Portable Noise Measurement Report

Curtis Dr.

Columbia, MD, 21045

Maryland Department of Transportation

Maryland Aviation Administration

November 2018

MARYLAND

MARYLAND DEPARTMENT OF TRANSPORTATION

Maryland Aviation Administration

BW282 Summary

? WHEN
WAS NOISE MEASURED

Thursday, September 27, 2018 to Thursday, October 11, 2018

15 DAYS

SEP - OCT 2018

S	M	T	W	T	F	S
23	24	25	26	27	28	29
				measurements		
30	1	2	3	4	5	6
measurements						
7	8	9	10	11	12	13
measurements						

HOW MANY
AIRCRAFT NOISE EVENTS OCCURRED AND WHAT WERE THEY

124 EVENTS / 24 HRS. ON AVERAGE

338 EVENTS / 24 HRS. AT THE MOST

4 EVENTS / 24 HRS. AT LEAST

TOP 3 MOST FREQUENT AIRCRAFT DURING THE MEASUREMENT PERIOD

Rank	Aircraft type		Operation type and Runway
1	Boeing 737-700		Arrival, 10
2	Boeing 737-800		Arrival, 10
3	Airbus A320		Arrival, 10

CONCLUSION

During the 15-day measurement period, the Day Night Average Sound Level (DNL) from aircraft noise events was 54 decibels (dB), while the DNL from community noise was 58 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
54 dB	58 dB	59 dB	65 dB

BWI BALTIMORE/WASHINGTON INTERNATIONAL Thurgood Marshall AIRPORT

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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 Straughan Environmental.

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 between September 27 and October 11, 2018 at Curtis Dr., Columbia, MD, 21045. The monitoring locationis approximately 8.9 statute miles from the center of Baltimore/Washington International Thurgood Marshall (BWI Marshall) Airport. The figure to the right shows the location of the measurement site (marked as BW282) relative to BWI Marshall.

