Portable Noise Measurement Report

Susquehanna Avenue   Middle River, MD 21220

Maryland Department of Transportation
Maryland Aviation Administration

August 2022

MARYLAND DEPARTMENT OF TRANSPORTATION
MARYLAND AVIATION ADMINISTRATION

BW320 Summary

? WHEN
WAS NOISE MEASURED

Tuesday, August 6, 2022 to Tuesday, August 21, 2022

16 DAYS

AUGUST 2022

S	M	T	W	T	F	S
31	1	2	3	4	5	6
7	8	9	10	11	12	13
			measurements			
14	15	16	17	18	19	20
			measurements			
21	22	23	24	25	26	27

HOW MANY
AIRCRAFT NOISE EVENTS OCCURRED AND WHAT WERE THEY

97 EVENTS / 24 HRS. ON AVERAGE

163 EVENTS / 24 HRS. AT THE MOST

42 EVENTS / 24 HRS. AT LEAST

TOP 3 MOST FREQUENT AIRCRAFT DURING THE MEASUREMENT PERIOD

Rank	Aircraft Type		Operation Type and Runway
1	Cessna 172		Circut, 15
2	Airbus AS350 Helicopter		Arrival, H
3	Cessna 172 Cutlass		Circut, 15

CONCLUSION

During the 16-day measurement period, the Day Night Average Noise Level (DNL) from aircraft noise events was 60 decibels (dB), while the DNL from community noise was 61 dB.

FAA's threshold for land use compatibility is an aircraft-only DNL of 65 dB based on annual average daily aircraft operations.

Aircraft DNL	Community DNL	Total DNL	FAA Threshold
60 dB	61 dB	63 dB	65 dB

BWI BALTIMORE/WASHINGTON INTERNATIONAL Thurgood Marshall AIRPORT

MARTIN STATE AIRPORT

Introduction

The purpose of the portable noise monitoring report is to summarize aircraft and community noise levels at a specific location upon request of a homeowner. The program is offered by the Maryland Department of Transportation Maryland Aviation Administration (MDOT MAA), with technical support and report preparation provided by Harris Miller Miller & Hanson Inc. (HMMH) and Airport Design Consultants, Inc. (ADCI).

It should be noted that the noise data provided in this report represents noise and operating levels only during the period of the measurements. Noise levels associated with aircraft overflights can vary with the number of operations, wind and weather patterns, temperatures, pilot procedures and Air Traffic Control instruction, and other variables.

This report presents the measured aircraft and community noise levels from August 6 to August 21, 2022, at Susquehanna Avenue, Middle River, MD 21220. The monitoring location is approximately 1.2 statute miles from the center of Martin State Airport. The figure to the right shows the location of the measurement site (marked as BW320) relative to Martin State Airport.

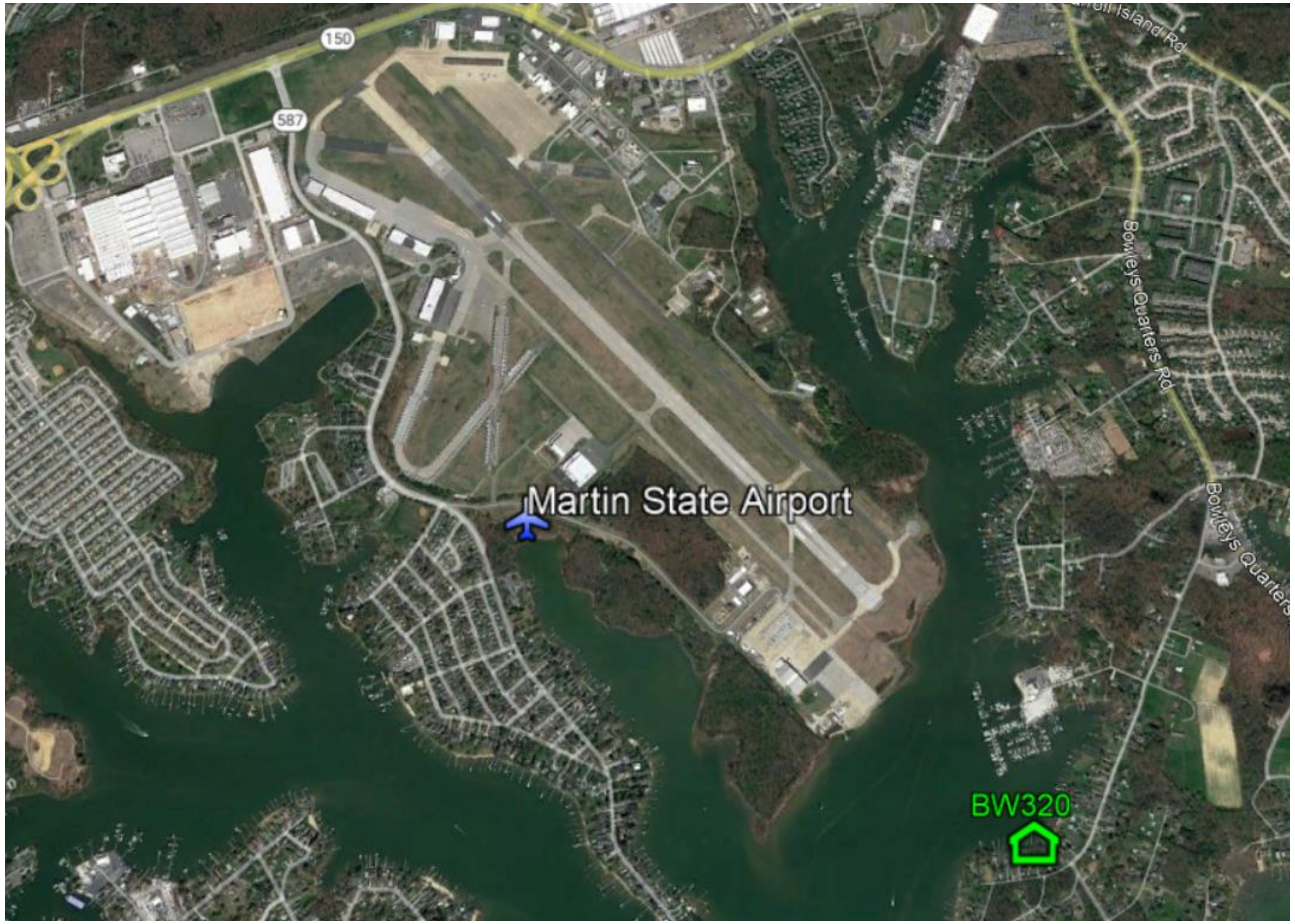

Figure 1. Noise Monitoring Location in Relation to Martin State Airport

Aircraft Operations

Operations at Martin State Airport fluctuate on a daily basis. During the measurement period, there were 1,526 flights in and out of Martin State Airport (582 arrivals, 629 departures, and 315 circuits), in addition to overflights to other airports. A circuit is an operation in which an aircraft departs and arrives at the same airport. Circuits are often used in flight training where pilots practice takeoffs and landings at the same airport and are also referred to as a "touch and go". A single circuit operation may include multiple touch and go flights.

