

# Portable Noise Measurement Report

Flintfeet Lane  
Columbia, MD 21045

Maryland Department of Transportation  
Maryland Aviation Administration

September 2018



# BW280 Summary

## ? WHEN WAS NOISE MEASURED

Friday, July 27, 2018 to  
Wednesday, August 15, 2018



JUL - AUG 2018	S	M	T	W	T	F	S
	22	23	24	25	26	27	28
							measurements
	29	30	31	1	2	3	4
	measurements						
	5	6	7	8	9	10	11
	measurements						
	12	13	14	15	16	17	18
	measurements						



## HOW MANY AIRCRAFT NOISE EVENTS OCCURRED AND WHAT WERE THEY



### 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 19-day measurement period, the Day Night Average Sound Level (DNL) from aircraft noise events was 48 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
48 dB	58 dB	59 dB	65 dB

# 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 July 27 and August 15, 2018 at Flintfeet Lane, Columbia, MD, 21045. The monitoring location is approximately 8.3 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 BW280) relative to BWI Marshall.

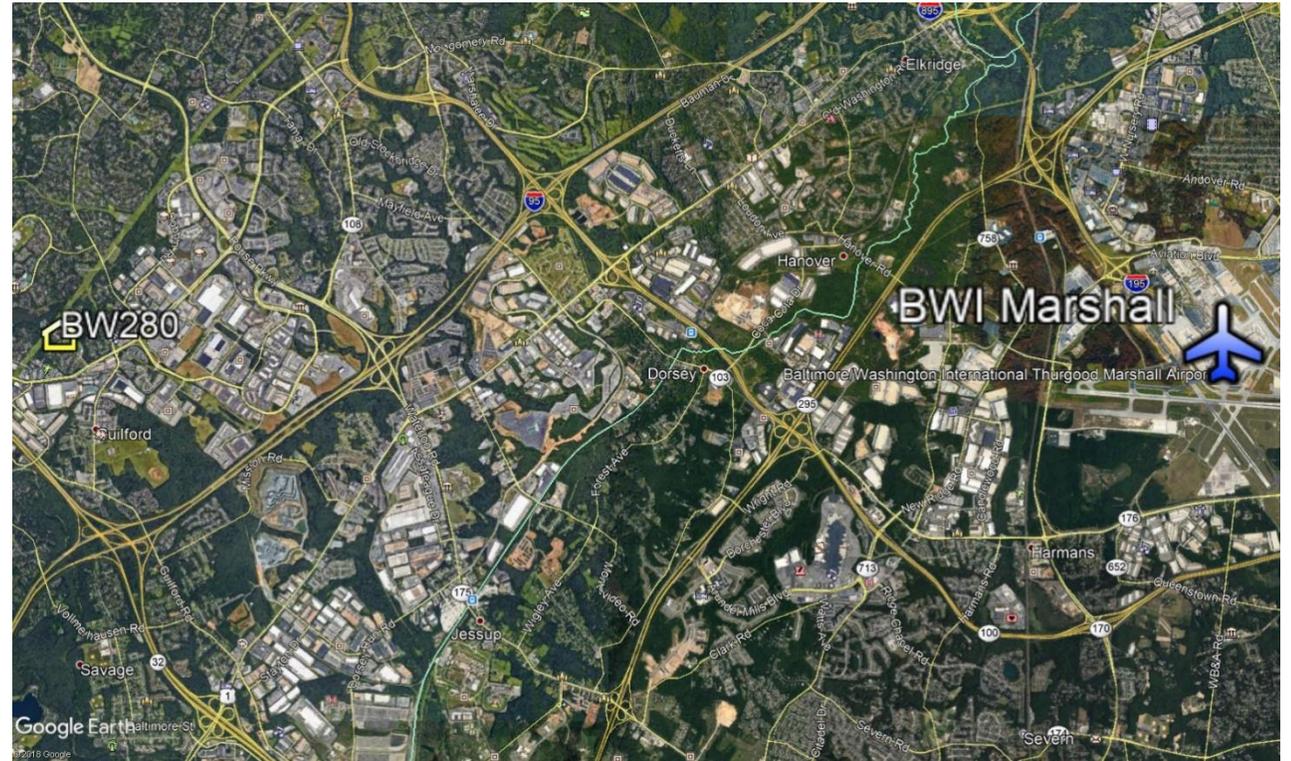


Figure 1. Noise Monitoring Location in relation to BWI Marshall

# Aircraft Operations

Operations at BWI Marshall fluctuate on a daily basis. During the measurement period, there were 13,407 flights in and out of BWI Marshall (6,694 arrivals, 6,713 departures), in addition to overflights to other airports. The number of flights per day ranged from 607 to 803. 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, the flight path for departures on Runway 28 lies well to the north of the site. A small percentage of Runway 28 departures do overfly the site. 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. Difference in percentages are due to rounding.

