Jackson Hole Airport

2021 Annual Noise Report

Jackson Hole Airport Board
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August 2022

Prepared For:

Jackson Hole Airport Board

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1.0 Introduction

The purpose of this report is to present the results from the 2021 noise measurement and modeling survey at Jackson Hole Airport. Noise measurements are conducted year around to determine the annual noise exposure levels from the airport. Periods during the peak winter and peak summer seasons are also presented in order to illustrate the peak activity during each season. This year-end report summarizes the results from the peak winter and peak summer noise periods as well as the annual measurements for 2021. 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.

Historically from 1984 to 2003, noise monitored was conducted using portable noise monitors for seasonal periods at three locations around the airport. Each site was monitored for one to three weeks during both the winter and summer peak season. The three sites that were monitored historically were Moulton Loop south of the airport, Moose, and Barker Ranch in Grand Teton National Park (GTNP). In 2003, Jackson Hole Airport installed six (6) permanent noise monitors to collect noise data continuously year around. Moulton Loop, Moose, and Barker Ranch were converted to permanent monitoring sites as part of this upgrade. These measurement locations at these three sites and the three additional sites are presented in **Table 1-1** and **Figure 1-1.**

In 2014 radar data collection system was installed that allowed the noise system to store flight track information. Prior to that, it was not possible to always identify a noise event to the aircraft that caused the event. It was a manual process based upon the flight logs. The initial annual reports were based upon seasonal noise monitoring. The radar data during this time period did not have radar coverage at lower altitudes near the airport. Often the aircraft was not tracked until it reached 10,000 feet MSL. In 2020 the FAA's ADS-B surveillance became fully operational and the airport installed a local ground station that now provides radar coverage at areas close to the airport.

The historical annual reports provided information on the season measurement results for the period measured. With the installation of the permanent system, the reports still presented seasonal data to continue to show the peak period activities in summer and winter. The reports since the radar data was captured also provided the annual results. Starting in the 2020 report, the report format was refreshed to show both seasonal and annual data, with the focus on the annual results. The report also presents calendar year results, and no split year based upon full seasons (October through September).

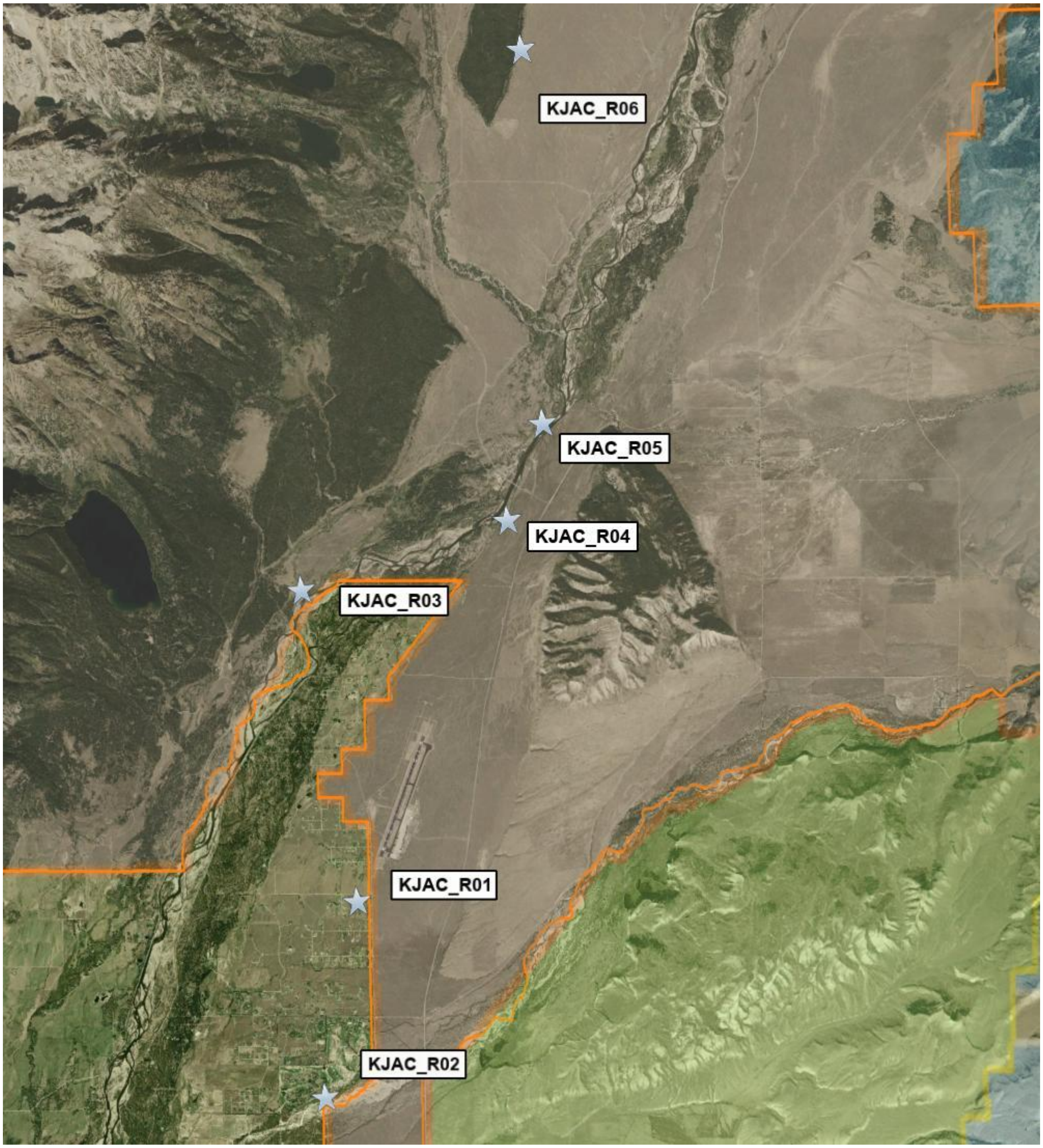
Table 1-1
Noise Measurement Sites

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

Source: BridgeNet International, 2022

One of the purposes 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 Use Agreement. Aircraft noise levels within the Park are measured to be below the levels specified within the Use Agreement with the Department of the Interior. In addition, the FAA has established a guideline of 65 DNL as the goal for compatibility with residential land use. The 65 DNL noise level does not extend into residential land uses.