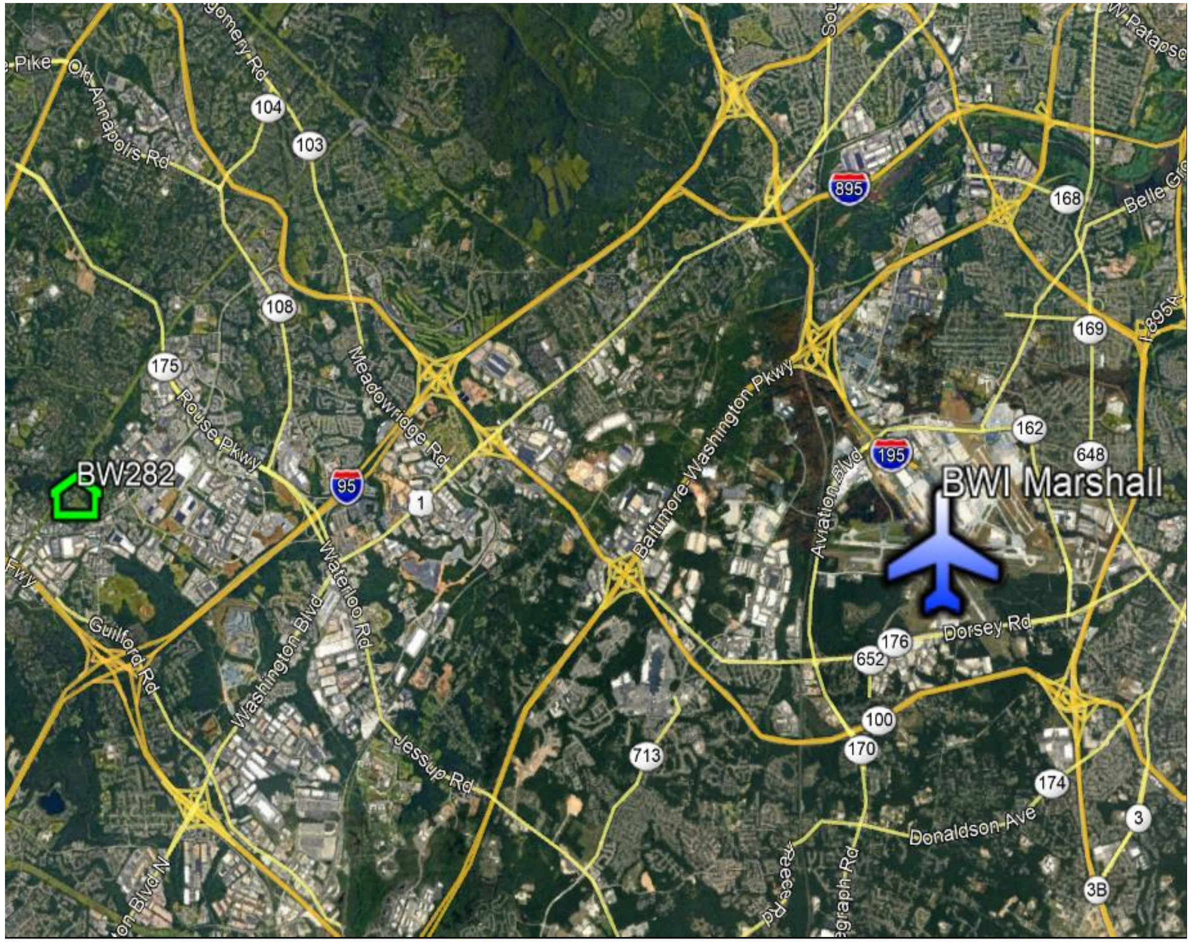

Figure 1. Noise Monitoring Location in relation to BWI Marshall

Aircraft Operations

Operations at BWI Marshall fluctuate on a daily basis. During the measurement period, there were 11,052 flights in and out of BWI Marshall (5,508 arrivals, 5,544 departures), in addition to overflights to other airports. The number of flights per day ranged from 632 to 797. The primary BWI Marshall overflights at this site are arrivals to Runway 10. Less common overflights include departures from Runway 28.

BWI Marshall has three runways, designated as Runway 10/28, Runway 15R/33L, and Runway 15L/33R. Runway 10/28 is 10,502 feet in length, while Runway 15R/33L is 9,500 feet in length. Runway 15L/33R is 5,000 feet in length and is only used by certain aircraft. The figures to the right present runway use during the measurement period. As aircraft cannot arrive and depart from the same runway, BWI Marshall generally operates in two configurations –west flow (primarily departures from Runway 28 and arrivals to Runway 33L) and east flow (primarily departures from Runway 15R and arrivals to Runway 10). On an annual basis, west flow is used roughly 70% of the time while east flow is used roughly 30% of the time. During west flow, aircraft overflights primarily consist of departures from Runway 28. During east flow, the primary source of aircraft overflights are arrivals to Runway 10.

The figures to the right display runway use for west and east flow during the measurement period. Differences in percentages are due to rounding.

West Flow Runway Use was 60% during the measurement period
(Historical Annual Average of 70%)

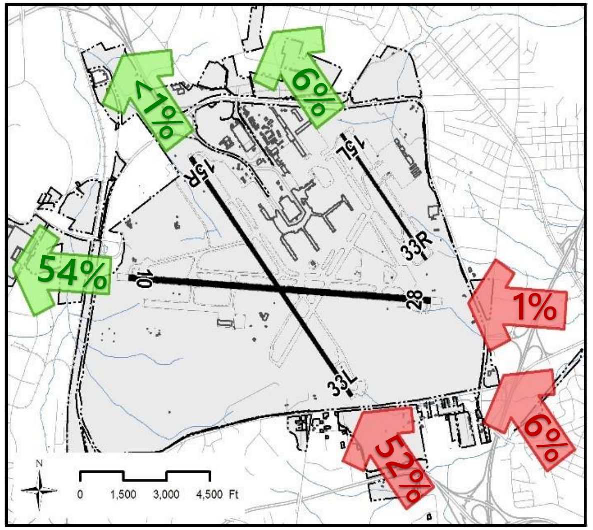

Figure 2. West Flow Runway Use During Measurement Period

East Flow Runway Use was 40% during the measurement period
(Historical Annual Average of 30%)

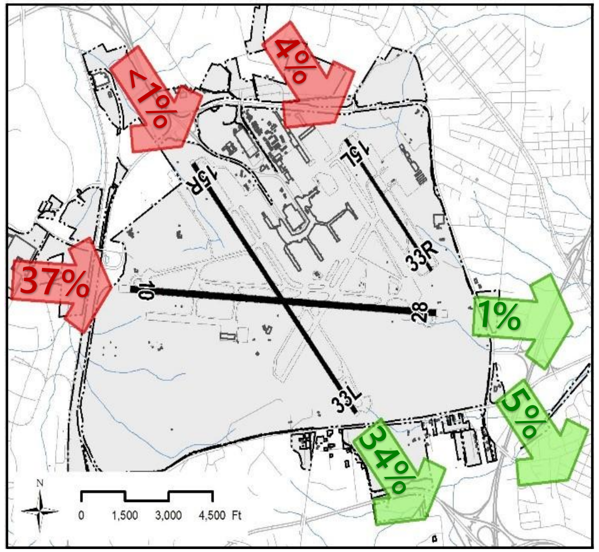

Figure 3. East Flow Runway Use During Measurement Period

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Methodology & Location

Aircraft noise levels were measured continuously from September 27 through October 11, 2018 at Curtis Dr., Columbia, MD, 21045. The noise monitor is a Type I sound level meter and wascalibrated every two to three days during the measurements during equipment checks. During setup, a baseline threshold was established for the noise monitor. Once the sound level exceeded thebaseline 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 monitorwas placed in the backyard of the residence. Notable noise sources at this site included aircraft overflights to and from BWI Marshall, as well as typical suburban sounds including neighborhood animals, landscaping work, and local vehicle traffic which all may trigger a noise event.

