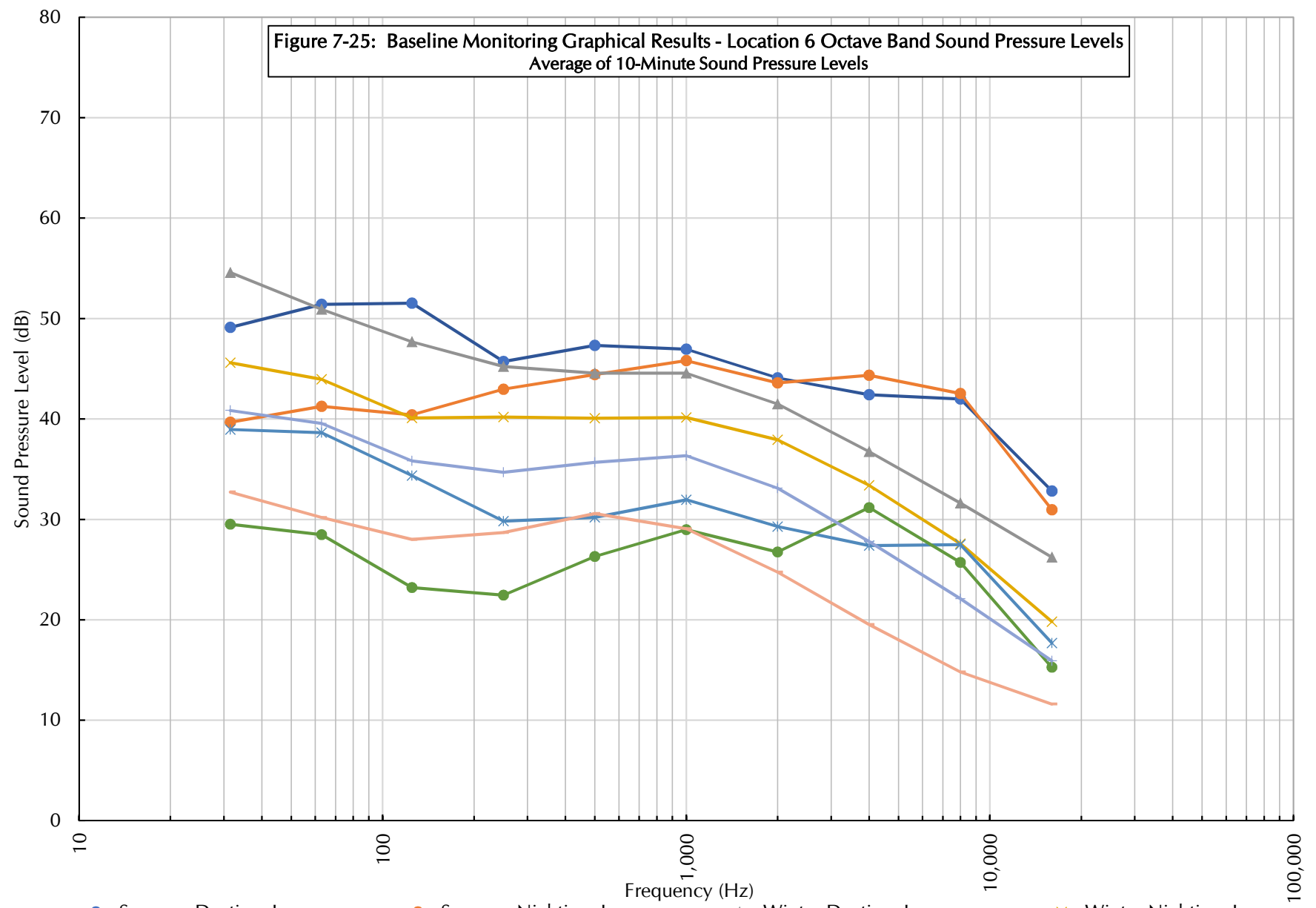


Figure 7-24: Baseline Monitoring Graphical Results - Location 6 (Summer)
 10-Minute Ambient Sound Level Data



----- Leq Measured ----- L90 Measured ——— Leq Valid ——— L90 Valid
——— Ground Level Wind Speed ■ High Wind ■ Precipitation ■ Range Exceedance