Figure 1-1
Noise Measurement Location Map



Source: BridgeNet International, 2022

2.0 Background and Information on Noise

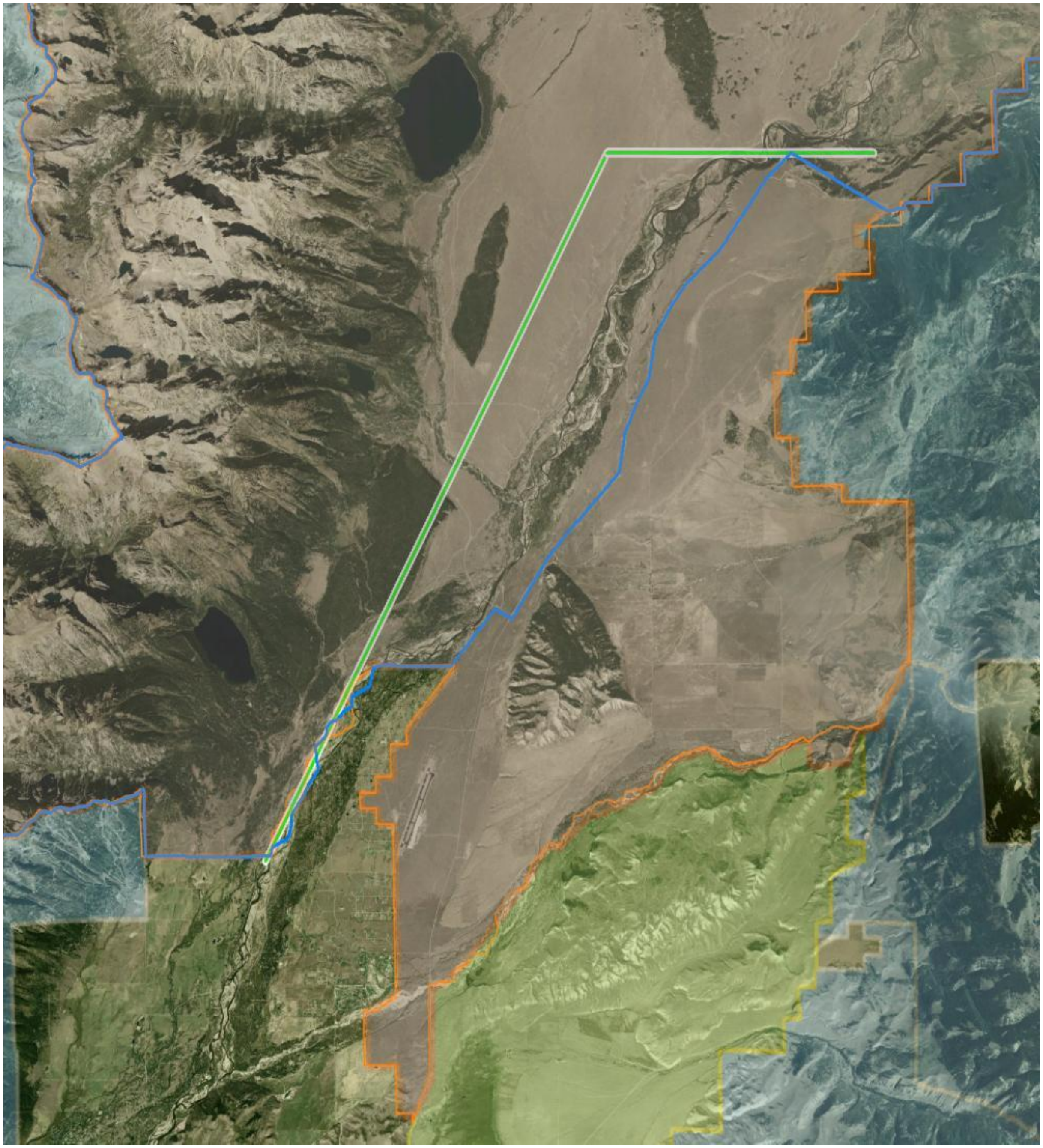
2.1 Background

Jackson Hole Airport is the only commercial service airport in the country that is located entirely within a National Park. Accordingly, it has had a long history of addressing noise and operates under a number of special restrictions. The Airport Board itself has also developed a number of special noise abatement measures to minimize impacts from aircraft noise. These measures and a brief history of their development are presented in this section.

In 1983 the Airport Board and the Department of the Interior entered into a new agreement for the continued operation of the Airport in Grand Teton National Park, subject to noise restrictions. The primary restrictions are that the Airport cannot exceed specific Day-Night Level (DNL) cumulative noise levels at critical locations within the Park boundary. The annual cumulative level from aircraft noise at the Moose measurement location cannot exceed 55 DNL. In addition, there is a Critical Area Boundary within the Park where annual aircraft noise levels cannot exceed 45 DNL. The 45 DNL Critical Area Boundary line is presented in **Figure 2-1**.

In order to meet the cumulative noise limits of the Agreement, the Airport Board developed an Airline Access Plan. This Access Plan places a limit on the number of operations of commercial jet aircraft which are necessary to meet the cumulative standards. Operations of the 737-200/D17 “base class” aircraft were limited to 6.85 Average Daily Departures. Increases in the number of operations may only be accomplished by substituting quieter, new generation of aircraft, which at that time were just entering service.

Figure 2-1
Noise Sensitive and Critical Area Boundary



Source: BridgeNet International, 2022

The Agreement also included a single event noise limit which restricted the operation of any aircraft that generated sound levels above 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, and at particular locations in relation to the Airport).* This essentially eliminated aircraft from operating at the Airport that generated higher noise levels than the Boeing 737-200/D17 aircraft.

The Agreement also 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.*"

Shortly after entering into the 1983 agreement, the Airport Board then initiated a study to investigate methods of mitigating the aircraft noise levels. This resulted in the development of a new comprehensive noise control program for the Airport. The Noise Control Program includes a number of elements in addition to the cumulative and single event limits described above. The major elements of the program are summarized below:

- Limitation on the scheduling of night operations by commercial turbojet air carrier aircraft and a voluntary curfew on General Aviation night operations.
- A preferential runway program that requests that all aircraft depart to the south and arrive from the south when wind conditions permit.
- A request that all aircraft departing to the south make an immediate left turn, weather conditions permitting. This procedure is seldom utilized today because it is no longer an FAA-published procedure.
- A request that aircraft entering the area from the south, but landing from the north, perform a left downwind turn near Blacktail 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.
- A voluntary Fly Quiet Program.

In order to ensure compliance with cumulative noise limits of the Agreement, the Airport Board conducts annual noise measurements. These measurements are conducted for approximately a one-week period during the peak winter and summer seasons. This report presents the results of the 2021 winter noise measurements, and documents compliance with the noise limits contained in the 1983 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 the Maximum Noise Level (Lmax). 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.

Lmax 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. Lmax is the peak or loudest sound reach during an aircraft flyover. There are no noise and land use compatibility standards in terms of Lmax. Disturbances from aircraft noise (i.e., speech and sleep interference) however can be related to Lmax levels. In general, it is the metric that is more easily related to by the public in that it is what is experienced for each flight. But it does not factor in how often these events occur. The DNL also takes into account the loudness of the events and how often they occur.

