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Title: Aesthetic resources study, Study plan Section 12.6, 2014 Study Implementation Report	**SuWa 289**
Author(s) – Personal:	
Author(s) – Corporate: AECOM	
AEA-identified category, if specified: November 2015; Study Completion and 2014/2015 Implementation Reports	
AEA-identified series, if specified:	
Series (ARLIS-assigned report number): Susitna-Watana Hydroelectric Project document number 289	**Existing numbers on document:**
Published by: [Anchorage : Alaska Energy Authority, 2015]	**Date published:** *Main report:* October 2015 *Attachment 1:* September 2015
Published for: Alaska Energy Authority	**Date or date range of report:**
Volume and/or Part numbers: Study plan Section 12.6	**Final or Draft status, as indicated:**
Document type:	**Pagination:** 147 pages in various pagings
Related works(s):	**Pages added/changed by ARLIS:**

Notes:

Contents:

- Main report
- Attachment 1. Soundscape technical memorandum

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SUSITNA-WATANA HYDRO

Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Aesthetic Resources Study
Study Plan Section 12.6

2014 Study Implementation Report

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

Prepared by

AECOM

October 2015

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LIST OF ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

Abbreviation	Definition
AEA	Alaska Energy Authority
CFR	Code of Federal Regulations
DEM	Digital Elevation Model
FERC	Federal Energy Regulatory Commission
GIS	Geographic Information System
ILP	Integrated Licensing Process
ISR	Initial Study Report
PRM	Project River Mile
RSP	Revised Study Plan
SPD	Study Plan Determination

1. INTRODUCTION

This Aesthetic Resources Study, Section 12.6 of the Revised Study Plan (RSP) approved by the Federal Energy Regulatory Commission (FERC) for the Susitna-Watana Hydroelectric Project, FERC Project No. 14241, focuses on inventorying and documenting baseline aesthetic conditions within the Aesthetic Resources Study Area and evaluating the potential effects to aesthetic resources that may result from construction and operation of the proposed Project.

A summary of the development of this study, together with the Alaska Energy Authority's (AEA) implementation of it through the 2013 study season, appears in Part A, Section 1 of the Initial Study Report (ISR) filed with FERC in June 2014. As required under FERC's regulations for the Integrated Licensing Process (ILP), the ISR describes AEA's "overall progress in implementing the study plan and schedule and the data collected, including an explanation of any variance from the study plan and schedule." (18 CFR 5.15(c)(1)).

Since filing the ISR in June 2014, AEA has continued to implement the FERC-approved plan for the Aesthetic Resource Study. Progress included:

- On October 23, 2014, AEA held an ISR meeting for the Aesthetic Resources Study.
- As described in detail below, AEA completed the assessment of baseline soundscape for the Study Area.

In furtherance of the next round of ISR meetings and FERC's Study Plan Determination (SPD) expected in 2016, this report describes AEA's overall progress in implementing the Aesthetic Resources Study during calendar year 2014. Rather than a comprehensive reporting of all field work, data collection, and data analysis since the beginning of AEA's study program, this report is intended to supplement and update the information presented in the ISR for the Aesthetic Resources Study through the end of calendar year 2014. It describes the methods and results of the 2014 effort, and includes a discussion of the results achieved.

2. STUDY OBJECTIVES

The study objectives are established in RSP Section 12.6.1. The goals and objectives for the Aesthetic Resources Study are to inventory and document baseline aesthetic (e.g., visual, auditory) conditions within the Aesthetic Resources Study area and evaluate the potential effects to aesthetic resources that may result from construction and operation of the proposed Project. The analysis will focus on assessing these potential impacts and will help identify potential design and other mitigation options.

3. STUDY AREA

Figure 3-1 shows the Aesthetic Resources Study area as established by RSP Section 12.6.3. The study area was designed to be sufficient in size to address likely established indicators of change, including potential direct and indirect effects to recreation, cultural resources, subsistence, socioeconomics, geomorphology/ice processes, and riparian vegetation.

The Aesthetic Resources Study area was divided into primary and secondary study areas. The primary study area is a 30-mile radius surrounding all Project components, including: the proposed dam and camp facilities including construction sites; the reservoir, transmission corridors, access road corridors, borrow sites, and rail sidings. The primary study area was defined in Q1 2013 using viewshed models generated from the most current Project design information at a resolution of a 10m Digital Elevation Model (DEM). At present, the analysis is focused on the following broadly defined viewer areas:

- The Susitna River corridor, downstream of Devils Canyon to Talkeetna
- The Susitna River corridor, from Devils Canyon to the proposed dam site
- The Susitna River, upstream of the proposed dam site to the upriver extent of the inundation zone
- Upland areas adjacent to the Susitna River, with emphasis on those areas within the viewshed of the inundation zone, proposed access roads, and proposed transmission corridors
- Common air transportation routes used for transportation and recreational air tours

The secondary study area for this study includes all lands located between the Denali Highway, south to the Glenn Highway and from the Richardson Highway, east to the mouth of the Susitna River. This area will be evaluated using existing information to understand the distribution of aesthetic resources within a larger geographic context.

The Study Plan noted that the aesthetics resource study area could be adjusted during the next study year to include areas within the river corridor located downriver of Talkeetna, if 2013 studies in the lower reach indicate a possible Project-related effect on aesthetic resources in this area.

As described in Part C, Section 7.1.2 of the ISR filed with FERC in June 2014, AEA added the Denali East Option road and transmission corridor to the study area. Consequently, the study area was changed from that described in the RSP (Section 12.6.3). The modified study area showing the Denali East Option is depicted on Figure 7.1-1 and Figure 7.1-2. Figure 7.1-1 illustrates the project viewshed (primary study area), with the viewshed for the Denali East Option overlaid.

4. METHODS AND VARIANCES IN 2014

The following section provides a brief summary of the tasks performed, the methods utilized, and any variances from the methods described in the Study Plan (Section 12.6.3 of RSP 12.6).

4.1. Viewshed Modeling

The methods to prepare viewshed models were previously discussed in the ISR Section 12.6.3 filed in June, 2014.

4.1.1. Variances

No additional work was performed in 2014, and thus there were no variances to the methods described in Section 12.6.3 of the RSP 12.6 for 2013 and 2014.

4.2. Identification of Analysis Locations

The methods to identify analysis locations were previously discussed in the ISR Section 12.6.3 filed in June, 2014.

4.2.1. Variances

No additional work was performed in 2014, and thus there were no variances to the methods described in Section 12.6.3 of the RSP 12.6 for 2013 and 2014.

4.3. Baseline Data Collection

The methods used for baseline data collection were previously discussed in the ISR Section 12.6.3 filed in June, 2014.

4.3.1. Variances

No additional work was performed in 2014, and thus there were no variances to the methods described in Section 12.6.3 of the RSP 12.6 for 2013 and 2014.

4.4. Photosimulations

The methods used for photosimulations were previously discussed in the ISR Section 12.6.3 filed in June, 2014.

4.4.1. Variances

No additional work was performed in 2014, and thus there were no variances to the methods described in Section 12.6.3 of the RSP 12.6 for 2013 and 2014.

4.5. Soundscape Analysis

The methods used for the soundscape analysis were previously discussed in the ISR Section 12.6.3 filed in June, 2014.

4.5.1. Variances

No variances to the methods described in Section 12.5.4 of the RSP 12.5 for 2013 and 2014 occurred for work completed on the soundscape analysis during 2014.

4.6. GIS Maps and Figures

The methods used for geographic information system (GIS) maps and figures were previously discussed in the ISR Section 12.6.3 filed in June, 2014.

4.6.1. Variances

No additional work was performed in 2014, and thus there were no variances to the methods described in Section 12.6.3 of the RSP 12.6 for 2013 and 2014.

4.7. Assessment of Downriver Study Area

The methods used for the assessment of the downriver study area were previously discussed in the ISR Section 12.6.3 filed in June, 2014.

4.7.1. Variances

No additional work was performed in 2014, and thus there were no variances to the methods described in Section 12.6.3 of the RSP 12.6 for 2013 and 2014.

5. RESULTS

This section summarizes the aesthetic resources data from the 2013 and 2014 study season collected pursuant to Section 12.6.3 of the RSP.

5.1. Aesthetics

The results of the aesthetic resources study have been previously report in June 2014 in ISR 12.6.

5.1.1. Viewshed Modeling

No additional work was performed in 2014 for viewshed modelling.

5.1.2. Comprehensive Plan Review

No additional work was performed in 2014 for the comprehensive plan review.

5.1.3. Landscape Character Types

No additional work was performed in 2014 for the landscape character types.

5.1.4. Field Investigation

No additional filed investigations were performed in 2014.

5.1.5. Selection of Analysis Locations

No additional work was performed in 2014 for the selection of analysis locations. ISR 12.6 of June 2014 presents aesthetic resource data collected from within the Aesthetic Resources Study Area.

5.1.6. Summary of Analysis Locations

No additional work was performed in 2014 for the summary of analysis locations. ISR 12.6 summarizes analysis locations within the Aesthetic Resources Study Area.

5.1.7. Baseline Data Collection

No additional baseline data was collected in 2014. ISR 12.6 of June 2014 presents aesthetic resource data collected from within the Aesthetic Resources Study Area.

5.1.8. Photosimulations

No additional work was performed for photosimulations in 2014.

5.2. Soundscape

5.2.1. Review Documentation and Develop Data Needs

No additional document review and data needs development was completed in 2014.

5.2.2. Seasonal Surveys of Ambient Sound Levels

No additional seasonal surveys of ambient sounds levels were completed in 2014. The results of the 2013 studies were analyzed; a summary is provided in Attachment 1.

5.2.3. Modeling of Project Sound Levels

No modelling of project sounds levels was completed in 2014.

5.3. Assessment of Downriver Study Area

No assessment of the downriver study areas was completed in 2014.

6. DISCUSSION

6.1. Aesthetic Resources

A discussion of the aesthetic resources study is presented in the June 2014 ISR 12.6 reports. As reported in Part C of the June 2014 ISR the following tasks still remain to be completed in the Aesthetic Resources Study:

- Develop viewshed models for pre- and post-Project conditions of the inundation zone of the Susitna River to depict expected changes in viewshed areas (RSP Section 12.6.4).
- Baseline data collection of basic landscape components (RSP Section 12.6.4).
- Produce photosimulations to illustrate the expected visibility of Project components (RSP Section 12.6.4).

6.2. Soundscape

A discussion of the soundscape study is presented in Attachment 1. All components of the soundscape analysis task have been completed.

7. CONCLUSION

From 2013 to 2014, AEA completed the baseline soundscape assessment, including review, compilation and interpretation of baseline sound data collected during the 2013 field season. This work on the Aesthetics Resources Study successfully meets the study objectives in the FERC-approved Study Plan. The results of this Aesthetics Resources Study component are reported herein and in the June 2014 ISR.

Implementation of the Aesthetic Resources Study is planned, with no modification of the methods in the FERC-approved Study Plan. This study is interrelated with the Recreation Resources Study (Study 12.5) and Recreation River Flow and Access Study (Study 12.7). AEA expects the approved Study Plan objectives for both this study and Studies 12.5 and 12.7 will be achieved, as AEA proposes no modifications to the methods of this study. The results of this study will be reported in the USR.

7.1. Decision Points from Study Plan

In 2013 AEA collected information on river recreation use and experience and coordinated with the study teams for the Instream Flow Study (Study 8.5), Ice Processes in the Susitna River Study (Study 7.6), Geomorphology Study (Study 6.5), River Recreation and Flow Study (Study 12.7), and Aesthetics Resources Study (Study 12.6). The first year results from these studies indicate that Project operations will only slightly influence river flows and river morphology, such that projected changes will be within the range of normal variation downstream of the Parks Highway Bridge (PRM 88.9) under existing, baseline conditions, and therefore will not adversely affect aesthetic conditions in the lower river. These data, which are summarized in

Section 7.1.1. of Part C of the June 2014 ISR, support AEA's decision not to extend the aesthetics studies below the George Parks Highway Bridge.

8. FIGURES

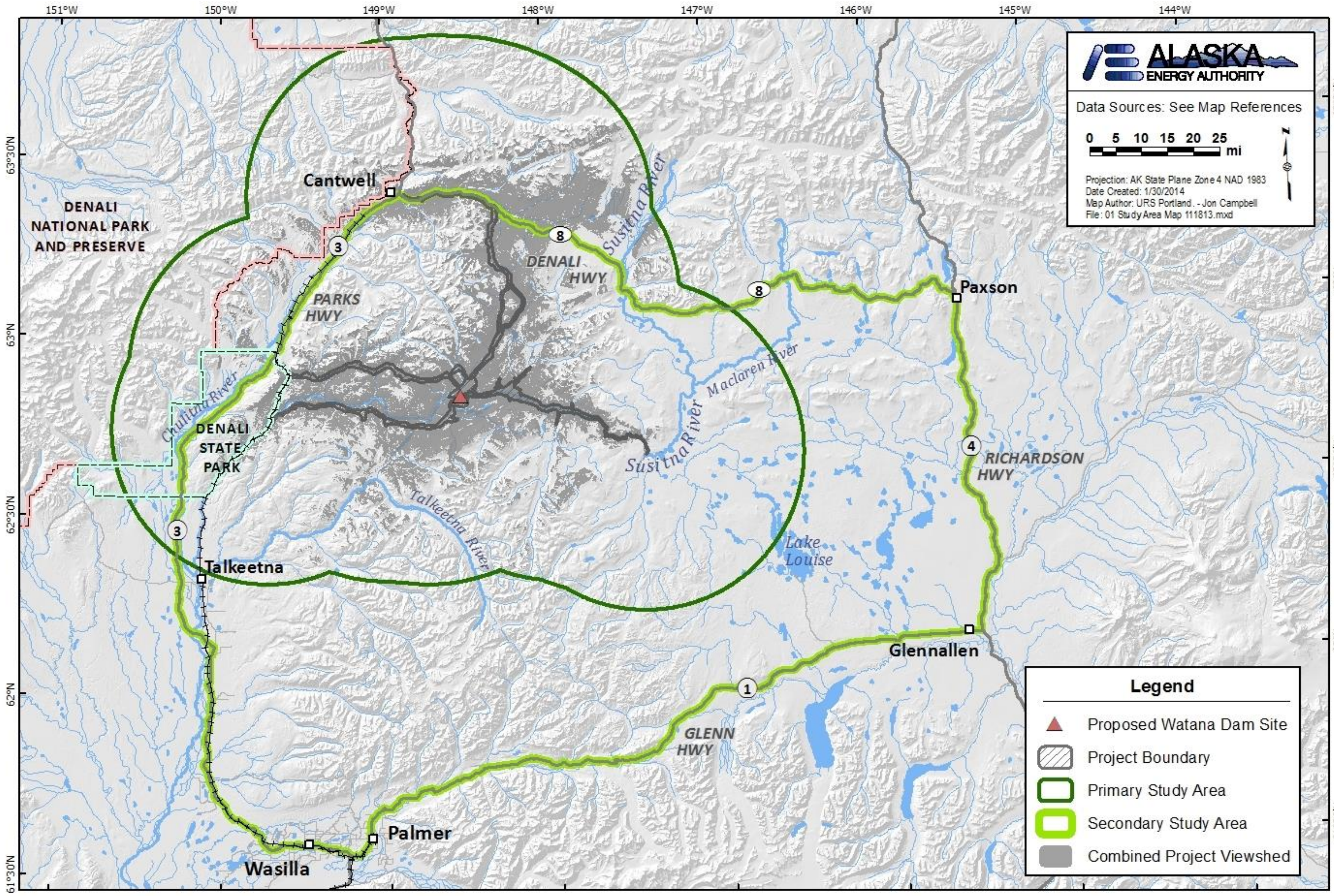

Figure 3-1. Aesthetics Resource Study Area

ATTACHMENT 1 – SOUNDSCAPE TECHNICAL MEMORANDUM

Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Aesthetics Resources Study
Study Plan Section 12.6

Soundscape Technical Memorandum

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

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Prepared by

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September 2015

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LIST OF ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

Abbreviation	Definition
%TA	Percent-Time Audible
AEA	Alaska Energy Authority
ASAG	Acoustic Sampling and Analysis Guide
CFR	Code of Federal Regulations
DAR	Digital Audio Recorder
dBA	A-Weighted Decibel
DNP	Denali National Park
EPA	U.S. Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
GPS	Global Positioning System
Hz	Hertz
ISO	International Organization of Standardization
L_{10}	Sound Level Exceeded 10 Percent of the Time
L_{50}	Median Sound Level
L_{90}	Background Sound Level
L_{dn}	Day-Night Sound Level
L_{eq}	Equivalent Sound Level
L_p or SPL	Sound Pressure Level
LD	Larson-Davis
LT	Long-Term (≥ 24-Hour Period)
NIST	National Institute of Standards and Technology
NPS	U.S. National Park Service

Abbreviation	Definition
NVLAP	National Voluntary Laboratory Accreditation Program
RSP	Revised Study Plan
SPD	Study Plan Determination
SPL or L_p	Sound Pressure Level
SLM	Sound Level Meter
ST	Short-Term (< 24-Hour Period)
USC	United States Code

1. INTRODUCTION

On December 14, 2012, Alaska Energy Authority (AEA) filed with the Federal Energy Regulatory Commission (FERC or Commission) its Revised Study Plan (RSP) for the Susitna-Watana Hydroelectric No. 14241 (Project), which included 58 individual study plans (AEA 2012). Included within the RSP was the Aesthetic Resources Study, Section 12.6. RSP Section 12.6 focuses on inventorying and documenting baseline aesthetic conditions within the Aesthetic Resources Study Area and evaluating the potential effects to aesthetic resources that may result from construction and operation of the proposed Project. RSP Section 12.6 provided provides goals, objectives, and proposed methods for aesthetic resources data collection and analysis.

On February 1, 2013, FERC staff issued its study plan determination (February 1 SPD) for 44 of the 58 studies, approving 31 studies as filed and 13 with modifications. RSP Section 12.6 was one of the 13 approved with modifications. In its February 1 SPD, FERC recommended the following:

> *We recommend that AEA modify the Aesthetic Resources Study Plan as follows:*
>
> - *Conduct surveys of ambient sound levels in all four seasons.*
> - *Include in the initial study report any proposed modifications to the study plan based on the first year's data on the lower river uses, hydrology, and ice processes.*

This 2014 End of Year Report on Aesthetic Resources Study has been prepared in accordance with FERC's Integrated Licensing Process regulations and details AEA's status in implementing the study, as set forth in the FERC-approved RSP and as modified by FERC's February 1 SPD (referred to herein as the "Study Plan").

2. STUDY OBJECTIVES

The study objectives are established in RSP Section 12.6.1. The goals and objectives for the Aesthetic Resources Study are to inventory and document baseline aesthetic (e.g., visual, auditory) conditions within the Aesthetic Resources Study Area and evaluate the potential effects to aesthetic resources that may result from construction and operation of the proposed Project. The analysis will focus on assessing these potential impacts and will help identify potential design and other mitigation options.

3. STUDY AREA

Figure 3-1 shows the Aesthetic Resources Study Area as established by RSP Section 12.6.3. The Study Area was designed to be sufficient in size to address likely established indicators of change, including potential direct and indirect effects to recreation, cultural resources, subsistence, socioeconomics, geomorphology/ice processes, and riparian vegetation.

The Aesthetic Resources Study Area was divided into primary and secondary study areas. The primary Study Area is a 30-mile radius surrounding all Project components, including the proposed dam and camp facilities, including construction sites; the reservoir; transmission corridors; access road corridors; borrow sites; and rail sidings. The primary Study Area was defined in Q1 2013 using viewshed models generated from the most current Project design information at a resolution of a 10-meter Digital Elevation Map. At present, the analysis is focused on the following broadly defined viewer areas:

- The Susitna River corridor, downstream of Devils Canyon to Talkeetna
- The Susitna River corridor, from Devils Canyon to the proposed dam site
- The Susitna River, upstream of the proposed dam site to the upriver extent of the inundation zone
- Upland areas adjacent to the Susitna River, with emphasis on those areas within the viewshed of the inundation zone, proposed access roads, and proposed transmission corridors
- Common air transportation routes used for transportation and recreational air tours

As explained in Part C of the ISR, Section 1.4, when the ISR was filed AEA explained that it had decided to pursue the study of an additional alternative north-south corridor alignment for transmission and access from the dam site to the Denali Highway. Referred to the “Denali East Option,” these areas were added to the study area for this study beginning in 2014.

In addition, Section 1.4 of the ISR noted that AEA was considering the possibility of eliminating the Chulitna Corridor from further study. In September 2014, AEA filed with FERC a formal proposal to implement this change. Thus, this report reflects a change in the study area to no longer include the Chulitna Corridor.

The secondary Study Area for this study includes all lands located between the Denali Highway, south to the Glenn Highway, and from the Richardson Highway, east to the mouth of the Susitna River. This area will be evaluated using existing information to understand the distribution of aesthetic resources within a larger geographic context.

The Study Plan noted that the Aesthetics Resource Study Area could be adjusted during the next study year to include areas within the river corridor located downriver of Talkeetna, if 2013 studies in the lower reach indicate a possible Project-related effect on aesthetic resources in this area.

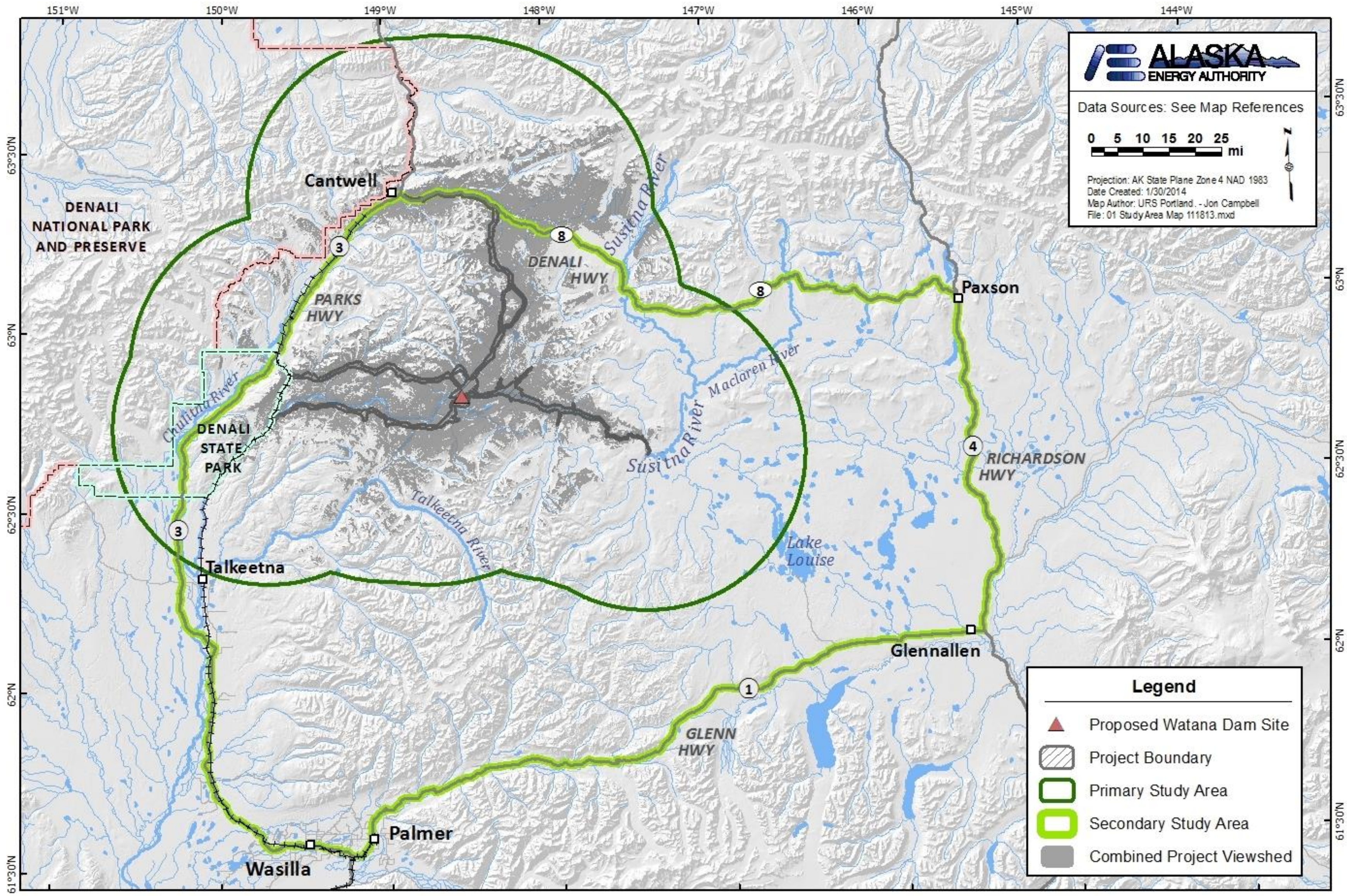

Figure 3-1. Aesthetics Resource Study Area

4. METHODS

AEA implemented the methods for the soundscape analysis described in Section 12.6.4 of with no variances. Data was collected to characterize the existing ambient sound environment in the Study Area to provide a baseline for assessment of potential change as a result of construction and operational activities of the proposed Project. Methods presented in this section tier from Section 4.5.2 of ISR 12.6.Review Documentation

Relevant Project data contained in AEAs Pre-Application Document (AEA 2011) was reviewed for information on potential noise sources associated with construction and operating of the proposed Project. A regulatory review was completed to determine relevant management framework with a nexus to the proposed Project. Analysis locations were selected based on information gleaned from this review, and through coordination with the visual resources assessment (Section 4.2 of the Initial Study Report), Recreation Resources Study (Study 12.5), and the River Recreation Flow and Access Study (Study 12.7).

4.1. Seasonal Surveys of Ambient Sound Levels

AEA implemented seasonal surveys of ambient sound levels per methods described in the Study Plan with no variances.

Ambient sound level measurements were collected with the goal of establishing baseline soundscape data. Outdoor ambient sound level survey methods followed the U.S. National Park Service (NPS) *Acoustic Sampling and Analysis Guide* (ASAG; NPS 2008) and methods described in the Denali National Park (DNP) *Acoustic Monitoring Report* (NPS 2009). Sound measurements included (1) unattended long-term (LT) monitors deployed for a minimum of 24 continuous hours and up to a single week, and (2) attended short-term (ST) monitors deployed for 15-20 minutes duration during day and night conditions. Perceived and identifiable sources of sound, such as bird calls, aircraft, or passing train or vehicle traffic, and the conditions during which they occur, were documented as part of the baseline data collection effort. This survey was conducted across four discrete survey periods corresponding with winter, spring, summer, and fall of 2013.

4.1.1. Site Selection

Landscapes sharing similar characteristics such as vegetative cover, terrain features, elevation, and meteorology are assumed to have similar sources of natural sound (both geophony and biophony) and inherent sound attenuating properties (e.g., linearly occluding hill crests or ridgelines, acoustically absorptive foliage and fallen snow, etc.). Hence, valid sound measurements from a small sample quantity of outdoor ambient sound monitoring locations in shared settings are considered representative of the outdoor sound environment of a much larger area, or multiple areas that also share these geographic parameters and acoustical contributors.

Ambient sound pressure level (SPL or L_p) measurements and digital audio recordings were taken in the Study Area. These measurements are used to characterize the audibility and frequency of man-made disturbance to the natural soundscape in the Project area. Unattended LT measurements were recorded at representative noise-sensitive receivers, recreation sites, and locations addressing the geographic diversity of the Study Area. Attended ST sound measurements were recorded at similar locations and used to further characterize the affected environment by expanding the geographic area where measurements were recorded. Observations of perceived and identifiable sources of sound and the conditions during which they occur were documented as part of these field surveys. Soundscape surveys were conducted during each of the four seasons: winter (March 7-18, 2013), spring (May 18-30, 2013), summer (July 12-20, 2013), and fall (September 7-14, 2013). To the extent practicable, surveys were implemented at the same geographic location across multiple seasons.

Target locations for unattended LT monitoring stations were planned prior to each seasonal survey. In some cases, these survey locations coincided with Key Observation Points used in the Project's visual resource assessment. Final LT monitor installation locations were determined based on site-specific field conditions such as topography, helicopter access, and vegetative cover.

4.1.2. Equipment

Each LT monitor included a standard "831H" kit containing items listed in Table 4-1. Figure 4-1 provides a photograph of a typical LT monitor. The primary component of the L_p monitoring system, the Larson-Davis (LD) Model 831, is the same ANSI S1.4-1983 (R2006) Type 1 sound level meter (SLM) recommended for usage by the NPS ASAG. The SLM and its key components (i.e., microphone and pre-amplifier) were factory calibrated, and thus consistent with the NPS ASAG requiring the SLM system be calibrated annually by an International Organization of Standardization (ISO) 17025 certified, National Voluntary Laboratory Accreditation Program (NVLAP) accredited, and/or other National Institute of Standards and Technology (NIST)-traceable acoustical calibration facility.

Table 4-1. Long-Term (LT) Soundscape Monitoring Equipment Roster (per Deployment)

Item	Quantity
Larson Davis (LD) Model 831 Sound Level Meter (SLM)	1
LD EXC020 Preamp Extension Cable	1
LD 377B02 Type 1 Microphone	1
LD PRM831 Preamplifier	1
Vaisala WXT520 Weather Transmitter	1
Environmental Shroud (Windscreen and Bird Spikes)	1
Heavy Duty Tripod	1
Adapters for Preamp/Microphone and Weather Transmitter	3
1/8" to 1/16" Audio Cable (Mono, Male-Male)	1
Roland R-05 Digital Audio Recorder (DAR)	1
60Ah 3.4v LiFePO4 Battery (For DAR)	1
21Ah 12-volt Lead-Acid Battery (For SLM and WXT520)	2
Power Cables for DAR, SLM, and WXT520	3
Weather Data Cable	1
Serial to USB Adapter	1
Guy Wire (Paracord)	3
MSR Groundhog Tent Stakes	3
Pelican Case (1170) - Dedicated DAR Battery Casing	1
Pelican Large Case - Housing SLM, DAR, and Lead-Acid Batteries	1
Master Lock Padlock (For Pelican Case)	1
Cable Loom (Conduit)	2

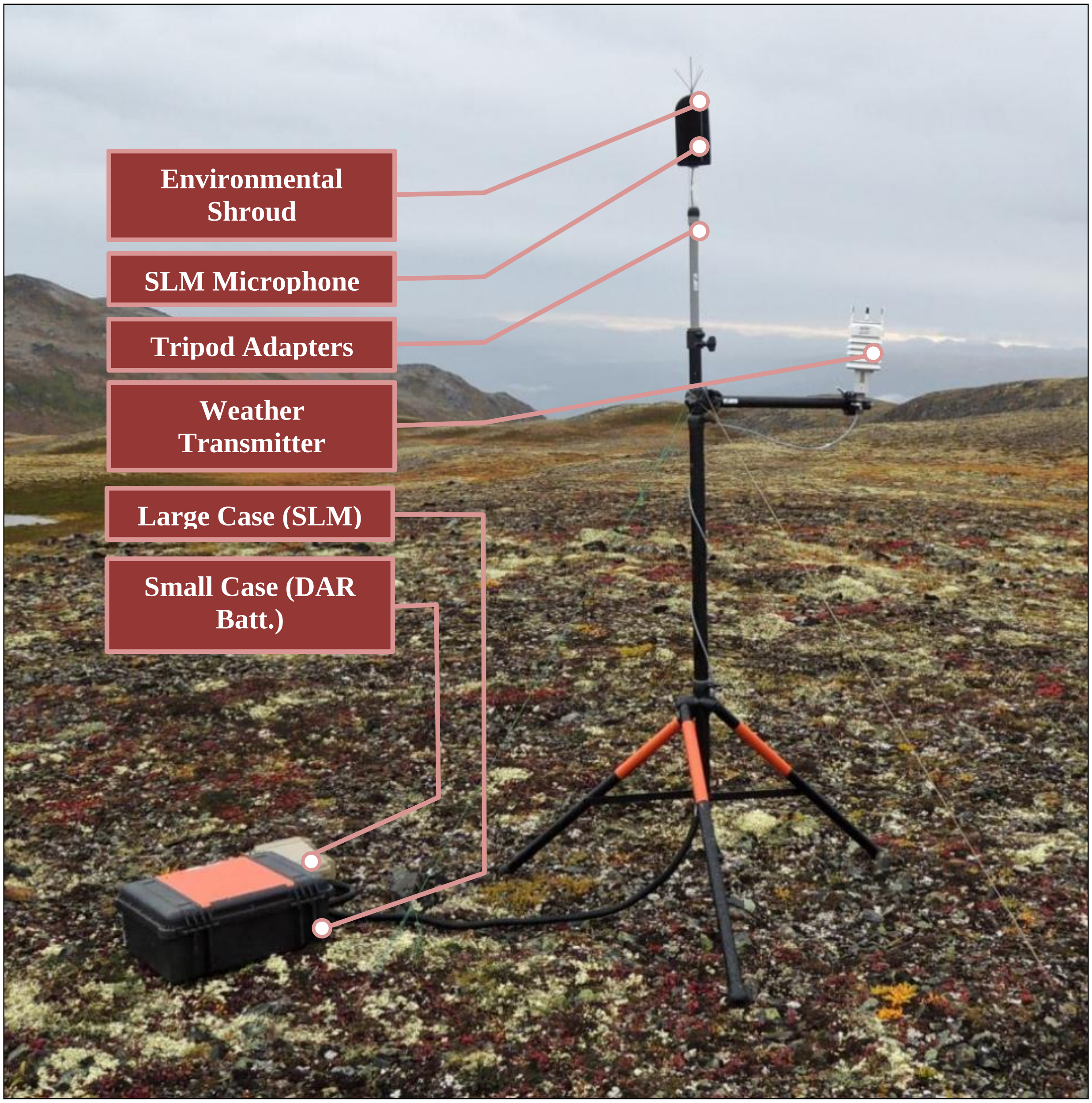

Figure 4-1. Typical Components of a Long-Term (LT) Monitoring Deployment

Audio recording was performed with the following components: One Roland R-05 digital audio recorder (DAR) outfitted with a 1/8" to 1/16" male-to-male monophonic audio cable to transmit signal from the SLM to the DAR. A porous open-cell foam windscreen was installed over the SLM microphone in the form of an environmental shroud with bird spikes. Digital audio was recorded onto a 16 GB Secure Digital memory card.

The unit was powered by a custom-built power cable attached to a 60Ah 3.4v LiFePO4 battery. While the LD 831 (SLM) and R-05 (DAR) each had separate dedicated power supplies, the R-05 received audio signal directly from the SLM. Hence, if the SLM were to deplete the charge in its external battery, it would result in an automatic discontinuation of signal to the R-05. If, on the other hand, the R-05 were to exhaust its power supply, the SLM would continue to function as allowed by its separate dedicated power supply.

A LD 200 Calibrator was used to field-check SLM calibration prior to, and upon completion of, LT L_p monitoring. The LD 200 Calibrator is ANSI S1.4-1983 (R2006) and IEC 60942:2003 Class 1 performance rated and compatible with the NPS ASAG. The calibrator is factory-calibrated annually.

The Vaisala WXT520 weather transmitter recorded wind speed and direction, temperature, relative humidity, and precipitation rates and accumulation. This site-specific meteorological data were not recorded consistently across all LT sites, either due to the weather transmitter not being installed or problems relating to power supply and/or interface with the SLM.

The ST monitors consisted of a tripod-mounted LD 831 SLM (Figure 4-2). The ST SLMs were factory calibrated as described for the LT SLMs. A hand-held WeatherHawk Skymaster SM-28 wind/weather meter was used to measure and collect air temperature, relative humidity, barometric pressure, and average wind speed at each ST measurement location.

Figure 4-2. Typical Components of a Short-Term (ST) L_p Measurement Setup

4.1.3. Data Collection

4.1.3.1. Long-Term Monitoring

Continuous, A-weighted L_p and unweighted, one-third octave band spectra from 20 to 20,000 Hertz (Hz) were collected at 1-second intervals (1-second L_{eq}). The SLMs were set to operate with "fast" collection, which represents a 0.125 second time constant. Wind speed, temperature and relative humidity data were collected by the Vaisala WXT520 weather transmitter, with its data collection controlled and logged by the on-board LD 831 SLM software and user settings. Continuous DAR data were collected by the Roland R-05. Data were stored as multi-hour (up to 262 MB size) MPEG-1 Audio Layer III (MP3) format files.

The LT monitors were left unattended to record L_p and DAR data at survey locations for a maximum of 1 week. The duration of up to 1 week was selected based on the following factors:

- External power (i.e., the 12-volt batteries) provided as part of the standard "831H" kits was expected to supply adequate charge for up to a week, depending on field conditions such as ambient air temperature. Supplemental sources of power, such as solar panels, were not elected for use due to logistical concerns such as size, weight, setup time, and available maximum helicopter load.
- One week, if assumed typical of several weeks during a monitored season, would comprise a sequence of diurnal cycles that exhibit varying L_p and DAR data that correspond with likely changes in acoustical contributors (e.g., road or rail traffic) due to the day of the week. For instance, L_p measured on Saturday and Sunday at a location might demonstrate greater contribution from nearby highway traffic noise—if such highway traffic volumes were indeed higher during these weekend days than during Monday through Friday dates of the monitored week. If the measured L_p on a Saturday is dominated by such highway traffic noise, a subsequent Saturday within the same season would likely result in similar measured L_p at the same monitoring location.

In practice, LT monitoring duration depended on external battery performance under the field conditions. Generally, L_p and DAR data were successfully measured and collected for a minimum of one completed diurnal cycle (24 continuous hours). Identification of audible acoustical contributors to the outdoor ambient L_p and digital audio was performed after the completion of fieldwork.

A minimum of four digital photographs corresponding to the four cardinal directions of each LT monitoring setup were taken at each site. As part of permit compliance, several photographs were also taken of LT monitor locations prior to and after disassembly to document local site conditions before and after the survey period.

4.1.3.2. Short-Term Monitoring

Continuous, A-weighted L_p and unweighted, one-third octave band spectra from 20 to 20,000 Hz were collected at 1-second intervals (1-second L_{eq}) and tagged to specific time periods. The SLMs were set to operate with "fast" collection, which represents a 0.125 second time constant. The study team limited their movements and other actions (e.g., speech) while the SLM was measuring and collecting data. During L_p measurement and data collection by the activated SLM, field conditions and acoustical contributors were recorded. Digital photographs of each ST tripod-mounted SLM setup, corresponding approximately with the four cardinal directions, were taken at each site.

LT and ST acoustic monitoring systems were deployed at 23 locations within the Study Area over the four surveys seasons of 2013. Of these, seven LT positions were co-located, representing L_p and DAR data collection at the same location across more than one season.

The data from co-located LT positions allowed for comparison of soundscapes and underlying acoustical contributors across seasons. Data collection included a variety of acoustical metrics and statistical values, such as existing ambient equivalent continuous sound level (L_{eq}), and percent time audible (%TA). Counts and post-measurement classification of natural and anthropogenic events were developed by attentive listening and visual review of acoustical spectrograms. The LT systems operated for a minimum of 24 hours, and up to 9 days, during which 1-second L_p and digital audio were recorded. Table 4-2 provides LT measurement location information, including elevation, global positioning system (GPS) geographic coordinates, and L_p data collection period.

Table 4-2. 2013 Long-Term (LT) Outdoor Ambient Sound Pressure Level (L_p) Monitoring Locations

Site ID	Elevation (ft)	Latitude	Longitude	Sampling Period (mm/dd)
Winter LT1	2,600	63.36646	-148.35935	03/07 - 03/12
Winter LT2	2,600	63.28942	-148.06701	03/07 - 03/12
Winter LT4	2,250	62.83047	-148.66463	03/08 - 03/11
Winter LT5	2,250	62.84934	-149.09233	03/08-03/15
WinterLT7	3,350	63.17352	-148.26231	03/11 - 03/18
Spring LT1	2,500	62.62237	-150.09857	05/18 - 05/24
Spring LT2	800	62.78604	-149.65572	05/18 - 05/24
Spring LT3	3,230	62.81964	-149.75472	05/20 - 05/27
Spring LT4	2,400	62.84393	-149.11560	05/20 - 05/30
Spring LT5	2,200	62.83000	-148.65740	05/23 - 05/29
Spring LT6	2,515	62.86830	-148.25330	05/23 - 05/31
Spring LT7	2,410	63.39105	-148.56028	05/21 - 05/26
Spring LT9	2,800	62.67589	-147.52700	05/23 - 05/30
Summer LT1	2,500	62.62237	-150.09857	07/12 - 07/19

Site ID	Elevation (ft)	Latitude	Longitude	Sampling Period (mm/dd)
Summer LT3	3,500	63.18611	-148.27378	07/12 - 07/19
Summer LT4	2,800	62.88214	-148.37250	07/12 - 07/19
Summer LT5	2,400	62.76392	-148.41756	07/12 - 07/20
Summer LT6	2,200	62.83011	-148.65817	07/12 - 07/19
Summer LT7	3,200	62.86900	-148.70400	07/12 - 07/19
Summer LT8	2,630	62.84956	-149.09381	07/12- 07/20
Summer LT9	3,250	62.82242	-149.76122	07/12 - 07/18
Fall LT1	3,250	62.82242	-149.76122	09/07 - 09/09
Fall LT2	2,450	62.70147	-147.53439	09/07 - 09/09
Fall LT3	3,300	63.18611	-148.27378	09/07 - 09/09
Fall LT4	2,800	62.88214	-148.37250	09/07 - 09/09
Fall LT5	2,400	62.76392	-148.41756	09/07 - 09/08
Fall LT7	3,200	62.86900	-148.70400	09/07 - 09/14
Fall LT8	2,690	62.84956	-149.09381	09/07 - 09/12
Fall LT9	3,280	62.82242	-149.76122	09/07 - 09/14

4.1.4. Data Analysis

4.1.4.1. Spectrogram Preparation

An Excel-based technique was used to visually display 1-second interval L_p data. This approach is similar to spectrograms of one-third octave band resolution L_p measurement data developed by NPS. Using conditional formatting, plots of A-weighted one-third octave spectra L_p versus time were developed (Figure 4-3). Spectrograms enabled analysts to visually distinguish impulsive, intermittent and short-duration sounds of particular third-octaves (or wider spectra) against a backdrop of relatively continuous and/or indistinct background sound. The typical conditional formatting developed for this tool was applied to individual columns of data (L_p at one-third octave band center frequency resolution) in a three-color scale format of black, blue, and white, and was adjustable to raise or reduce sharpness and clarity. This approach resulted in improved source visibility (by raising the contrast against background noise) and enhanced the accuracy of source identification. In addition to Figure 4-3, below, spectrograms illustrating various other distinct and recognizable sources (i.e., aircraft, trains, and fauna) are provided in Appendix A.

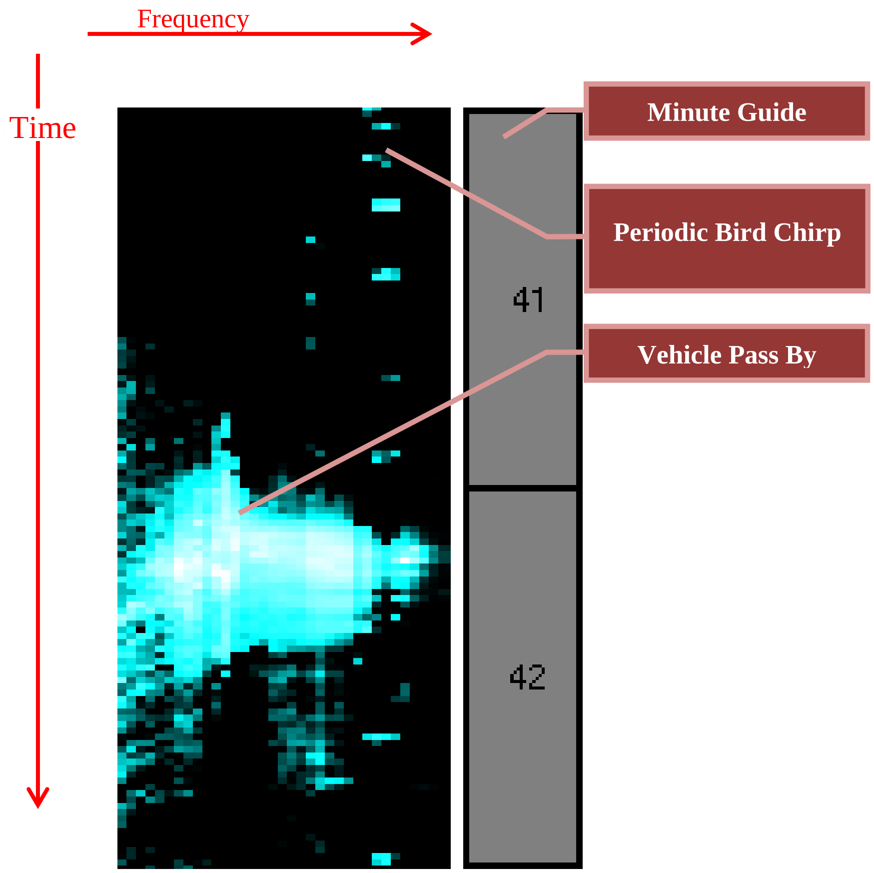

Figure 4-3. Plot of A-Weighted One-Third Octave Spectra L_p Versus Time: Mechanized Sound (Motorized Vehicle) and Biophony (Birdsong), Spring Season

4.1.4.2. Audible Sound Analysis

Audible sound was characterized by listening to the audio file segments corresponding to the graphical anomaly or prominence identified on the spectrogram. Anomalies were recorded and differentiated by type of audible sound to determine the overall quantity within a specific period (e.g., 1 hour) at the LT monitoring location. To ensure audible events were adequately quantified and categorized, analysts performed this kind of "attentive listening" to measured days at the LT monitors, with the following exceptions:

- Partial diurnal cycles (i.e., less than 24 hours) occurring on instrument installation and recovery days. During such times, investigator and helicopter activity occurred at the monitoring locations. Further, field investigators were flying by helicopter among the LT monitoring sites across the Study Area, and thus potentially adding audible helicopter noise to the measured L_p that would not be considered representative of the non-Project ambient sound environment.
- In some cases, and after a preview of overall or summarized acoustical metrics and statistics as well as spectrogram-formatted L_p data, some LT measurement days were considered sufficiently similar to adjoining measured days and thus not subject to detailed

attentive listening. For example, L_p collected at a location on a Tuesday might appear quite similar (per this preview) to data from the preceding Monday and proceeding Wednesday.

Collectively, attentive listening over the entire surveyed period amounted to approximately 360 hours or roughly 7 minutes of listening for each 1-hour period of the total 3096 monitored hours. Spectrogram analysis was completed for approximately 93 percent of the spectrograms—each analyzed for every hour of each 24-hour measurement period. Natural sound disturbance was classified as "Very High," "High," "Medium," and "Low" per criteria provided in NPS (2006) (Table 4-3).

Table 4-3. Natural Sound Disturbance Classification

Classification	Standard
Very High	Natural sounds are often interrupted by motorized noise including loud noise. Motorized noise may be audible up to 50% of any hour, and there may be up to 50 motorized noise intrusions per day that exceed natural ambient sound. Motorized noise does not exceed 60 A-weighted decibels (dBA).
High	Natural sounds are frequently interrupted by motorized noise, including some loud noise. Motorized noise may be audible up to 25% of any hour, and there may be as many as 25 motorized noise intrusions per day that exceed natural ambient sound. Motorized noise does not exceed 60 dBA.
Medium	Natural sounds predominate in this area, but there are infrequent motorized intrusions, a few of which may be loud. Motorized noise may be audible up to 15% of any hour, and there may be as many as 10 motorized noise intrusions per day that exceed natural ambient sound. Motorized noise does not exceed 40 dBA
Low	Natural sounds predominate in this area and motorized noise intrusions are very rare and usually faint. Motorized noise may be audible up to 5% of any hour, and there is no more than 1 motorized intrusion each day that exceeds natural ambient sound. Motorized noise does not exceed 40 dBA.

Source: DNP 2006

Notes: "Audible" means audibility to a person of normal hearing. Maximum sound levels assume the measurement device is more than 50 feet from the noise source. For comparison, 40 dBA is the overall sound level inside a typical residential home. 70 dBA is the sound level of a vacuum cleaner as perceived by the user.

4.2. Variances

AEA implemented the methods described in RSP Section 12.6.1 with no variances.

5. RESULTS

Results presented in this section tier off those provided in Section 5.2 of IRS 12.6.

5.1. Review Documentation and Develop Data Needs

The following are laws, ordinances, regulations, standards, and guidance that may influence the Project construction and operation noise impact assessment:

- The second edition of the U.S. Bureau of Reclamation *Water and Land Recreation Opportunity Spectrum Handbook* describes guidelines for several social setting attributes used to characterize or categorize recreation land uses or opportunities. With respect to sound, a "reasonable standard for the percent of noise disturbances per number of recreation groups" ranges from 10 percent for an "urban" category to 1 percent for a "primitive" recreation setting (Bureau of Reclamation 2011).
- Table 4-3 reproduces Table 2.5 from the 2006 *Denali National Park Backcountry Management Plan* (DNP 2006) and describes four categories of disturbance to what is otherwise natural soundscape.
- There are guidelines at the federal level that direct the consideration of a broad range of noise and vibration issues as listed below:
    - National Environmental Policy Act (42 United States Code [USC] 4321, et seq.) (Public Law-91-190) (40 Code of Federal Regulations [CFR] § 1506.5)
    - Noise Control Act of 1972 (42 USC 4910)
    - U.S. Department of Housing and Urban Development Noise Guidelines (24 CFR § 51 subpart B)
    - The U.S. Environmental Protection Agency (EPA) has not promulgated standards or regulations for environmental noise generated by power plants; however, the EPA has published a guideline that specifically addresses issues of community noise (EPA 1978). This guideline, commonly referred to as the "levels document," contains goals for noise levels affecting residential land use of day-night sound level (L_{dn}) <55 A-weighted decibel (dBA) for exterior levels and L_{dn}<45 dBA for interior levels. Chapter 2 of the U.S. Department of Housing and Urban Development Noise Guidebook (24 CFR Section 51.101(a)(8)) also recommends that exterior areas of frequent human use follow the EPA guideline of 55 $dBAL_{dn}$. However, the same Section 51.101(a)(8) indicates that a noise level of up to 65 $dBAL_{dn}$ could be considered acceptable.
- Occupational exposure to noise is regulated by 29 CFR 1910.95, Occupational Noise Exposure, which in summary describes requirements of an employer for implementation of feasible administrative or engineering controls, personal protective equipment, and/or a hearing conservation program to protect its employees against the effects of noise exposure when it exceeds an average of 90 dBA for an 8-hour period.

As of this writing, no state, borough, or municipality laws, ordinances, or regulations have been found that specifically apply to noise from hydropower facilities or their construction.

5.2. Seasonal Surveys of Ambient Sound Levels

The following section summarizes results of L_p measurement and DAR data for each LT monitoring site. Results include percent audibility for categories of natural sounds and anthropogenic noise, hourly ambient sound levels, and number of "mechanized" sound events per day. "Mechanized" sound events are also characterized as anthropogenic "disturbances" to the background typically dominated by naturally occurring sounds.

Table 4-3, in the previous section, lists the criteria used to determine the natural sound disturbance classifications of low, medium, high, and very high.

For the purposes of this study, "night" is from 2200 hours to 0700 hours, "day" is from 0700 hours. to 1900 hours p.m., and "evening" is from 1900 hours to 2200 hours.

In the text summaries in this section, the data reported are typically hourly averages over the monitoring period. For example, to determine the highest percentage of audible mechanized disturbance for any given hour of the day, data were averaged from the same hour each day (for example, 6 a.m.) over the whole monitoring period. The highest *average* percent of that hour where mechanical noise was audible is discussed. If a different hour (for example, noon) had a larger maximum on a particular day but the average of that hour over the days of the monitoring period was lower, only the higher average was considered.

Figures summarizing the collected data for each site follow the report in Appendix C. These figures are called out as applicable in the text; however, in cases where, for example, no audible mechanized disturbance events were recorded, the charts depicting disturbance occurrence and distribution were omitted. The location of each LT monitoring site is shown in Figure 5-1.

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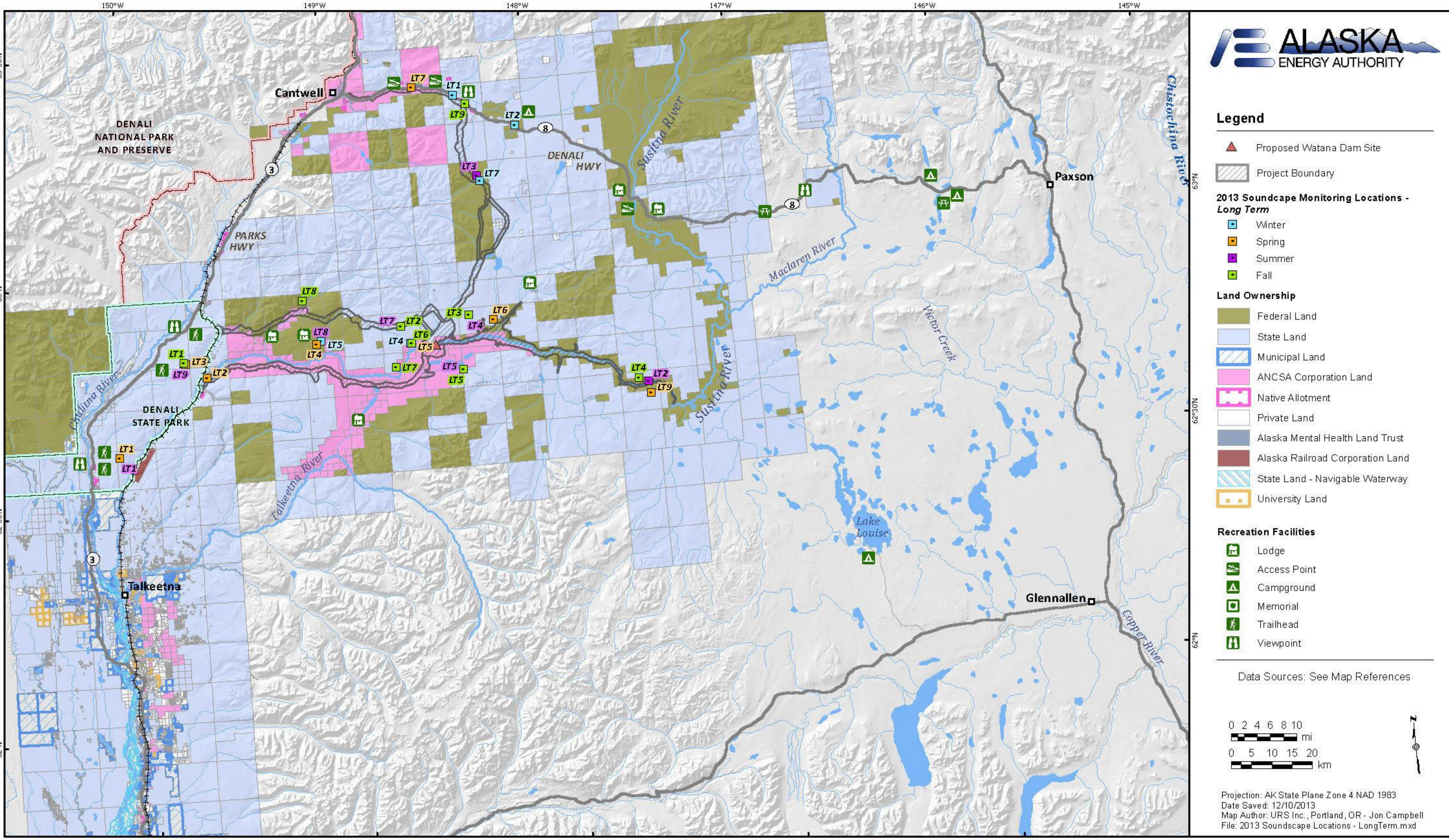

Figure 5-1. Soundscape Locations - Long Term

5.2.1. Winter Long-Term Acoustic Monitoring

5.2.1.1. Winter LT1

The Winter LT1 soundscape monitor was located 200 feet south of the Denali Highway (Figure 5-2) and approximately 25 miles west of the Susitna River. This station was within the proposed Denali Corridor boundary. It was deployed on March 7, 2013, and was operational through March 11, 2013. Table 5-1 provides summary information on Winter LT1.