Once the temporary noise monitoring period was complete, the noise event data was uploaded into MDOT MAA's Noise and Operating Monitoring System (NOMS) to compare the times of noise events at the site to its database of aircraft radar flight paths. The NOMS conservatively attributes any noise event that occurs when an aircraft is within 10,000 ft. of a measurement site to that aircraft. 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.

The figures on the next page display density maps of all BWI Marshall flight tracks during the measurement period. The location of the measurement site is marked with its unique identifier "BW282". Arrivals, as shown in Figure 4, to BWI Marshall were generally 1,300 to 2,000 ft. above ground level at their point of closest approach to the measurement site. Departures, as shown in Figure 5 were generally 3,400 to 5,200 ft. above ground level at their closest approach to the measurement site.

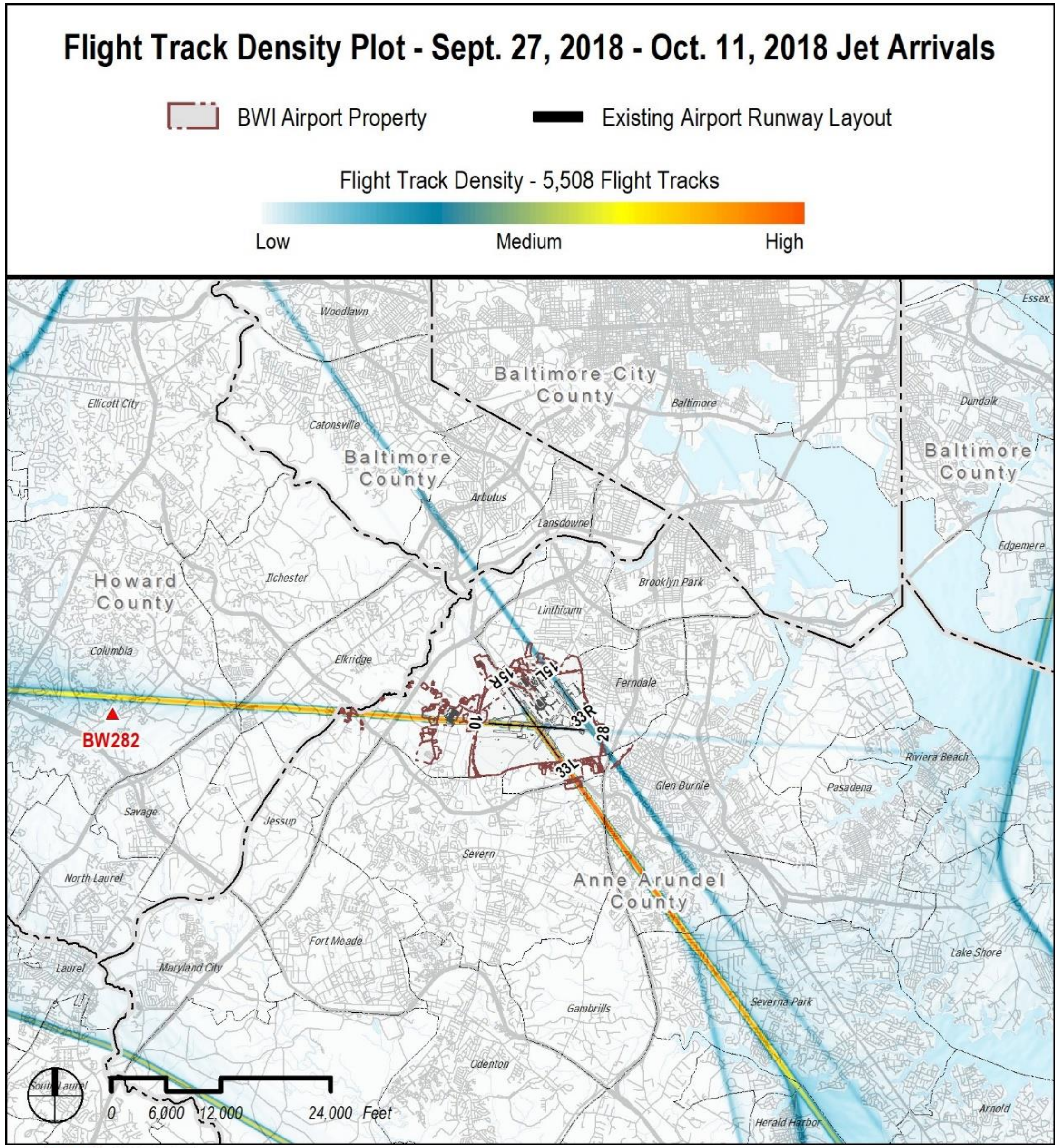

Figure 4. Arrival Density Map – 5,508 Tracks

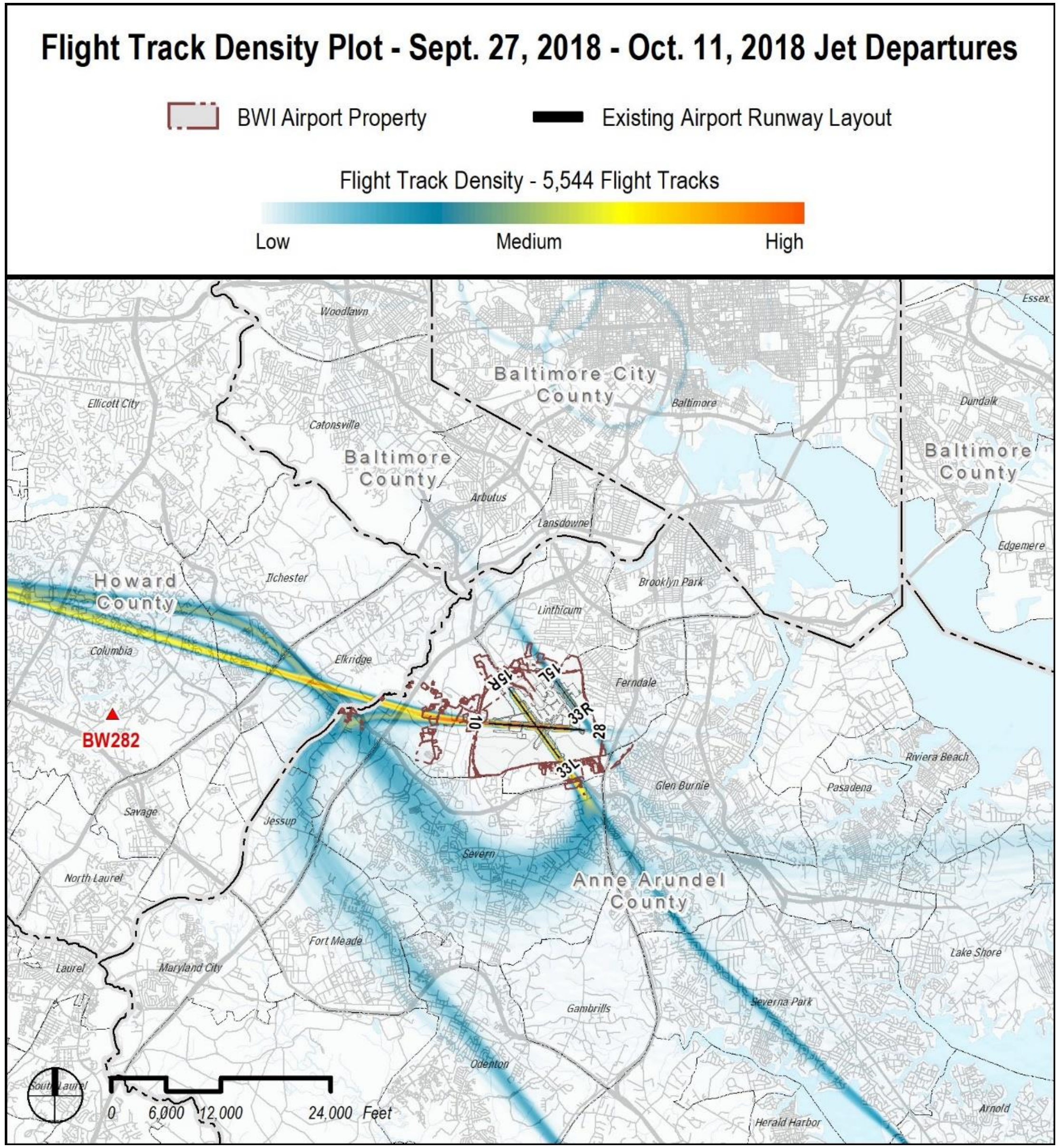

Figure 5. Departure Density Map – 5,554 Tracks

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 Lmax are indicators of the intrusiveness, loudness, or noisiness of individual noise events while cumulative metrics like DNL are generally used to measure long term noise and are indicators of community annoyance.