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. This is the southeastern corner of the area defined as the noise sensitive areas of the park. This area is shown in Figure 2-1. In addition, the Critical Area Boundary Line, also 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 from the airport's permanent monitoring system of aircraft and ambient noise sources, then incorporating these results into the FAA's airport noise computer model (AEDT). The noise measurement surveys determine the DNL noise level, the Lmax levels from each aircraft flyover, the sound exposure level (SEL) and the background or non-aircraft ambient noise environment.

The measurements are annualized by correlating the measured noise events results with the flight radar that caused that event. 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. Note in past years, the measurements were conducted seasonally.

Noise measurements are conducted at six (6) locations around the airport shown in Table 1-1. These locations include Moulton Loop, 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, which 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 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 2021 aircraft operations were derived directly from the airport summary of daily logs, the Airport's noise monitoring system radar data and the FAA's OPSNET data. The breakdown in the category of operations is based upon the FAA's TFMS data. The 2021 annual operations, along with data from 2001 to the most recent period, are presented in **Table 3-1**. The total number of operations during the twelve-month period was 40,628 or 111.3 average daily operations. The total operations showed an increase in all categories of operations. An operation is either 1 departure or 1 arrival. This included 9,301 commercial jet operations, 3,592 regional jet operations and 18,730 corporate jet operations.

The operations have seasonable differences, with more activity during the summer and winter months. This is shown in **Figure 3-1** that presents the monthly activity broken down by Total Operations, Commercial/Regional Operations and Corporate Jet activity; this breakdown is from the airport's noise monitoring system, therefore, the totals will not exactly match FAA data in Table 3-1. August 2021 had the highest number of operations during the 2021 time period.

3.2 Enplaned Passengers

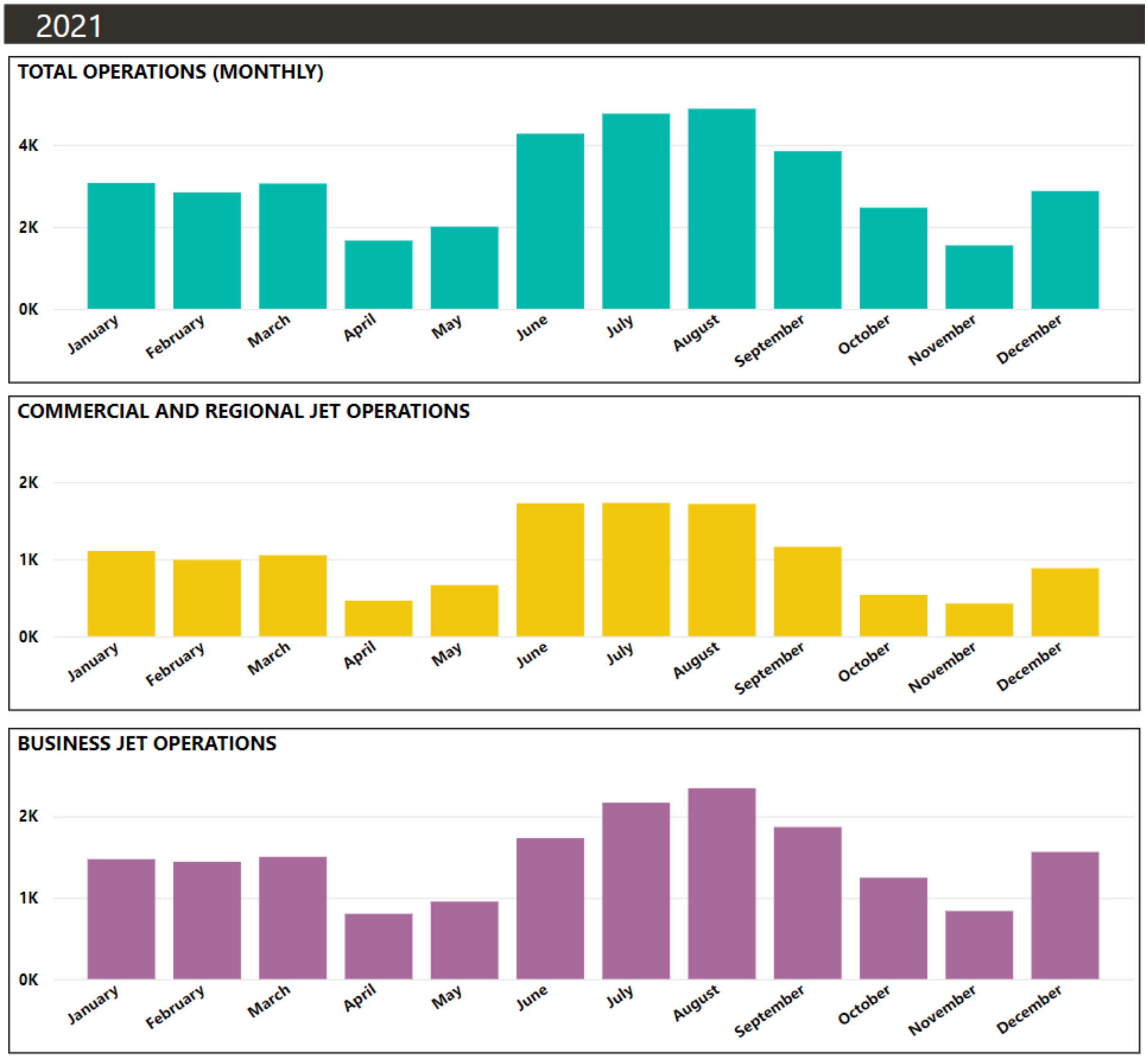
The total number of enplaned passengers was also presented in **Table 3-1**. For the 2021 annual period, there were 508,838 enplaned passengers. This shows an increase as compared to 2020 as a result of the Covid-19 pandemic.

Table 3-1
Annual Operations and Enplaned Passengers

YEAR	AIRCRAFT ANNUAL OPERATIONS					ENPLANED PASSENGERS
	COMMERCIAL JET	REGIONAL JET	CORPORATE JET	OTHER	TOTAL	
2021	9,310	3,592	18,730	8,996	40,628	508,838
2020	5,854	1,934	14,628	6,706	29,122	284,433
2019	7,096	2,480	11,346	6,403	27,325	454,629
2018	6,018	2,670	11,972	6,303	26,963	391,353
2017	5,632	2,322	11,794	9,241	28,989	353,776
2016	5,212	3,008	10,422	11,737	30,379	346,127
2015	4,582	2,798	10,104	10,656	28,140	316,674
2014	4,062	3,100	9,372	9,583	26,117	305,186
2013	3,592	2,530	8,822	8,549	23,493	292,176
2012	3,586	2,698	8,440	11,354	26,078	272,888
2011	3,868	2,840	8,484	10,584	25,776	281,808
2010	4,112	2,722	7,904	10,869	25,607	286,660
2009	3,738	2,736	7,702	14,826	29,002	281,674
2008	4,110	2,648	9,252	14,209	30,219	304,393
2007	3,514	2,358	10,862	13,871	30,605	275,569
2006	3,676	2,506	10,204	15,848	32,234	271,416
2005	3,774	592	10,510	18,196	33,072	241,925
2004	3,106	50	9,744	18,893	31,793	208,000
2003	3,646	334	8,844	20,769	33,593	212,731
2002	2,304	12	8,240	25,422	35,978	179,510
2001	1,666	584	7,374	30,974	40,598	169,249

