BWI-Thurgood Marshall Airport Aircraft Operations and Noise Exposure

Presented by DC Metroplex BWI Community Roundtable in cooperation with Vianair, Inc.

Monthly Report for February 2023

DC Metroplex BWI Community Roundtable link to Noise Exposure Monthly Reports below
https://marylandaviation.com/environmental/environmental-compliance-sustainability/dc-metroplex-bwi-community-roundtable/

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Introduction

This is a summary of a larger report (the "Monthly Report") prepared by Vianair, Inc. ("Vianair") for the benefit of the DC Metroplex BWI Community Roundtable (the "BWI Roundtable").

The Monthly Reports are the first comprehensive data detailing the noise pollution generated by daily commercial jet plane operations across the entire geography of significantly overflown communities in our region. The BWI Roundtable believes that the analysis of the full environmental impact of airport operations on overflown communities has been understudied, but it is essential information in order to improve the likelihood of success in achieving balanced solutions for the complex set of stakeholders involved in airport operations.

Howard and Anne Arundel Counties hired Vianair to help analyze flight activity in and out of BWI Thurgood Marshall Airport ("BWI-Marshall"). In coordination with representatives from the two counties and support from the BWI Roundtable, Vianair developed the Monthly Report which includes the analysis of key elements (operational and acoustic) to help the wide array of stakeholders understand the existing noise exposure and to provide the ability to track changes over time.

While comprehensive, the elements in the report were selected by those who contributed to the report development (representatives from the two counties and the BWI Roundtable). This report will be published monthly, beginning with March 2022. Report content may change based on input from the contributors and/or the community. This report uses A-weighted decibels or dBA and DNL, described later within this summary report.

What is the Virtual Noise Monitoring Grid?

The BWI Roundtable could locate no single data source covering the entire region for the noise pollution generated by commercial aviation at BWI-Marshall. Although the Maryland Aviation Administration (MAA) maintains noise 24 permanent monitors in areas immediately surrounding the airport, these monitors are not widely dispersed across the entirety of overflown communities. Therefore, the Roundtable asked Vianair, Inc. to establish a **virtual noise monitoring grid** with a total of 89 monitors evenly spread at 2.5-mile intervals covering most of Anne Arundel and Howard Counties (see the map on this page). An additional 36 locations in each county were selected, representing specific areas of interest or "Landmarks" (see pages 5 and 6 of this Executive Summary). The result is a total of 125 discrete locations for which aircraft noise data is collected and analyzed. These locations are referred to as "virtual noise monitor locations" in this report and result in more comprehensive coverage of the study area.

Definitions

Decibel (dB(A)): A unit of measurement of sound pressure adjusted for the human ear's response to particular frequencies

Day-Night Average Sound Level (DNL): A descriptor of 24-hour noise (midnight to midnight) that adds a ten-decibel (dB) nighttime penalty to noise events which occur between the hours of 10 p.m. and 7 a.m to account for the intrusive nature of noise at night. DNL is the standard metric used by the Federal Aviation Administration ("FAA") as required by federal regulation. Federal guidelines require **DNL 65** as the level of aircraft noise exposure that is incompatible with noise-sensitive applications including residential development. This metric is required by FAA and COMAR

The Noise-above (NA): A noise metric counts the number of times the noise level exceeds a specific threshold. In this report, the Number-of-Events-Above 55 metric (NA55) is calculated. NA55 quantifies the number of aircraft events resulting in noise exposure of 55 decibels or higher at each location depicted.

Day-evening-night level (Lden): It is a descriptor of noise level defined by the European Environment Agency ("EEA") and based on energy equivalent noise level (Leq) over a whole day with a penalty of 10 dB(A) for night-time noise (11.00 pm -7.00 am) and an additional penalty of 5 dB(A) for evening noise (7.00 pm -11.00 pm).

Airport Noise Zone (ANZ): An area of land surrounding the airport within which noise levels are equal to or greater than DNL 65 dBA.

Maryland Department of Transportation Maryland Aviation Administration (MDOT MAA): Operator of Baltimore/Washington International Thurgood Marshall Airport (BWI Marshall Airport).

Code of Maryland Regulations (COMAR): Requires MDOT MAA to control development in areas where noise levels are DNL 65 dBA or more..

Disclaimer and Information Sources and Disclosures

Disclaimer: The views and opinions expressed in this document are those of the BWI Roundtable and do not necessarily reflect the views or positions of the state senators who appoint voting members to the BWI Roundtable, the MDOT/MAA, the FAA, Howard or Anne Arundel County elected or appointed officials, commercial carriers or Vianair, Inc. Technical presentations prepared by Vianair Inc. are labeled with the Vianair logo.

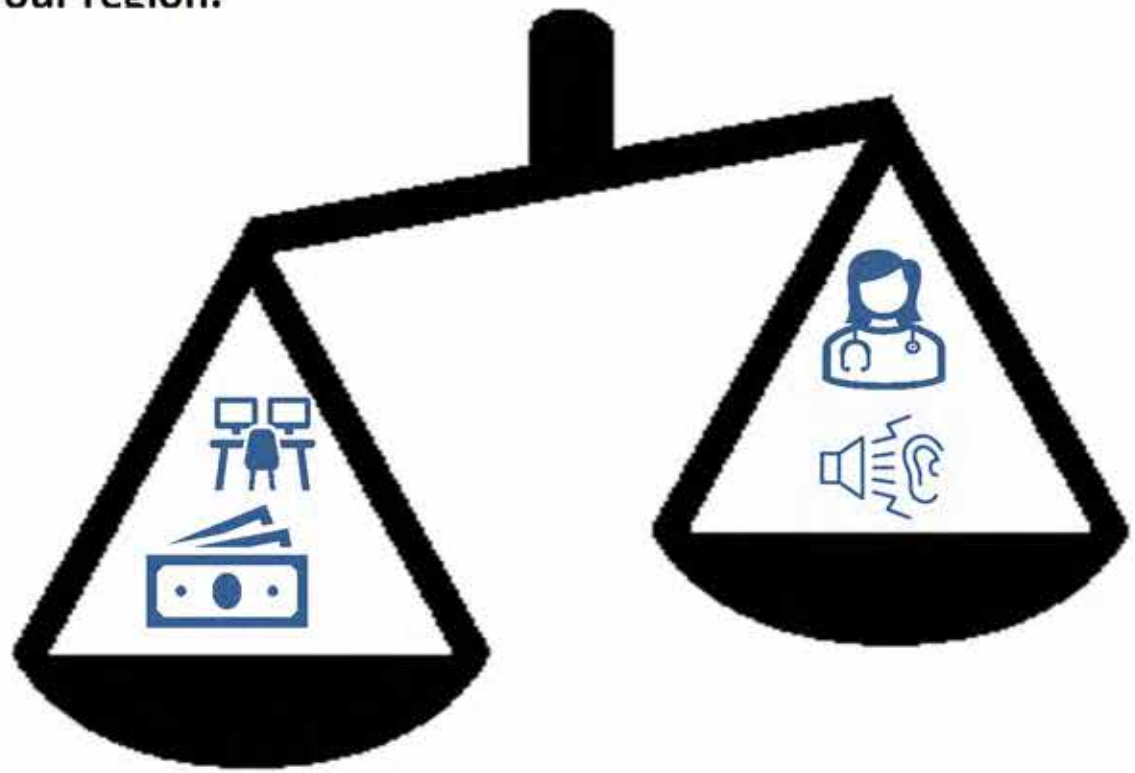
Information Sources and Disclosures:

1. Page 7 - Economic Impact of BWI-Marshall. **Regional Economic Impact of BWI Marshal Airport, December 2017, a brochure of the Maryland Aviation Administration**. In response to a Public Information Act (PIA) request made on November 1, 2022, MDOT/MAA provided "The Economic Impact of Public Use Airports in Maryland", July 2015. The study was prepared by Martin Associates and Landrum and Brown, consultants. MDOT/MAA states that "The 2017 Economic Impact Brochure [..] is an update to the 2015 Economic Impact Report. The 2015 Economic Impact Report and Monthly BWI Statistical Report Summaries serve as the source for the 2017 Economic Impact Brochure." Once the BWI Roundtable verifies the underlying sources of the brochure's statements, we will update this section.

