

Jackson Hole Airport

2019 Annual Noise Report



Jackson Hole Airport Board
Jackson Hole Airport
1250 East Airport Road
Jackson, Wyoming 83001



BridgeNet International
20201 SW Birch Street
Suite 250
Newport Beach, CA 92660

Table of Contents

1.0 Introduction	1-1
2.0 Background Information on Noise	2-1
2.1 Background	2-1
2.2 Noise Metrics	2-4
2.3 Noise Assessment Guidelines	2-4
2.4 Methodology in Determining the Noise Environment	2-5
3.0 Operational and Flight Data	3-1
3.1 Aircraft Operations	3-1
3.2 Enplaned Passengers	
3.3 Measurement and Analysis Procedures	3-4
Continuous Measurement of the Noise	3-4
3.4 Operational Data	3-4
Correlation of Noise and Flight Data	3-5
Calculation of Aircraft Noise Metrics	3-5
4.0 Noise Measurement Results	4-1
4.1 Introduction	4-2
4.2 Continuous Noise Measurement Data	4-2
4.3 Ambient Noise Measurement Results	4-4
4.4 Aircraft Single Event Noise Measurement Results	4-8
4.5 DNL Noise Measurement Results	4-16
4.6 Hourly LEQ Noise Measurement Results	4-19
4.7 Summary of Spring/Summer Noise Measurement	4-20
4.8 Summary of Annual Noise Levels	4-20
5.0 Computer Modeling	
5.1 Introduction	5-1
5.2 Existing Aircraft Operations	5-2
Fleet Mix	5-3
Time of Day	5-3
Runway Use	5-3
Flight Path Utilization	5-6
5.3 Modeling Results	5-9
6.0 Summary	6-1
6.1 Overall Summary	

Table of Appendix

A	Time History Noise Event Plots	A-1
B	Ambient Noise Measurement Results	B-1
C	One Day of Measured Aircraft Noise Events	C-1
D	Single Departure Noise Level by Aircraft	D-1
E	Single Arrival Noise Level by Aircraft	E-1
F	Loudest Aircraft Noise Events	F-1
G	Noise Event Plot Reports	G-1
H	DNL Contribution and SEL Distribution Results	H-1
I	Hourly LEQ Aircraft and Total Noise Data	I-1

List of Tables

Table 1-1 Noise Measurement Sites	1-1
Table 3-1 Fall/Winter Aircraft Operations	3-2
Table 3-2 Comparison of Average Daily Operations for Seasons 2014 and 2015	3-3
Table 4-1 Ambient Noise Measurement Results	4-6
Table 4-2 Aircraft DNL Noise Measurement Results	4-15
Table 4-3 Hourly Total LEQ Noise Measurement Results	4-20
Table 5-1 Summary of Operations	5-2
Table 5-2a AEDT Detailed Case Summary	5-4
Table 5-2b AEDT Detailed Case Summary (Continued)	5-5
Table 5-3 Daytime Runway Utilization	5-6
Table 5-4 Nighttime Runway Utilization	5-6

List of Figures

Figure 1-1	Noise Measurement Location Map	1-2
Figure 2-2	Critical Area Boundary	2-2
Figure 4-1	Sample Time History Noise Plot of Aircraft and Ambient Noise	4-3
Figure 4-2	Ambient Noise Measurement Results for All Sites	4-6
Figure 4-3	Site Specific Ambient Noise Measurement Results	4-7
Figure 4-4	One Day of Measured Aircraft Noise Events	4-9
Figure 4-5	Range of Noise and Number of Events Histograms	4-10
Figure 4-6	Single Event Departure Noise Level by Aircraft Report	4-11
Figure 4-7	Single Event Arrival Noise Level by Aircraft Report	4-12
Figure 4-8	Loudest Aircraft Noise Events Site Report	4-14
Figure 4-9	Noise Event Plot	4-15
Figure 4-10	Aircraft DNL	4-17
Figure 4-11	All Histo Site Noise Report	4-18
Figure 4-12	2019 Winter/Summer Annual DNL Report	4-22
Figure 4-13	Historical Trend for Passengers, Operations and Noise Environment	4-23
Figure 5-1	Arrival and Departure Tracks for Runway 19	5-8
Figure 5-2	Arrival and Departure Tracks for Runway 01	5-9
Figure 5-3	2019 Annual DNL Noise Contours	5-11

1.0 Introduction

The purpose of this report is to present the final results from the 2019 noise measurement survey at Jackson Hole Airport. This report also includes data from the Fall 2018 – Winter 2019 interim report. Noise measurements are conducted during the winter and summer seasons in order to determine the annual noise exposure levels from the airport. This year-end report summarizes the results from winter and summer noise measurements for 2019. These results are compared and summarized with respect to the noise limits established at the airport. The results are also compared to previous noise measurements conducted since 1984, presenting the changes in noise levels at the airport that have occurred over time.

From 1984 to 2003, noise monitors were stationed at the same three sites for each measurement period. Each site is monitored for approximately one week during both the winter and summer season. The three sites that were monitored during this survey are Moulton Loop, the Village of Moose, and Barker Ranch. In 2003, Jackson Hole Airport installed six (6) permanent noise monitors located in the Grand Teton National Park that collect data continuously year around. Moulton Loop, the Village of Moose, and Barker Ranch have been permanently monitored sites since 2003. These measurement locations and the three additional sites are presented in Table 1-1 and Figure 1-1.

Table 1-1
Noise Measurement Sites

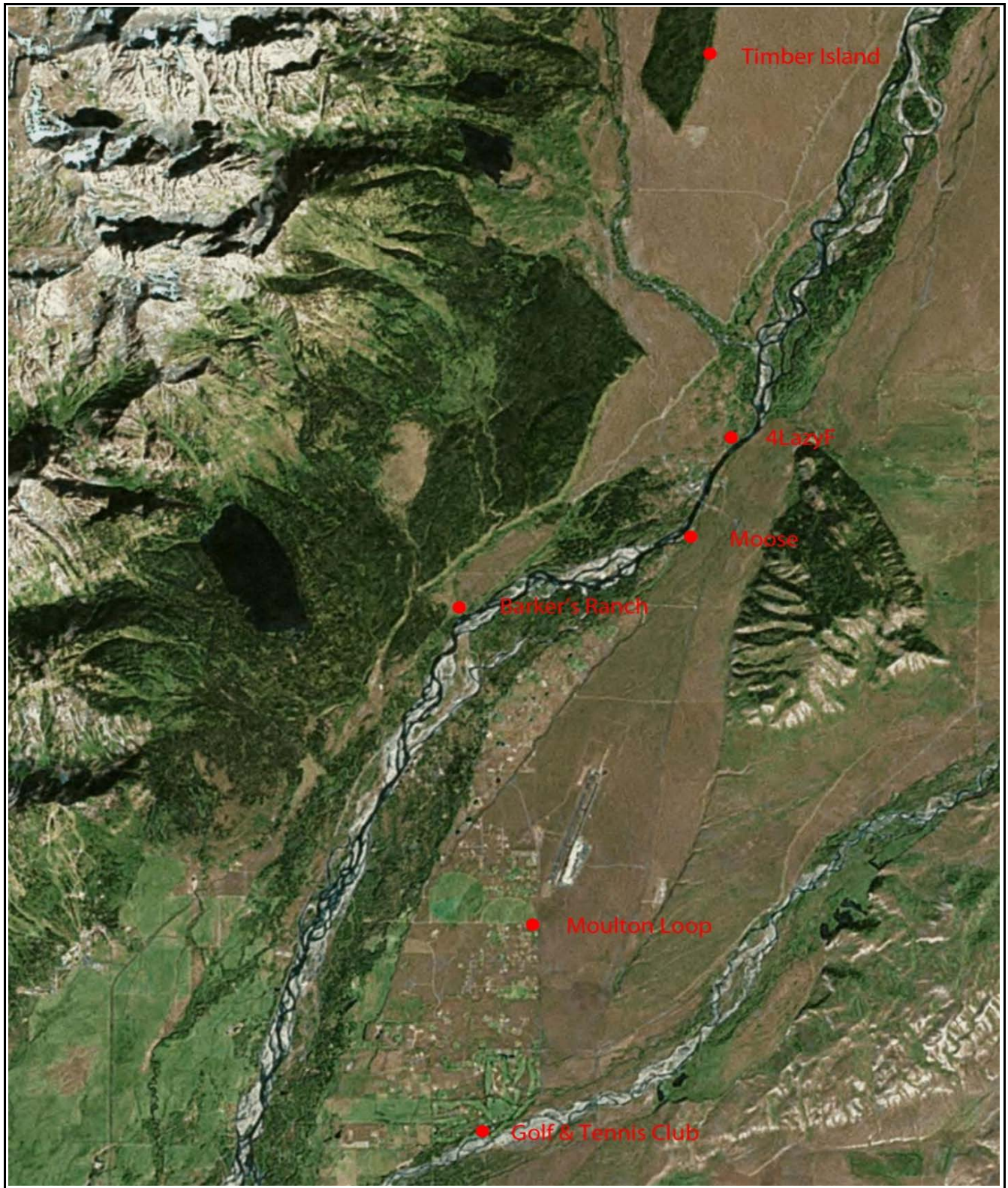
Sites	Name	Location	Longitude	Latitude
1	Moulton Loop	Zenith Drive and Spring Gulch Road	-110.744542	43.592342
2	Golf Course	Jackson Hole Golf & Tennis Club	-110.753580	43.562232
3	Barker Ranch	Circle H Ranch (Barker's Residence)	-110.758610	43.637980
4	Moose	Moose Entrance	-110.716753	43.648249
5	4 Lazy F Ranch	4 Lazy F Ranch	-110.708956	43.662913
6	Timber Island	East of Timber Island	-110.713525	43.714844

The primary purpose of the measurements is to determine if the airport is in compliance with the Agreement between the U.S. Department of the Interior and the Jackson Hole Airport Board (Agent). The results of the measurements show that the airport is in compliance with the requirements of the airport Agreement. Aircraft noise levels within the Park are calculated to be greater than 5 dBA below the levels specified within the airport Agreement with the Department of the Interior. In addition, the 65 DNL noise contours do not extend into residential land uses.

Figure 1-1
Location Map

Jackson Hole Airport 2019 Annual Report

Noise Measurement Location Sites: ●



2.0 Background and Information on Noise

2.1 Background

Jackson Hole Airport is the only commercial airport in the country that is located within a system area that is designated a National Park. Subsequently, it has had a long history of controversy concerning its operation and development. As a result of this, the airport operates under a number of special restrictions and the Airport Board has developed a number of special noise abatement measures to minimize the impacts from aircraft noise. These procedures and a brief history of their development are presented in the following section.

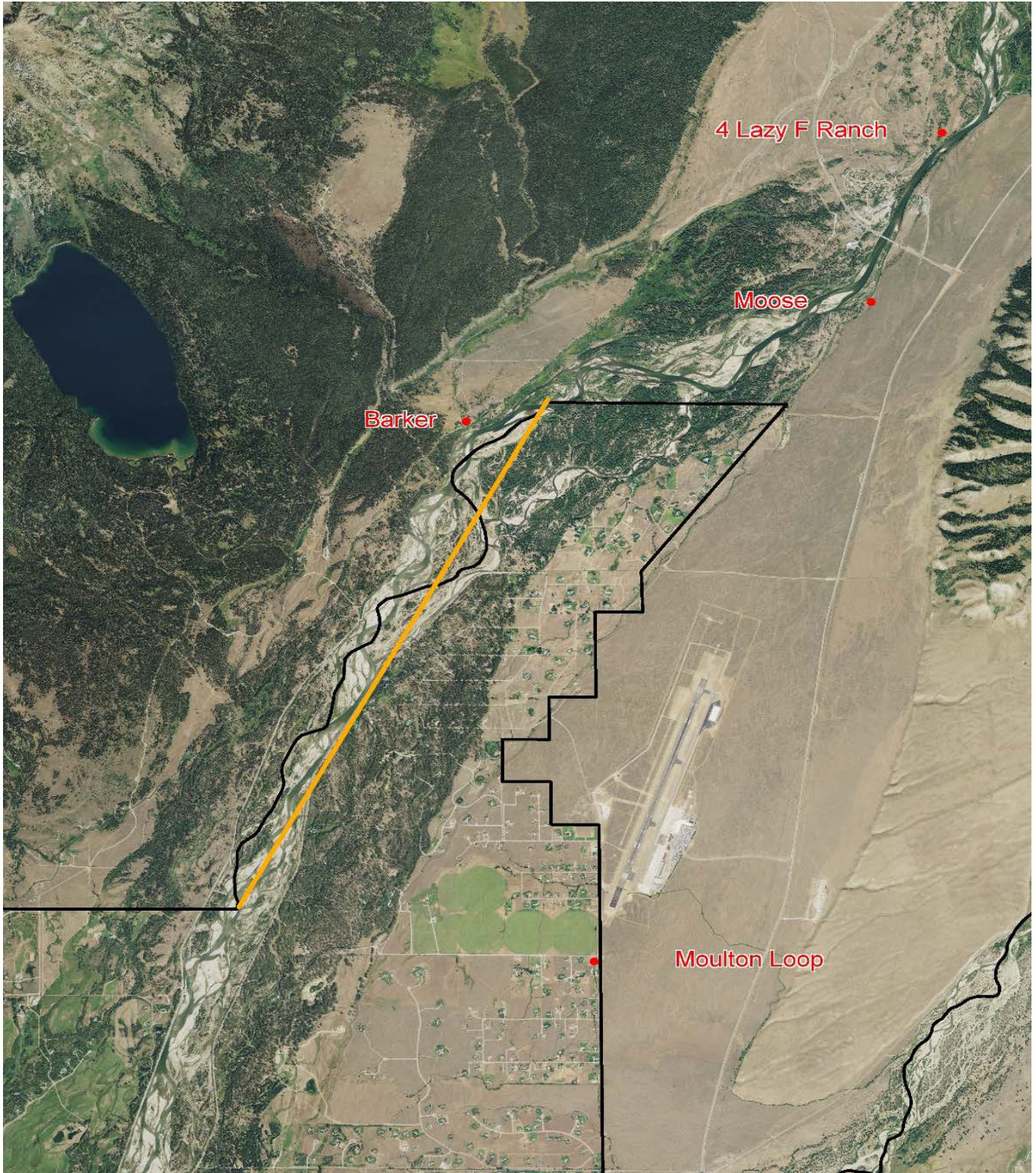
In the early 1980s the Airport Board and the Department of the Interior entered into negotiations for a new agreement for the continued operation of the airport. The Agreement required that a revised noise control plan be developed which “... utilizes the latest in noise mitigation technology and procedures. The revised plan will be developed in a comprehensive study to consider all of the relevant environmental, economic, and operational considerations.” The primary objectives of the noise control plan as stated in the Agreement were “to ensure that future airport operations are controlled in such a manner that aircraft noise exposure will remain compatible with the purposes of Grand Teton National Park and will result in no significant increase in cumulative or single event noise impacts on noise sensitive areas of the Park.” As a result, the Airport Board initiated a study to investigate methods of mitigating the aircraft noise levels resulting in the development of a new comprehensive noise control program for the airport.

The Agreement contains several key restrictions in terms of cumulative and single event noise levels. The primary restriction is that the airport cannot exceed specific Day-Night Level (DNL) noise levels at critical locations within the Park boundary. Another requirement is that the annual level from aircraft noise at the Moose measurement location cannot exceed 55 DNL. In addition, there is a restriction line within the Park where the aircraft annual noise levels cannot exceed 45 DNL. The 45 DNL limit is shown as the Critical Area Boundary as presented in Figure 2-1.

In order to meet the requirements of the Agreement, the Airport Board developed an Airline Access Plan. This Access Plan placed a limit on the number of operations of commercial jet aircraft that was then adopted by all the airlines at the airport. The limit on operations was determined to be 6.5 Average Daily Departures of the 737-200/D17. Increases in operations could only be accomplished by substituting these aircraft with the quieter, new generation of aircraft which at that time were just entering service.

Figure 2-1

Critical Area Boundary: ———
Grand Teton National Park Boundary: ———
Jackson Hole Airport 2019 Annual Report



The Agreement also included a single event limit provision. The single event limit restricted the operations of any aircraft that generated sound levels above the specified limit. This single event limit was 92 dBA as defined by the approach dBA level from FAR 36 regulations (*Note: this numeric value should not be compared to noise levels shown in this report in that the measurements utilized a different noise metric at different locations from the airport*). This essentially eliminated aircraft from operating at the airport that generated higher noise levels than the 737-200/D17 aircraft. The Noise Control Program at Jackson Hole also includes a number of additional elements. The major elements of the program are summarized below:

- Limit on the level of overall noise that can be generated at the airport. This is enforced through an Airline Access Plan.
- Limitation on the single event aircraft noise level for all aircraft operating at the airport. This noise abatement measure is designed to limit the single event noise levels over the park as well as eliminating the higher noise level aircraft from operating at the airport.
- Limitation on night operations by turbojet air carrier aircraft.
- A preferential runway program that requests that all aircraft depart to the south and arrive from the south when wind conditions permit. Monitoring of this provision is documented for every commercial jet operation.
- A request that all aircraft departing to the south make an immediate left turn, weather conditions permitting. Monitoring of this provision is documented for every commercial jet operation.
- A request that aircraft arriving from the south perform a left downwind turn near Black Tail Butte, when weather conditions permit. Right downwind turns over the Park are discouraged.
- A comprehensive operational and noise-monitoring program that documents the level of compliance with these noise abatement procedures.

In order to ensure compliance with the Agreement restrictions, the Jackson Hole Airport Board conducts a semi-annual noise measurement survey. These measurements are conducted for approximately a one-week period during the peak winter and summer seasons. The purpose of this report is to present the results of the winter noise measurement survey which documents compliance with the noise limits contained in the Agreement between the Airport Board and the Department of Interior.