Source: FAA Opsnet and TFMS data, 2021

Figure 3-1
Month-to-Month Operations for 2021



Source: Airport Operations and Noise Monitoring System Data, 2021

3.3 Noise 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 (Lmax), cumulative daily noise levels (DNL), and the ambient levels. Since all the noise is collected during the measurements, it is possible to post 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 aircraft 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 Aircraft Operational and Radar Track Data

Initially the airport did not have the ability to obtain radar track information. 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 to obtain this data. The upgrade consisted of numerous components, including access to the BI-6 radar data, weather data, and the addition 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 approximates the Volpe Center's standards for measuring aircraft noise in a park setting using other metrics. 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.

The BI-6 radar was the primary source for aircraft operational information, however, initially the data was just radar tracks without aircraft identification. In 2014, a national radar feed became available that that the airport subscribes to which provided both radar track and flight information data. The airport maintains a live feed of all the IFR aircraft activity in the United States directly from FAA center data. This provides data on all domestic civilian IFR aircraft, and the data stream includes aircraft type, position and altitude by time. VFR aircraft are often tracked, but typically doesn't contain ID information. The radar coverage in the valley does not reach the airport surface, so operations near the airport and low altitude flights were not typically tracked by this data source.

In 2020, the FAA's ADS-B NextGen tracking system became operational nationwide which greatly increased the coverage and accuracy of the radar data. The airport also installed a ground station at the airport that allowed for better coverage of operations at low altitude around the airport. The ADS-B radar data includes flight information for every ADS-B equipped flight, as well as position information with 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 aircraft type, airline code, departing and arriving airport codes, aircraft unique tail number and flight ID number. The position information includes the X and Y coordinates as well as the altitude of the aircraft at each point at greater accuracy then with conventional radar information. The location information given provides the information necessary to determine the direction of flow for runway usage.

The ADS-B surveillance requires an aircraft to be equipped with an ADS-B transponder and it is turned on. All commercial and large general aviation aircraft have this equipment, and it is turn on during flight. Smaller visual flight aircraft are not required to have this equipment to operate in non-busy airspaces, but most aircraft do. There will be some visual flight rules aircraft that are not tracked by ADS-B.

Correlation of Noise and Flight Data

The noise monitoring software was used to help correlate aircraft flight activity to the noise data. This software utilizes such methods as aircraft position information (the position of the aircraft at the time of the noise events to correlate the aircraft to the noise event), 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 computer process 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. This includes the ambient background dBA noise levels, the Lmax single event noise levels, the DNL cumulative noise levels.

4.0 Annual 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 the 2021 annual noise measurement results. This includes an explanation of the results and is divided into the following sub-sections:

<u>Noise Measurement Results</u>

Continuous noise measurement data
Ambient noise measurement results by hour
Single event noise measurement results (Lmax)
DNL daily noise measurement results

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.

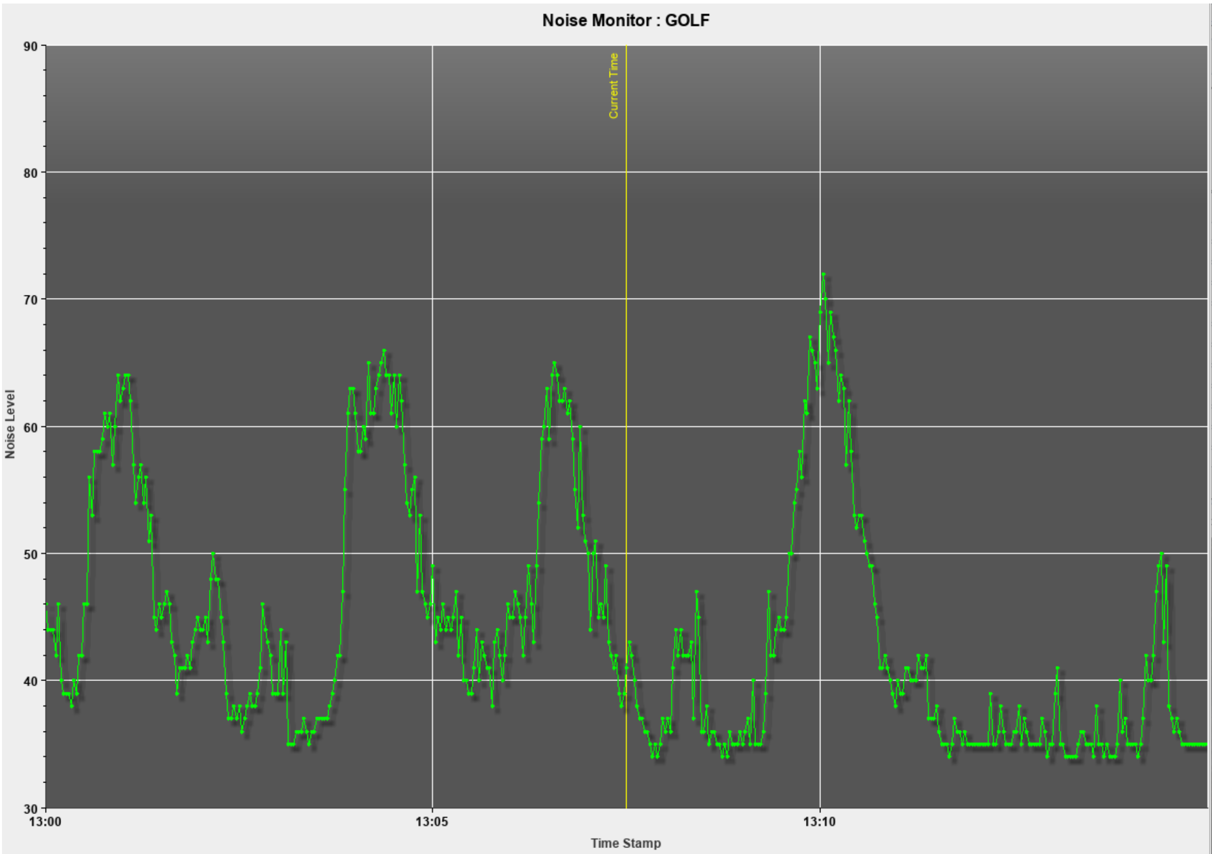
The data collected by the permanent monitors includes the continuous measurement of 1-second average or equivalent (LEQ) noise levels. This type of measurement system allows for the measurement and identification of Lmax noise events at a lower threshold than the equipment previously used at this site. 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 single event noise levels from each individual flyover, hourly data and the daily DNL noise levels for the measurement period.