2. Page 7 – Commercial Aviation and Health.
   - Zafari Z and Park, J. "Projecting the health and economic burden of aircraft noise". University of Maryland School of Pharmacy, 2022
   https://www.pharmacy.umaryland.edu/media/SOP/wwwpharmacyumarylandedu/about/depts/p-shor/pdf/projecting-the-health-and-economic-burden-of-aircraft-noise-final-report.pdf
   - Quarterly Noise Reports, Maryland Aviation Administration
   https://marylandaviation.com/environmental/environmental-compliance-sustainability/quarterly-noise-reports/
   - World Health Organization: Environmental Noise Guidelines for the European Union. 2018
   https://www.euro.who.int/__data/assets/pdf_file/0008/383921/noise-guidelines-eng.pdf
   - European Environment Agency: European Noise Directive. 2018
   https://www.eea.europa.eu/airs/2018/environment-and-health/environmental-noise

Seeking Balance at BWI-Marshall Airport

The growth in operations at BWI-Marshall brings a number critically important social and economic impacts to communities surrounding the airport and to the State of Maryland, including economic development, jobs, and taxes collected. However, this also results in significant negative impacts, especially for residents of Anne Arundel and Howard counties, including stress, likely adverse health outcomes and a diminished quality of life. **Over the course of our almost six (6) years of existence, the BWI Roundtable has come to believe those impacts are unsustainably unbalanced in favor of economic impacts in our region.**



Economic Impact of BWI-Marshall

Airport-Generated	Visitor-Generated
$4.4 B Total Impact	$4.9 B Total Economic Impact
Total Jobs 24,211 Direct 12,753 Indirect 11,458	Total Jobs 82,277 Direct 46,857 Indirect 35,420
$1.6 B Total Earnings	$2.5 B Total Earnings
$175.4 M Total State/Local Taxes	$416.5 M Total State/Local Taxes

State taxes are estimated to be $336.3 million and Local taxes are estimated to be $255.7 million

Commercial Aviation and Health

University of Maryland- Baltimore study shows over $800 million (2022 dollars) in health costs over 30-years from current BWI-Marshall operations

123,133 BWI-Marshall noise complaints (230 individuals) during 2nd Quarter of 2022. The airport received a total of 620,276 noise complaints in 2021.

The World Health Organization recommends aircraft noise levels in Europe to below 45 dB during the day (40 dB at night). Higher levels of noise is associated with adverse health effects.

55 dB Lden is the EU threshold for excess exposure defined in the Environmental Noise Directive

FAA has adopted 65 dBA DNL as the threshold of significant noise exposure, below which residential land uses are compatible

BWI Airport Noise Zone is noise above 65 dBA DNL

Runway Use

BWI has six runways: 10, 15R, 15L, 28, 33R, and 33L. Runway selection is based primarily on wind direction. BWI operates in two flows. When winds are out of the east or south, aircraft will arrive and depart in an **EAST FLOW** and when winds are out of the west or north, aircraft will arrive and depart in a **WEST FLOW**. Aircraft noise levels vary when below an aircraft landing or taking-off. Runway use also influences routes to and from the airport, which also affects aircraft noise for communities below.

EAST FLOW

WEST FLOW

East and West Flow

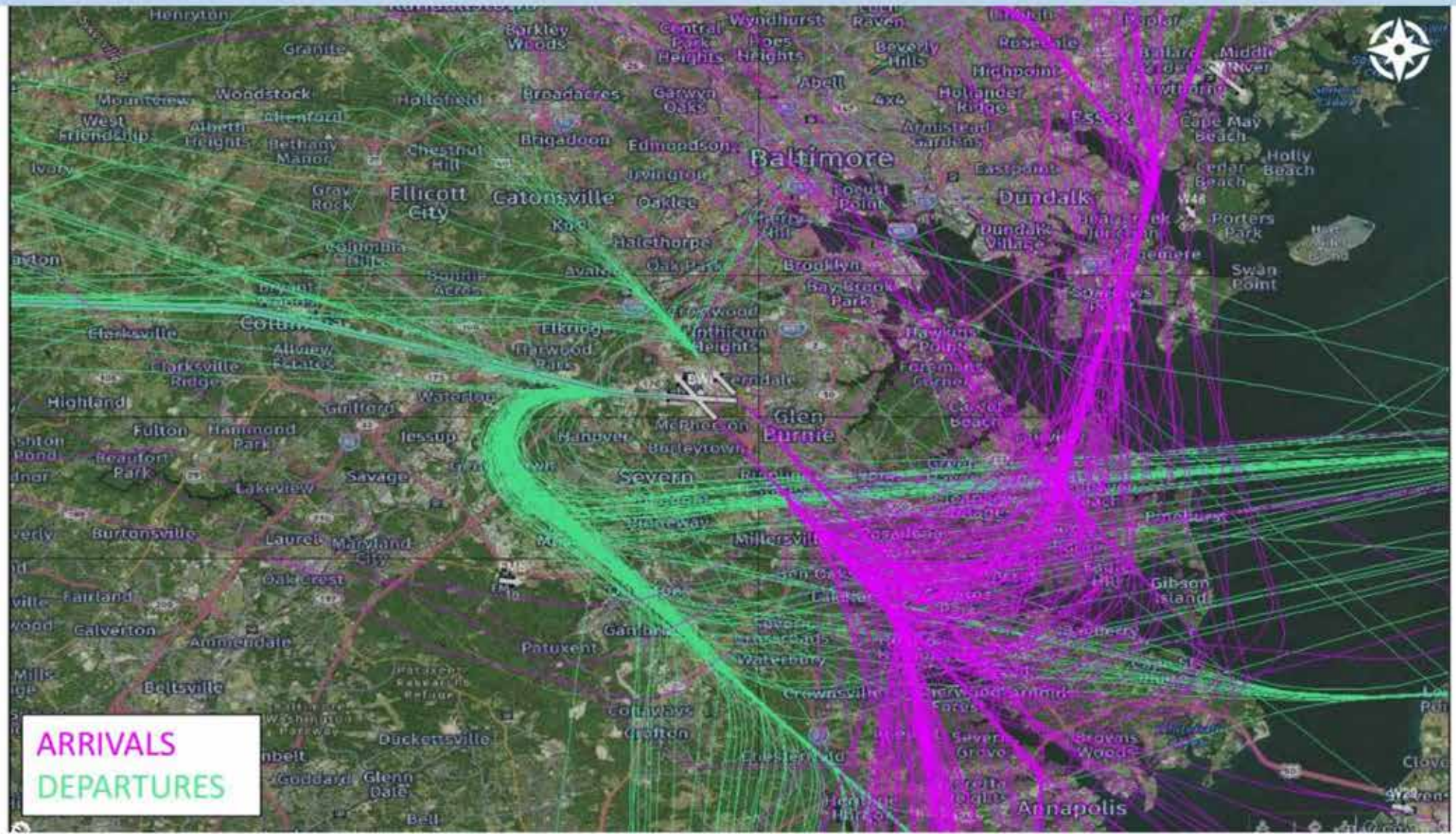
Prevailing wind speed, direction and weather factors determine the direction of air traffic flow from BWI-Marshall airport. Aircraft usually take off and land into the wind to meet safety and operational requirements.

During **EAST FLOW** conditions (winds from the south or east), aircraft arrive and depart toward the east. This includes runways 15L, 15R, and 10.