2.2 Noise Metrics

The description, analysis and reporting of community sound levels from aircraft is made difficult by the complexity of human response to sound and the myriad of noise metrics that have been developed for describing acoustic impacts. This analysis utilizes the two major noise metrics for analysis of aircraft noise impacts: Day Night Noise Level (DNL), and Sound Exposure Level (SEL). Both of these metrics are based on the A-weighted decibel (dBA).

DNL, the primary metric for analysis, is a “cumulative” noise metric because it represents a measure of the total noise over a 24-hour period. Cumulative noise metrics have been developed to assess community response to noise. They are useful because these scales attempt to combine the loudness of each event, the duration of these events, the total number of events, and the time of day these events occur into a single number rating scale. They are also designed to account for the known health effects of noise on people. The FAA, the EPA, and various other agencies use DNL in assessing noise and land use compatibility.

SEL is a measure of single event noise that describes the loudness of a single flyover regardless of the time of day or the number of such events. SEL also includes the effect of the duration of the noise event. There are no noise and land use compatibility standards in terms of SEL. Disturbances from aircraft noise (i.e., speech and sleep interference) however can be related to SEL levels.

2.3 Noise Assessment Guidelines

Noise/Land use guidelines have been developed by a number of agencies including the Federal Aviation Administration. As a means of implementing the Aviation Safety and Noise Abatement Act, the FAA adopted Regulations on Airport Noise Compatibility Planning Programs. The guidelines specify a maximum amount of noise exposure (in terms of the cumulative noise metric DNL) that will be considered acceptable to, or compatible with, people in both living and working areas. Residential land use is deemed compatible for noise exposures up to 65 DNL.

As part of the Agreement with the Department of Interior, Jackson Hole Airport is required to comply with certain noise limits within Grand Teton National Park. These limits are in terms of the DNL noise levels. One requirement is that the annual noise level from aircraft measured at the Moose location cannot exceed 55 DNL. In addition, the Critical Area Boundary Line, shown in Figure 2-1 sets the limit beyond which the aircraft annual noise level cannot exceed 45 DNL.

2.4 Methodology in Determining the Noise Environment

The noise environment at Jackson Hole Airport was determined through the employment of comprehensive noise measurement surveys of aircraft and ambient noise sources, then incorporating these results into the FAA's airport noise computer model. The noise measurement surveys determine the DNL noise level, the SEL levels from each aircraft flyover, and the background or non-aircraft ambient noise environment.

The measurement of aircraft noise is limited by duration and the time of the survey and may not exactly reflect the operational levels that exist at the airport on an annual basis. Thus, the measurements are annualized by correlating these results with the average annual airport operations. The results of the measurements, in conjunction with annual airport operational data, are incorporated into the FAA's Aviation Environmental Design Tool (AEDT) software program through which annual average noise levels at any location around the airport can be predicted. The noise environment is commonly depicted in terms of lines of equal noise levels, or noise contours.

Noise measurements are conducted at six (6) locations around the airport. These locations include Moulton Loop, the Village of Moose, and Barker Ranch and are illustrated in Figure 1-1. The Moulton Loop measurement site is indicative of the residential area directly south of the airport. This site is directly under the extended runway centerline approximately 2,200 feet south of the runway end and is one of the areas exposed to the highest noise levels. *Note: In 2003, the Moulton Loop site was moved approximately 200 feet closer to the runway end than the old temporary site. This results in slightly higher noise level readings.* This location falls under the Federal Aviation Administration noise and land use compatibility guidelines, which recommend that residential land uses should not be exposed to noise levels in excess of 65 DNL.

The Village of Moose measurement site is located in the National Park, south of Teton Park Road and directly under the extended runway centerline. The Lease Agreement with the National Park requires that the aircraft noise levels at this location not exceed 55 DNL. The Barker Ranch measurement site is also within the National Park, along Moose Wilson Road northwest of the airport. This site is on the restriction line that requires that aircraft noise levels not exceed 45 DNL.

3.0 Operational and Flight Data

3.1 Aircraft Operations

The 2018 - 2019 aircraft operations were derived directly from the airport summary of daily logs, the Airport's BI-6 radar data and the FAA's OPSNET data. The 2018 - 2019 analysis season is presented for the operations between October 1, 2018 and September 30, 2019. The total number of operations during the twelve-month period was 27,263 or 74.7 average daily operations. An operation is either 1 departure or 1 arrival. This included an average of 19.1 commercial jet operations per day, 6.7 regional jet operations per day and 30.1 corporate jet operations per day. The fall 2018 – summer 2019 operations are presented in Table 3-1. Comparison of Average Daily Operations for Seasons 2018 and 2019 using OPSNET Data are presented in Table 3-2.

3.2 Enplaned Passengers

The total number of enplaned passengers is also presented in Table 3-1. For the 2018 - 2019 season, there were 449,128 enplaned passengers.

Table 3-1
Aircraft Operational Summary
Jackson Hole Airport 2019 Annual Noise Report
 October 1, 2018 - September 30, 2019

Monthly Operations By: Aircraft Airlines	Fall			Winter			Spring			Summer			Totals	Average Daily Operations				
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep		Fall/Winter	Spring/Summer	Annual		
Commercial Jets																		
A319	American		18		74	144	146	180	64	62	218	256	262	242	1,666	3.1	6.1	4.6
	Delta		184	176	200	194	178	212	176	184	194	244	246	190	2,378	6.2	6.8	6.5
	Frontier									14	16	26	26	20	102		0.6	0.3
	United		48	109	68	110	88	94	4	52	72	72	65	24	806	2.8	1.6	2.2
A320	Frontier										2				2		0.0	0.0
	United		80	11	66	42	56	42		18	144	200	217	212	1,088	1.6	4.3	3.0
B737-700	Delta				4		20	44							68	0.4		0.2
	United		2		70	124	92	116			70	60	54	72	660	2.2	1.4	1.8
B757-200	Delta				26	30	24	32			22	36	26		196	0.6	0.5	0.5
Regional Jets																		
CRJ7	GoJet		66	62	44	78	58	64	58		14	8	32	2	486	2.0	0.6	1.3
	SkyWest					86	30	4	4	52	52	100	112	100	592	0.7	2.6	1.6
E75L	SkyWest		46		90	138	140	210	4	6	214	288	220	26	1,382	3.4	4.2	3.8
Air Taxi																		
Turboprop			148	68	152	180	128	172	85	141	211	258	257	209	2,009	4.6	6.4	5.5
General Aviation																		
Corporate Jet			640	420	1,000	1,060	896	1,027	343	457	986	1,276	1,667	1,211	10,983	27.4	32.6	30.1
GA Other			413	245	263	175	124	194	161	322	540	878	715	606	4,636	7.7	17.7	12.7
Military																		
C-21			15	1	6	10	4	29	20	28	47	10	16	23	209	0.4	0.8	0.6
TOTAL			1,660	1,092	2,149	2,315	1,958	2,420	967	1,336	2,850	3,724	3,903	2,889	27,263	63.0	86.1	74.7
Enplaned Passengers			23,816	13,804	24,223	40,335	38,690	47,472	13,945	19,624	49,328	63,657	65,366	48,868	449,128	Passengers 1024	Passengers 1,433	Passengers 1,230

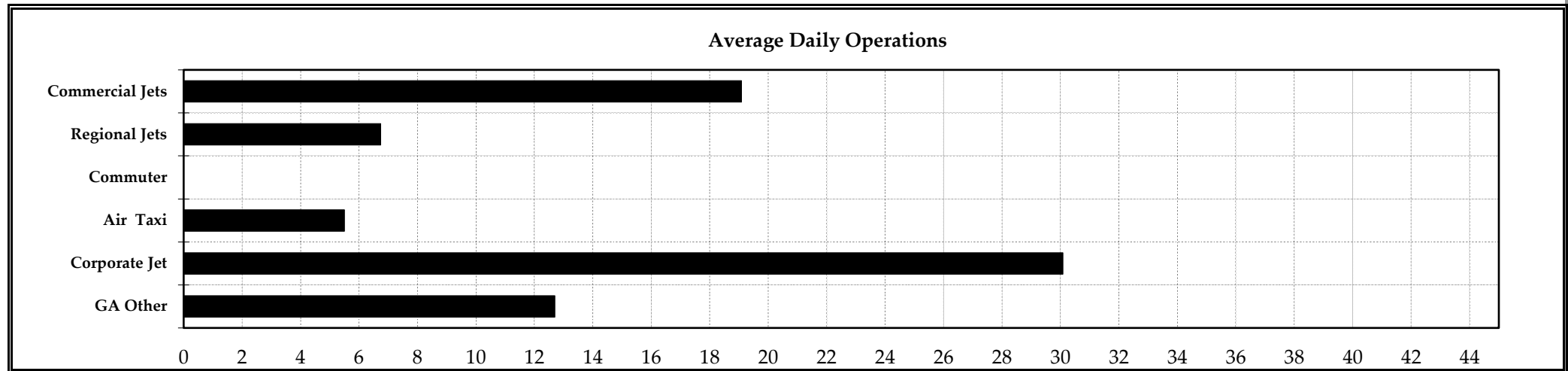


Table 3-2
Comparison of Average Daily Operations for Seasons 2018 (Top) and 2019 (Bottom) using OPSNET Data
Jackson Hole Airport 2019 Annual Noise Report

Date	IFR Itinerant					VFR Itinerant					Local			Total Operations
	Air Carrier	Air Taxi	General Aviation	Military	Total	Air Carrier	Air Taxi	General Aviation	Military	Total	Civil	Military	Total	
Oct-2017	296	527	425	10	1,258	0	19	247	16	282	75	0	75	1,615
Nov-2017	226	334	375	10	945	0	5	118	1	124	118	2	120	1,189
Dec-2017	610	721	664	5	2,000	0	10	99	2	111	143	4	147	2,258
Jan-2018	790	683	621	7	2,101	0	11	77	1	89	72	0	72	2,262
Feb-2018	697	769	696	10	2,172	2	6	41	2	51	22	0	22	2,245
Mar-2018	815	671	607	8	2,101	0	9	64	8	81	52	4	56	2,238
Apr-2018	388	356	220	9	973	0	12	104	1	117	18	7	25	1,115
May-2018	272	424	407	5	1,108	2	10	204	11	227	83	0	83	1,418
Jun-2018	840	655	672	2	2,169	0	38	353	27	418	57	6	63	2,650
Jul-2018	1,090	930	851	7	2,878	0	11	544	22	577	198	10	208	3,663
Aug-2018	1,014	1,032	966	11	3,023	1	16	519	21	557	44	8	52	3,632
Sep-2018	728	709	727	7	2,171	0	7	575	6	588	78	2	80	2,839
Total	7,766	7,811	7,231	91	22,899	5	154	2,945	118	3,222	960	43	1,753	27,124

Date	IFR Itinerant					VFR Itinerant					Local			Total Operations
	Air Carrier	Air Taxi	General Aviation	Military	Total	Air Carrier	Air Taxi	General Aviation	Military	Total	Civil	Military	Total	
Oct-2018	418	494	466	3	1,381	0	5	228	12	245	34	0	34	1,660
Nov-2018	330	367	267	1	965	0	5	72	0	77	50	0	50	1,092
Dec-2016	693	747	555	6	2,001	0	15	117	0	132	16	0	16	2,149
Jan-2019	863	663	685	4	2,215	0	14	70	4	88	10	2	12	2,315
Feb-2019	720	655	514	4	1,893	0	7	52	0	59	6	0	6	1,958
Mar-2019	931	683	608	7	2,229	2	24	120	20	166	23	2	25	2,420
Apr-2019	331	321	200	8	860	0	18	67	12	97	10	0	10	967
May-2019	367	346	362	3	1,078	0	17	155	23	195	61	2	63	1,336
Jun-2019	1,006	738	512	10	2,266	1	38	402	37	478	106	0	106	2,850
Jul-2019	1,234	991	856	6	3,087	0	17	580	4	601	36	0	36	3,724
Aug-2019	1,215	1,022	944	9	3,190	0	21	661	7	689	24	0	24	3,903
Sep-2019	815	766	759	11	2,351	0	29	461	8	498	36	4	40	2,889
Total	8,923	7,793	6,728	72	23,516	3	210	2,985	127	3,325	412	10	422	27,263

Percentage Change in Operations from 2018 to 2019

% Change	14.9%	-0.2%	-7.0%	-20.9%	2.7%	-40.0%	36.4%	1.4%	7.6%	3.2%	-57.1%	-76.7%	-75.9%	0.5%
-----------------	--------------	--------------	--------------	---------------	-------------	---------------	--------------	-------------	-------------	-------------	---------------	---------------	---------------	-------------

3.3 Measurement and Analysis Procedures

The following section outlines the methodology used to measure and quantify noise levels from aircraft operations and ambient noise level conditions. Measurement methodology and analysis techniques used in the study are also included.

Continuous Measurement of the Noise

The methodology employed in this study uses the continuously recorded one second LEQ noise levels at each of the six permanent measurement locations. From this data different noise metrics can be calculated. This includes the aircraft single event noise event level, cumulative daily noise levels, time above levels, and the ambient levels. Since all the noise is collected during the measurements, it is possible to process the data and calculate different metrics of interest that may arise. The process of calculating noise events from this data uses a floating threshold methodology. This allows for the measurement and identification of lower noise level events. The parameters are adjustable and can be modified so that it is possible to recalculate noise events from raw data any time in the future.

3.4 Operational Data

In fall of 2008, the FAA installed a BI-6 radar system at the airport. With the installation of radar, the noise monitoring system was also upgraded. The upgrade consisted of numerous components, including; access to the BI-6 radar data, weather data, and the additional of new features to the remote noise monitoring stations. The BI-6 radar data connection allows for the noise monitoring system to correlate an aircraft noise event to the aircraft causing the event. At the same time the noise monitoring sites were also upgraded to measure detectability. Detectability follows along the Volpe Center's standards for measuring aircraft noise in a park setting. The audible contribution of aircraft and other noise sources to the Park's natural quiet can be approximated using the detectability metric. The upgrade allows the noise monitoring system to more accurately measure the aircraft noise levels at the noise measurement points and to also quantify the aircraft audibility levels at these locations.

BI-6 radar is the primary source for aircraft operational information. However, the airport maintains a live feed of all the IFR aircraft activity in the United States directly from FAA center data as a secondary information source. This data source is the Aircraft Situational Display (ASD). This provides data on all domestic civilian IFR aircraft, and the data stream includes aircraft type, position and altitude by time. VFR aircraft are not included in this data source. When possible, this data is correlated with the noise event data using custom software.

The ASD radar data includes IFR flight information for every flight, as well as position information as to the location of the flight. Each flight is also assigned a unique identification track number so all of the data for any particular flight can be compiled. The flight information includes data such as the ARTS aircraft type, ARTS airline code, departing and arriving airport codes, and flight number. The position information includes the X and Y

coordinates as well as the altitude of the aircraft at each point. The location information given provides the information necessary to determine the direction of flow for runway usage.

Correlation of Noise and Flight Data

Custom noise monitoring software was used to help correlate aircraft flight activity to the noise data. This software utilizes such methods as aircraft position information, noise event sequencing, and noise event profiling to correlate noise data to the aircraft activity. The noise event profiling is used to identify characteristics of both the aircraft and non-aircraft noise events.

Calculation of Aircraft Noise Metrics

Once the collection and correlation of the noise and flight data is complete, the various noise metrics can be calculated. A custom computer program is used to calculate the single event, cumulative, and ambient noise metrics of interest from the data collected at each of the noise monitoring sites.

4.0 Spring/Summer Noise Measurement Results

4.1 Introduction

The existing noise environment for Jackson Hole Airport was determined through a noise measurement survey. The results of the measurement survey are summarized in the following paragraphs. This section presents noise survey information for the Spring & Summer 2019 season as well as the 2018 - 2019 annual noise measurement results. Additional data, which includes more detailed results for each measurement site, is presented in the Appendices. This section presents the overall findings from the noise measurement survey. This includes an explanation of the results and is divided into the following subsections:

Noise Measurement Results

- Continuous noise measurement data
- Ambient noise measurement results
- Single event noise measurement results (SEL)
- DNL noise measurement results
- Hourly noise measurement results (LEQ)

The airport's permanent noise monitoring system utilizes 01dB Opera and CUBE noise monitors at all of the measurement sites. The permanent monitoring system is state-of-the-art and complies with all specific International Standards (IEC), and measurement standards established by the American National Standards Institute (ANSI) for Type 1 instrumentation.

The data collected by the permanent monitors includes the continuous measurement of 1-second average or equivalent (LEQ), noise levels. This type of measurement system allows for the measurement and identification of SEL noise events at a lower threshold than the equipment previously used at this site. This allows for a more accurate measurement of lower aircraft noise levels that are typical of the sites in the Park. Analysis of this data resulted in the SEL noise levels from each individual flyover, the hourly LEQ noise levels, and the daily DNL noise levels for the measurement period.

Although the airport installed a permanent noise monitoring system that monitors noise year-round, for the purposes of this agreement, the periodic noise studies will continue to be conducted for two weeks a year, one week in the summer and one week in the winter. In keeping the study to the original two weeks, the consistency of the noise measurement is intact; in addition, the period of correlation focuses on the times when operations are at their highest levels. The time period chosen for detailed analysis was the period between August 30, 2019 and September 12, 2019.

4.2 Continuous Noise Measurement Data

Noise levels are continuously recorded at each of the noise-monitoring sites. In addition to recording the noise events from aircraft, monitors also record the ambient noise level of the community surrounding the site. A sample of this data is presented in the top portion of Figure 4-1 which displays a 10-minute segment of continuous noise data that was measured at Site 4, at Moose. The measured A-weighted noise level value is shown on the vertical axis and time of day, in minutes, is displayed on the horizontal axis. The difference between an aircraft event and the ambient noise can be easily distinguished in this plot with each of the peaks generated by an aircraft overflight.