The report presents data for the annual levels, and during peak periods in the summer and winter seasons. Presenting seasonal data along with the annual data is keeping with the original reporting periods and focuses on the times when operations are at their highest levels.

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 **Figure 4-1** which displays a 15-minute segment of continuous noise data that was measured at Site 2, Golf. 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. For this example, the peak noise levels from the aircraft flyovers were in the mid 60s and low 70s dBA. The ambient levels between aircraft events were in the mid 30s dBA.

Figure 4-1
Sample Time History Noise Plot of Aircraft and Ambient Noise



Source: BridgeNet International, 2022

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 L99, L90, L50, L10 and L1. The L1 is presented for the near loudest 1-second dBA value that was measured while the L99 is the near 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.

Table 4-1
Annual Ambient Noise Measurement Results

Site	Name	Statistical Noise Levels (dBA)				
		L1	L10	L50	L90	L99
1	Moulton Loop	67	53	41	30	26
2	Golf Course	62	50	41	36	35
3	Barker Ranch	52	43	39	36	35
4	Moose	61	44	38	34	32
5	4 Lazy F Ranch	59	43	37	34	33
6	Timber Island	52	41	28	21	20

Source: BridgeNet International, 2022

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 24 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 mid 30s 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. However, a number of the sites are near the Snake River or Gros Ventre River that does influence the background and ambient noise levels.

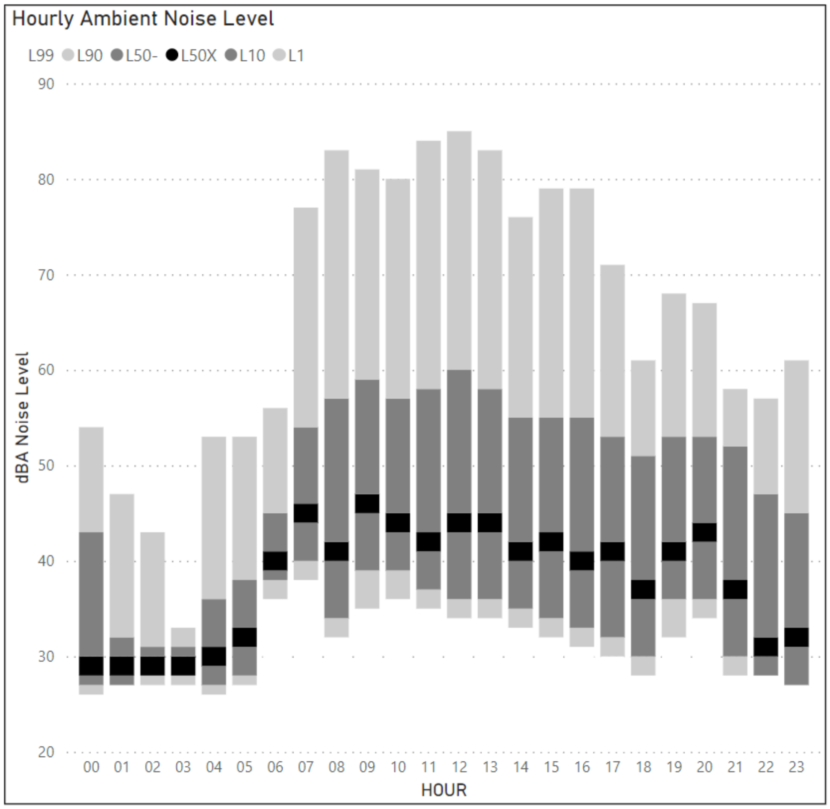
Ambient noise levels vary by day and time of day as summarized in the data from the Moulton Loop site which is presented in **Figure 4-2**. The Figure shows each hour of ambient measurement data for one typical day (August 1, 2021) at that site. Day-to-day ambient noise levels are generally similar with higher levels occurring during high wind conditions. Ambient noise levels vary by time of day with quieter levels typically occurring during nighttime and early morning hours, and with higher levels occurring during daytime hours. Typical quiet ambient noise hours range from 5 to 10 dBA lower than average hours.

Figure 4-2

Site Specific Ambient Noise Measurement Results

Site: Moulton - August 1, 2021

HOUR	Lmax	L1	L10	L50	L90	L99	Lmin
00	61	55	43	29	27	26	25
01	59	48	32	29	27	27	26
02	65	44	31	29	28	27	27
03	94	34	31	29	28	27	26
04	94	54	36	30	27	26	25
05	62	54	38	32	28	27	26
06	64	57	45	40	38	36	35
07	97	78	54	45	40	38	37
08	96	84	57	41	34	32	31
09	98	82	59	46	39	35	34
10	97	81	57	44	39	36	35
11	96	85	58	42	37	35	34
12	97	86	60	44	36	34	33
13	96	84	58	44	36	34	33
14	95	77	55	41	35	33	32
15	93	80	55	42	34	32	31
16	94	80	55	40	33	31	30
17	86	72	53	41	32	30	28
18	93	62	51	37	30	28	27
19	92	69	53	41	36	32	31
20	92	68	53	43	36	34	32
21	64	59	52	37	30	28	28
22	66	58	47	31	28	28	27
23	71	62	45	32	27	27	26
Total	**84**	**67**	**49**	**38**	**33**	**31**	**30**



Source: BridgeNet International, 2022

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) as well as other noise metrics used in noise model validation. 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 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 4-3**. This figure presents the average Lmax noise level by category of jet and a histogram of Lmax values for all the aircraft events that were measured at the Moose site and at the 4Lazy F Ranch site. These are all jet arrivals to the south on Runway 19. The histogram shows the measured Lmax noise level on the horizontal axis and the number of measured aircraft events with that Lmax level on the vertical axis. The Moose site is representative of a location closest to the airport to the north 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 and the deference in noise by category of jet aircraft.

Figure 4-4 presents the same results for two sites to the south, the Moulton and Golf Site which are primarily exposed to departure noise on Runway 19. This data also shows the ranges in single event noise levels by total and by category of jet aircraft.

The single event data were also analyzed in terms of noise level per aircraft type. Examples of the single event noise level by aircraft type are presented in **Figure 4-5**. This figure displays the average single event noise level by aircraft type for departures measured at Moulton Loop and the average Lmax by aircraft type for arrivals measured at Moose. These figures show the type of aircraft commercial and regional jet 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 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.