The number of flights per day at Martin State Airport ranged from 67 to 138. Martin State Airport has one runway, designated as Runway 15/33 which is 6,997 feet in length. As aircraft cannot arrive and depart from the same runway, Martin State Airport generally operates in two configurations – southeast flow (arrivals and departures on Runway 15) and northwest flow (arrivals and departures on Runway 33). During southeast flow, aircraft primarily consist of departures from Runway 15. During northwest flow, the primary source of aircraft are circuits from Runway 33. Arrivals to Martin State Airport were generally 100 to 500 feet above ground level at their point of closest approach to the measurement site. Departures from Martin State Airport were generally 400 to 1,100 feet above ground level at their point of closest approach to the measurement site. Circuits at Martin State Airport were generally 200 to 1,000 feet above ground level at their point of closest approach to the measurement site.

In addition to fixed-wing aircraft operations arriving and departing from Runway 15/33, helicopter operations were a source of consistent noise at the measurement site. These operations generally occurred at the helipad on the southern end of the airport, designated as "H" on the airport maps. Helicopter arrivals were generally 100 to 500 feet above ground level at the point of closest approach to the measurement site. Helicopter departures were generally 200 to 400 feet above ground level at the point of closest approach to the measurement site. Ground noise originating from the helipad was also present during the measurement period.

Northwest Flow Runway Use was 43% during the measurement period

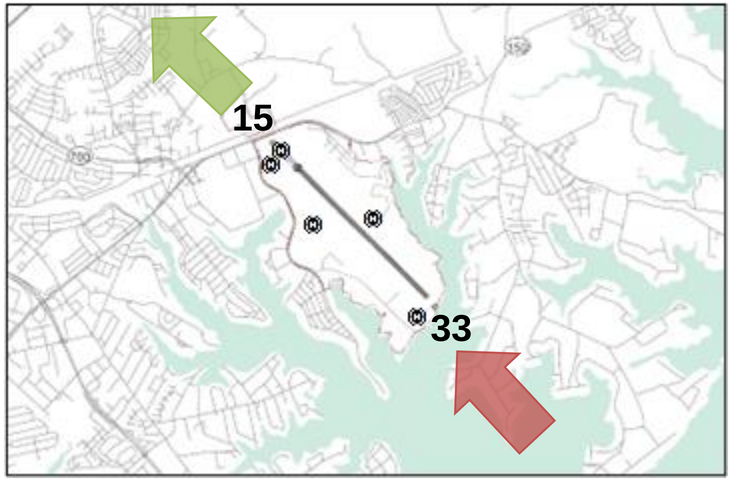

Figure 2. Southeast Flow Runway Use During Measurement Period

Southeast Flow Runway Use was 57% during the measurement period

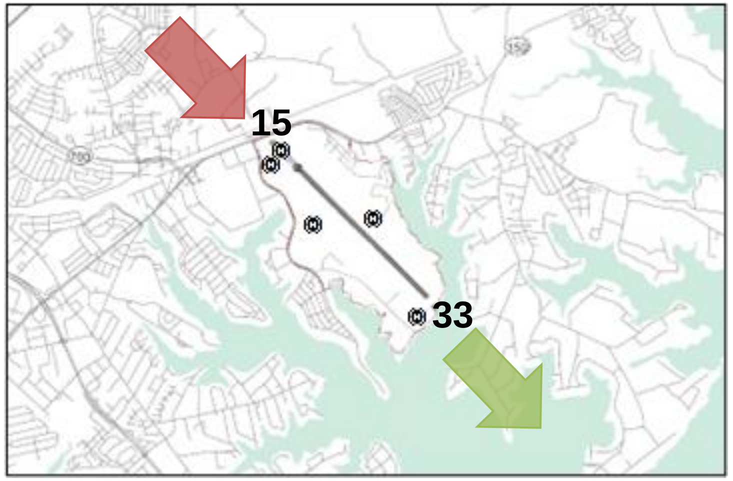

Figure 3. Southwest Flow Runway Use During Measurement Period

Methodology & Location

Aircraft noise levels were measured from August 6 to August 21, 2022, at Susquehanna Avenue, Middle River, MD 21220. The noise monitor is a Type I sound level meter and was regularly calibrated. Additionally, the system was checked every two to four days during the measurements to ensure proper operation. The meter ran continuously during all days of testing. During setup, a baseline threshold was established for the noise monitor. Once the sound level exceeded the baseline threshold for five seconds, a noise event was recorded. The sound level meter recorded the following information about each noise event: date, time, duration and noise levels. The noise monitor was placed in the backyard of the residence. Notable noise sources at this site included aircraft overflights to and from Martin State Airport, helicopter ground noise at Martin State Airport, wind noise, and other typical suburban sounds such as local vehicle traffic.

Once the temporary noise monitoring period was complete, the noise event data was collected from MDOT MAA ’s Noise and Operating Monitoring System (NOMS) to analyze the times of noise events at the site to its database of aircraft radar flight paths. The NOMS conservatively attributes any noise event to an aircraft if the aircraft is within 8,000 feet of the measurement site at an altitude no greater than 10,000 ft. Noise events which occurred while aircraft were passing within the vicinity were associated with an actual aircraft flight and therefore assigned as aircraft noise events. Noise events that did not correlate with an aircraft overflight were assigned as community noise events. Using this methodology, some noise events that are correlated with aircraft overflights may include other community noise, which may or may not exceed the noise level from the aircraft overflight. Figure 4 on the next page displays all arrivals and departures to and from Martin State Airport during the measurement period. Figure 5 displays all arrivals and departures to and from Martin State Airport that were correlated with aircraft noise events. Figures 6 and 7 on the follow page display the circuit flights and noise event correlated circuit flights, respectively.