The bottom portion of Figure 4-1 presents corresponding data measured at Site 5, 4 Lazy F Ranch, for the same time period. Given the relative close proximity of the noise measurement sites, aircraft overflights are generally measurable in all areas around the airport. This graphic also illustrates the pattern of the noise event that can be used in separating aircraft noise from other noise sources. Sample time history plots measured at each of the other noise monitoring sites is presented in Appendix A.

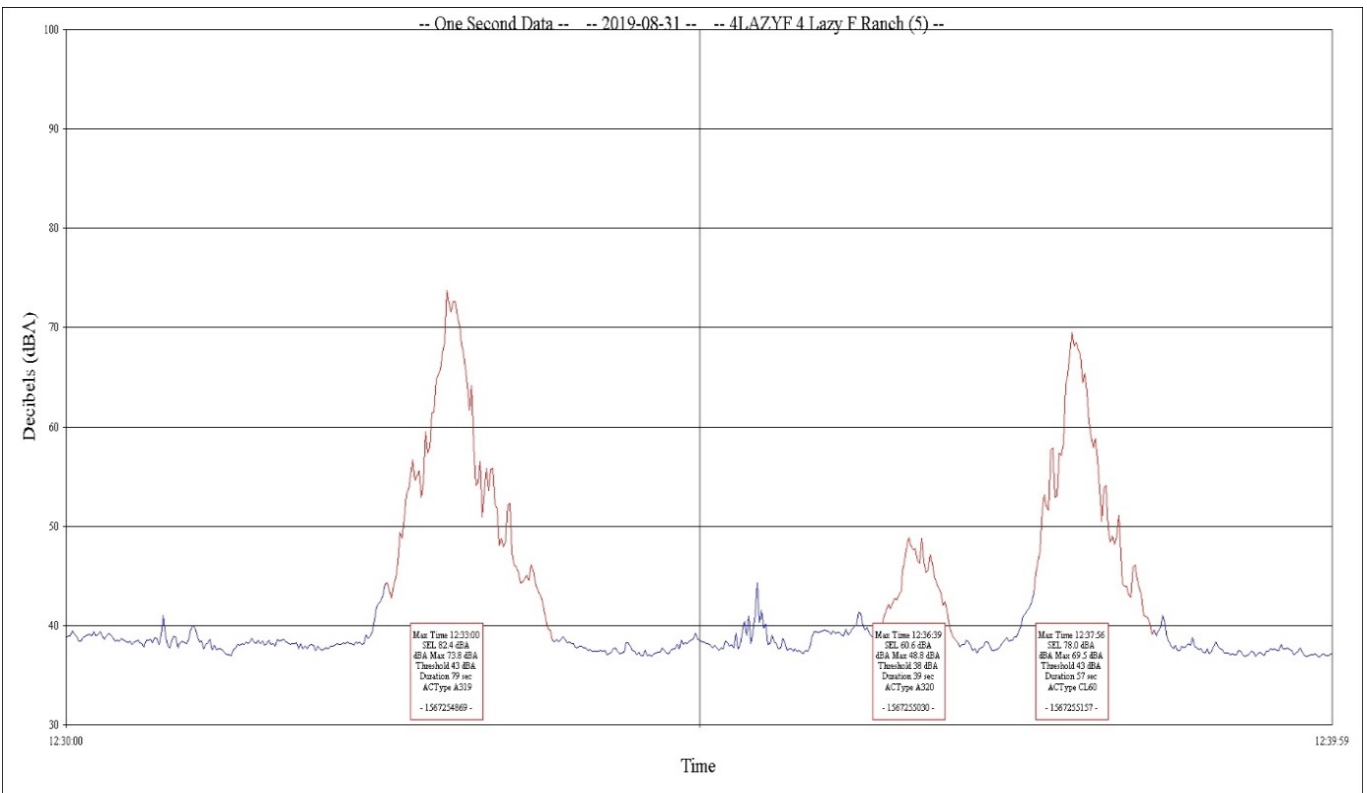
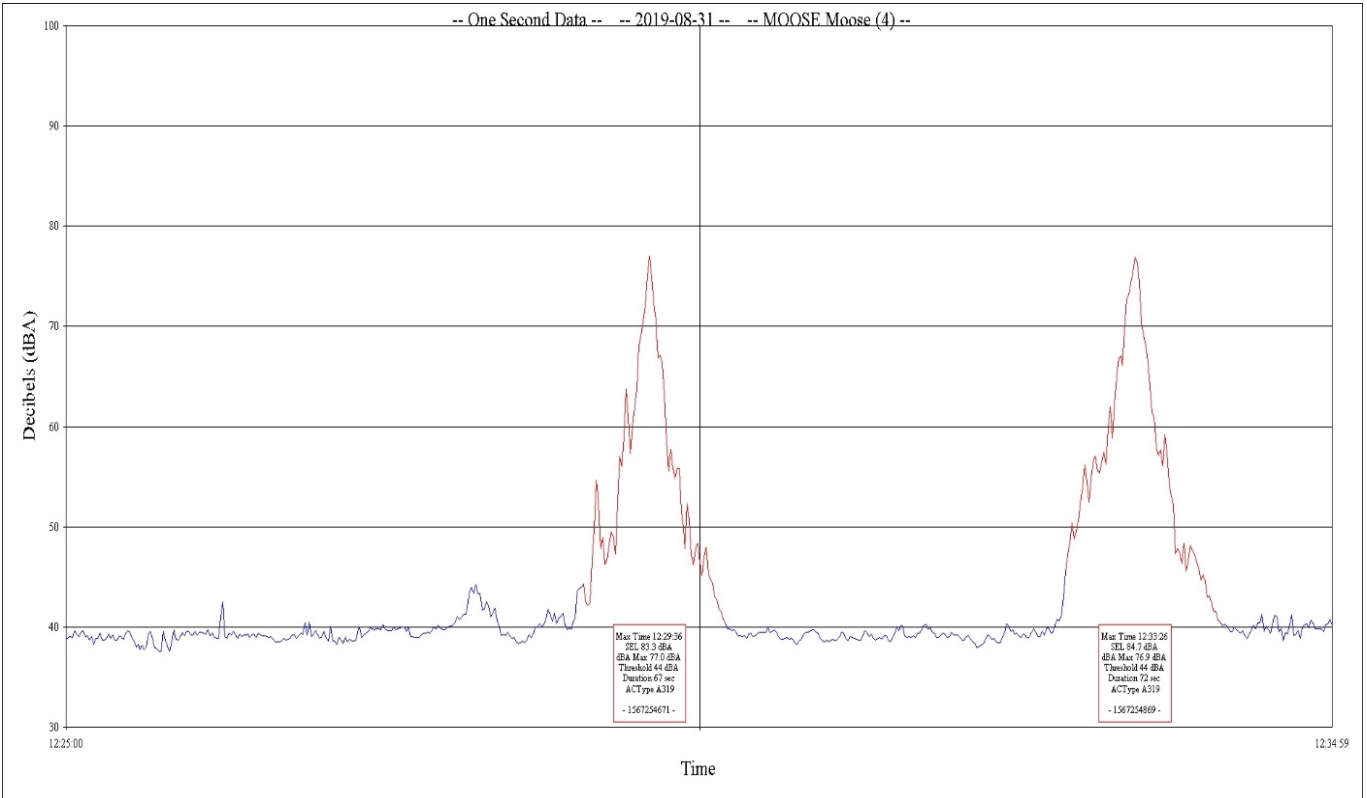
Figure 4-1

Sample Time History Noise Plot of Aircraft and Ambient Noise

Jackson Hole Airport 2019 Annual Report

Period: August 31, 2019 12:25:00 to August 31, 2019 12:44:59

Site: Moose (top) - 4 Lazy F Ranch (bottom)



4.3 Ambient Noise Measurement Results

Background, or ambient noise levels, (those without aircraft noise) are measured at each of the monitoring locations, and these results are presented using Percent Noise Levels (Ln). Percent Noise Level characterizes intermittent or fluctuating noise by showing the noise level that is exceeded during a significant percent of time during the noise measurement period. Ln is most often used to characterize the statistical distribution of measured noise levels. For example, L90 is the noise level exceeded 90 percent of the time, L50 is the level exceeded 50 percent of the time, and L10 is the level exceeded 10 percent of the time. Typically, L90 represents the background noise level; L50 represents the median or ambient noise level, and L10 the most intrusive noise levels.

Other noise sources that are part of the background noise environment include roadway, wind in the trees, and people activities. This data aids in assessing how intrusive aircraft noise is on the ambient environment.

Results of the ambient noise measurement survey at each measurement site are displayed in the following figures and tables. Table 4-1 presents the statistical summary of the ambient measurements for the entire measurement period at each site using the Ln noise levels for the Lmin, L90, L50, L10 and Lmax. The Lmax (Maximum Noise Level) is presented for the loudest 1-second dBA value that was measured while the Lmin (Minimum Noise Level) is the lowest 1-second dBA value that was measured. This table illustrates the range in noise levels that exist at each site. Note that aircraft noise events are included in this data and are typically the source of the peak or maximum noise levels. A graphic depiction of the same information is presented in Figure 4-2.

Figure 4-2
Ambient Noise Measurement Results for All Sites
Jackson Hole Airport 2019 Annual Report
 Period: August 31, 2019 to September 13, 2019

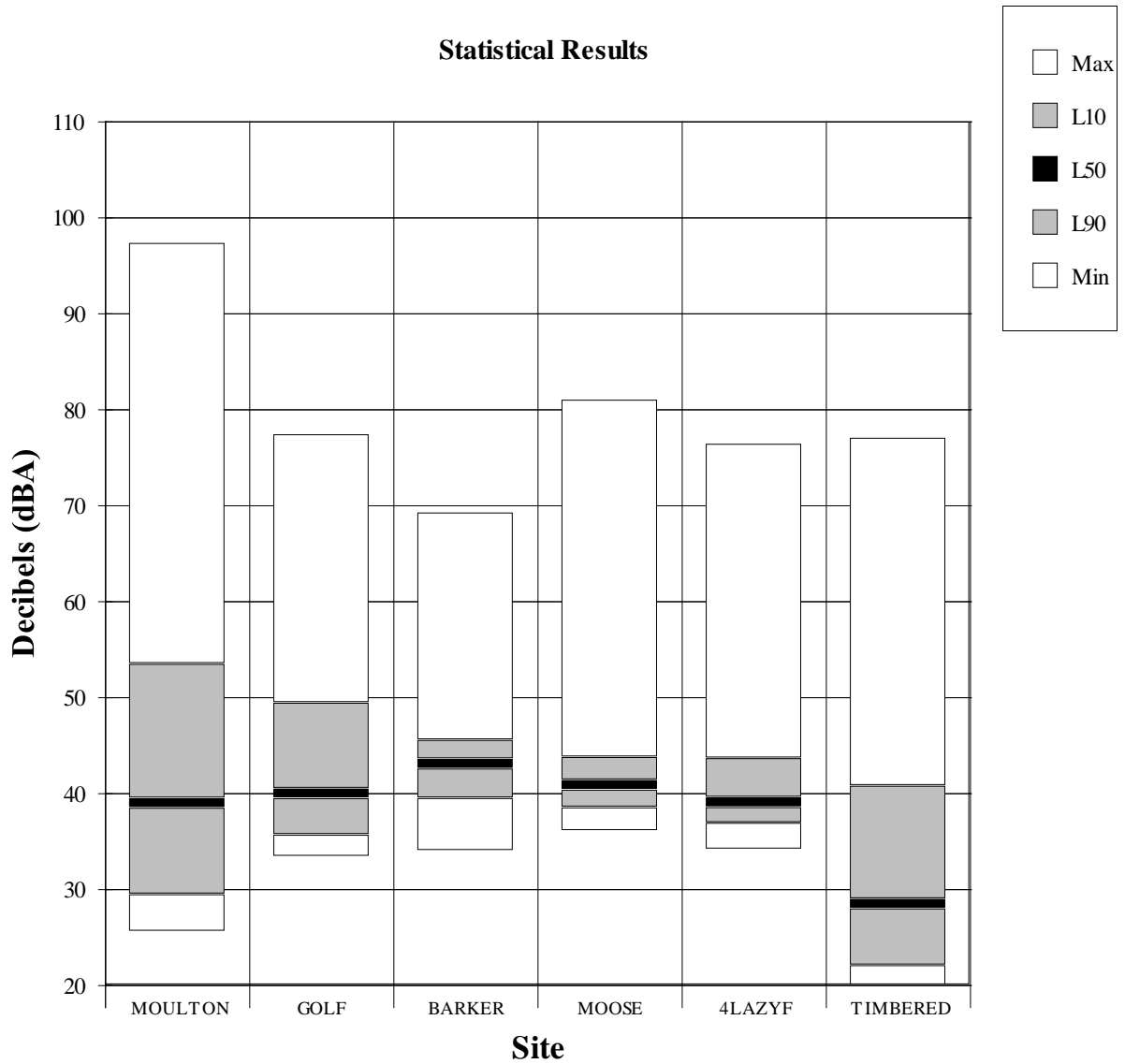


Table 4-1
Ambient Noise Measurement Results
Jackson Hole Airport 2019 Annual Report

Site#	Name	Description	Statistical Noise Levels (dBA)				
			LMax	L10	L50	L90	LMin
1	Moulton Loop	Zenith Drive and Spring Gulch	97	53	39	29	26
2	Golf Course	Jackson Hole Golf & Tennis	77	49	40	36	33
3	Barker Ranch	Circle H Ranch	69	46	43	39	34
4	Moose	Moose Entrance	81	44	41	39	36
5	4 Lazy F Ranch	4 Lazy F Ranch	76	44	39	37	34
6	Timber Island	East of Timber Island	77	41	28	22	18

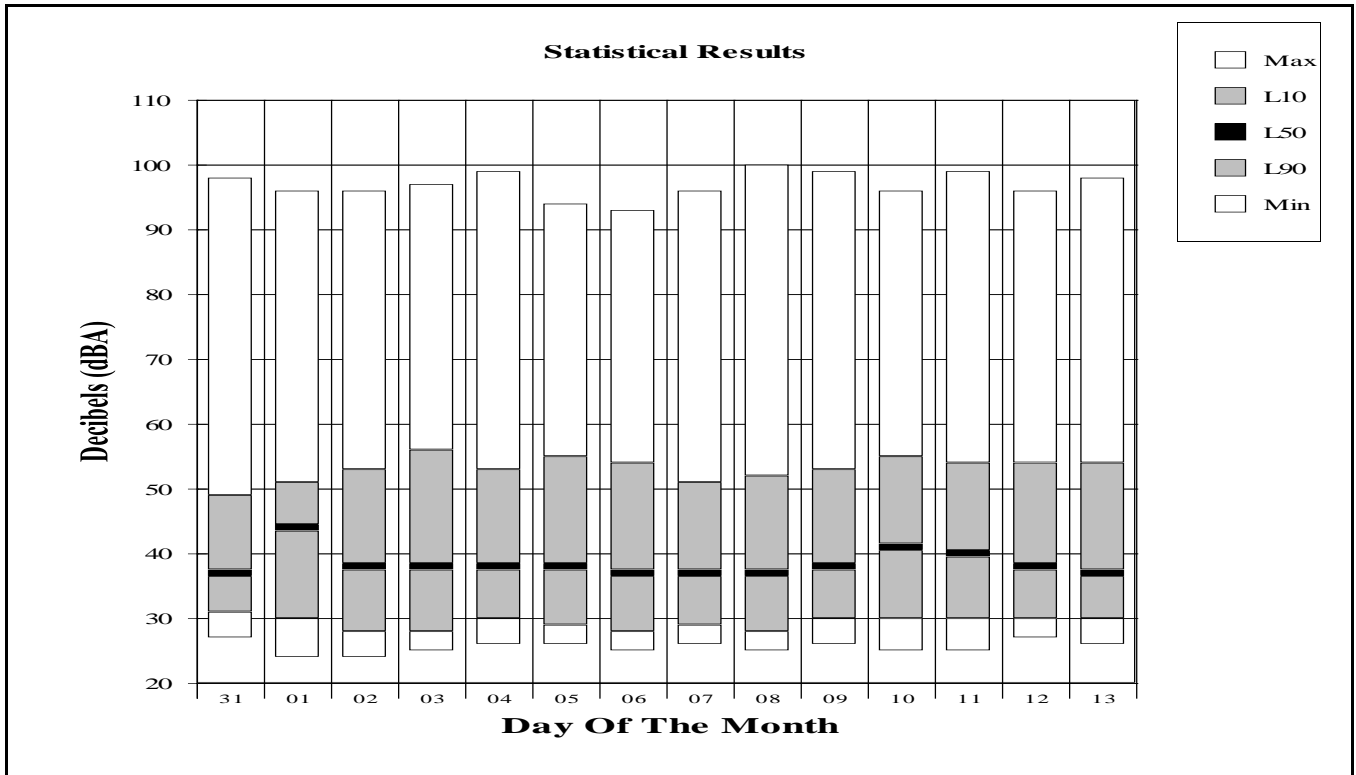
Industry practices indicate that L90 is a good representation of the background noise level and L50 the ambient noise level. These represent the levels that are exceeded 90 percent of the time and 50 percent of the time, respectively. The L90 is referred to as the residual noise, when other sources of noise are not present, and is the level above which noise events occur, such as an aircraft overflight or a vehicle pass-by. Aircraft noise would have very little if any contribution to this noise level because of the relatively short duration of these noise events. The L50 noise level is referred to as the median or ambient noise level. Half the time the noise is below this level, and half the time it is above this level. Even during peak hours of aircraft activity, the L50 noise level would not be influenced by the aircraft noise. On a 24-hour basis, this level is generally reflective of ambient noise levels.