The most common geophony identified was wind. On average, wind was audible 89 percent of the time (Figure C-1). The most common biophony identified was birdsong (7 percent) (Figure C-2). Mechanized sound was audible during 15 events per day (Figures C-6 and 7) lasting 3 percent of each day. The highest hourly audibility was 11 percent (Figure C-3). Snow machines traversing the Denali Highway were the primary contributors of mechanized sound, generally peaking in volume and frequency from 9:00 through 15:00 (Figure C-4). Based on these results, disturbance to the existing soundscape at Winter LT1 is medium to high.

Based on post-measurement sound source identification and analysis, it is apparent that strong and continuous wind noise throughout the 24-hour period may significantly reduce audibility and cataloging of other natural and mechanized noise sources—specifically those that are more distant and/or have lower sound level magnitudes. For example, DAR and measured noise level data from March 11, 2013 suggest the Winter LT1 experienced very strong, continuous winds, resulting in very low detectability of discrete noise-producing events, which may explain the drop in apparent mechanical events for that 24-hour period.

Over the 4-day period, the average hourly L_{50} (i.e., median sound level) measurement values ranged from 30 to 35 dBA at night (Figure C-5), which is consistent with a rural environment. Hourly L_{50} increases to a range of 35 to 42 dBA during the daytime. With winds occurring fairly continuously, the higher daytime range is likely due to birdsong and other fairly continuous sources of natural sound, such as increased wind speeds.

Figure 5-2. Photo of Long-Term Sound Monitor Winter LT1 Location

Table 5-1. Long-Term Sound Monitor Winter LT1 Summary

<table>
<tr><td>Location and purpose</td><td colspan="5">Located approximately 200 feet south of Denali Highway at milepost (MP) 115. The purpose of this station was to collect data along the proposed vehicular access route to the Denali or Denali East Corridors.</td></tr>
<tr><td>Coordinates</td><td colspan="2">Lat: 63.36646, Long: -148.35935</td><td colspan="2">Elevation</td><td>2,600 feet</td></tr>
<tr><td>Deployed</td><td colspan="2">March 7 – March 12, 2013</td><td colspan="2">Analysis period</td><td>March 8 – 11, 2013</td></tr>
<tr><td>Disturbance Classification</td><td colspan="2">medium - high</td><td colspan="2">Access by</td><td>Snow machine</td></tr>
<tr><td>Temperature (°F)</td><td>Average: 23.3</td><td colspan="2">Maximum: 26.9</td><td colspan="2">Minimum: 17.6</td></tr>
<tr><td>Average Humidity (%)</td><td>70.7</td><td colspan="3">Average Barometric Pressure (Bar)</td><td>0.920</td></tr>
<tr><td>Wind Speed (mph)</td><td>Average: 5</td><td colspan="4">Gust: 26.8</td></tr>
</table>

5.2.1.2. Winter LT2

The Winter LT2 soundscape monitor was located approximately 200 feet south of the Denali Highway (Figure 5-3). This station is approximately 240 feet from Brushkana Creek. It was deployed on March 7, 2013. Data were collected from March 8 through March 11, 2013. Table 5-2 provides summary information on Winter LT2.

The most common geophony identified was wind (audible 48 percent of the time) and flowing water (43 percent) (Figure C-8). The most common biophony identified was birdsong, (4 percent) (Figure C-9). On average, mechanized sound was audible 5 percent of each day (Figure C-10), with as much as 19 percent in the highest hour (8 a.m.), and an average of 12 events per day (Figures C-13 and 14). Due its proximity to the Denali Highway, snow machines traversing the highway were the primary contributor of mechanized sound, generally peaking in volume from 6:00 through 16:00 (Figure C-11). Based on these results, the existing soundscape disturbance at Winter LT2 is medium to high.

LT2 is characterized by lower average wind speed and lower wind gust velocity; consequently, this site has a lower wind noise audibility percentage than Winter LT1. The reduced audibility of wind is likely a factor in mechanized sound sources being more frequently audible at Winter LT2 than at Winter LT1. Although apparent snow machine traffic was greater at Winter LT1, other mechanized sounds (including passing aircraft) were more apparent at Winter LT2.

Over the 4-day period, the hourly L_{50} measurement values ranged from 16 to 23 dBA at night, which is consistent with a remote rural environment, and rise to a range of 19 to 29 dBA during the daytime (Figure C-12). The higher daytime range is likely due to birdsong and other fairly continuous sources of natural sound, such as increased wind speeds and flow rate of running water (Brushkana Creek).

Figure 5-3. Photo of Long-Term Sound Monitor Winter LT2 Location

Table 5-2. Long-Term Sound Monitor Winter LT2 Summary

Location and purpose	Located approximately 7.4 miles east of the intersection of the Denali Corridor and the Denali Highway. The purpose of this station was to collect data representative of the BLM-managed Brushkana campground.		
Coordinates	Lat: 63.28942, Long: -148.06701	**Elevation**	2,600 feet
Deployed	March 7 – March 27, 2013	**Analysis period**	March 8 – 11
Disturbance Classification	medium - high	**Access by**	Snow machine
Temperature (°F)	Average: 20.7	Maximum: 29.8	Minimum: 8.5
Average Humidity (%)	70.7	**Average Barometric Pressure (Bar)**	0.920
Wind Speed (mph)	Average: 5	Gust: 26.8	

5.2.1.3. Winter LT4

The Winter LT4 soundscape monitor was located on a remote hillside, approximately 1 mile north of the Susitna River and 3.5 miles west of the proposed dam site (Figure 5-4). This location was accessed via helicopter. The monitor was deployed on March 8, 2013, and data were collected on March 9 through March 10, 2013. Table 5-3 provides summary information on Winter LT4.

The most common geophony identified was flowing water (audible 20 percent of the time) and wind (59 percent) (Figure C-15). The most common biophony identified was birdsong (3 percent) (Figure C-16). On average, mechanized sound was audible 17 percent of each day (Figures C-17 and 18), with as much as of 35 percent during the highest hour (due solely to passing aircraft) and an average of 10 events per day (Figures C-20 and C-21). The number of audible mechanized events were measured at 16 (March 9, 2013) and 4 (March 10, 2013). Based on these results, the existing soundscape disturbance at Winter LT4 is high to very high.

The hourly L_{50} measurement values narrowly ranged between 15 and 18 dBA during both day and night (Figure C-19). This measurement is consistent with a very remote rural environment under conditions of low average wind speeds (2 mph) and modest wind gust velocity (10 mph), as was measured during the survey. This very quiet background helps explain why passing aircraft were audible and why this location was classified in the high to very high disturbance range, despite maximum hourly sound levels measuring lower than 30 dBA L_{eq}.

Figure 5-4. Photo of Long-Term Sound Monitor Winter LT4 Location

Table 5-3. Long-Term Sound Monitor Winter LT4 Summary

Location and purpose	Located on a hillside approximately 3.4 miles west of the proposed dam site. This site represented locations near the proposed dam. Monitoring occurred during all four seasons at this location.		
Coordinates	Lat: 62.83047, Long: -148.66463	**Elevation**	2,250 feet
Deployed	March 8 – March 27, 2013	**Analysis period**	March 9 – March 10
Disturbance Classification	high to very high	**Access by**	Helicopter
Temperature (°F)	Average: 23	Maximum: 28.9	Minimum: 17
Average Humidity (%)	79.96	**Average Barometric Pressure (Bar)**	0.931
Wind Speed (mph)	Average: 2	Gust: 10.1	

5.2.1.4. Winter LT5

The Winter LT5 soundscape monitor was located on a hillside approximately 0.6 miles east of High Lake (Figure 5-5). It was deployed on March 8, 2013. Data were collected on March 9 through 11 and March 13 and 14, 2013. Table 5-4 provides summary information on Winter LT5.

The most common geophony identified was wind (audible 92 percent of the time) and rain (3 percent) (Figure C-22). The most common biophony identified was birdsong (3 percent) (Figure C-23). On average, mechanized sound was audible 2.5 percent of each day (Figures C-24 and 25), with as much as 5 percent during the highest hour (due solely to passing aircraft). An average of 9 events occurred per day (Figure C-27 and C-28). Based on these results, the existing soundscape disturbance at Winter LT5 is low to medium.

Over the 5-day period, the hourly L_{50} measurement values seemed to remain steady at 30 dBA at night, which is consistent with a rural environment, and rose to a range of 30 to 40 dBA during the daytime (Figure C-26). The higher daytime range is likely due to birdsong and other fairly continuous sources of natural sound, such as increased wind speeds. The average hourly L_{eq} values of between 45 and 65 dBA are indicative of the high average measured wind speed (10 mph) and very high wind gust velocities (53 mph). These high wind speeds, and the corresponding high noise levels, would also likely be responsible for the very high wind noise audibility (greater than 90 percent) and thus the very low audibility (5 percent) associated with mechanized sound sources. In other words, during sustained periods of high winds and wind-caused noise, the likelihood of such wind noise to mask mechanized sounds in the outdoor ambient environment would be greater.

Figure 5-5. Photo of Long-Term Sound Monitor Winter LT5 Location

Table 5-4. Long-Term Sound Monitor Winter LT5 Summary

Location and purpose	On a hillside 0.6 miles east of High Lake. High Lake is equidistant from the Chulitna and Gold Creek proposed corridors. Monitoring occurred here during winter, spring, and summer.			
Coordinates	Lat: 62.84934, Long: -149.09233		**Elevation**	2,680 feet
Deployed	March 8 – March 15, 2013		**Analysis period**	March 9 – 11, 13 –14
Disturbance Classification	low - medium		**Access by**	Helicopter
Temperature (°F)	Average: 14.6	Maximum: 20.2	Minimum: 8.3	
Average Humidity (%)	61.5	**Average Barometric Pressure (Bar)**		0.916
Wind Speed (mph)	Average: 11.6	Gust: 52.8		

5.2.1.5. Winter LT7

The Winter LT7 soundscape monitor was located approximately 9 miles southwest of the Denali Highway, 25 miles north of the proposed dam site, and approximately 23 miles west of the Susitna River (Figure 5-6). The instrument was deployed on March 11, 2013. Data were recorded for six consecutive days between March 12 and March 17, 2013. Table 5-5 provides summary information on Winter LT7.

The most common geophony identified was wind (audible 83 percent of the time) (Figure C-29). The most common biophony identified was birdsong (3 percent) (Figure C-30). On average, mechanized sound was audible 3 percent of each day (Figures C-31 and C-32), with as much as 9 percent during the highest hour (due solely to passing aircraft), and an average of 7 events per day (Figure C-34 and 35). Based on these results, the existing soundscape at Winter LT7 is low to medium.

Over the 6-day period, the hourly L_{50} measurement values narrowly ranged between 15 and 20 dBA (Figure C-33). This is consistent with a very remote rural environment. Given this quiet background, the variance of average hourly L_{eq} (16 dBA to 41 dBA) indicates the outdoor ambient noise level is largely driven by wind gusts and/or passing aircraft.

Figure 5-6. Photo of Long-Term Sound Monitor Winter LT7 Location

Table 5-5. Long-Term Sound Monitor Winter LT7 Summary

Location and purpose	1.7 miles west of Brushkana Creek, within proposed Denali Corridor. Low anthropogenic activity is expected outside of hunting season.		
Coordinates	Lat: 63.17352, Long: -148.26231	**Elevation**	3,350 feet
Deployed	March 11 – March 27, 2013	**Analysis period**	March 12 – 17
Disturbance Classification	low - medium	**Access by**	Helicopter
Temperature (°F)	Average: 1.7	Maximum: 10.25	Minimum: -7.87
Average Humidity (%)	52.94	**Average Barometric Pressure (Bar)**	0.894
Wind Speed (mph)	Average: 5.1	Gust: 20.1	

5.2.2. Spring Long-Term Acoustic Monitoring

5.2.2.1. Spring LT1

The Spring LT1 soundscape monitor was located 4 miles east of the Parks Highway and 2.25 miles northwest of the Susitna River and the Alaska Railroad (Figure 5-7) for five consecutive days from May 19 through May 23, 2013. Table 5-6 provides summary information on Spring LT1.

The most common geophony identified was wind (audible 53 percent of the time) (Figure C-36). The most common biophony identified was birdsong (20 percent) (Figure C-37). On average, mechanized sound was audible 16 percent of each day (Figures C-38 and 39), with as much as 34 percent during the highest hour (due to passing aircraft and trains), and an average of 34 events per day (Figure C-41 and 42). Based on these results, the existing soundscape disturbance at Spring LT1 is high to very high.

The hourly L_{50} measurement values ranged between 17 and 22 dBA across both day and night hours (Figure C-40). This measurement is consistent with a very remote rural environment under conditions of low average wind speeds (2.5 mph) and modest wind gust velocity (8 mph). This very quiet background explains why passing aircraft and trains were so frequently audible and why the existing soundscape disturbance was classified as high to very high despite measured maximum hourly sound levels of less than 50 dBA L_{eq}.

Figure 5-7. Photo of Long-Term Sound Monitor Spring LT1 Location

Table 5-6. Long-Term Sound Monitor Spring LT1 Summary

<table>
<tr><td>Location and purpose</td><td colspan="5">Near Curry Lookout and Camp Regalvista in Denali State Park. This is a prominent viewpoint and includes a shelter on the National Register of Historic Places. This location represents a visitor attraction. Spring and summer monitoring took place here.</td></tr>
<tr><td>Coordinates</td><td colspan="2">Lat: 62.62237, Long: -150.09857</td><td colspan="2">Elevation</td><td>2,550 feet</td></tr>
<tr><td>Deployed</td><td colspan="2">May 18 – May 24, 2013</td><td colspan="2">Analysis period</td><td>May 19 – 23</td></tr>
<tr><td>Disturbance Classification</td><td colspan="2">high – very high</td><td colspan="2">Access by</td><td>Helicopter</td></tr>
<tr><td>Temperature (°F)</td><td>Average: 32.58</td><td colspan="2">Maximum: 39.3</td><td colspan="2">Minimum: 26.42</td></tr>
<tr><td>Average Humidity (%)</td><td>52.16</td><td colspan="3">Average Barometric Pressure (Bar)</td><td>0.933</td></tr>
<tr><td>Wind Speed (mph)</td><td>Average: 2.54</td><td colspan="4">Gust: 7.86</td></tr>
</table>

5.2.2.2. Spring LT2

The Spring LT2 soundscape monitor was located on the banks of the Susitna River at the confluence of the Indian River, approximately 8 miles southeast of the Parks Highway (Figure 5-8). The instrument was deployed on May 18, 2013. Data were collected for five consecutive days between May 19 and May 23, 2013. Table 5-7 provides summary information on Spring LT2.

The most common geophony identified was wind (audible 32 percent of the time) and flowing water (100 percent) (Figure C-43). The most common biophony identified was birdsong (32 percent) and insects (2 percent) (Figure C-44). On average, mechanized sound was audible 14 percent of each day (Figures C-45 and 46), with as much as 31 percent during the highest hour (due to passing aircraft and trains), and an average of 48 events per day (Figures C-48 and 49). Based on these results, the existing soundscape disturbance at Spring LT2 is high to very high.

Over the 5-day period, the hourly L_{50} measurement values narrowly ranged between 54 and 56 dBA over both day and night hours (Figure C-47). This indicates the acoustical dominance of the flowing water of the Susitna River. Low average wind speeds (< 1 mph) and low wind gust velocity (< 5 mph) as measured during the survey explain audibility of wind-generated noise during only about a third of the survey period. Despite this steady background noise of flowing water, passing aircraft and trains on the Alaska Railroad approximately 0.6 miles away were audible, resulting in the existing soundscape disturbance being rated as high to very high, despite measured maximum hourly sound levels of less than 60 dBA L_{eq}.

Figure 5-8. Photo of Long-Term Sound Monitor Spring LT2 Location

Table 5-7. Long-Term Sound Monitor Spring LT2 Summary

Location and purpose	On the northern shore of the confluence of the Susitna and Indian Rivers. The purpose of this station was to collect data on the riparian habitat, changes in hydraulic flow during the peak spring melt-off, and the nearby Alaska railroad.		
Coordinates	Lat: 62.78604, Long: -149.65572	**Elevation**	800 feet
Deployed	May 18 – May 24, 2013	**Analysis period**	May 19 – 23
Disturbance Classification	high – very high	**Access by**	Helicopter
Temperature (°F)	Average: 38.77	Maximum: 51.62	Minimum: 26.55
Average Humidity (%)	51.73	**Average Barometric Pressure (Bar)**	0.998
Wind Speed (mph)	Average: 0.76	Gust: 4.57	

5.2.2.3. Spring LT3

The Spring LT3 soundscape monitor was located approximately 4.5 miles southeast of the Parks Highway, 3.5 miles northwest of the Susitna River, and 40 miles west of the proposed dam site (Figure 5-9). It was deployed on May 20, 2013. Data were collected for six consecutive days between May 21 and May 26, 2013. Table 5-8 provides summary information on Spring LT3.

The most common geophony identified was wind (audible 60 percent of the time) (Figure C-50). The most common biophony identified was birdsong (58 percent) (Figure C-51). On average, mechanized sound was audible 24 percent of each day (Figures C-52 and 53), with as much as 46 percent during the highest hour (due to passing aircraft and trains), and an average of 57 events per day (Figures C-55 and 56). Based on these results, the existing soundscape disturbance at Spring LT3 is very high.

Over the 6-day period, the hourly L_{50} measurement values narrowly ranged between 17 and 27 dBA across the day and night hours (Figure C-54). This is consistent with a remote rural environment. This quiet baseline soundscape explains why passing aircraft and trains on the Alaska Railroad were frequently audible and why the soundscape was characterized by a very high disturbance range, despite measured maximum hourly sound levels of less than 50 dBA L_{eq}.

Figure 5-9. Photo of Long-Term Sound Monitor Spring LT3 Location

Table 5-8. Long-Term Sound Monitor Spring LT3 Summary

Location and purpose	Located on Kesugi Ridge in Denali State Park. The purpose of this station was to collect data at this prominent viewpoint and visitor attraction. Long-term data were collected during spring, summer, and fall.			
Coordinates	Lat: 62.81964, Long: -149.75472		**Elevation**	3,230 feet
Deployed	May 20 - 27, 2013		**Analysis period**	May 21 – 26
Disturbance Classification	very high		**Access by**	Helicopter
Temperature (°F)	Average: No data	Maximum: No data	Minimum: No data	
Average Humidity (%)	No data	**Average Barometric Pressure (Bar)**		No data
Wind Speed (mph)	Average: No data	Gust: No data		

5.2.2.4. Spring LT4

The Spring LT4 soundscape monitor was located at the High Lake Lodge and airstrip, approximately 2 miles north of the Susitna River and 19 miles west of the proposed dam site (Figure 5-10). The instrument was deployed on May 20, 2013. Data were collected between May 21 and May 27, 2013. Table 5-9 provides summary information on Spring LT4.

The most common geophony identified at the site was wind (audible 23 percent of the time) (Figure C-57). The most common biophony identified at the site was birdsong (95 percent) (Figure C-58). On average, mechanized sound was audible 11 percent of each day (Figures C-59 and 60), with as much as 22 percent during the highest hour (due to passing aircraft), and an average of 26 events per day (Figures C-62 and 63). Based on these results, the existing soundscape disturbance at Spring LT4 is high.

On May 28, 2013, the property owner visited the site via fixed-wing aircraft and performed noise-generating tasks, including running a gas generator and operating a bulldozer tractor. Data collected from this date were not reported due to the atypical ambient noise level at this location. Over the 7-day period, the hourly L_{50} measurement values range from 19 to 25 dBA during the daytime and evening (Figure C-61). Average nighttime L_{50} values ranged from 17 to 30 dBA, which may reflect higher wind speeds in the early morning hours during the survey period. These measurements are consistent with a remote rural environment.

Figure 5-10. Photo of Long-Term Sound Monitor Spring LT4 Location

Table 5-9. Long-Term Sound Monitor Spring LT4 Summary

Location and purpose	Southwest of High Lake Lodge, which is equidistant between the Chulitna and Gold Creek proposed project corridors. Long-term monitoring took place here in winter, spring, and summer.			
Coordinates	Lat: 62.84393, Long: -149.11560		**Elevation**	2,400 feet
Deployed	May 20 – May 30, 2013		**Analysis period**	May 21 – 27
Disturbance Classification	high		**Access by**	Helicopter
Temperature (°F)	Average: No data	Maximum: No data	Minimum: No data	
Average Humidity (%)	No data	**Average Barometric Pressure (Bar)**		No data
Wind Speed (mph)	Average: No data	Gust: No data		

5.2.2.5. Spring LT5

The Spring LT5 soundscape monitor was located approximately 1 mile northwest of the Susitna River, and approximately 3.25 miles west of the proposed dam site (Figure 5-11). The instrument was deployed May 23, 2013. Data were collected between May 24 and May 28, 2013. Table 5-10 provides summary information on Spring LT5.

The most common geophony identified was flowing water (audible 100 percent of the time) and wind (35 percent) (Figure C-64). The most common biophony identified was birdsong (98 percent) (Figure C-65). On average, mechanized sound was audible 8 percent of each day (Figures C-66 and 67), with as much as 36 percent during the highest hour (due to passing aircraft), and up to 17 events per day (Figures C-69 and 70). Based on these results, the existing soundscape disturbance at Spring LT5 is between high and very high.

Over the 5-day period, the hourly L_{50} measurement values ranged from 26 to 38 dBA (Figure C-68). Generally lower values in the daytime suggest these measurements depend on wind speeds (< 1 mph on average, and 6 mph gust), and possibly nearby flowing water from either the Susitna or a closer tributary.

Figure 5-11. Photo of Long-Term Sound Monitor Spring LT5 Location

Table 5-10. Long-Term Sound Monitor Spring LT5 Summary

Location and purpose	Located on a hillside approximately 3.4 miles west of the proposed dam. This site represented locations near the proposed dam. Monitoring occurred during all four seasons at this location.			
Coordinates	Lat: 62.83047, Long: -148.66463		**Elevation**	2,250 feet
Deployed	May 23 – May 29, 2013		**Analysis period**	May 24 – 28
Disturbance Classification	very high		**Access by**	Helicopter
Temperature (°F)	Average: 50.97	Maximum: 62.68	Minimum: 38.61	
Average Humidity (%)	44.27	**Average Barometric Pressure (Bar)**		0.933
Wind Speed (mph)	Average: 0.79	Gust: 6.09		

5.2.2.6. Spring LT6

The Spring LT6 soundscape monitor was located on a hillside approximately 2.5 miles north of the Susitna River and 1.25 miles northwest of the Watana Creek (Figure 5-12). The instrument was deployed on May 23, 2013. Data were recorded between May 24 and May 30, 2013. Table 5-11 provides summary information on Spring LT6.

The most common geophony identified was rain (audible 1 percent of the time) and wind (57 percent) (Figure C-71). The most common biophony identified was birdsong (91 percent) (Figure C-72). On average, mechanized sound was audible 2 percent of each day (Figures C-73 and 74), with as much as 11 percent during the highest hour (solely from passing aircraft), and an average of 11 events per day (Figures C-76 and 77). Based on these results, the existing soundscape disturbance at Spring LT6 is medium.

Over the 7-day period, the hourly L_{50} measurement values ranged from 25 to 33 dBA across the day and night hours (Figure C-75). The generally lower values in the morning hours suggest hourly L_{50} measurements are driven by wind patterns.

Figure 5-12. Photo of Long-Term Sound Monitor Spring LT6 Location

Table 5-11. Long-Term Sound Monitor Spring LT6 Summary

<table>
<tr><td>Location and purpose</td><td colspan="5">Located 2.6 miles NNE of the Confluence of Watana Creek and the Susitna River, to collect data at this major confluence.</td></tr>
<tr><td>Coordinates</td><td colspan="2">Lat: 62.8683, Long: -148.2533</td><td colspan="2">Elevation</td><td>2,515 feet</td></tr>
<tr><td>Deployed</td><td colspan="2">May 23 – May 31, 2013</td><td colspan="2">Analysis period</td><td>May 24 – 30</td></tr>
<tr><td>Disturbance Classification</td><td colspan="2">medium</td><td colspan="2">Access by</td><td>Helicopter</td></tr>
<tr><td>Temperature (°F)</td><td>Average: No data</td><td colspan="2">Maximum: No data</td><td colspan="2">Minimum: No data</td></tr>
<tr><td>Average Humidity (%)</td><td>No data</td><td colspan="3">Average Barometric Pressure (Bar)</td><td>No data</td></tr>
<tr><td>Wind Speed (mph)</td><td>Average: No data</td><td colspan="4">Gust: No data</td></tr>
</table>

5.2.2.7. Spring LT7

The Spring LT7 soundscape monitor was located along the Denali Highway, 0.5 mile south of the Nenana River, and 10.5 miles east of the Denali and Parks Highway intersection near Cantwell (Figure 5-13). The instrument was deployed on May 21, 2013. Data were collected from May 22 through May 25, 2013. Table 5-12 provides summary information on Spring LT7.

The most common geophony identified was wind (audible 58 percent of the time) and flowing water (100 percent) (Figure C-78). The most common biophony identified was birdsong (99 percent) (C-79). Human speech and activity was audible 25 percent of the time. On average, mechanized sound was audible 19 percent of each day (Figures C-80 and 81), with as much as 39 percent during the highest hour, and an average of 71 events per day (Figures C-83 and 84). Anthropogenic sound sources along Denali Highway include generators, music, and automotive and all-terrain vehicle traffic. Based on these results, existing soundscape disturbance at Spring LT7 is very high.

Under conditions of low average wind speed (1 mph) and low gust velocity (6 mph), monitoring position Spring LT7 has correspondingly low wind noise audibility compared to Winter LT1, a comparable monitoring location along the Denali Highway. In addition, in spite of the nearly constant audibility of running water, the reduced audibility of wind likely gave mechanized sound sources (such as passing aircraft and vehicle traffic on the Denali Highway) a greater likelihood of being audible.

Over the 4-day period, the hourly L_{50} measurement values ranged from 20 to 29 dBA across the day and night hours (Figure C-82). This measurement is consistent with a remote rural environment. The lower end of this range appears to occur during the midday hours and may suggest a correlation with reduced wind speeds during that time.

Figure 5-13. Photo of Long-Term Sound Monitor Spring LT7 Location

Table 5-12. Long-Term Sound Monitor Spring LT7 Summary

Location and purpose	Located adjoining a gravel pullout near milepost 122 of the Denali Highway. The purpose was to monitor soundscape conditions at the proposed transmission line and vehicular access route to the Denali Corridor.		
Coordinates	Lat: 63.39105, Long: -148.56028	**Elevation**	2,410 feet
Deployed	May 21 – May 26, 2013	**Analysis period**	May 22 – 25
Disturbance Classification	very high	**Access by**	Helicopter
Temperature (°F)	Average: 41.9	Maximum: 52.4	Minimum: 28.0
Average Humidity (%)	51.84	**Average Barometric Pressure (Bar)**	0.932
Wind Speed (mph)	Average: 1.12	Gust: 6.15	

5.2.2.8. Spring LT9

The Spring LT9 soundscape monitor was located approximately 1.5 miles south of the Susitna River (Figure 5-14). The instrument was deployed on May 23, 2013. Data were collected from May 24 through May 30. Table 5-13 provides summary information on Spring LT9.

The most common geophony identified was wind (audible 52 percent of the time) and flowing water (100 percent) (Figure C-85). The most common biophony identified was birdsong (76 percent) (Figure C-86). On average, mechanized sound (passing aircraft) was audible 2 percent of each day (Figures C-87 and 88), with as much as 6 percent during the highest hour, and an average of 6 events per day (Figures C-90 and 91). Based on these results, existing natural sound disturbance at Spring LT9 is between low and medium.

Averaged over the 4-day period, the hourly L_{50} measurement values range from 32 to43 dBA throughout the diurnal cycle (Figure C-89). This measurement is consistent with a rural environment. The lower end of this range appears to occur during the daytime hours and suggests a correlation with reduced wind speeds during that time.

Figure 5-14. Photo of Long-Term Sound Monitor Spring LT9 Location

Table 5-13. Long-Term Sound Monitor Spring LT9 Summary

Location and purpose	Located 1.8 miles south of Vee Canyon. The purpose of this station was to collect data at the easternmost proposed extent of the project reservoir. Long-term monitoring occurred here during spring, summer, and fall.		
Coordinates	Lat: 62.67589, Long: -147.527	**Elevation**	2,800 feet
Deployed	May 23 – May 30, 2013	**Analysis period**	May 24 – 30
Disturbance Classification	low - medium	**Access by**	Helicopter
Temperature (°F)	Average: No data	Maximum: No data	Minimum: No data
Average Humidity (%)	No data	**Average Barometric Pressure (Bar)**	No data
Wind Speed (mph)	Average: No data	Gust: No data	

5.2.3. Summer Long-Term Acoustic Monitoring

5.2.3.1. Summer LT1

The Summer LT1 soundscape monitor was located approximately 4 miles east of the Parks Highway, approximately 2.25 miles northwest of the Susitna River and the Alaska Railroad (Figure 5-15). The instrument was deployed on July 12, 2013. Data were collected July 13 through 15 and July 17 and 18, 2013. Its position was located, and is only 35 feet west of the Spring LT1 monitoring position. Table 5-14 provides summary information on Summer LT1.

The most common geophony identified was wind (audible 88 percent of the time) and rain (8 percent) (Figure C-92). The most common biophony identified were birdsong (32 percent) and insects (20 percent) (Figure C-93). On average, mechanized sound was audible 7 percent of each day (Figures C-94 and 95), with as much as 26 percent during the highest hour (from passing aircraft and trains), and an average of 27 events per day (Figures C-97 and 98). Based on these results, existing soundscape disturbance at Summer LT1 is high.

Over the 5-day period, the hourly L_{50} measurement values ranged between 27 and 38 dBA across the day and night hours (Figure C-96). This measurement is considerably higher than the Spring LT1 range of 17-22 dBA. This is likely due to the higher average winds and gusts recorded at the Summer LT1 position (i.e., 10 mph and 25 mph gust [summer], compared to 2.5 mph and 8 mph gust [spring]). This variation in wind speed also explains the difference in wind audibility: 88 percent for Summer LT1 versus only 53 percent for Spring LT1. Despite this greater audibility of natural sounds compared to the Spring LT1 data, passing aircraft and trains were still audible at a frequency that characterized natural soundscape disturbance as high, despite the maximum hourly sound levels of less than 55 dBA L_{eq}.

Figure 5-15. Photo of Long-Term Sound Monitor Summer LT1 Location

Table 5-14. Long-Term Sound Monitor Summer LT1 Summary

Location and purpose	Near Curry Lookout and Camp Regalvista in Denali State Park. This is a prominent viewpoint and includes a shelter on the National Register of Historic Places. This location represents a visitor attraction. Spring and summer monitoring took place here.		
Coordinates	Lat: 62.62237, Long: -150.09857	**Elevation**	2,550 feet
Deployed	July 12 – July 20, 2013	**Analysis period**	July 13 – 15, 17 – 18
Disturbance Classification	high	**Access by**	Helicopter
Temperature (°F)	Average: 53.72	Maximum: 67.8	Minimum: 45.6
Average Humidity (%)	81.34	**Average Barometric Pressure (Bar)**	0.93
Wind Speed (mph)	Average: 10.25	Gust: 25.4	

5.2.3.2. Summer LT3

The Summer LT3 soundscape monitor was located approximately 8.5 miles southwest of the Denali Highway (Figure 5-16). The instrument was deployed on July 12, 2013. Data were recorded from July 13 through July 18, 2013. Table 5-15 provides summary information on Summer LT3.

The most common biophony identified was birdsong (audible 78 percent of the time) and insects (22 percent) (Figure C-100). The most common geophony identified was rain (2 percent) and wind (50 percent) (Figure C-99). On average, mechanized sound was audible 1 percent of each day (Figures C-101 and 102), with as much as 4 percent during the highest hour (solely from passing aircraft), and an average of 4 events per day (Figures C-104 and 105). Based on these results, the existing soundscape disturbance at Summer LT3 is low.

Over the 5-day period, the hourly L_{50} measurement values narrowly ranged between 27 and 33 dBA across the day and night hours (Figure C-103). This measurement is consistent with a remote rural environment. Higher values in the nighttime hours indicate higher wind speeds compared to daytime. This average hourly L_{50} range is higher than the 15-20 dBA measured at Winter LT7; however, the average wind speed and gust velocities measured at the two locations are generally comparable, which suggests that the frequency of audible mechanized noise at both locations is more contingent on the frequency of passing aircraft than on acoustic masking by the natural soundscape.

Figure 5-16. Photo of Long-Term Sound Monitor Summer LT3 Location

Table 5-15. Long-Term Sound Monitor Summer LT3 Summary

Location and purpose	Located 2.1 miles WNW of Brushkana Creek. The purpose of this station was to collect data within the middle section of the proposed Denali corridor. This is expected to have low anthropogenic activity outside of hunting season.		
Coordinates	Lat: 63.18611, Long: -148.27378	**Elevation**	3,350 feet
Deployed	July 12 – July 20, 2013	**Analysis period**	July 13 – 15, 17 – 18
Disturbance Classification	low	**Access by**	Helicopter
Temperature (°F)	Average: 56.9	Maximum: 71.2	Minimum: 59.3
Average Humidity (%)	66.2	**Average Barometric Pressure (Bar)**	0.903
Wind Speed (mph)	Average: 3.1	Gust: 18.2	

5.2.3.3. Summer LT4

The Summer LT4 soundscape monitor was located approximately 3.3 miles north of the Susitna River (Figure 5-17). The instrument was deployed on July 12, 2013. Data were collected from July 13 to July 17, 2013. Table 5-16 provides summary information on Summer LT4.

The most common geophony identified was wind (audible 97 percent of the time) (Figure C-106). The most common biophony identified was birdsong (69 percent) (Figure C-107). On average, mechanized sound was audible 3 percent of each day (Figures C-108 and 109), with as much as 20 percent during the highest hour (solely from passing aircraft), and an average of 8 events per day (Figures C-111 and 112). Based on these results, the existing soundscape disturbance at Summer LT4 is between medium and high.

Over the 4-day period, the hourly L_{50} measurement values ranged between 26 and 41 dBA (Figure C-110). This measurement is consistent with a rural environment. Higher values in the daytime and evening suggest the contribution of higher wind speeds (7 mph average, 24 mph gusts) during those hours. Although the nearly 100 percent audibility of wind noise provides potential sound-masking of mechanized sound events, there were daytime hours during which aircraft activity was frequent and led to the 20 percent audibility in the highest hour. These episodic disturbances were the primary driver for the classification of natural sound disturbance of medium to high.

Figure 5-17. Photo of Long-Term Sound Monitor Summer LT4 Location

Table 5-16. Long-Term Sound Monitor Summer LT4 Summary

Location and purpose	Located on a hillside north of the Susitna and near a group of large, unnamed lakes. The purpose of this station was to collect data in the northeast portion of the project.			
Coordinates	Lat: 62.88214, Long: -148.3725		**Elevation**	2,800 feet
Deployed	July 12 – July 20, 2013		**Analysis period**	July 13 – 15, 17
Disturbance Classification	medium - high		**Access by**	Helicopter
Temperature (°F)	Average: 57.4	Maximum: 72.68	Minimum: 47.12	
Average Humidity (%)	69.3	**Average Barometric Pressure (Bar)**		0.922
Wind Speed (mph)	Average: 6.6	Gust: 23.9		

5.2.3.4. Summer LT5

The Summer LT5 soundscape monitor was located approximately 4.25 miles south of the Susitna River (Figure 5-18). It was deployed on July 12, 2013. Data were collected from July 13 through 15 and July 17 through 19, 2013. Table 5-17 provides summary information on Summer LT5.

The most common geophony identified was running water (audible 100 percent of the time), wind (87 percent), and rain (8 percent) (Figure C-113). The most common biophony identified was birdsong (30 percent) (Figure C-114). The sound of running water was from a flowing creek located approximately one-tenth of a mile to the north. On average, mechanized sound was audible 4 percent of each day (Figures C-115 and 116), with as much as 15 percent during the highest hour (solely from passing aircraft), and an average of 12 events per day (Figures C-118 and 119). Based on these results, existing soundscape disturbance at Summer LT5 is medium.

Over the 5-day period, the hourly L_{50} measurement values ranged between 27 and 37 dBA (Figure C-117). Higher average values at night suggest the sound contribution of the higher measured wind speeds (2 mph average with 17 mph gusts). The consistent water and wind sound may provide sound masking for mechanized disturbance events. The data suggest that aircraft disturbance is more frequent during certain daylight hours.

Figure 5-18. Photo of Long-Term Sound Monitor Summer LT5 Location

Table 5-17. Long-Term Sound Monitor Summer LT5 Summary

Location and purpose	Located 0.7 miles southeast of the Fog Lakes group, and south of Fog Creek. The purpose of this location was to collect data approaching the land ownership boundary.			
Coordinates	Lat: 62.76392, Long: -148.41756		**Elevation**	2,400 feet
Deployed	July 12 – July 20, 2013		**Analysis period**	July 13 – 15, 17 – 19
Disturbance Classification	medium		**Access by**	Helicopter
Temperature (°F)	Average: 58.3	Maximum: 67.6	Minimum: 48.5	
Average Humidity (%)	71.4	**Average Barometric Pressure (Bar)**		0.932
Wind Speed (mph)	Average: 1.9	Gust: 16.6		

5.2.3.5. Summer LT6

The Summer LT6 soundscape monitor was located approximately 1 mile northwest of the Susitna River (Figure 5-19). This location was 40 feet north of Spring LT5 and 0.25 miles east of Winter LT4. The monitor was deployed on July 12, 2013. Data were collected from July 13 through 15 and July 17, 2013. Table 5-18 provides summary information on Summer LT6.

The most common geophony identified was running water (audible 100 percent of the time) and wind (78 percent) (Figure C-120). The most common biophony identified was birdsong (51 percent) (Figure C-121). The sound of running water was from the Susitna River, 1 mile away. On average, mechanized sound was audible 3 percent of each day (Figures C-122 and 123), with as much as 17 percent during the highest hour (solely from passing aircraft), and an average of 13 events per day (Figures C-125 and 126). Based on these results, existing soundscape disturbance at Summer LT6 is between medium and high.

Over the 4-day period, the hourly L_{50} measurement values ranged between 29 and 34 dBA throughout the diurnal cycle (Figure C-124). Higher average values at night suggest the sound contribution of the higher measured wind speeds (3 mph average with 38 mph gusts). The consistent water and wind sound may provide sound masking for mechanized disturbance events. The data suggest that aircraft disturbance is more frequent during certain daylight hours.

Figure 5-19. Photo of Long-Term Sound Monitor Summer LT6 Location

Table 5-18. Long-Term Sound Monitor Summer LT6 Summary

Location and purpose	Located on a hillside approximately 3.4 miles west of the proposed dam site. This site represented locations near the proposed dam. Monitoring occurred during all four seasons at this location.			
Coordinates	Lat: 62.83047, Long: -148.66463		**Elevation**	2,250 feet
Deployed	July 12 – July 20, 2013		**Analysis period**	July 13 – 15, 17
Disturbance Classification	medium - high		**Access by**	Helicopter
Temperature (°F)	Average: 60	Maximum: 77.7	Minimum: 48.9	
Average Humidity (%)	66.45	**Average Barometric Pressure (Bar)**		0.943
Wind Speed (mph)	Average: 3.2	Gust: 37.6		

5.2.3.6. Summer LT7

The Summer LT7 soundscape monitor was located on a hillside approximately 3.75 miles north of the Susitna River (Figure 5-20). The monitor was deployed on July 12, 2013. Data were collected from July 13 through July 18, 2013. Table 5-19 provides summary information on Summer LT7.

The most common geophony identified was wind (audible 47 percent of the time) (Figure C-127). The most common biophony identified was birdsong (32 percent) (Figure C-128). The sound of running water was from the Susitna River, 1 mile away. On average, mechanized sound was audible 1 percent of each day (Figures C-129 and 130), with as much as 5 percent during the highest hour (solely from passing aircraft), and an average of 5 events per day (Figures C-132 and 133). Based on these results, existing soundscape disturbance at Summer LT7 is between low and medium.

Over the 6-day period, the hourly L_{50} measurement values ranged between 25 and 35 dBA throughout the diurnal cycle (Figure C-131). Higher average values in the afternoon and evening suggest the sound contribution of the higher measured wind speeds (6 mph average with 21 mph gusts) during those hours. With wind audible only half the time there is greater opportunity for mechanized disturbance events to be audible. However, the distance of this site from mechanized activity resulted in a low number of events.

Figure 5-20. Photo of Long-Term Sound Monitor Summer LT7 Location

Table 5-19. Long-Term Sound Monitor Summer LT7 Summary

Location and purpose	Approximately 5.7 miles NW of the proposed dam, along the Chulitna corridor.			
Coordinates	Lat: 62.869, Long: -148.704		**Elevation**	3,180 feet
Deployed	July 12 – July 20, 2013		**Analysis period**	July 13 – 18
Disturbance Classification	low-medium		**Access by**	Helicopter
Temperature (°F)	Average: 55.7	Maximum: 70.3	Minimum: 44.8	
Average Humidity (%)	72.23	**Average Barometric Pressure (Bar)**		0.911
Wind Speed (mph)	Average: 6	Gust: 21		

5.2.3.7. Summer LT8

The Summer LT8 soundscape monitor was located approximately 2 miles north of the Susitna River (Figure 5-21). This location was 250 feet west of Winter LT5 and 0.8 miles northeast of Spring LT4. The monitor was deployed on July 12, 2013. Data were collected from July 13 through 15 and July 17 through 19, 2013. Table 5-20 provides summary information on Summer LT8.

The most common geophony identified was wind (audible 72 percent of the time) and rain (3 percent) (Figure C-134). The most common biophony identified was birdsong (42 percent), insects (2 percent) and mammals (1 percent) (Figure C-135). The sound of running water was from the Susitna River, 1 mile away. On average, mechanized sound was audible 13 percent of each day (Figures C-136 and 137), with as much as 34 percent during the highest hour (solely from passing aircraft), and an average of 44 events per day (Figures C-139 and 140). Based on these results, existing soundscape disturbance at Summer LT8 is between high and very high.

Over the 6-day period, the hourly L_{50} measurement values ranged between 20 and 35 dBA throughout the diurnal cycle (Figure C-138). Higher average values during the day suggest the sound contribution of the higher measured wind speeds (6 mph average with 21 mph gusts) during those hours. When compared to the winter LT5 data from close to the same location, the far greater number of aircraft events during the summer contributed to the seasonal change from a low-to-medium rating to a high-to-very high rating for existing soundscape disturbance.

Figure 5-21. Photo of Long-Term Sound Monitor Summer LT8 Location

Table 5-20. Long-Term Sound Monitor Summer LT8 Summary

Location and purpose	Located on a hillside 0.6 miles east of High Lake. The purpose of this station was to establish baseline monitoring between the proposed Chulitna and Gold Creek corridors.			
Coordinates	Lat: 62.84956, Long: -149.09381		**Elevation**	2,680 feet
Deployed	July 12 – July 20, 2013		**Analysis period**	July 13 – 15, 17 – 19
Disturbance Classification	high – very high		**Access by**	Helicopter
Temperature (°F)	Average: 55.5	Maximum: 71.6	Minimum: 46.0	
Average Humidity (%)	77.26	**Average Barometric Pressure (Bar)**		0.920
Wind Speed (mph)	Average: 6.2	Gust: 21.5		

5.2.3.8. Summer LT9

The Summer LT9 soundscape monitor was located approximately 3.75 miles northwest of the Susitna River (Figure 5-22). This location was 0.25 miles northwest of Spring LT3. The monitor was deployed on July 12, 2013. Data were collected from July 13 through July 13 through 15 and July 17, 2013. Table 5-21 provides summary information on Summer LT9.

The most common geophony identified was wind (audible 86 percent of the time) and rain (5 percent) (Figure C-141). The most common biophony identified was birdsong (31 percent) and insects (5 percent) (Figure C-142). On average, mechanized sound was audible 5 percent of each day (Figures C-143 and 144), with as much as 12 percent during the highest hour (from passing aircraft and trains), and an average of 19 events per day (Figures C-146 and 47). Based on these results, existing soundscape disturbance at Summer LT9 is between medium and high.

Over the 4-day period, the hourly L_{50} measurement values ranged between 20 and 40 dBA across the day and night hours (Figure C-145). Higher average values at night suggest the sound contribution of the higher measured wind speeds (9 mph average with 32 mph gusts) during those hours.

Figure 5-22. Photo of Long-Term Sound Monitor Summer LT9 Location

Table 5-21. Long-Term Sound Monitor Summer LT9 Summary

Location and purpose	Located on Kesugi Ridge in Denali State Park. The purpose of this station is to collect data at this prominent viewpoint and visitor attraction.			
Coordinates	Lat: 62.82242, Long: -149.76122		**Elevation**	3,300 feet
Deployed	July 12 – July 20, 2013		**Analysis period**	July 13 – 15, 17
Disturbance Classification	medium - high		**Access by**	Helicopter
Temperature (°F)	Average: 52.8	Maximum: 66	Minimum: 45.6	
Average Humidity (%)	48.12	**Average Barometric Pressure (Bar)**		0.908
Wind Speed (mph)	Average: 9.1	Gust: 32.5		

5.2.4. Fall Season Long-Term Acoustic Monitoring

5.2.4.1. Fall LT1

The Fall LT1 soundscape monitor was located 3.75 miles northwest of the Susitna River and 4.25 miles south of the Parks Highway (Figure 5-23). The monitor was deployed on September 7, 2013. Data were collected on September 8, 2013. Table 5-22 provides summary information on Fall LT1.

The most common geophony identified was wind (audible 92 percent of the time) and rain (40 percent) (Figure C-148). The most common biophony identified was birdsong (4 percent) (Figure C-149). Mechanized sound was audible 3 percent of the day, and 43 percent during the highest hour (from passing aircraft and trains) (Figure C-150). Six disturbance events occurred (Figure C-151). Based on these results, existing soundscape disturbance at Fall LT1 is between high and very high.

Hourly L_{50} measurement values ranged between 22 and 59 dBA (Figure C-152). Higher values at night suggest the sound contribution of the higher measured wind speeds (3 mph average with 38 mph gusts). The consistent water and wind sound may provide sound masking for mechanized disturbance events. The data suggest that aircraft disturbance is more frequent during certain daylight hours. Despite the low overall percentage of time that mechanized noise is audible, its concentration within a brief time period resulted in this site exceeding the criteria for high disturbance on September 8.

Figure 5-23. Photo of Long-Term Sound Monitor Fall LT1 Location

Table 5-22. Long-Term Sound Monitor Fall LT1 Summary

Location and purpose	Located on Kesugi Ridge in Denali State Park.			
Coordinates	Lat: 62.822417, Long: -149.761222	**Elevation**	3,240 feet	
Deployed	September 7 – September 16, 2013	**Analysis period**	September 8	
Disturbance Classification	high – very high	**Access by**	Helicopter	
Temperature (°F)	Average: 43.64	Maximum: 46.7	Minimum: 40.6	
Average Humidity (%)	81.3	**Average Barometric Pressure (Bar)**	0.880	
Wind Speed (mph)	Average: 14.8	Gust: 33.5		

5.2.4.2. Fall LT2

The Fall LT2 soundscape monitor was located 3.75 miles north of the Susitna River, in the same location as Summer LT7 (Figure 5-24). The monitor was deployed on September 7, 2013. Data were collected on September 8, 2013. Table 5-23 provides summary information on Fall LT2.

The most common geophony identified was wind (audible 100 percent of the time) and rain (76 percent) (Figure C-153). The most common biophony identified was birdsong (3 percent) (Figure C-154). No mechanized sound was audible. Based on these results, existing soundscape disturbance at Fall LT2 is none to low.

Hourly L_{50} measurement values ranged between 29 and 40 dBA (Figure C-155). Higher values during the day and evening suggest the sound contribution of the higher measured wind speeds (5 mph average with 23 mph gusts) during those times. The constant wind may provide sound masking for mechanized disturbance events. As was noted for Summer LT7, the remoteness of this location from mechanized activity also contributed to the lack of soundscape disturbance events.

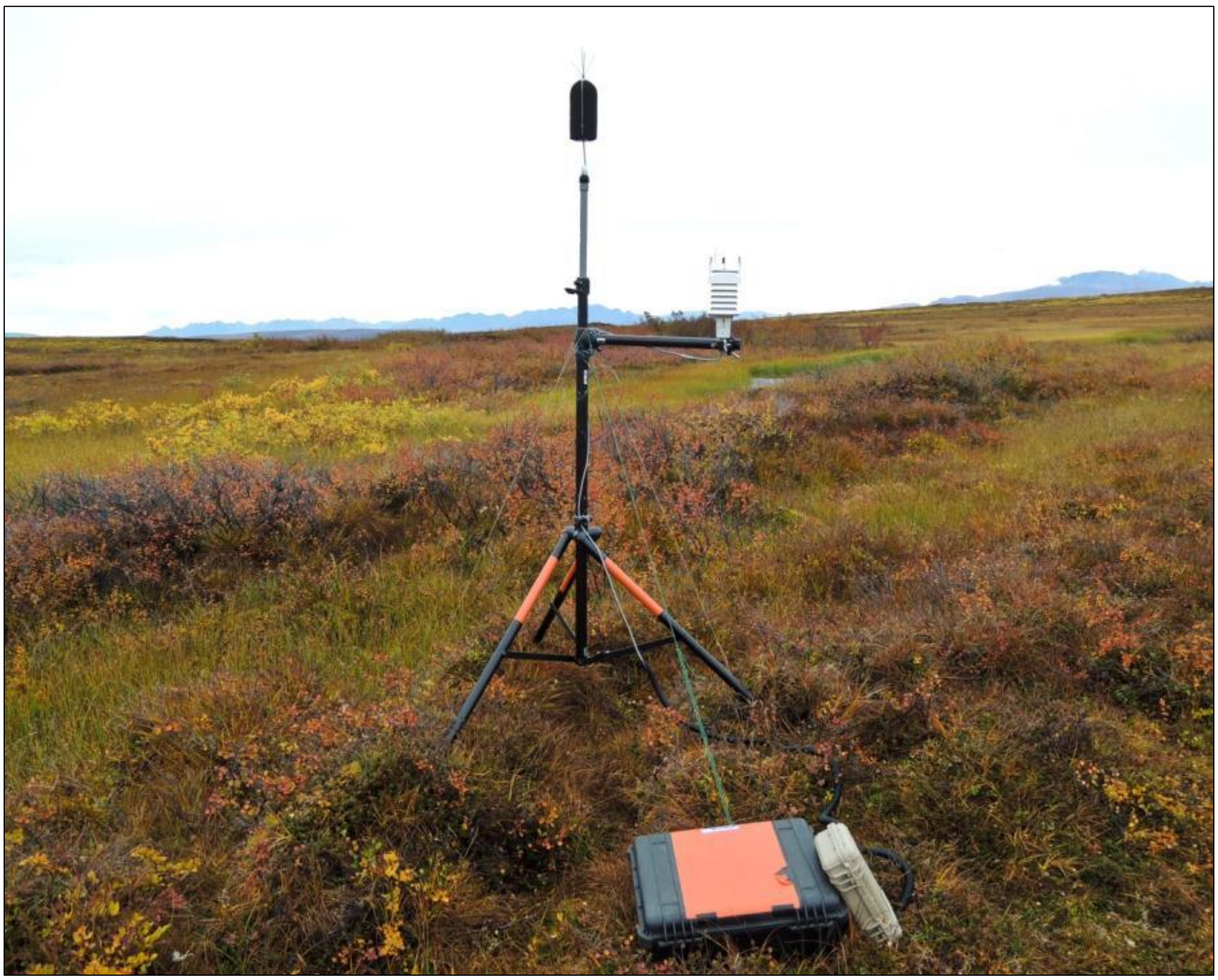

Figure 5-24. Photo of Long-Term Sound Monitor Fall LT2 Location

Table 5-23. Long-Term Sound Monitor Fall LT2 Summary

Location and purpose	Located along the Chulitna corridor, approximately 5.7 miles NW of the proposed Dame site.		
Coordinates	Lat: 62.869, Long: -148.704	**Elevation**	3,180 feet
Deployed	September 7 – September 16, 2013	**Analysis period**	September 8
Disturbance Classification	none to low	**Access by**	Helicopter
Temperature (°F)	Average: 44.4	Maximum: 48.2	Minimum: 413
Average Humidity (%)	85.37	**Average Barometric Pressure (Bar)**	0.890
Wind Speed (mph)	Average: 5.4	Gust: 23	

5.2.4.3. Fall LT3

The Fall LT3 soundscape monitor was located 3.3 miles north of the Susitna River, in the same location as Summer LT4 (Figure 5-25). The monitor was deployed on September 7, 2013. Data were collected on September 8, 2013. Table 5-24 provides summary information on Fall LT3.

The most common geophony identified was wind (audible 100 percent of the time) and rain (39 percent) (Figure C-156). The most common biophony identified was birdsong (7 percent) (Figure C-157). No mechanized sound was audible. Based on these results, existing soundscape disturbance at Fall LT3 is none to low.

Hourly L_{50} measurement values ranged between 22 and 44 dBA (Figure C-158). This reflects varying contributions of noise from rain and wind (5 mph average with 23 mph gusts) during those times. The constant wind may provide sound masking for mechanized disturbance events. The lack of passing aircraft that day contributed to the lack of soundscape disturbance, as compared to the summer LT4 data.