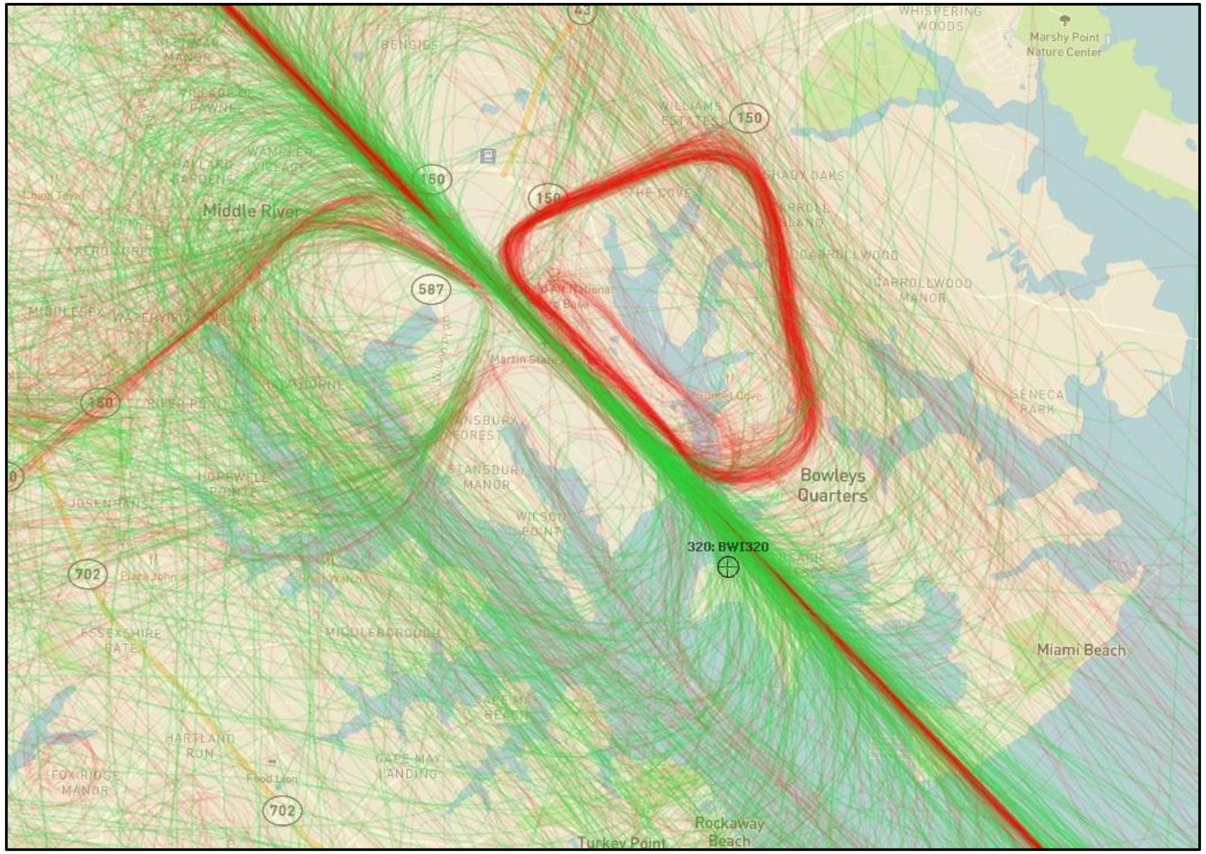

Figure 4. All Martin State Airport Arrivals and Departures During the Measurement Period
(Green = Departures, Red = Arrivals)