The measurements show that background L90 noise levels ranged from a low of 22 dBA to a high of the high 30s dBA. Most sites had an average L90 noise level right around the mid 30s dBA. The ambient L50 noise levels ranged from the high 28s dBA to the low 40s dBA. The majority of these sites are located in relatively quiet settings that are not exposed to other noise sources, such as highways or people activities.

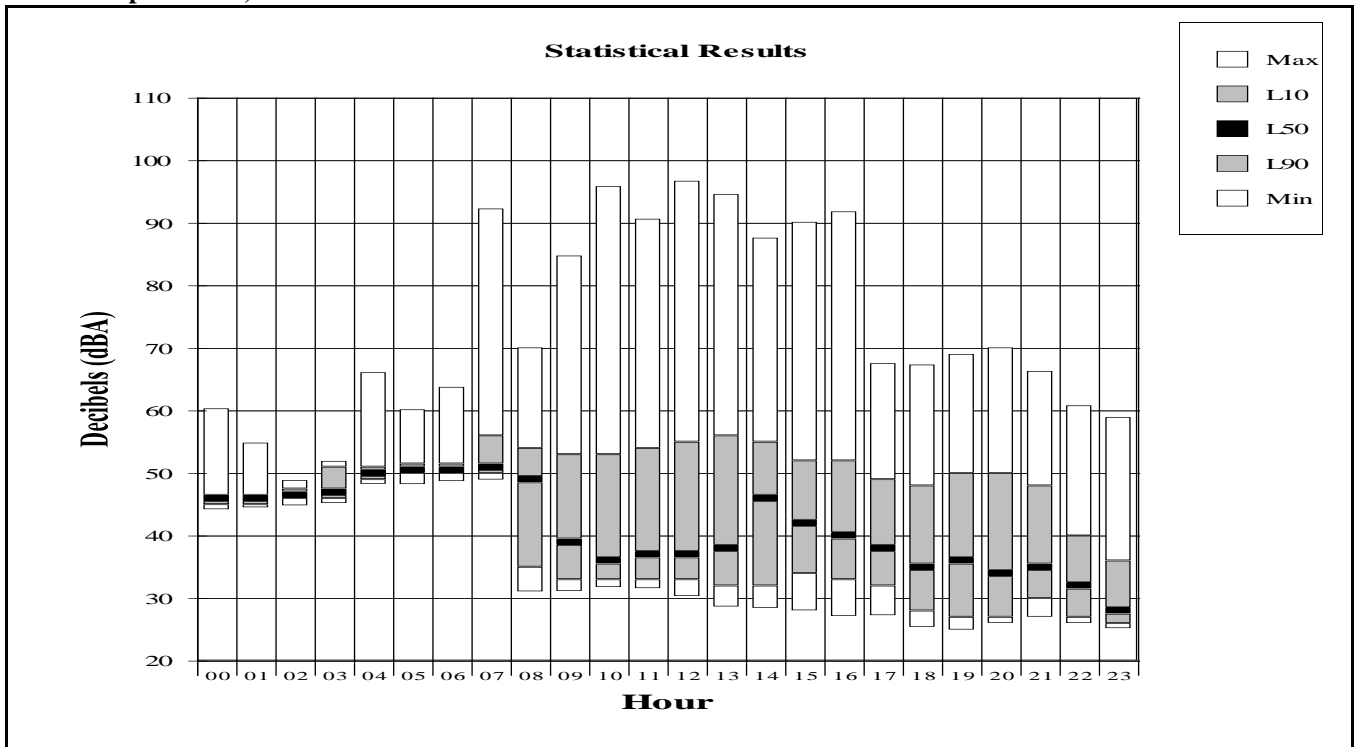
Ambient noise levels vary by day and time of day as summarized in the data from the Moulton Loop site which is presented in Figure 4-3. The top portion of this figure presents the day-to-day ambient measurement results. The bottom portion of the figure shows each hour of ambient measurement data for one typical day (September 01). Day-to-day ambient noise levels are generally similar with higher levels occurring during high wind conditions. Ambient noise levels vary by time of day with quieter levels typically occurring during night and early morning hours, and with higher levels occurring during daytime hours. Typical quiet ambient noise levels range from 5 to 10 dBA lower than average hours. The ambient noise data from the remaining sites is presented in Appendix B.

Figure 4-3
Site Specific Ambient Noise Measurement Results
Jackson Hole Airport 2019 Annual Report
 Site: Moulton Loop

Period: August 31, 2019 to September 13, 2019



Period: September 1, 2019



4.4 Aircraft Single Event Noise Measurement Results

Aircraft single event noise levels were identified at each measurement site. The acoustic data included the maximum noise level (Lmax), the Sound Exposure Level (SEL), and the time duration of aircraft events. The single events measured during the survey were correlated with flight operations information. With this correlated single event noise data, it was possible to separately identify the single event noise levels from the different sources of aircraft noise. The single event results are summarized in the following paragraphs.

The number of aircraft noise events measured daily at a site is presented graphically in Figure 4-4. This figure presents one day of events for the 4 Lazy F Ranch Site. The table presents the SEL noise values plotted as a histogram. The vertical axis presents the number of events that occurred in each hour; the horizontal axis reports the hour of the day. The SEL values are plotted vertically for each event in each hour. Graphs showing the number of aircraft noise events measured at the other sites are presented in Appendix C.

The single event data were analyzed in terms of the distribution of events by calculated single event noise level. An example of the range in noise data is presented for two sites in Figure 4-5. This figure presents a histogram of SEL values for all the aircraft events that were measured at the Moose site and at the 4Lazy F Ranch site. The histogram shows the measured SEL noise level on the horizontal axis and the number of measured aircraft events with that SEL level on the vertical axis. The Moose Loop site is representative of a location close to the airport while the 4Lazy F Ranch site is representative of a location more distant from the airport. These results show the wide range in noise level generated by aircraft events that occur at each site as well as the number of noise events.

Once correlated to the operational information, the single event data were analyzed in terms of noise level per aircraft type. Examples of the single event noise level by aircraft type are presented in Figures 4-6 and 4-7. Figure 4-6 displays the average single event noise level by aircraft type for departures measured at Moulton Loop. Figure 4-7 displays the average SEL by aircraft type for arrivals measured at Moose. These figures show the type of aircraft, the number of measured noise events correlated to that aircraft type, and the average single event noise level measured for that aircraft type. The longer bar graph illustrates those aircraft with the loudest events. The louder events were generally produced by older generation corporate aircraft. These data illustrate the difference in noise levels generated by departure operations versus arrival operations. The data shows that departure events generate higher noise levels and a wider range in noise per the different aircraft types. Single event noise level exhibits for the other sites are presented in Appendices D and E for departures and arrivals, respectively.

Figure 4-4
One Day of Measured Aircraft Noise Events

Jackson Hole Airport 2019 Annual Report

Period: September 1, 2019

Site: 4 Lazy F Ranch

This table presents one day of events for one measurement site. The table presents the SEL noise value plotted as a histogram. The vertical axis presents the number of events in each hour. The horizontal axis is the hour of the day. The SEL values are plotted vertically for each event in each hour. The data shows that the noise events generally occur during peak times of the day. This peak period varies from day to day and is not always the same hours. Numbers in Red are higher noise level events when the SEL exceeds 94.5 dBA.

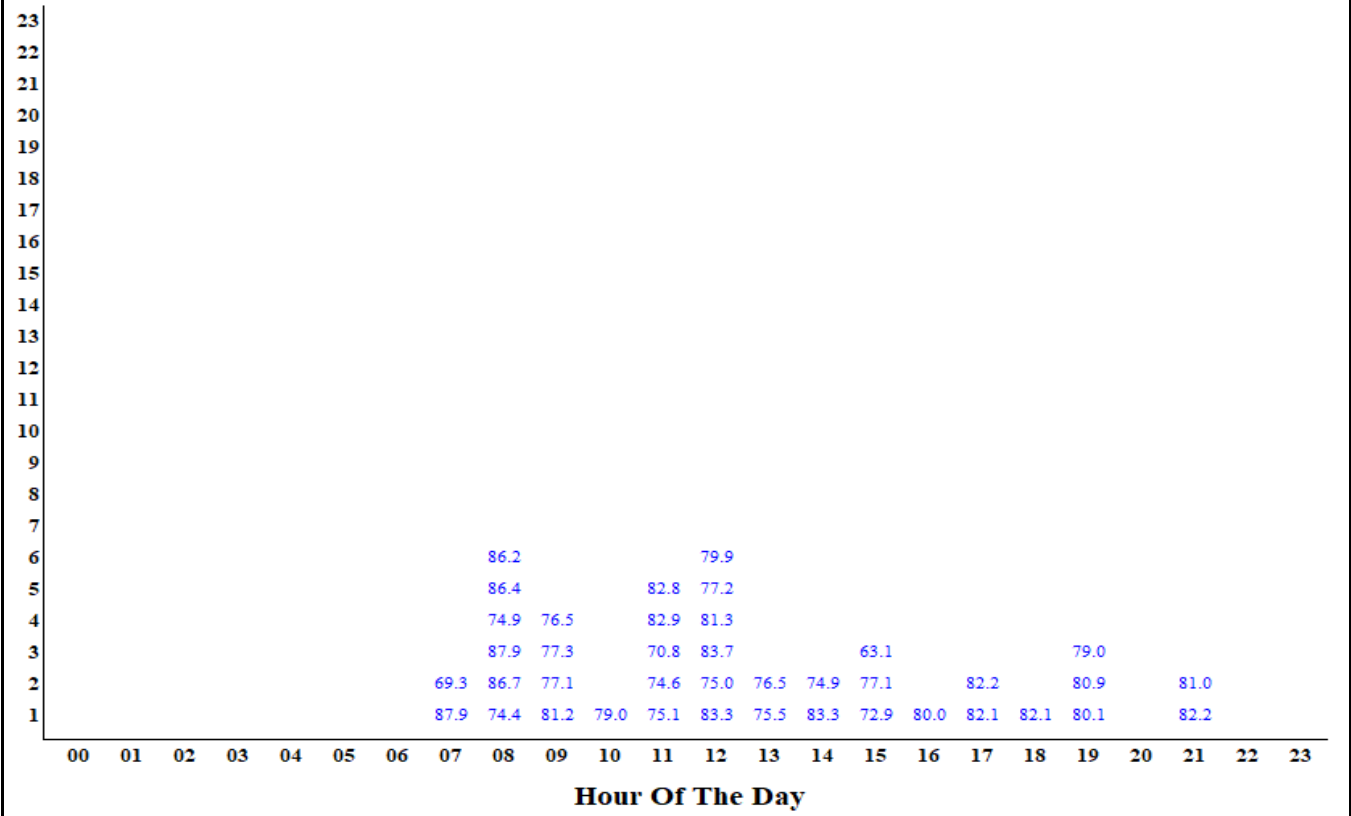


Figure 4-5

Range of Noise and Number of Events Histograms

Jackson Hole Airport 2019 Annual Report

Period: August 31, 2019 to September 13, 2019

Sites: Moose (top) - 4 Lazy F Ranch (bottom)