Figure 7-25: Baseline Monitoring Graphical Results - Location 6 Octave Band Sound Pressure Levels
Average of 10-Minute Sound Pressure Levels



- Summer Daytime Leq
- Summer Nighttime Leq
- ▲ Winter Daytime Leq
- ✕ Winter Nighttime Leq
- ✕ Summer Daytime L90
- Summer Nighttime L90
- + Winter Daytime L90
- Winter Nighttime L90

Figure 7-26: Baseline Monitoring Graphical Results - Location 6-Third Octave Band Sound Pressure Levels
Average of 10-Minute Sound Pressure Levels

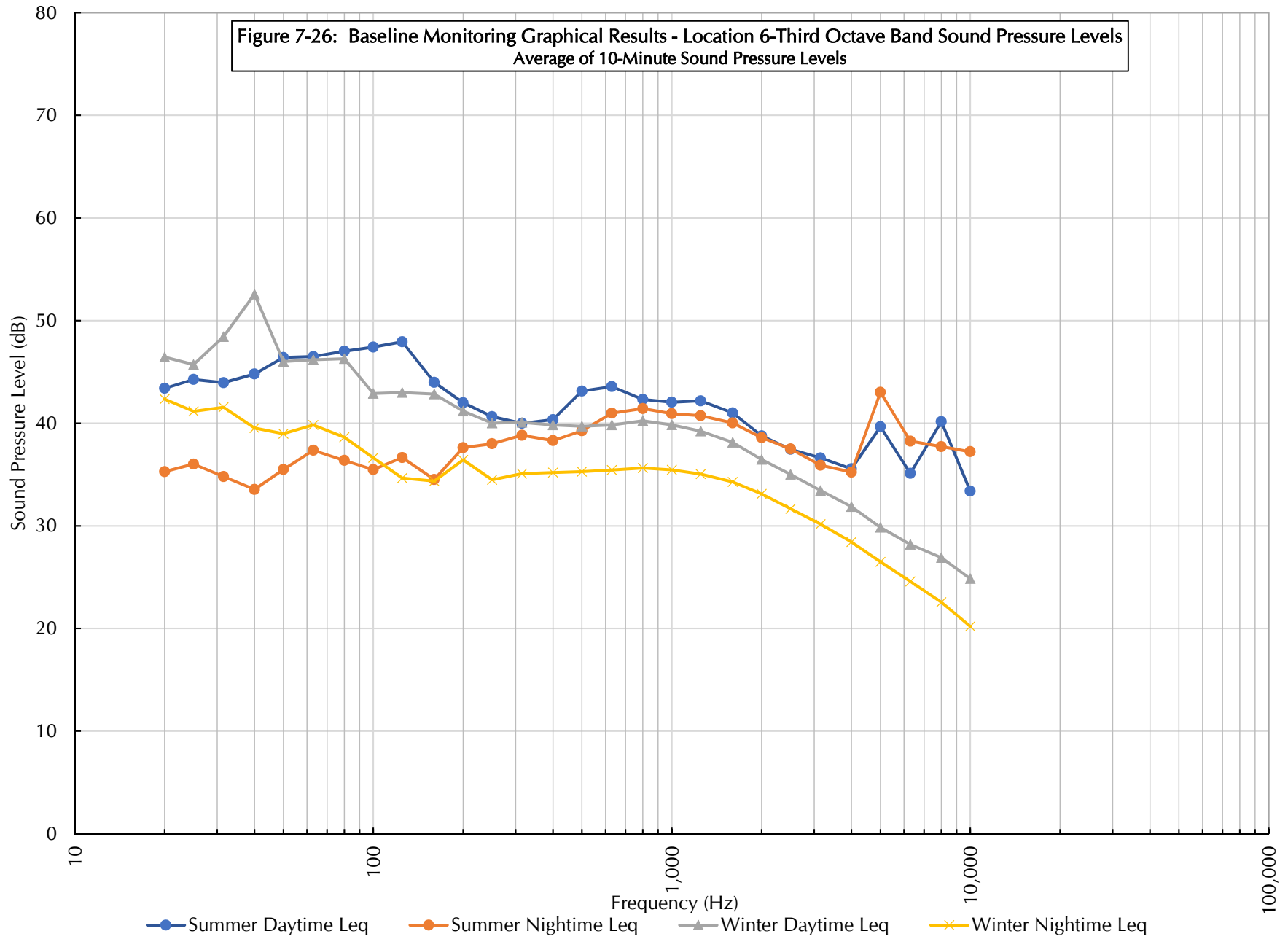


Figure 7-27: Baseline Monitoring Graphical Results - Location 7 (Winter)
 10-Minute Ambient Sound Level Data