Figure 6 presents the range of maximum single event sound levels for 1,949 aircraft overflights at the measurement site for the complete measurement period. For a particular noise event, such as an aircraft overflight, the loudest level at any instant during the event is the Maximum A-Weighted Sound Level (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 7 shows common environmental A-weighted noise levels in dB for typical outdoor sounds.

Figure 8 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, airline, aircraft type, operation type, runway, and slant range (the line of sight distance between the ground and the aircraft overhead). Note that these events only represent the nosiest 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.

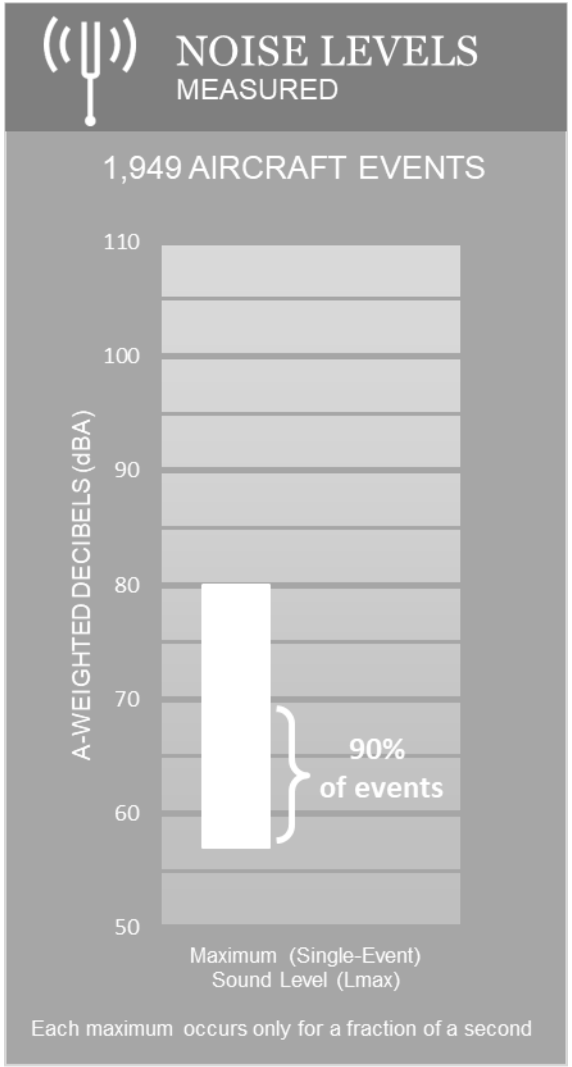

Figure 6. Maximum Single Event Aircraft Noise Levels

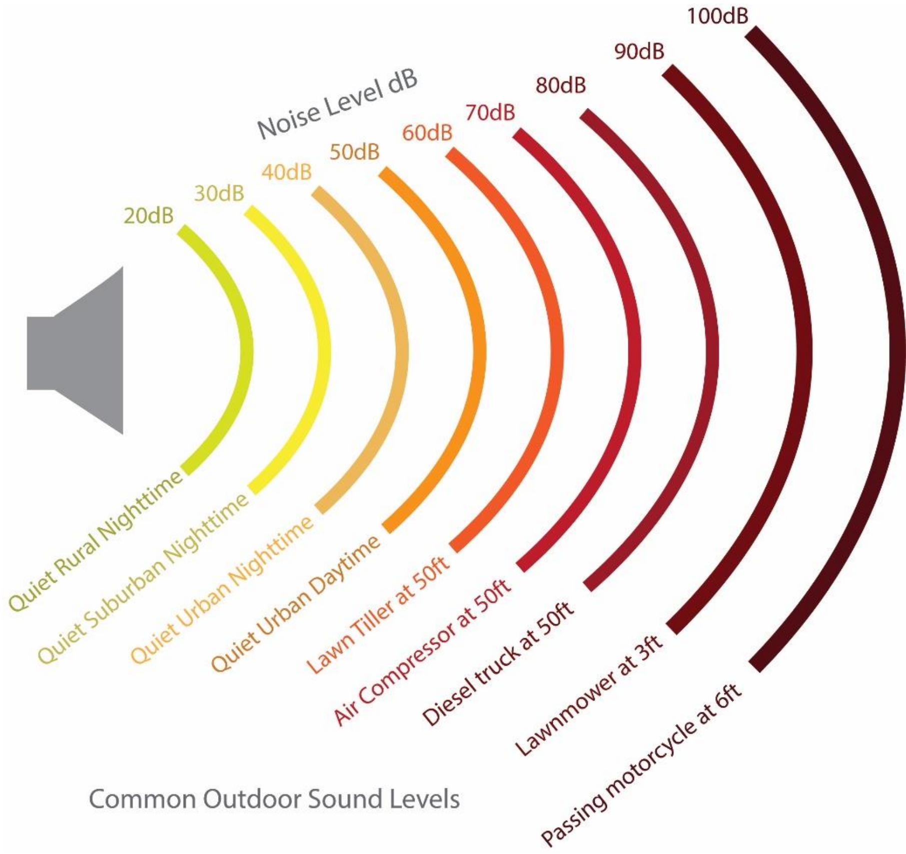

Figure 7. Common Environmental Noise Levels

Loudest Aircraft Events

Flight Time	Airline	Aircraft Type	Operation Type	Runway	Altitude (ft.)	Slant Range (ft.)	Maximum Sound Level (dBA)
9/28/2018 19:57	KALITTA AIR	Boeing 727-200	Departure	28	3,421	3,686	80
10/5/2018 16:27	Southwest	Boeing 737-800	Arrival	10	1,634	2,087	79
10/9/2018 17:04	Southwest	Boeing 737-800	Arrival	10	1,184	1,299	79
10/1/2018 22:52	DELTA AIR LINES	McDonnell-Douglas MD-88	Arrival	10	1,759	1,832	77
9/29/2018 18:32	KALITTA AIR	Boeing 727-200	Departure	28	4,181	4,804	77
10/9/2018 13:01	Southwest	Boeing 737-800	Arrival	10	1,622	2,104	76
9/27/2018 17:55	Southwest	Boeing 737-700	Arrival	10	1,642	2,601	76
10/10/2018 9:22	American Airlines	Boeing 737-800	Arrival	10	1,634	1,693	76
10/8/2018 11:25	DELTA AIR LINES	McDonnell-Douglas MD-88	Arrival	10	1,559	2,508	76
10/5/2018 7:13	Southwest	Boeing 737-800	Arrival	10	1,321	1,334	76
10/11/2018 9:21	DELTA AIR LINES	McDonnell-Douglas MD-88	Arrival	10	1,659	2,807	76
9/27/2018 21:04	Southwest	Boeing 737-800	Arrival	10	1,609	1,773	75
10/8/2018 11:01	American Airlines	Boeing 737-800	Arrival	10	1,634	1,882	75
10/11/2018 22:55	DELTA AIR LINES	Boeing 737-900	Arrival	10	1,584	1,616	75