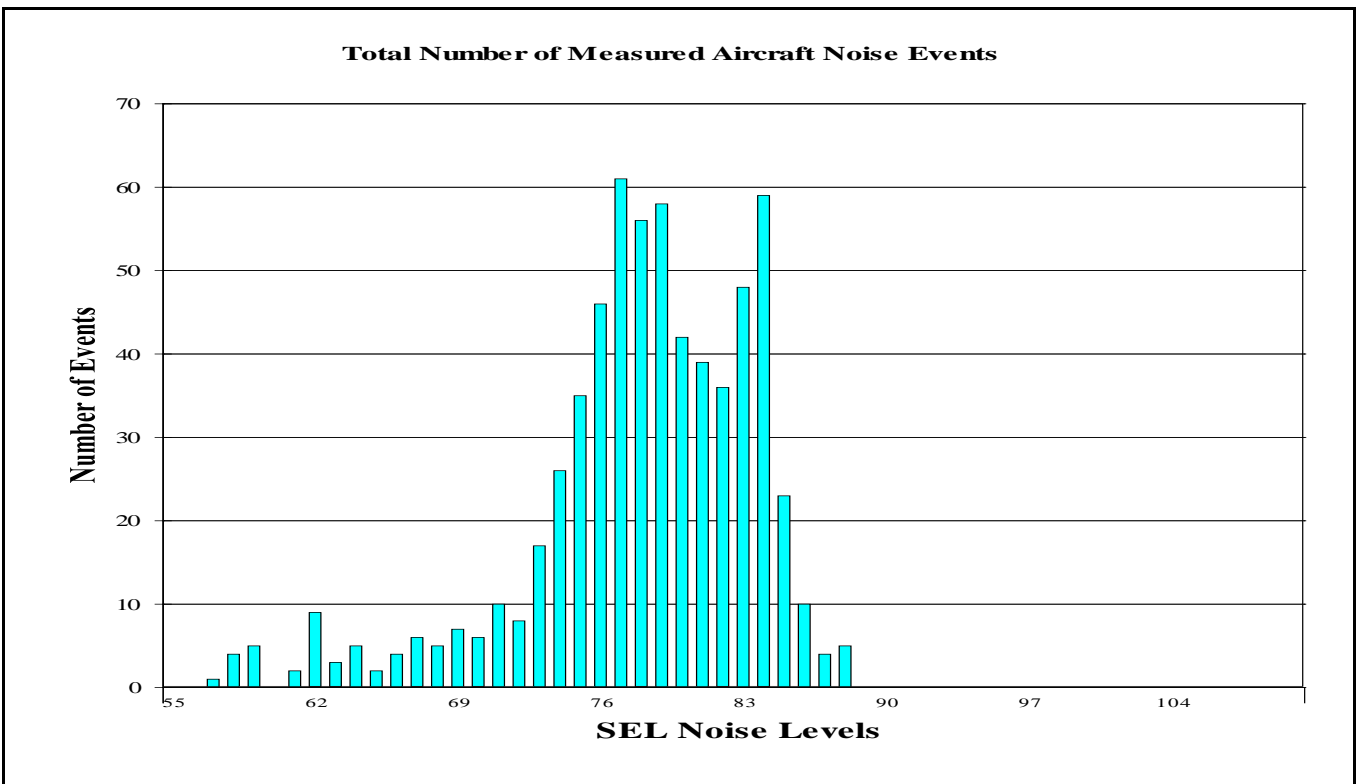
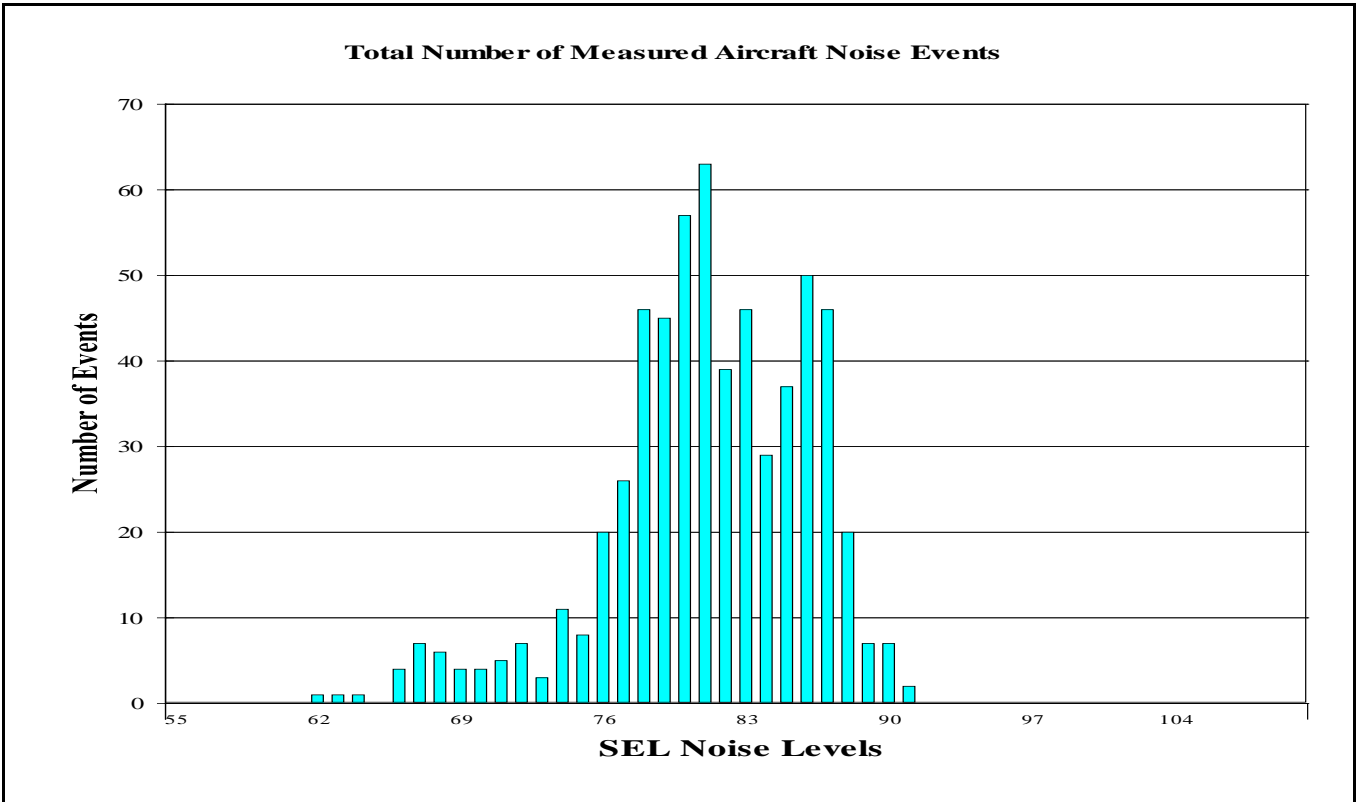
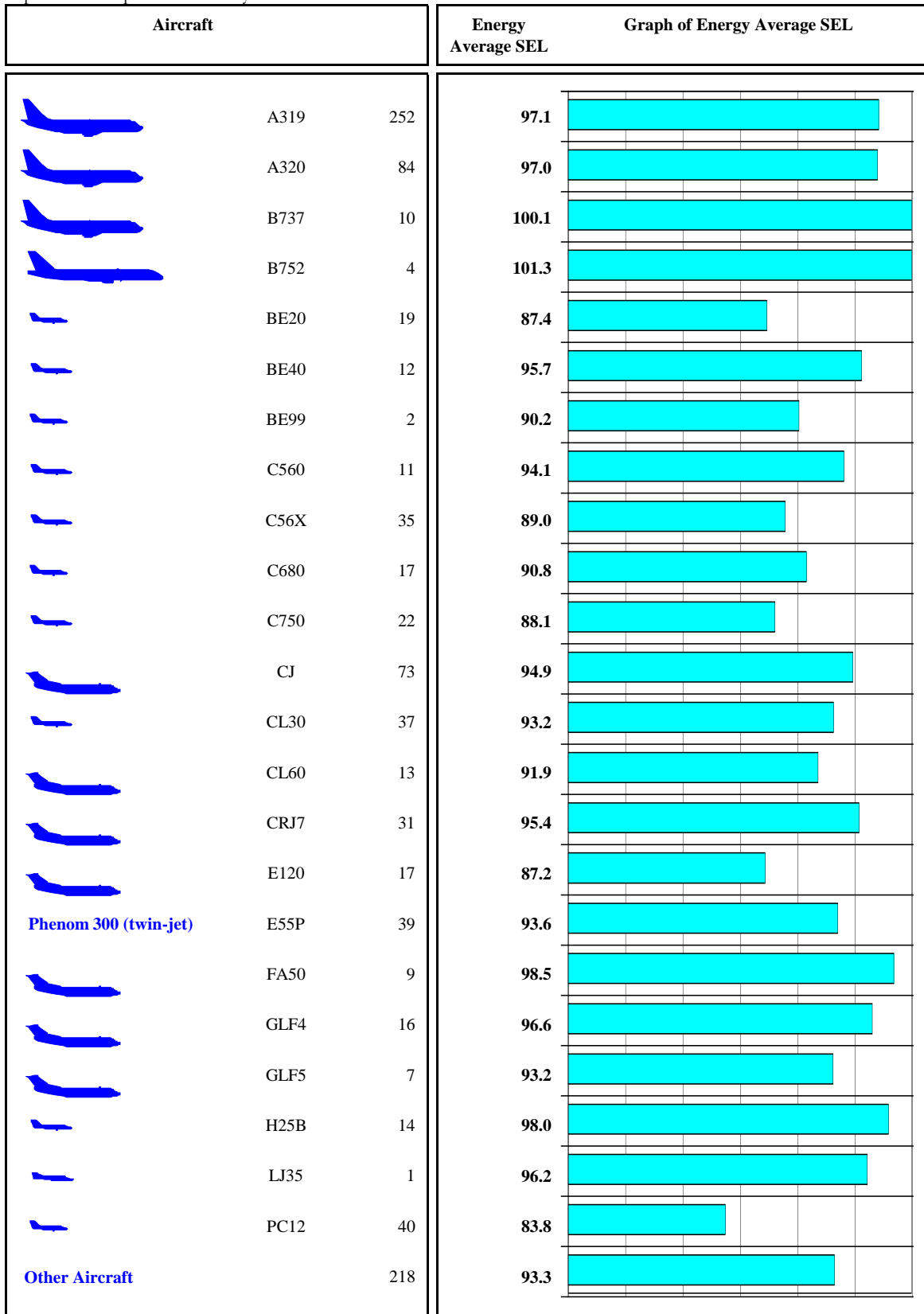
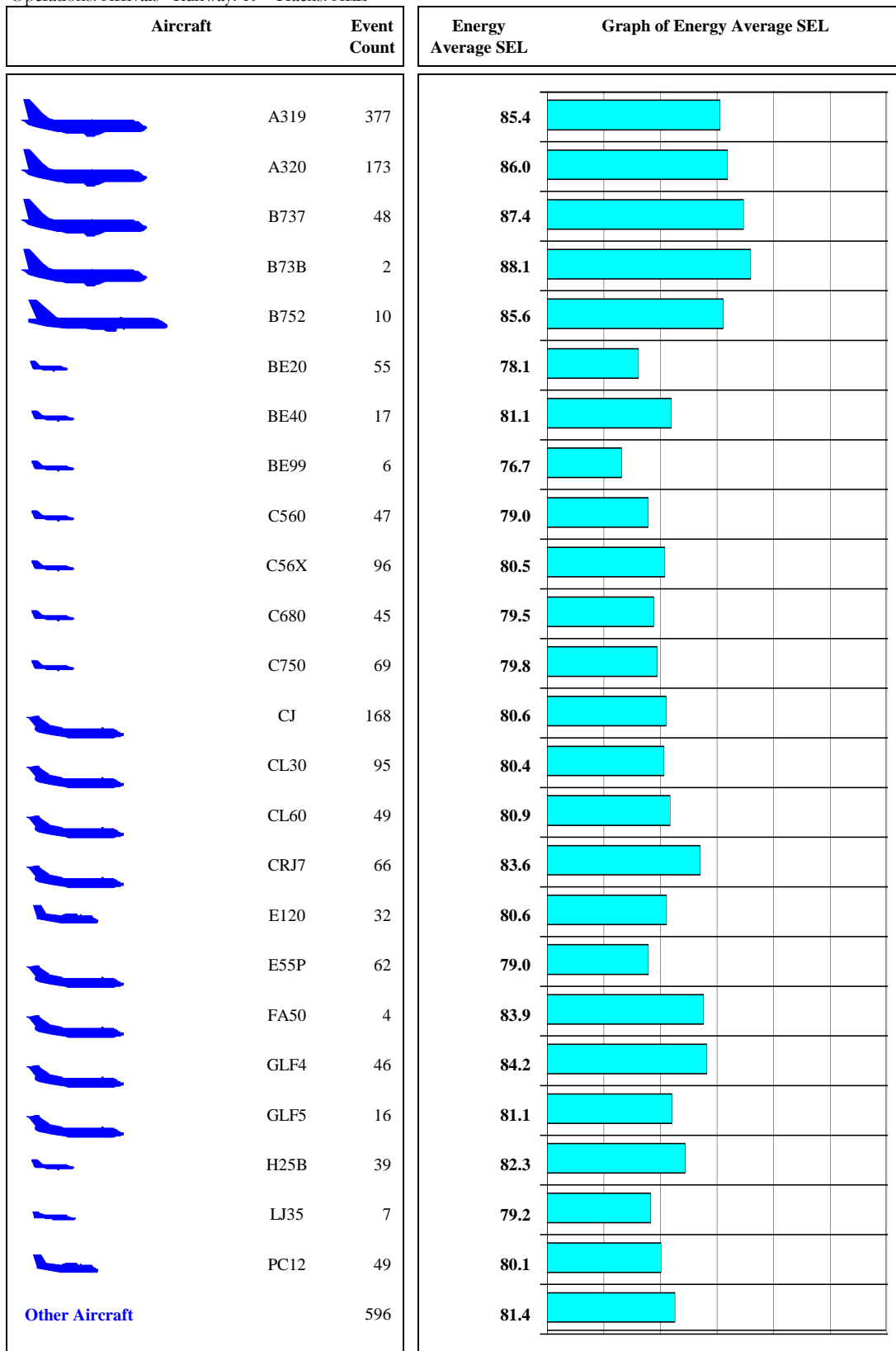


Figure 4-6
Single Event Noise Level by Aircraft Report
Jackson Hole Airport 2019 Annual Report
 Period: August 2019 to September 2019
 Site: Moulton Loop - Zenith Drive and Spring Gulch Road
 Operations: Departure Runway: 19 Tracks: ALL



Note: Energy Average is average of all events on a noise energy basis.

Figure 4-7
Single Event Noise Level by Aircraft Report
Jackson Hole Airport 2019 Annual Report
 Period: August 2019 to September 2019
 Site: Moose
 Operations: Arrivals Runway: 19 Tracks: ALL



Note: Energy Average is average of all events on a noise energy basis.

To better illustrate which aircraft generate the highest noise events, the 25 loudest single event noise levels at each measurement site were identified. These events were then correlated with an aircraft type and plotted. The results are shown in Figure 4-8 for the Moulton Loop. The figure includes the date and time of the event, the aircraft type, the operation, and the associated single event noise levels. For most of the measurement locations, the loudest identified aircraft were typically older generation corporate jets. Per the agreement between the airport and the U.S. Department of Interior, older generation Stage 2 aircraft with higher noise levels are not permitted to operate at Jackson Hole Airport. It is uncommon for an older aircraft to operate at Jackson Hole, however occasionally one operates without permission. The other sites are presented in Appendix F.

Once the single event data is correlated with the aircraft type and operation, the individual events can then be displayed. One such correlated event is displayed in Figure 4-9 for an aircraft measured at the Moose site. The figure shows the measured noise level from the time it exceeds the ambient threshold noise level, which was 44 dBA in this case, until it dropped below that threshold. The duration of the event in seconds is displayed along the horizontal axis while the noise level in dBA is displayed on the vertical axis. All of the acoustical data relating to the event, along with the correlated aircraft data, is shown in the event summary. Specific event data measured at the other measurement sites is presented in Appendix G.

Figure 4-8

Loudest Aircraft Noise Events Site Report

Jackson Hole Airport 2019 Annual Report

Period: August 31, 2019 to September 13, 2019

Site: Moulton Loop - Zenith Drive and Spring Gulch Road











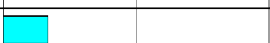


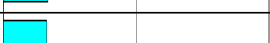






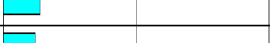



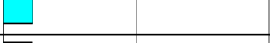


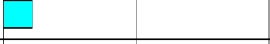








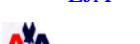
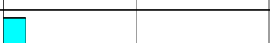




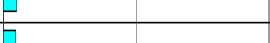


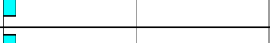

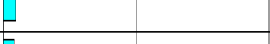








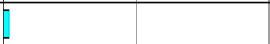




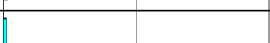
Aircraft	Airline	Event Time	Aircraft	Ops	Rwy	Lmax	SEL	Graph Of SEL
	TFF	Sep 11, 07:07	H25B	D	19	99.8	103.1	
	 American	Sep 09, 07:07	A319	D	19	99.5	102.8	
	 SkyWest	Aug 31, 07:45	E75L	D	19	98.5	101.9	
	 American	Sep 07, 07:11	A319	D	19	96.9	101.7	
	 UNITED	Sep 03, 08:25	B737	D	19	97.3	101.7	
	 SkyWest	Sep 03, 07:21	E75L	D	19	97.6	101.6	
	GA	Sep 11, 13:05	C650	D	19	97.0	101.4	
	TFF	Sep 11, 07:22	H25B	D	19	96.6	101.2	
	GA	Sep 02, 11:13	C650	D	19	96.8	101.1	
	DCM	Sep 03, 11:36	FA50	D	19	96.1	101.1	
	 American	Sep 11, 11:43	A319	D	19	95.8	101.0	
	 American	Sep 08, 07:15	A319	D	19	96.0	101.0	
	EJA	Sep 11, 11:05	E55P	D	19	94.3	100.9	
	EJA	Sep 08, 08:39	C68A	D	19	95.8	100.9	
	 American	Sep 12, 07:15	A319	D	19	96.1	100.8	
	GA	Sep 01, 10:46	C650	D	19	95.9	100.5	
	 Delta Air Lines	Sep 10, 22:30	A319	D	19	96.4	100.5	
	 American	Sep 13, 07:23	A319	D	19	96.6	100.5	
	LXJ	Sep 13, 08:38	E550	D	19	95.7	100.4	
	EJA	Sep 08, 13:35	CL60	A	19	94.8	100.4	
	 American	Sep 13, 07:57	A319	D	19	94.3	100.3	
	GA	Sep 13, 13:01	H25B	A	19	97.0	100.2	
	RAX	Sep 12, 10:00	FA50	D	19	93.7	100.2	
	 American	Sep 12, 07:31	A319	D	19	94.6	100.1	
	GA	Sep 13, 09:24	C650	D	19	93.7	100.1	

Figure 4-9

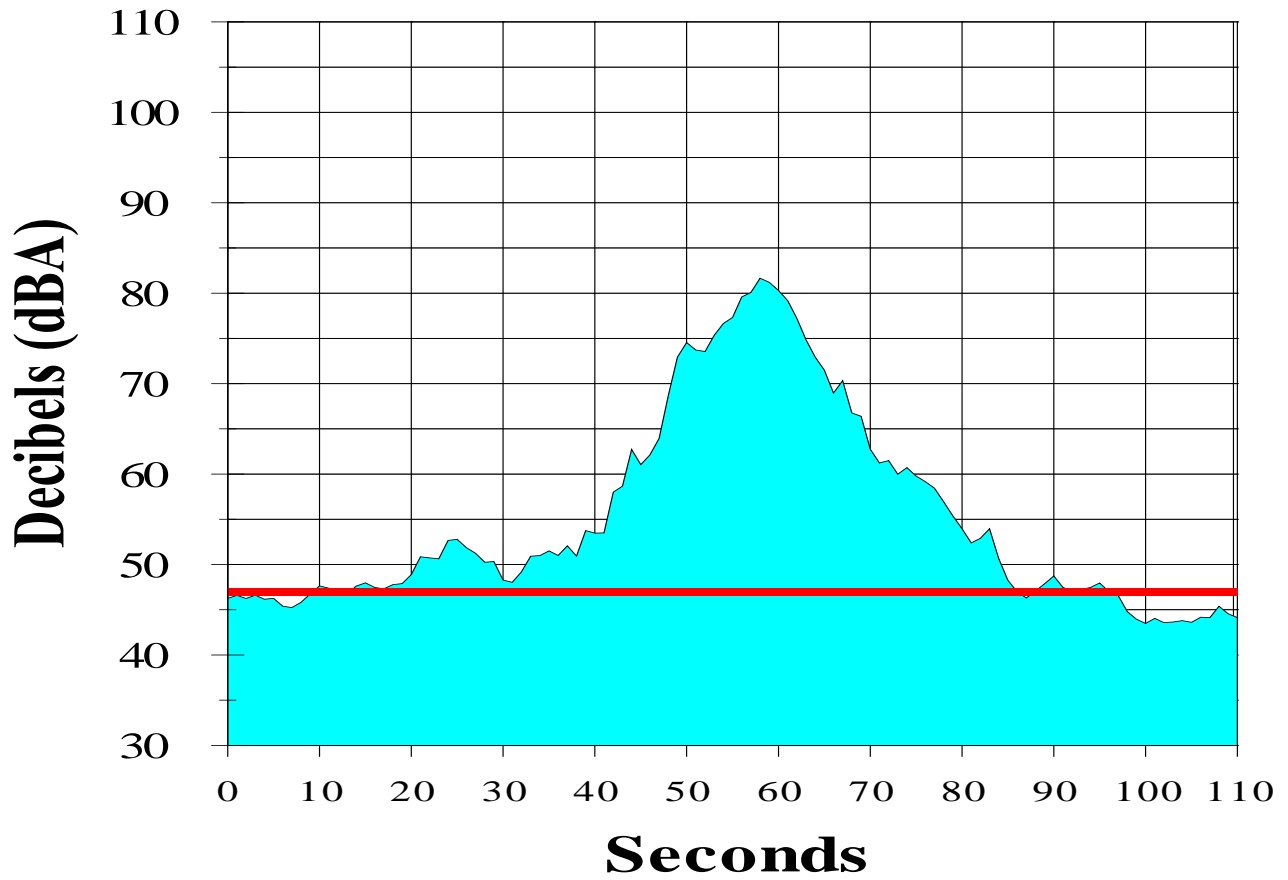
Noise Event Plot Report

Jackson Hole Airport 2019 Annual Report

Period: 9/1/2019 7:12:03 AM

Site: Moose

Start time:	07:11:15	Lmax time:	07:12:03
SEL (dBA):	90.3	Max (dBA):	81.7
Duration (seconds):	92	Start to peak (seconds):	48
SEL threshold (dBA):	47		
Flight No:	UAL2158		
Aircraft Type:	B737	Boeing 737-700	
Operation:	Departure		
Runway:	01		
Destination:	KORD	Chicago O'hare Intl - IL - USA	



4.5 DNL Noise Measurement Results

Aircraft-related DNL levels were calculated for each of the six long-term noise monitoring locations. Table 4-2 presents the results of the DNL noise measurements at the six noise-monitoring locations. This table lists the average aircraft-related DNL for the Spring/Summer measurement survey monitored at each site (August 31, 2019 to September 13, 2019).

Figure 4-10 shows the same results of the DNL noise measurements at the noise-monitoring locations in a graphical format. The top portion of the graph shows the average DNL noise level measured at each noise monitoring location. The bottom portion of the graph shows the range of daily DNL values along with the overall DNL for the entire measurement period. The results show the average noise exposure level at each site stays fairly consistent, with the range of DNL values at any given site being less than 10 dB, which is a narrow range in noise levels experienced at each location. While the number of operations measured at each site varies with the distance from the airport, the peak DNL days were an average of only 3 to 4 dBA higher than the average day. At the Moulton Loop site, the noise levels are nearly all as a result of aircraft noise. At the park sites, where the aircraft noise levels are lower, other sources of noise were a significant contributor to the DNL level.