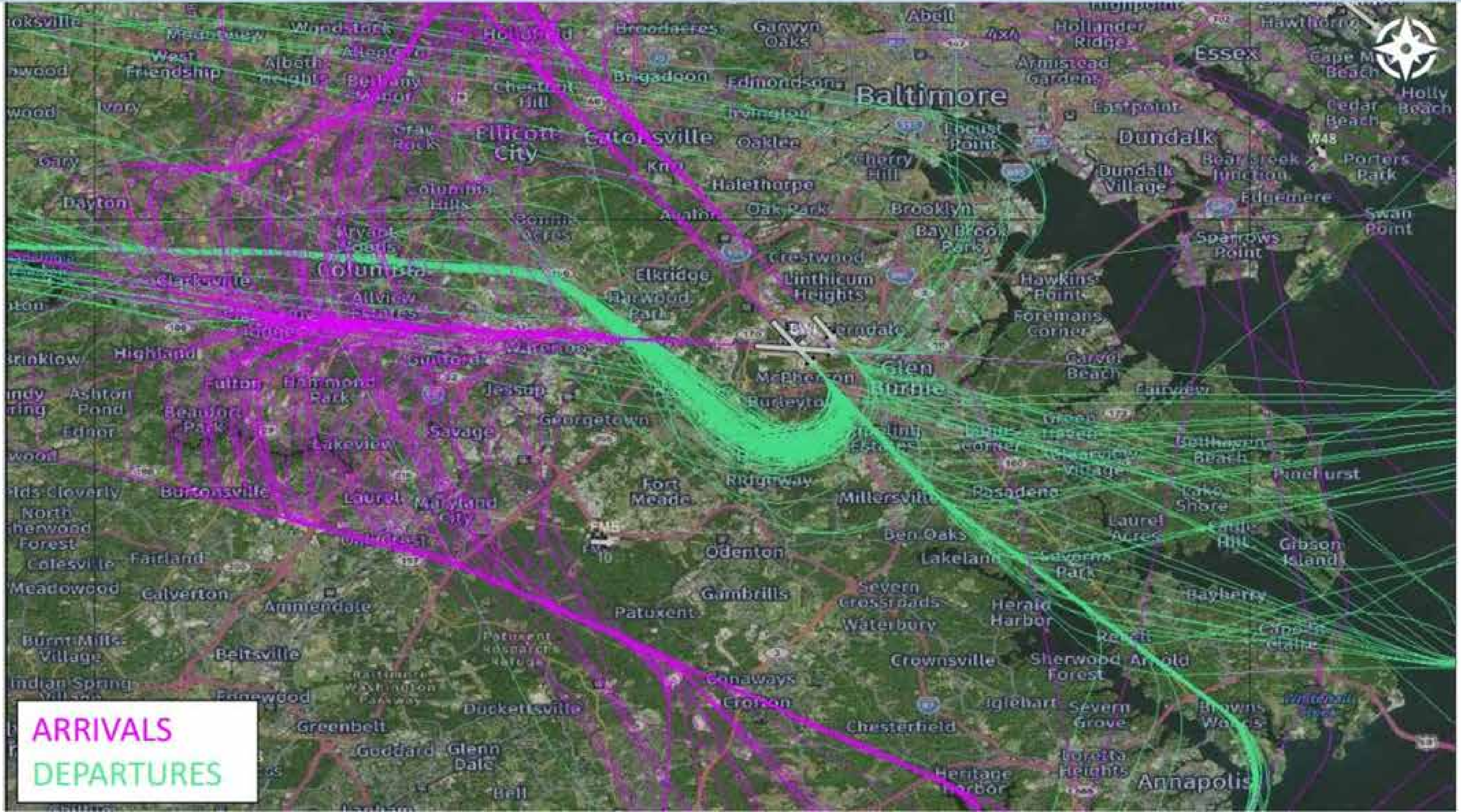
During **WEST FLOW** conditions (winds from the north or west), aircraft arrive and depart toward the west. This includes runways 33L, 33R, and 28. The following slides are intended to illustrate arrival and departure flight paths across the region during sample EAST and WEST flows days.

The next two pages illustrate a typical East Flow day and a typical West Flow day at the airport. Sample days were analyzed by Vianair and then depicted as all arrivals and departures consistent with a specific flow on a given day. While these flight patterns are typical, they may vary on other days based on operational conditions.

Visual representation of daily traffic patterns over the Baltimore region during West Flow operations at BWI-Marshall



Visual representation of daily traffic patterns over the Baltimore region during East Flow operations at BWI-Marshall



Monthly Noise Exposure – Anne Arundel County Landmark Locations

February 2023 – Both East and West Flow Operations

Name	Description	Number of Events Above 55dBA (Monthly)	Daily Average (Monthly)	Number of Events Above 55 dBA (YTD)	DNL (Monthly)
AAR_VNM1	RAVNN	92	0	25	12.85
AAR_VNM2	JETNA	16	1	40	19.37
AAR_VNM3	Arden on the Severn	4419	158	9838	57.21
AAR_VNM4	London Public House	1391	50	3050	38.47
AAR_VNM5	Annapolis Middle School	613	22	1310	37.86
AAR_VNM6	West Annapolis Elementary	1100	39	2445	43.98
AAR_VNM7	Herald Harbor	8	0	21	16.78
AAR_VNM8	Eastport Terrace	562	20	1204	37.93
AAR_VNM9	Truxton Park	682	24	1471	39.84
AAR_VNM10	Shipley's Choice Elementary	5685	203	12510	58.25
AAR_VNM11	Robinwood	551	20	1153	35.89
AAR_VNM12	Wordour Bluffs	998	36	2138	42.55
AAR_VNM13	Millersville Elementary School	784	28	1649	43.02
AAR_VNM14	Sherwood Forest	1638	58	3725	48.54
AAR_VNM15	Brookeville, Montogomery County	25	1	59	27.7
AAR_VNM16	Rolling Knolls	1967	70	4246	46.62
AAR_VNM17	Maryland State House	832	30	1817	41.48
AAR_VNM18	I-97 and MD 178 Crownsville	703	25	1486	42.35

This table shows the noise pollution metrics at the "Landmark" locations identified by the Roundtable for Anne Arundel County, which primarily experiences arrivals to the airport.

Locations closest to the airport and/or concentrated flight corridors many miles away from the airport will typically see the highest noise exposure. For instance, **West Annapolis Elementary School (WAES**) is approximately 23.4 miles from the end of Runway 33L, the dominant runway for arrivals. Yet, the DNL is almost 44, there were an average of 39 flight per day over 55 decibels **(2,445 such flights year-to-date in 2023).**

Monthly Noise Exposure – Howard County Landmark Locations

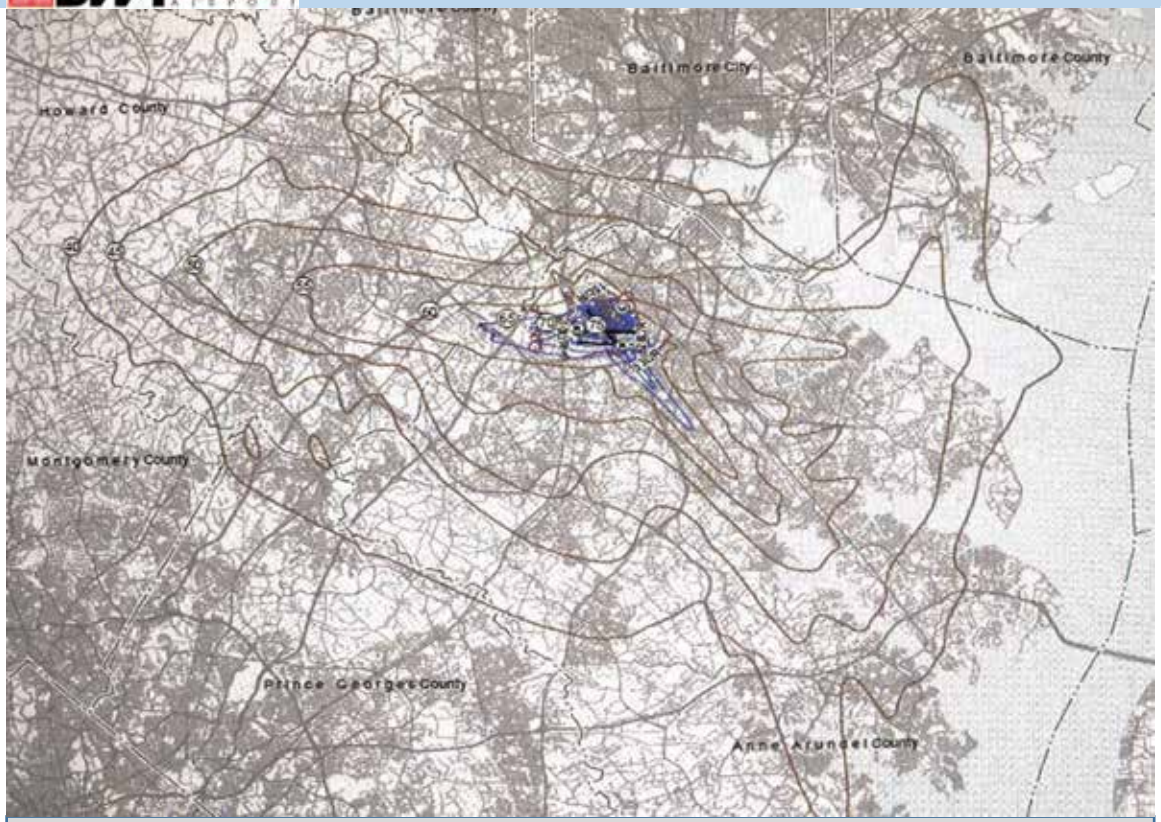
February 2023 – Both East and West Flow Operations