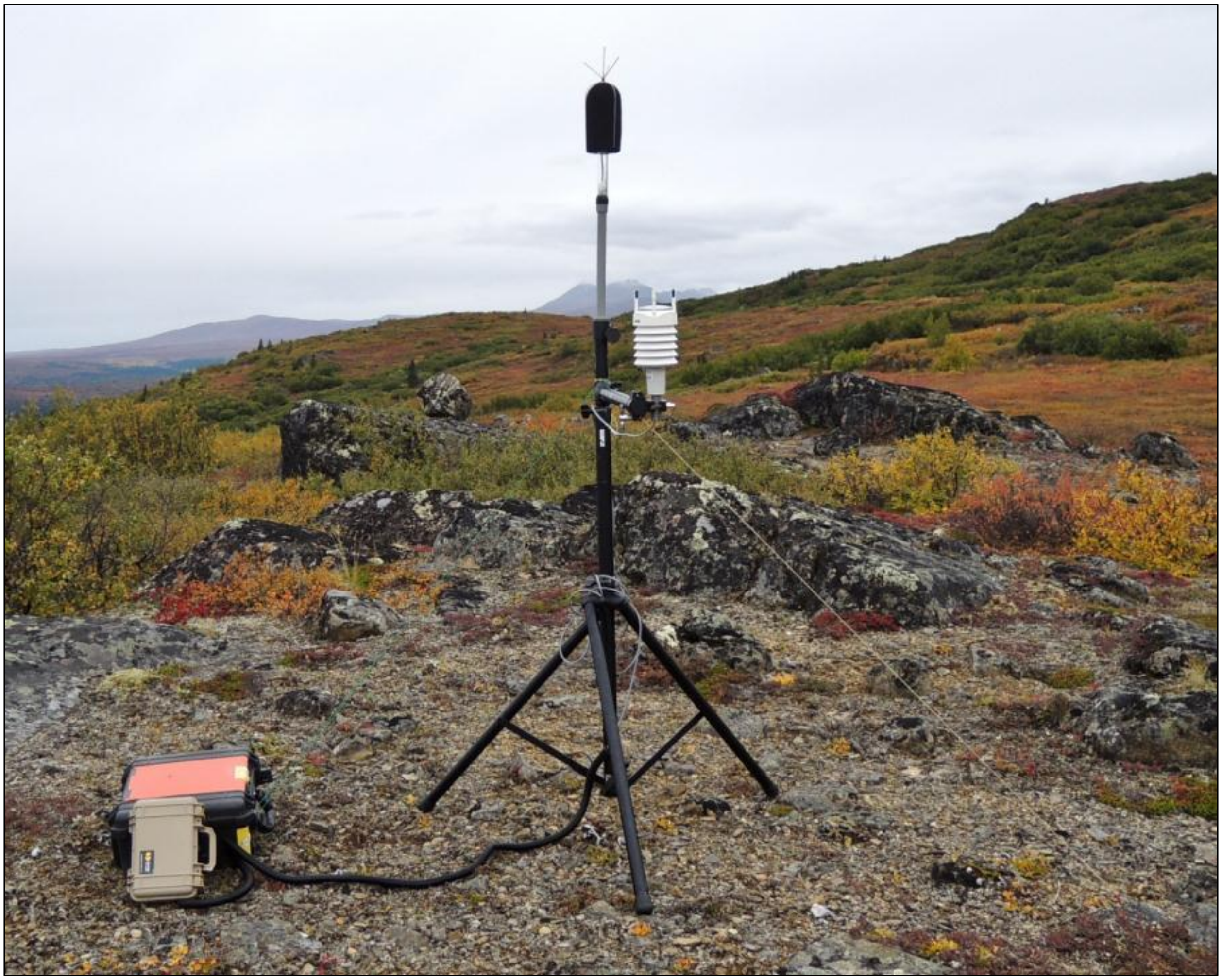

Figure 5-25. Photo of Long-Term Sound Monitor Fall LT3 Location

Table 5-24. Long-Term Sound Monitor Fall LT3 Summary

Location and purpose	Located on a hillside north of the Susitna River, near a group of large, unnamed lakes.			
Coordinates	Lat: 62.882139, Long: -148.3725		**Elevation**	2,820 feet
Deployed	September 7 – September 16, 2013		**Analysis period**	September 8
Disturbance Classification	none - low		**Access by**	Helicopter
Temperature (°F)	Average: 50.75	Maximum: 64.2	Minimum: 48.0	
Average Humidity (%)	66.05	**Average Barometric Pressure (Bar)**		0.900
Wind Speed (mph)	Average: 3.6	Gust: 16.8		

5.2.4.4. Fall LT4

The Fall LT4 soundscape monitor was located 1 mile north of the Susitna River (Figure 5-26). The monitor was deployed on September 7, 2013. Data were collected on September 8, 2013. Table 5-25 provides summary information on Fall LT4.

The most common geophony identified was wind (audible 100 percent of the time) and rain (59 percent) (Figure C-159). The most common biophony identified was birdsong (9 percent) (Figure C-160). Mechanized sound was audible 2 percent of the day (Figures C-161 and 162) and 10 percent during the highest hour (solely from passing aircraft). Seven disturbance events occurred. Based on these results, existing soundscape disturbance at Fall LT4 is between low and medium.

Hourly L_{50} measurement values ranged between 17 and 32 dBA (Figure C-163). The dBA levels were low overall during this monitoring event, which can contribute to the audibility of mechanized activity.

Figure 5-26. Photo of Long-Term Sound Monitor Fall LT4 Location

Table 5-25. Long-Term Sound Monitor Fall LT4 Summary

Location and purpose	Located on a hilltop approximately one mile WNW of Vee Canyon.			
Coordinates	Lat: 62.711356, Long: -147.579455		**Elevation**	3,090 feet
Deployed	September 7 – September 16, 2013		**Analysis period**	September 8
Disturbance Classification	medium		**Access by**	Helicopter
Temperature (°F)	Average: 49.2	Maximum: 55.0	Minimum: 32.0	
Average Humidity (%)	71.64	**Average Barometric Pressure (Bar)**		0.890
Wind Speed (mph)	Average: 5.4	Gust: 22.5		

5.2.4.5. Fall LT5

The Fall LT5 soundscape monitor was located 4.25 miles south of the Susitna River, in the same location as Summer LT5 (Figure 5-27). The monitor was deployed on September 7, 2013. Data were collected on September 8, 2013. Table 5-26 provides summary information on Fall LT5.

The most common geophony identified was flowing water (audible 100 percent of the time), wind (67 percent), and rain (21 percent) (Figure C-164). The most common biophony identified was birdsong (8 percent) (Figure C-165). The sound of flowing water was from a creek approximately one tenth of a mile to the north. Mechanized sound was audible 1 percent of the day (Figure C-166) and 20 percent during the highest hour (solely from passing aircraft). Four disturbance events occurred (Figure C-167. Based on these results, existing soundscape disturbance at Fall LT5 is between medium and high.

Hourly L_{50} measurement values ranged between 38 and 42 dBA (Figure C-168). Higher levels at night suggest the contribution of higher measured wind speeds (5 mph average, 23 mph gusts) during those hours. The constant sound of flowing water and wind may provide sound masking of mechanized disturbance events and was louder due to seasonal weather than the data collected from Summer LT5. Although mechanized sound was only audible for 1 percent of the day, its concentration in a single hour (20 percent) exceeds the medium rating for soundscape disturbance.

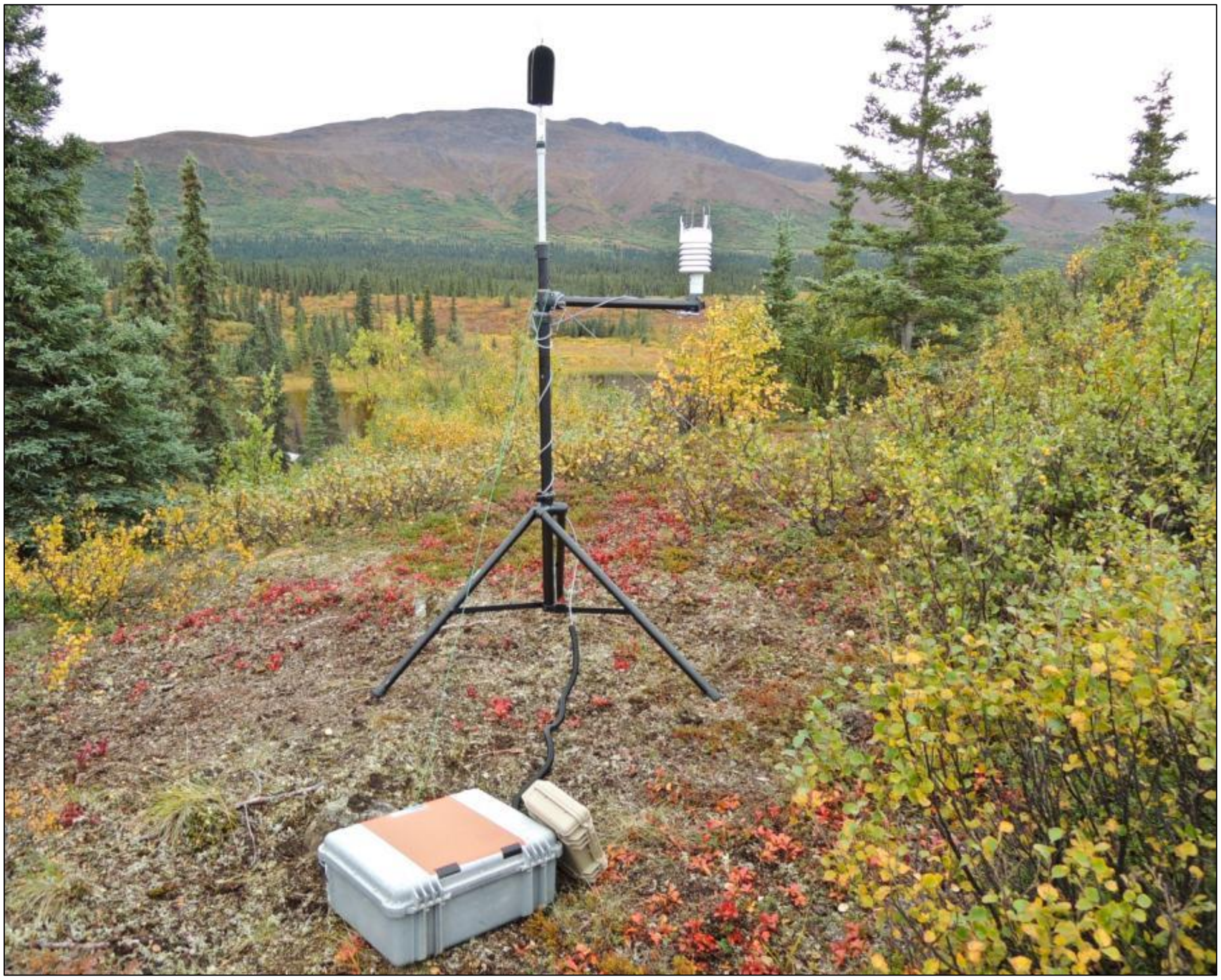

Figure 5-27. Photo of Long-Term Sound Monitor Fall LT5 Location

Table 5-26. Long-Term Sound Monitor Fall LT5 Summary

Location and purpose	Located 0.7 miles southeast of the Fog Lakes, and south of Fog Creek.			
Coordinates	Lat: 62.763917, Long: -148.417556		**Elevation**	2,400 feet
Deployed	September 7 – September 16, 2013		**Analysis period**	September 8
Disturbance Classification	medium - high		**Access by**	Helicopter
Temperature (°F)	Average: 46.9	Maximum: 53.06	Minimum: 42.26	
Average Humidity (%)	83.18	**Average Barometric Pressure (Bar)**		0.920
Wind Speed (mph)	Average: 5.3	Gust: 22.8		

5.2.4.6. Fall LT7

The Fall LT7 soundscape monitor was located approximately 0.75 mile northwest of the Susitna River (Figure 5-28). The monitor was deployed on September 7, 2013. Data were collected from September 8 through September 13, 2013. Table 5-27 provides summary information on Fall LT7.

The most common geophony identified was flowing water (audible 100 percent of the time), wind (53 percent), and rain (37 percent) (Figure C-169). The most common biophony identified was birdsong (8 percent) (Figure C-170). The sound of flowing water came from the Susitna River. On average, mechanized sound was audible 7 percent of each day (Figures C-171 and 172), with as much as 15 percent during the highest hour (from passing aircraft), and an average of 20 events per day (Figures C-174 and 175). Based on these results, existing soundscape disturbance at Fall LT7 is between medium and high.

Over the 4-day period, the hourly L_{50} measurement values ranged between 25 and 32 dBA throughout the diurnal cycle (Figure C-173).The constant sound of water and frequent wind may sound-mask mechanized disturbance events. Data suggest that aircraft activity is concentrated during certain hours of the day.

Figure 5-28. Photo of Long-Term Sound Monitor Fall LT7 Location

Table 5-27. Long-Term Sound Monitor Fall LT7 Summary

Location and purpose	Located in a bog in a U-bend of the Susitna River. The purpose of this station was to collect data near the land ownership boundary.		
Coordinates	Lat: 62.7805, Long: -148.7414	**Elevation**	2,040 feet
Deployed	September 7 – September 16, 2013	**Analysis period**	September 8 – 13
Disturbance Classification	medium - high	**Access by**	
Temperature (°F)	Average: 45.3	Maximum: 55.9	Minimum: 39.5
Average Humidity (%)	83.21	**Average Barometric Pressure (Bar)**	0.935
Wind Speed (mph)	Average: 2.19	Gust: 25.2	

5.2.4.7. Fall LT8

The Fall LT8 soundscape monitor was located approximately 8.75 miles north of the Susitna River (Figure 5-29). The monitor was deployed on September 7, 2013. Data were collected on September 8, 9, and 11, 2013. Table 5-28 provides summary information on Fall LT8.

The most common geophony identified was flowing water (audible 100 percent of the time), rain (48 percent), and wind (30 percent) (Figure C-176). The most common biophony identified was birdsong (31 percent) (Figure C-177). The sound of flowing water came from nearby creeks, the closest being less than 0.25 mile west. On average, mechanized sound was audible 4 percent of each day (Figures C-178 and 179), with as much as 12 percent during the highest hour (from passing aircraft), and an average of 15 events per day (Figures C-181 and 182). Based on these results, existing soundscape disturbance at Fall LT8 is between medium and high.

Over the 4-day period, the hourly L_{50} measurement values ranged between 25 and 32 dBA (Figure C-180).The constant sound of water and frequent wind may sound-mask mechanized disturbance events. Data suggest that aircraft activity is concentrated during certain hours of the day.

Figure 5-29. Photo of Long-Term Sound Monitor Fall LT8 Location

Table 5-28. Long-Term Sound Monitor Fall LT8 Summary

Location and purpose	Located 1.5 miles north of the confluence of Portage Creek and Thoroughfare Creek, on a hillside between the creeks. The purpose of this station was to collect data representative of the north section of the project area.		
Coordinates	Lat: 62.94146, Long: -149169973	**Elevation**	2,200 feet
Deployed	September 7 – September 16, 2013	**Analysis period**	September 8 – 9, 11
Disturbance Classification	medium - high	**Access by**	Helicopter
Temperature (°F)	Average: No data	Maximum: No data	Minimum: No data
Average Humidity (%)	No data	**Average Barometric Pressure (Bar)**	No data
Wind Speed (mph)	Average: No data	Gust: No data	

5.2.4.8. Fall LT9

The Fall LT9 soundscape monitor was located approximately 0.25 mile south of the Denali Highway (Figure 5-30). The monitor was deployed on September 7, 2013. Data were collected on September 8, 9, 11, and 12, 2013. Table 5-29 provides summary information on Fall LT9.

The most common geophony was wind (audible 39 percent of the time) and rain (35 percent) (Figure C-183). The most common biophony was birdsong (4 percent) (Figure C-184). On average, mechanized sound was audible 24 percent of each day (Figures C-185 and 186), with as much as 41 percent during the highest hour, and an average of 109 events per day (Figures C-188 and 189). Disturbance was from a variety of sources such as generators, music, aircraft, and automotive and ATV traffic on the highway. Based on these results, the existing soundscape disturbance at Fall LT9 is very high.

Over the 4 days, the hourly L_{50} measurement values ranged between 27 and 32 dBA (Figure C-187).The relatively intermittent wind and low wind speeds (less than 2 mph average with gusts up to 19 mph) provided little opportunity for sound masking. This and proximity to the highway contributed to the high level of disturbance.

Figure 5-30. Photo of Long-Term Sound Monitor Fall LT9 Location

Table 5-29. Long-Term Sound Monitor Fall LT9 Summary

Location and purpose	Located where the proposed Denali corridor intersects the Denali Highway, near milepost 113.			
Coordinates	Lat: 63.345244, Long: -148.301793		**Elevation**	2,740 feet
Deployed	September 7 – September 16, 2013		**Analysis period**	September 8, 9, 11 – 12
Disturbance Classification	very high		**Access by**	Helicopter
Temperature (°F)	Average: 44.2	Maximum: 54.8	Minimum: 36.6	
Average Humidity (%)	83.65	**Average Barometric Pressure (Bar)**		0.910
Wind Speed (mph)	Average: 1.4	Gust: 17.9		

6. DISCUSSION

6.1. Review Documentation

Per Section 12.6.4 of the RSP, the study team reviewed laws, ordinances, regulations, standards, and guidance that may influence the Project construction and operation noise impact assessment. These efforts fulfill the objectives specified in the RSP Section 12.6.2. The data presented in Section 5.1 will be used for further analyses of soundscape impacts from the Project.

6.2. Seasonal Surveys of Ambient Sound Levels

As specified in Section 12.6.4 of the RSP, the study team conducted observations of perceived and identifiable sources of sound contributing to the ambient sound environment and the conditions during which they occur. This survey was conducted four times, associated with each of the four distinct seasons (i.e., summer, fall, winter, spring).

At a total of 23 LT locations, SPL metrics, statistical data, and DAR data from the four seasonal soundscape field surveys were successfully collected for multiple consecutive 24-hour periods. Of these, at least seven LT positions could reasonably be considered "co-located" and thus represent SPL and DAR data collection for more than one seasonal survey, which provides the kind of data that enables both a comparison of seasonal soundscapes (and the underlying acoustical contributors) and the comparison of predicted Project operation and construction noise with a seasonally appropriate baseline setting. For example, if a particular noise-producing construction activity was expected to take place during the summer season, then available baseline soundscape data from the summer survey would likely be used for any relative (e.g., increase over existing ambient) noise impact assessment.

Section 5.2 outlines the results of the detailed analysis of the baseline data from the seasonal survey conducted and the following detailed findings and information were presented:

- Reasonable identification of apparent significant acoustical contributors during a measurement period, including Project study activities and non-Project transportation and recreation activities that can be distinguished from the apparent "natural" background or specific naturally occurring sound events or conditions.
- Reasonable identification of apparent significant acoustical contributors attributed to naturally occurring sound events or conditions (e.g., birds or insects).
- Where and when data is available, correlation of wind speed with measured SPL and AR.
- One-third or octave-band analysis of measured sound, plotted versus time.
- Statistical values to help characterize the frequency of apparent anthropogenic sounds as a portion of entire measurement duration.

The overall soundscape of the Study Area is dominated by natural sounds such as winds traversing the rocky and/or vegetated landscape, rain and other meteorological phenomena, running water, and by birds, insects, and other fauna. However, within the Study Area the soundscape at the local scale depends on the individual site's proximity to the near and distant acoustical contributors that make up the outdoor ambient sound environment, which includes natural sounds that can range from very quiet to very loud. In other words, a naturally dominated soundscape should not be interpreted as being synonymous with very low measured sound levels.

The Study Area contains soundscapes having a wide range of existing natural sound disturbance. Very remote locations such as Brushkana (Winter LT7 and Summer LT3) and Vee Canyon (Spring LT9 and Fall LT4) had on average fewer than 10 natural sound disturbances per day and such disturbances (due largely to passing aircraft) were audible for no more than 6 minutes out of a given hour. On the other end of the spectrum, locations along the Denali Highway (e.g., Fall LT9) experience a much greater frequency of natural sound disturbance. While these observations may seem obvious for monitoring locations like Fall LT9 and Winter LT1 that adjoin or are close to this known seasonal travel route, it is less obvious for soundscapes like Kesugi Ridge (e.g., Spring LT3, Fall LT1). These sites seem remote based on access difficulty, but are in fact exposed to very high counts of natural sound disturbance. Both the potential of a very low natural sound level (calm winds) and the proximity of surface (highway and railroad) and aviation transportation routes contribute to the audibility of mechanized sound events.

The study team found that some soundscapes in the Study Area exhibit characteristics of an environment where a visitor would experience little or no evidence of human settlement, influence, or contact. However, many soundscapes within the Study Area currently have some degree of existing natural sound disturbance. Although the seasons certainly impart changes on the surveyed environment, in some instances, disturbance sources were found to change with the seasons. For instance, road vehicles using the unpaved Denali Highway in the summer and fall are replaced by snow machines using the same route in the winter and early spring.

Common to all seasons and at virtually all surveyed locations is the influence of passing aircraft as both a source of natural sound disturbance and a nearly ubiquitous component of the existing soundscape in the Study Area.

The data presented in Section 5.2 support the following findings and observations:

- The narrow difference (i.e., less than 2 dBA) among overall average L_{eq}, L_{10} (sound level exceeded 10 percent of the time), L_{50}, and L_{90} at Spring LT2 is consistent with the proximity of the monitor to a continuous source of sound emission: flowing water of Indian River.
- Background sound (L_{90}) tends to be 5-6 dBA less than L_{50} (median sound level) during spring. Aside from LT2, it ranged between 16 and 30 dBA. Median sound levels ranged (again, with the exception of LT2) between 20 and 35 dBA. These dBA ranges are generally compatible with an EPA expectation of 35 dBA day-night sound level (L_{dn}) for "wilderness ambient" (EPA 1978). Aircraft overflights, which can be significantly louder than the background sound level, help caused the overall average L_{eq} for some monitoring locations, such as LT1, to be considerably higher than the L_{50} or even the L_{10} measurement results.

6.3. Variances

AEA provided results as described in RSP Section 12.6.1 with no variances.

7. REFERENCES

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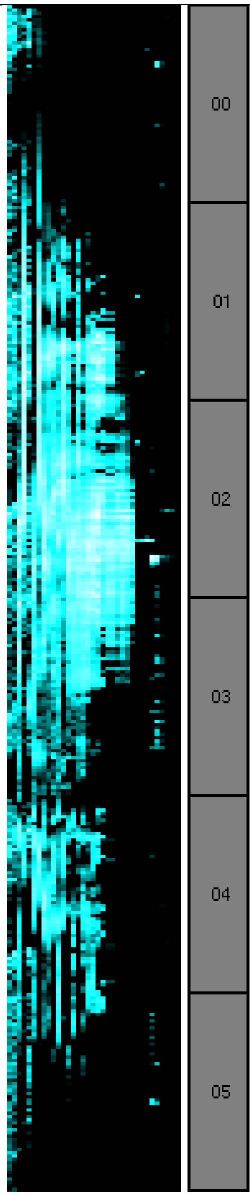
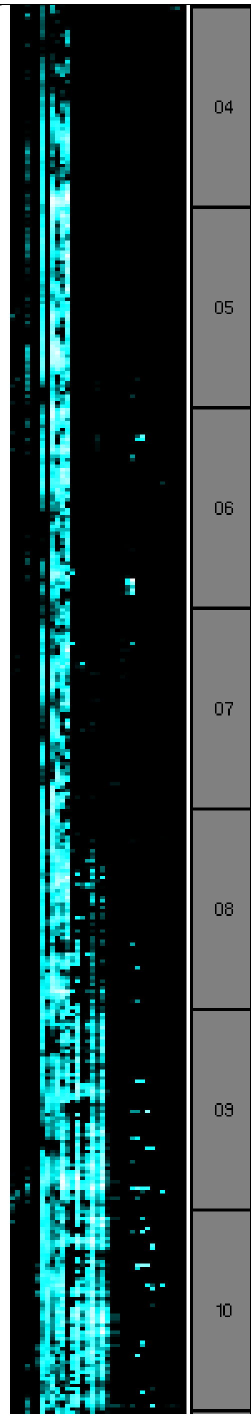
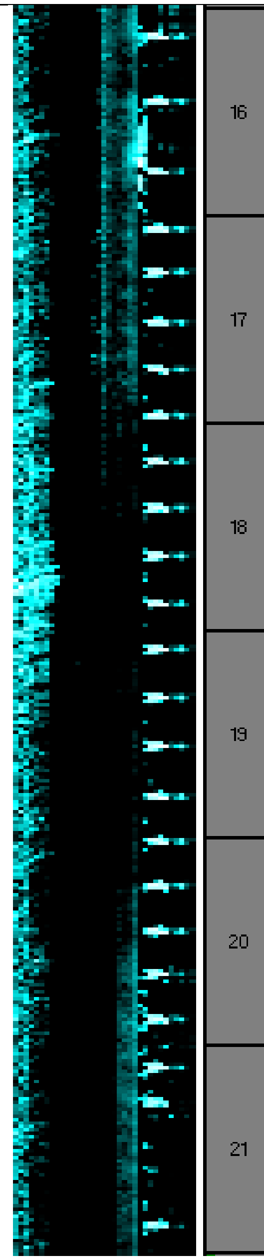
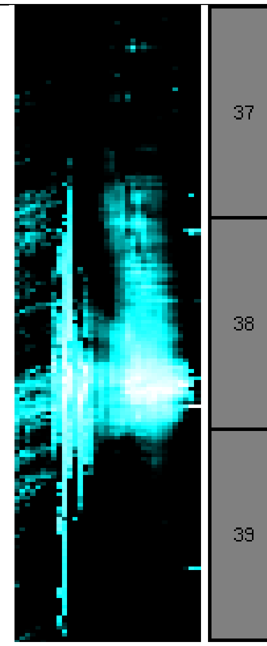
APPENDIX A: GLOSSARY OF TERMS

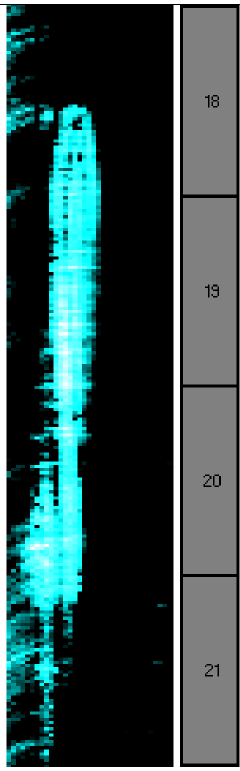
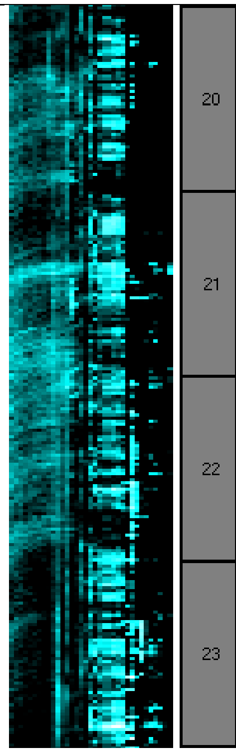
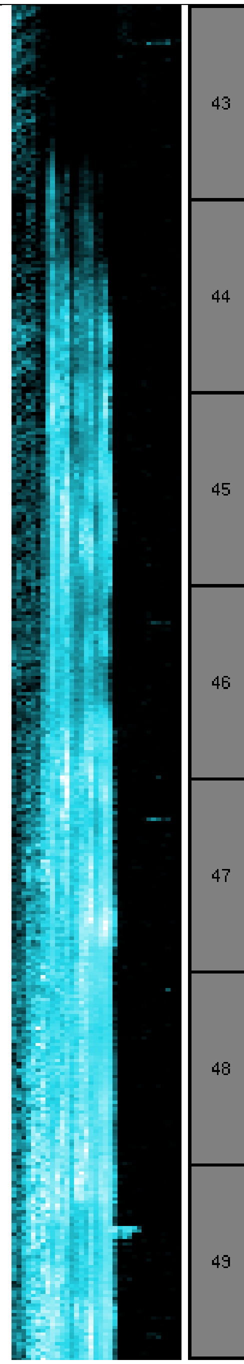
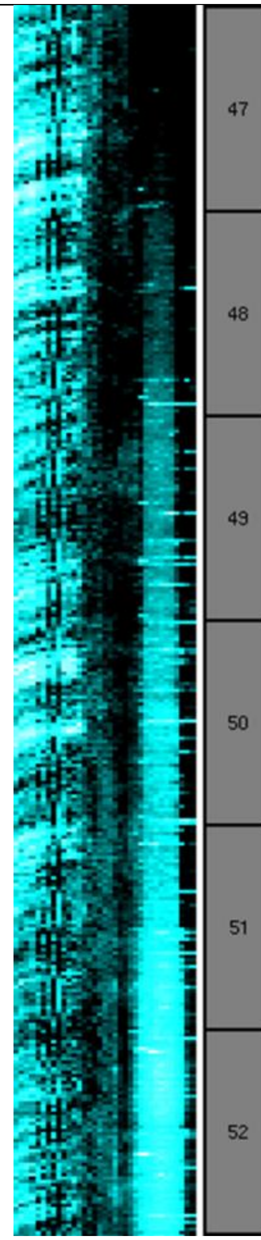
The following terms, metrics, statistical values and concepts are used in the presentation of field survey data and observations in this study report.

Noise	Whether something is perceived as a noise event is influenced by the type of sound, the perceived importance of the sound and its appropriateness in the setting, the time of day, the type of activity during which the noise occurs, and the sensitivity of the listener.
Sound	For purposes of this document, sound is a physical phenomenon generated by minute vibrations that result in waves that travel through a medium, such as air, and result in auditory perception by the human brain. Sound may, in most cases, be used interchangeably with “noise” when the latter is not used specifically to denote unwanted sound.
Frequency (Hz)	Sound frequency is measured in Hertz (Hz), which is a measure of how many times each second the crest of a sound pressure wave passes a fixed point. For example, when a drummer beats a drum, the skin of the drum vibrates a number of times per second. When the drum skin vibrates 100 times per second it generates a sound pressure wave that is oscillating at 100 Hz, and this pressure oscillation is perceived by the ear/brain as a tonal pitch of 100 Hz. Sound frequencies between 20 and 20,000 Hz are within the range of sensitivity of the best human ear.
Amplitude or Level (dB)	Sound level or amplitude is measured in decibels (dB) using a logarithmic scale. A sound level of zero dB is approximately the threshold of human hearing and is barely audible under extremely quiet listening conditions. Normal speech has a sound level of approximately 60 dB. Sound levels above approximately 110 dB begin to be felt inside the human ear as discomfort and eventually pain at 120 dB and higher levels. The minimum change in the sound level of individual events that an average human ear can detect is about 1 to 2 dB. A 3 to 5 dB change is readily perceived. A change in sound level of about 10 dB is usually perceived by the average person as a doubling (or if decreasing by 10 dB, halving) of the sound’s loudness.
Sound Pressure Level (L_p or SPL)	Sound level is usually expressed by reference to a known standard. This document refers to sound pressure level (SPL or L_p). In expressing sound pressure on a logarithmic scale, the sound pressure is compared to a reference value of 20 micropascals (µPa). L_p depends not only on the power of the source, but also on the distance from the source and on the acoustical characteristics of the space surrounding the source.
A-weighting	Sound from a tuning fork contains a single frequency (a pure tone), but most sounds one hears in the environment do not consist of a single frequency and instead are composed of a broad band of frequencies differing in sound level. The method commonly used to quantify environmental sounds consists of evaluating all frequencies of a sound according to a weighting system that reflects the typical frequency-

	dependent sensitivity of average healthy human hearing. This is called “A-weighting,” and the decibel level measured is referred to as dBA. In practice, the level of a noise source is conveniently measured using a sound level meter that includes a filter corresponding to the dBA “curve” of decibel adjustment per octave band center frequency from a “flat” or unweighted SPL.
Equivalent Sound Level (L_{eq})	L_{eq} is the energy mean, A-weighted sound or noise level during a period of time. It is the “equivalent” continuous decibel level that would have to be produced by a given source to equal the fluctuating decibel level over the same period of time that is either measured or modeled.
Median Sound Level (L_{50})	What the National Park Service often calls an “existing ambient sound,” this statistical value is the A-weighted dB level exceeded 50 percent of the time for a given short-term measurement or long-term monitoring period. In other words, the indicated dBA is the median L_p measured for that period. Like the equivalent sound level (L_{eq}), the dBA represented by this value includes contribution from all natural sounds and all mechanical, electrical, and other human-caused sounds in an area.
Percentile Sound Level (L_x)	The x-percentile-exceeded sound level is the sound level that is exceeded x percent of the measurement period. For example, the hourly L_{10} is the sound level that is exceeded 10 percent of a measurement hour. The hourly L_{50} is the sound level that is exceeded 50 percent of the measurement hour. The L_{50} is also known as the median sound level. Similarly, the hourly L_{90} is the sound level that is exceeded 90 percent of a given measurement hour.
Time Audible (%TA)	The cumulative (not necessarily continuous) percentage of time within a defined time period that a particular and identifiable sound source (or if not specific, considered to belong to some defined category) is audible to a listener of average healthy human hearing.
Maximum Sound Level (L_{max})	The maximum or largest-value sound level (in A-weighted decibels) measured during a given monitoring period at a measurement location.
Minimum Sound Level (L_{min})	The minimum or lowest-value sound level (in A-weighted decibels) measured during a given monitoring period at a measurement location.

APPENDIX B: SPECTROGRAPHS

			
Helicopter Flyover Sample from Summer LT1 7/13/13 – 08:00	**Fixed Wing Propeller Flyover** Sample from Summer LT4 7/13/13 – 09:00	**Birdcall** Sample from Spring LT4 5/27/13 – 06:00	**ATV Pass-By** Sample from Fall LT9 9/9/13 – 09:00

			
Jet Aircraft Pass-By Sample from Fall LT9 9/9/13 – 10:00	**Proximal Flying Insect** Sample from Summer LT1 7/13/13 – 09:00	**Locomotive Noise with Whistle at 49 Minute Mark** Sample from Spring LT3 5/22/13 – 02:00	**Precipitation Onset** Sample from Fall LT9 9/11/13 – 04:00

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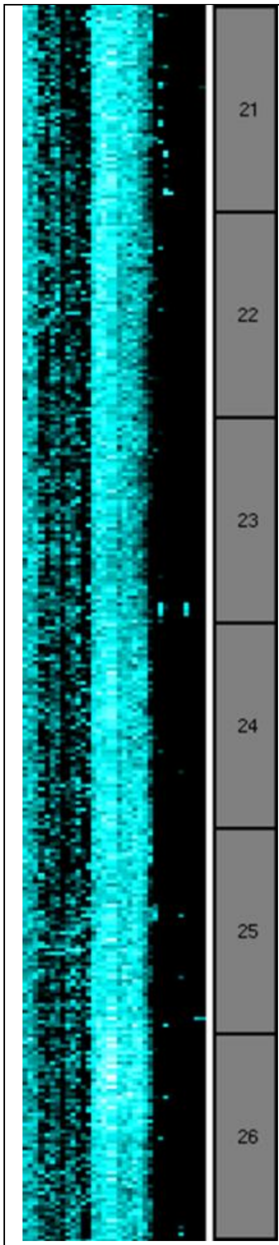
<td>
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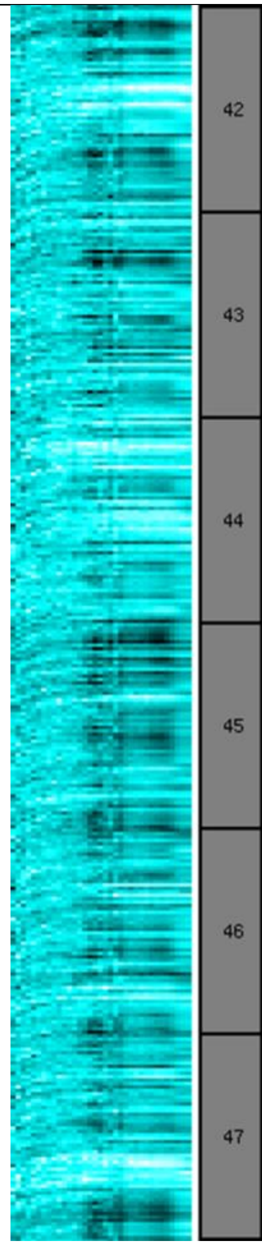
<td>
</td>
</tr>
<tr>
<td>Running Water
Sample from Fall LT5
9/8/13 – 07:00</td>
<td>Source Masking Caused by Wind (25MPH Gusts)
Sample from Winter LT5
7/13/13 – 19:00</td>
</tr>
</table>