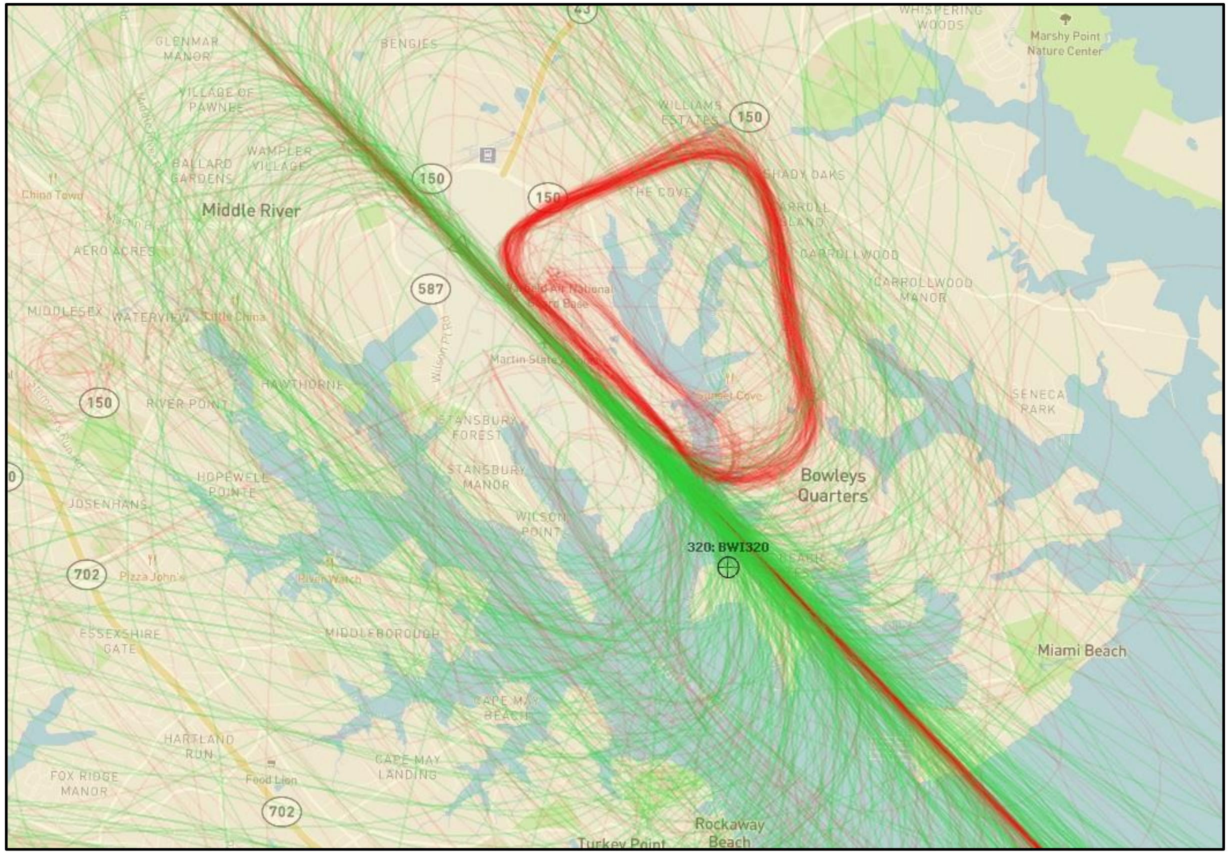

Figure 5. All Martin State Airport Arrivals and Departures Correlated to Aircraft Noise Events During the Measurement Period
(Green = Departures, Red = Arrivals)