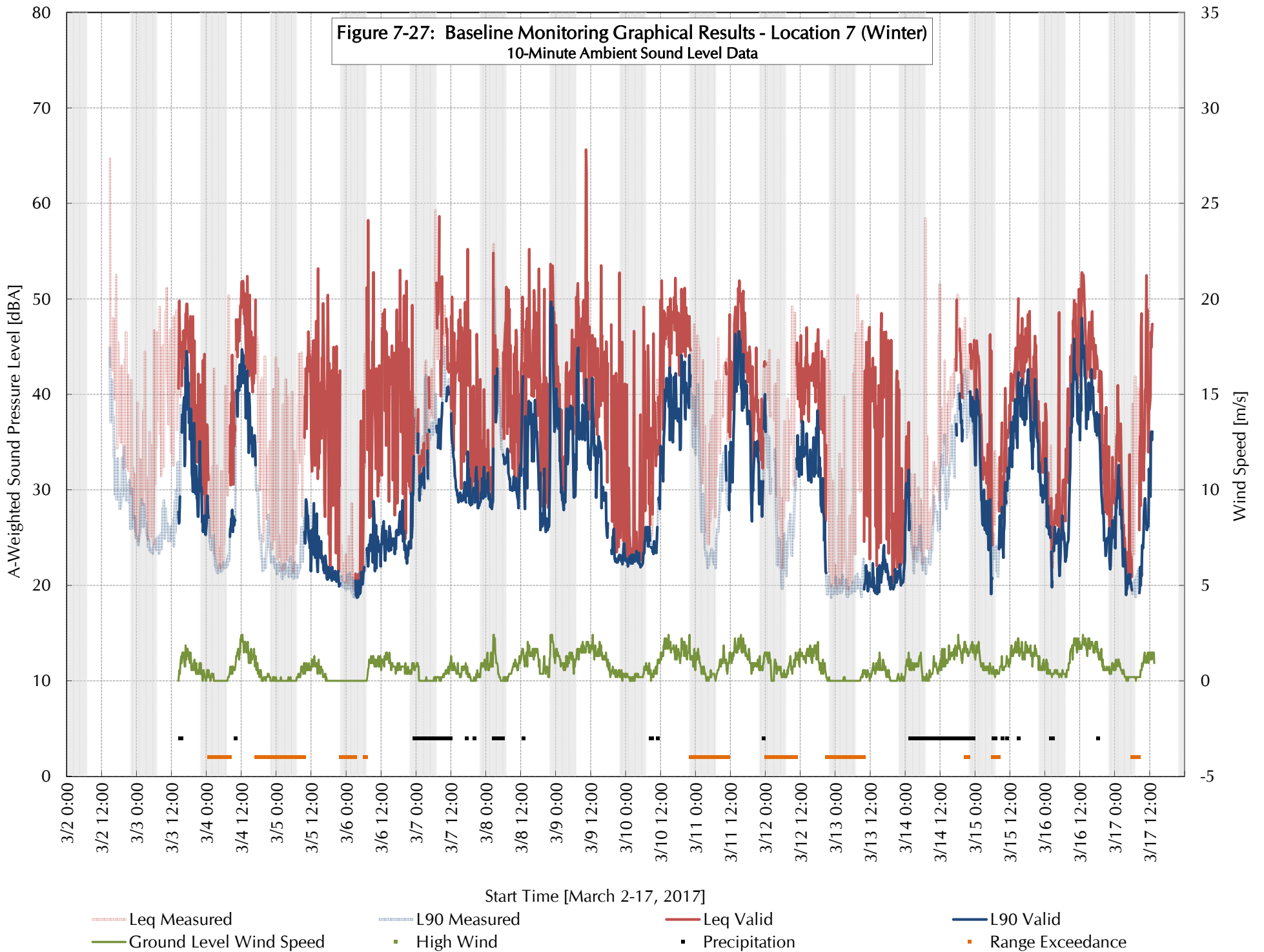