Name	Description	Number of Events Above 55dBA (Monthly)	Daily Average (Monthly)	Number of Events Above 55 dBA (YTD)	DNL (Monthly)
HOCO_VNM1	Howard Square Apartments	7095	253	14742	54.41
HOCO_VNM2	HCPSS Administration Campus	3233	115	7141	48.7
HOCO_VNM3	Centennial Park	3121	111	6781	47.36
HOCO_VNM4	HoCo General Hospital	4309	154	9325	52.33
HOCO_VNM5	Merriweather Post Pavillion	4633	165	9864	53.74
HOCO_VNM6	Oakland Mills HS	4877	174	10329	54.91
HOCO_VNM7	Long Reach HS	5030	180	10593	55.78
HOCO_VNM8	Troy Park	6252	223	13343	58.86
HOCO_VNM9	Harwood Park N'hood	6366	227	13652	57.79
HOCO_VNM10	Abiding Savior Lutheran	3970	142	8680	50.8
HOCO_VNM11	Tridelphia Ridge ES	129	5	320	34.92
HOCO_VNM12	Atholton HS	3656	131	7955	51.98
HOCO_VNM13	Christ Church Episcopal	5341	191	11219	55.81
HOCO_VNM14	Mayfield Woods MS	5210	186	10928	58.62
HOCO_VNM15	Manor Woods ES	142	5	307	38.36
HOCO_VNM16	Gateway Site	5587	200	11565	56.25
HOCO_VNM17	Oxford Square Neighborhood	8431	301	17599	65.23
HOCO_VNM18	St. Louis Catholic	2280	81	5134	46

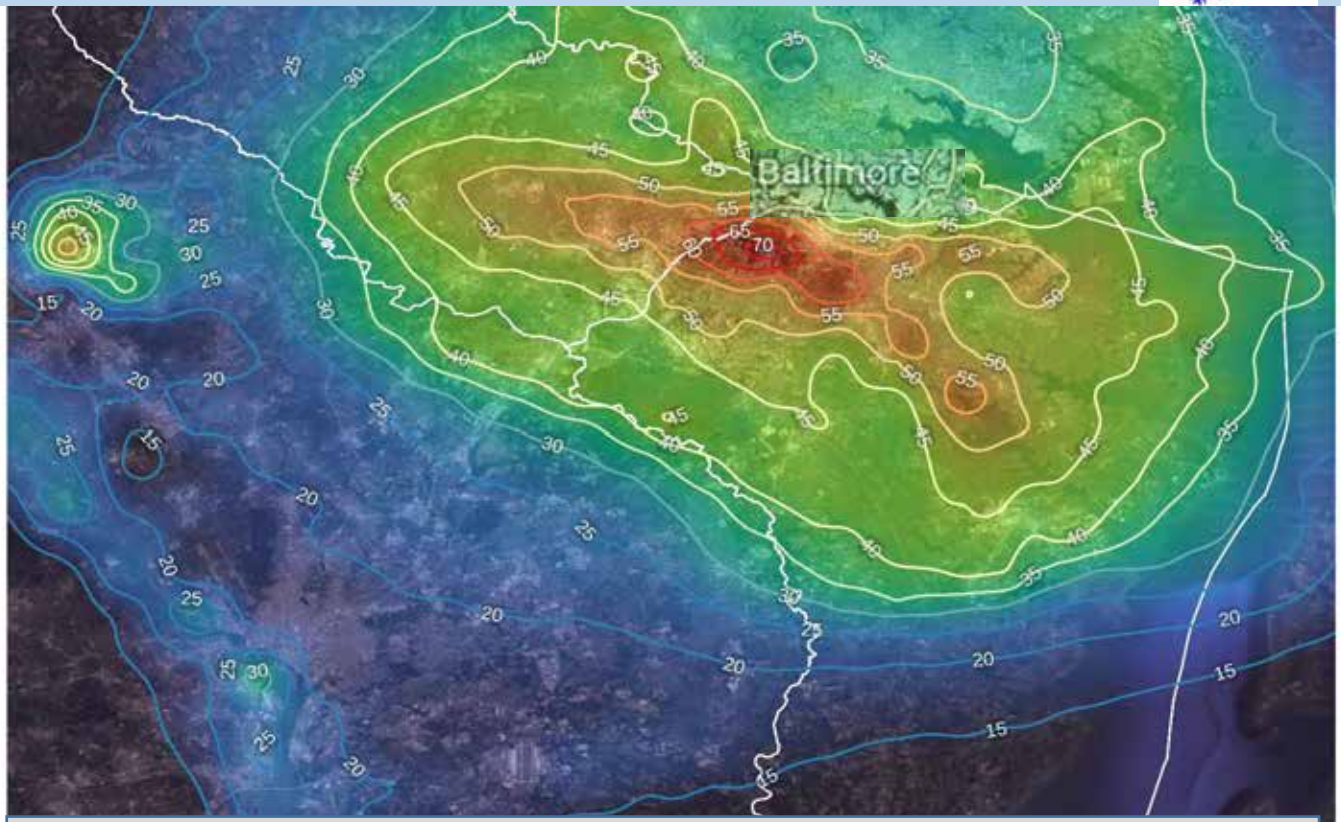
This table shows the noise pollution metrics at the "Landmark" locations identified by the Roundtable for Howard County, which primarily experiences departures from the airport.