Figure 4-11 graphically presents the DNL noise level due to the aircraft events as well as the ambient environment for each day the noise level was monitored at the Moulton Loop site. This figure presents the day-to-day change in noise levels. The top portion of the exhibit shows the total DNL level at the site for the day as well as the contribution due to aircraft noise events. The bottom portion of the graphic shows the distribution of measured SEL noise levels during the measurement period. Additional figures presenting this information for the other noise measurement sites are presented in Appendix H.

Table 4-2

Aircraft DNL Noise Measurement Results

Jackson Hole Airport 2019 Annual Report

Site #	Name	Description	Aircraft DNL
1	Moulton Loop	Zenith Drive and Spring Gulch Rd.	62
2	Golf Course	Jackson Hole Golf & Tennis Club	47
3	Barkers Ranch	Circle H Ranch (Barker's Residence)	32
4	Moose	Moose Entrance	51
5	4 Lazy F Ranch	4 Lazy F Ranch	48
6	Timber Island	East of Timber Island	26

Figure 4-10

Aircraft DNL

Jackson Hole Airport 2019 Annual Report

Period: August 31, 2019 to September 13, 2019

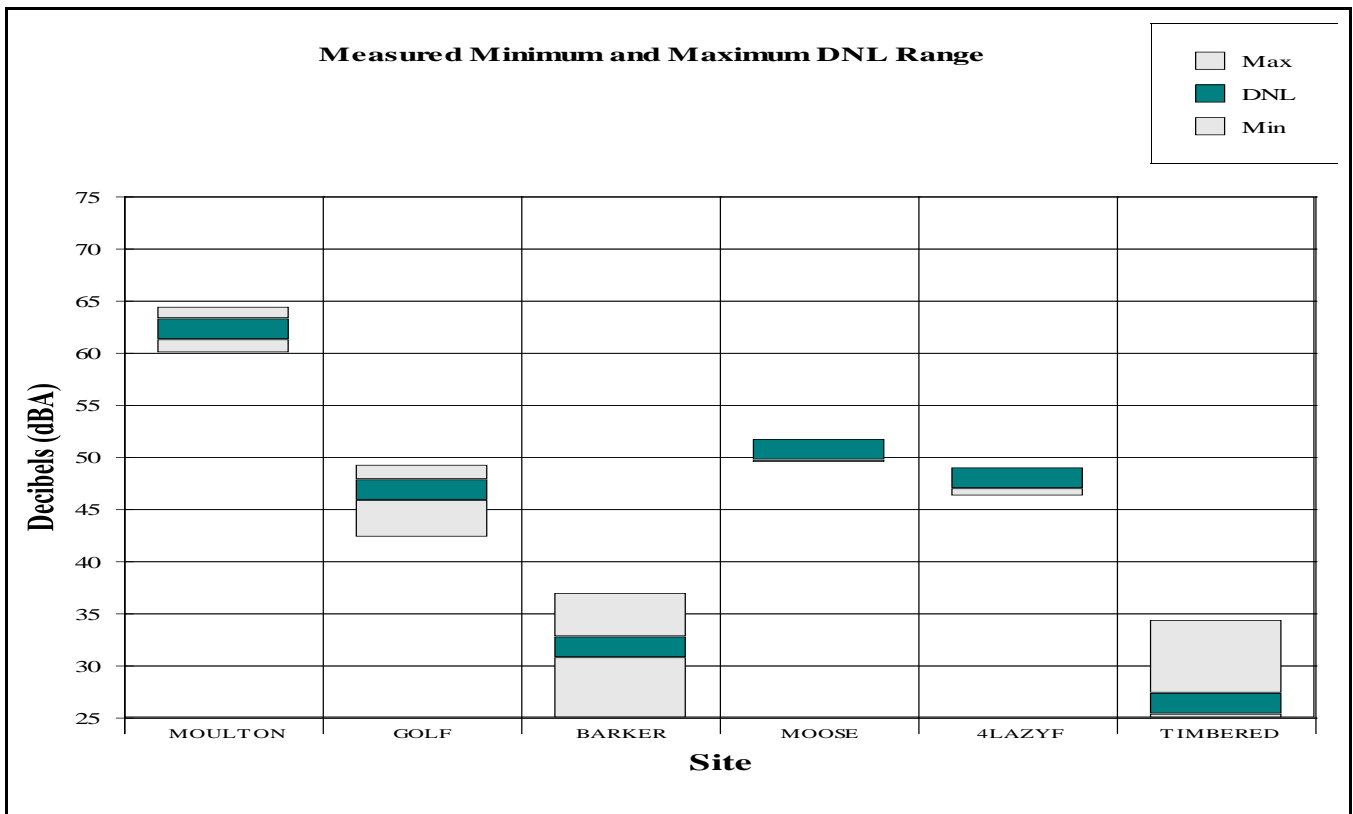
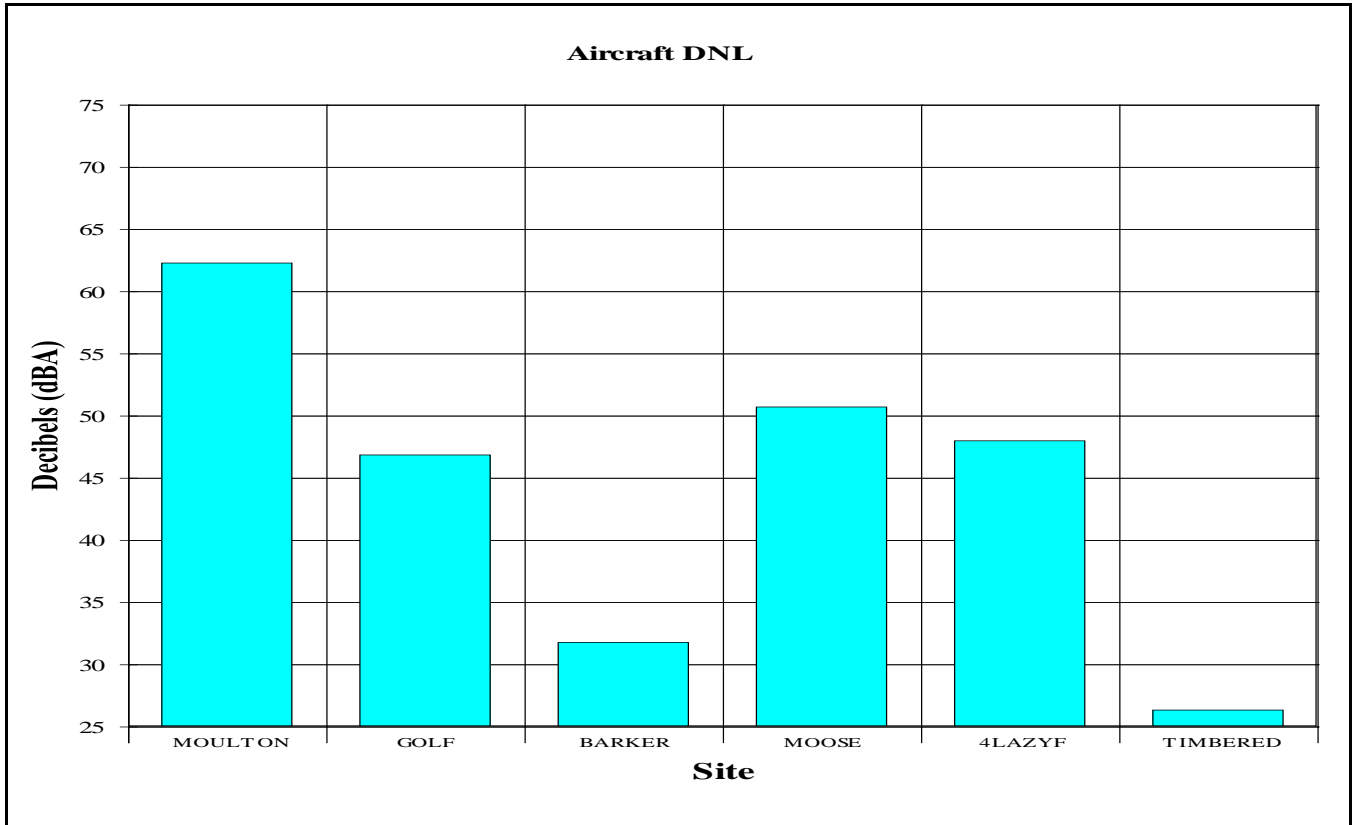


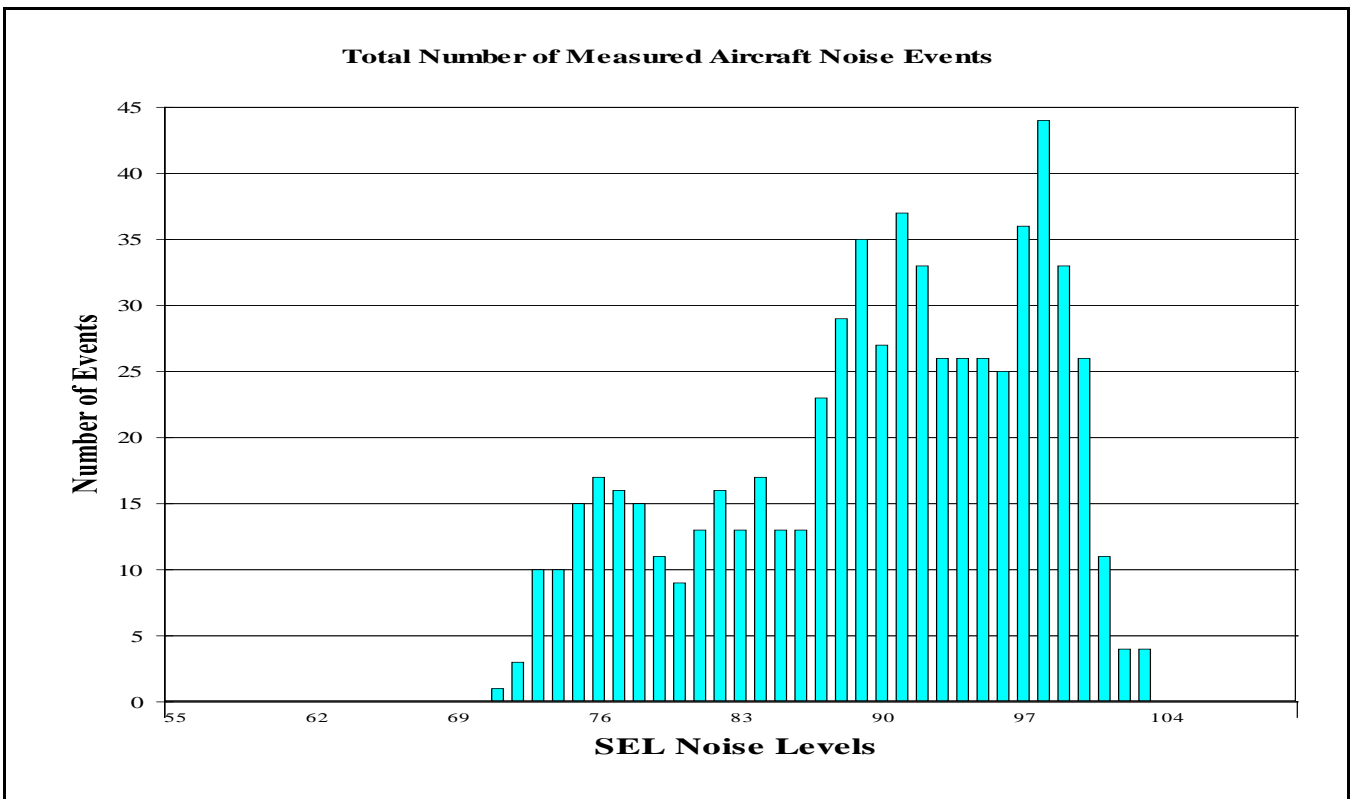
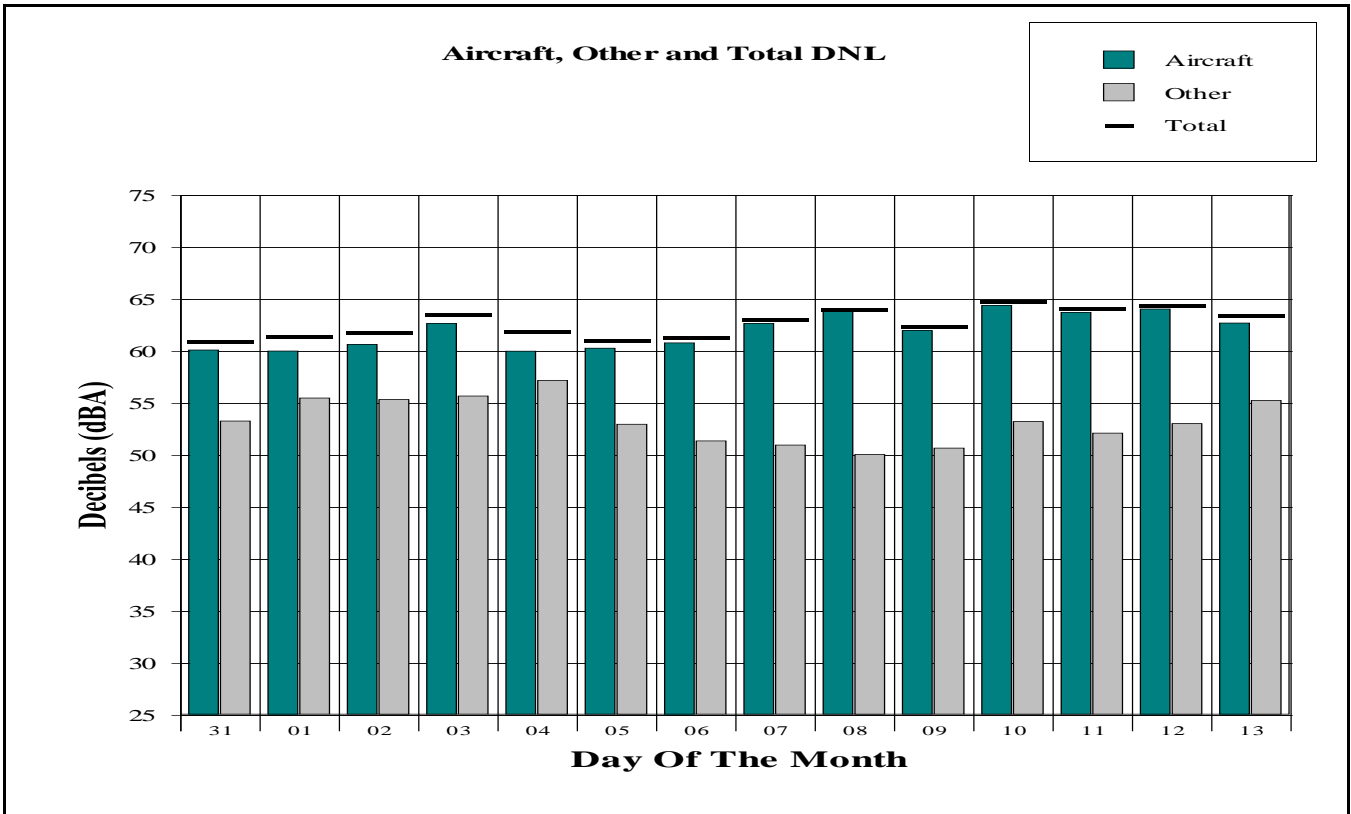
Figure 4-11

DNL Contribution and SEL Distribution Results

Jackson Hole Airport 2019 Annual Report

Period: August 31, 2019 to September 13, 2019

Site: Moulton Loop - Zenith Drive and Spring Gulch Road



4.6 Hourly LEQ Noise Measurement Results

Hourly average noise level values were calculated for each of the measurement locations. Hourly values include the aircraft LEQ, non-aircraft LEQ, and total LEQ. An example of the hourly aircraft LEQ and total LEQ noise data for the 4 Lazy F Ranch site is presented in Table 4-3. The total LEQ noise level includes all sources of noise, including aircraft, other man made, and natural sources. This table shows that the hourly LEQ noise level varies throughout the day. Tables listing the calculated hourly LEQ noise levels for the remaining sites during each hour of measurement are presented in Appendix I.