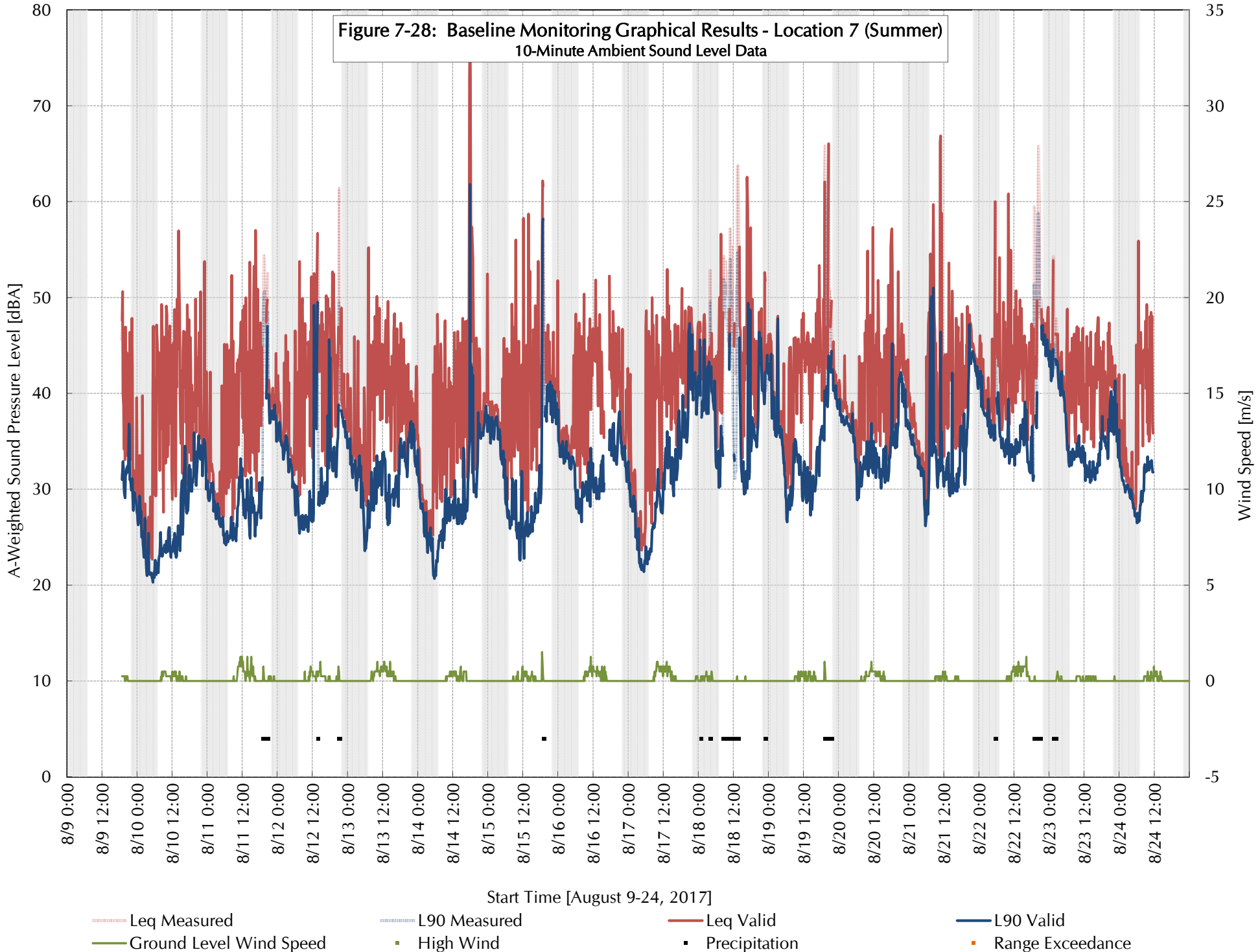