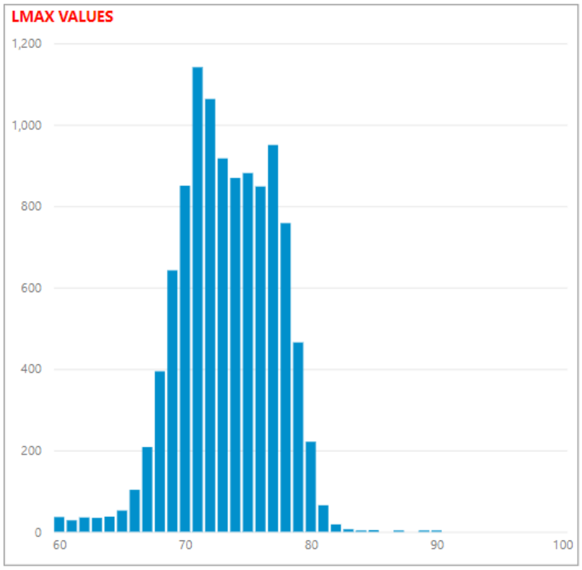
Figure 4-3
Noise Event Summary and Histogram Report
Moose and 4LAZYF Sites - Arrivals on Runway 19

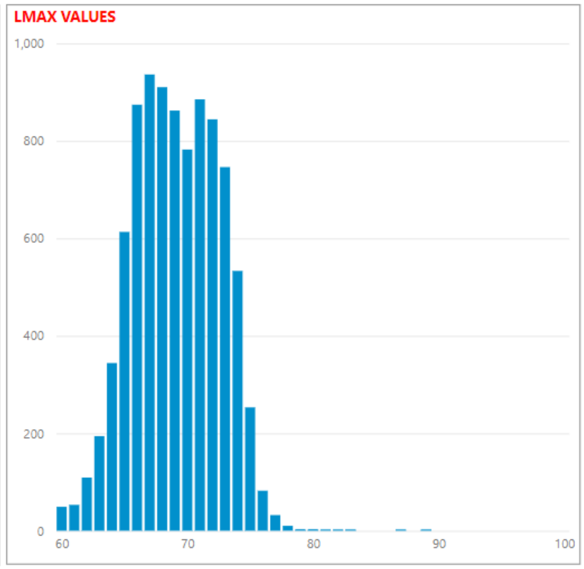
MOOSE 2021

Jet Category	Total Events	Lmax (Avg)
Commercial	2,954	76.9
Regional	1,212	75.7
Business	6,632	71.6
Total	10,798	73.5

4LAZYF 2021

Jet Category	Total Events	Lmax (Avg)
Commercial	2,663	71.7
Regional	1,131	70.9
Business	5,751	67.1
Total	9,545	68.9



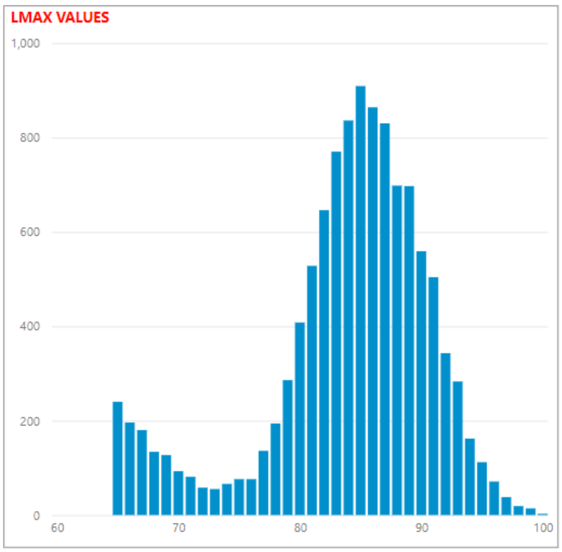


Source: BridgeNet International, 2022

Figure 4-4
Noise Event Summary and Histogram Report
Moulton and Golf Sites – Departures on Runway 19

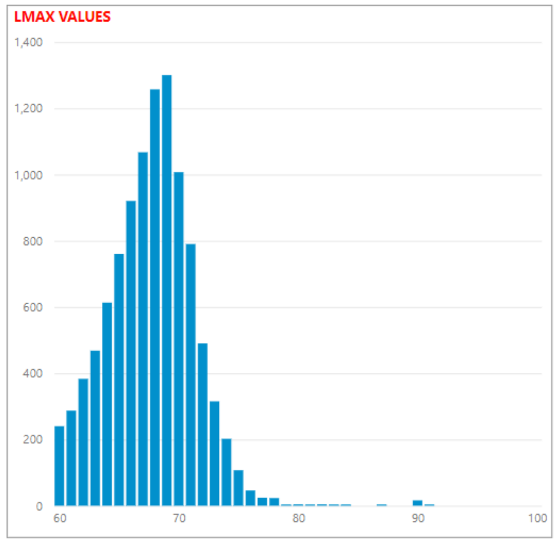
MOULTON 2021

Jet Category	Total Events	Lmax (Avg)
Commercial	3,489	86.1
Regional	1,302	85.1
Business	6,508	83.3
Total	11,299	84.4



GOLF 2021

Jet Category	Total Events	Lmax (Avg)
Commercial	3,119	69.9
Regional	1,307	69.7
Business	5,907	66.8
Total	10,333	68.1



Source: BridgeNet International, 2022

Figure 4-5
Range of Noise by Aircraft Type (Commercial and Regional Jet)

MOULTON 2021

Aircraft	Jet Category	Total Events	Lmax (Avg)
A319	Commercial	2,863	83.8
E75L	Regional	1,257	84.1
A320	Commercial	661	85.0
B737	Commercial	308	88.7
CRJ7	Regional	196	84.3
B752	Commercial	187	87.7
A20N	Commercial	1	78.8
Total		5,473	84.4

MOOSE 2021

Aircraft	Jet Category	Total Events	Lmax (Avg)
A319	Commercial	1,977	76.5
E75L	Regional	1,028	76.0
A320	Commercial	524	77.2
B737	Commercial	294	78.4
CRJ7	Regional	184	73.8
B752	Commercial	159	77.8
Total		4,166	76.6

Source: BridgeNet International, 2022

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 annual noise levels for 2021.

Table 4-2
Aircraft DNL Noise Measurement Results

Site #	Name	Description	Aircraft DNL
1	Moulton Loop	Zenith Drive and Spring Gulch Rd.	64
2	Golf Course	Jackson Hole Golf & Tennis Club	53
3	Barkers Ranch	Circle H Ranch (Barker’s Residence)	31
4	Moose	Moose Entrance	53
5	4 Lazy F Ranch	4 Lazy F Ranch	49
6	Timbered Island	East of Timber Island	33

Source: BridgeNet International, 2022

5.0 Annual Noise Contours

5.1 Introduction

Contour modeling is a key element of the report; generating accurate noise contours is largely dependent on the use of a reliable, validated, and updated noise model. 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.