Due to the high level of thrust required for take-offs, Howard County noise metrics are generally quite high, especially under concentrated flight corridors. For instance, **Oakland Mills High School (OMHS)** is approximately 8.3 miles from the end of Runway 28, the dominant runway for departures. Yet, the DNL is almost 55 and there were an average of 174 flight per day over 55 decibels **(10,329 such flights year-to-date in 2023).**

REGIONAL MAPS OF BWI-MARSHALL NOISE POLLUTION



MAA modeled *actual historical* flights projected for the 2020 Airport Noise Zone and updated in Aug 2022 for a report to the Maryland General Assembly

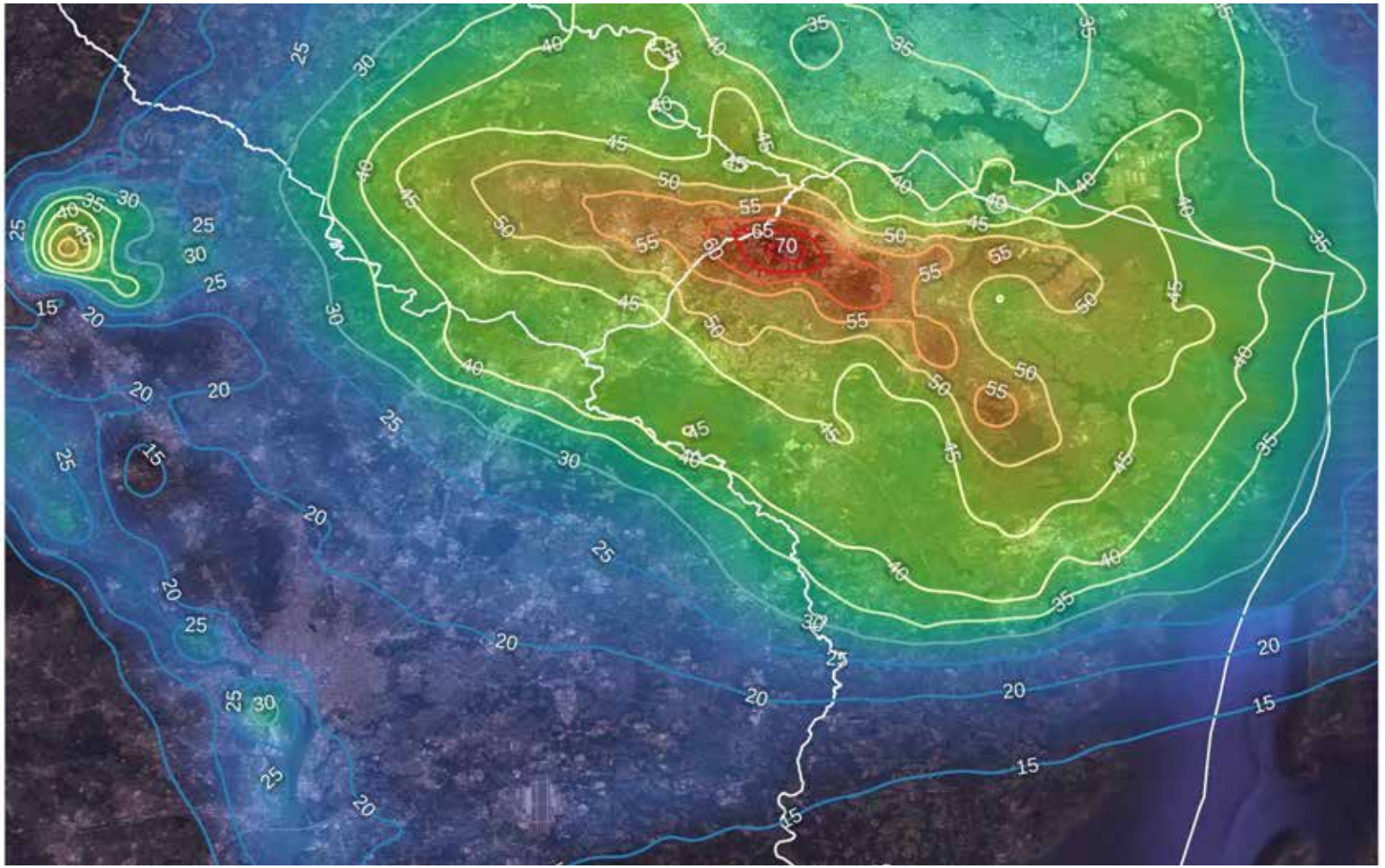


Vianair, Inc. modeled *actual daily* flights for February 2023 for the Monthly Aircraft Operations and Noise Exposure Report of the DC Metroplex BWI Community Roundtable

These images represent two versions of the mapped regional noise pollution generated by commercial flight operations at BWI-Marshall. The map on the left was generated by MDOT-MAA based on actual **historical** operations collected by the MDOT MAA's Airport Noise and Operations Monitoring System (ANOMS) with computer modeling of future expected noise. It is focused on the 65 DNL contour of the Airport Noise Zone. The Vianair-generated map on the right is based on **actual daily flights** from the airport with computer modeling of the resulting expected noise, creating a more in-depth look at all DNL noise contours.

Noise Exposure – DNL Contours

Howard and Anne Arundel Counties



In this Vianair-generated map, noise is expressed in DNL contours. For reference, the **50 DNL** contour stretches westward to encompass the approximate boundaries of **Columbia/ Clarksville**, eastward to **Fort Smallwood/Lake Shore/ Annapolis** and south to **Crownsville /Millersville/Fort Meade**.

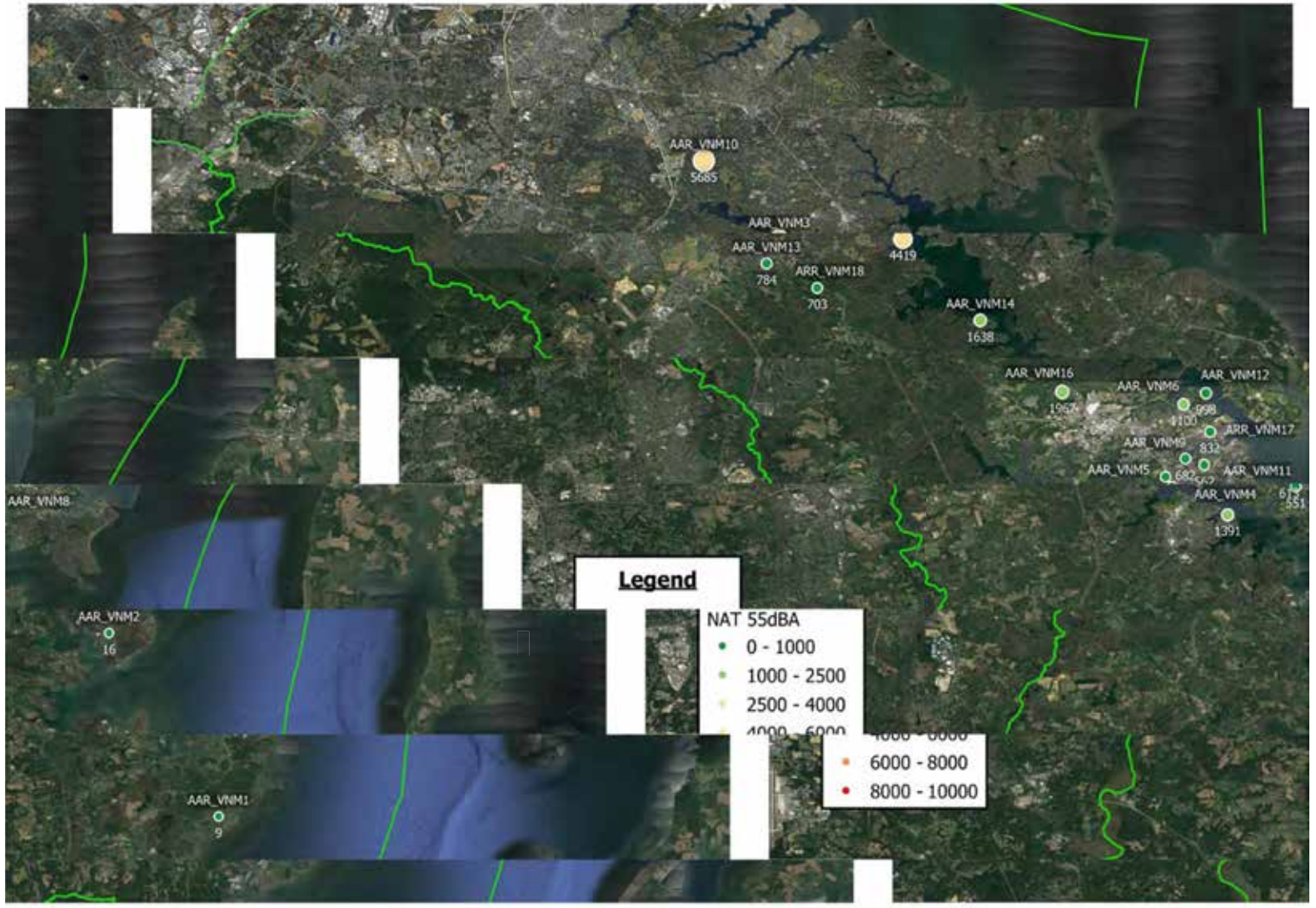
The WHO has identified adverse health effects at this noise level.