APPENDIX C: GRAPHS OF LONG-TERM MONITORING DATA

Figure C-1. Geophony at Monitor Winter LT1

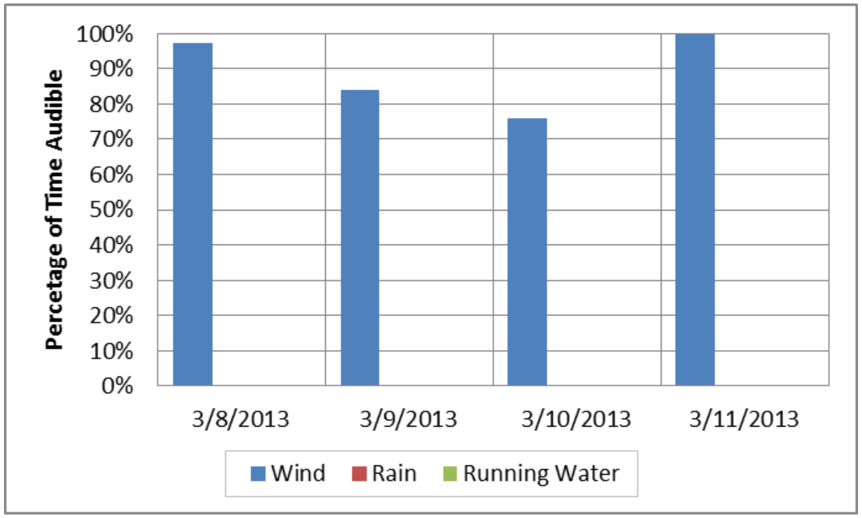


Figure C-2. Biophony at Monitor Winter LT1

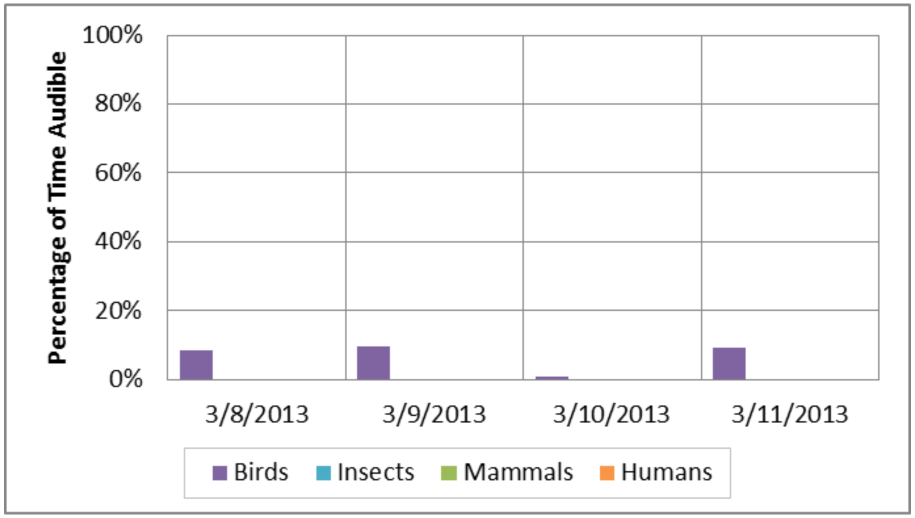


Figure C-3. Mechanized sound at Winter LT1: Average hourly %

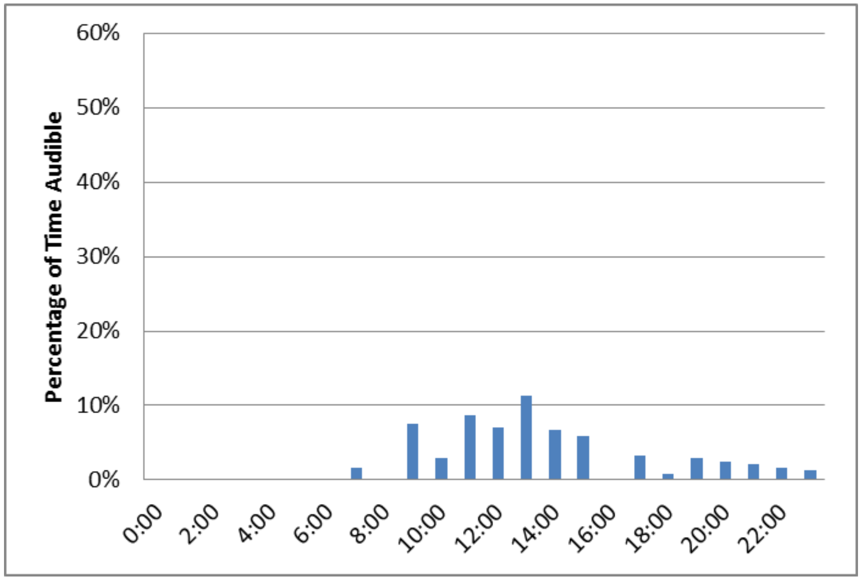


Figure C-4. Mechanized sound at Winter LT1: Daily hourly %

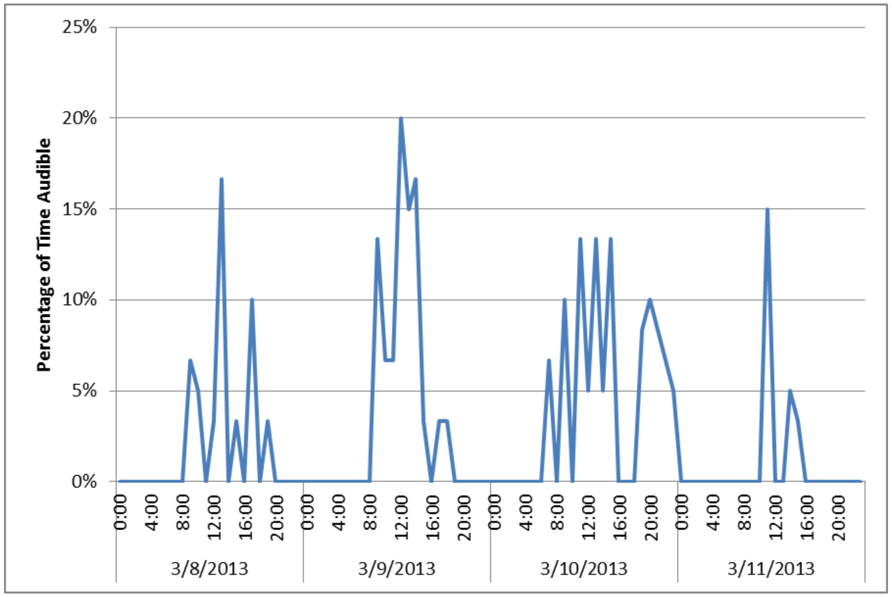


Figure C-5. Sound Pressure Levels at Winter LT1

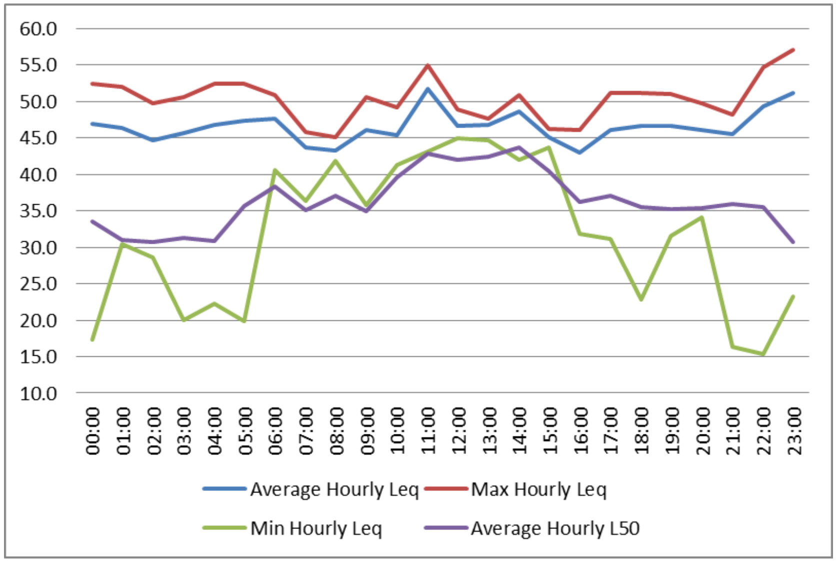


Figure C-6. Audible mechanized events per day at Winter LT1

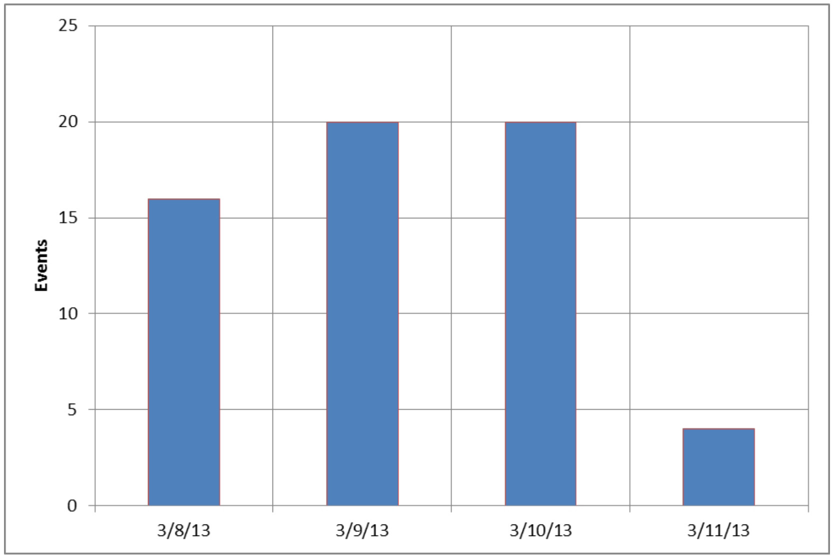


Figure C-7. Audible mechanized events distribution by hour at Winter LT1

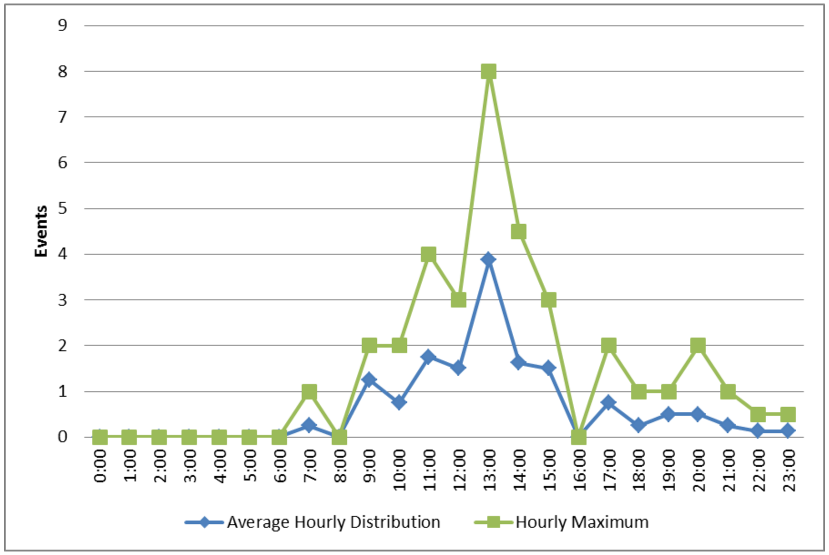


Figure C-8. Geophony at Monitor Winter LT2

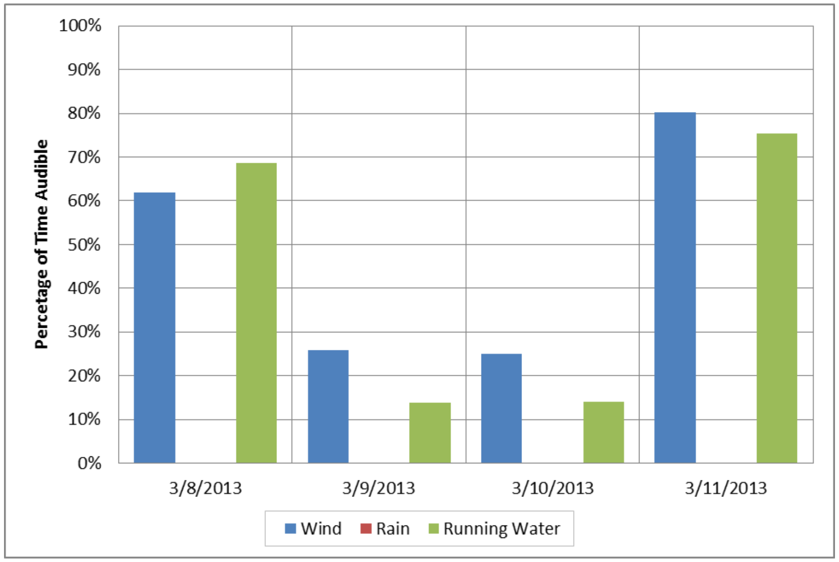


Figure C-9. Biophony at Monitor Winter LT2

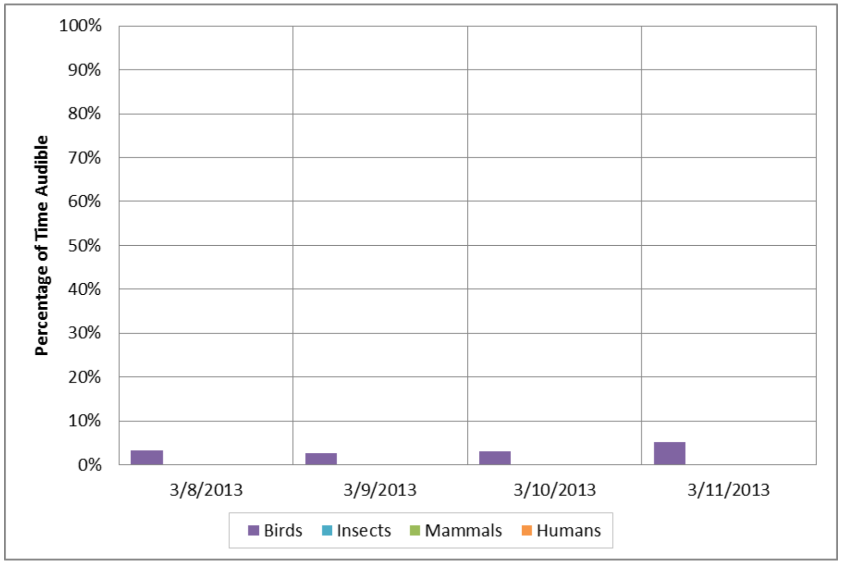


Figure C-10. Mechanized sound at Winter LT2: Average hourly %

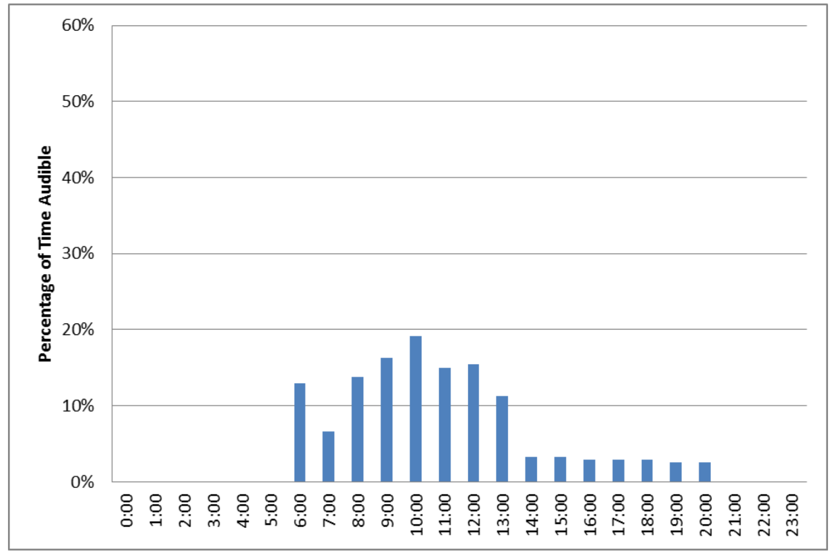


Figure C-11. Mechanized sound at Winter LT2: Daily hourly %

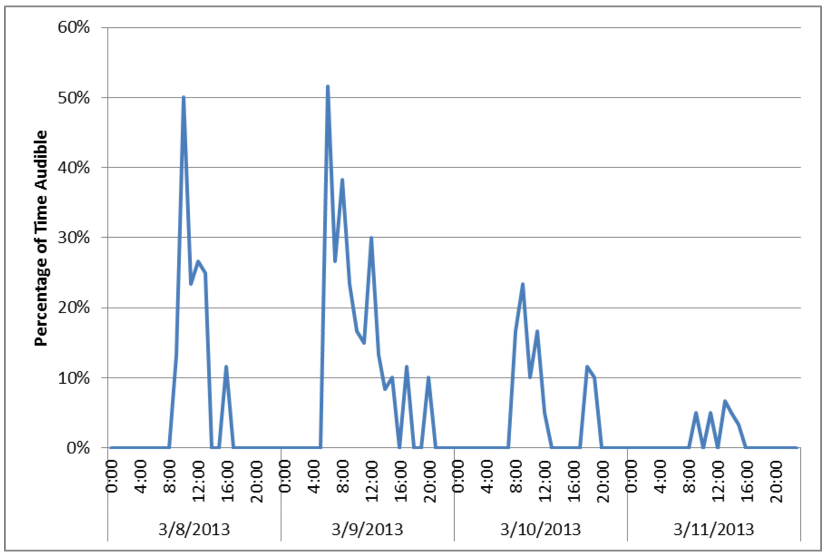


Figure C-12. Sound Pressure Levels at Winter LT2

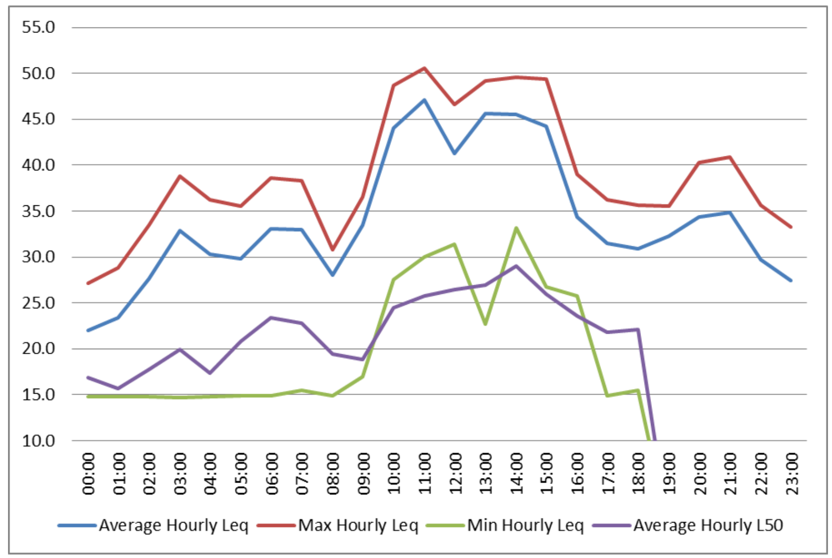


Figure C-13. Audible mechanized events per day at Winter LT2

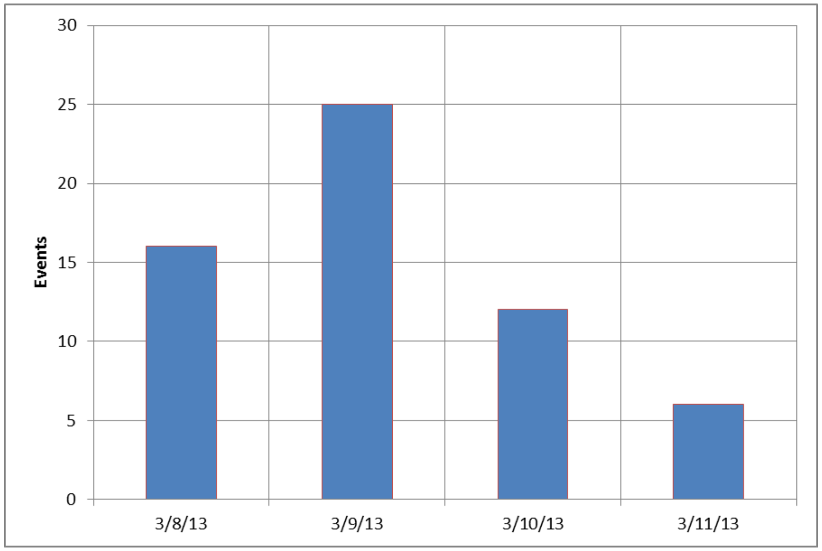


Figure C-14. Audible mechanized events distribution by hour at Winter LT2

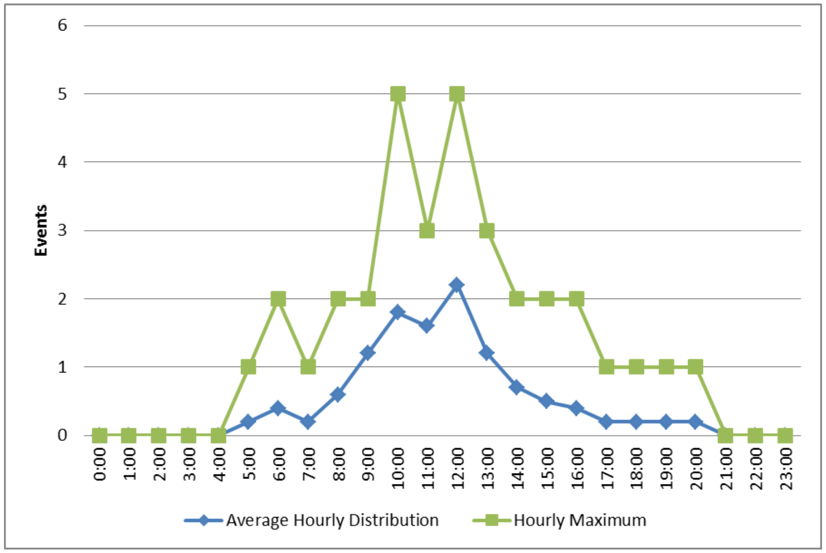


Figure C-15. Geophony at Monitor Winter LT4

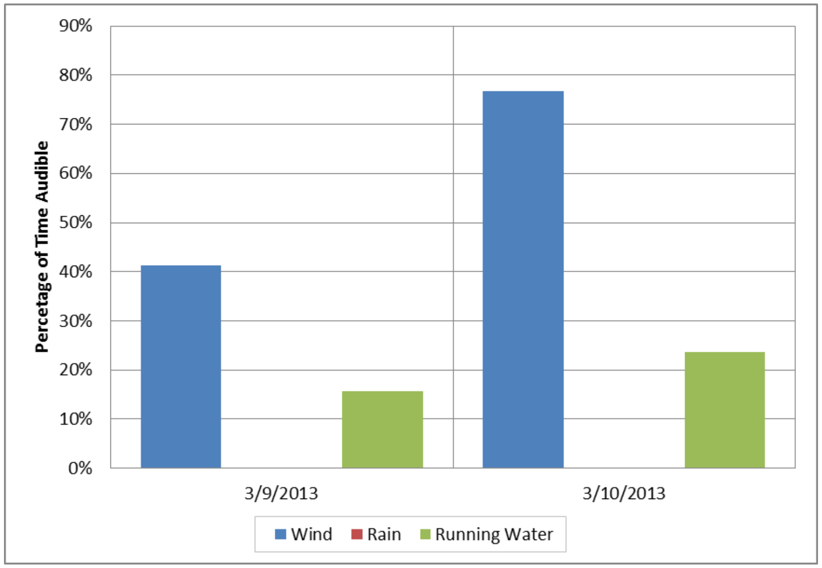


Figure C-16. Biophony at Monitor Winter LT4

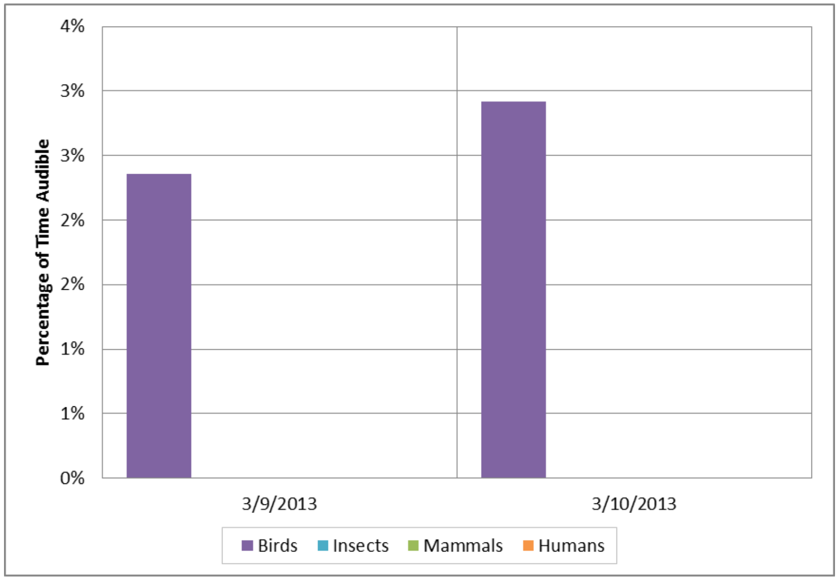


Figure C-17. Mechanized sound at Winter LT4: Average hourly %

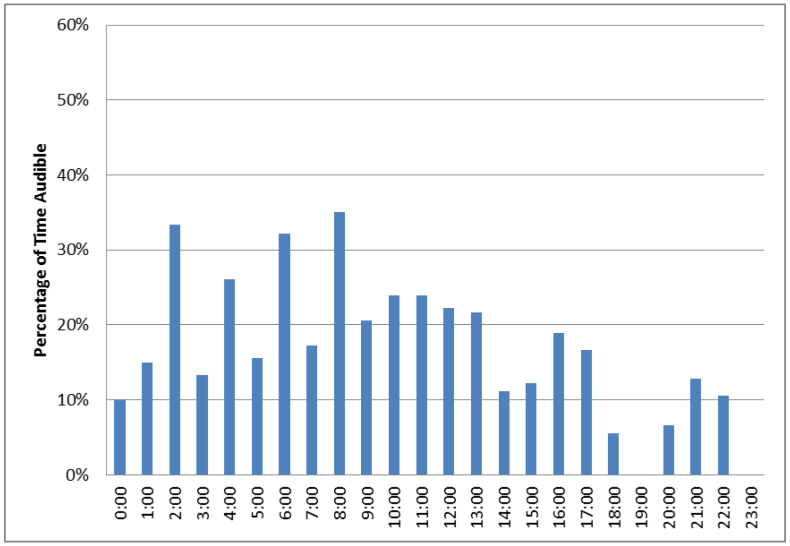


Figure C-18. Mechanized sound at Winter LT4: Daily hourly %

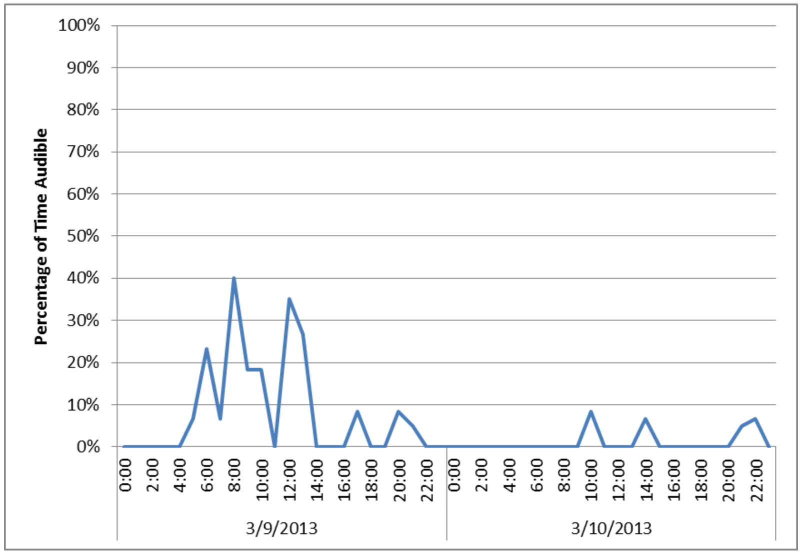


Figure C-19. Sound Pressure Levels at Winter LT4

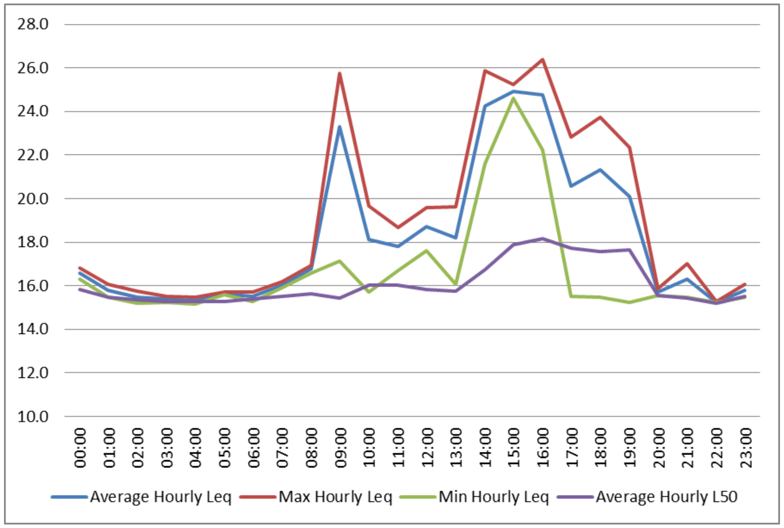


Figure C-20. Audible mechanized events per day at Winter LT4

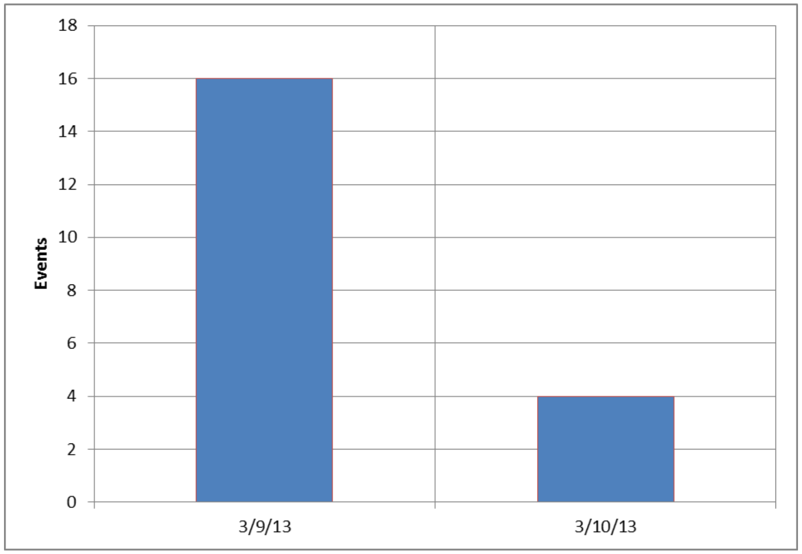


Figure C-21. Audible mechanized events distribution by hour at Winter LT4

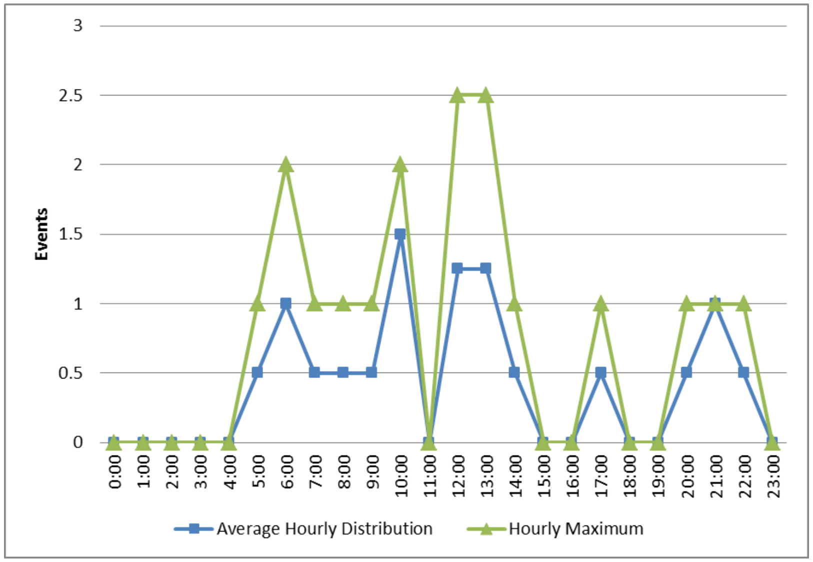


Figure C-22. Geophony at Monitor Winter LT5

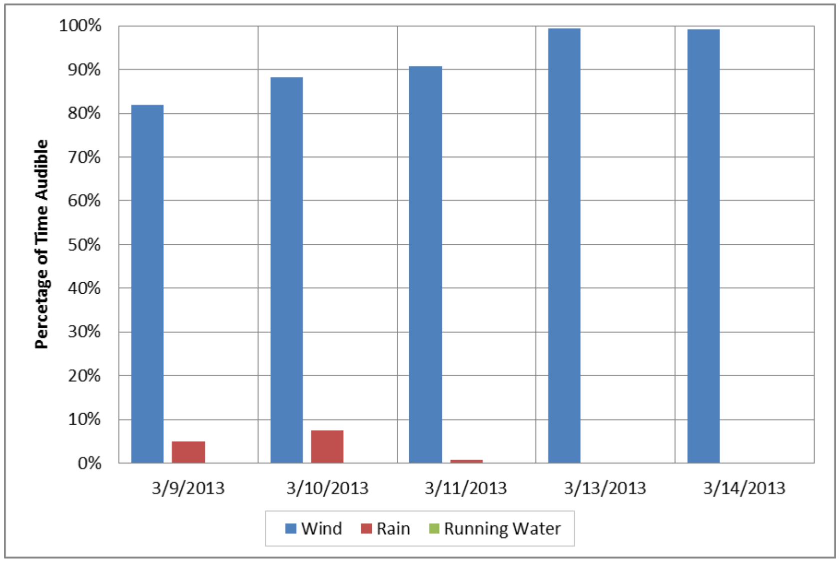


Figure C-23. Biophony at Monitor Winter LT5

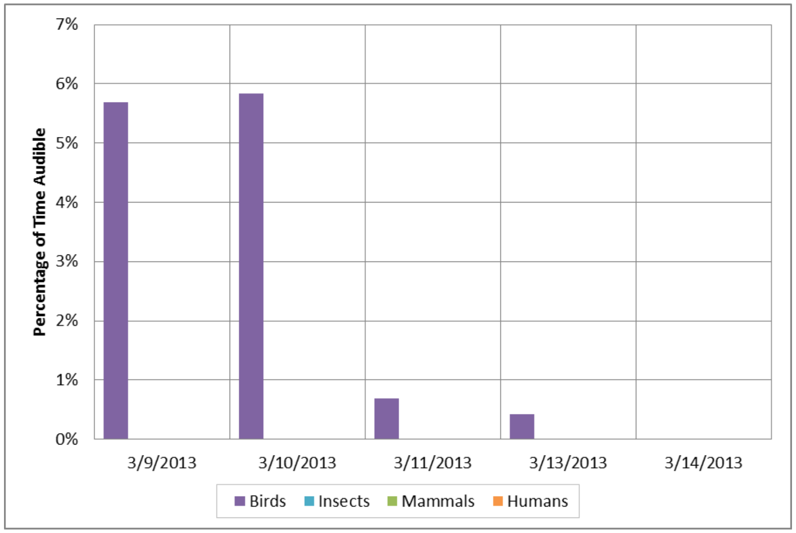


Figure C-24. Mechanized sound at Winter LT5: Average hourly %

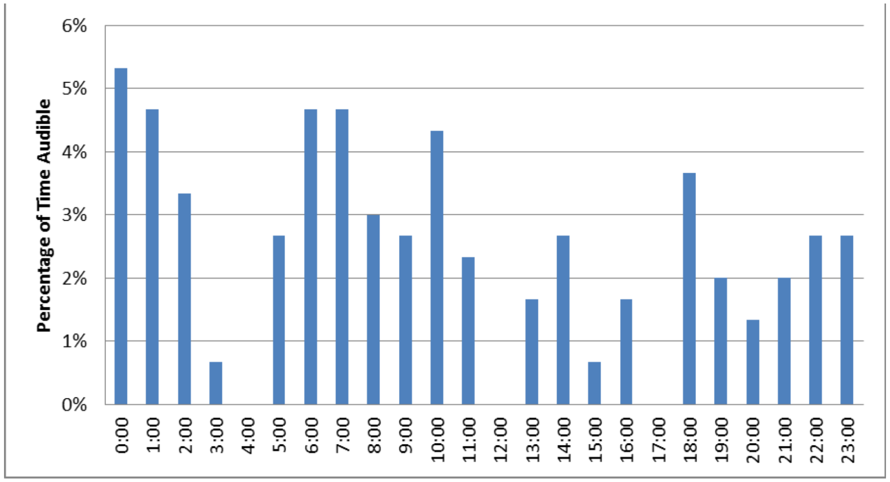


Figure C-25. Mechanized sound at Winter LT5: Daily hourly %

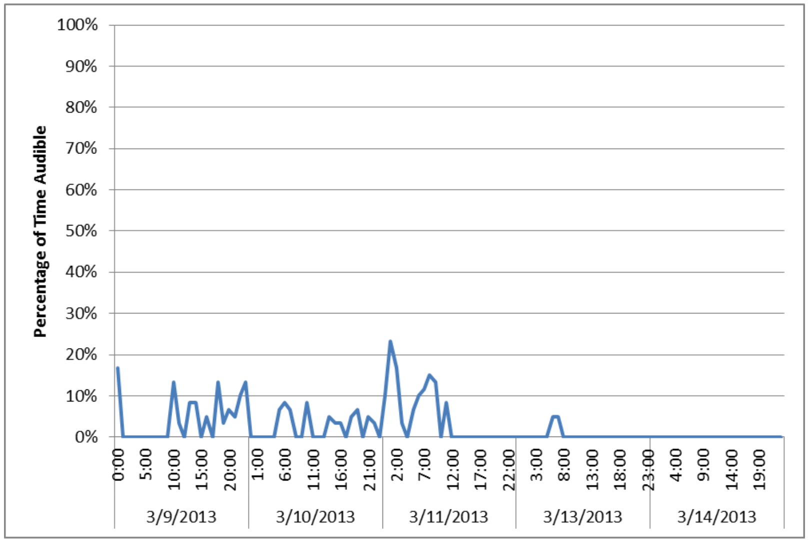


Figure C-26. Sound Pressure Levels at Winter LT5

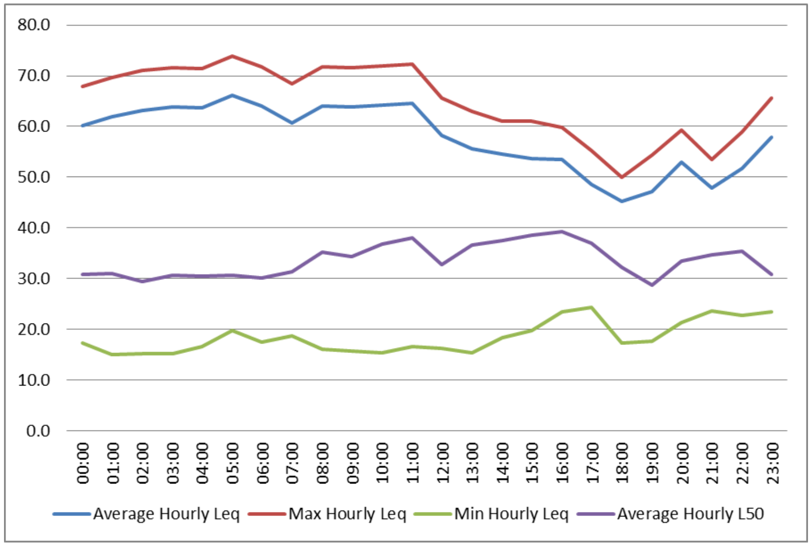


Figure C-27. Audible mechanized events per day at Winter LT5

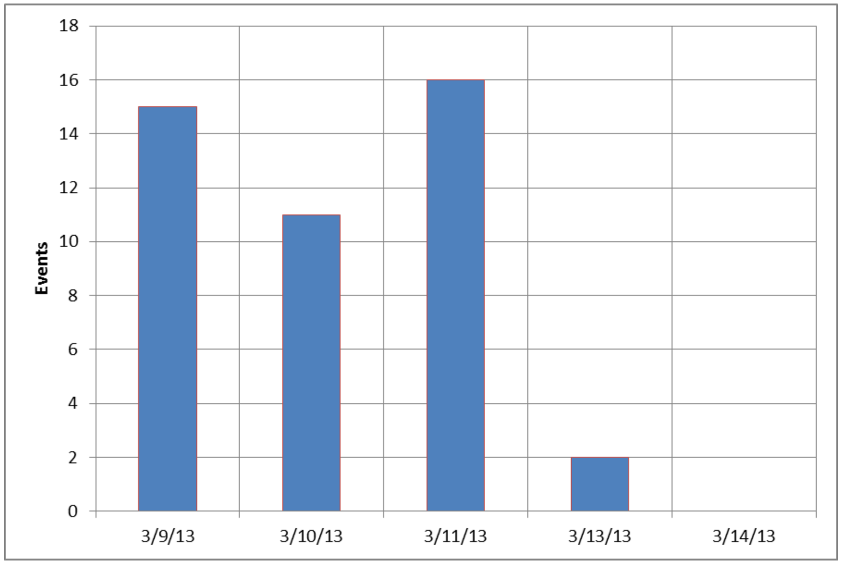


Figure C-28. Audible mechanized events distribution by hour at Winter LT5

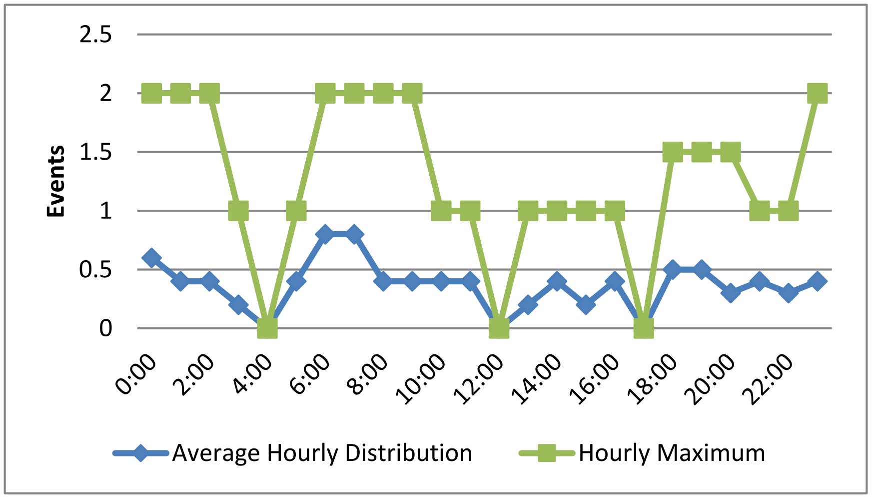


Figure C-29. Geophony at Monitor Winter LT7

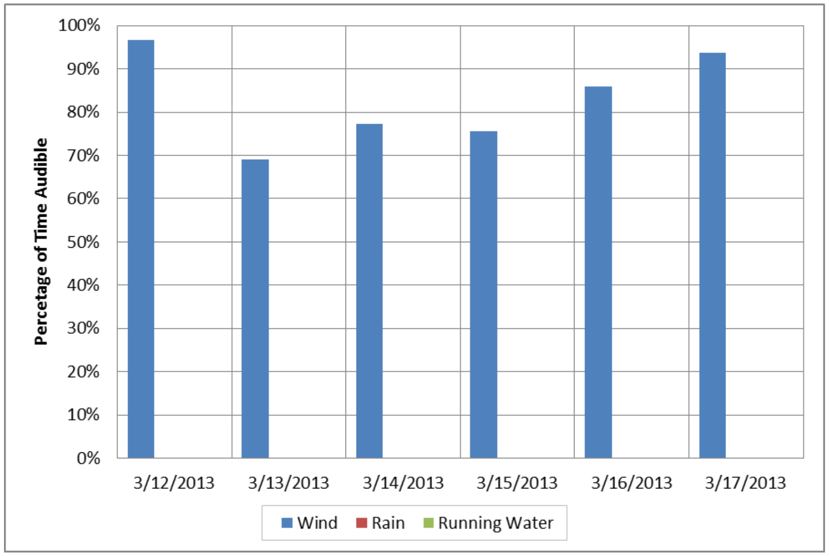


Figure C-30. Biophony at Monitor Winter LT7

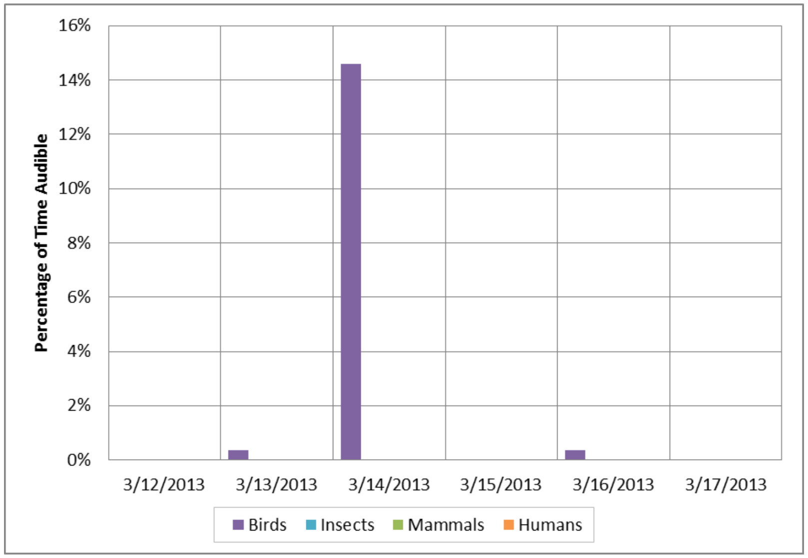


Figure C-31. Mechanized sound at Winter LT7: Average hourly %

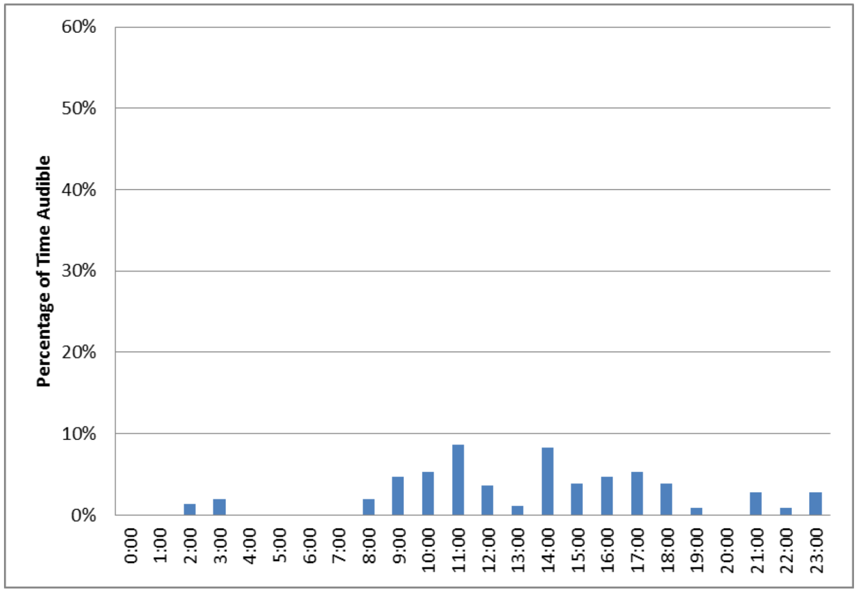


Figure C-32. Mechanized sound at Winter LT7: Daily hourly %

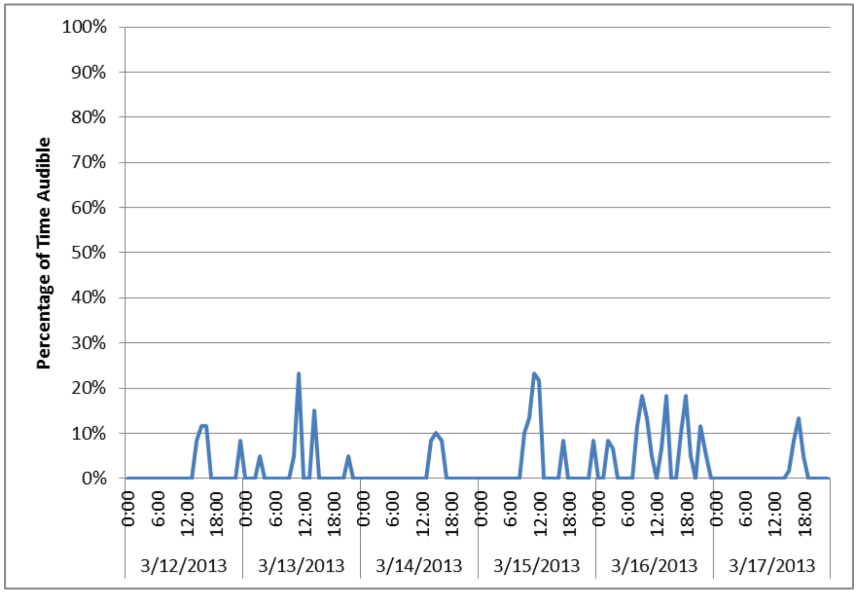


Figure C-33. Sound Pressure Levels at Winter LT7

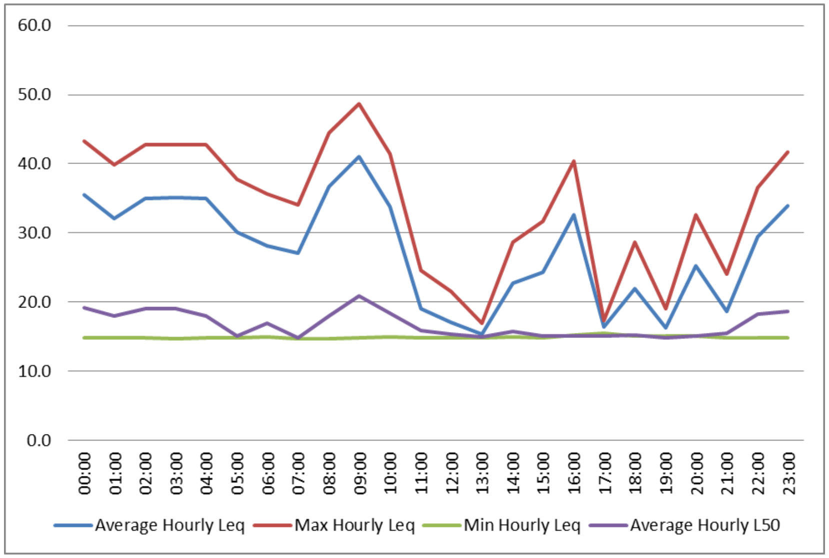


Figure C-34. Audible mechanized events per day at Winter LT7

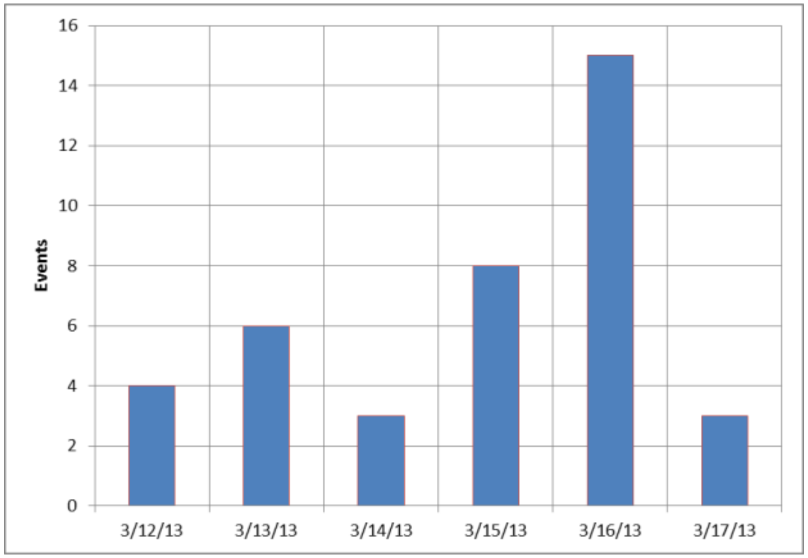


Figure C-35. Audible mechanized events distribution by hour at Winter LT7

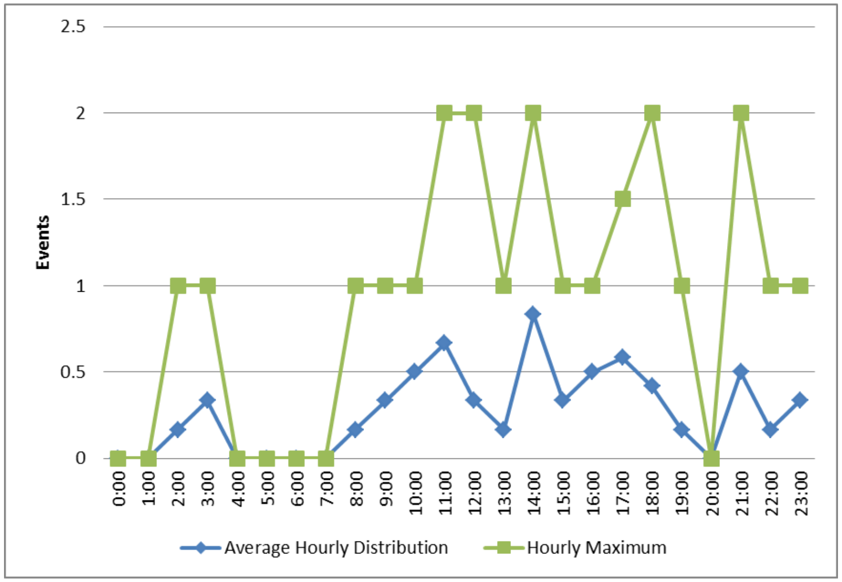


Figure C-36. Geophony at Monitor Spring LT1

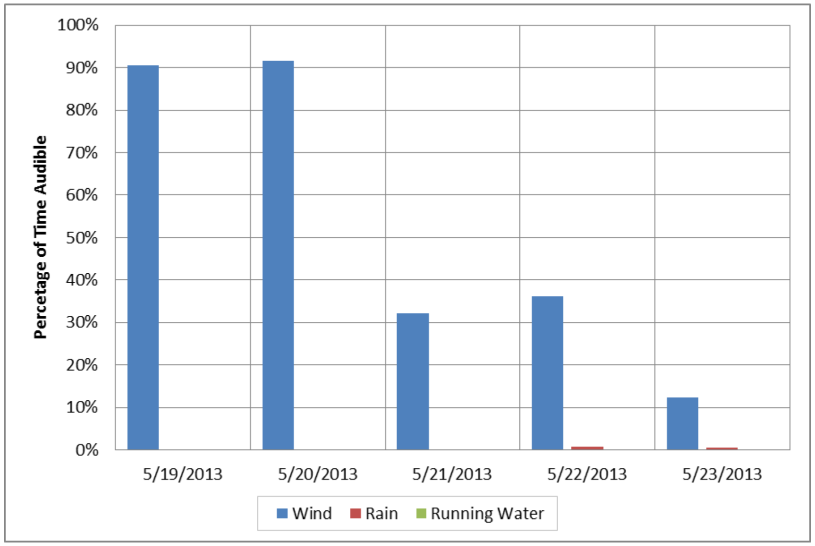


Figure C-37. Biophony at Monitor Spring LT1

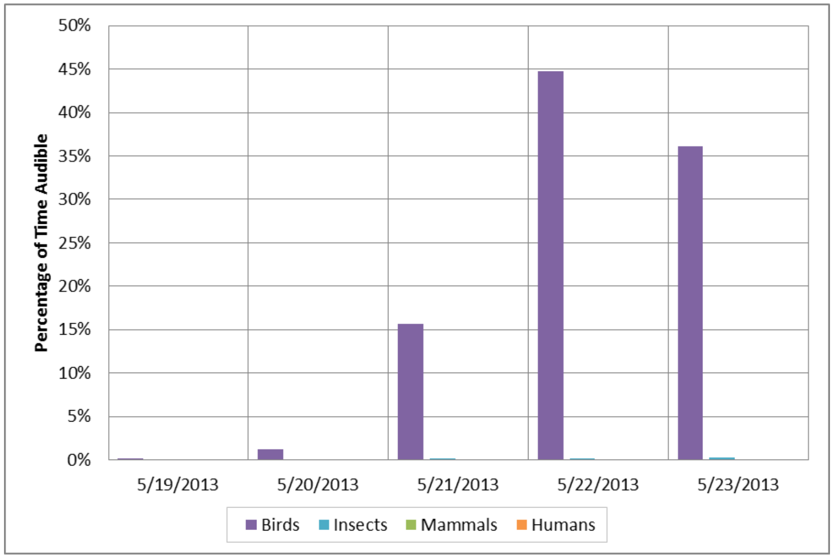


Figure C-38. Mechanized sound at Spring LT1: Average hourly %