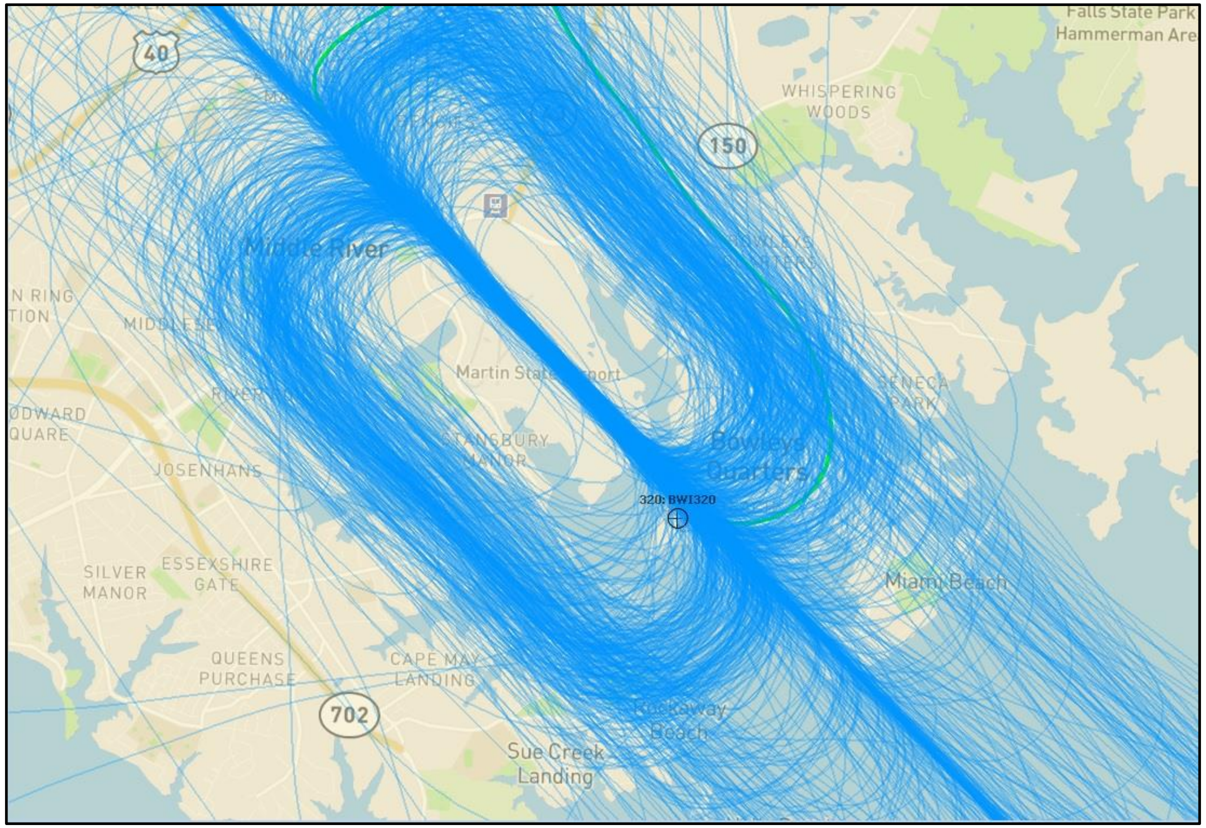

Figure 6. All Martin State Airport Circuits During the Measurement Period

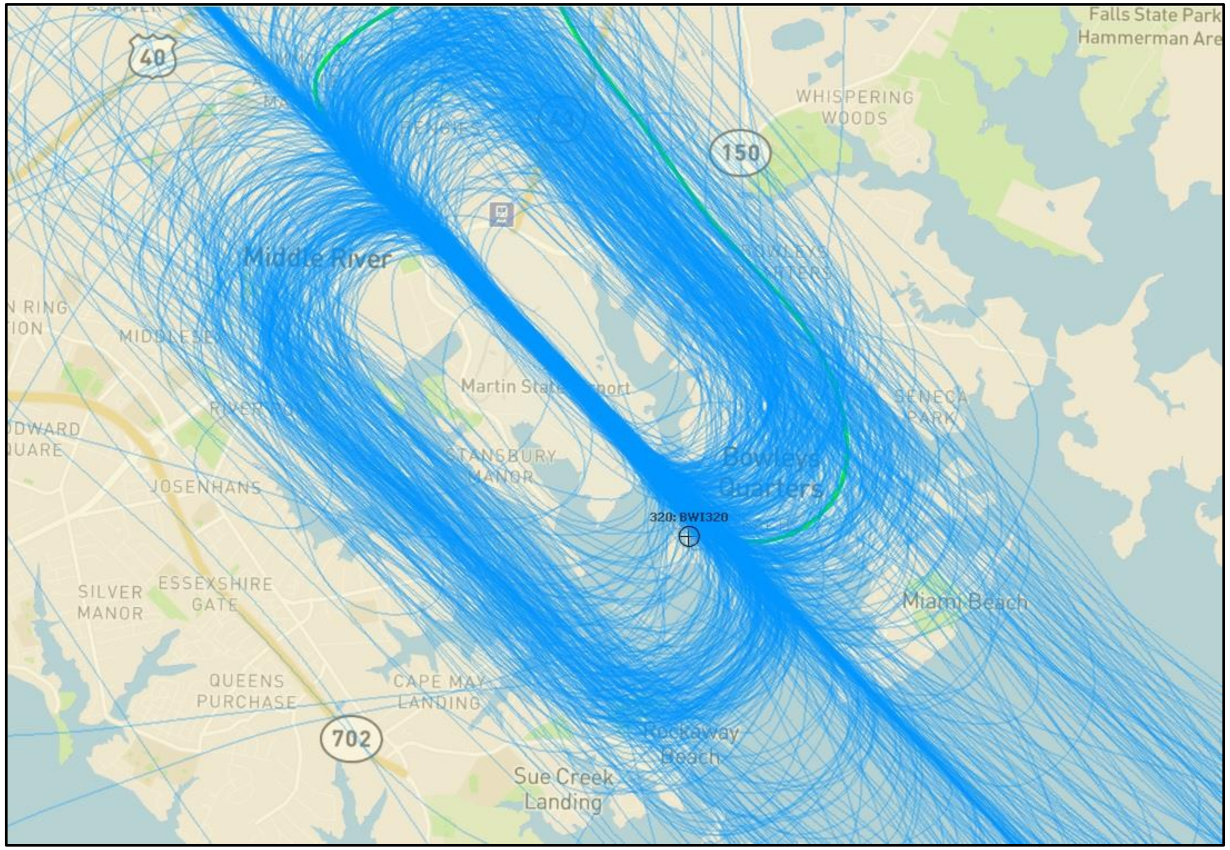

Figure 7. All Martin State Airport Circuits Correlated to Aircraft Noise Events During the Measurement Period

Measured Noise Levels

There are several key metrics which are used to describe aircraft and community noise on a single-event and cumulative basis. The appendix titled "How Do We Describe Aircraft Noise" provides a more detailed overview of the metrics which are discussed in this section. Single event metrics such as Maximum A-Weighted Sound Level (Lmax) are indicators of the intrusiveness, loudness, or noisiness of individual noise events while cumulative metrics like Day-Night Average Sound Level (DNL) are generally used to measure long term noise and are indicators of community annoyance and land use compatibility.

Figure 8 presents the range of maximum single event sound levels for 1,526 aircraft overflights at the measurement site for the measurement period. For a particular noise event, such as an aircraft overflight, the loudest level at any instant during the event is the Lmax. For typical conversational speech at a distance of approximately three feet, speech is interrupted by noise levels at or above 65 dB. Any noise events shown in this figure with a maximum level at or above 65 dB would, briefly for quieter events and longer for louder events, interrupt typical conversations outdoors. Figure 9 shows common environmental A-weighted noise levels for typical outdoor sounds.

Figure 10 on the following page shows the top 15 loudest aircraft events that occurred during the measurement period including details about the date and time the event occurred, aircraft type, operation type, runway, and slant range (the line-of-sight distance between the receptor and the aircraft). Note that these events only represent the noisiest aircraft events at the measurement site and that the majority of aircraft overflights at the measurement site were less noisy than those shown in Figure 8. Also note that ground noise is not recorded as an aircraft event. In some cases, community events may occur simultaneously with aircraft overflights, causing aircraft overflights to have higher recorded sound levels than were actually present.