West Flow Runway Use was 69% during the measurement period (Historical Annual Average of 70%)

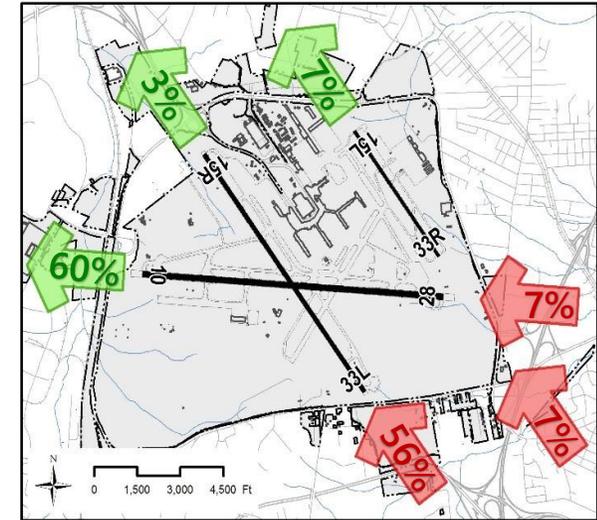


Figure 2. West Flow Runway Use During Measurement Period

East Flow Runway Use was 31% during the measurement period (Historical Annual Average of 30%)

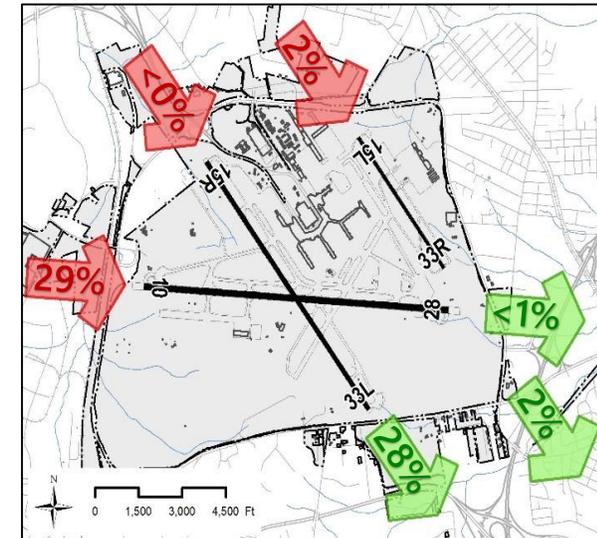


Figure 3. East Flow Runway Use During Measurement Period

# Methodology & Location

Aircraft noise levels were measured from early afternoon on July 27, 2018 through early afternoon on August 15, 2018 at Flintfeet Lane, Columbia, MD 21045. The noise monitor is a Type I sound level meter and was calibrated every two to five days during the measurements during equipment checks. 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 BWI Marshall, as well as typical suburban sounds including construction and neighborhood landscaping which all may trigger a noise event. Two power failures occurred during the measurements. The first occurred on the morning of July 31<sup>st</sup>. The meter was restarted on the morning of August 1<sup>st</sup>. The second power failure occurred in the early afternoon of August 7<sup>th</sup>. The meter was restarted on the morning of August 8<sup>th</sup>. The measurements were extended to ensure that 14 complete days of data were recorded.