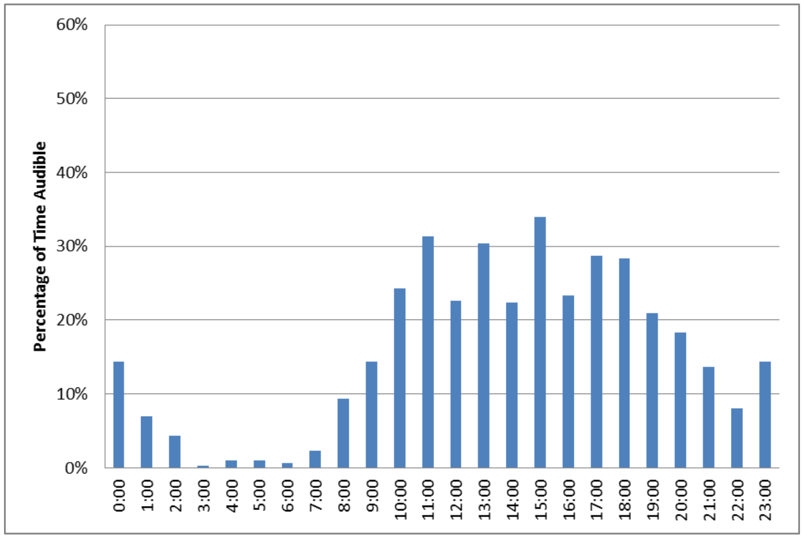


Figure C-39. Mechanized sound at Spring LT1: Daily hourly %

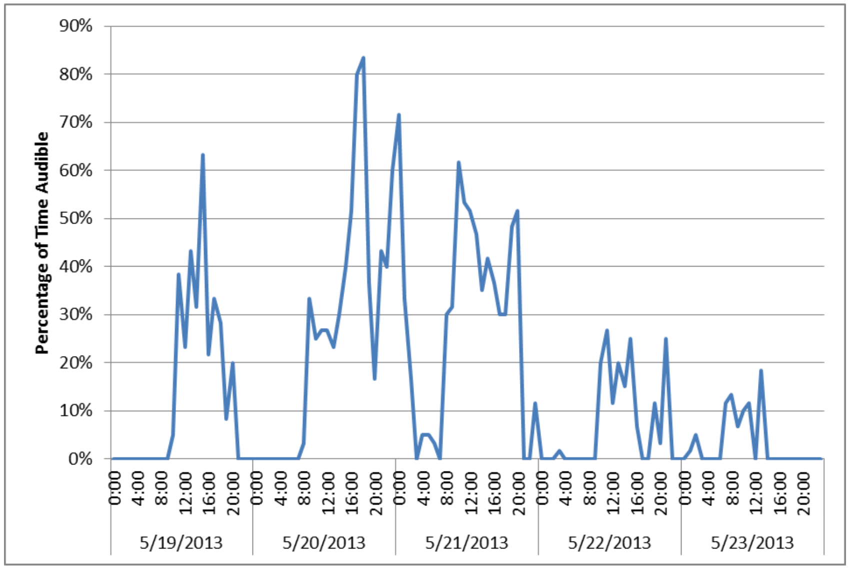


Figure C-40. Sound Pressure Levels at Spring LT1

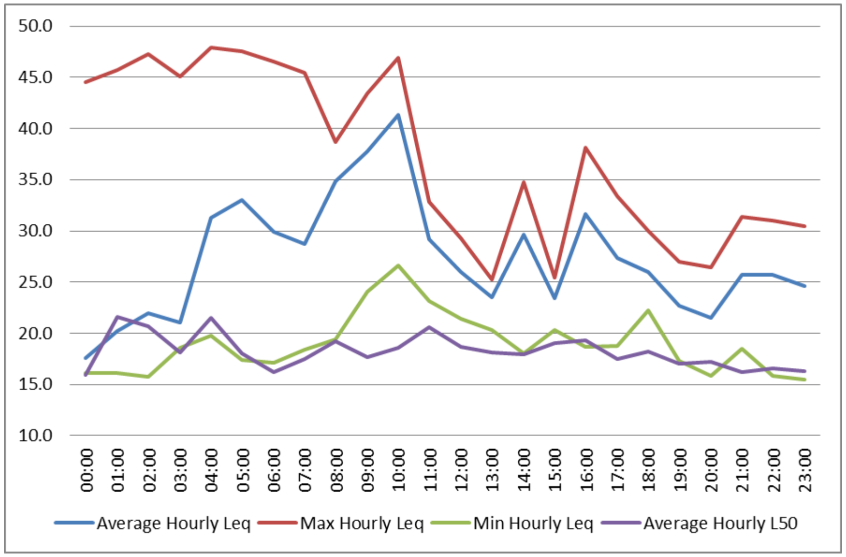


Figure C-41. Audible mechanized events per day at Spring LT1

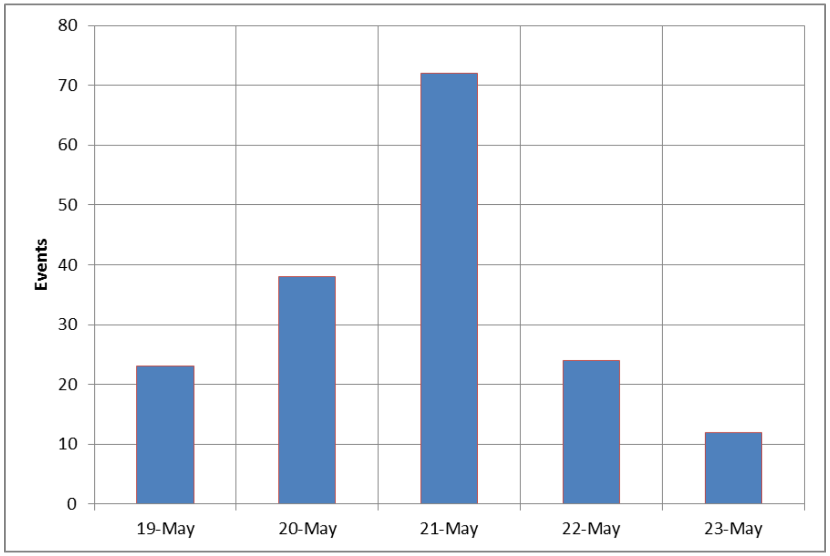


Figure C-42. Audible mechanized events distribution by hour at Spring LT1

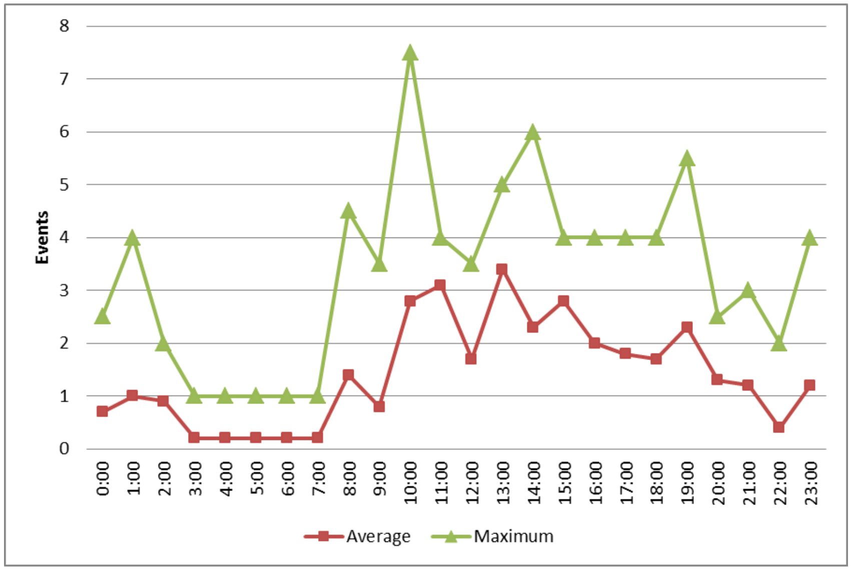


Figure C-43. Geophony at Monitor Spring LT2

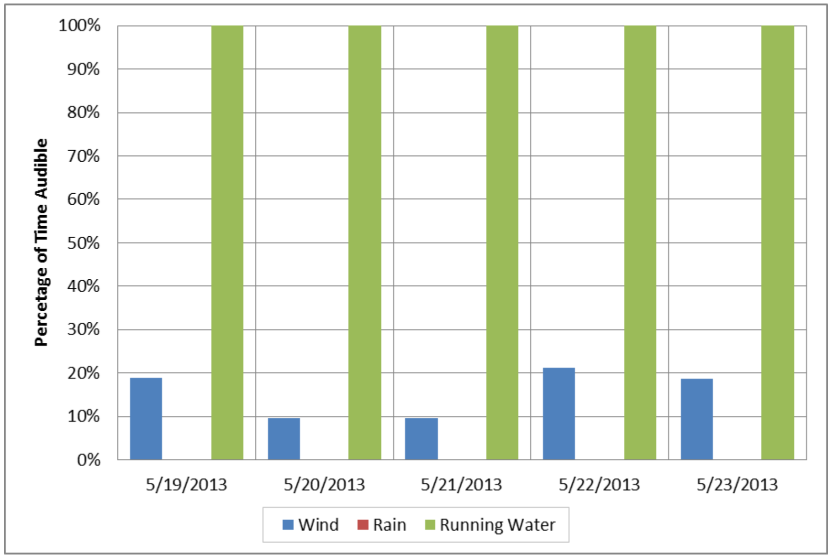


Figure C-44. Biophony at Monitor Spring LT2

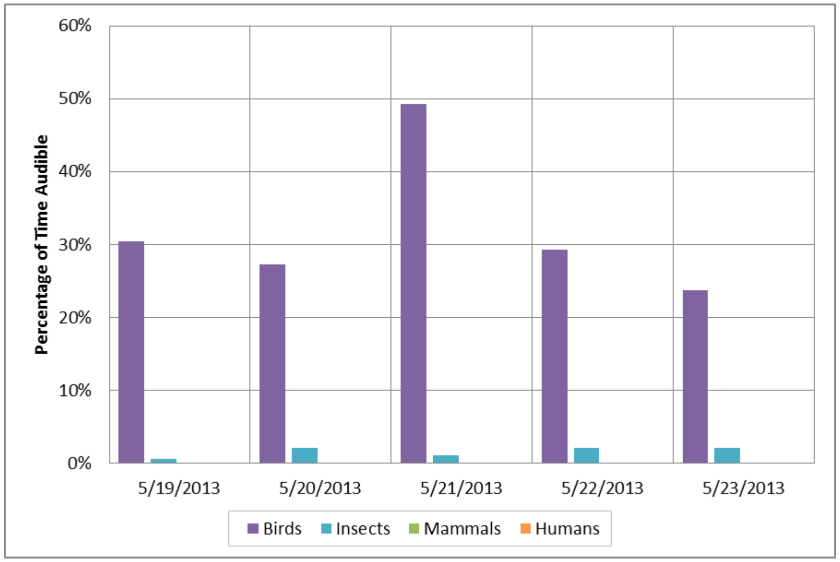


Figure C-45. Mechanized sound at Spring LT2: Average hourly %

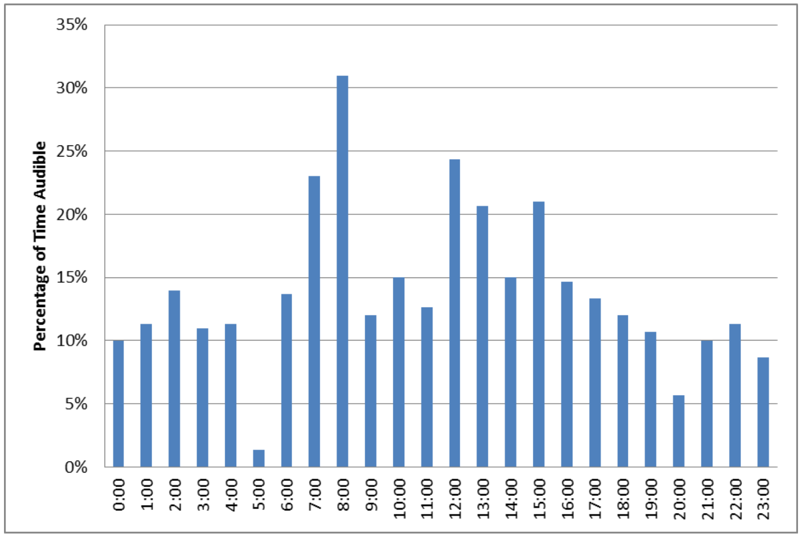


Figure C-46. Mechanized sound at Spring LT2: Daily hourly %

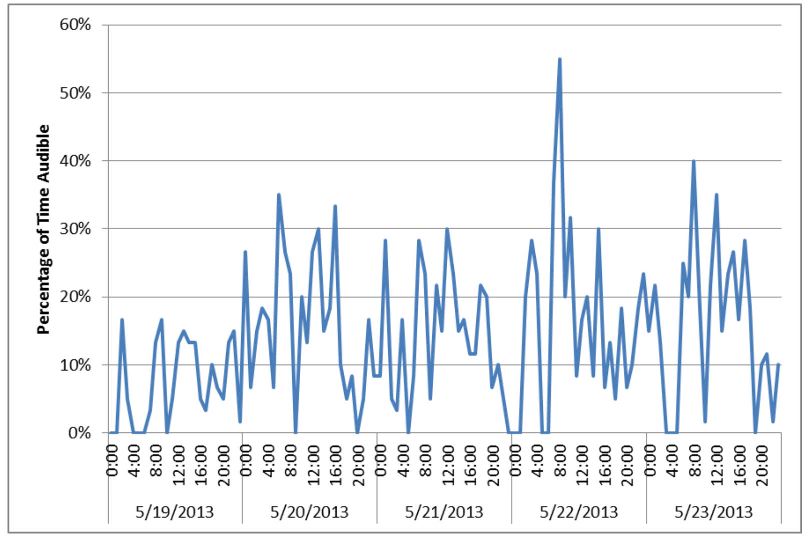


Figure C-47. Sound Pressure Levels at Spring LT2

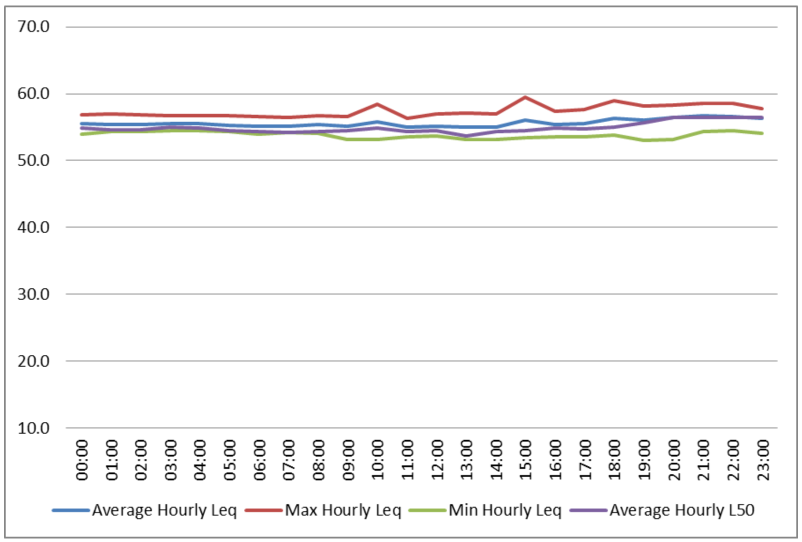


Figure C-48. Audible mechanized events per day at Spring LT2

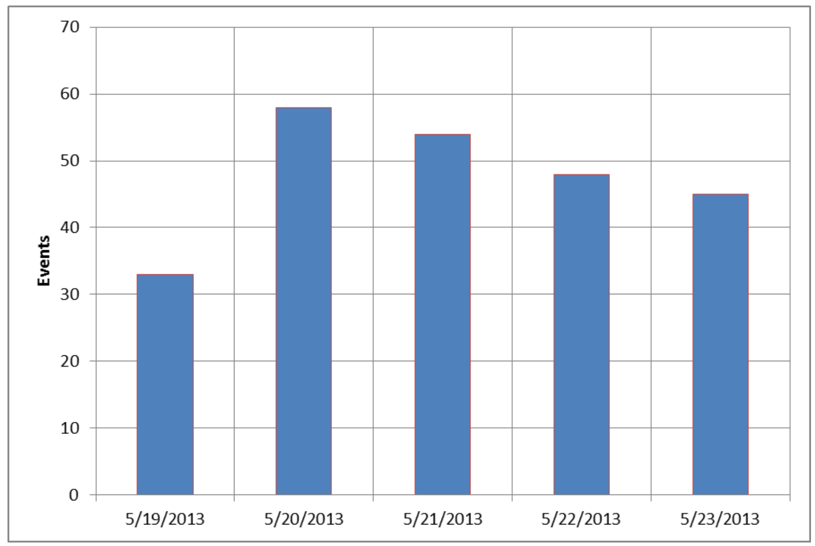


Figure C-49. Audible mechanized events distribution by hour at Spring LT2

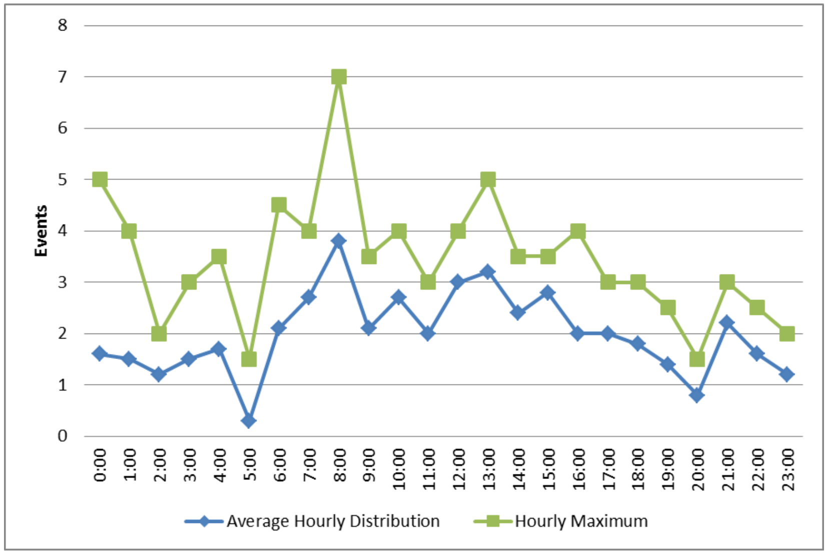


Figure C-50. Geophony at Monitor Spring LT3

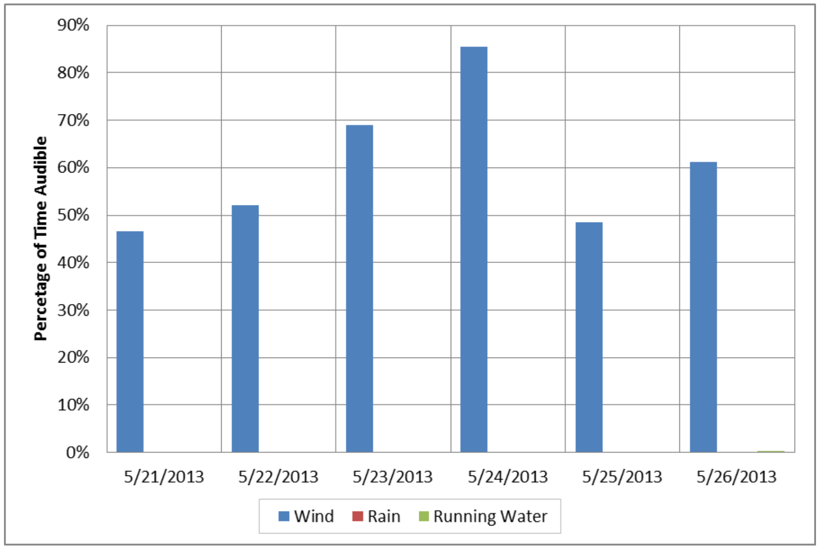


Figure C-51. Biophony at Monitor Spring LT3

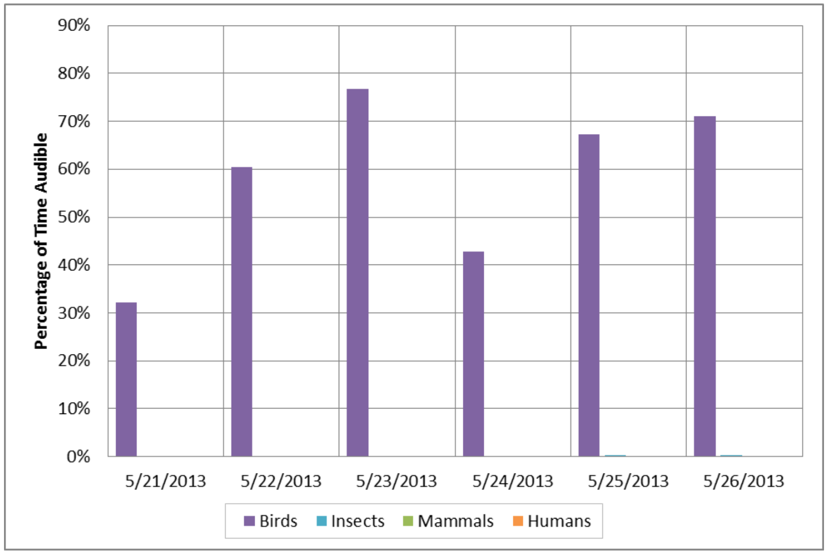


Figure C-52. Mechanized sound at Spring LT3: Average hourly %

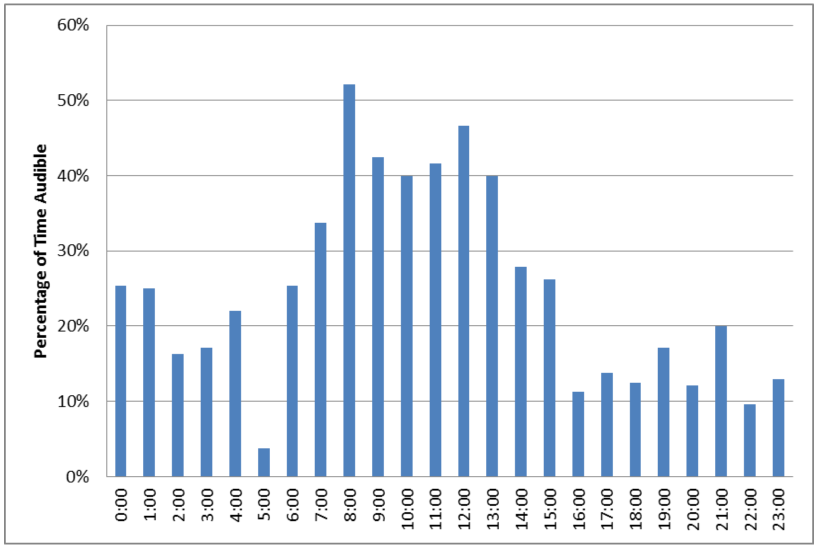


Figure C-53. Mechanized sound at Spring LT3: Daily hourly %

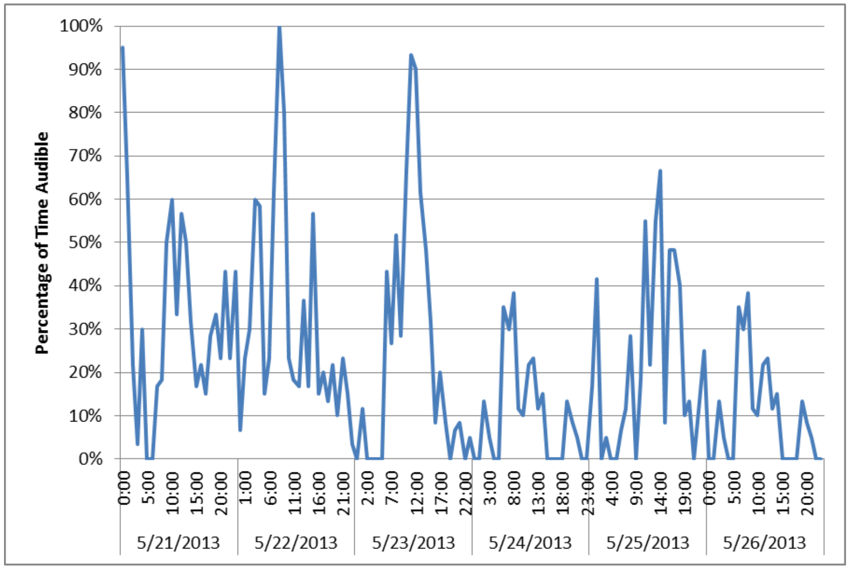


Figure C-54. Sound Pressure Levels at Spring LT3

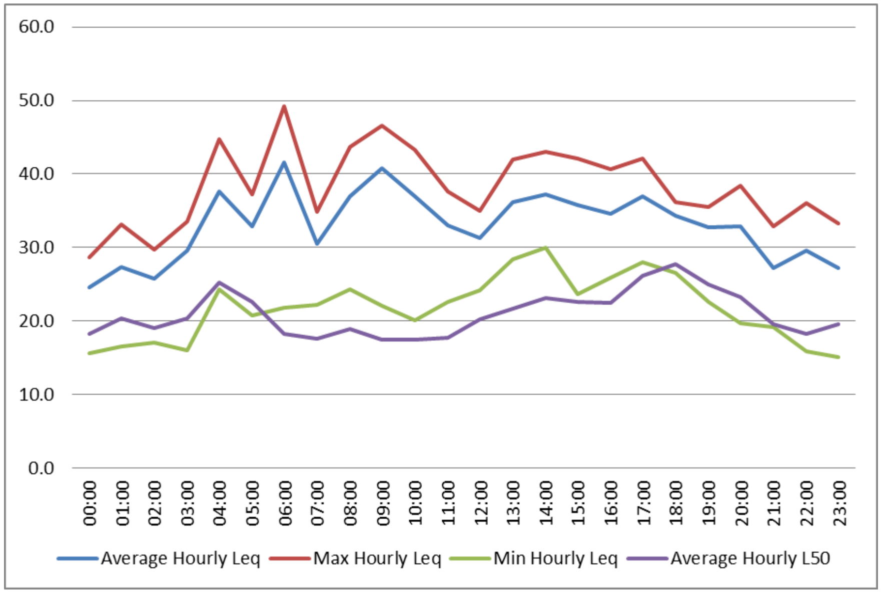


Figure C-55. Audible mechanized events per day at Spring LT3

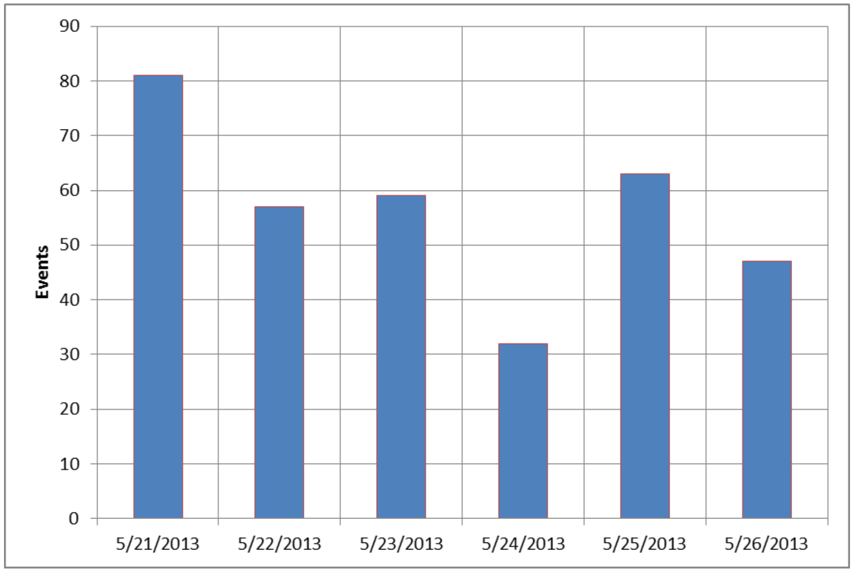


Figure C-56. Audible mechanized events distribution by hour at Spring LT3

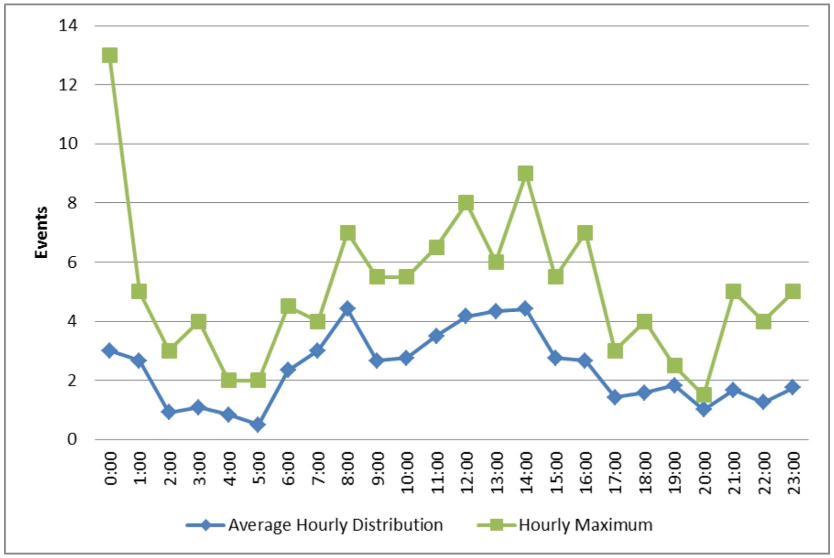


Figure C-57. Geophony at Monitor Spring LT4

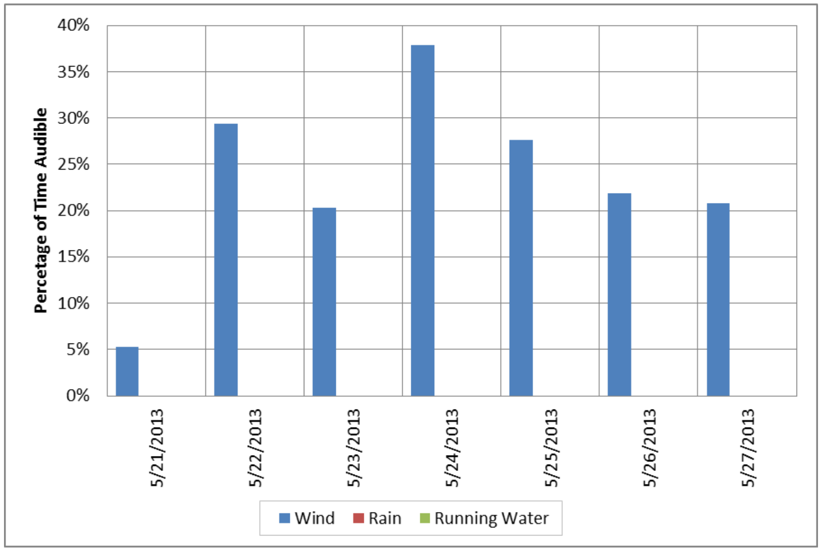


Figure C-58. Biophony at Monitor Spring LT4

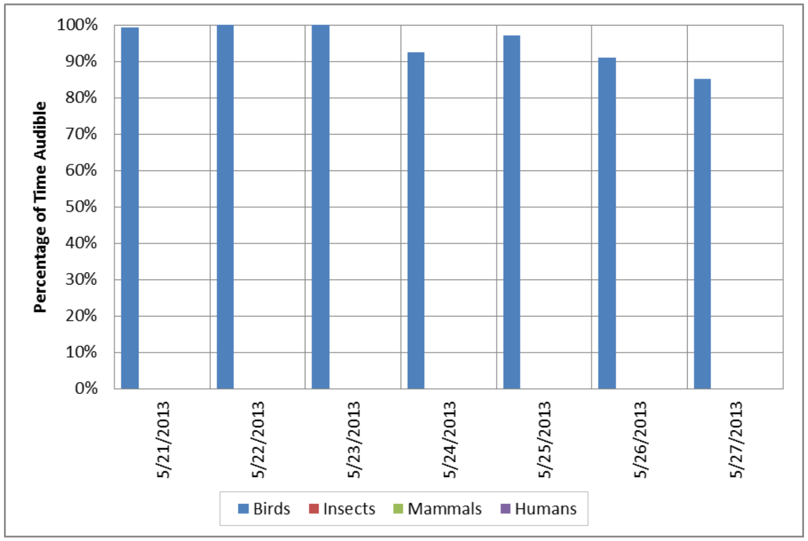


Figure C-59. Mechanized sound at Spring LT4: Average hourly %

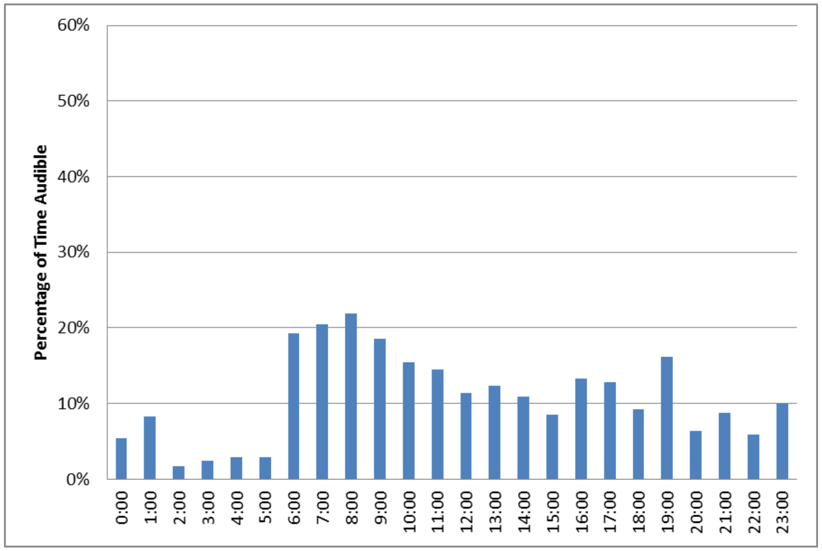


Figure C-60. Mechanized sound at Spring LT4: Daily hourly %

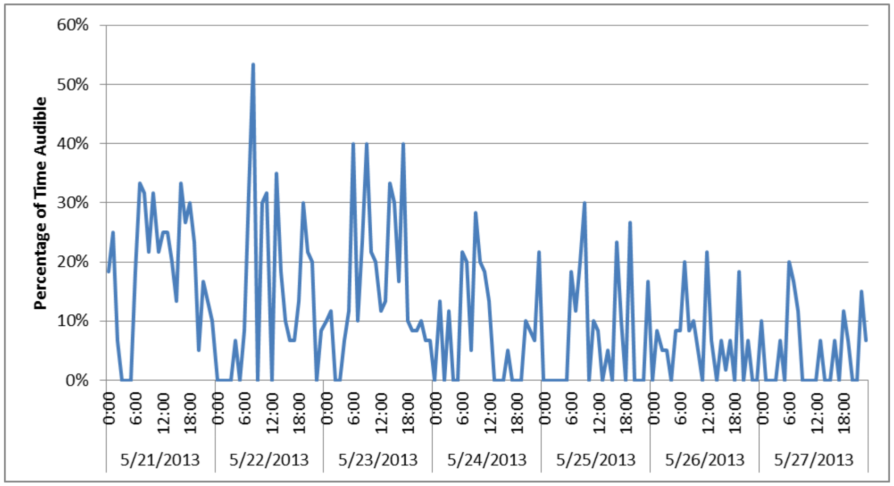


Figure C-61. Sound Pressure Levels at Spring LT4

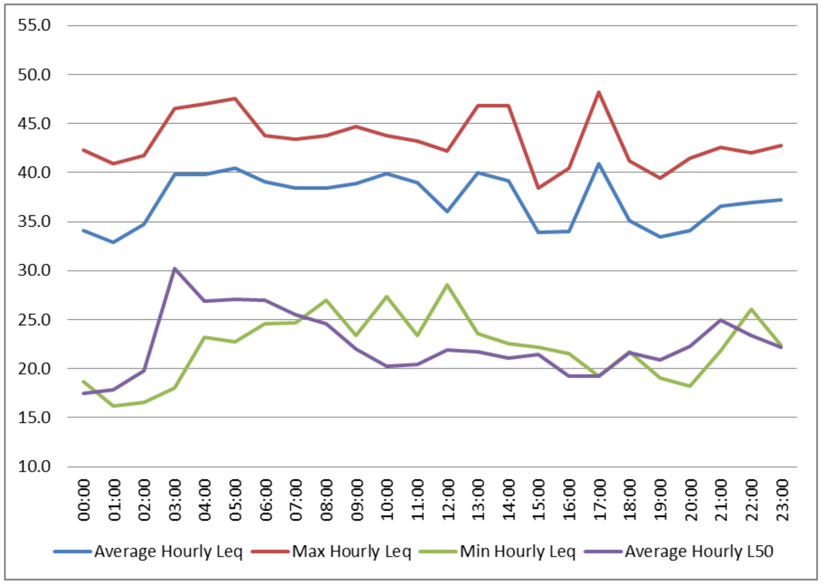


Figure C-62. Audible mechanized events per day at Spring LT4

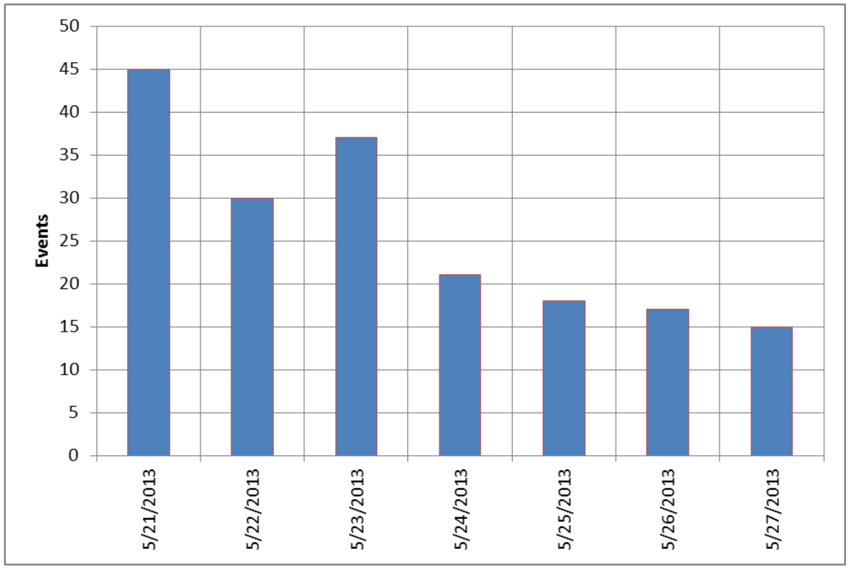


Figure C-63. Audible mechanized events distribution by hour at Spring LT4

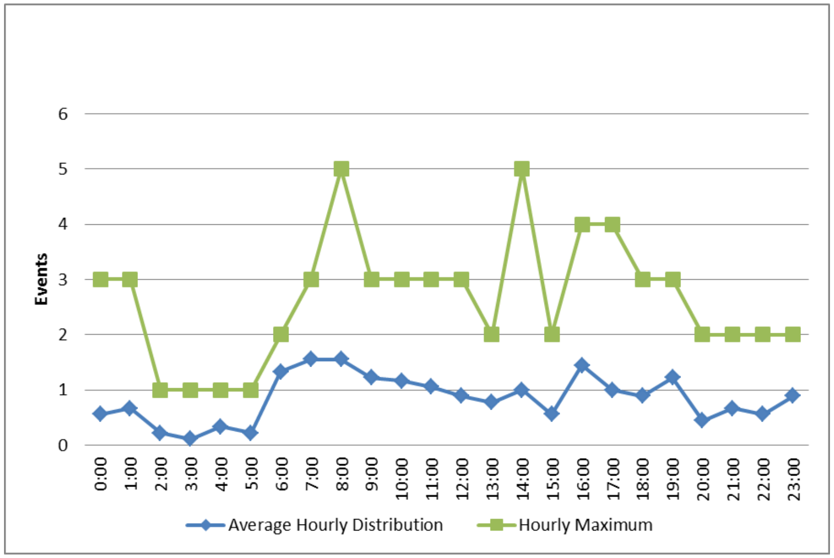


Figure C-64. Geophony at Monitor Spring LT5

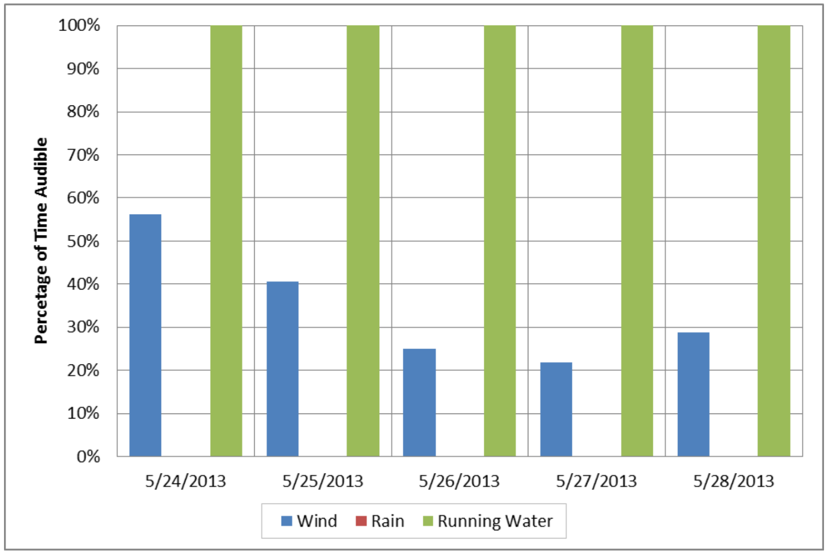


Figure C-65. Biophony at Monitor Spring LT5

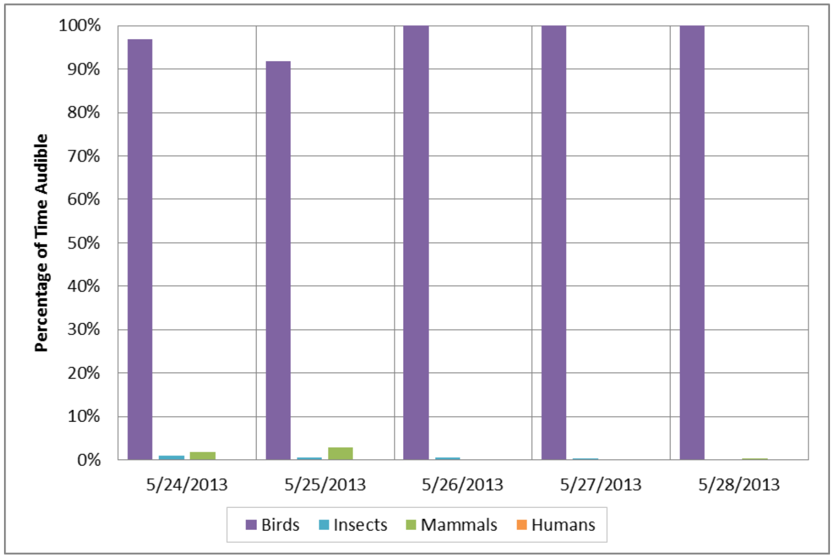


Figure C-66. Mechanized sound at Spring LT5: Average hourly %

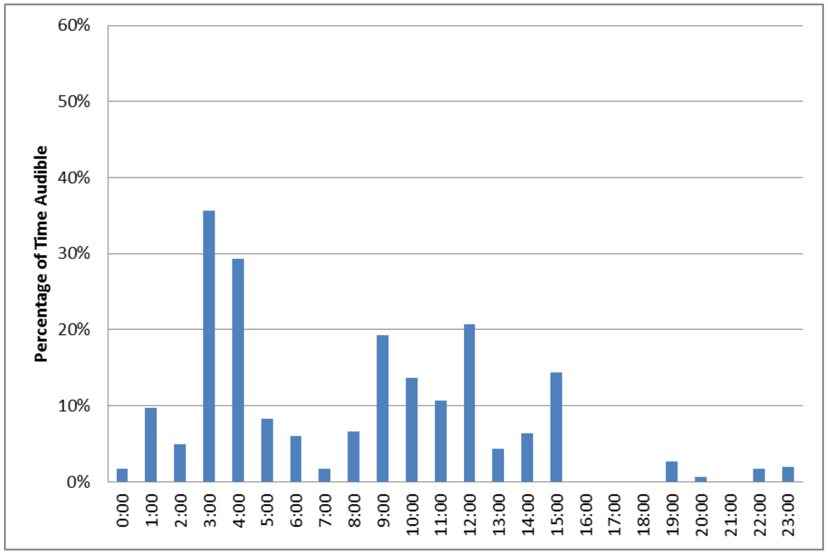


Figure C-67. Mechanized sound at Spring LT5: Daily hourly %

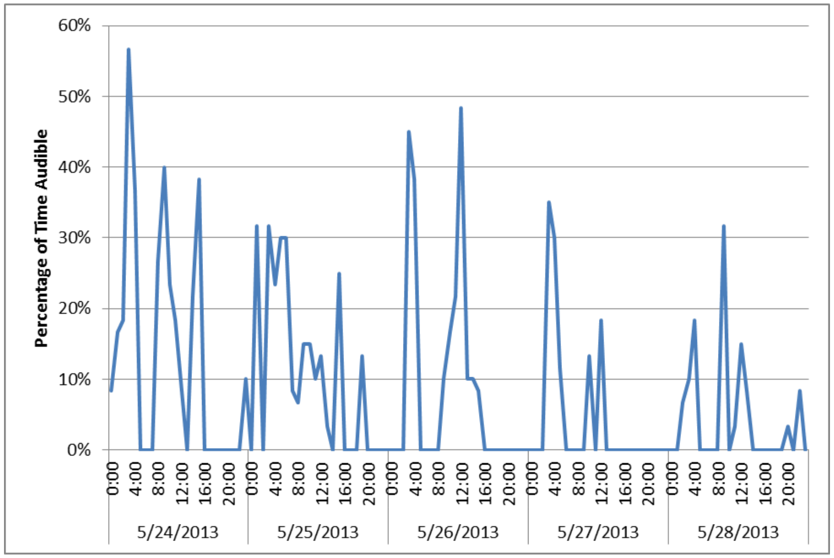


Figure C-68. Sound Pressure Levels at Spring LT5

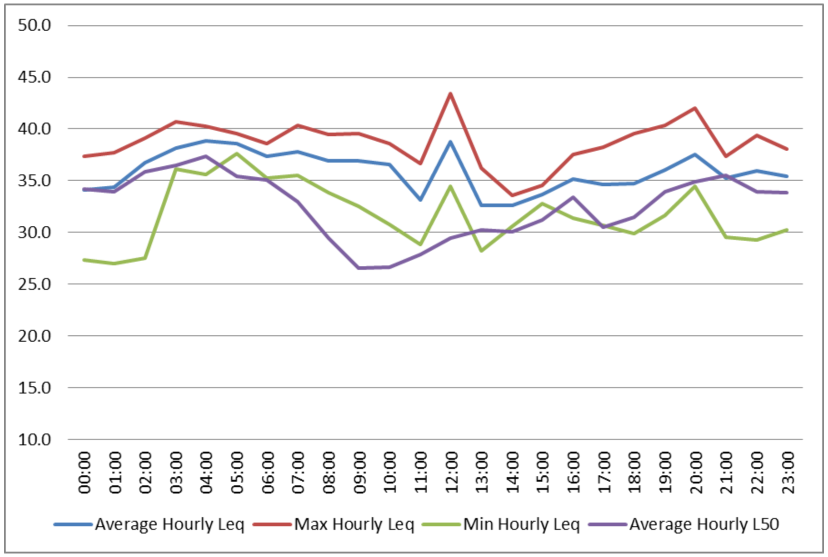


Figure C-69. Audible mechanized events per day at Spring LT5

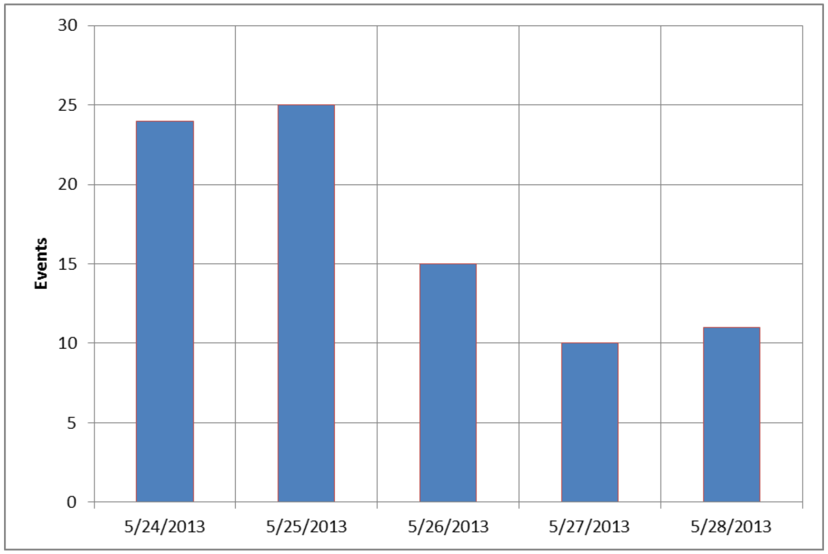


Figure C-70. Audible mechanized events distribution by hour at Spring LT5

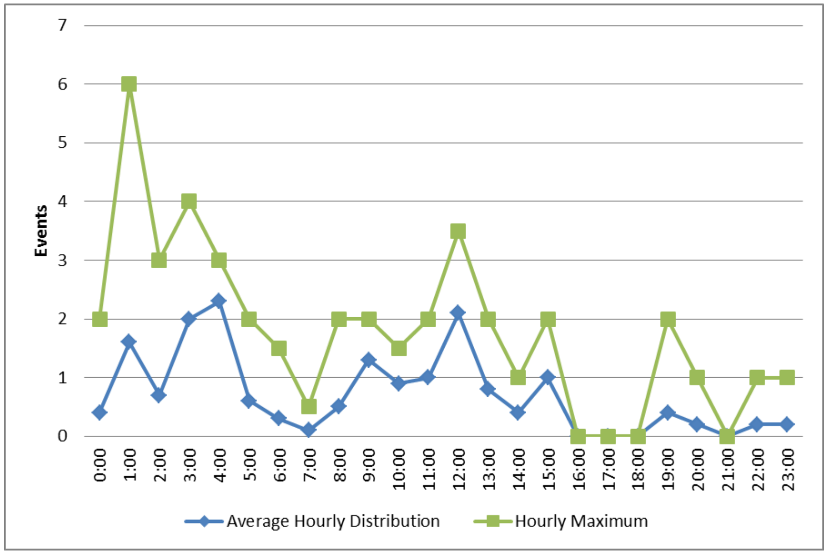


Figure C-71. Geophony at Monitor Spring LT6

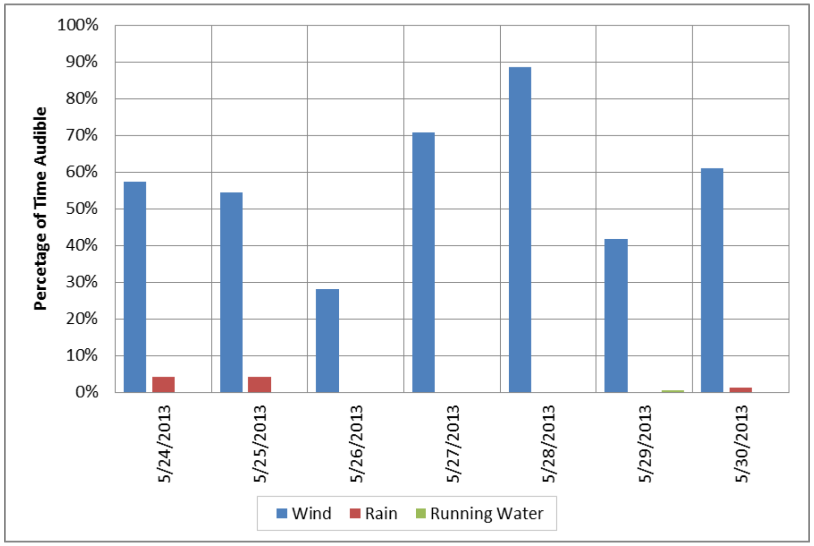


Figure C-72. Biophony at Monitor Spring LT6

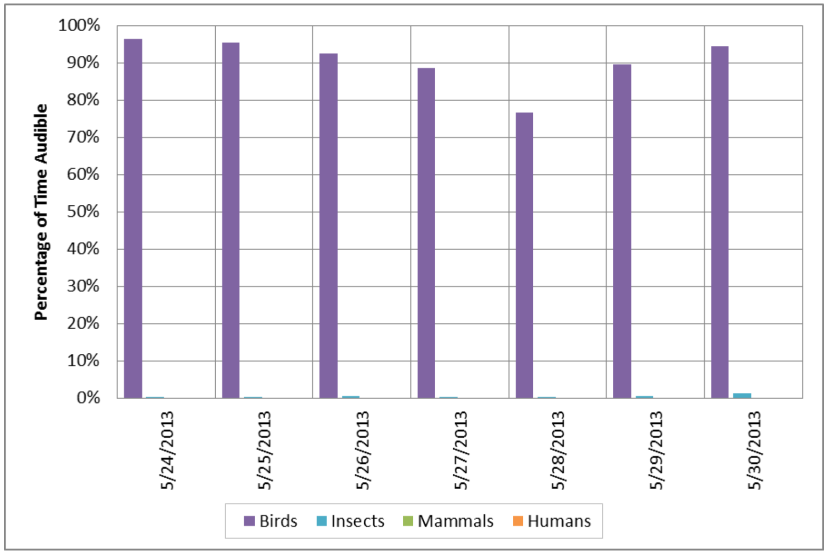


Figure C-73. Mechanized sound at Spring LT6: Average hourly %

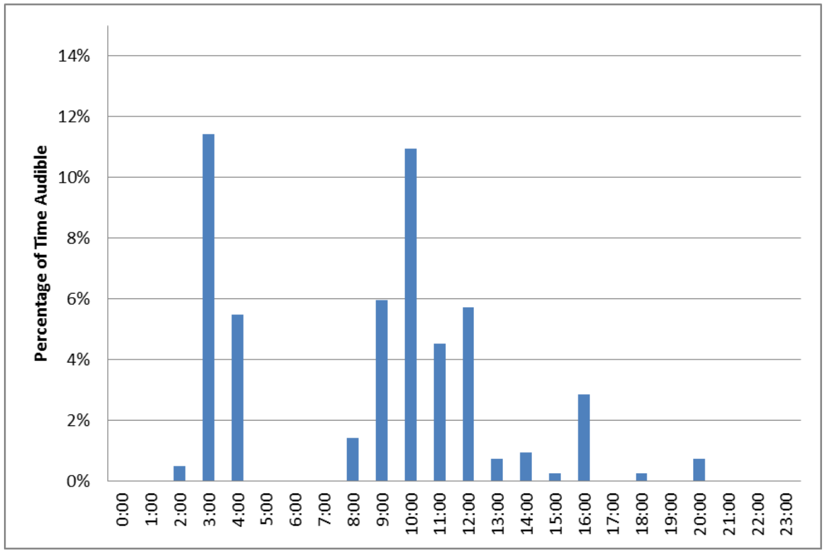


Figure C-74. Mechanized sound at Spring LT6: Daily hourly %

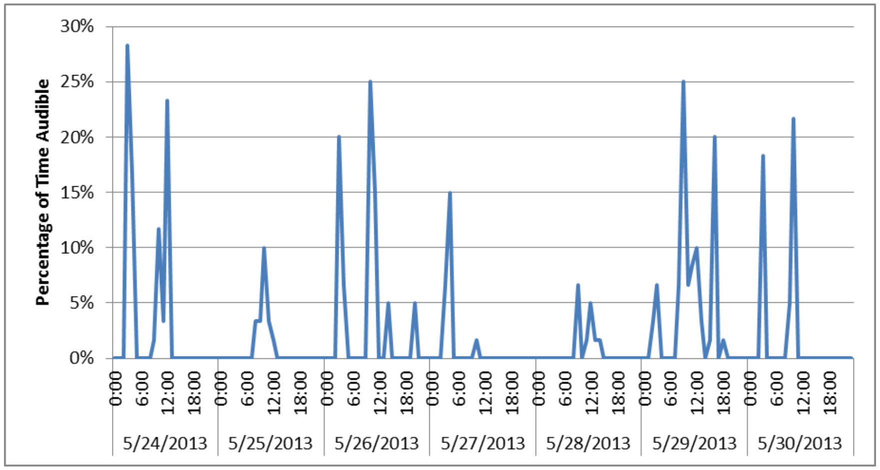


Figure C-75. Sound Pressure Levels at Spring LT6

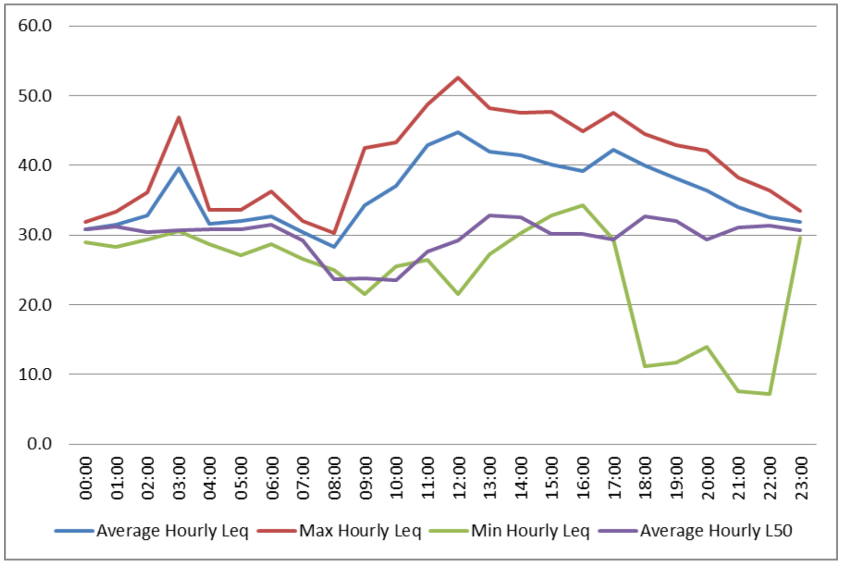