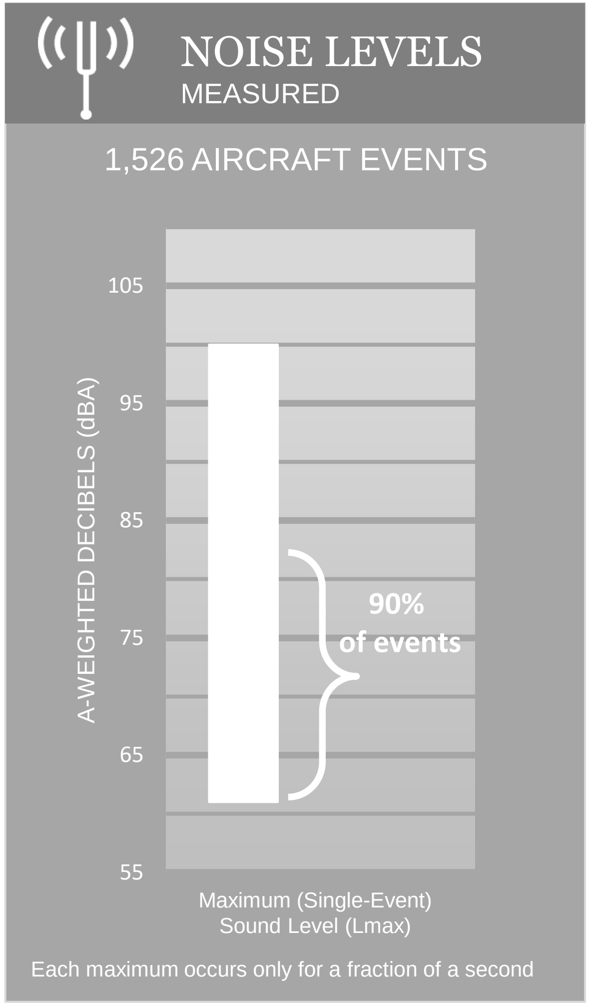

Figure 8. Maximum Single Event Aircraft Noise Levels

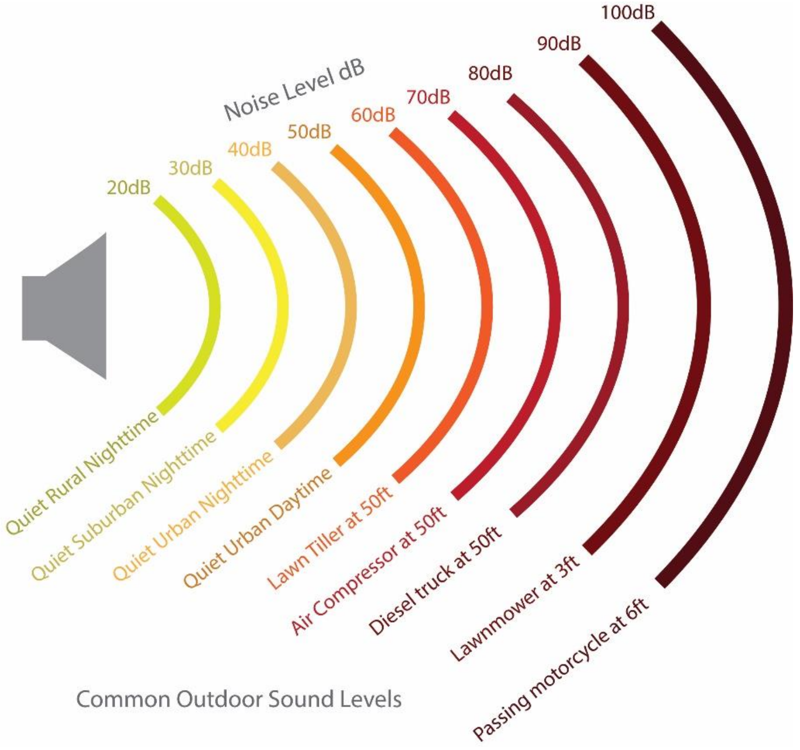

Figure 9. Common Environmental Noise Levels

Loudest Aircraft Events

Rank	Flight Time	Aircraft Type	Operation Type	Runway	Altitude (ft. AGL)	Slant Range (ft.)	Maximum Sound Level (dBA)
1	8/11/2022 14:43	Unknown	Arrival	33	497	5,840	100
2	8/11/2022 14:51	Unknown	Departure	33	191	253	100
3	8/13/2022 11:32	Unknown	Circuit	33	87	4,603	100
4	8/16/2022 13:32	Piaggio P.180 Avanti	Departure	15	684	774	99
5	8/13/2022 12:33	British Aerospace Jetstream 32	Circuit	33	377	827	99
6	8/11/2022 14:33	Unknown	Departure	33	87	561	98
7	8/11/2022 14:58	Unknown	Circuit	33	188	774	97
8	8/10/2022 14:15	Unknown	Arrival	33	414	571	97
9	8/11/2022 14:49	Unknown	Departure	33	528	6,099	96
10	8/11/2022 14:38	Unknown	Circuit	33	389	5,522	95
11	8/11/2022 14:45	Unknown	Arrival	33	193	833	95
12	8/16/2022 7:55	AgustaWestland AW139 Helicopter	Arrival	H	251	384	94
13	8/13/2022 11:24	Unknown	Circuit	33	191	860	94
14	8/13/2022 11:56	Unknown	Circuit	33	301	2,283	93
15	8/17/2022 11:25	Piper Cherokee Six	Departure	15	602	702	93

Figure 10. Top Fifteen Loudest Aircraft Events During the Measurement Period

Note: In some cases, community events may occur simultaneously with aircraft overflights, causing aircraft overflights to have higher recorded sound levels

Conclusion

Figure 11 presents the cumulative DNL at the measurement site for the sixteen complete days of the measurement period for community, aircraft and total noise exposure. Figure 12 presents the daily DNL at the site for aircraft noise exposure. DNL sums the noise from every noise event over the day. The formula for DNL gives an extra ten decibel weighting to nighttime noise events to account for the intrusive nature of these events. The aircraft DNL ranged from 55 to 65 dB during the measurement period. The DNL for all recorded community noise events (wildlife, landscaping, weather, etc.) during the measurement period was 61 dB.

Aircraft noise levels at this site are higher when Martin State Airport operates in northwest flow. During the measurement period, Martin State Airport operated in northwest flow 43% of the time and in southeast flow 57% of the time.

The results of the portable noise monitoring are for informational purposes only and capture the aircraft noise environment for a snapshot in time. The conditions during a monitoring period can vary greatly due to wind and weather (atmospheric conditions), the runway(s) in use at the time for arrivals and departures, and the number and type of operations occurring during the monitoring period.

In Appendix A of 14 CFR Part 150, the Federal Aviation Administration provides guidelines for the compatibility of land uses with various annual DNL values. See also COMAR 11.03.03.03 which establishes limits for cumulative noise exposure for certain land uses around Martin State Airport. These guidelines consider residential land use to be noncompatible when the DNL is 75 dB or greater. For noise levels between 65 dB and 75 dB DNL, residential land use is considered noncompatible, but where the community determines that this land use must be allowed, measures to achieve greater than typical outdoor to indoor noise level reduction should be incorporated into building codes. The guidelines designate all land uses, including residential, as compatible for DNL values below 65 dB.