Table 4-3

Hourly Noise Level Site Report*Jackson Hole Airport 2019 Annual Report*

Period: August 31, 2019 to September 13, 2019

Site: 4 Lazy F Ranch

Metric: Aircraft LEQ

DATE	Hour Of The Day																							DNL	
	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22		23
Aug 31	0	0	0	0	0	0	0	49	41	48	48	53	53	52	51	50	47	47	53	50	47	47	0	41	48
Sep 1	0	0	0	0	0	0	0	52	57	49	49	51	53	43	48	43	44	50	47	49	0	49	0	0	48
Sep 2	0	0	0	0	0	0	0	56	45	54	46	52	44	49	49	43	46	47	39	52	47	51	0	0	48
Sep 3	0	0	0	0	0	0	47	43	42	49	50	51	50	47	46	31	50	48	40	52	48	48	0	0	48
Sep 4	0	0	0	0	0	0	37	55	50	49	50	52	50	48	48	51	47	40	49	42	46	47	0	0	48
Sep 5	0	0	0	0	0	0	46	53	50	48	49	53	53	46	50	47	50	51	46	49	44	48	0	0	49
Sep 6	0	0	0	0	0	0	0	55	0	50	56	54	49	46	51	48	51	52	0	50	50	51	0	0	49
Sep 7	0	0	0	0	0	0	0	0	43	47	52	46	54	51	47	49	0	51	0	51	0	0	0	0	46
Sep 8	0	0	0	0	0	0	0	29	0	49	52	54	56	49	49	51	46	52	50	52	48	49	0	0	49
Sep 9	0	0	0	0	0	0	42	45	0	0	51	53	50	44	53	39	47	38	48	51	41	49	0	0	47
Sep 10	0	0	0	0	0	0	0	55	47	52	54	52	52	0	51	45	49	51	51	0	49	51	0	0	49
Sep 11	0	0	0	0	0	0	45	44	47	45	52	49	54	50	50	48	0	51	51	50	48	48	0	0	48
Sep 12	0	0	0	0	0	0	0	0	50	47	49	54	52	51	48	48	53	45	49	49	51	49	0	0	48
Sep 13	0	0	0	0	0	0	0	0	39	47	48	52	50	49	51	49	50	36	50	44	52	48	0	0	47
Energy Average	0	0	0	0	0	0	40	51	49	49	51	52	52	48	50	48	48	49	48	50	48	49	0	30	48

Metric: Total LEQ

DATE	Hour Of The Day																							DNL	
	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22		23
Aug 31	40	40	39	39	41	41	44	51	45	48	48	54	53	52	51	50	48	47	53	50	48	48	42	44	51
Sep 1	40	40	40	39	40	41	44	55	58	49	49	51	53	45	49	46	47	50	47	50	41	50	41	41	51
Sep 2	40	40	39	39	40	41	43	56	48	54	47	52	46	50	50	46	48	49	44	52	48	51	41	40	51
Sep 3	40	40	39	39	39	41	48	48	46	51	51	51	50	48	46	40	51	48	43	52	49	49	40	41	50
Sep 4	41	40	39	39	40	41	45	55	51	50	50	53	50	49	50	51	48	43	49	44	47	48	41	44	51
Sep 5	40	39	39	40	40	40	47	54	51	50	49	53	53	47	50	48	50	51	47	50	46	49	39	39	51
Sep 6	38	39	39	39	39	40	40	55	42	50	56	54	49	47	52	49	51	52	41	50	50	51	39	38	51
Sep 7	38	37	38	37	37	37	38	41	45	47	53	46	54	51	51	50	43	51	37	51	41	42	40	39	49
Sep 8	39	39	39	39	38	38	39	45	48	50	52	54	56	52	49	52	46	54	49	52	49	50	38	38	51
Sep 9	40	38	38	40	38	39	44	47	43	42	52	54	53	47	53	43	49	42	48	51	44	49	41	39	50
Sep 10	38	37	38	40	40	37	39	55	48	52	54	52	52	44	54	46	50	51	51	40	50	53	38	37	51
Sep 11	37	37	37	37	37	37	46	45	50	45	53	51	54	50	51	49	37	52	52	50	48	48	37	37	50
Sep 12	36	36	36	36	37	38	41	39	50	49	49	54	52	51	48	49	53	47	51	49	52	48	40	38	50
Sep 13	37	38	38	37	39	40	44	45	45	48	48	53	52	50	52	49	50	44	50	45	52	49	39	39	50
Energy Average	39	39	38	39	39	40	44	52	50	50	51	53	53	49	51	49	49	50	49	50	48	49	40	40	50

4.7 Summary of Spring/Summer Noise Measurements

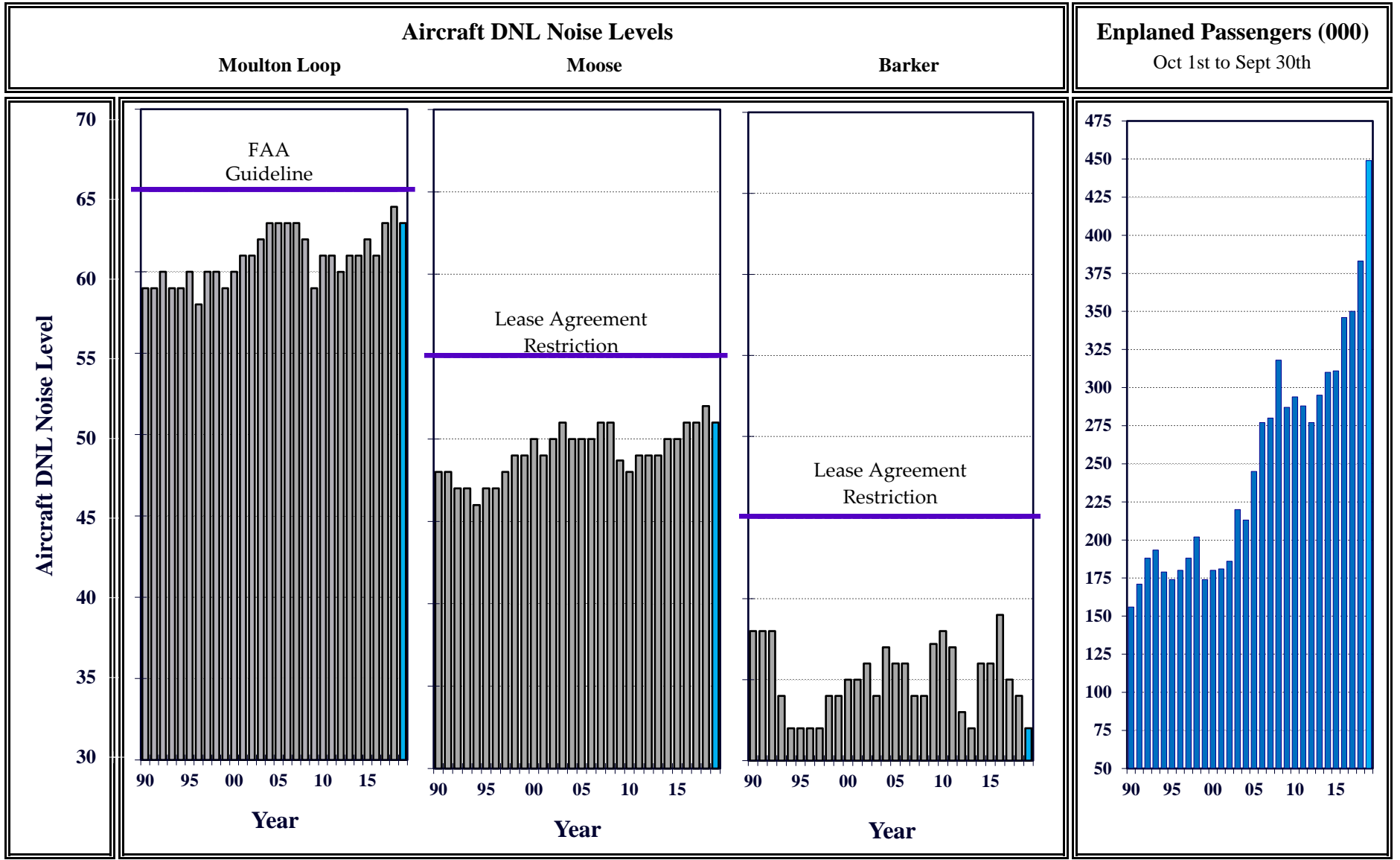
The results of the annual noise measurements show that the airport is in compliance with the requirements of the airport Agreement. The measured noise levels are below the limits contained within the agreement. The requirements are that the annual DNL noise levels from aircraft noise at the Moose measurement location cannot exceed 55 DNL. The Barker site measurement cannot exceed 45 DNL. Aircraft noise levels within the park are calculated to be greater than 5 dBA below the levels specified within the airport Agreement with the Department of Interior.

4.8 Summary of Annual Noise Levels

The results of the annual 2019 DNL noise measurement results are presented in Figure 4-12 (includes both summer and winter measurement results). The results of these noise measurements were also compared with the measurement data from previous studies. Figure 4-12 presents the annual aircraft DNL noise levels from 1984 through 2019 for each of the measurement sites. (Note: the accuracy of the results diminishes at DNL levels below 40). The annual enplaned passengers for each of these years is also presented. Figure 4-13 presents the historical trend for passengers and noise environment since 2001.

The results show that the airport is in compliance with the Use Agreement restrictions with the Department of Interior. The annual aircraft DNL noise levels were measured to be 51 dBA and 32 dBA at the Moose and Barker sites respectively. This is significantly less than the 55 DNL limit at Moose and the 45 DNL limit at Barker that is contained in the use agreement restriction. The noise level at the Moulton Loop site was measured to be 62 DNL. This is less than the 65 DNL criteria used by the FAA as a guideline for the acceptability of residential land use.

Figure 4-12
2019 Annual DNL Noise Report
Jackson Hole Airport 2019 Annual Report
 October 1st 2018 to September 30th 2019



5.0 Computer Modeling

5.1 Introduction

Contour modeling is a very key element of this noise study. Generating accurate noise contours is largely dependent on the use of a reliable, validated, and updated noise model. It is imperative that these contours be accurate for the meaningful analysis of airport noise impacts. The computer model can then be used to predict the changes to the noise environment as a result of any of the development alternatives under consideration.

The FAA's Aviation Environmental Design Tool (AEDT) was used to model the flight operations at Jackson Hole Airport. The AEDT has an extensive database of civilian aircraft noise characteristics and this most recent version of AEDT incorporates the advanced plotting features that are part of the Air Force's Noisemap computer model.

Airport noise contours were generated in this study using the FAA's AEDT 3b. The latest version, Version 3b, was released for use on September 24, 2019 and is the state-of-the-art in airport noise modeling. The AEDT is a large computer program developed to plot noise contours for airports. The program is provided with standard aircraft noise and performance data for over 200 aircraft types that can be tailored to the characteristics of the airport in question. Version 3b includes updated databases that include some newer aircraft, the ability to include run-ups in the computations, the ability to include topography in the computations, and the provision to vary aircraft profiles in an automated fashion.

One of the most important factors in generating accurate noise contours is the collection of accurate operational data. The AEDT program requires the input of the physical and operational characteristics of the airport. Physical characteristics include runway coordinates, airport altitude, temperature and optionally, topographical data. Operational characteristics include various types of aircraft data. This includes not only the aircraft types and flight tracks, but also departure procedures, arrival procedures and stage lengths that are specific to the operations at the airport. Aircraft data needed to generate noise contours include:

- Number of aircraft operations by type
- Types of aircraft
- Day/Evening/Nighttime distribution by type
- Flight tracks
- Flight track utilization by type
- Flight profiles
- Typical operational procedures
- Average Meteorological Conditions

5.2 Existing Aircraft Operations

The existing noise environment for Jackson Hole airport was analyzed based upon the 2019 analysis season (October 1, 2018 to September 30, 2019). The data was derived from various sources, which include aircraft tower counts and aircraft situation display (ASD) data. A variety of operational data is necessary in order to determine the noise environment around the airport. This data includes the following summary information and is discussed in detail in the following paragraphs:

- Aircraft Activity Levels
- Fleet Mix
- Time of Day
- Runway Use
- Flight Path Utilization

The tower count data showed that for the period from October 1, 2018 through September 30, 2019 there were a total of 27,263 annual operations, or an average of 74.7 operations per day (an operation is one takeoff or one landing). The breakdown by aircraft category was determined from a variety of sources that include:

- Airport Radar
- Review of the aircraft based at Jackson Hole
- Operations Network (OPSNET)

The 2019 season aircraft operations for each category of operation are summarized in Table 5-1. These operations are categorized as general aviation, business jets air taxi, commuters, regional and commercial jets. The total number of annual corporate jet aircraft was determined from the airport radar data source. The airport radar provides information on aircraft that file an instrument flight plan. It accounts for nearly all larger aircraft including corporate jets. Larger twin-engine propeller aircraft are also counted in airport radar, but smaller aircraft flying under visual flight rules are not always included. The AEDT model was based upon a compilation of all 27,263 operations at the airport.

Table 5-1

SUMMARY OF OPERATIONS, (October 1, 2018 thru September 30, 2019)

Jackson Hole Airport 2019 Annual Report

Category Type	Annual Operations	Daily Operations	Percent Nighttime
Commercial Jet	6,966	19.1	0.4%
Regional Jet	2,460	6.7	0.4%
Small Commuter	0	0	0.0%
Air Taxi (TurboProp)	2,009	5.5	1.0%
General Aviation			
Business Jet	10,983	30.1	1.2%
Turbo/Piston Propeller	4,446	12.2	3.3%
Helicopter	190	0.5	0.0%
Military	209	0.6	0.0%
Total Operations	27,263	74.7	0.7%

Fleet Mix. The fleet mix of aircraft that operate at the airport is one of the most important factors in terms of the aircraft noise environment. The corporate jet fleet mix data was determined from an extensive review of the airport radar database.

The airport has a restriction that bans Stage 2 corporate jet aircraft. Stage 2 refers to the FAA's Federal Aircraft Regulation Part 36 that categorizes jet aircraft based upon noise levels. Stage 2 refers to the older louder aircraft. Stage 3 refers to the newer generation quieter aircraft. For corporate jet aircraft the fleet was calculated to be 100% percent Stage 3.

Time of Day. In the DNL metric, any operations that occur after 10 p.m. and before 7 a.m. are considered more intrusive and are weighted by 10 dBA. Therefore, the number of nighttime operations is very critical in determining the DNL noise environment and is also very important to the residences around Jackson Hole Airport. The nighttime operations assumptions were estimated from a variety of sources. This included a review of the airport radar data. The nighttime operational assumption data are summarized in Table 5-1.

Runway Use. An additional important consideration in developing the noise contours is the percentage of time each runway is utilized. The speed and direction of the wind dictate the runway direction that is utilized by an aircraft. From a safety and stability standpoint, it is desirable, and usually necessary, to arrive and depart an aircraft into the wind. When the wind direction changes, the operations are shifted to the runway that favors the new wind direction.

For the Jackson Hole Airport, wind is generally calm with the predominate wind direction being from the south. Runway 19 is utilized more than the reverse runway direction, Runway 1. The airport also has a preferential runway use program to use Runway 19 when wind conditions permit. The runway utilization assumptions used in the study are presented in Tables 5-3 and 5-4. These tables present the percentage of operations by category utilizing each of the runways, for daytime and nighttime hours, respectively.

Table 5-2a

INM Case Summary Report

Jackson Hole Airport 2019 Annual Report

October 1, 2018 thru September 30, 2019

Operations Category	ICAO Type	ANP ID	ANP Description	Annual Operations
Commercial Jets	A319	A319-131	A319-131\IAE V2522-A5	4,952
	A320	A320-211	A320-211\CFM56-5A1	1,090
	B737	737700	BOEING 737-700/CFM56-7B24	728
	B752	757PW	BOEING 757-200/PW2037	196
Regional Jets	CRJ7, CRJ9	CRJ9-ER	CL-600-2D15/CL-600-2D24/CF34-8C5	1,078
	E75L	EMB175	ERJ170-200	1,382
	E190	EMB190	ERJ190-100	20
Commercial Air Carrier Operations (Total)				9,446
Business Jets				
	GLEX	BD-700-1A10	BD-700-1A10\BR700-710A2-20	7
	GL5T	BD-700-1A11	BD-700-1A11\BR700-710A2-20	66
	C650	CIT3	CIT 3/TFE731-3-100S	95
	CL30, CL35, CL60	CL600	CL600/ALF502L	1,627
	C25A, C25B, C501, C525			
	C500, C501, SF50	CNA500	CIT 2/JT15D-4	872
	C510, E50P, E454	CNA510	510 CITATION MUSTANG	289
	C25C, C52M	CNA525C	Cessna Model 525C CJ4	251
	C550, E550, E55P, PC24	CNA55B	CESSNA 550 CITATION BRAVO / PW530A	1,053
	C560	CNA560E	Cessna Citation Encore 560 / PW535A	2
	C560	CNA560U	Cessna 560 Citation V 1PW038 NONE	474
	C56X	CNA560XL	Cessna Citation Excel 560 / PW545A	995
	C680, C68A	CNA680	Cessna Model 680 Sovereign / PW306C	1,366
	C750, F2TH, FA50			
	GALX, HA4T, J328			
	LJ60, LJ75	CNA750	CITATION X / ROLLS ROYCE ALLISON	1,284
	EA50, HDJT, SF50	ECLIPSE500	Eclipse 500 / PW610F	68
	E135, E35L	EMB145	EMBRAER 145 ER/ALLISON AE3007	25
	FA20	FAL20	FALCON 20/CF700-2D-2	15
	F900, FA50	FAL900EX	GULFSTREAM GIV-SP/TAY 611-8	338
	GLF4, FA7X	GIV	GULFSTREAM GIV-SP/TAY 611-8	702
	GA5C, GLF5	GV	GULFSTREAM GV/BR 710	260
	GLF6	G650ER	G650ER\BR-700-725A1-12	51
	ASTR, G150, G280, WW24	IA1125	ASTRA 1125/TFE731-3A	100
	LF25, L39C, SBR1	LEAR25	LEAR 25/CJ610-8	5
	FA10, H25B, H25C, LJ31			
	LJ35, LJ40, LJ45, LJ55	LEAR35	LEAR 36/TFE731-2	746
	BE40, PRM1	MU3001	MU300-10/JT15D-5	292
Business Jets (Total)				10,983
Multi Engine Turbo	B190	1900D	BEECH 1900D / PT6A67	192
	BATP	HS748A	BAE Jetstream 61 ATP	311
	C425, C441	CNA441	CONQUEST II/TPE331-8	110
	AC90, AC95, B350, BE10			
	BE20, BE30, BE99, BE9L			
	BE9T, MU2, P180			
	SW3, SW4, TBM8	DHC6	DASH 6/PT6A-27	2,000
	E120	EMB120	EMBRAER 120 ER/ PRATT & WHITNEY PW118	286
	PAY1, PAY2, PAY3			
	PAY4, TBM8	PA42	Piper PA-42 / PT6A-41	12
Twin Turbo (Total)				2,911
Single Engine Turbo	C208, PC12, TBM7	CNA208	Cessna 208 / PT6A-114	740
Single Turbo (Total)				740
Sub Total				24,080

Table 5-2b
INM Case Summary Report
Jackson Hole Airport 2019 Annual Report
 October 1, 2018 thru September 30, 2019

Continued from Table 5-2a

Operations Category	ICAO Type	ANP ID	ANP Description	Annual Operations
Sub Totals from Table 5-2a				24,080
Multi Engine Piston	AC50, AC80, BE55, BE58 BE60, C310, C340, C421 PA23, PA34 PA30, PA31	BEC58P PA30	BARON 58P/TS10-520-L PIPER TWIN COMANCHE PA-30 / IO-320-B1A	166 12
Twin Engine Piston (Total)				178
Single Engine Piston	BE17, C172 C182 C206 S22T, SR22 C150, P28A, P46T AT5T, PA32, TBM7	CNA172 CNA182 CNA206 COMSEP GASEPF GASEPV	CESSNA 172R / LYCOMING IO-360-L2A CESSNA 182H / CONTINENTAL O-470-R CESSNA 206H / LYCOMING IO-540-AC 1985 1-ENG COMP 1985 1-ENG FP PROP 1985 1-ENG VP PROP	24 104 3 794 503 1,178
Single Engine Piston (Total)				2,606
Helicopter	B407 EC30 SUCO R44	B407 EC130 SA365N R44	Bell 407 / Rolls-Royce 250-C47B Eurocopter EC-130 w/Arriel 2B1 Aerospatiale SA-365N Dauphin (AS-365N) Robinson R44 Raven / Lycoming O-540-F1B5	16 122 22 30
Helicopter (Total)				190
Military	C130 C17, C17A	C-130E C17 C21A DHC6 S76	C-130H/T56-A-15 F117-PW-100 LEARJET 35 TFE731-2-2B NM DASH 6/PT6A-27 SIKORSKY S-76 SPIRIT	19 24 78 58 30
Military (Total)				209
Grand Totals				27,263

Table 5-3
DAYTIME RUNWAY UTILIZATION (7 a.m. to 10 p.m.)