Figure C-76. Audible mechanized events per day at Spring LT6

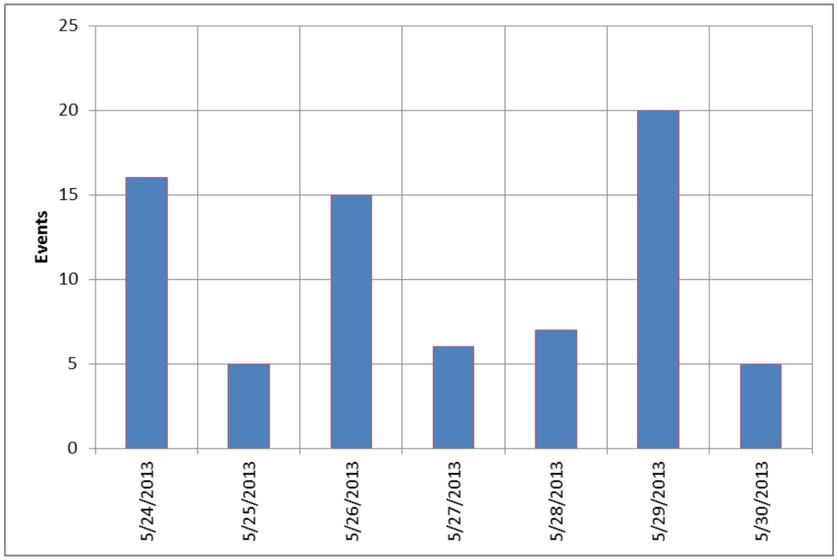


Figure C-77. Audible mechanized events distribution by hour at Spring LT6

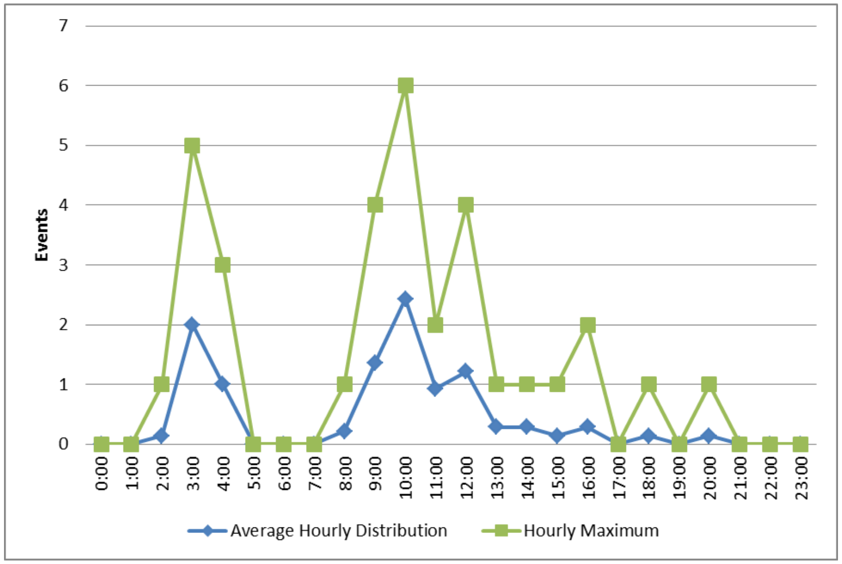


Figure C-78. Geophony at Monitor Spring LT7

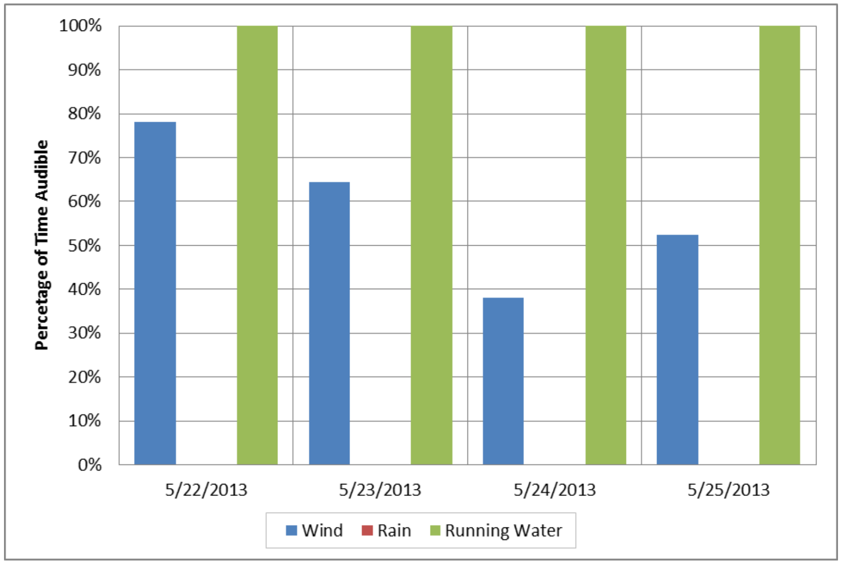


Figure C-79. Biophony at Monitor Spring LT7

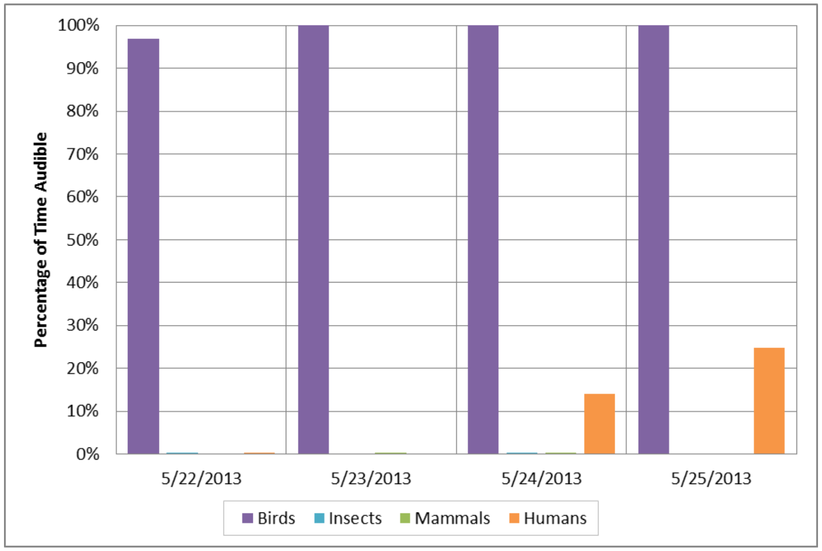


Figure C-80. Mechanized sound at Spring LT7: Average hourly %

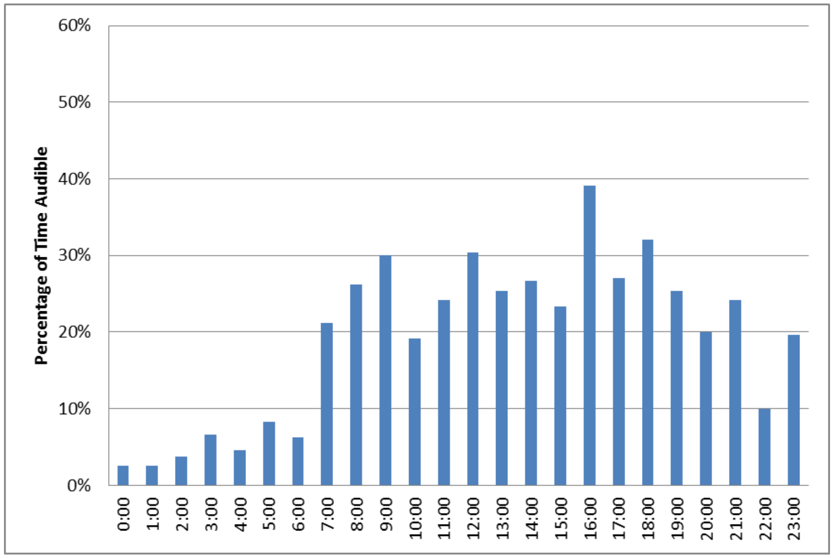


Figure C-81. Mechanized sound at Spring LT7: Daily hourly %

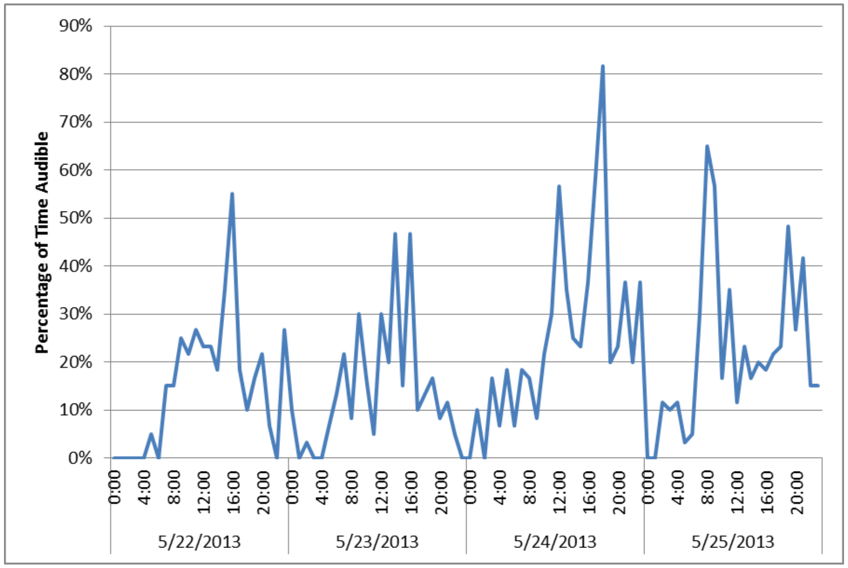


Figure C-82. Sound Pressure Levels at Spring LT7

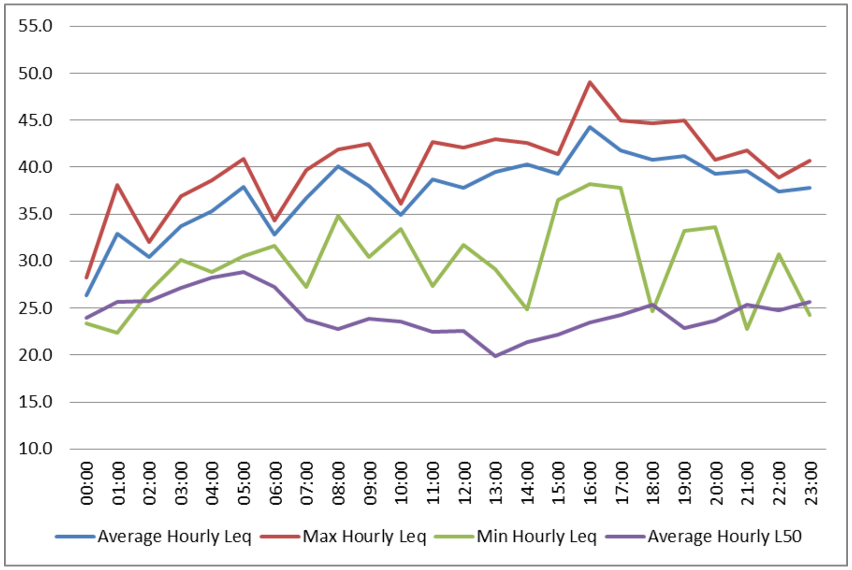


Figure C-83. Audible mechanized events per day at Spring LT7

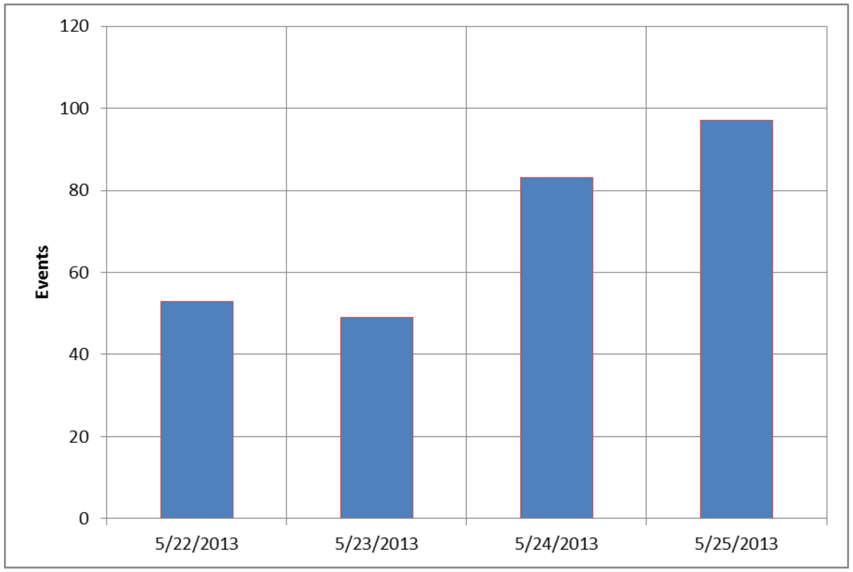


Figure C-84. Audible mechanized events distribution by hour at Spring LT7

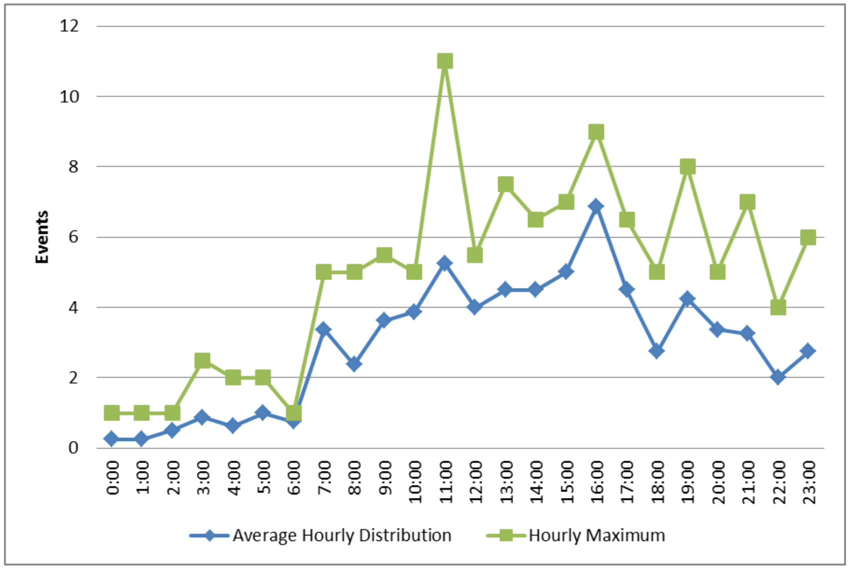


Figure C-85. Geophony at Monitor Spring LT9

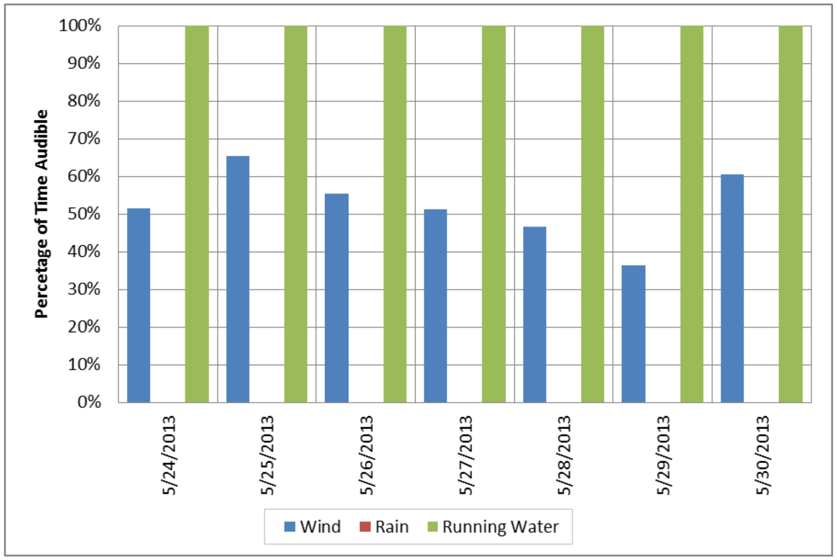


Figure C-86. Biophony at Monitor Spring LT9

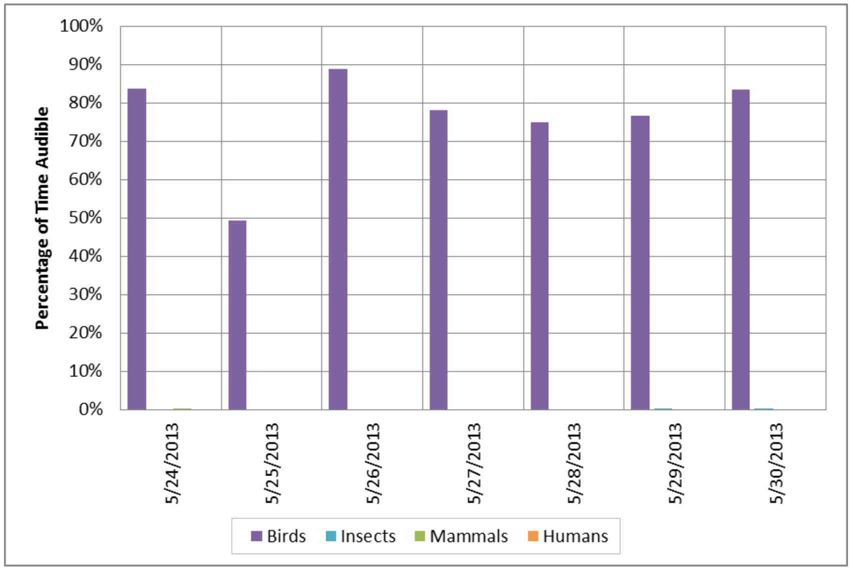


Figure C-87. Mechanized sound at Spring LT9: Average hourly %

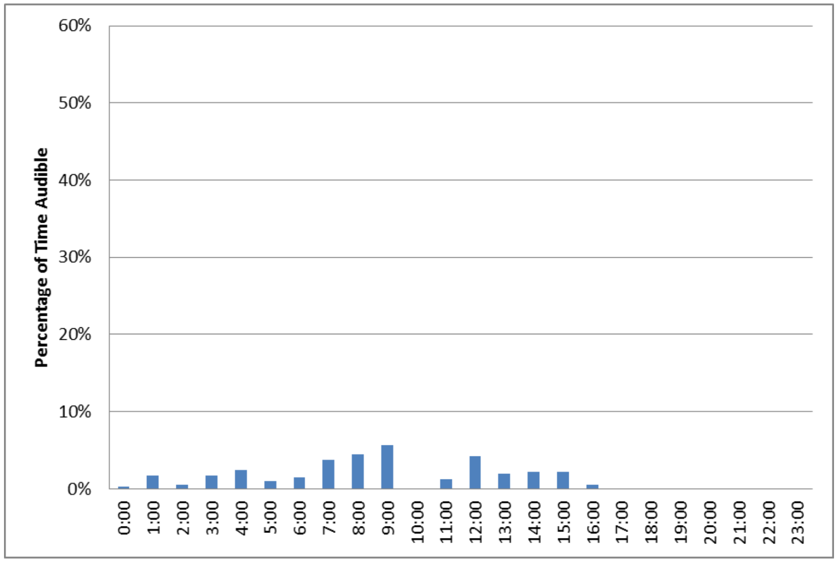


Figure C-88. Mechanized sound at Spring LT9: Daily hourly %

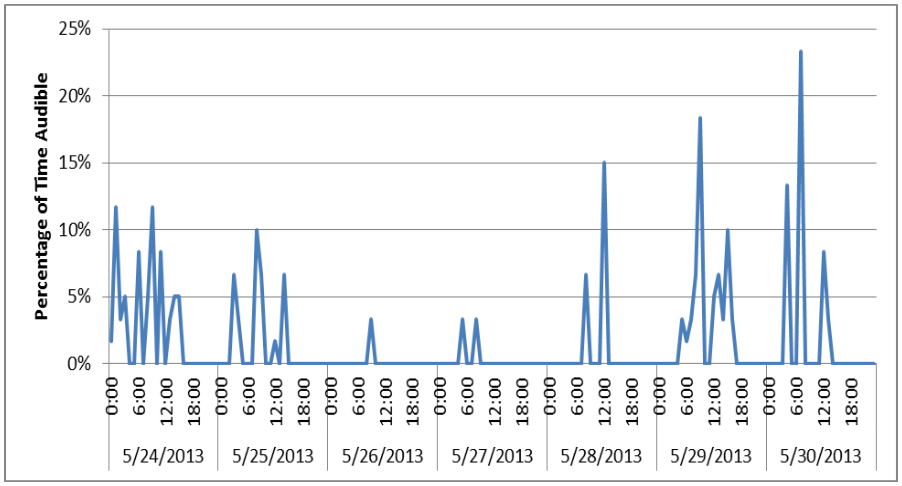


Figure C-89. Sound Pressure Levels at Spring LT9

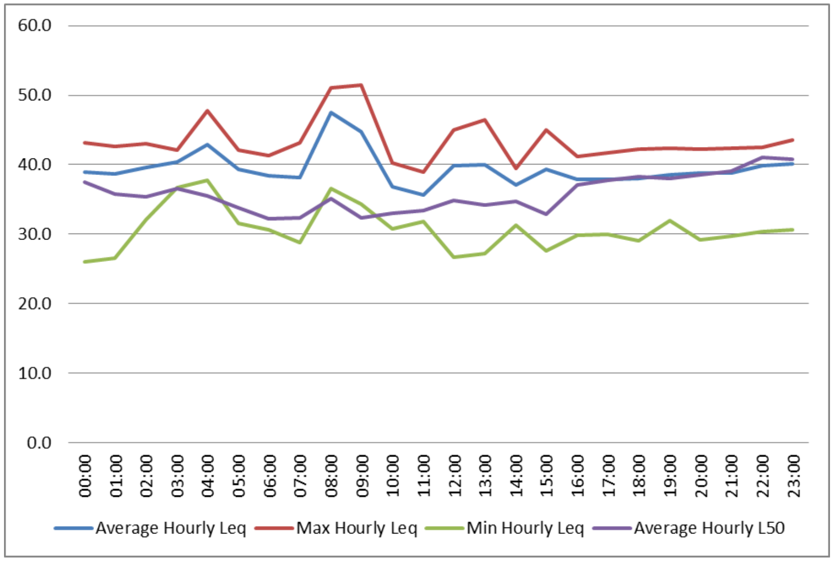


Figure C-90. Audible mechanized events per day at Spring LT9

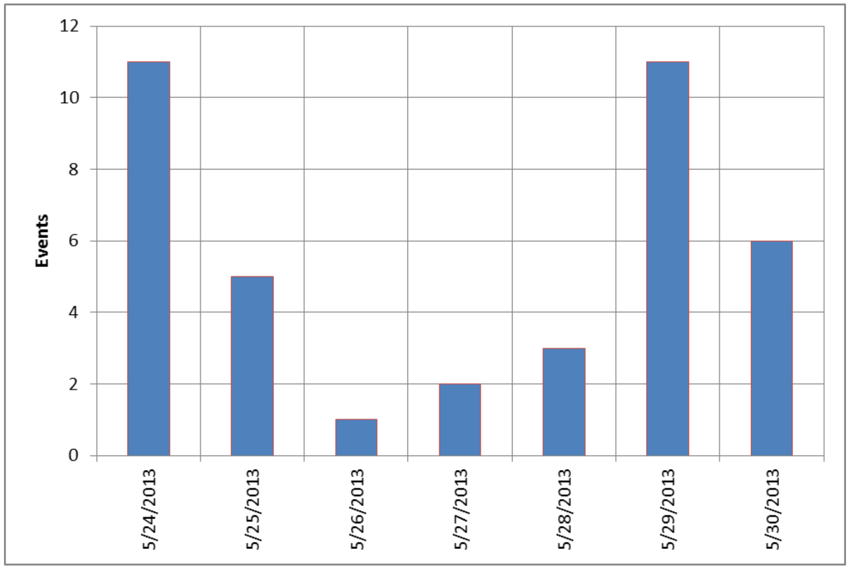


Figure C-91. Audible mechanized events distribution by hour at Spring LT9

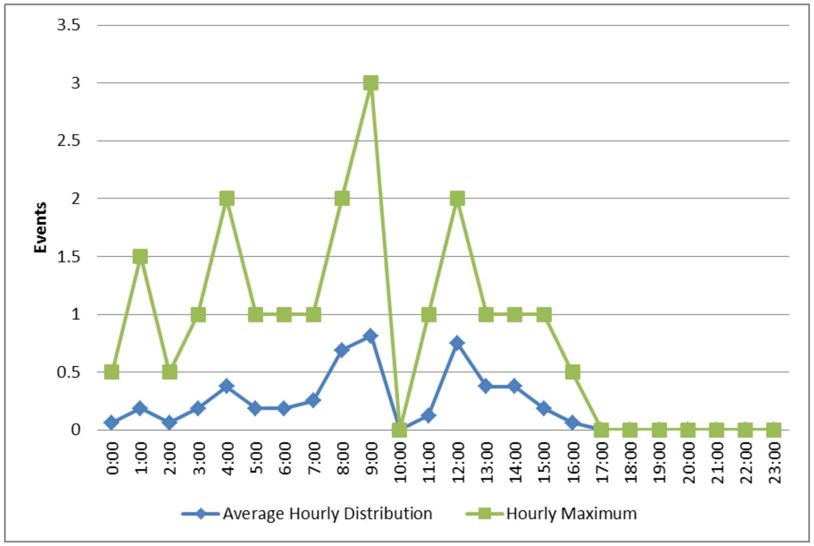


Figure C-92. Geophony at Monitor Summer LT1

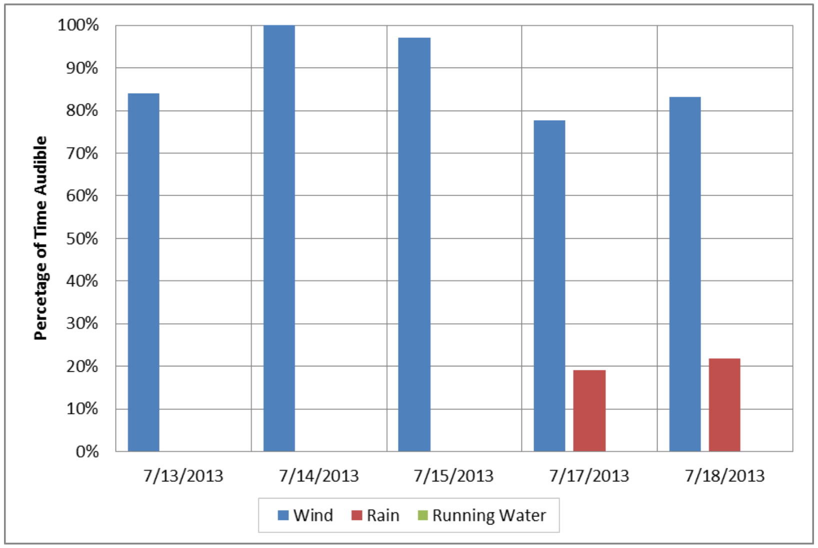


Figure C-93. Biophony at Monitor Summer LT1

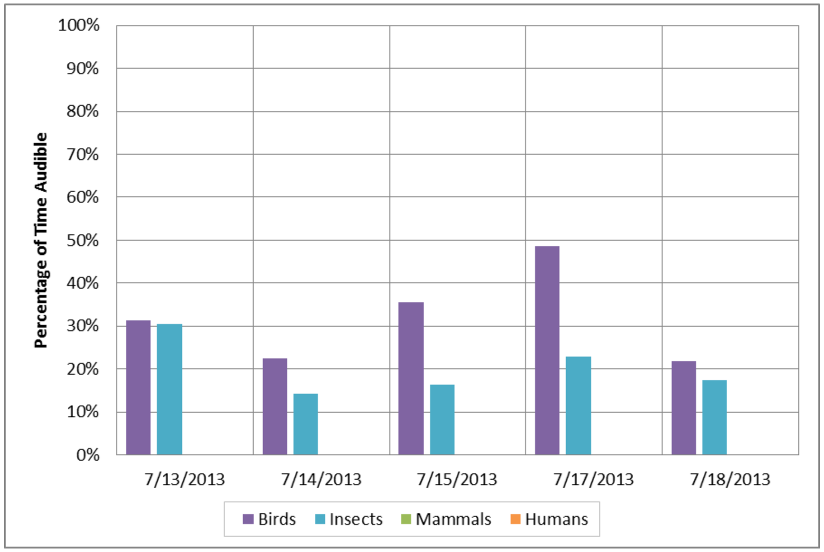


Figure C-94. Mechanized sound at Summer LT1: Average hourly %

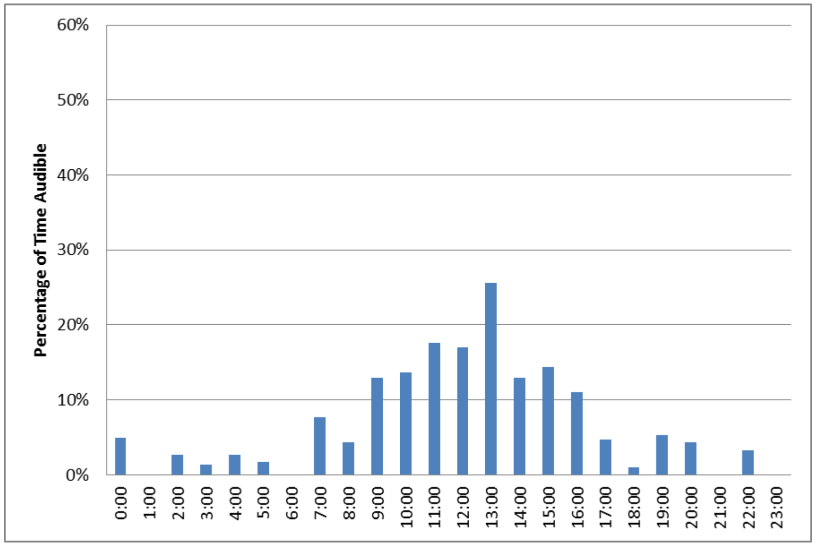


Figure C-95. Mechanized sound at Summer LT1: Daily hourly %

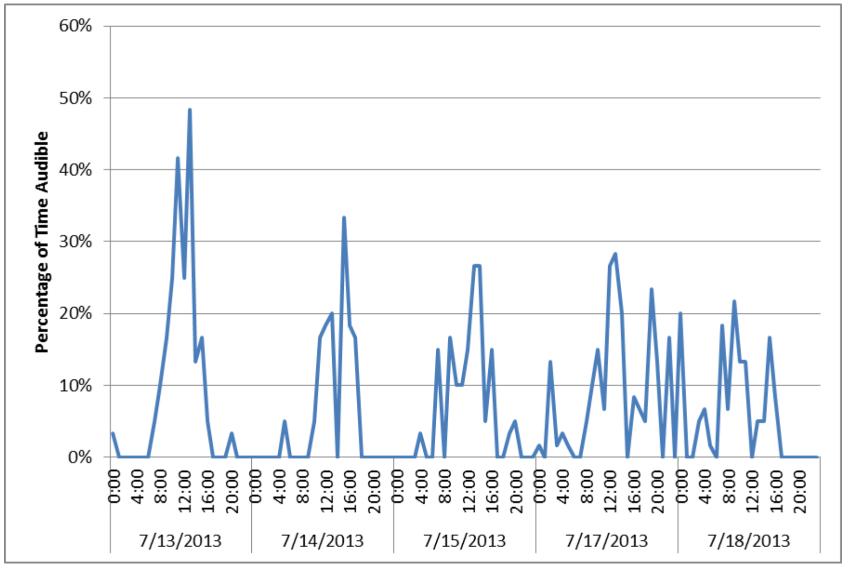


Figure C-96. Sound Pressure Levels at Summer LT1

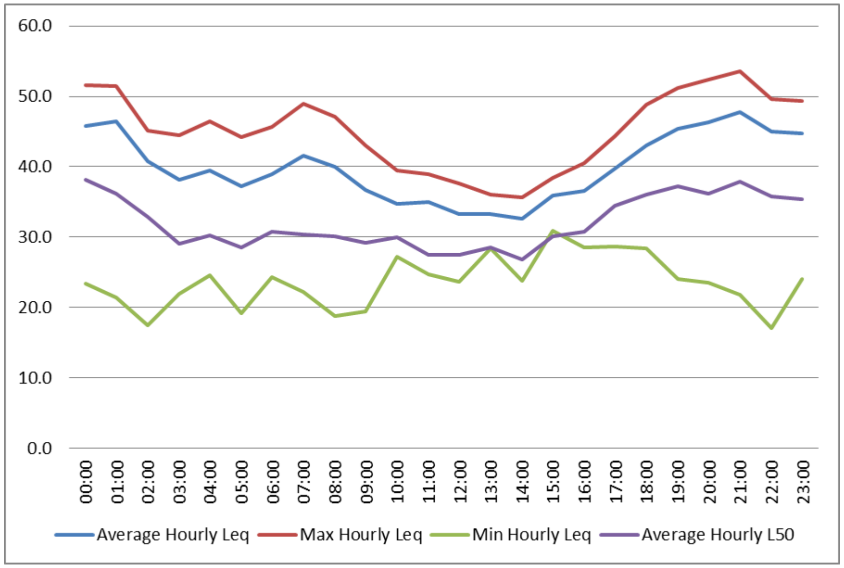


Figure C-97. Audible mechanized events per day at Summer LT1

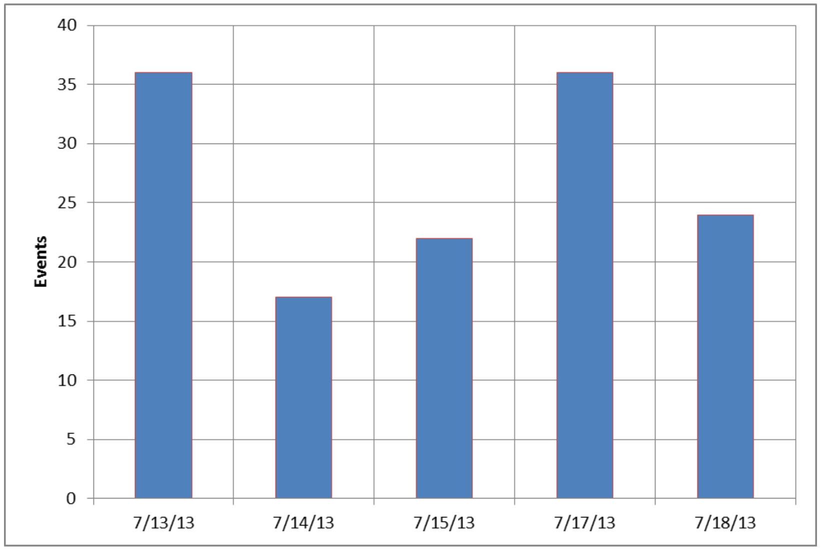


Figure C-98. Audible mechanized events distribution by hour at Summer LT1

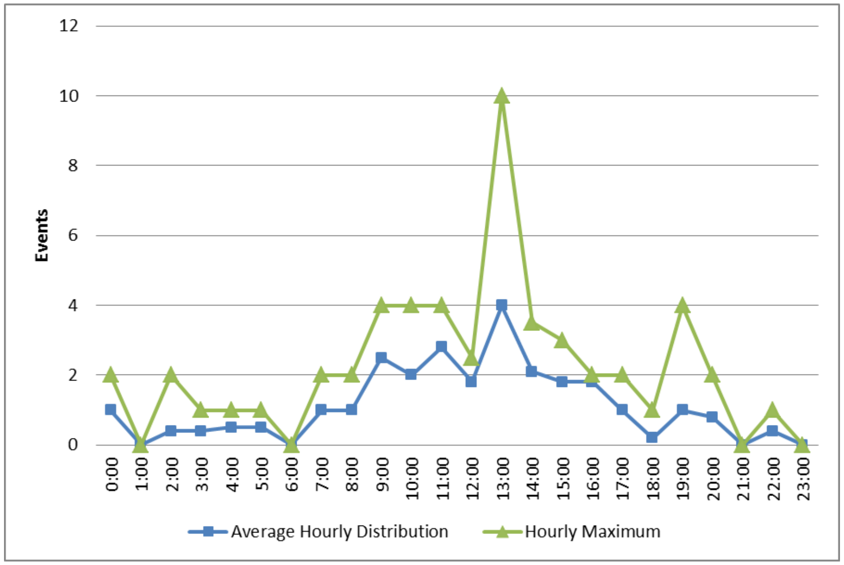


Figure C-99. Geophony at Monitor Summer LT3

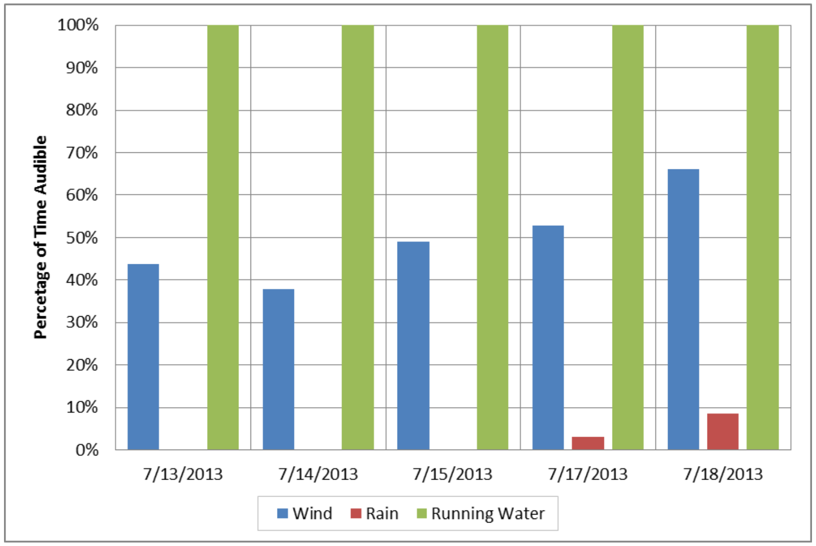


Figure C-100. Biophony at Monitor Summer LT3

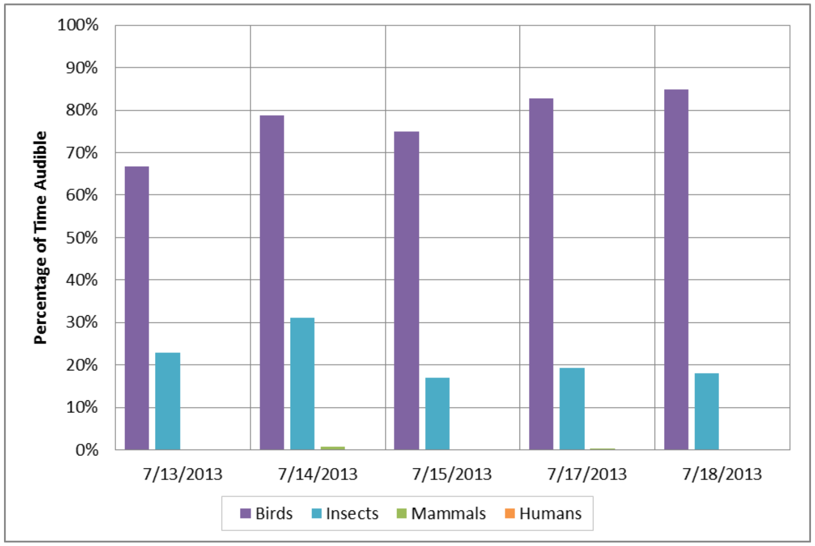


Figure C-101. Mechanized sound at Summer LT3: Average hourly %

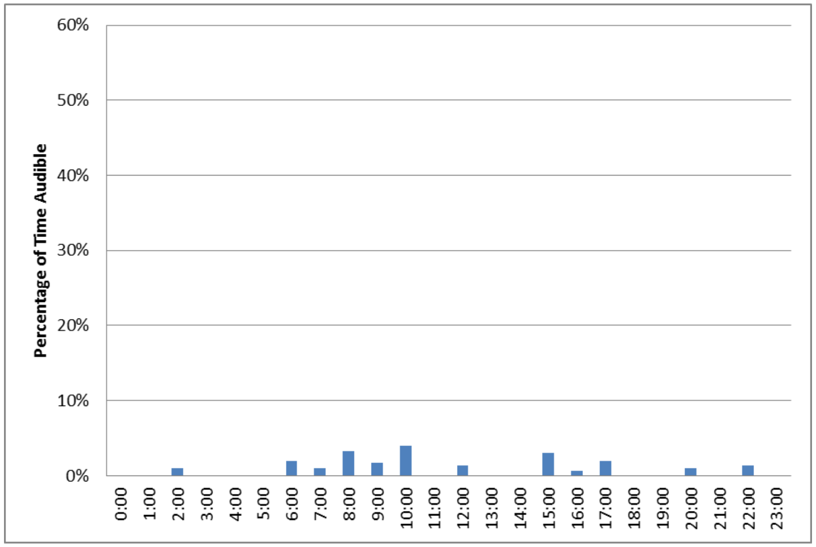


Figure C-102. Mechanized sound at Summer LT3: Daily hourly %

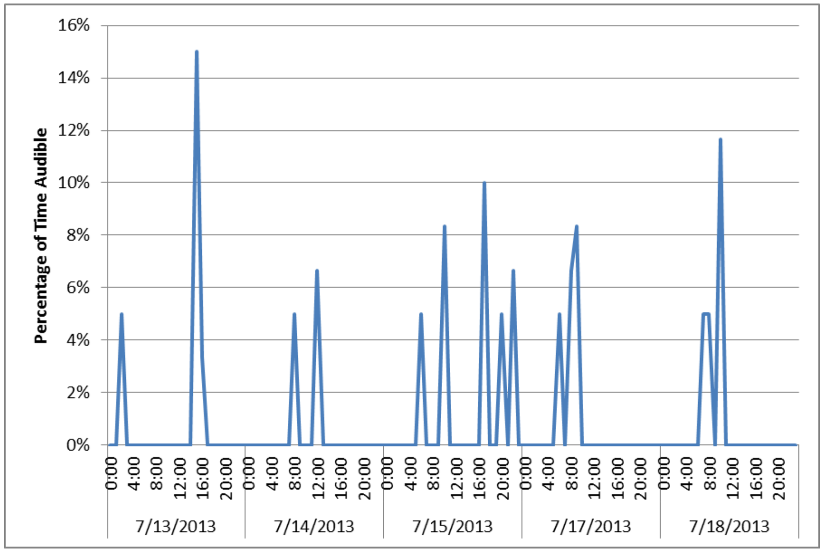


Figure C-103. Sound Pressure Levels at Summer LT3

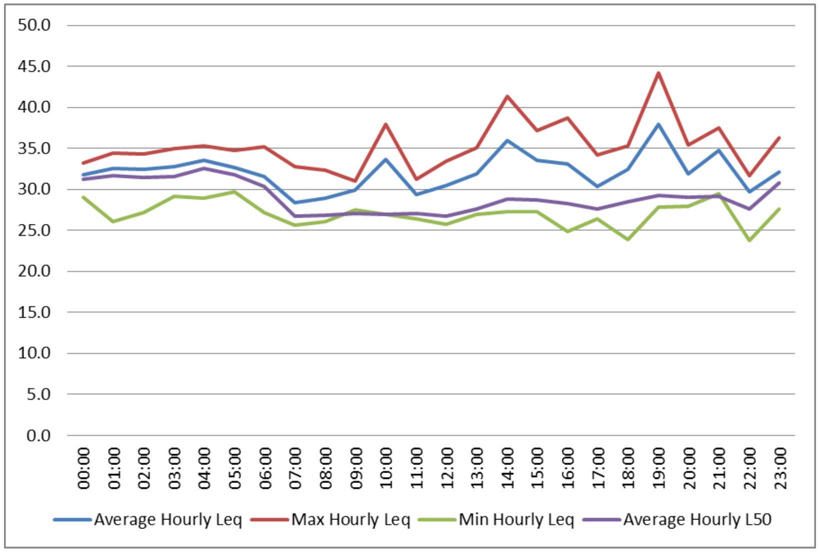


Figure C-104. Audible mechanized events per day at Summer LT3

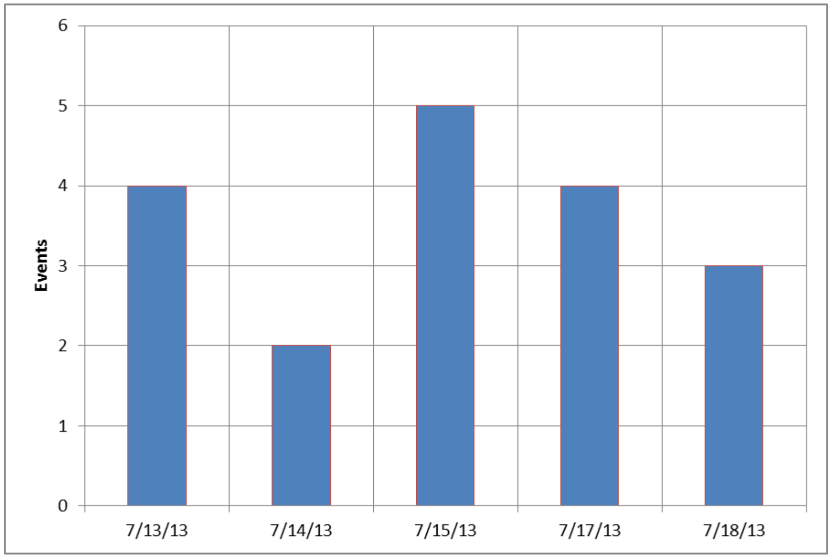


Figure C-105. Audible mechanized events distribution by hour at Summer LT3

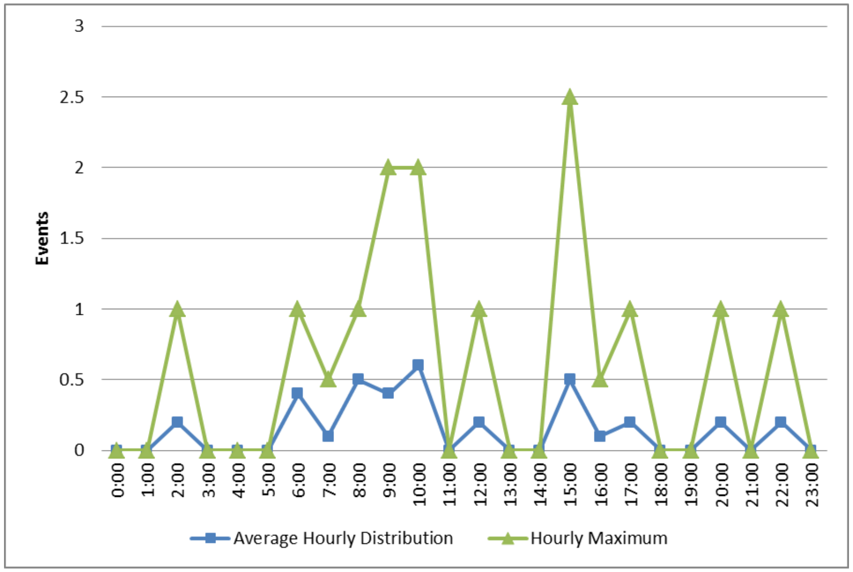


Figure C-106. Geophony at Monitor Summer LT4

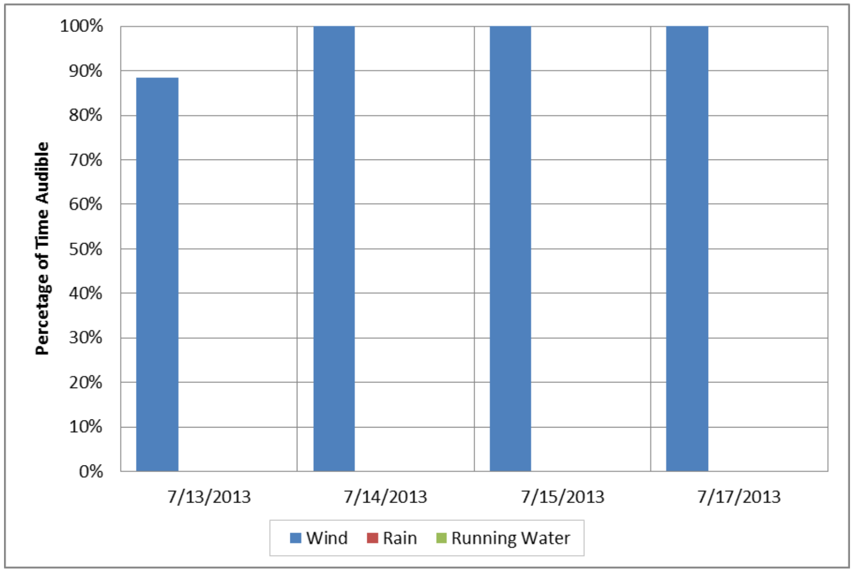


Figure C-107. Biophony at Monitor Summer LT4

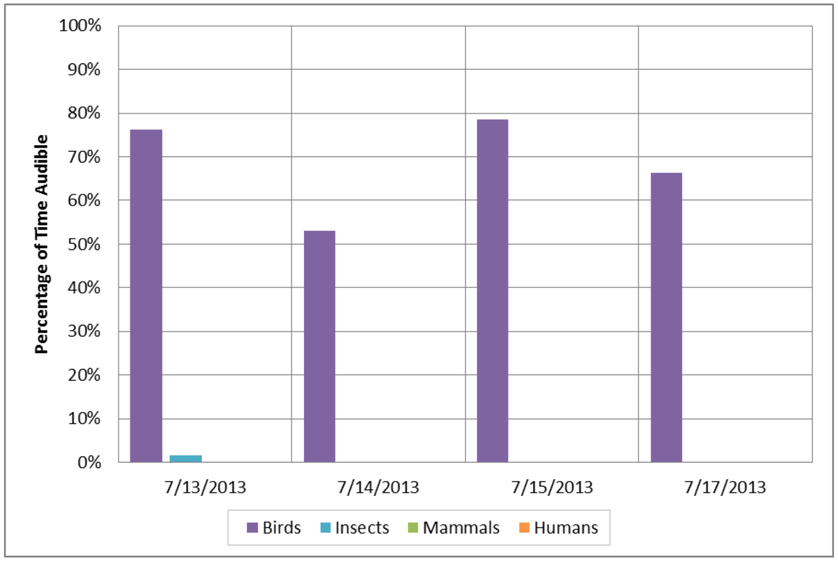


Figure C-108. Mechanized sound at Summer LT4: Average hourly %

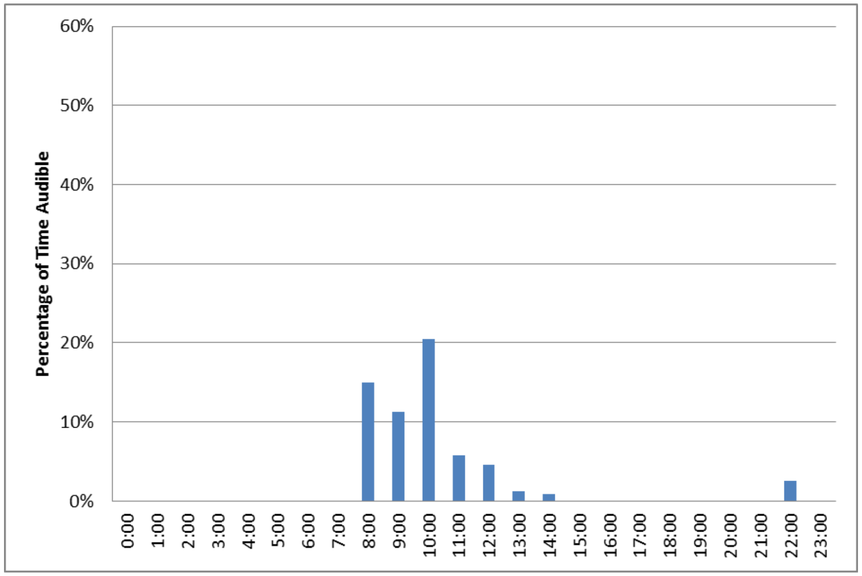


Figure C-109. Mechanized sound at Summer LT4: Daily hourly %

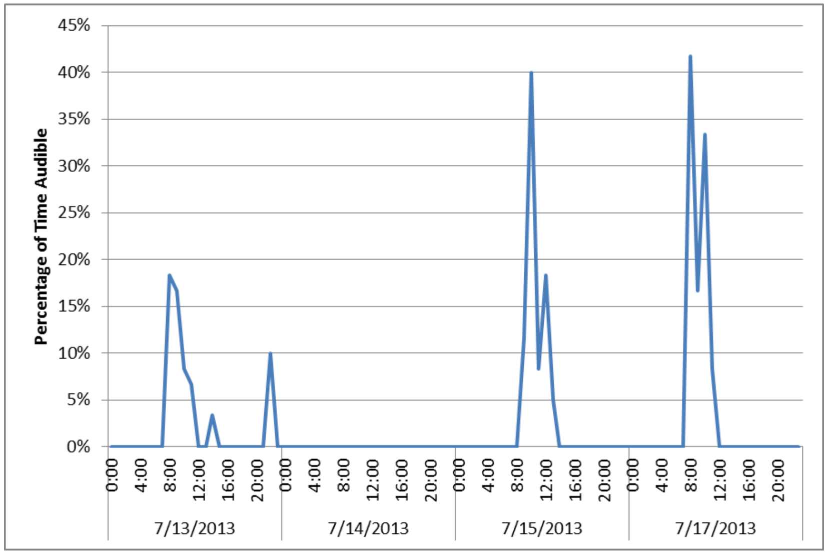


Figure C-110. Sound Pressure Levels at Summer LT4

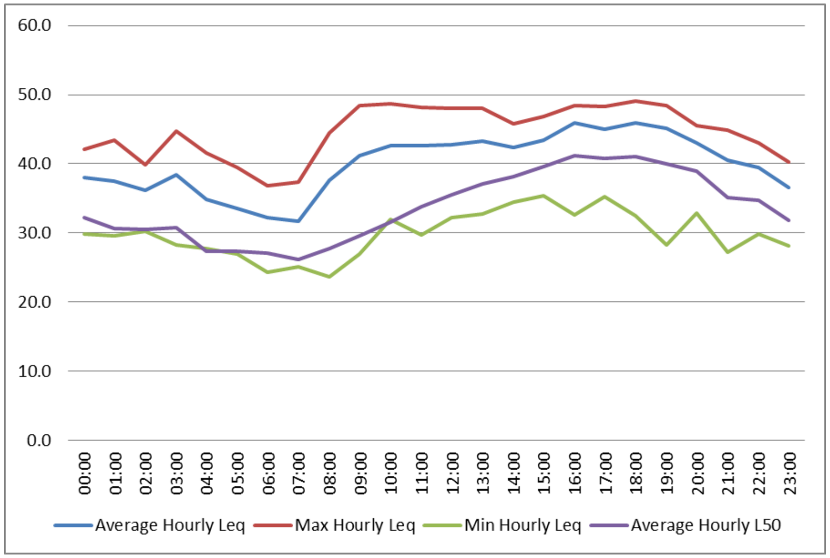


Figure C-111. Audible mechanized events per day at Summer LT4

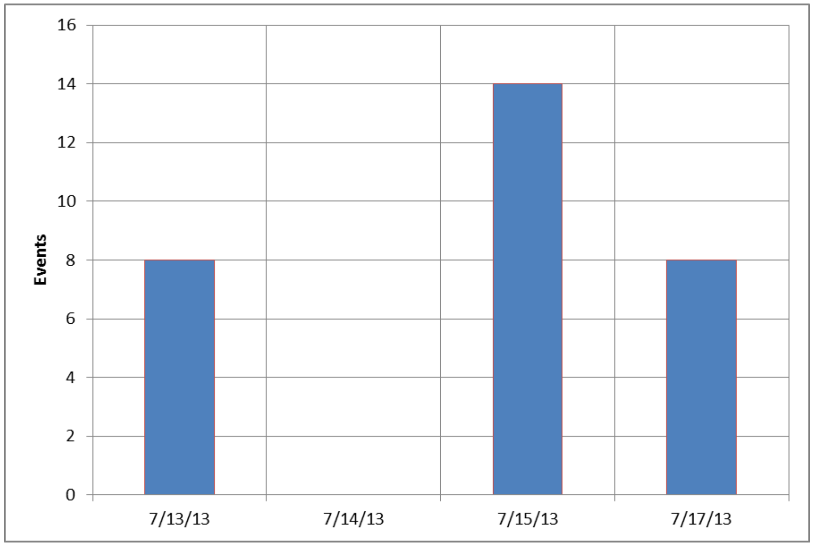


Figure C-112. Audible mechanized events distribution by hour at Summer LT4

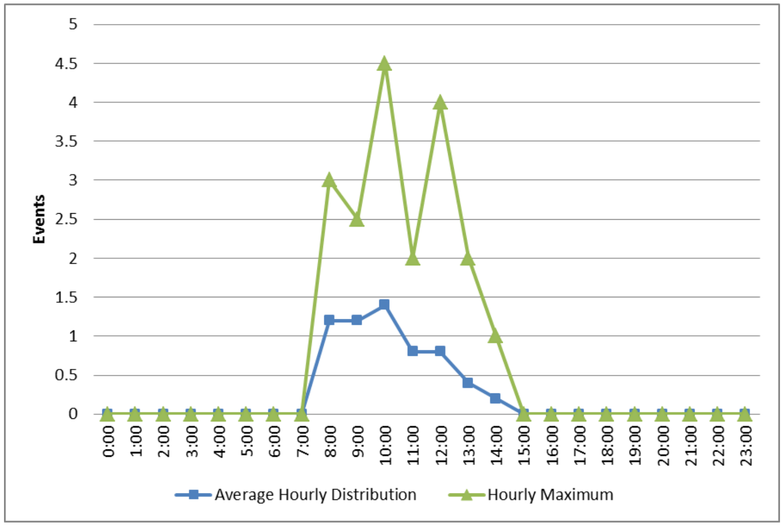


Figure C-113. Geophony at Monitor Summer LT5