10/9/2018 18:53	American Airlines	McDonnell-Douglas MD-83	Arrival	10	1,709	1,840	74

Figure 8. Top Fifteen Loudest Aircraft Events During the Measurement Period

Conclusion

Figure 9 presents the cumulative DNL at the measurement site for the fifteen complete days of the measurement period for community, aircraft and total noise exposure. Figure 10 presents the cumulative aircraft noise exposure over the fifteen complete days of recorded data within the measurement period using the DNL metric. 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 37 to 58 dB during the measurement period. The total aircraft DNL for measurement period was 54 dB. The DNL for all recorded community noise events (traffic noise, landscaping, weather, etc.) during the measurement period was 58 dB. The total DNL at the measurement site, which includes both aircraft and community noise events, was 59 dB.

Aircraft noise levels at this site are higher when BWI Marshall operates in east flow. During the measurement period, BWI Marshall operated in west flow 60% of the time and in east flow 40% of the time, which is a higher usage of east flow than the annual average of 70% west flow operations and 30% east flow operations.

Based only on the measurements and a seventy percent annual west flow assumption, the annual aircraft DNL at the measurement site is likely somewhat lower than the 54 dB that was measured for this period. Note however, that all things are generally not equal when comparing a small time period to a full year of data. Aircraft profiles and flight paths can vary due to weather and the types of aircraft and times of flights can change due to shifts in airline flight schedules.

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 BWI Marshall. These guidelines consider residential land use to be incompatible when the DNL is 75 dB or greater. For noise levels between 65 dB and 75 dB DNL, residential land use is considered incompatible, but where the community determines that this land use most 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.