Flight Track Density – Heat Map of Anne Arundel and Howard Counties

Flight track density analyzes the concentrations of flight activity in and out of BWI. Flight track density is calculated based on reviewing all flights for the month, then analyzing the concentration of flights within the study area. Concentration (or density) is then depicted using color. Red represents the highest density, fading to white as density lowers.

Noise Exposure – Number of Events Above 55 dBA

Anne Arundel County - Landmark Locations Only

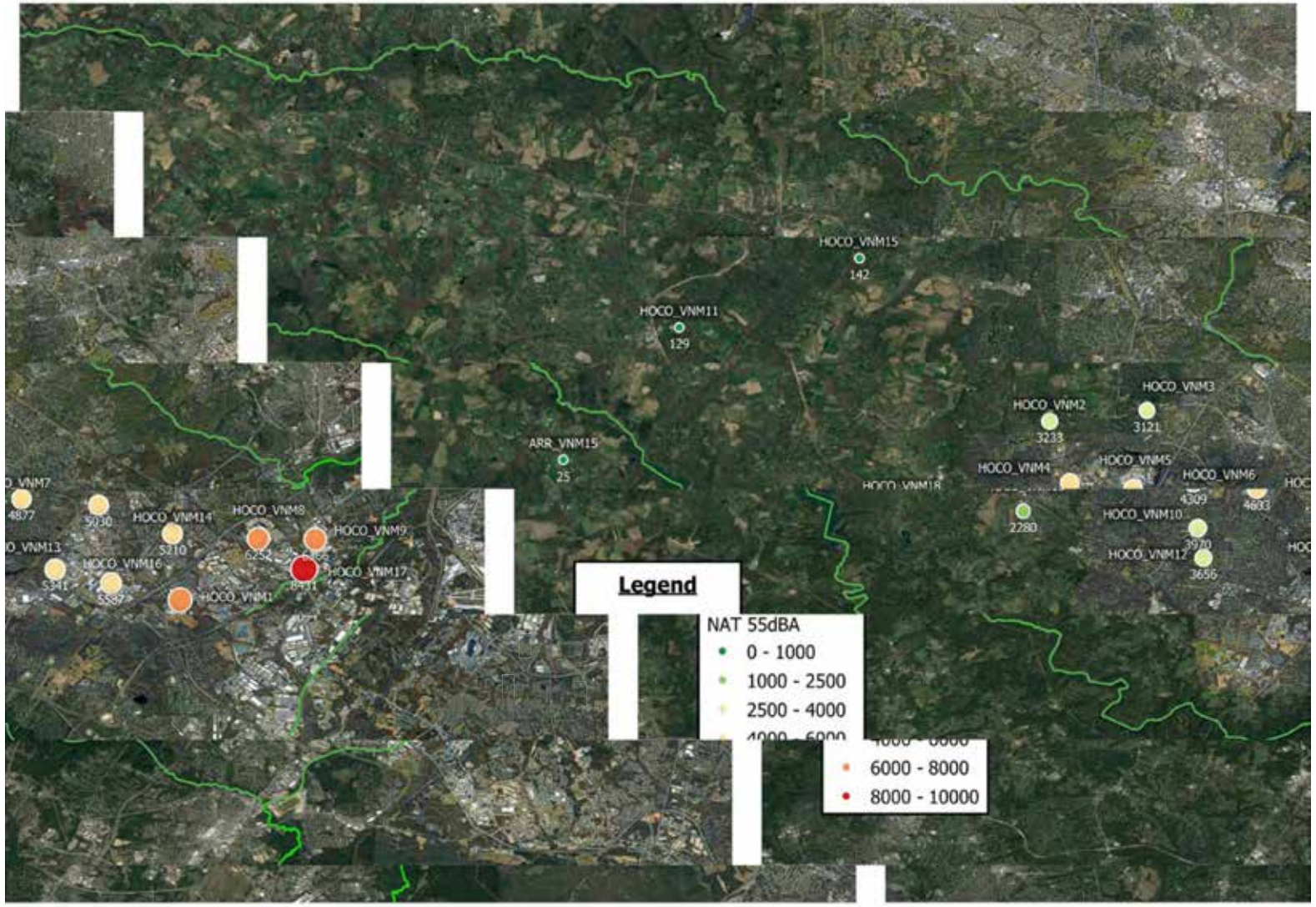


This map shows the Number of Events (single flights) at the local Landmarks during the month above the 55 decibel Threshold (NAT) for Anne Arundel County.

Note that the Annapolis peninsula and other communities along the Severn River experience many events above threshold.

Noise Exposure – Number of Events Above 55 dBA

Howard County - Landmark Locations Only



This map shows the Number of Events (single flights) at the local Landmarks during the month above the 55 decibel Threshold (NAT) for Howard County.

Note that while highly significant noise pollution extends to St. Louis Catholic School in Clarksville (HOCO_VNM18), areas as far west as Tridelphia Ridge Elementary School (HOCO_VNM11) also experienced many events above threshold.

Noise Exposure – Number of Events Above 55 dBA

Anne Arundel County – Full Virtual Noise Monitor Grid

This map shows the Number of Events (single flights) during the month above the 55 decibel Threshold (NAT) for the total grid of Virtual Noise Monitors in Anne Arundel County.

For individuals who wish to use this map to gauge the NAT for their location of interest (home, school, hospital, etc.) there will be noticeable differences in noise pollution between each Virtual Noise Monitor.

Noise Exposure – Number of Events Above 55 dBA

Howard County – Full Virtual Noise Monitor Grid

This map shows the Number of Events (single flights) during the month above the 55 decibel Threshold (NAT) for the total grid of Virtual Noise Monitors in Howard County.

For individuals who wish to use this map to gauge the NAT for their location of interest (home, school, hospital, etc.) there will be noticeable differences in noise pollution between each Virtual Noise Monitor.