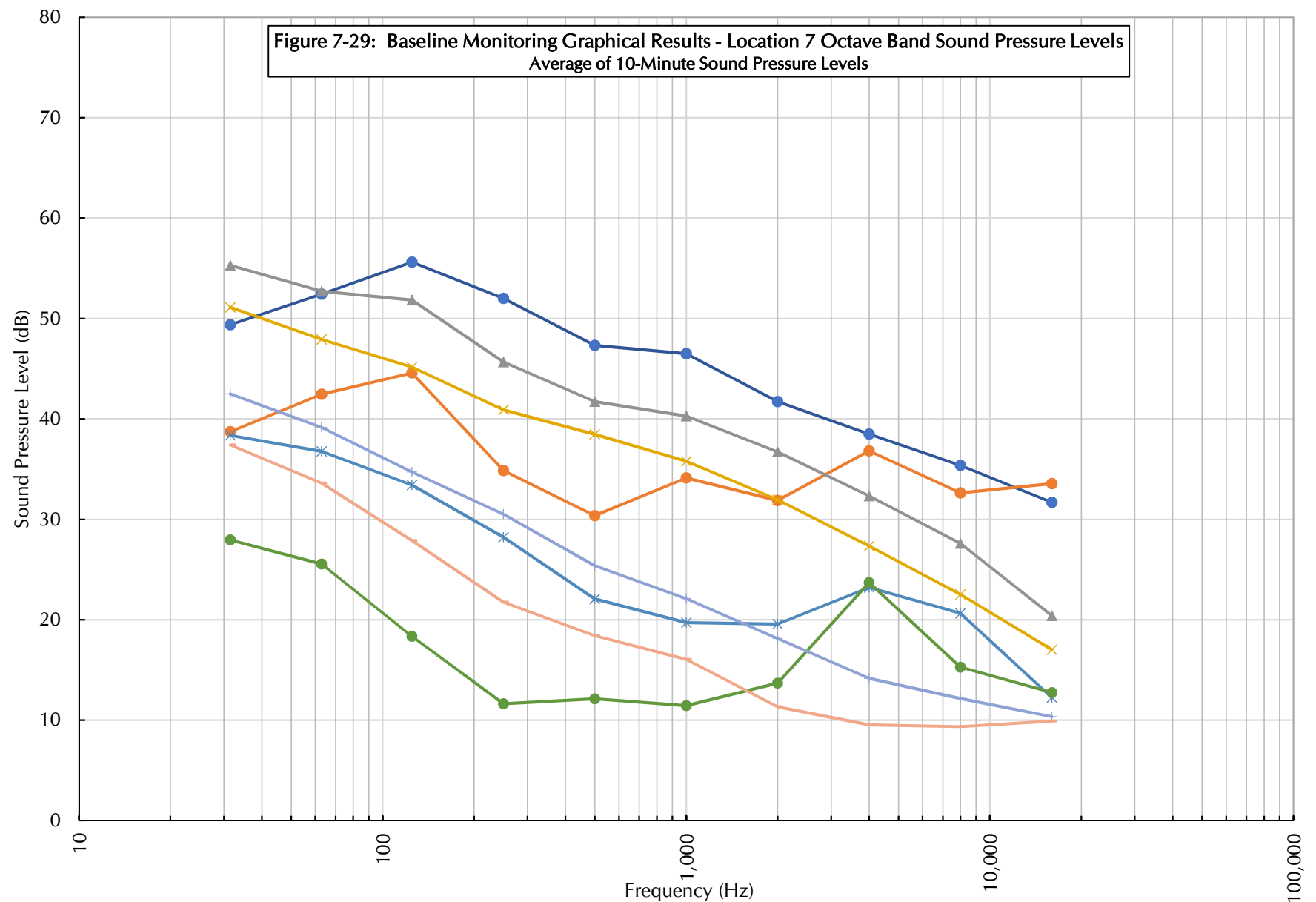
Figure 7-28: Baseline Monitoring Graphical Results - Location 7 (Summer)
 10-Minute Ambient Sound Level Data



Start Time [August 9-24, 2017]

- Leq Measured
- L90 Measured
- Leq Valid
- L90 Valid
- Ground Level Wind Speed
- High Wind
- Precipitation
- Range Exceedance

Figure 7-29: Baseline Monitoring Graphical Results - Location 7 Octave Band Sound Pressure Levels
Average of 10-Minute Sound Pressure Levels



- Summer Daytime Leq
- Summer Nighttime Leq
- ▲ Winter Daytime Leq
- ✕ Winter Nighttime Leq
- ✕ Summer Daytime L90
- Summer Nighttime L90
- ✕ Winter Daytime L90
- Winter Nighttime L90