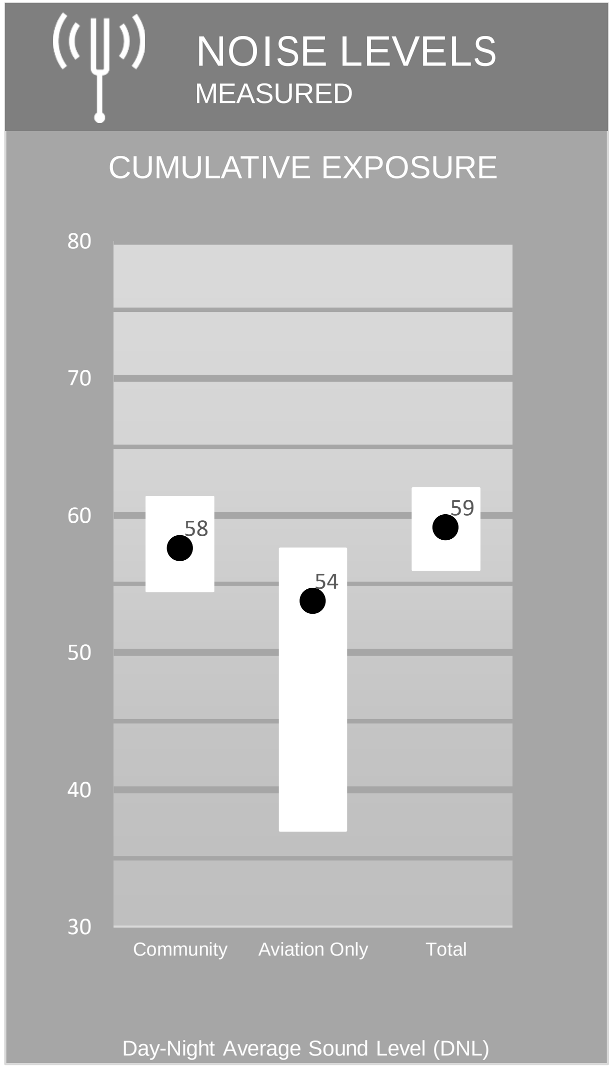

Figure 9. Cumulative Noise Exposure from Aircraft and Community Sources

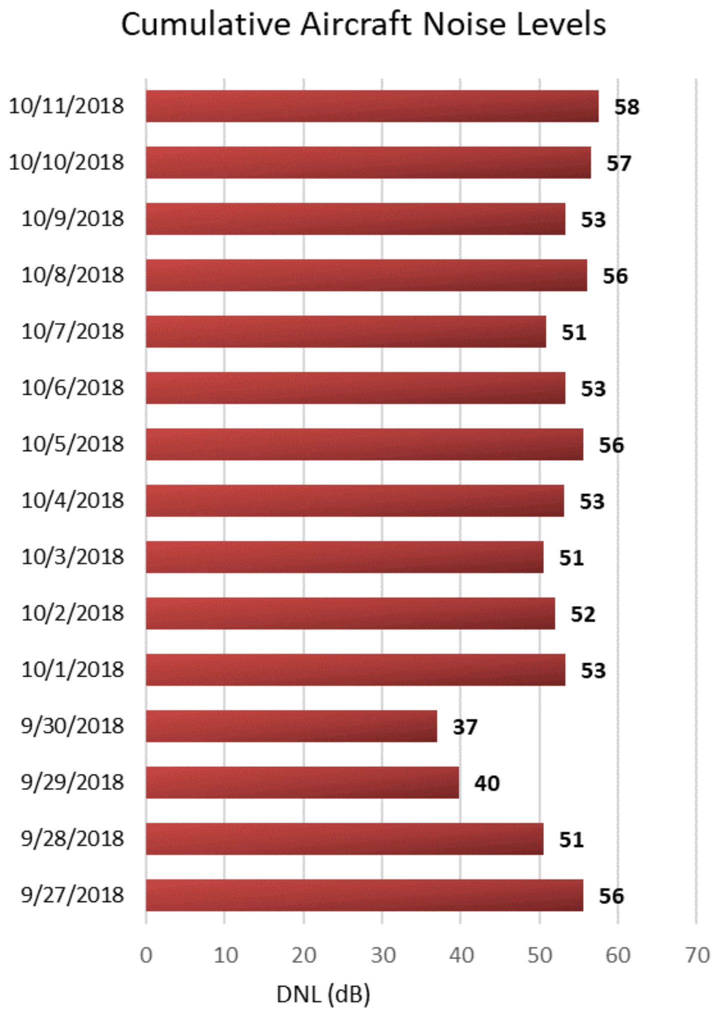

Figure 10. Measured Daily Aircraft Noise Levels

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For More Information

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

Noise Complaints: MDOT MAA provides multiple methods to submit aircraft noise complaints, including an on-line form (http://www.maacommunityrelations.com/content/anznoiseupdate/noisecomplaints.php) 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 tobwi_enews_express@maacommunityrelations.com.