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 displays density maps of all BWI Marshall flight tracks during the measurement period. The location of the measurement site is marked with its unique identifier "BW280". Arrivals, to Runway 10, as shown in Figure 4, were generally 1,400 to 2,100 ft. above ground level at their point of closest approach to the measurement site. Departures from Runway 28, as shown in Figure 5, were generally 3,000 to 4,600 ft. above ground level at their closest approach to the measurement site.

### Flight Track Density Plot - July 27, 2018 – August 15, 2018 Jet Arrivals

 BWI Airport Property       Existing Airport Runway Layout

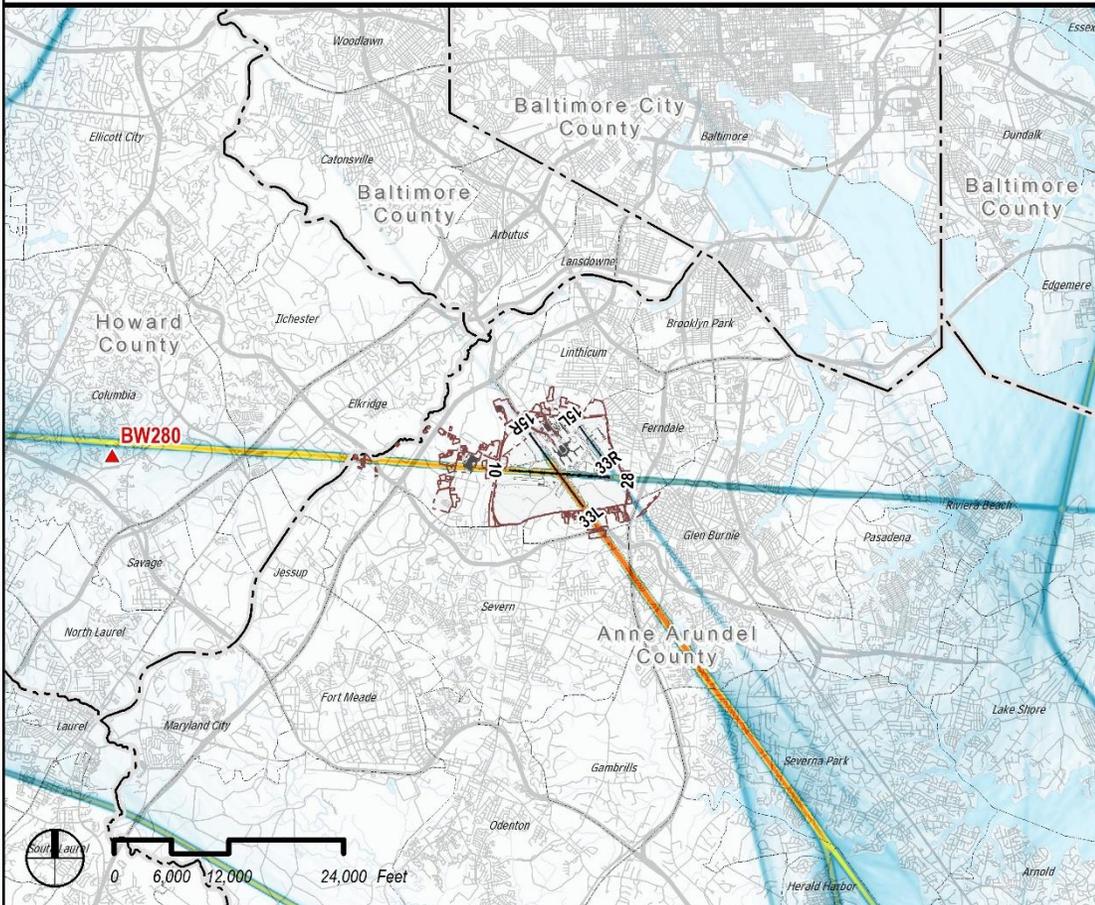
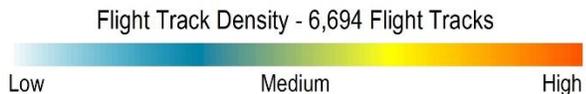