Airport noise contours were generated in this study using the FAA's AEDT v3d. The latest version, Version 3d, was released for use on March 29, 2021, 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 3d 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 2021 annual operations. The data was derived from various sources, which include aircraft tower counts and noise monitoring system operational 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 2021 period there were a total of 40,628 annual operations, or an average of 111.3 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 BI-6 Radar
- FAA Operations Network (OPSNET)
- FAA Traffic Flow Management System (TFMS)

The 2021 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 and 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 40,628 operations at the airport.

Table 5-1
SUMMARY OF OPERATIONS, 2021

Category Type	Annual Operations	Daily Operations	Percent Nighttime
Commercial Jet	9,310	25.5	0.6%
Regional Jet	3,592	9.8	0.2%
Small Commuter	0	0	0.0%
General Aviation			
Business Jet	18,730	51.3	1.2%
Turbo/Piston Propeller	7,740	21.2	3.2%
Helicopter	1,158	3.1	0.1%
Military	98	0.3	0.0%
Total Operations	**40,628**	**111.3**	**1.1%**

Source: BridgeNet International, 2022

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.

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 01.

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 2021 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 jets in south flow on Runway 19. **Figure 5-2** presents departure and arrival flight paths for jets in north flow on 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
Jet Arrival and Departure Flight Tracks
South Flow Runway 19

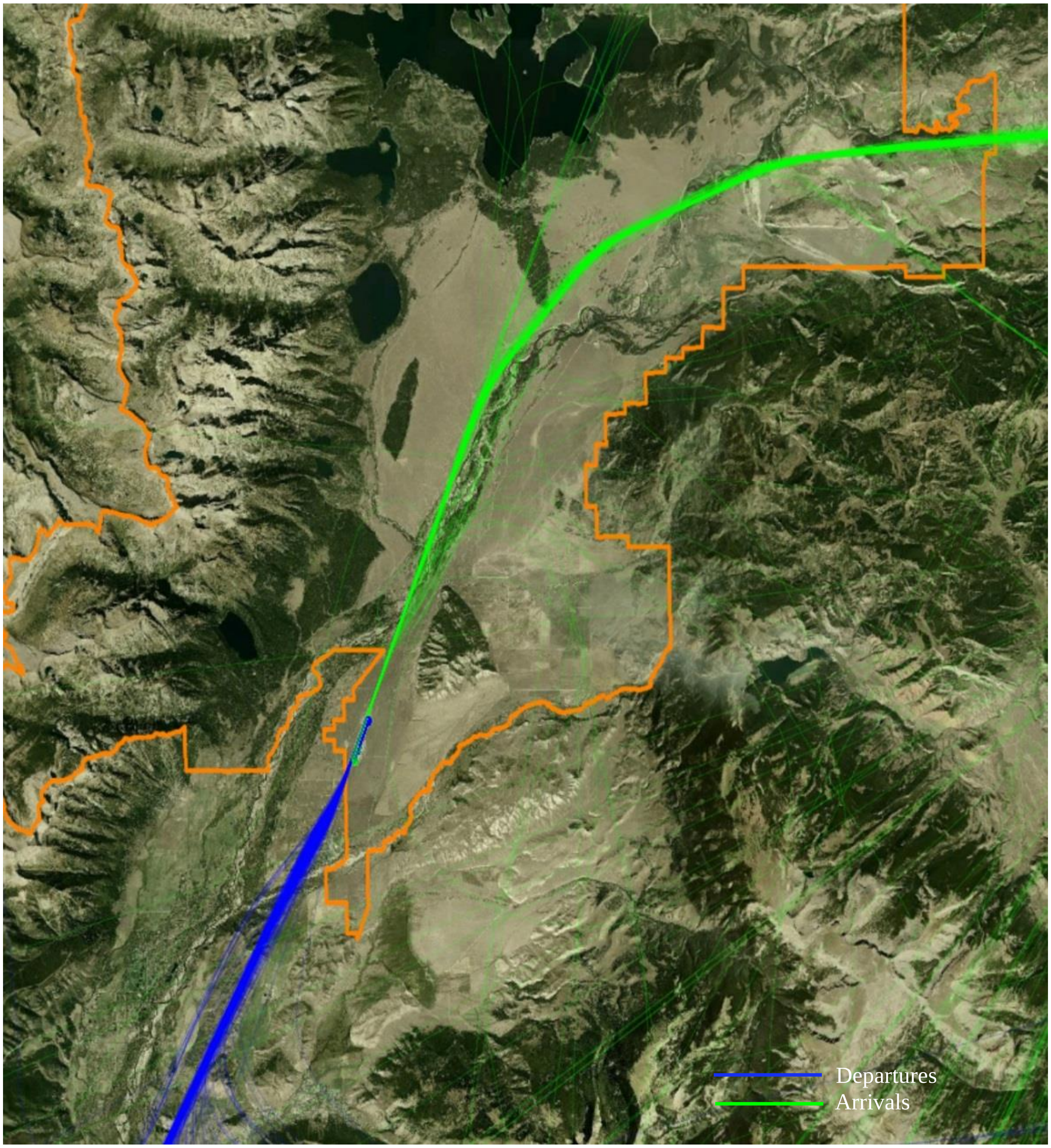
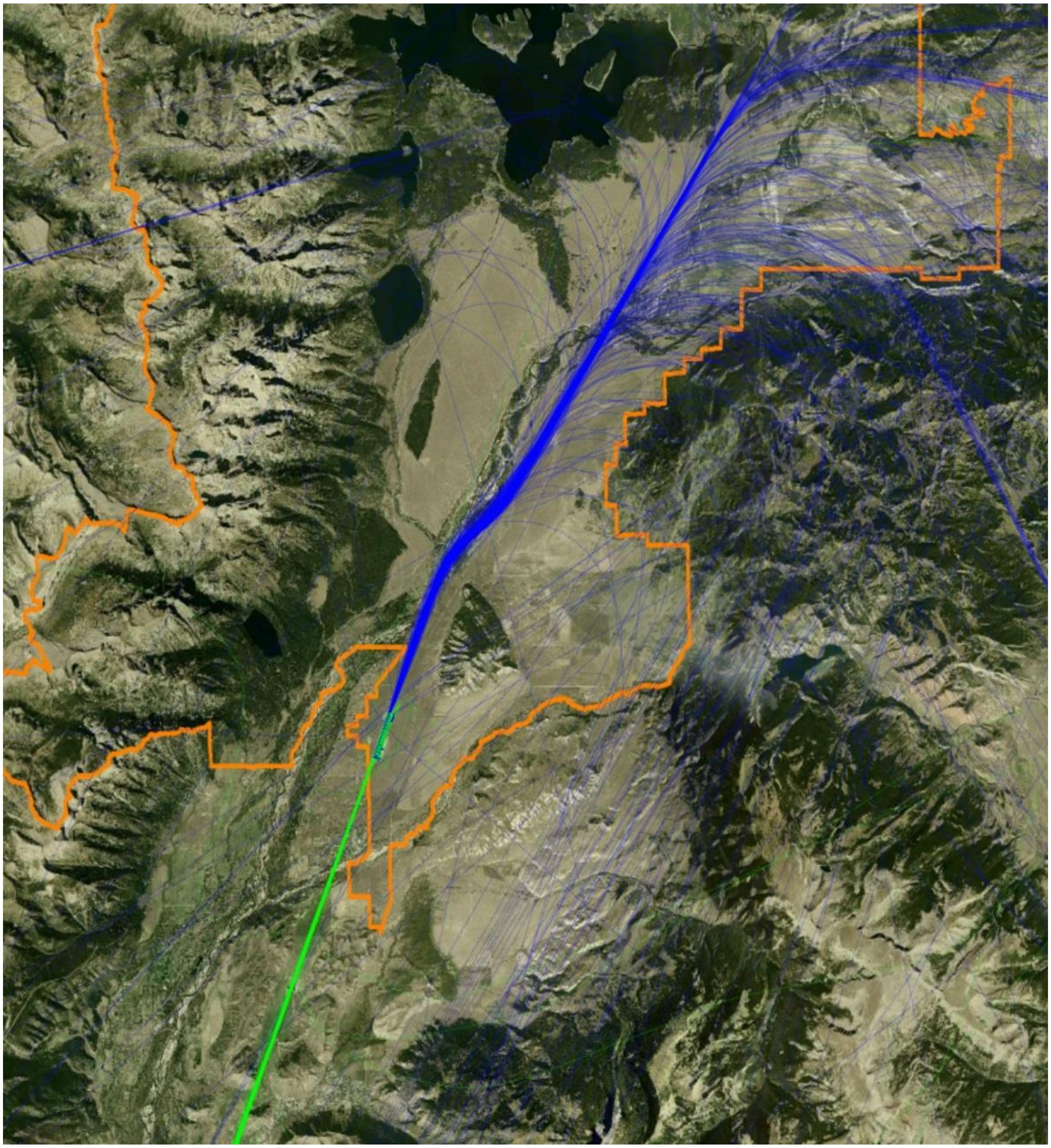