Noise Exposure – Full Virtual Noise Monitor Grid, All Operational Flows

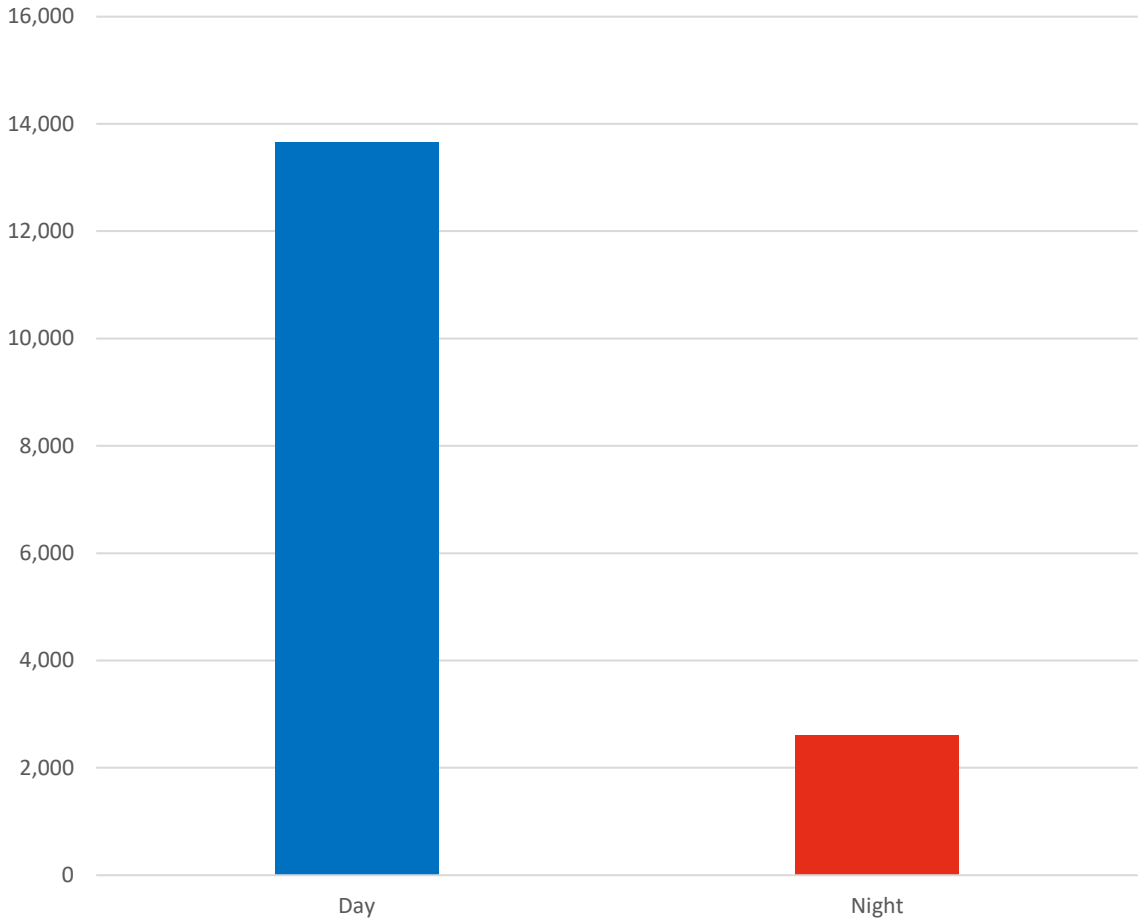
Name	Number-of-Events-Above 55dBA (Total)	Daily Average	DNL
VNM1	7	0	11.94
VNM2	12	0	17.78
VNM3	18	1	21.02
VNM4	29	1	25.87
VNM5	29	1	29.02
VNM6	82	3	34.48
VNM7	7	0	13.59
VNM8	13	0	19.36
VNM9	16	1	22.91
VNM10	37	1	28.29
VNM11	86	3	35.19
VNM12	192	7	39.38
VNM13	257	9	40.5
VNM14	317	11	43.87
VNM15	17	1	23.11
VNM16	27	1	27.69
VNM17	121	4	34.38
VNM18	333	12	41.74
VNM19	522	19	43.44
VNM20	262	9	42.26
VNM21	110	4	39.57
VNM22	38	1	29.39
VNM23	956	34	38.82
VNM24	2937	105	47.98
VNM25	4305	154	52.35
VNM26	4768	170	53.11
VNM27	3771	135	49.58
VNM28	1100	39	47.76
VNM29	330	12	44.66
VNM30	77	3	38.79

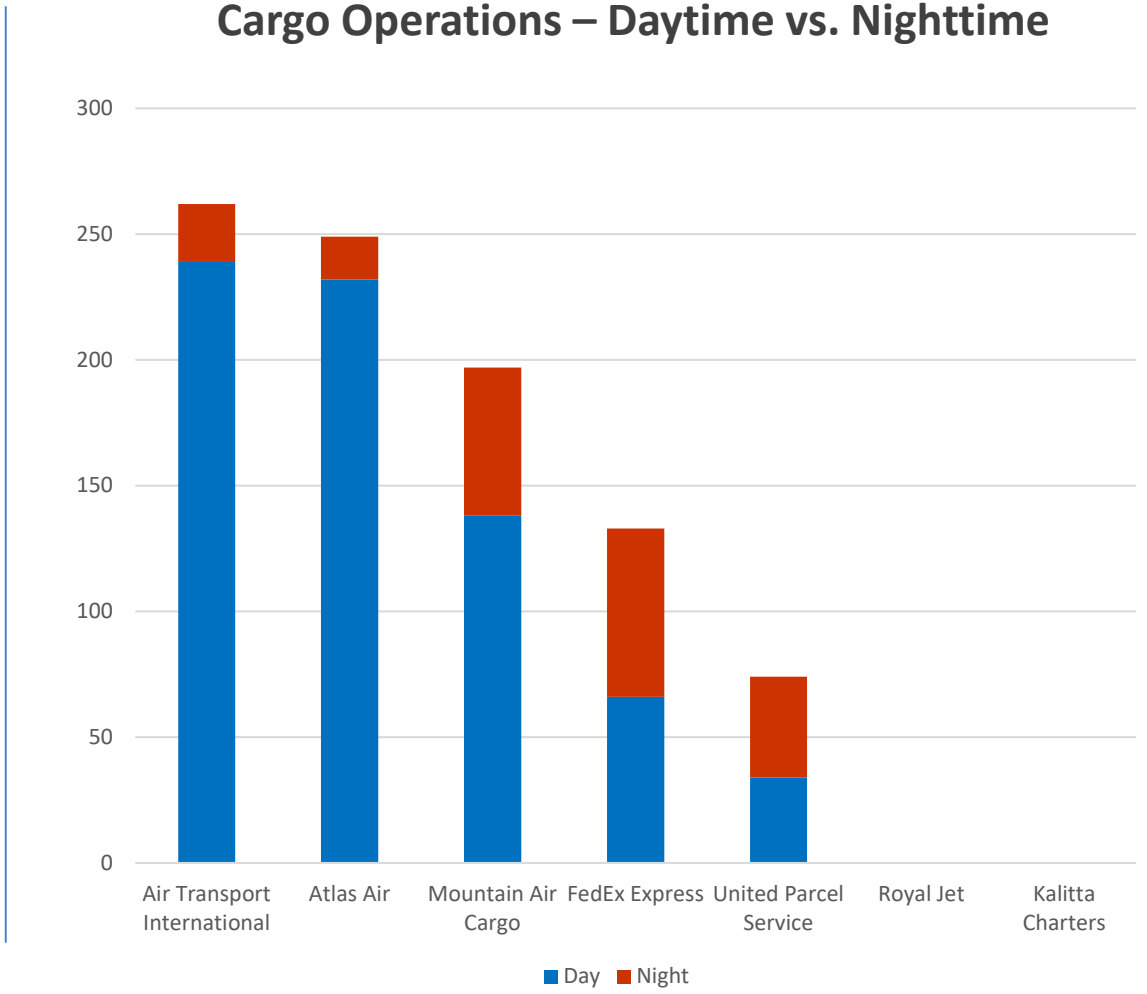
Name	Number-of-Events-Above 55dBA (Total)	Daily Average	DNL
VNM31	172	6	40.05
VNM32	108	4	34.35
VNM33	342	12	43.18
VNM34	979	35	48.49
VNM35	3892	139	50.96
VNM36	7580	271	56.31
VNM37	8490	303	69.32
VNM38	1176	42	51.34
VNM39	857	31	51.85
VNM40	1030	37	47.39
VNM41	169	6	37.87
VNM42	305	11	42.64
VNM43	344	12	43.91
VNM44	1615	58	49.63
VNM45	2587	92	51.62
VNM46	2356	84	59.35
VNM47	4279	153	54.17
VNM48	815	29	45.77
VNM49	1825	65	49.27
VNM50	762	27	45.06
VNM51	575	21	42.52
VNM52	328	12	41.54
VNM53	1421	51	48.42
VNM54	1190	42	45.1
VNM55	3745	134	50.07
VNM56	1729	62	50.8
VNM57	1012	36	47.43
VNM58	784	28	44.85
VNM59	61	2	34.83
VNM60	1064	38	44.57

Name	Number-of-Events-Above 55dBA (Total)	Daily Average	DNL
VNM61	209	7	40.66
VNM62	983	35	45.23
VNM63	445	16	42.71
VNM64	3786	135	53.03
VNM65	1153	41	47.3
VNM66	512	18	42.73
VNM67	444	16	39.96
VNM68	1046	37	43.41
VNM69	691	25	42.93
VNM70	1992	71	47.59
VNM71	1274	46	44.96
VNM72	450	16	39.8
VNM73	116	4	32.85
VNM74	400	14	38.67
VNM75	722	26	41.98
VNM76	1644	59	43.61
VNM77	655	23	40.02
VNM78	224	8	36.63
VNM79	251	9	34.59
VNM80	57	2	30.55
VNM81	250	9	34.99
VNM82	121	4	32.49
VNM83	37	1	26.48
VNM84	35	1	24.62
VNM85	16	1	20.83
VNM86	16	1	20.67
VNM87	16	1	20.07
VNM88	16	1	18.72
VNM89	40	1	25.3