Category Type	Percentage Utilization		
	Rwy 19	Rwy 01	Rwy H
Arrivals			
Narrow Body Jet	87%	13%	
Regional Jet	88%	12%	
Business Jet	87%	13%	
Turboprop	86%	14%	
Multi Piston	79%	21%	
Single Piston	83%	17%	
Helicopter			100%
Military	21%	79%	
Departures			
Narrow Body Jet	87%	13%	
Regional Jet	88%	12%	
Business Jet	87%	13%	
Turboprop	86%	14%	
Multi Piston	72%	28%	
Single Piston	87%	13%	
Helicopter			100%
Military	21%	10%	

Table 5-4
NIGHTTIME RUNWAY UTILIZATION (10 p.m. to 7 a.m.)

Category Type	Percentage Utilization		
	Rwy 19	Rwy 01	Rwy H
Arrivals			
Narrow Body Jet	100%	0%	
Regional Jet	71%	19%	
Business Jet	48%	52%	
Turboprop	86%	14%	
Multi Piston	85%	15%	
Single Piston	83%	17%	
Helicopter			0%
Military	0%	0%	
Departures			
Narrow Body Jet	95%	5%	
Regional Jet	100%	0%	
Business Jet	70%	30%	
Turboprop	95%	5%	
Multi Piston	50%	50%	
Single Piston	0%	100%	
Helicopter			0%
Military	0%	0%	

Flight Path Utilization. The Airport Board has established paths for aircraft arriving and departing Jackson Hole Airport. These paths are not precisely defined ground tracks but represent a broad area over which the aircraft will generally fly. The modeling analysis includes a total of eight departure flight tracks and six arrival flight tracks to model the aircraft flight paths at Jackson Hole Airport. Aircraft flight tracks were obtained by observations during the measurement survey, discussions with airport staff and air traffic control personnel, and a review of aeronautical charts.

A sample of the 2019 flight tracks use in AEDT modeling are presented in Figure 5-1 and 5-2. Figure 5-1 presents departure and arrival flight paths for Runway 19. Figure 5-2 presents departure and arrival flight paths for Runway 01.

The flight track data was used to help define the location of the aircraft flight paths and in the correlation of the noise measurement data with the aircraft operational data.

Figure 5-1
Flight Tracks for South Flow
Jackson Hole Airport 2019 Annual Report
1,000 Arrival and Departure Tracks for Runway 19
Legends: — Arrivals — Departures

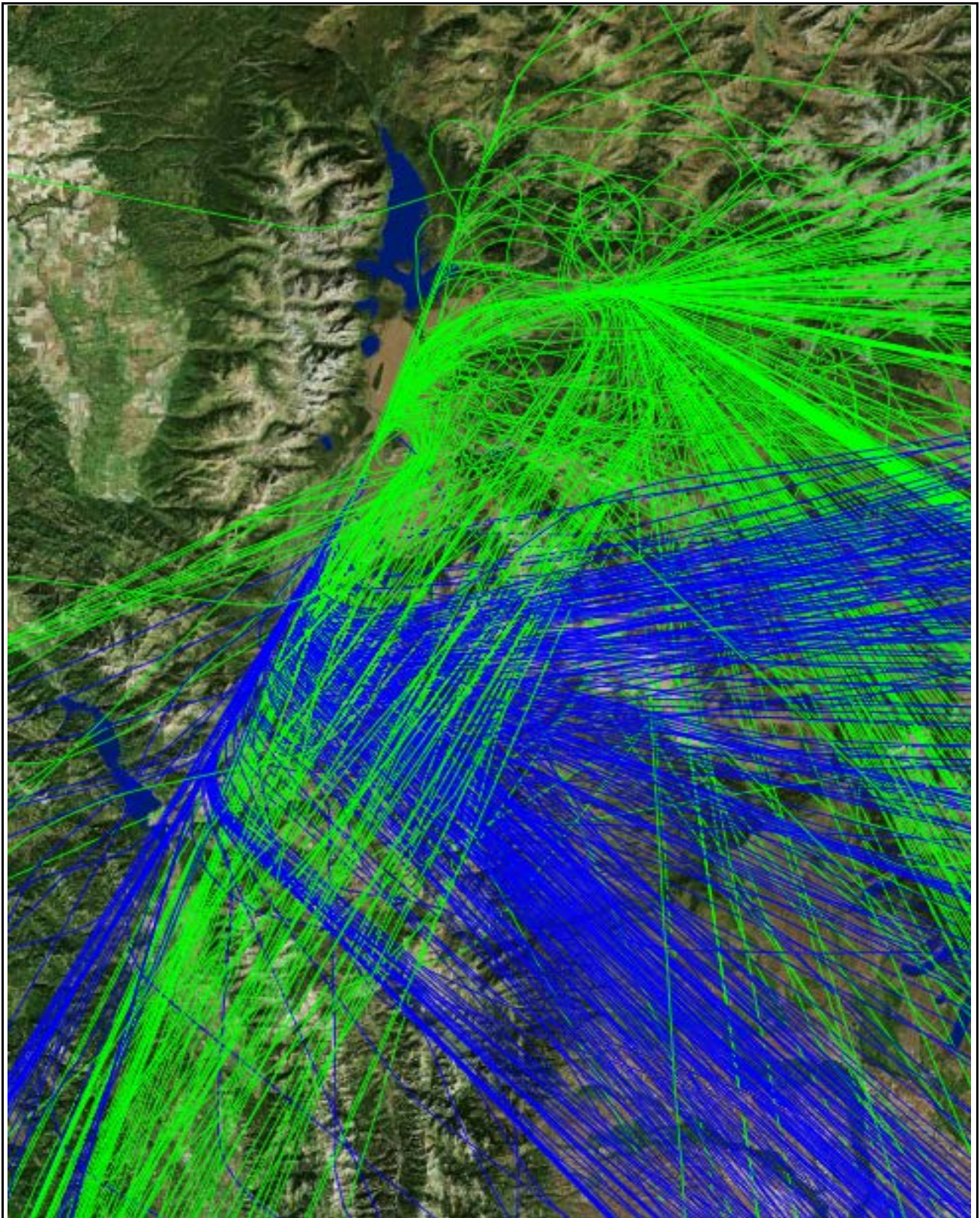
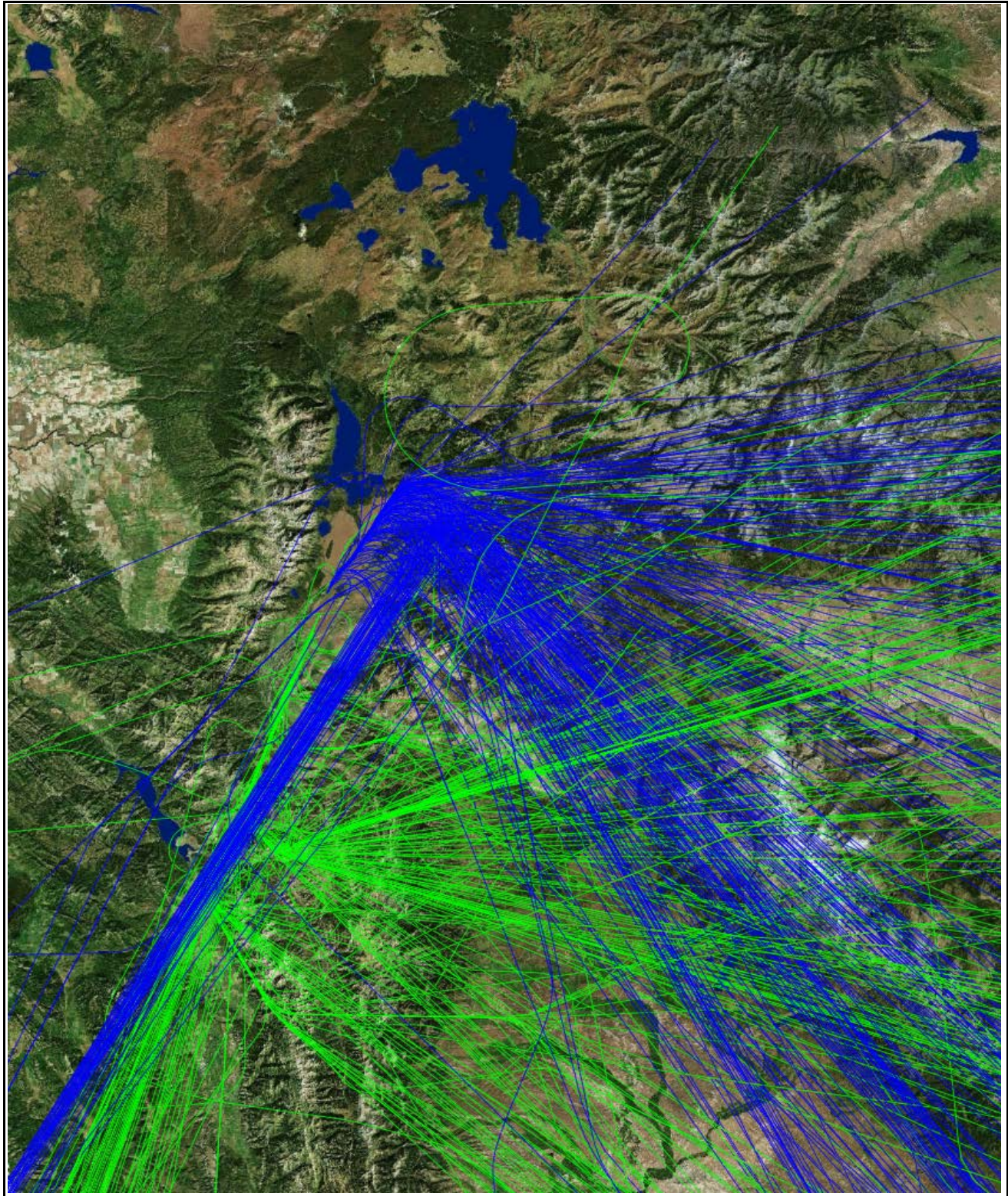


Figure 5-2
Flight Tracks for North Flow
Jackson Hole Airport 2019 Annual Report
Arrival and Departure Tracks for Runway 01

Legends: — Arrivals — Departures



5.4 AEDT Modeling Results

Noise metric used. The noise metric used to assess the 2019 annual noise contour is the Day Night Noise Level (DNL). The DNL index is a 24-hour, time-weighted energy average noise level based on the A-weighted decibel. It is a measure of the overall noise experienced during an entire year of flight operations. The time-weighted refers to the fact that noise that occurs during certain sensitive time periods is penalized for occurring at these times. In the DNL scale, noise occurring between the hours of 10 p.m. to 7 a.m. is penalized by 10 dB. This penalty was selected to attempt to account for the higher sensitivity to noise in the nighttime and the expected decrease in background noise levels that typically occurs in the nighttime. The AEDT contours are presented in Figure 5-3.

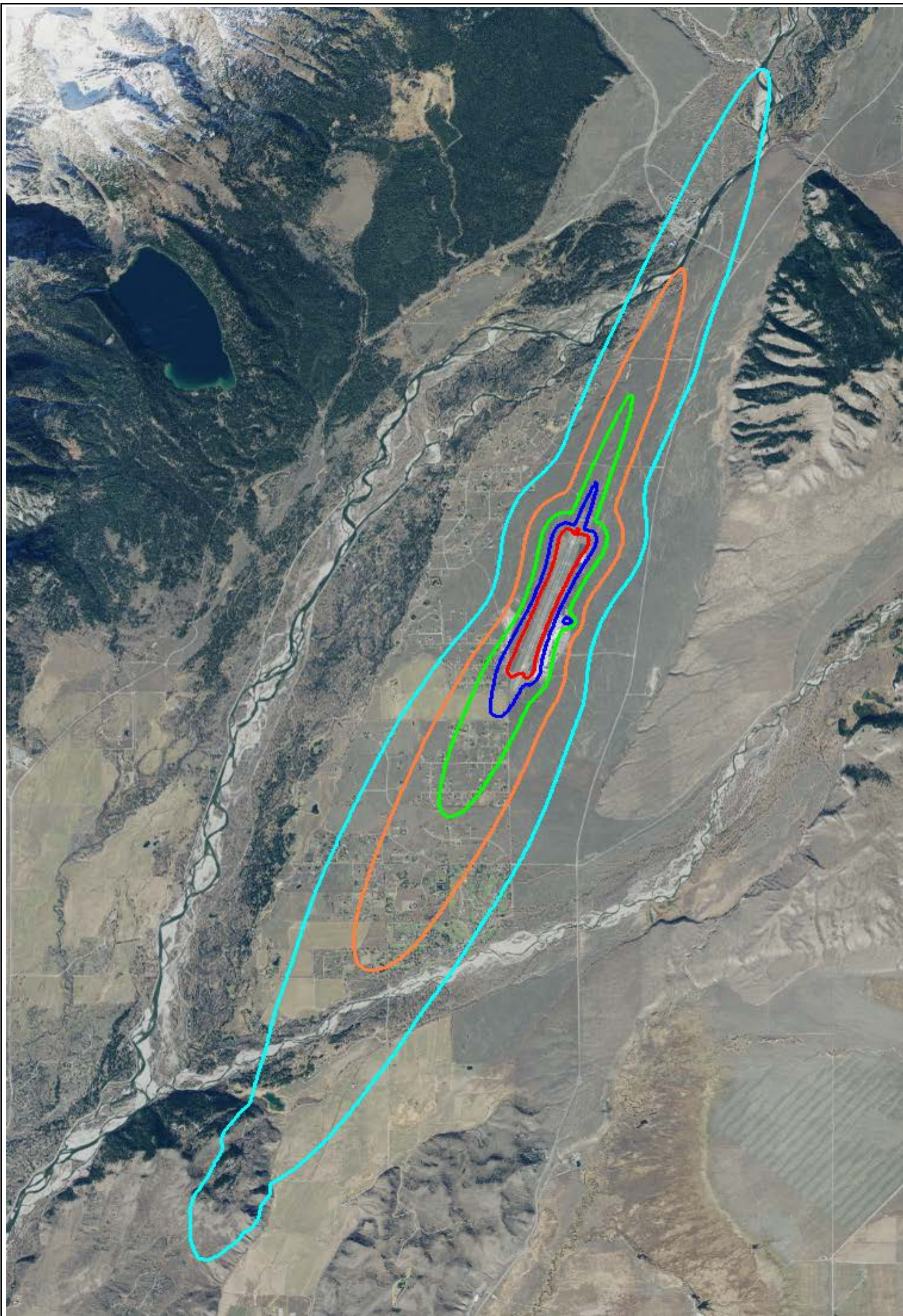


FIGURE: 5.3

2019
ANNUAL DNL
NOISE CONTOURS



LEGEND

45 dBA 50 dBA 55 dBA 60 dBA 65 dBA

6.0 Summary

6.0 Summary

The principal reason for the reduction in noise that has occurred at the airport since 1984 is the increased utilization of new generation Stage III, IV and now V aircraft that are substantially quieter than the aircraft that predominantly served the airport in the past. The results of the noise measurements show that the airport is in compliance with the requirements of the Airport Use Agreement. The measured noise levels are below the limits contained within the agreement. The requirements are that the annual DNL noise levels from aircraft noise at the Moose measurement location cannot exceed 55 DNL and at the Barker site cannot exceed 45 DNL. Aircraft noise levels within the park are calculated to be greater than 5 dBA below the levels specified within the Airport use agreement with the Department of Interior. The 65 DNL noise contours do not extend beyond the airport boundary. There are no residential land uses exposed to noise levels in excess of 65 DNL. The location of the new permanent Moulton Loop monitoring site is located closer to the airport than the temporary site used in the past. This is reflected in a 0.4 dBA increase reading at Moulton Loop.