Airport Noise Zone: The BWI Noise Abatement Plan and Airport Noise Zone, first established in 1976, includes a wide variety of strategies that are intended to reduce noise impacts for communities around the Airport while maintaining efficient airport operations. Noise abatement at BWI includes operational procedures such as aircraft arrival and departure procedures and a preferential runway use system intended to direct aircraft operations over less populated areas, where and when possible. Other elements of the Noise Abatement Plan include land use restrictions and programs such as land acquisition and soundproofing.

Additional Resources:

www.bwiairport.com

https://www.facebook.com/BWIairport/

Twitter - @BWI_Airport

Instagram - https://www.instagram.com/bwi_airport/

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.

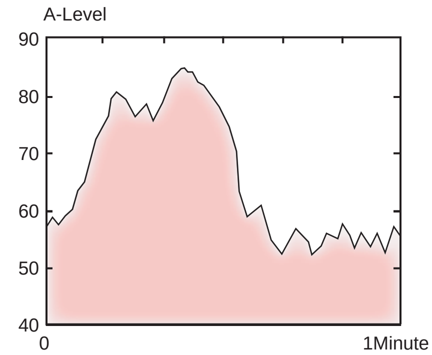

Figure 1. A-weighted Sound Levels Over Time

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.

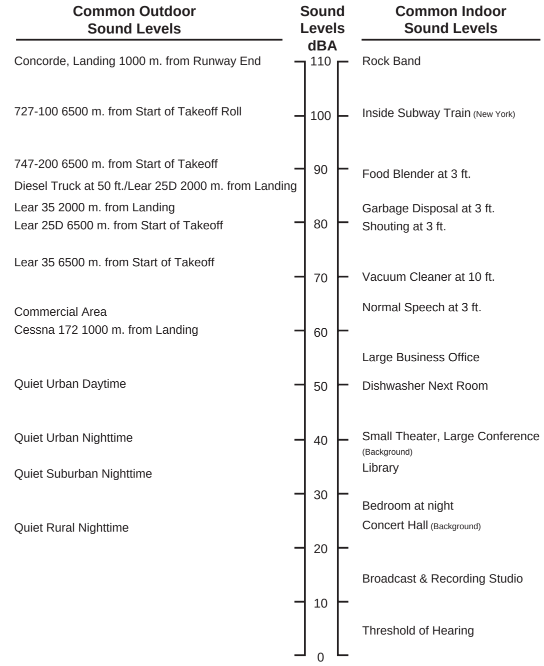

Figure 2. Common Environmental Sound Levels

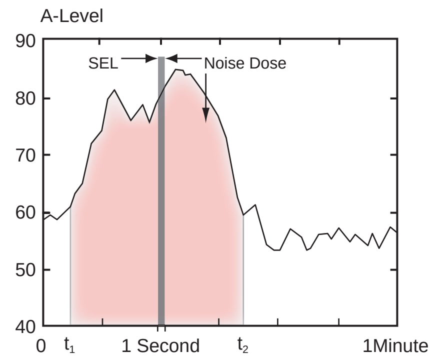

Figure 3. Sound Exposure Level

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.

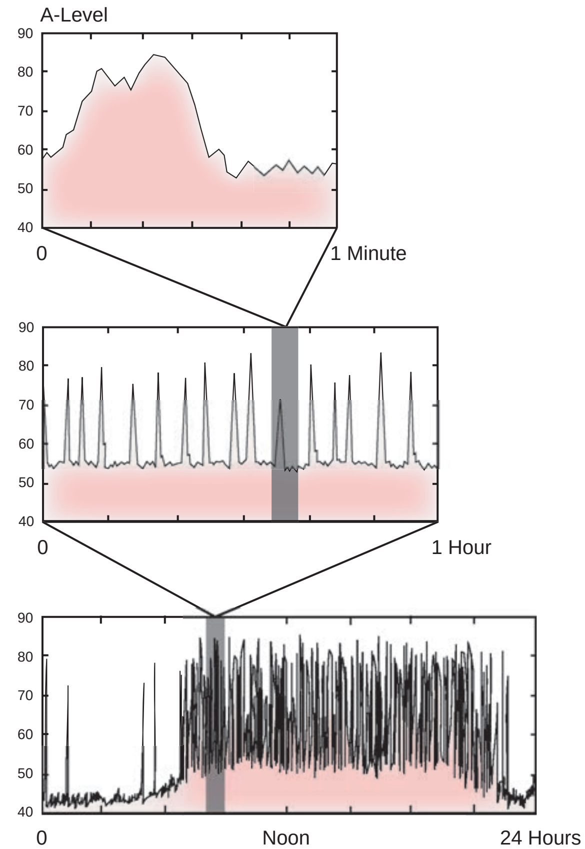

Figure 4. Daily Noise Dose

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.

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