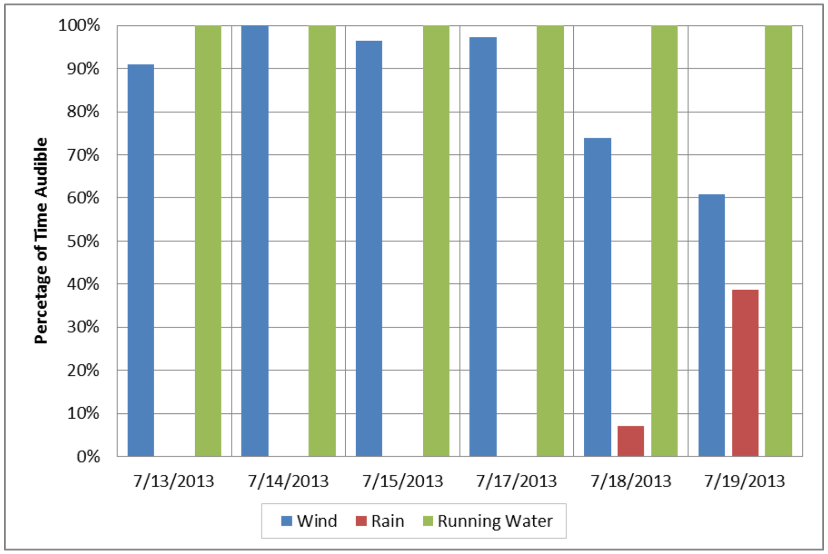


Figure C-114. Biophony at Monitor Summer LT5

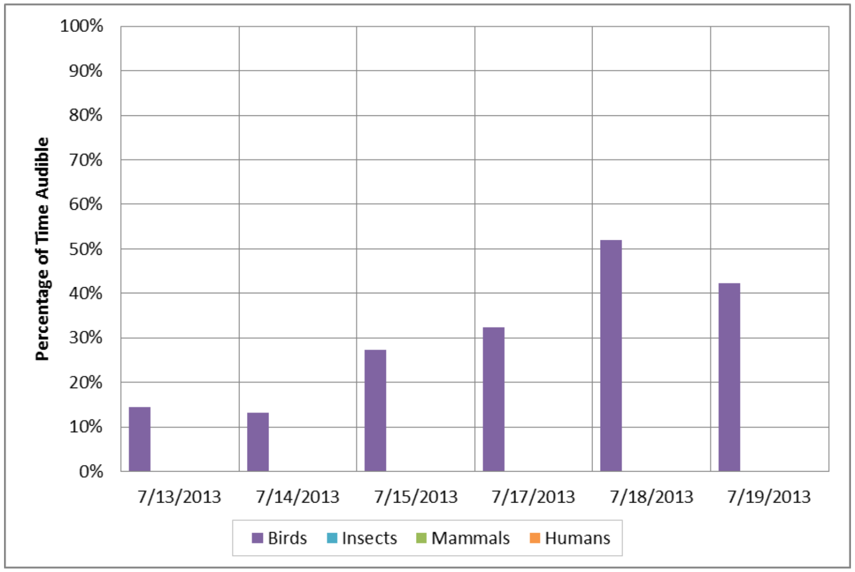


Figure C-115. Mechanized sound at Summer LT5: Average hourly %

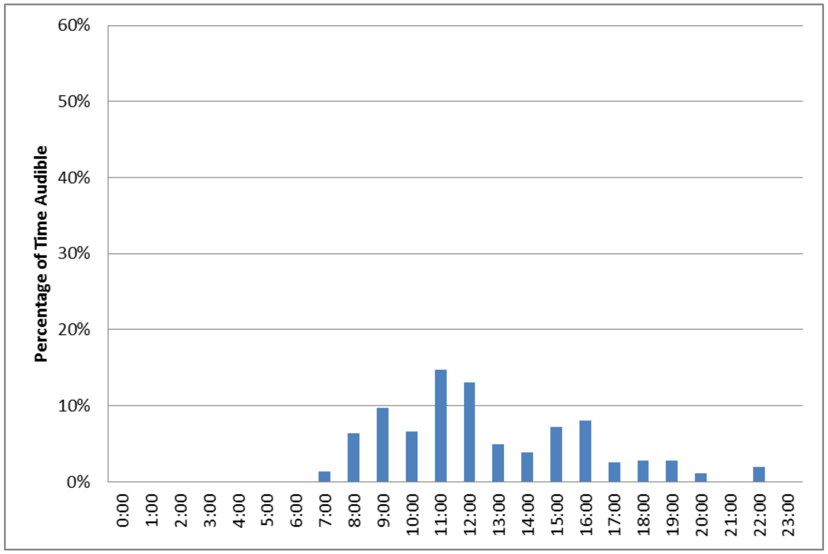


Figure C-116. Mechanized sound at Summer LT:5 Daily hourly %

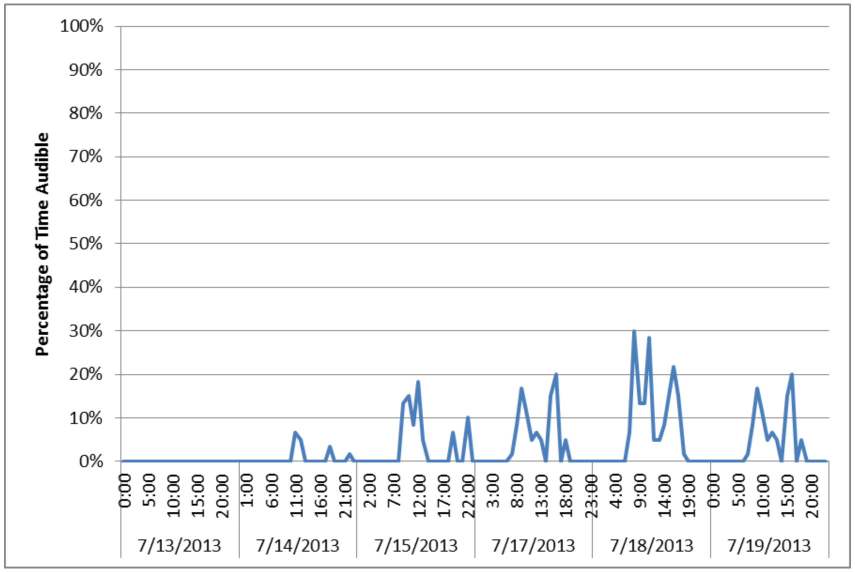


Figure C-117. Sound Pressure Levels at Summer LT5

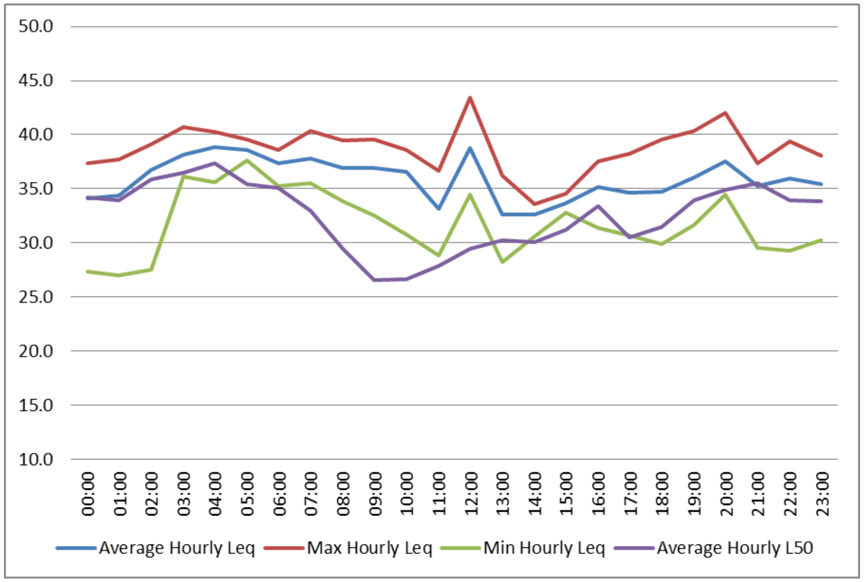


Figure C-118. Audible mechanized events per day at Summer LT5

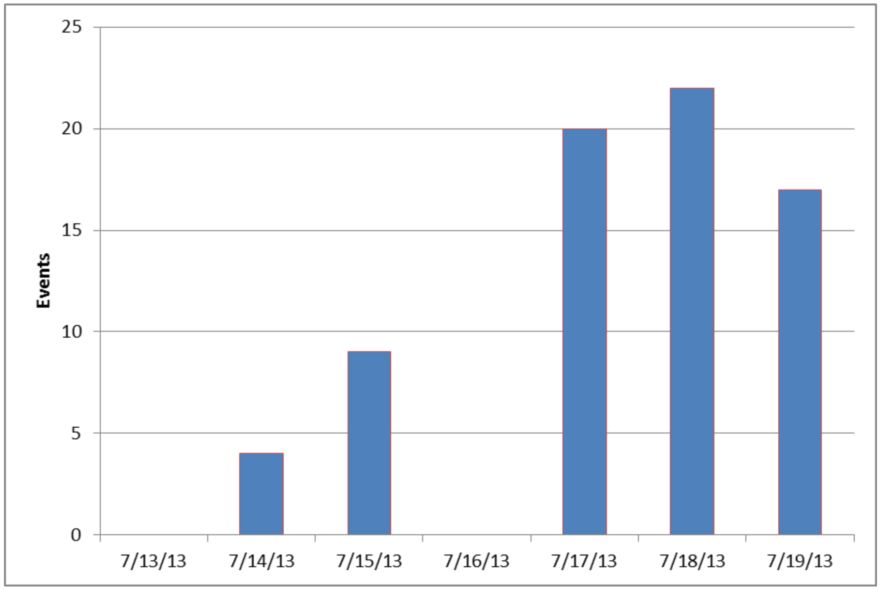


Figure C-119. Audible mechanized events distribution by hour at Summer LT5

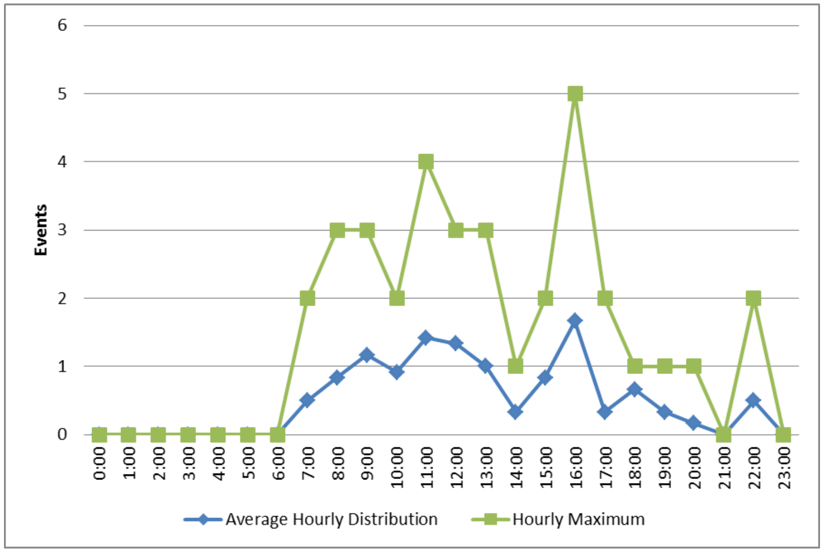


Figure C-120. Geophony at Monitor Summer LT6

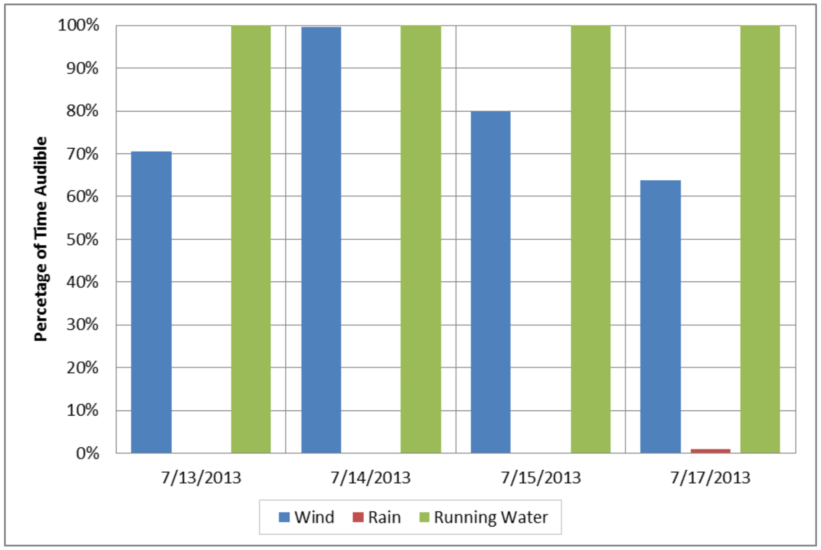


Figure C-121. Biophony at Monitor Summer LT6

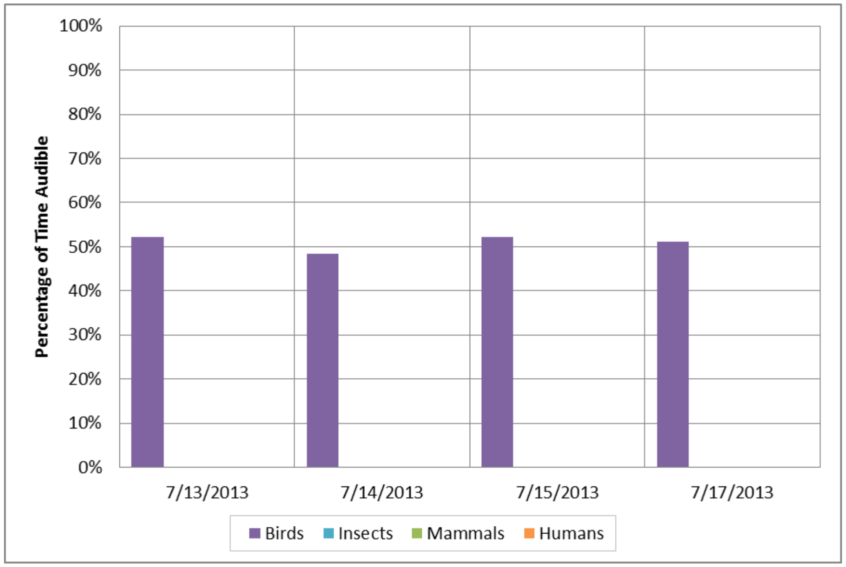


Figure C-122. Mechanized sound at Summer LT6: Average hourly %

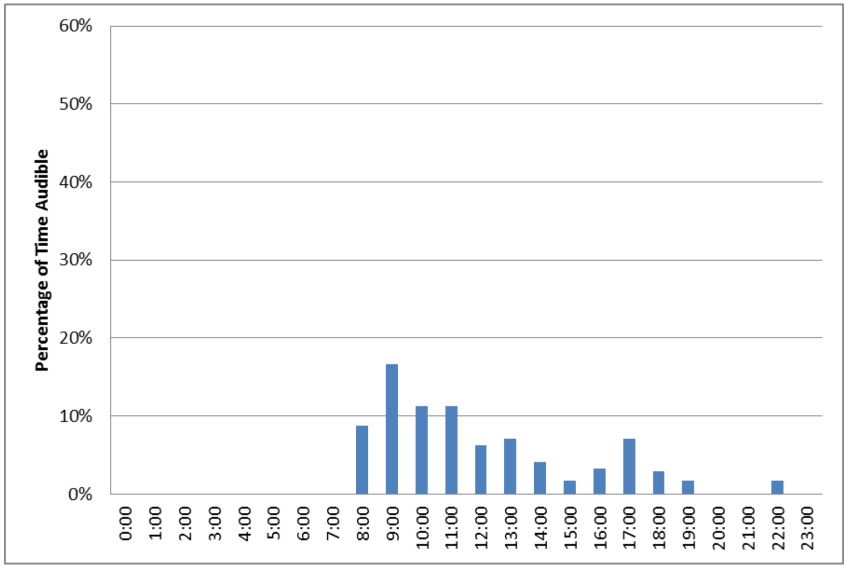


Figure C-123. Mechanized sound at Summer LT6: Daily hourly %

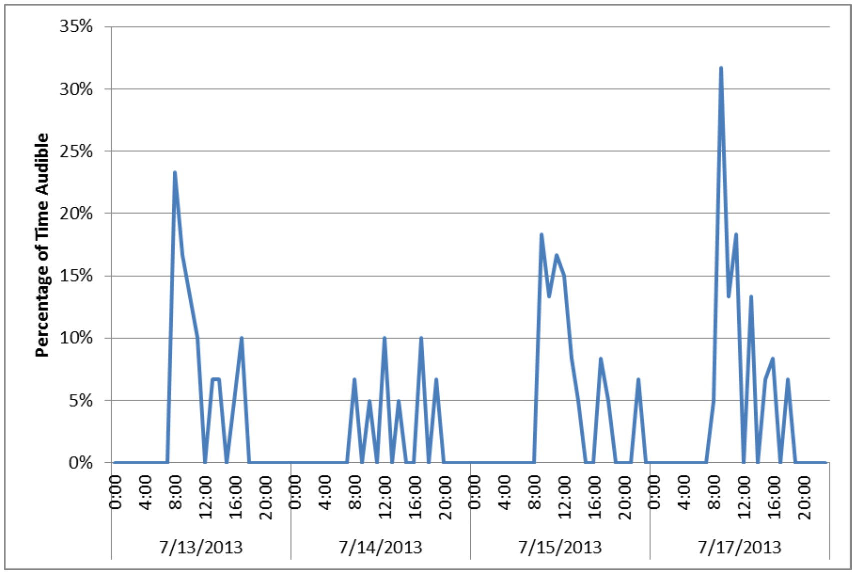


Figure C-124. Sound Pressure Levels at Summer LT6

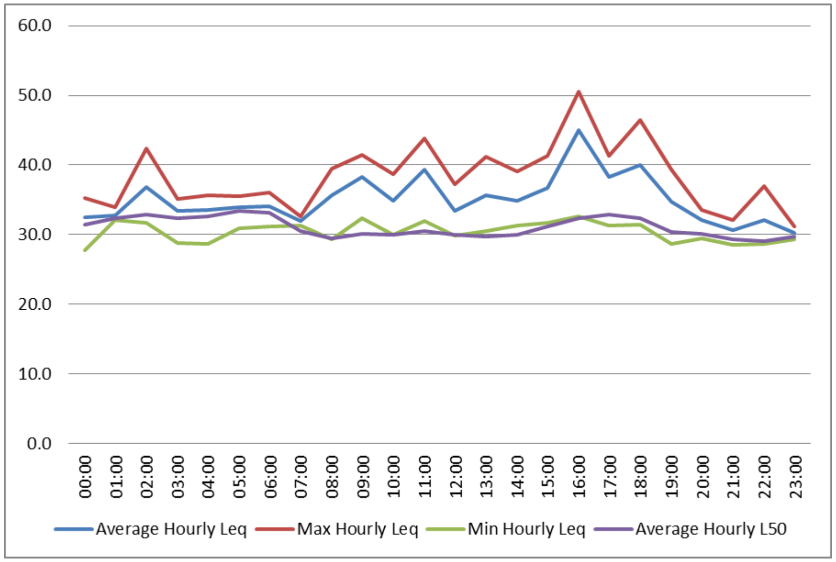


Figure C-125. Audible mechanized events per day at Summer LT6

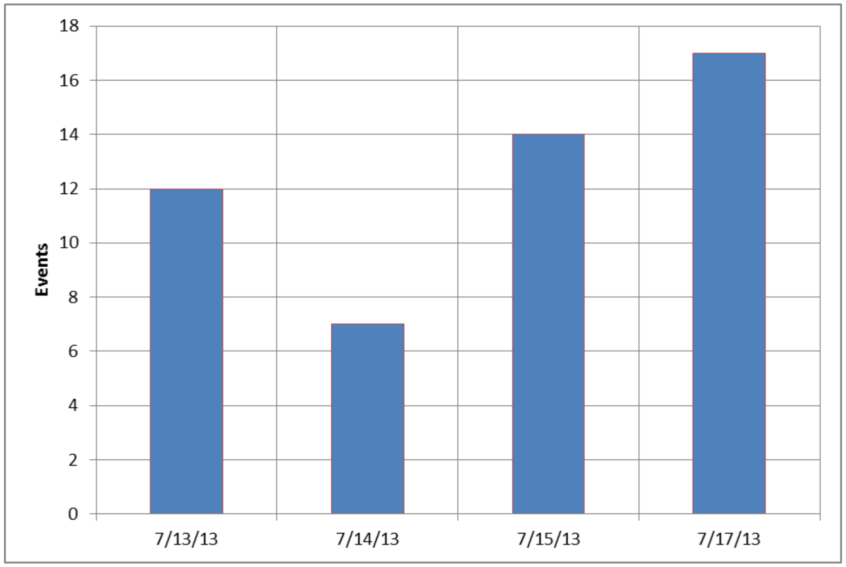


Figure C-126. Audible mechanized events distribution by hour at Summer LT6

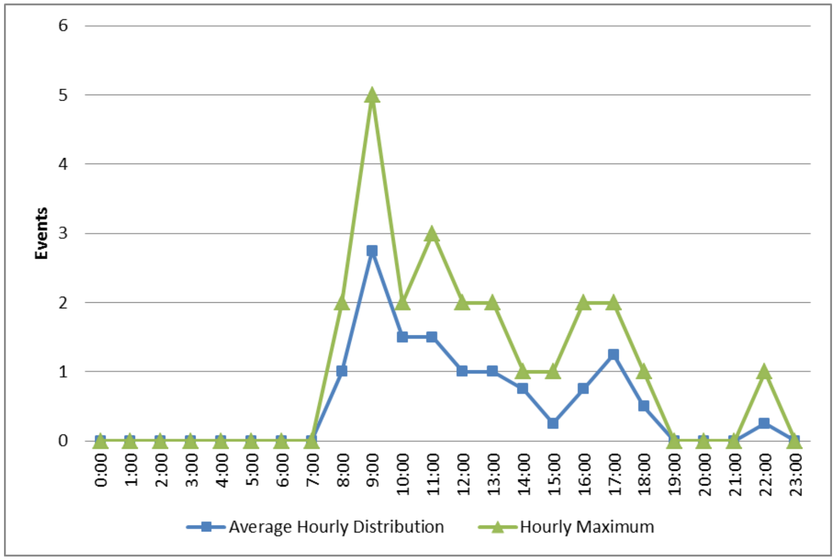


Figure C-127. Geophony at Monitor Summer LT7

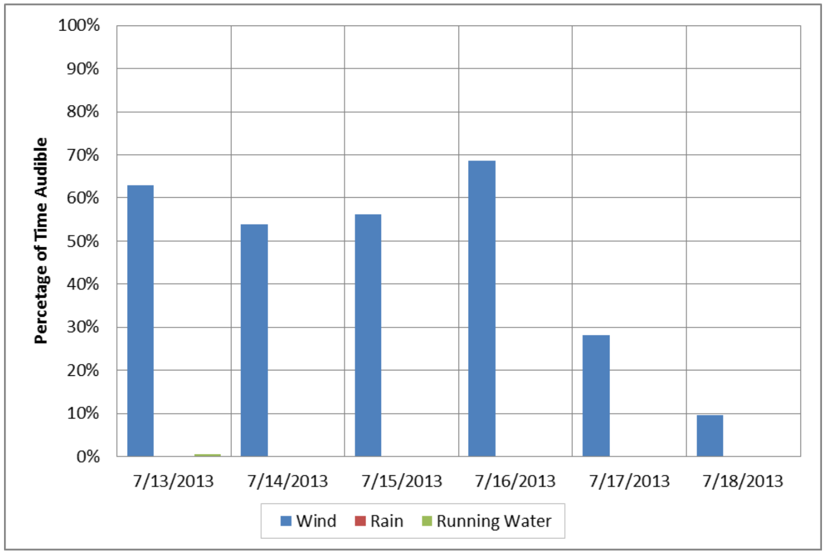


Figure C-128. Biophony at Monitor Summer LT7

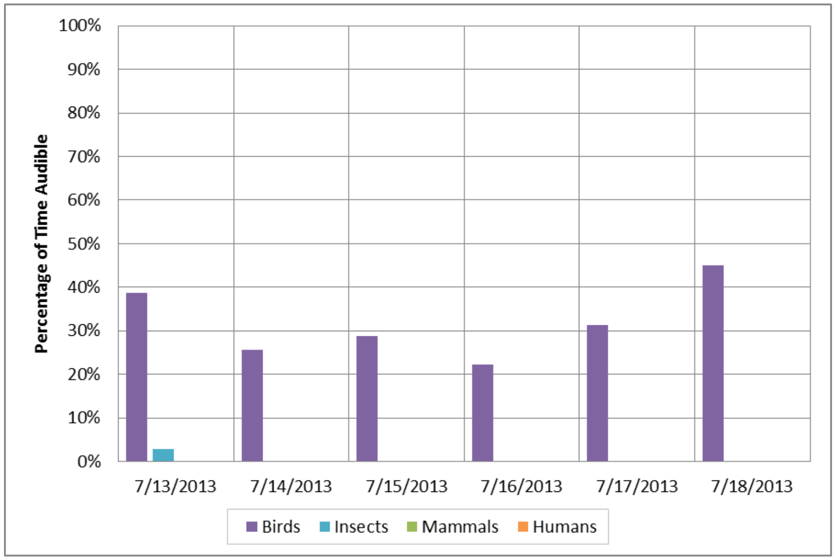


Figure C-129. Mechanized sound at Summer LT7: Average hourly %

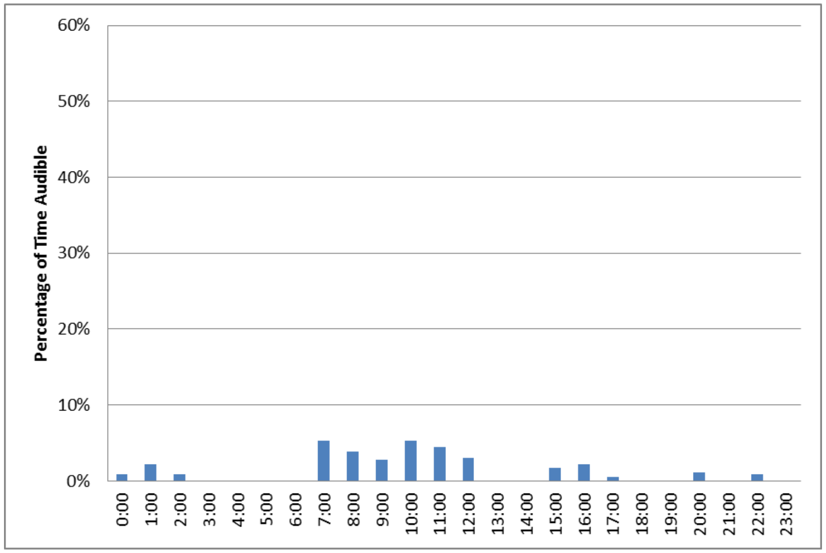


Figure C-130. Mechanized sound at Summer LT7: Daily hourly %

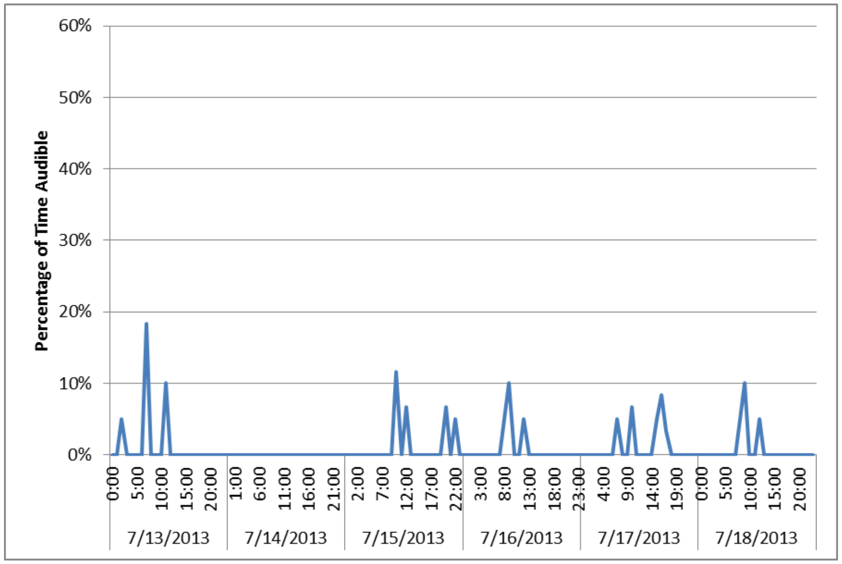


Figure C-131. Sound Pressure Levels at Summer LT7

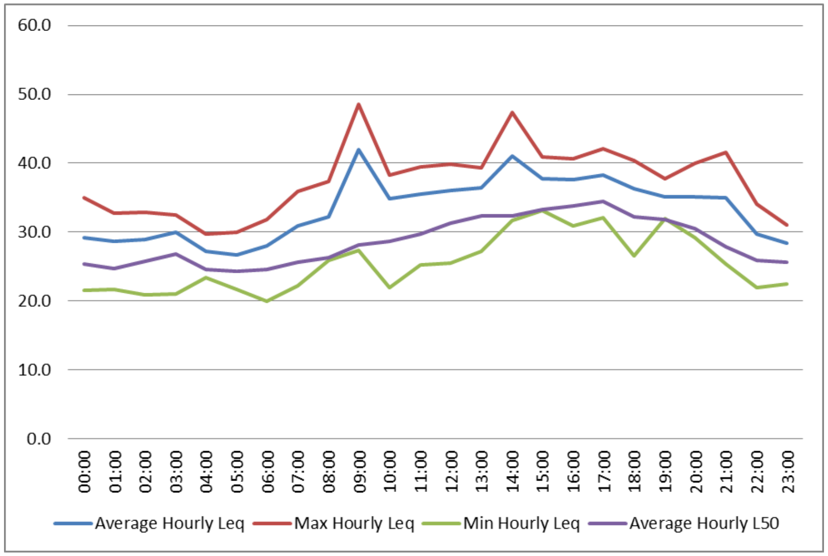


Figure C-132. Audible mechanized events per day at Summer LT7

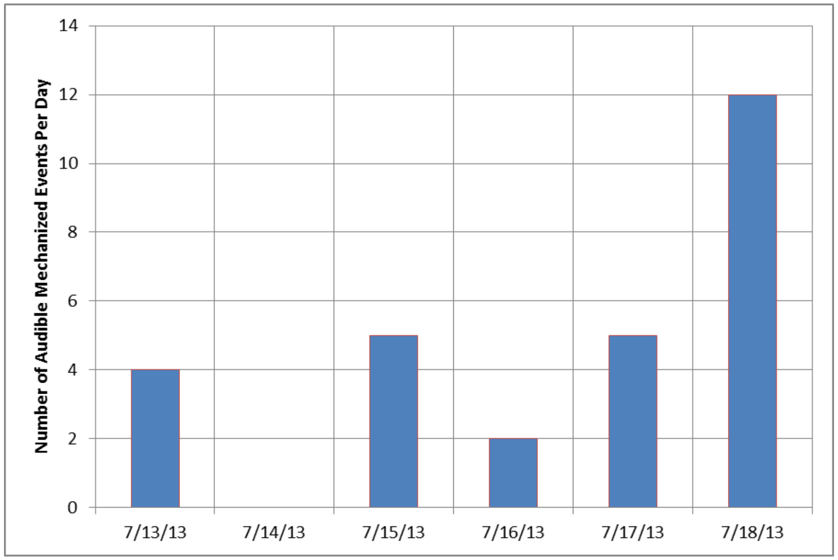


Figure C-133. Audible mechanized events distribution by hour at Summer LT7

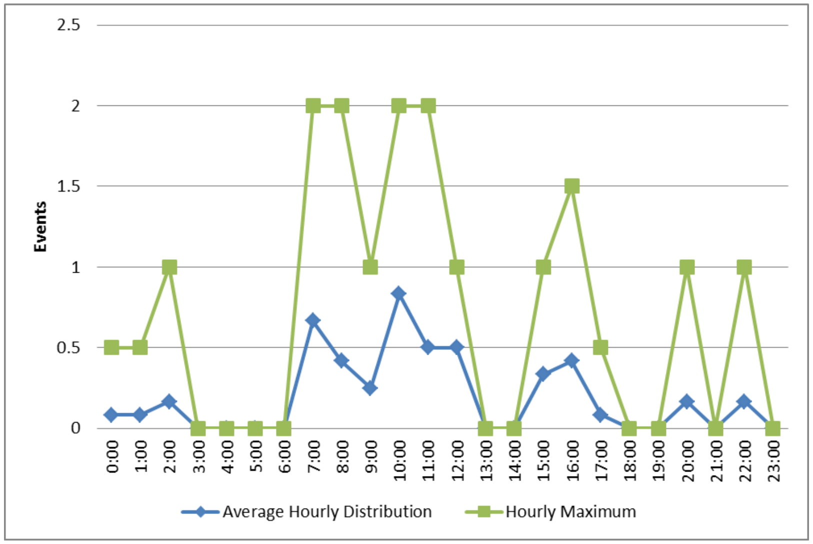


Figure C-134. Geophony at Monitor Summer LT8

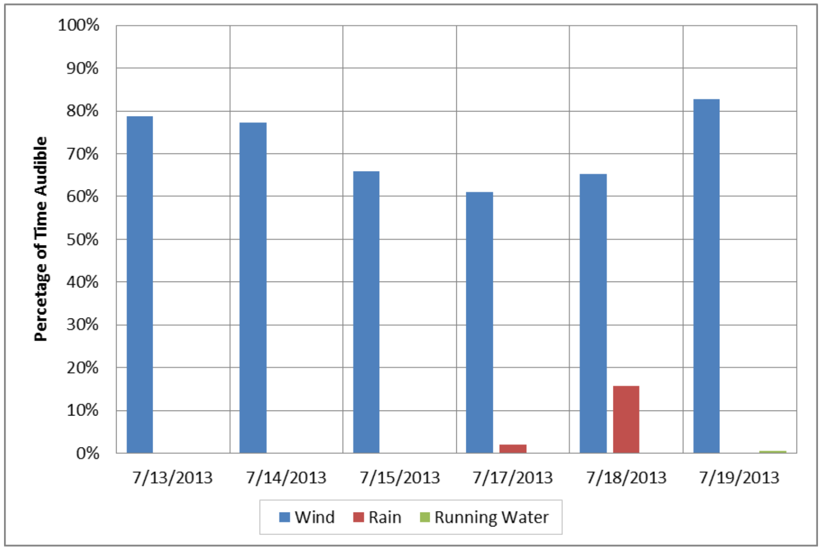


Figure C-135. Biophony at Monitor Summer LT8

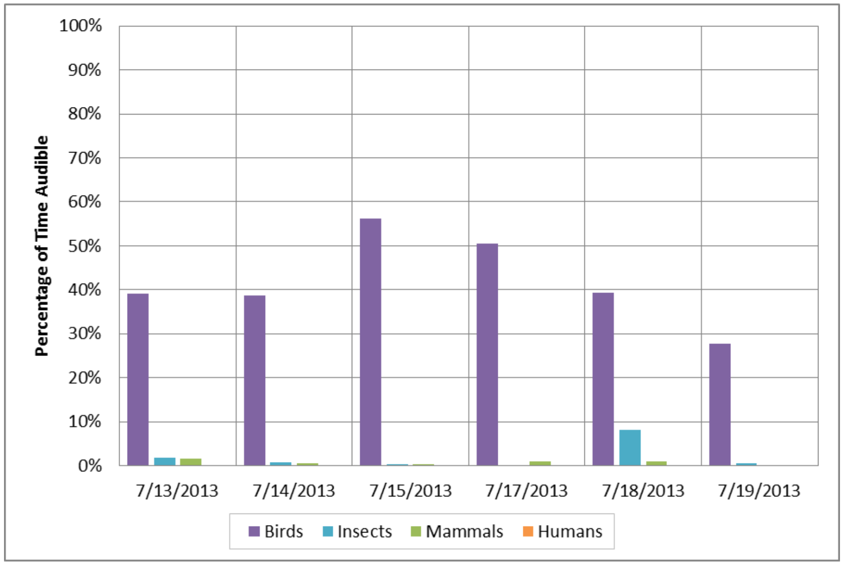


Figure C-136. Mechanized sound at Summer LT8: Average hourly %

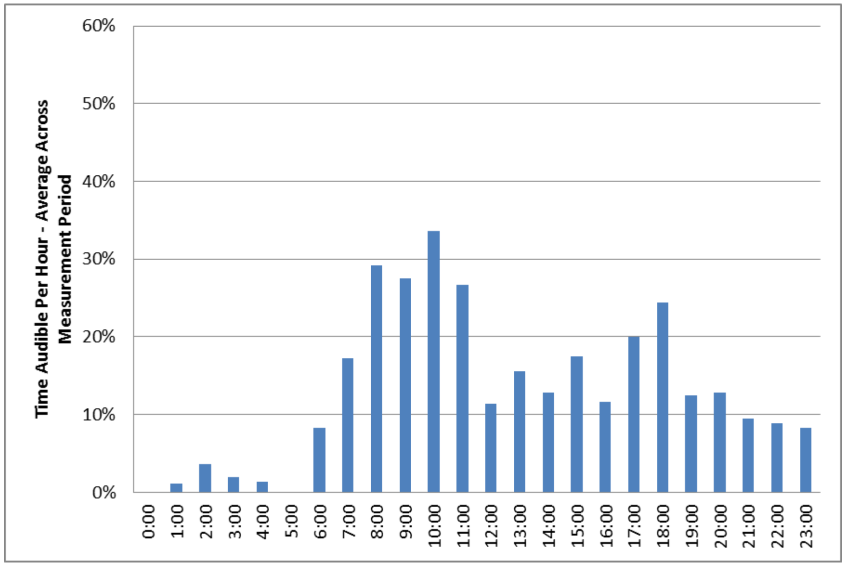


Figure C-137. Mechanized sound at Summer LT8: Daily hourly %

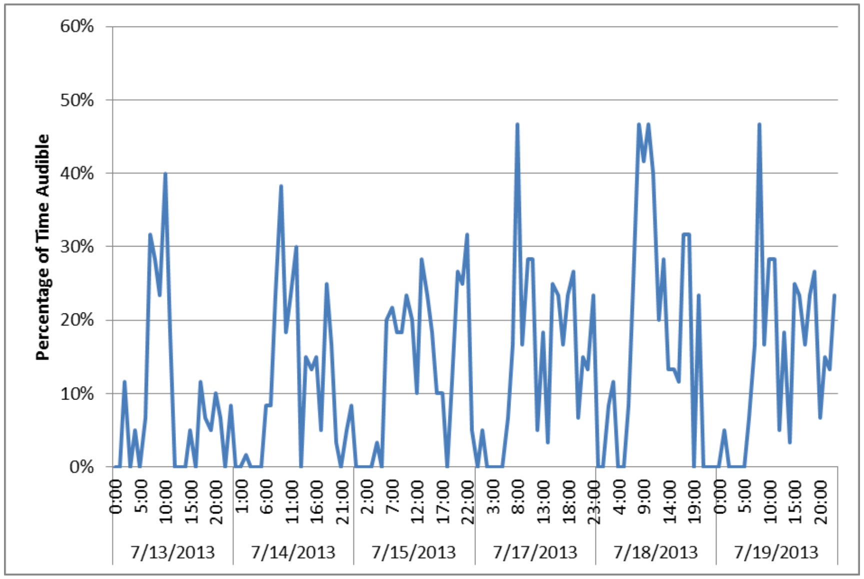


Figure C-138. Sound Pressure Levels at Summer LT8

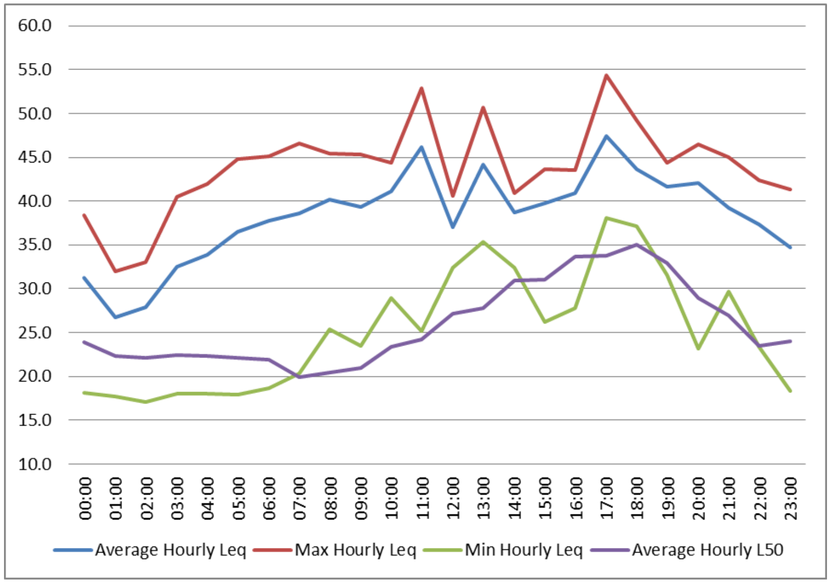


Figure C-139. Audible mechanized events per day at Summer LT8

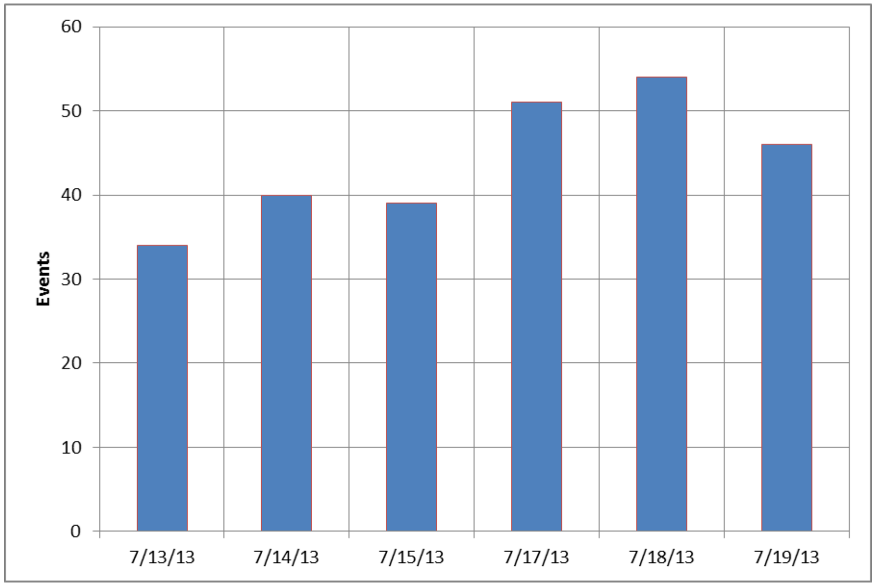


Figure C-140. Audible mechanized events distribution by hour at Summer LT8

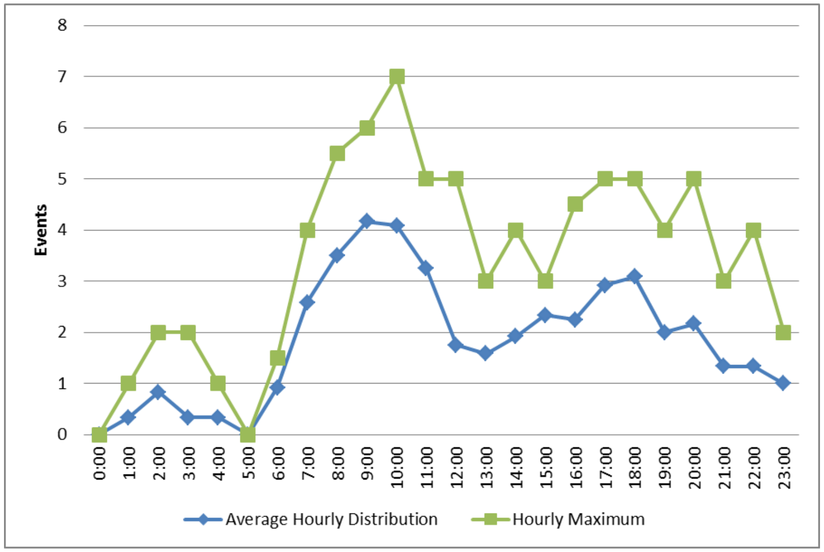


Figure C-141. Geophony at Monitor Summer LT9

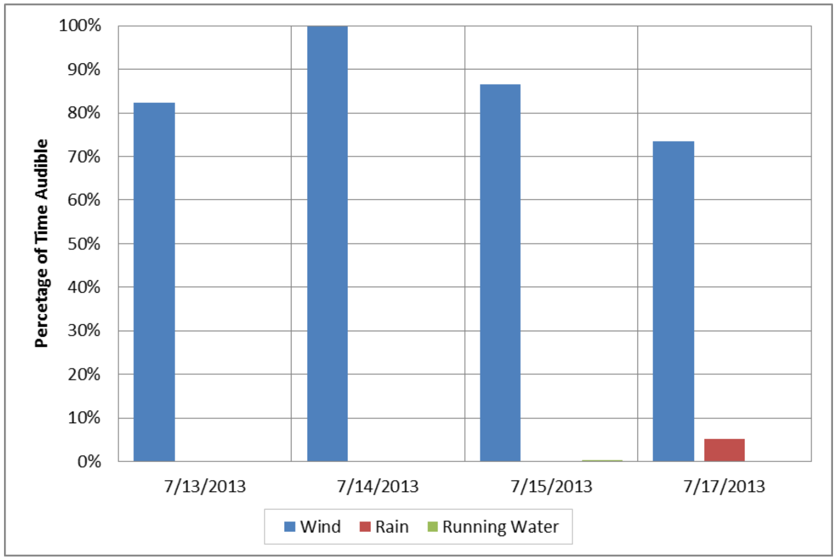


Figure C-142. Biophony at Monitor Summer LT9

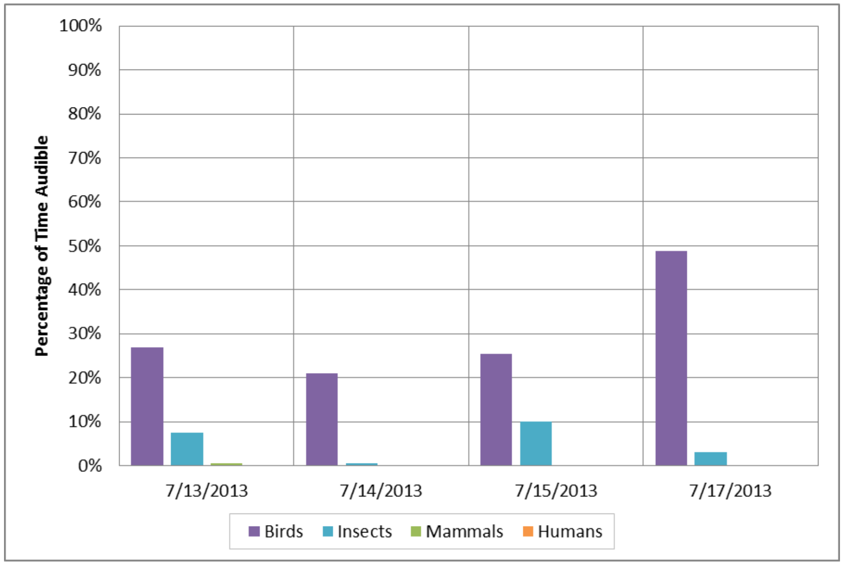


Figure C-143. Mechanized sound at Summer LT9: Average hourly %

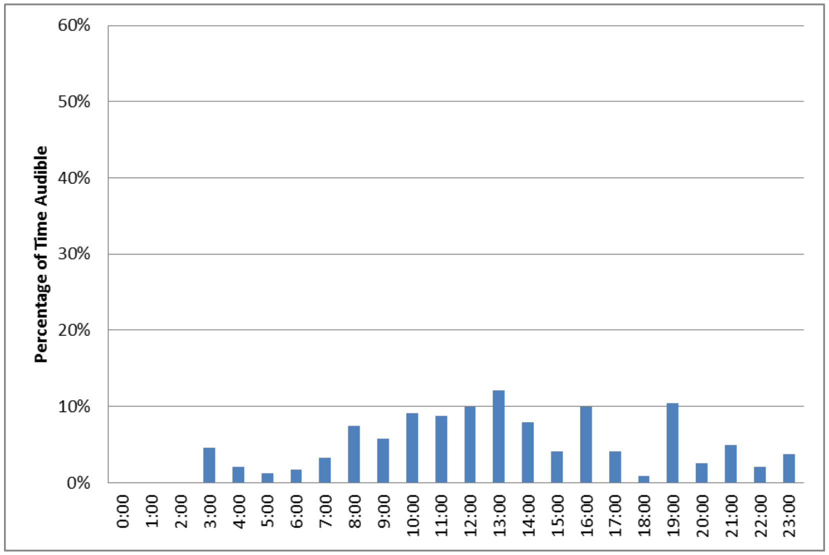


Figure C-144. Mechanized sound at Summer LT9: Daily hourly %

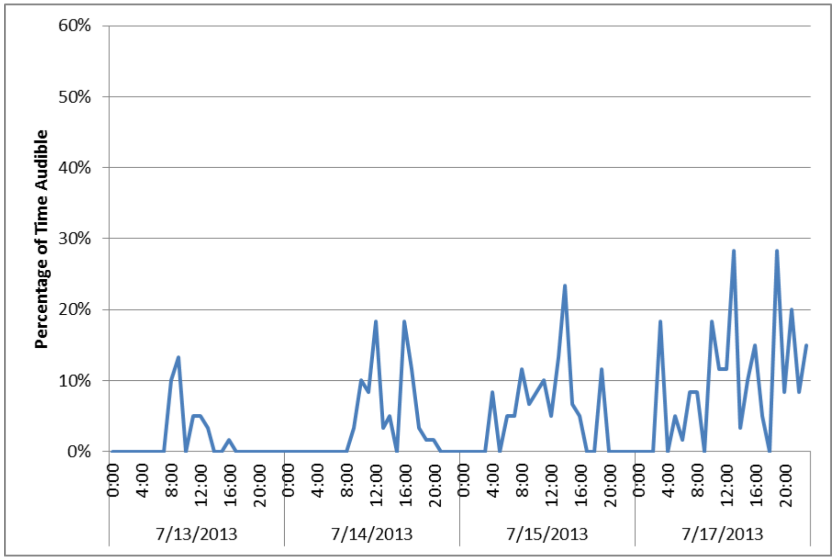


Figure C-145. Sound Pressure Levels at Summer LT9

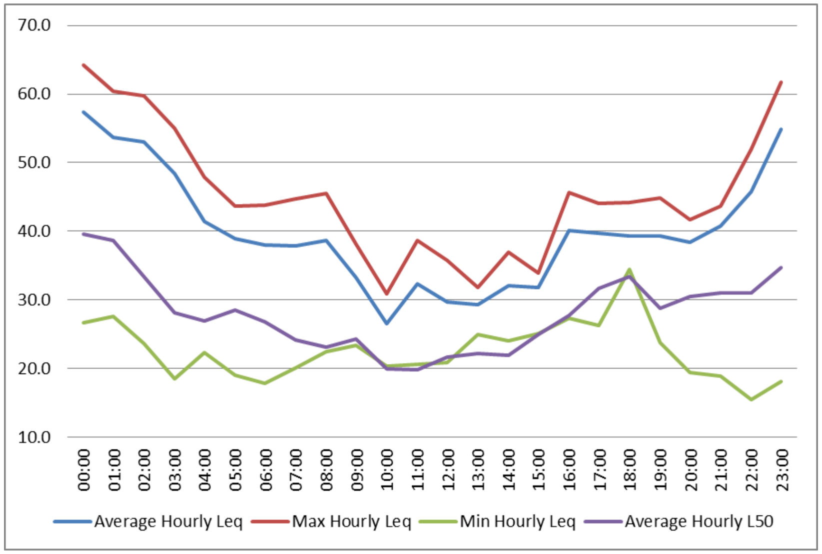


Figure C-146. Audible mechanized events per day at Summer LT9

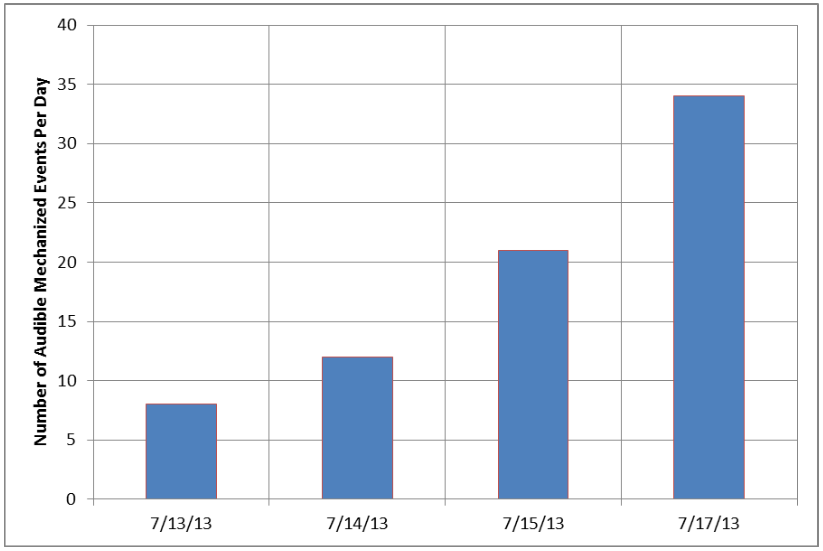


Figure C-147. Audible mechanized events distribution by hour at Summer LT9

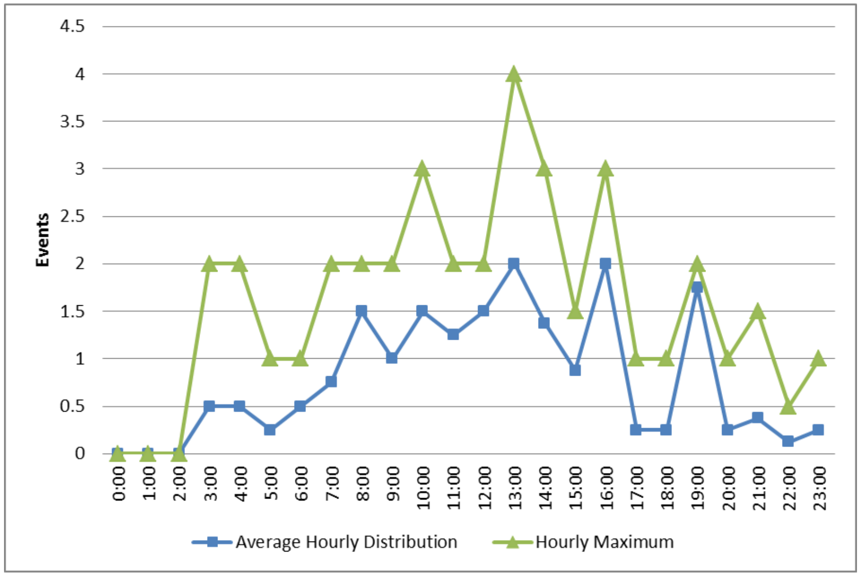


Figure C-148. Geophony at Monitor Fall LT1

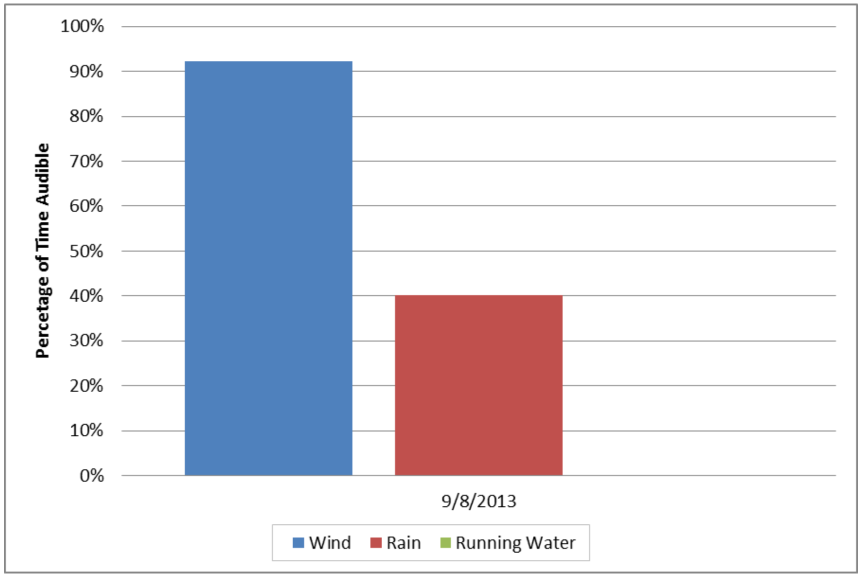


Figure C-149. Biophony at Monitor Fall LT1

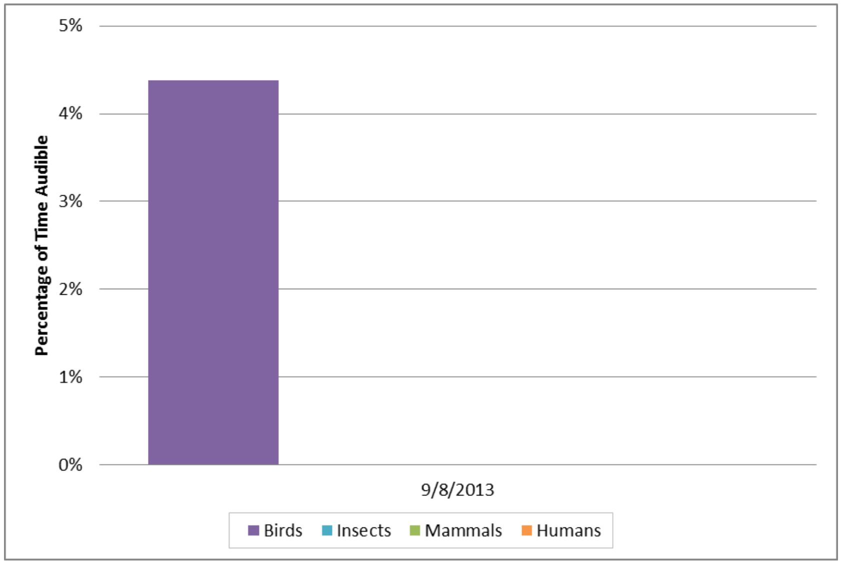


Figure C-150. Mechanized sound at Fall LT1: Daily hourly %

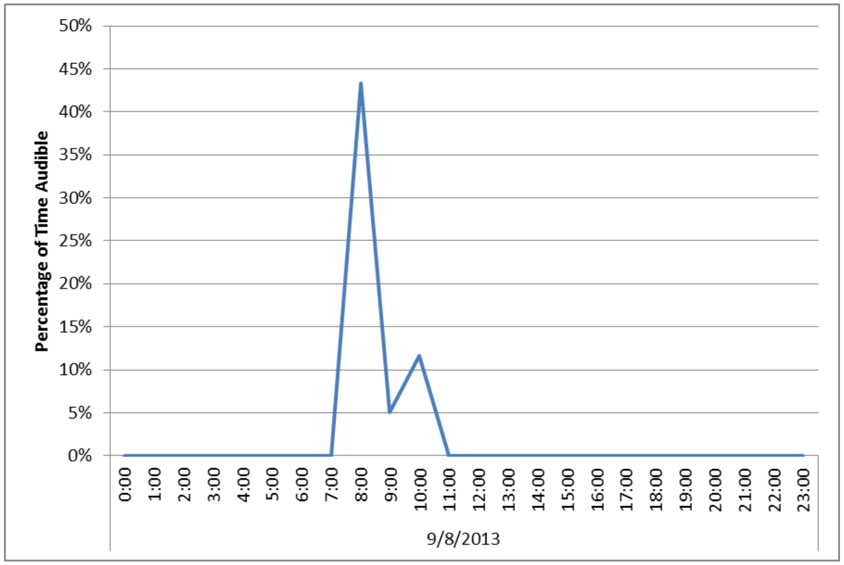