Figure 4. Arrival Density Map – 6,694 Tracks

### Flight Track Density Plot - July 27, 2018 – August 15, 2018 Jet Departures

 BWI Airport Property       Existing Airport Runway Layout

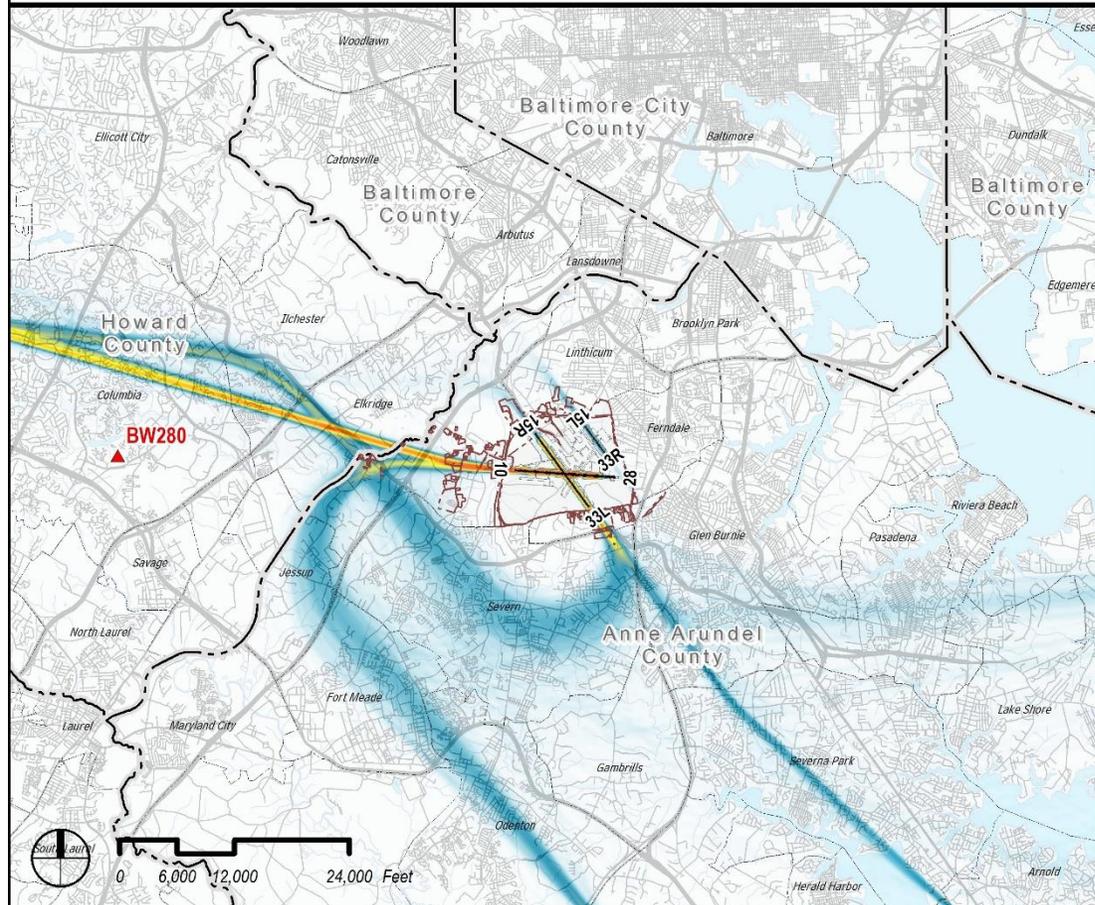
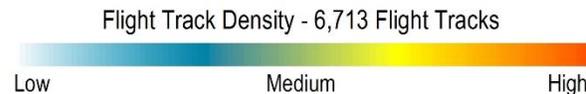


Figure 5. Departure Density Map – 6,713 Tracks

# 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 the 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.

Figure 6 presents the range of maximum single event sound levels for 1,261 aircraft noise events 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 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, and runway. 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.