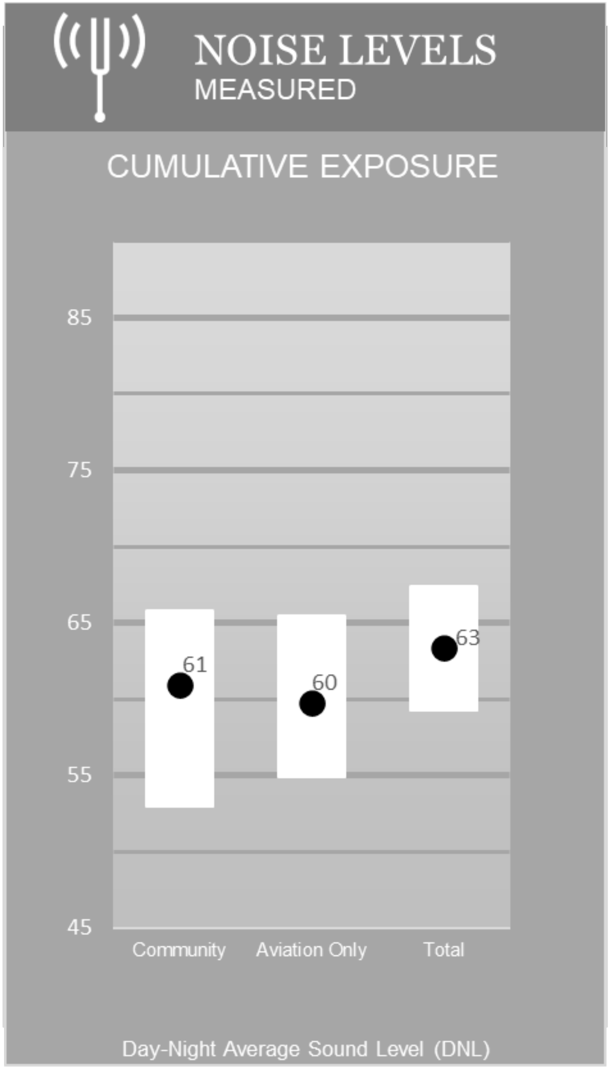

Figure 11. Cumulative Noise Exposure from Aircraft and Community Sources

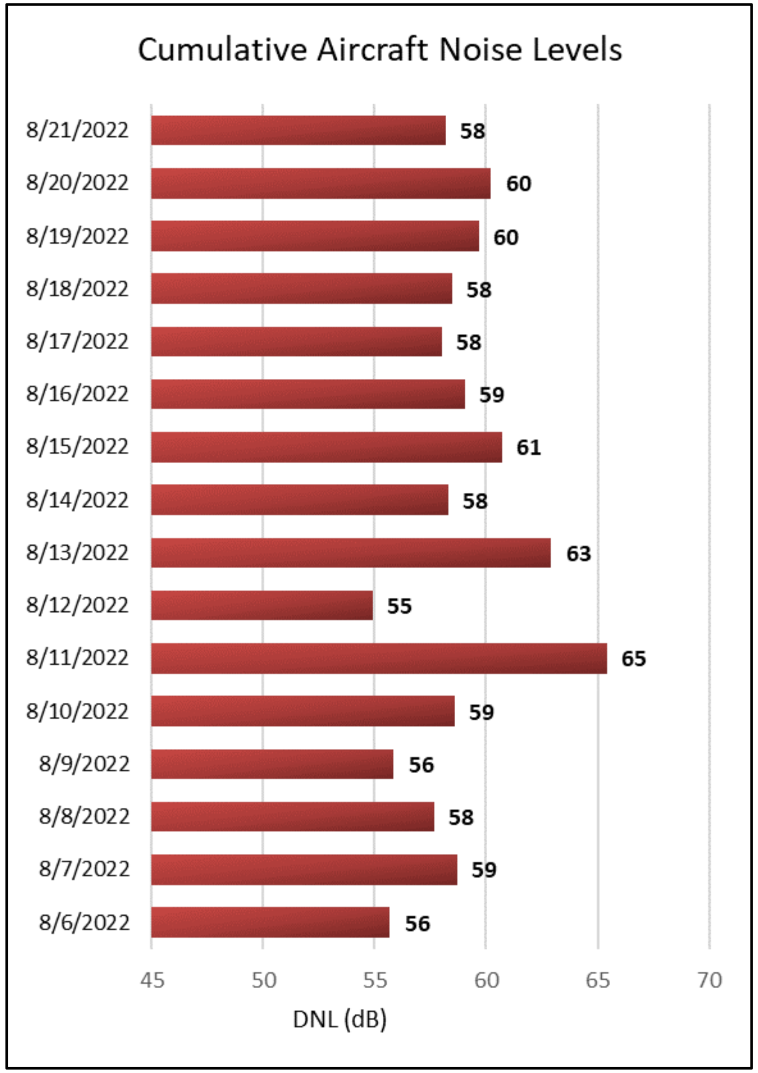

Figure 12. Measured Daily Aircraft Noise Levels

For More Information

Information about Maryland Department of Transportation Maryland Aviation Administration's (MDOT MAA) Noise Program activities can be found at https://marylandaviation.com/. Frequent topics of interest include:

Noise Complaints: MDOT MAA provides multiple methods to submit aircraft noise complaints, including an on-line form (https://marylandaviation.com/environmental/environmental-compliance-sustainability/noise-complaints/) or 24-hour noise complaint and information hotline at 410-859-7021. MDOT MAA reviews noise complaints daily, and logs, reviews, and analyzes all noise complaints on a regular basis.

Quarterly Noise Reports: Each quarter, MDOT MAA prepares and publishes a quarterly noise report. The report provides information on operational trends (including the number of jet and cargo operations, and the number of nighttime operations), runway use, flight corridors/flight density maps, noise complaints received, outreach efforts, permanent noise monitoring data and MDOT MAA's noise assistance programs.

eNews Express: Stay up-to-date on planned runway closures, as well as other important aviation topics, by subscribing to the BWI Marshall eNews Express, by sending an email to https://marylandaviation.com/environmental/environmental-compliance-sustainability/enews-express-signup/.

Airport Noise Zone: The Maryland Environmental Noise Act of 1974 provides for the protection of citizens from the impact of transportation related noise. The aviation portion of the Act requires the MDOT MAA to create an Airport Noise Zone (ANZ) to control incompatible land development around Martin State Airport and a Noise Abatement Plan (NAP) to minimize the impact of aircraft noise on people living near the Airport. The Martin State Noise Airport Noise Zone was first established in 1977.

Additional Resources:
Website - www.martinstateairport.com
Twitter - @MartinState

How do we Describe Aircraft Noise?

We use a number of terms to describe aircraft noise. These metrics form the basis for the majority of noise analyses conducted at most airports in the U.S.

The Decibel, dB

All sounds come from a source – a musical instrument, a voice speaking, an airplane. The energy that produces these sounds is transmitted through the air in waves, or sound pressures, which impinge on the ear, creating the sound we hear.

The decibel is a ratio that compares the sound pressure of the sound source of interest (e.g., the aircraft over flight) to a reference pressure (the quietest sound we can hear). Because the range of sound pressures is very large, we use logarithms to simplify the expression to a smaller range, and express the resulting value in decibels (dB). Two useful rules of thumb to remember when comparing individual noise sources are: (1) most of us perceive a six to ten dB increase to be about a doubling of loudness, and (2) changes of less than about three dB are not easily detected outside of a laboratory.

The A-Weighted Decibel, dB(A)

Frequency, or "pitch", is an important characteristic of sound. When analyzing noise, we are interested in how much is low-, middle-, and high-frequency noise. This breakdown is important for two reasons. First, our ears are better equipped to hear mid- and high-frequencies; thus, we find mid- and high-frequency noise more annoying. Second, engineering solutions to noise problems are different for different frequency ranges. The "A" filter approximates the sensitivity of our ear and helps us to assess the relative loudness of various sounds.

Maximum A-weighted Sound Level, Lmax

A-weighted sound levels vary with time. For example, the sound increases as an aircraft approaches, then falls and blends into the background as the aircraft recedes into the distance. Figure 1 illustrates this phenomenon. We often describe a particular noise "event" by its maximum sound level (Lmax). Figure 2 shows typical Lmax values for some common noise sources. In fact, two events with identical Lmax may produce very different total exposures. One may be of very short duration, while the other may be much longer.