Figure C-151. Audible mechanized events distribution by hour at Fall LT1

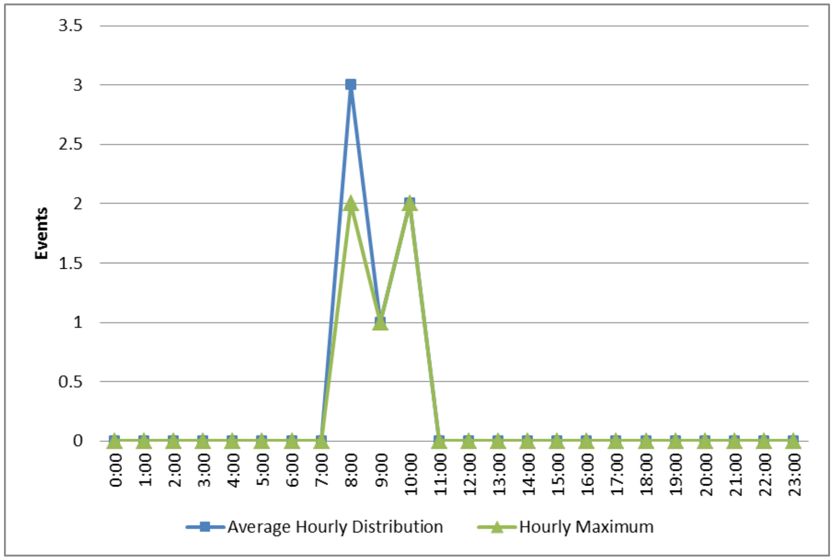


Figure C-152. Sound Pressure Levels at Fall LT1

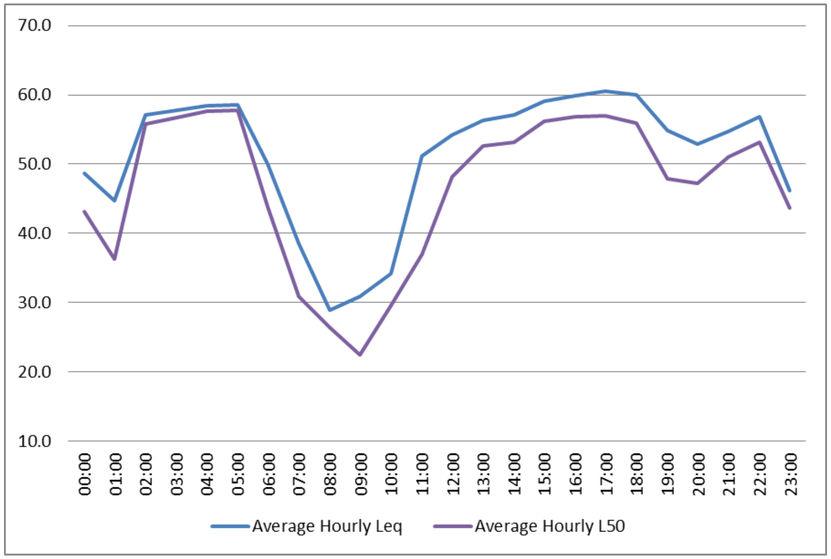


Figure C-153. Geophony at Monitor Fall LT 2

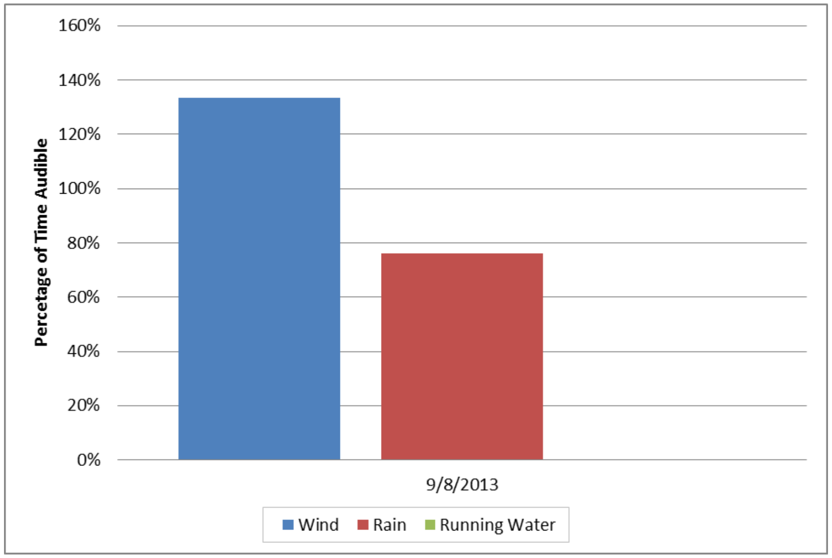


Figure C-154. Biophony at Monitor Fall LT2

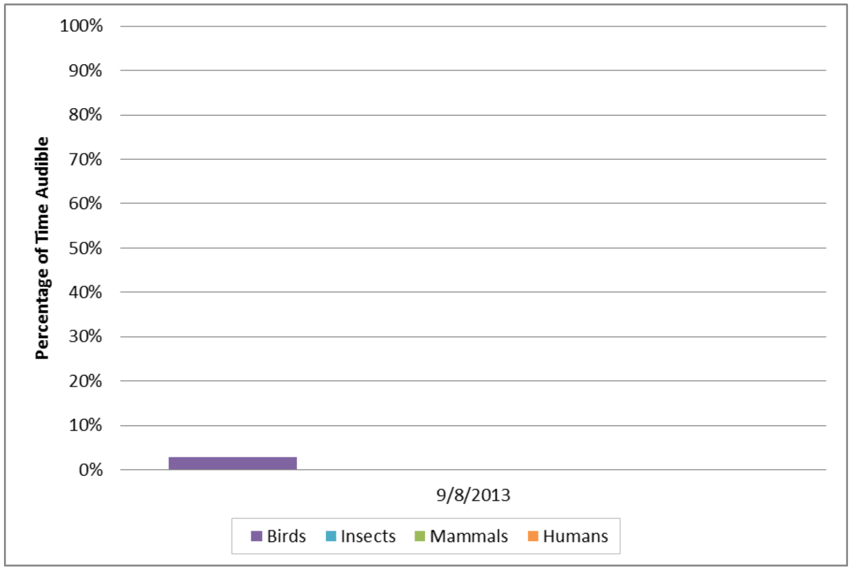


Figure C-155. Sound Pressure Levels at Fall LT2

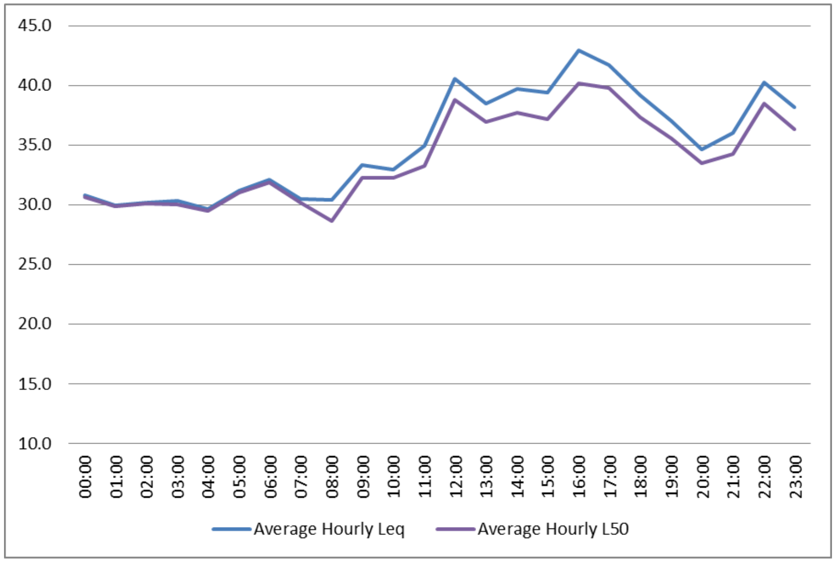


Figure C-156. Geophony at Monitor Fall LT3

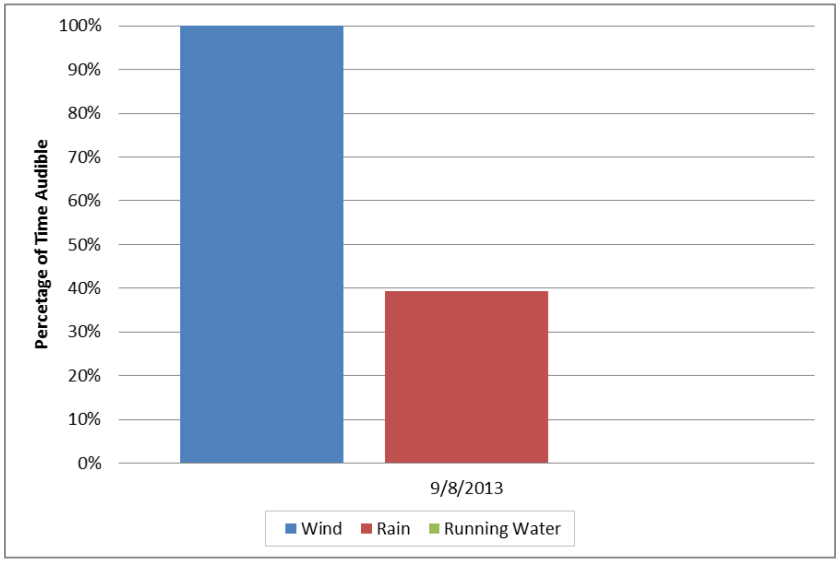


Figure C-157. Biophony at Monitor Fall LT3

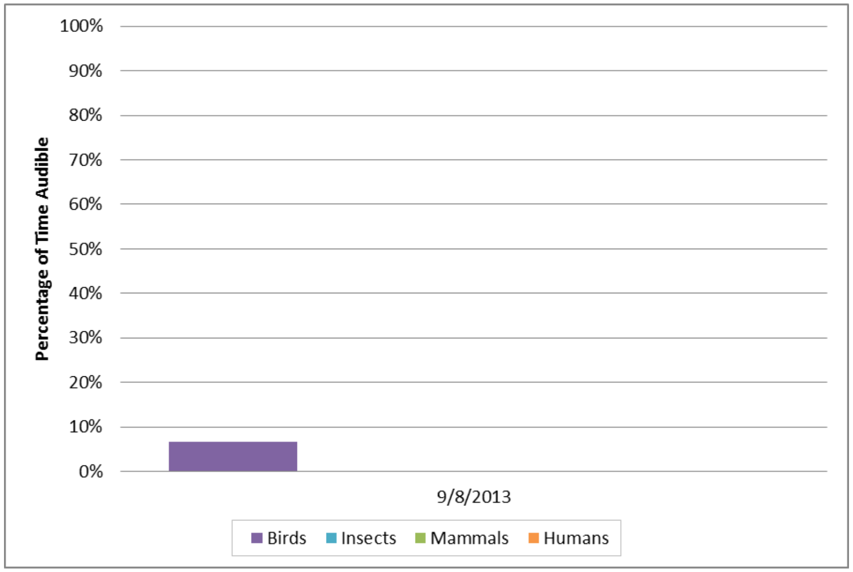


Figure C-158. Sound Pressure Levels at Fall LT3

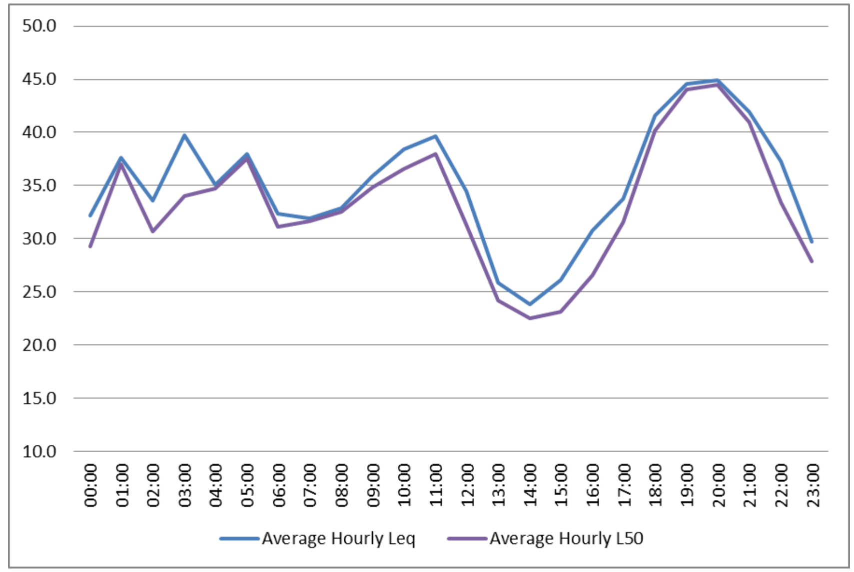


Figure C-159. Geophony at Monitor Fall LT4

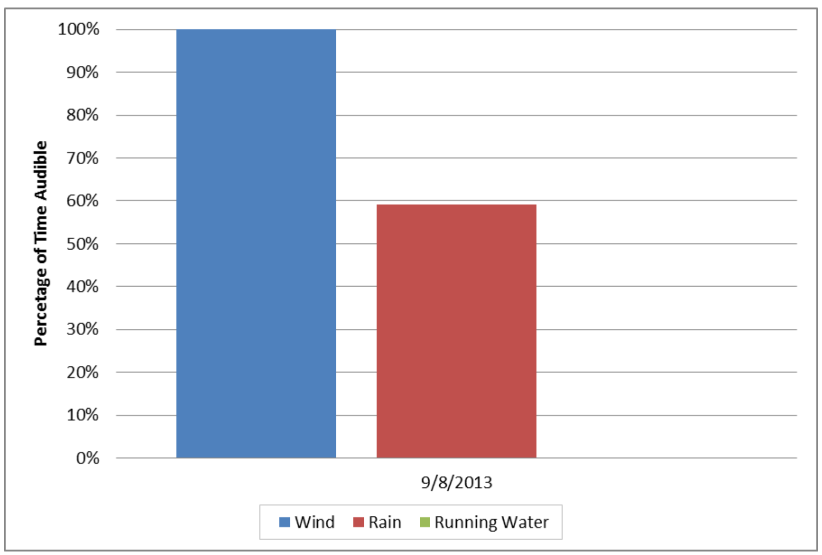


Figure C-160. Biophony at Monitor Fall LT4

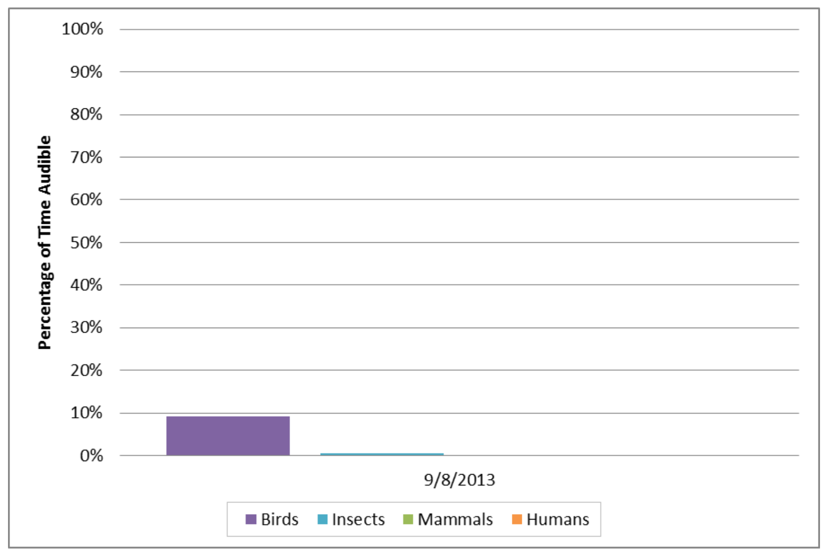


Figure C-161. Mechanized sound at Fall LT4: Daily hourly %

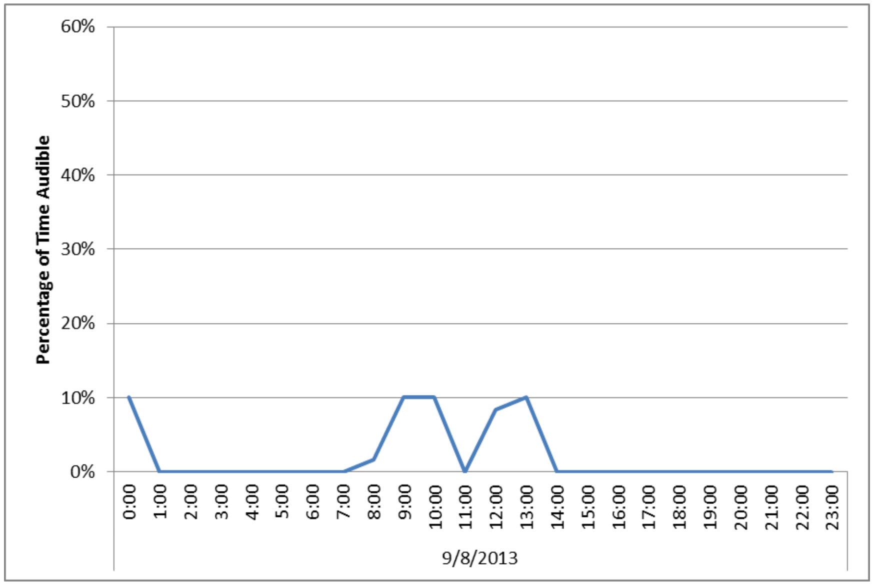


Figure C-162. Audible mechanized events distribution by hour at Fall LT4

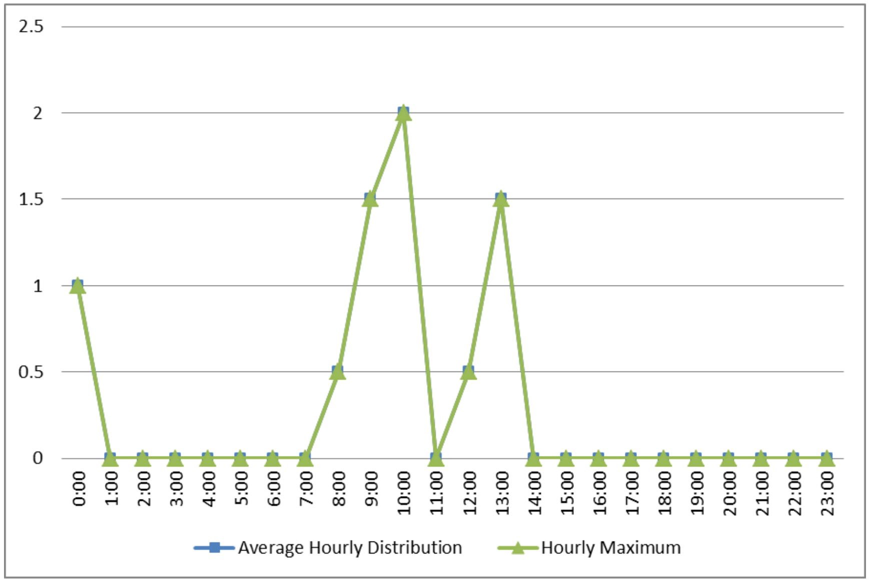


Figure C-163. Sound Pressure Levels at Fall LT4

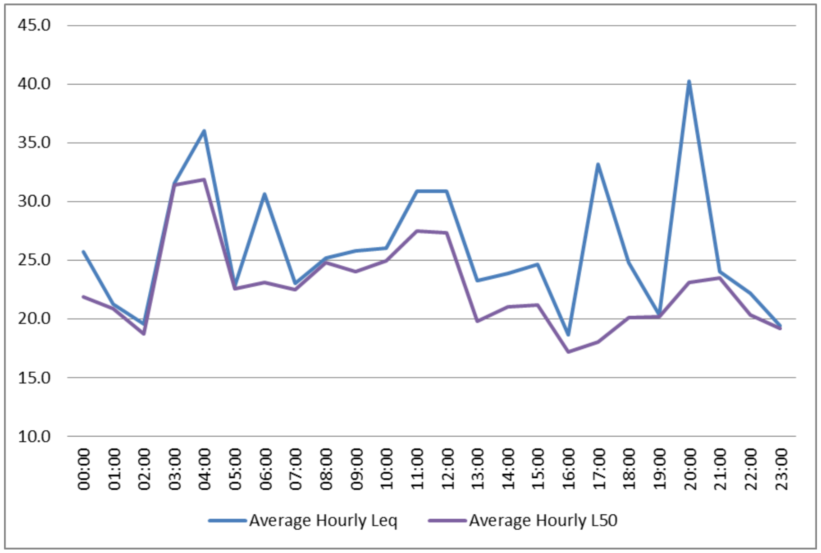


Figure C-164. Geophony at Monitor Fall LT5

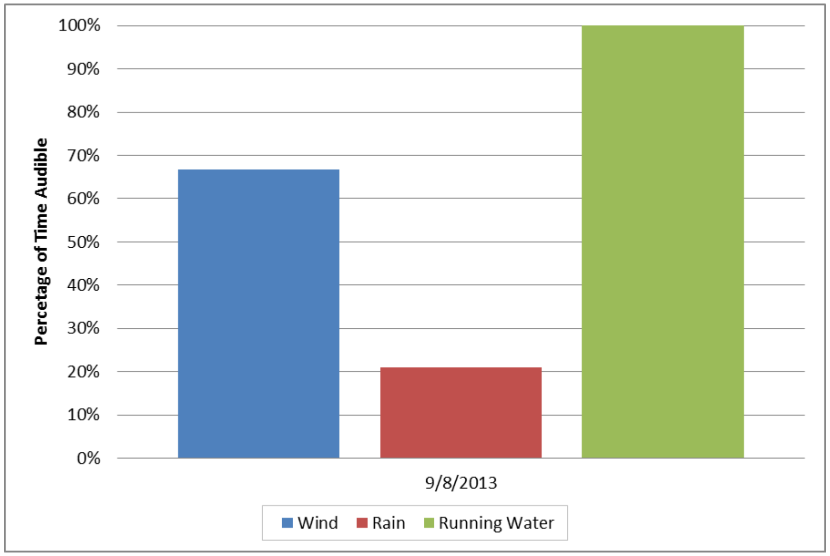


Figure C-165. Biophony at Monitor Fall LT5

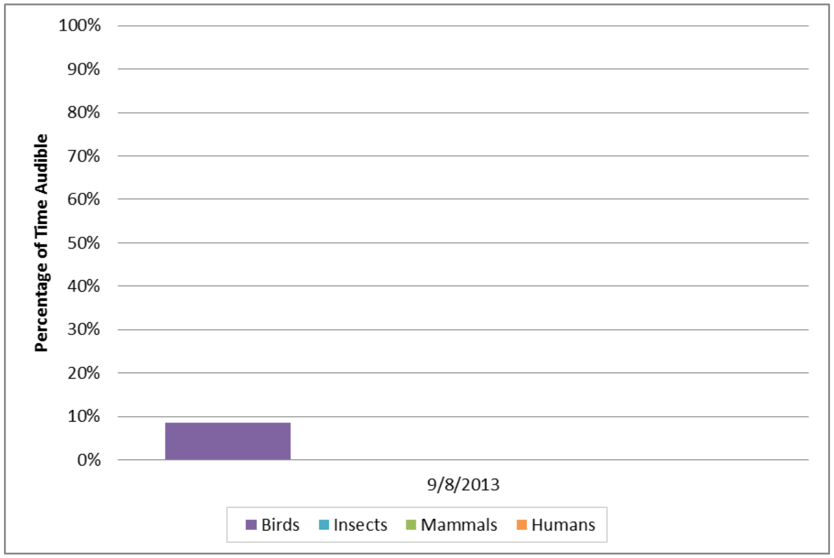


Figure C-166. Mechanized sound at Fall LT5: Daily hourly %

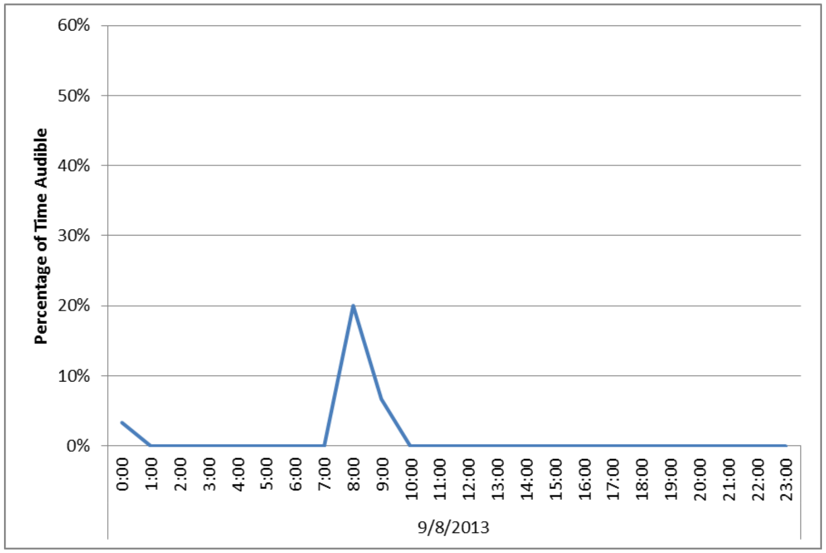


Figure C-167. Audible mechanized events distribution by hour at Fall LT5

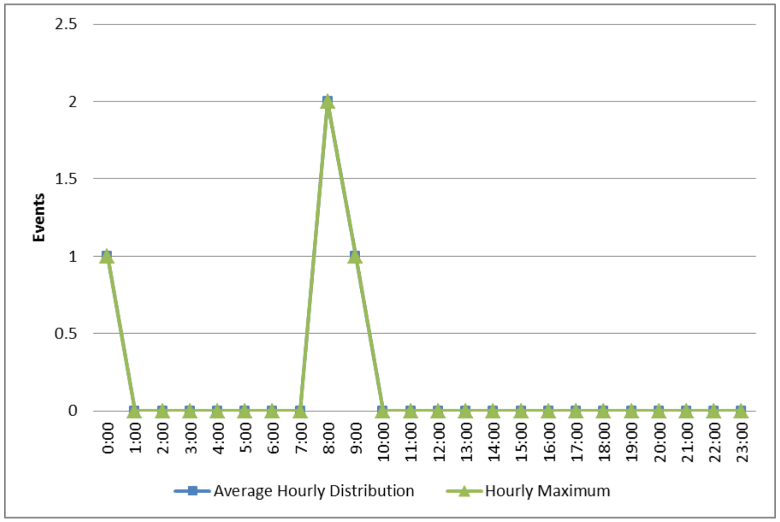


Figure C-168. Sound Pressure Levels at Fall LT5

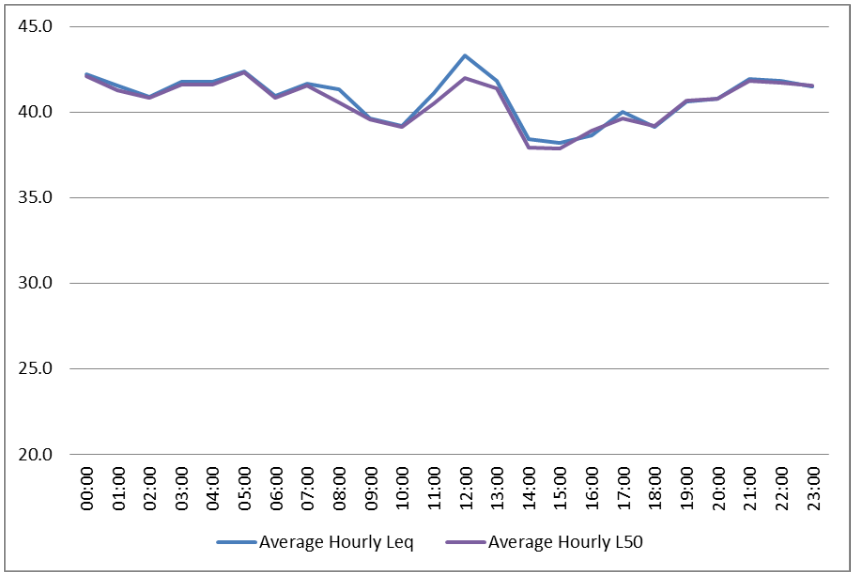


Figure C-169. Geophony at Monitor Fall LT7

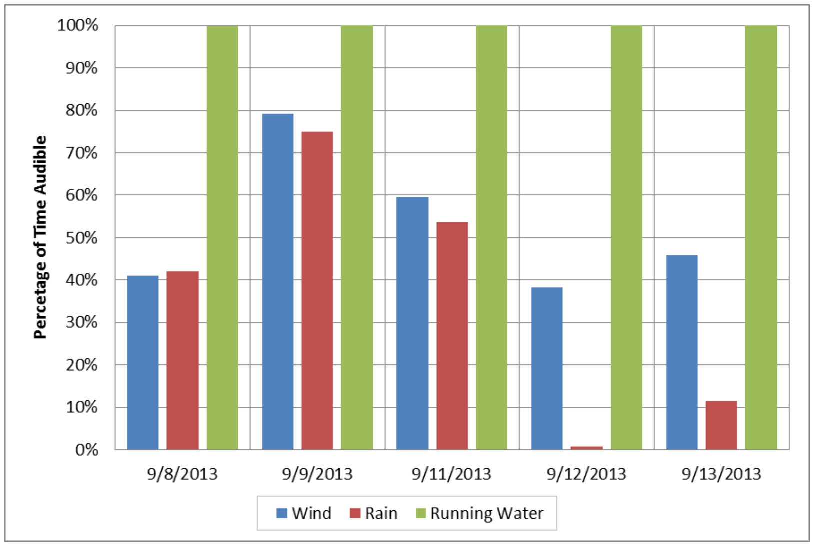


Figure C-170. Biophony at Monitor Fall LT7

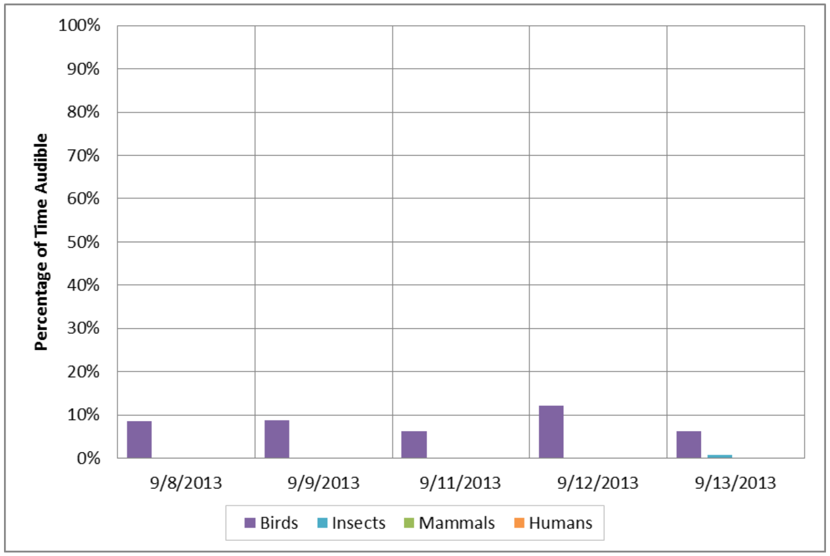


Figure C-171. Mechanized sound at Fall LT7: Average hourly %

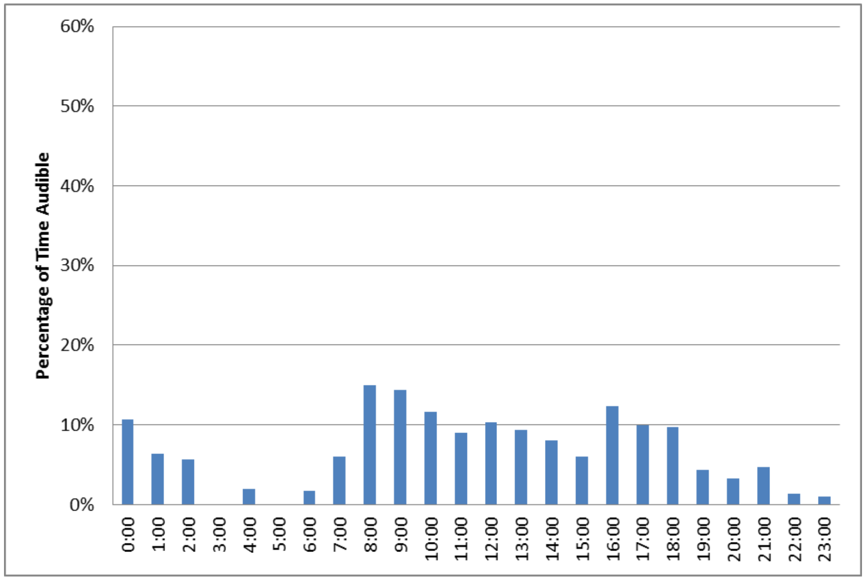


Figure C-172. Mechanized sound at Fall LT7: Daily hourly %

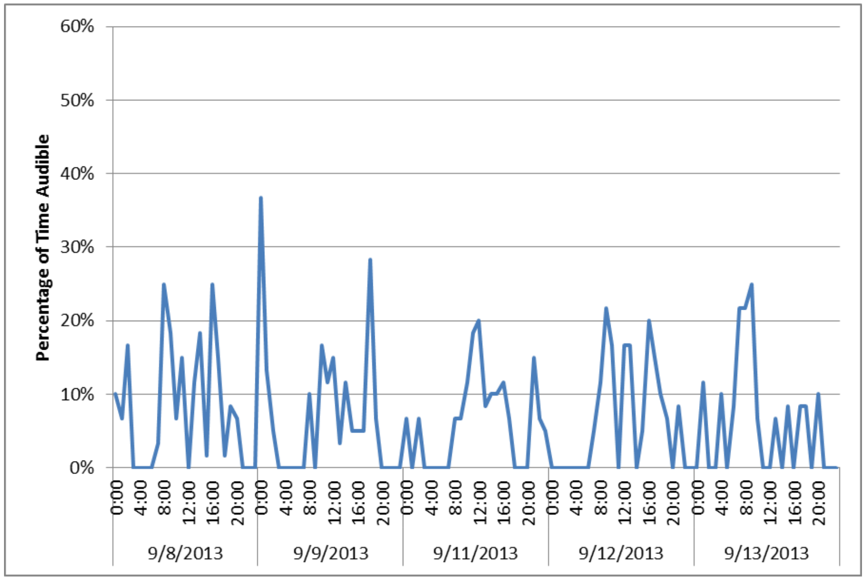


Figure C-173. Sound Pressure Levels at Fall LT7

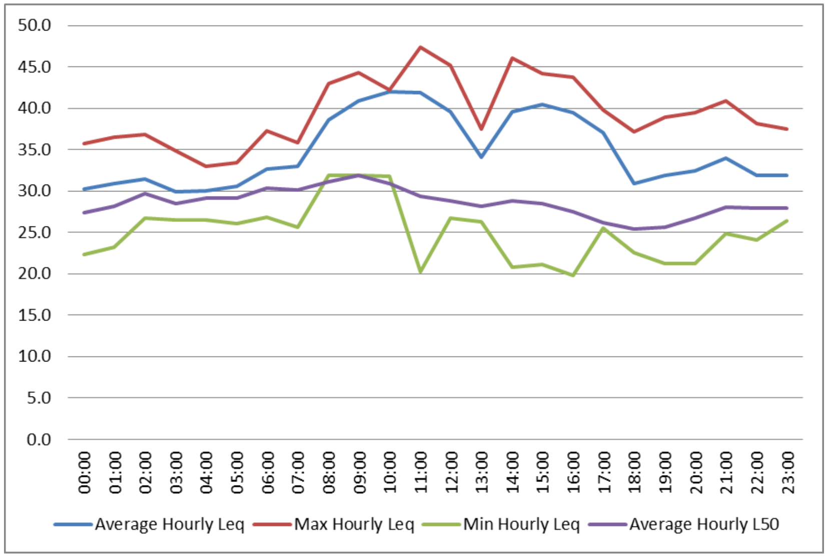


Figure C-174. Audible mechanized events per day at Fall LT7

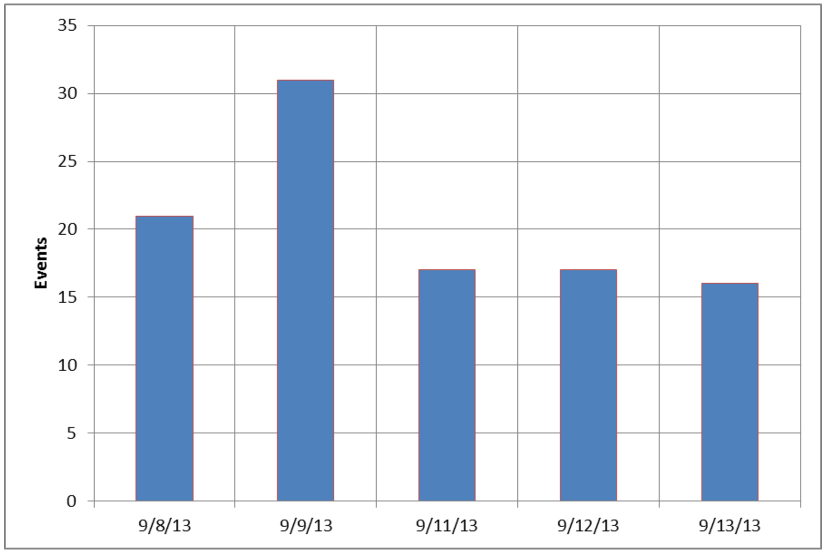


Figure C-175. Audible mechanized events distribution by hour at Fall LT7

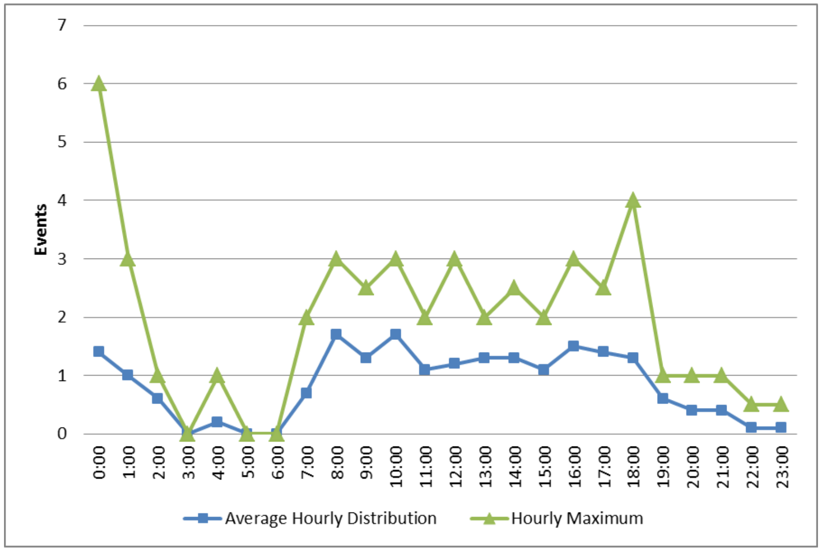


Figure C-176. Geophony at Monitor Fall LT8

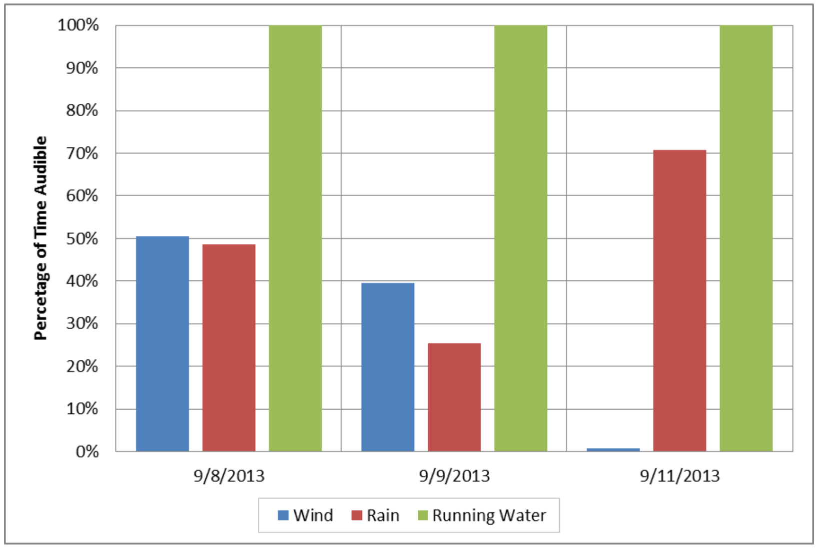


Figure C-177. Biophony at Monitor Fall LT8

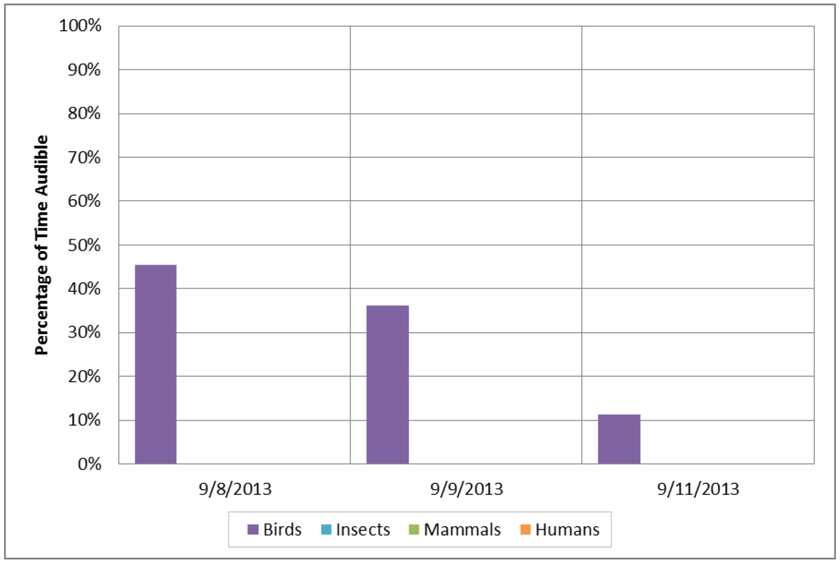


Figure C-178. Mechanized sound at Fall LT8: Average hourly %

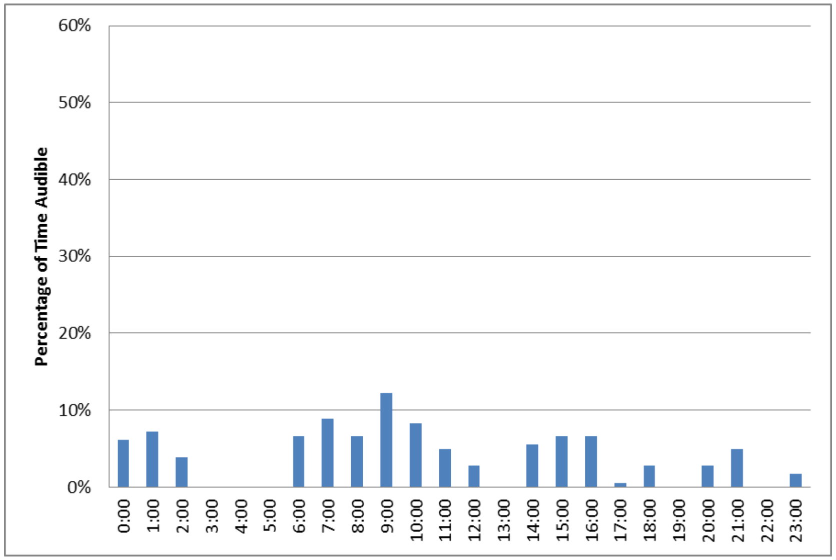


Figure C-179. Mechanized sound at Fall LT8: Daily hourly %

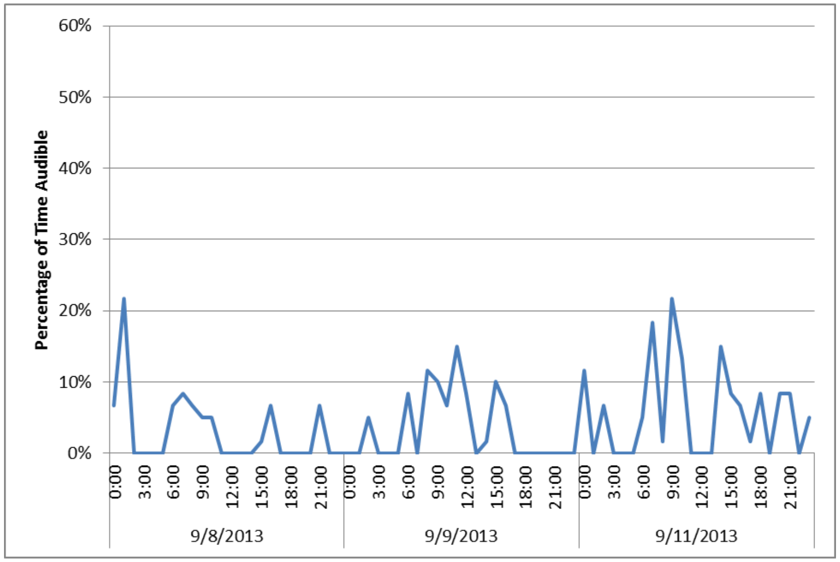


Figure C-180. Sound Pressure Levels at Fall LT8

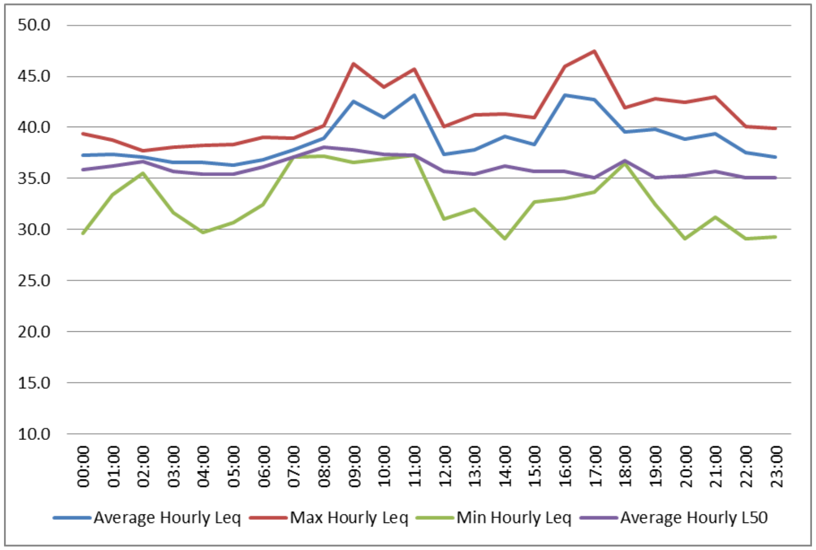


Figure C-181. Audible mechanized events per day at Fall LT8

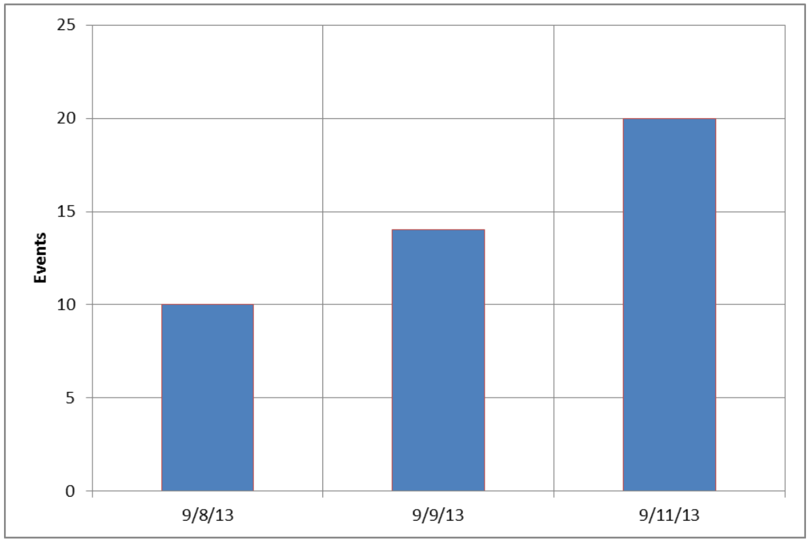


Figure C-182. Audible mechanized events distribution by hour at Fall LT8

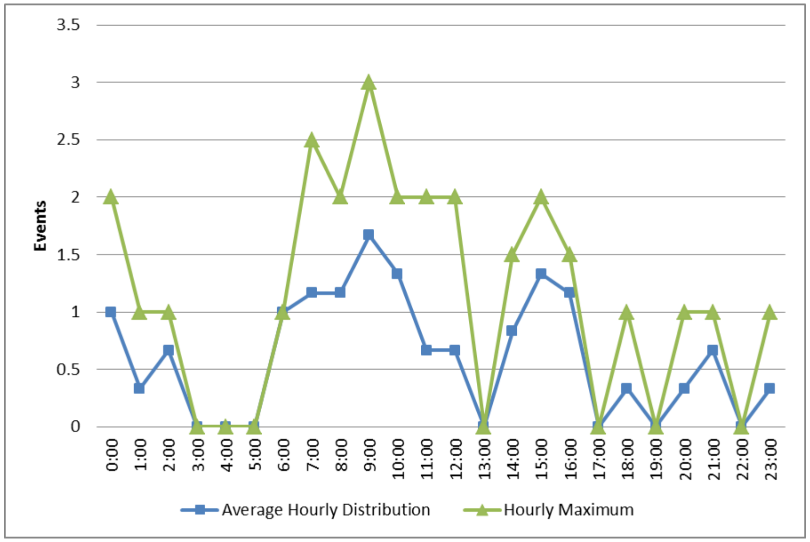


Figure C-183. Geophony at Monitor Fall LT9

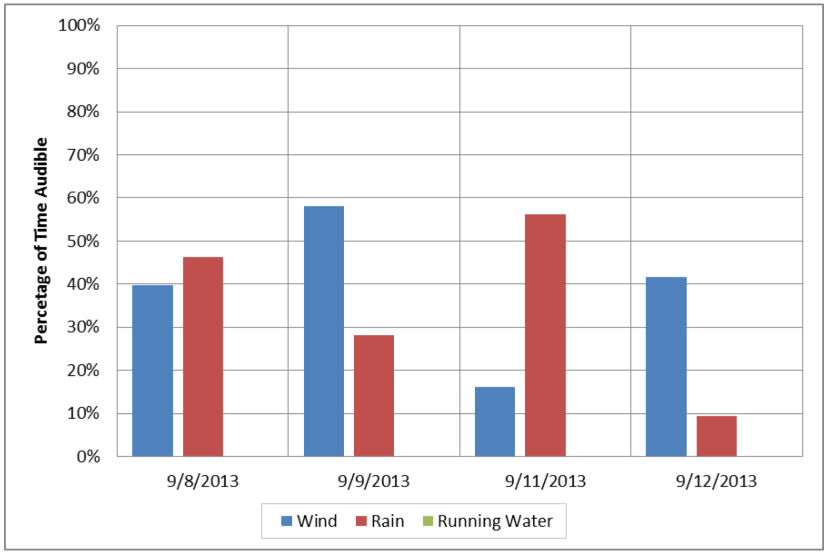


Figure C-184. Biophony at Monitor Fall LT9

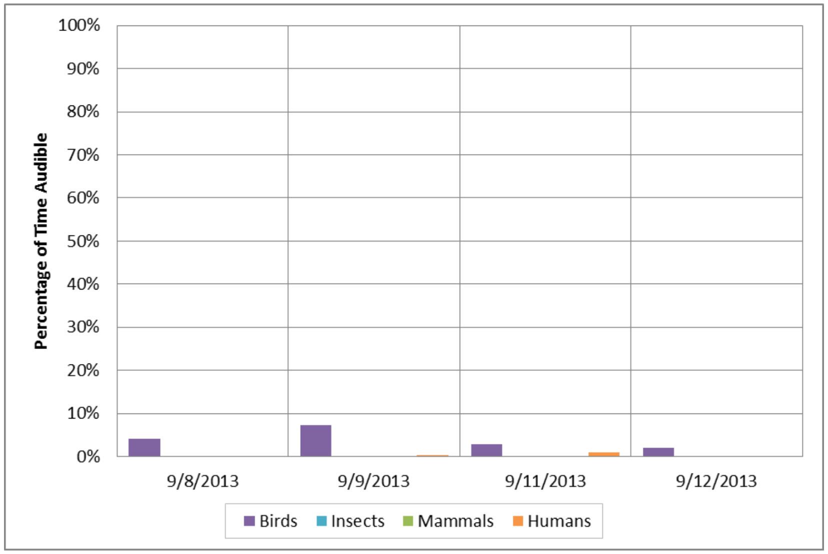


Figure C-185. Mechanized sound at Fall LT9: Average hourly %

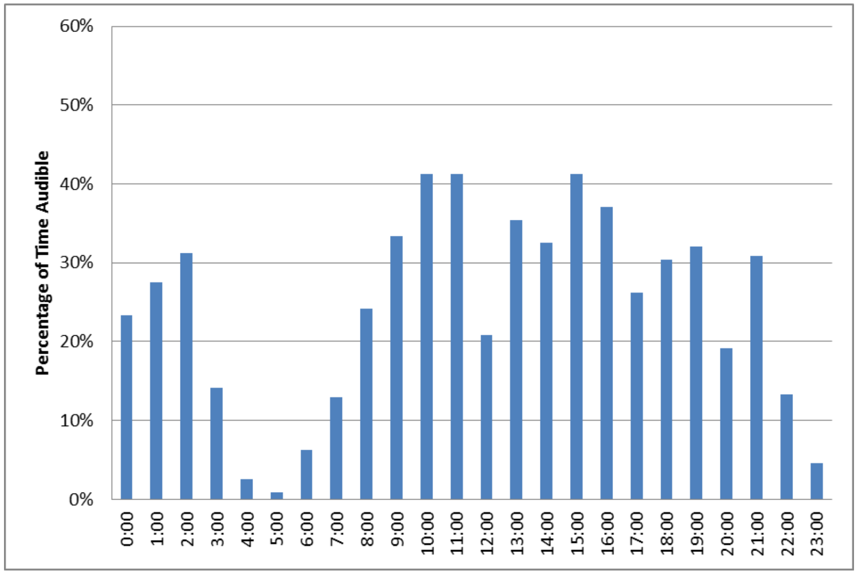


Figure C-186. Mechanized sound at Fall LT9: Daily hourly %

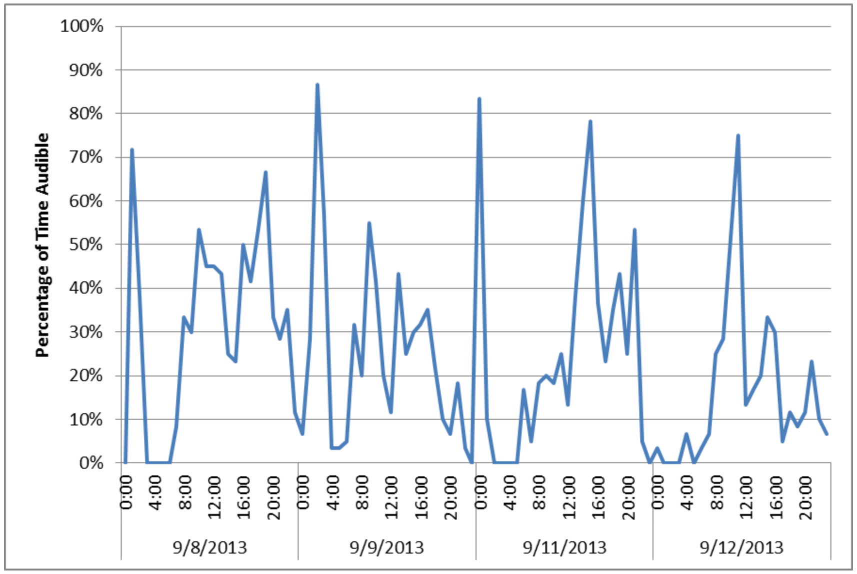


Figure C-187. Sound Pressure Levels at Fall LT9

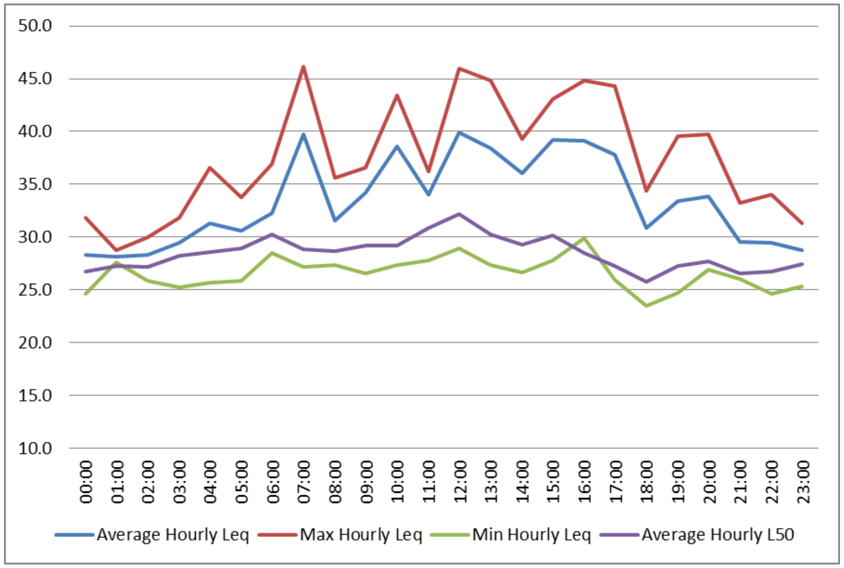


Figure C-188. Audible mechanized events per day at Fall LT9

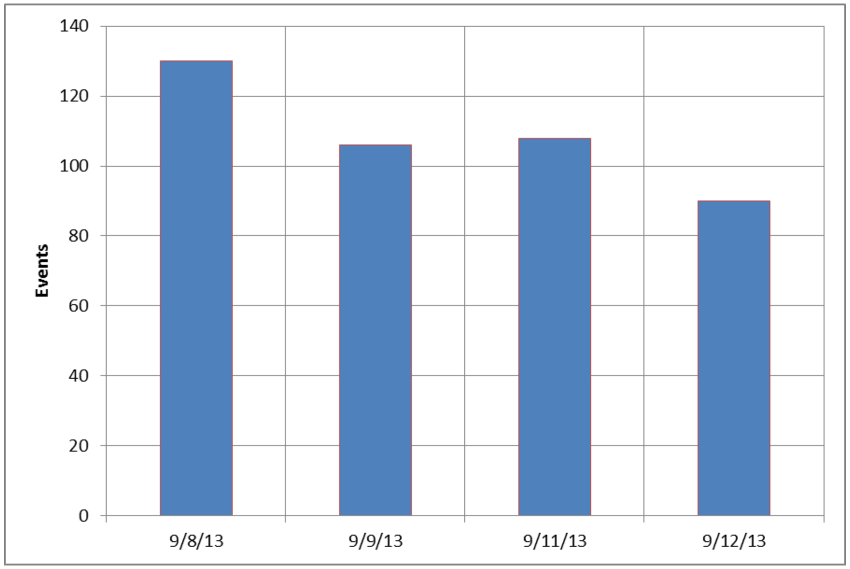


Figure C-189. Audible mechanized events distribution by hour at Fall LT9