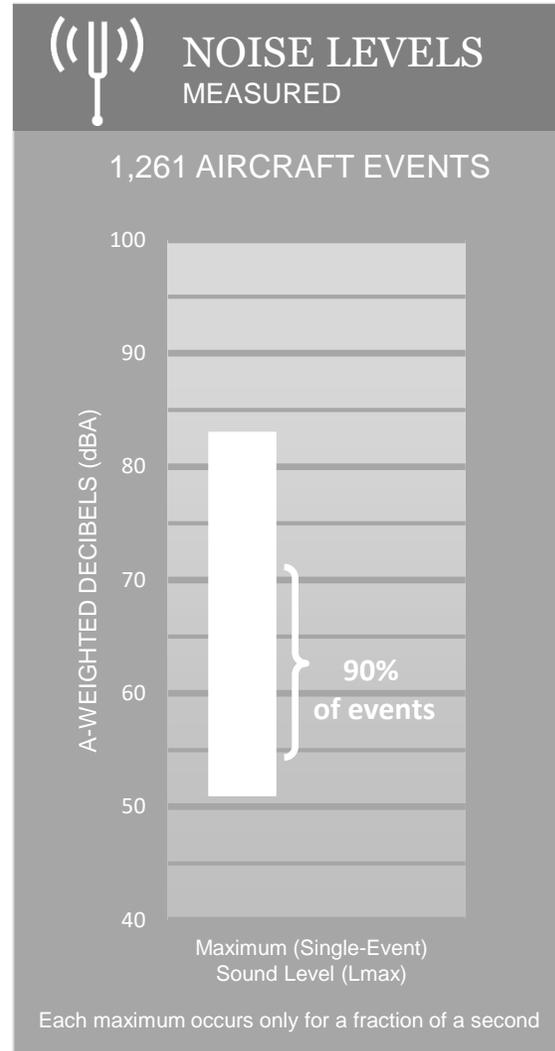


Figure 6. Maximum Single Event Aircraft Noise Levels

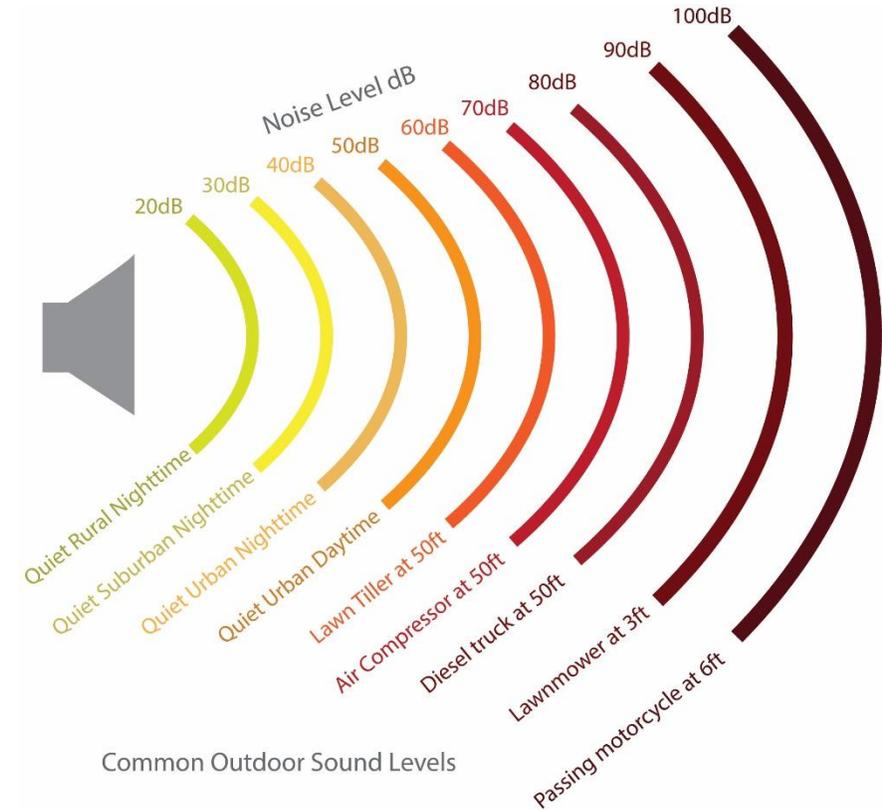


Figure 7. Common Environmental Noise Levels

# Loudest Aircraft Events

Flight Time	Airline	Aircraft Type	Operation Type	Runway	Altitude (ft.)	Slant Range (ft.)	Maximum Sound Level (dBA)
7/27/2018 14:35	Unknown	Unknown	Overflight	N/A	760	839	83
8/8/2018 15:57	 DELTA AIR LINES	McDonnell-Douglas MD-88	Departure	28	3,272	4,918	76
7/30/2018 12:25	 DELTA AIR LINES	McDonnell-Douglas MD-88	Arrival	10	1,654	2,290	76
7/30/2018 12:57	 American Airlines	Airbus A320	Arrival	10	1,716	2,176	75
7/30/2018 17:09	 DELTA AIR LINES	McDonnell-Douglas MD-88	Arrival	10	1,685	2,567	75
8/6/2018 16:46	 Southwest	Boeing 737-800	Arrival	10	2,079	2,124	75
7/30/2018 21:47	 American Airlines	Airbus A319	Arrival	10	1,697	1,708	75
7/31/2018 0:11	Unknown	Airbus A319	Arrival	10	1,584	1,742	75
8/3/2018 11:31	 DELTA AIR LINES	McDonnell-Douglas MD-88	Arrival	10	1,591	2,430	75
7/30/2018 16:46	 DELTA AIR LINES	McDonnell-Douglas MD-90	Arrival	10	1,791	1,941	75
7/30/2018 16:34	 jetBlue	Airbus A320	Arrival	10	1,635	1,711	75
7/27/2018 17:13	 DELTA AIR LINES	McDonnell-Douglas MD-88	Arrival	UNK	1,835	2,432	75
8/5/2018 17:00	Unknown	Airbus A319	Arrival	10	1,697	1,703	75
8/6/2018 15:39	 envoy	Embraer 170	Arrival	10	1,660	2,997	74
8/2/2018 18:35	 FedEx Express	Boeing 767-300	Arrival	10	1,641	2,308	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 14 complete days of data during the measurement period for community, aircraft and total noise exposure. The community DNL ranged from 54 to 60 with an average of 58 dB. The aircraft DNL ranged from 29 to 57 dB and averaged 48 dB. The total DNL, which accounts for all noise sources, was 59 dB at the measurement site.

Figure 10 presents the cumulative aircraft noise exposure over the fourteen 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 29 to 57 dB during the measurement period. The total aircraft DNL for measurement period was 48 dB. The DNL for all recorded community noise events (traffic noise, landscaping, construction, 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 69% of the time and in east flow 31% of the time, which is similar to 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 DNL at the measurement site is likely similar to the 48 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 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.