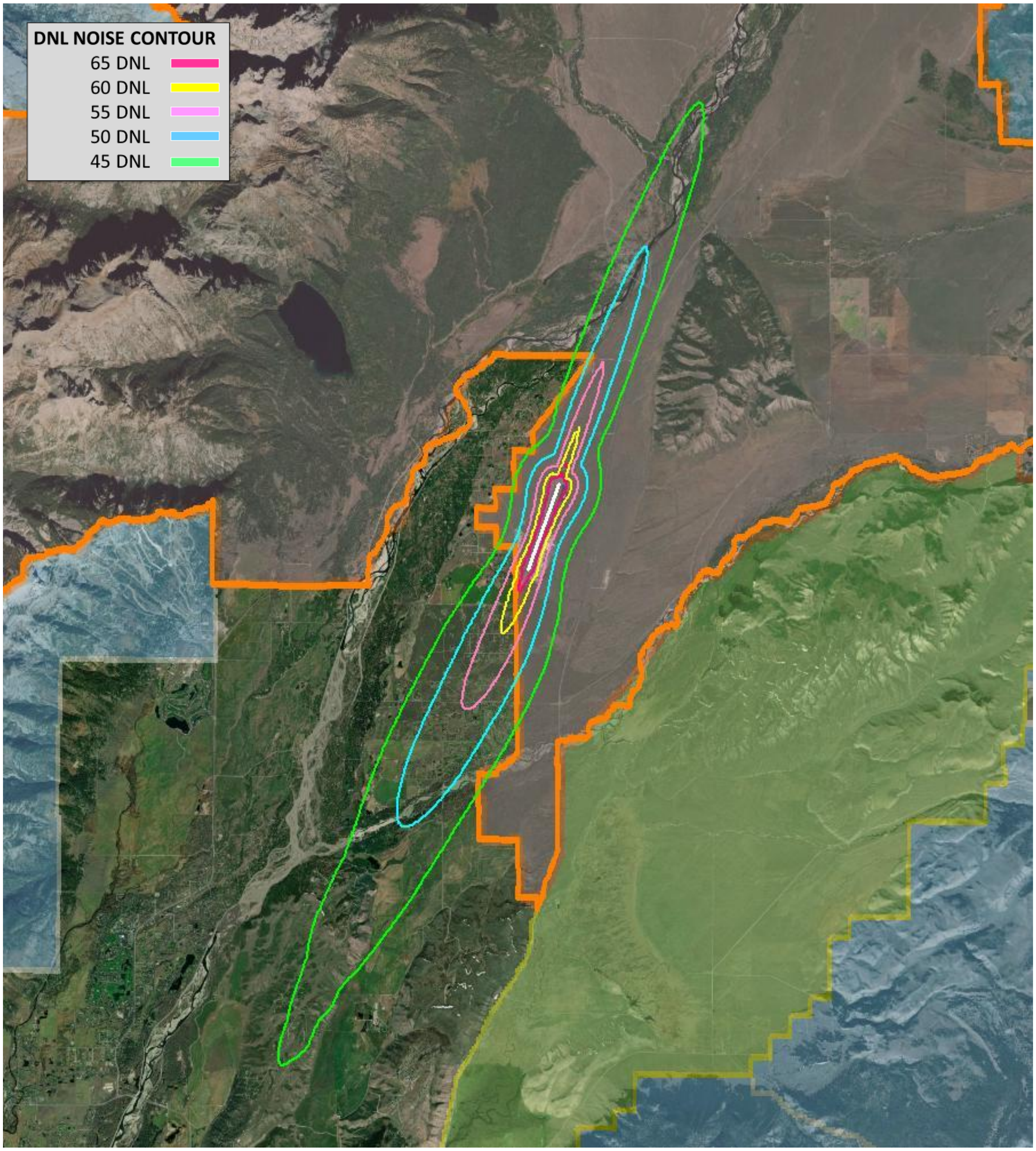
Figure 5-2
Jet Arrival and Departure Flight Tracks
North Flow Runway 01



5.3 Noise Modeling Results

The noise metric used to assess the 2021 annual noise contour is the Day Night Noise Level (DNL). This model run uses FAA standard modeling assumptions that would be required within a Part 150 or FAA sponsored environmental study. 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 2021 AEDT contours are presented in **Figure 5-3**.

Figure 5-3
2021 Annual DNL Noise Contour



6.0 **Summary**

6.1 Overall 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 3, 4 and now 5 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 level contour from aircraft noise at the Moose measurement location cannot exceed 55 DNL and at the Barker site cannot exceed 45 DNL. 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.