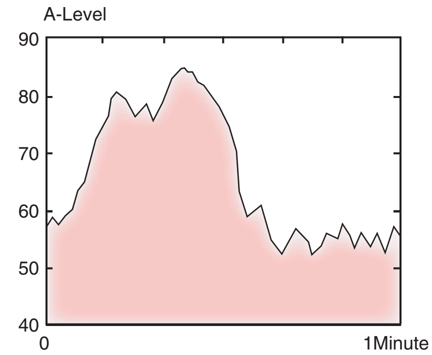

Figure 1. A-weighted Sound Levels Over Time

Sound Exposure Level, SEL

The most common measure of cumulative noise exposure for a single aircraft flyover is the Sound Exposure Level (SEL). Mathematically, it is the sum of the sound energy over the duration of a noise event – one can think of it as an equivalent noise event with a one-second duration. Figure 3 shows that portion of the sound energy included in this event. Because the SEL is normalized to one second, it will almost always be larger in magnitude than the Lmax for the event. In fact, for most aircraft events, the SEL is about 7 to 12 dB higher than the Lmax. Also, the fact that it is cumulative measure means that a higher SEL can result from either a louder or longer event, or some combination.

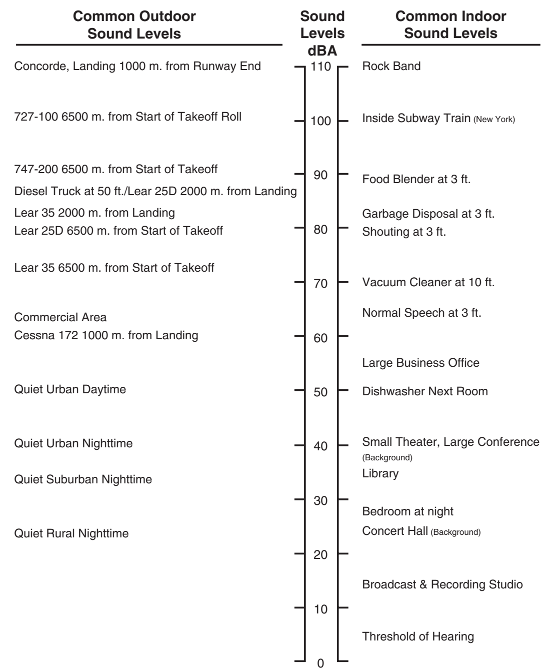

Figure 2. Common Environmental Sound Levels

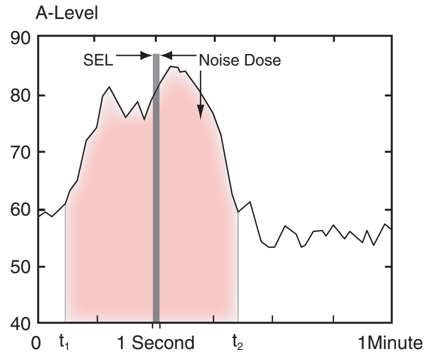

Figure 3. Sound Exposure Level

SEL provides a comprehensive way to describe noise events for use in modeling and comparing noise environments. Computer noise models base their computations on SEL values.

Day-Night Average Sound Level, DNL

The Day-Night Average Sound Level (DNL) represents noise as it occurs over a 24-hour period, with the assumption noise events occurring at night (10 p.m. to 7 a.m.) are 10 dB louder than they really are. This 10 dB penalty is applied to account for greater sensitivity to nighttime noise, and the fact that events at night are often perceived to be more intrusive because nighttime ambient noise is less than daytime ambient noise.

Figure 4 depicts a hypothetical daily noise dose. The top frame repeats the one-minute noise exposure that was shown in Figure 1. The center frame includes this one-minute interval within a full hour; now the shaded area represents the noise during that hour with 16 noise events, each producing an SEL. Finally, the bottom frame includes the one-hour interval within a full 24 hours. Here the shaded area represents the listener's noise dose over a full day.

DNL normally can be measured with standard monitoring equipment or predicted with computer models.

Most aircraft noise studies utilize computer-generated estimates of DNL, determined by accounting for all of the SELs from individual events which comprise the total noise dose at a given location on the ground.

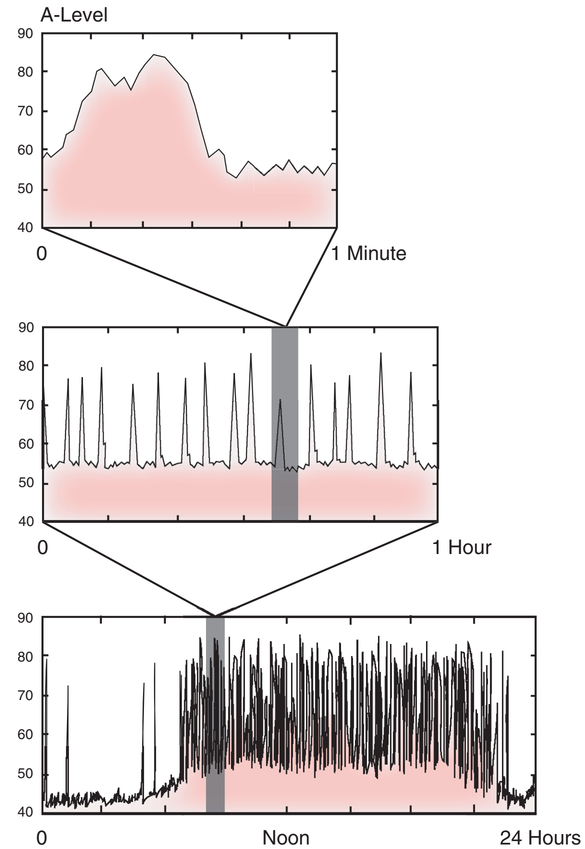

Figure 4. Daily Noise Dose

Computed values of DNL are often depicted as noise contours reflecting lines of equal exposure around an airport (much as topographic maps indicate contours of equal elevation). DNL contours usually reflect annual average operating conditions, taking into account the average number of flights each day, how often each runway is used throughout the year, and where over the surrounding communities the aircraft normally fly.