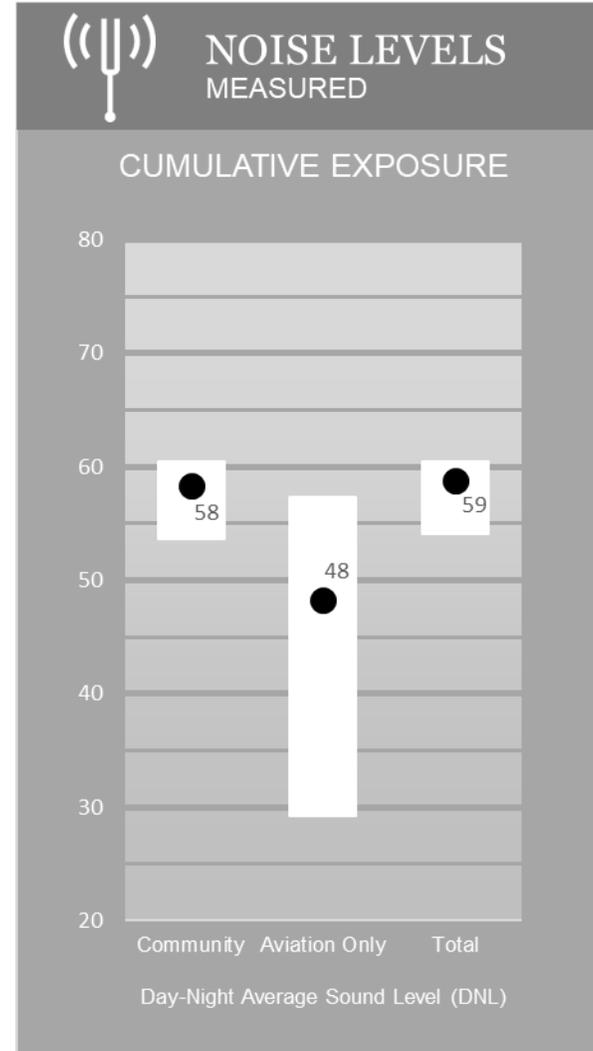


Figure 9. Cumulative Noise Exposure from Aircraft and Community Sources

Cumulative Aircraft Noise Levels

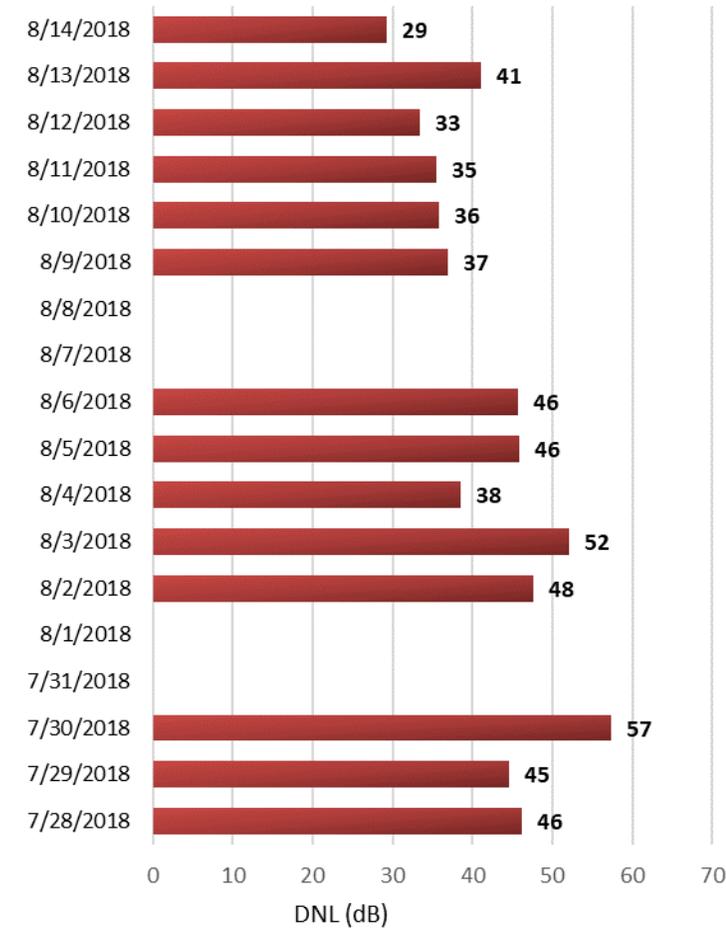


Figure 10. Measured Daily Aircraft Noise Levels

# For More Information

Information about Maryland Department of Transportation Maryland Aviation Administration's (MDOT MAA) Noise Program activities can be found at [www.maacommunityrelations.com](http://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 to [bwi\\_enevs\\_express@maacommunityrelations.com](mailto:bwi_enevs_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](http://www.bwiairport.com)

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

Twitter - @BWI\_Airport

Instagram - [https://www.instagram.com/bwi\\_airport/](https://www.instagram.com/bwi_airport/)



Prepared by HMMH on behalf of the Maryland Department of Transportation Maryland Aviation Administration



# 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, L<sub>max</sub>

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 (L<sub>max</sub>). Figure 2 shows typical L<sub>max</sub> values for some common noise sources. In fact, two events with identical L<sub>max</sub> may produce very different total exposures. One may be of very short duration, while the other may be much longer.

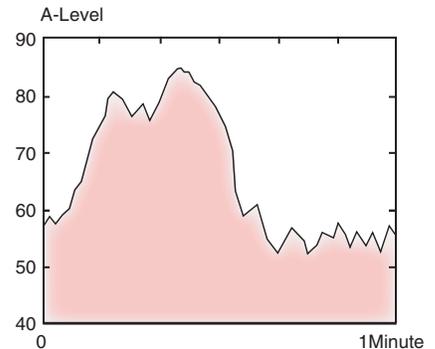


Figure 1. A-weighted Sound Levels Over Time

## 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 L<sub>max</sub> for the event. In fact, for most aircraft events, the SEL is about 7 to 12 dB higher than the L<sub>max</sub>. 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.

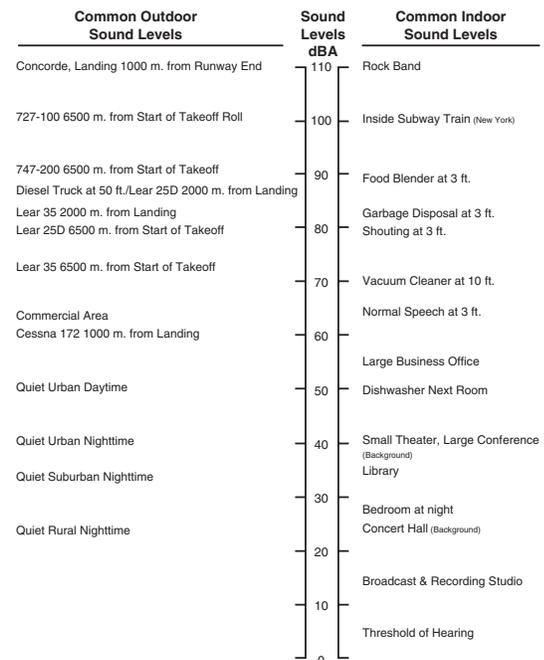
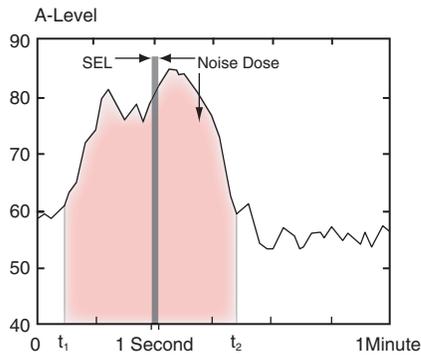


Figure 2. Common Environmental Sound Levels



**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.

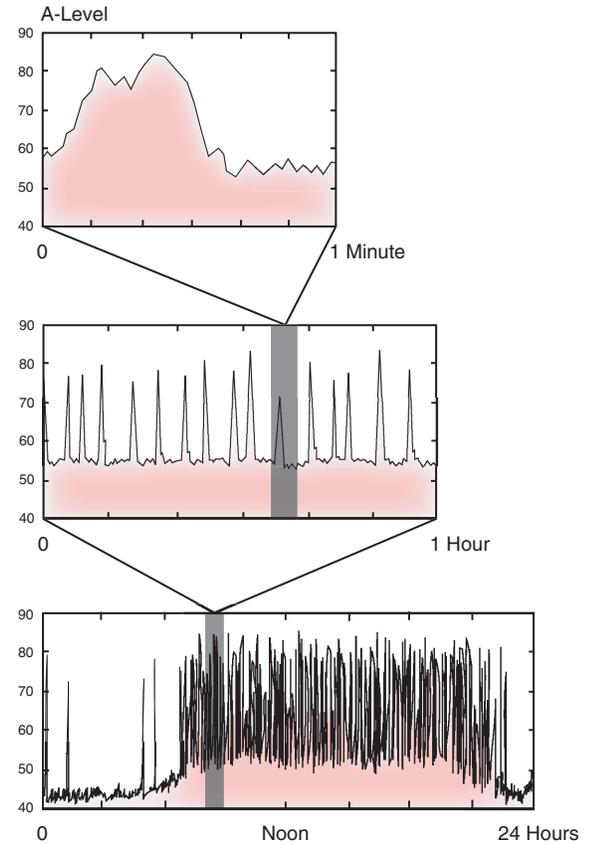
### Day-Night Average Sound Level, DNL

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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