Monthly Operations – Daytime versus Nighttime

February 2023



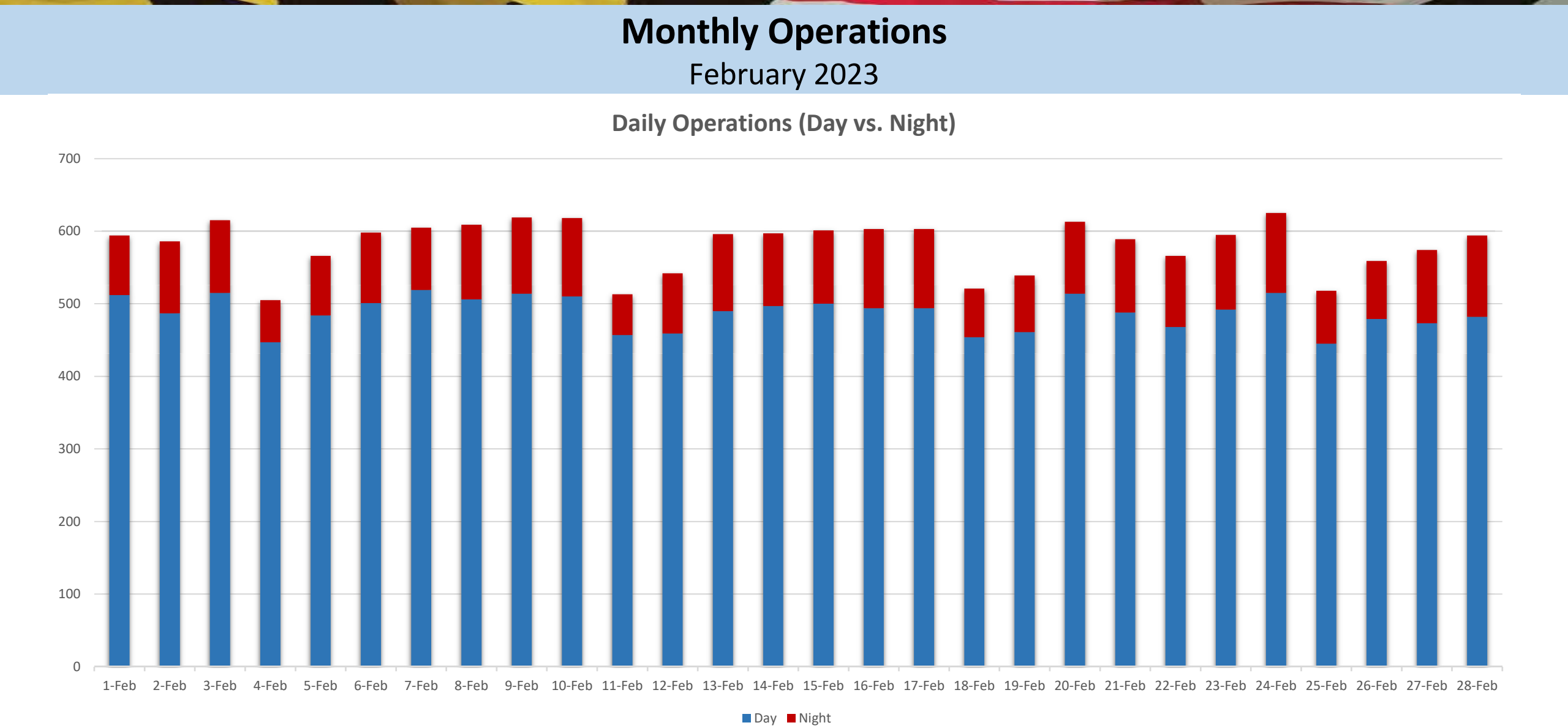


RED represents Nighttime flights. "Nighttime Hours" are from 10PM - 7AM

PRIMARY CUSTOMER(S) OF EACH INDEPENDENT CARGO CARRIER TO BE IDENTIFIED IN FUTURE REPORTS

Monthly Operations

February 2023

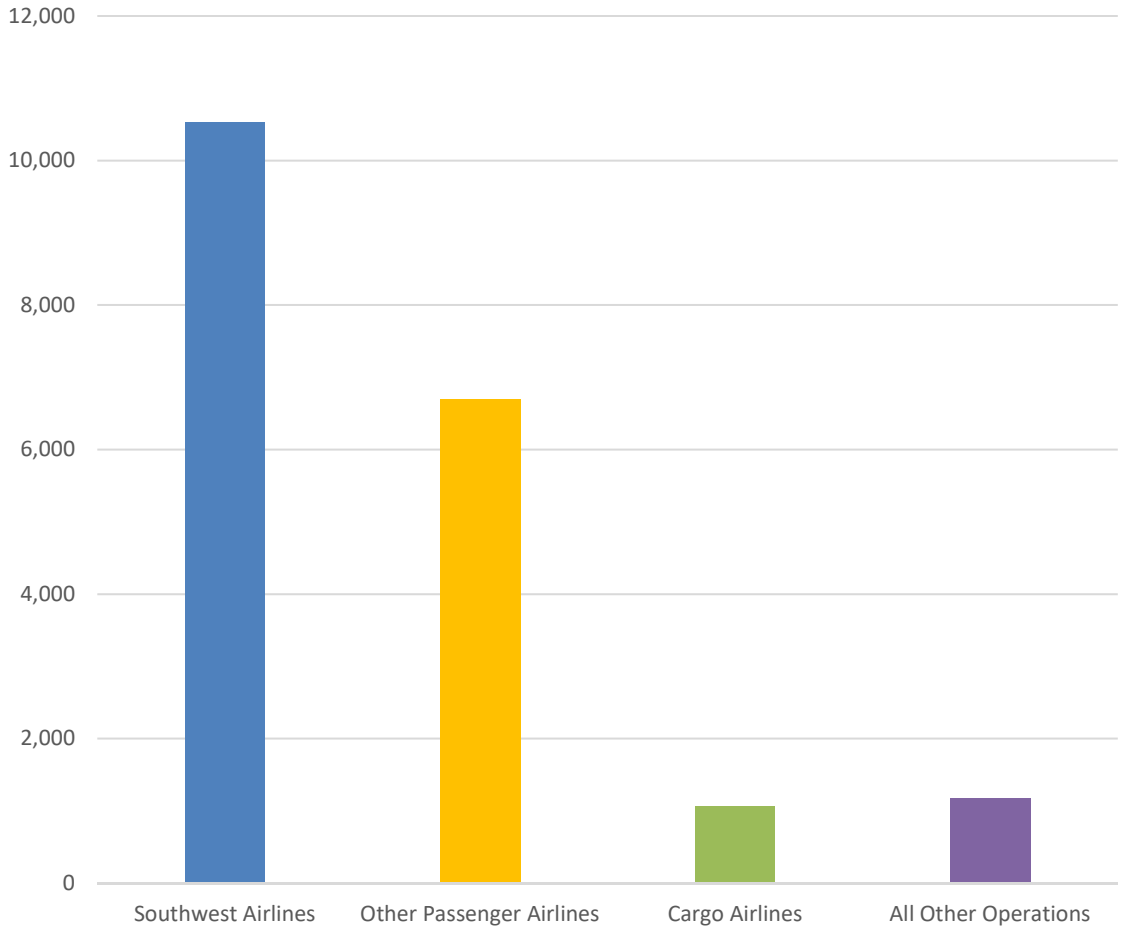


RED represents Nighttime flights. "Nighttime Hours" are from 10PM - 7AM

Aircraft Operations

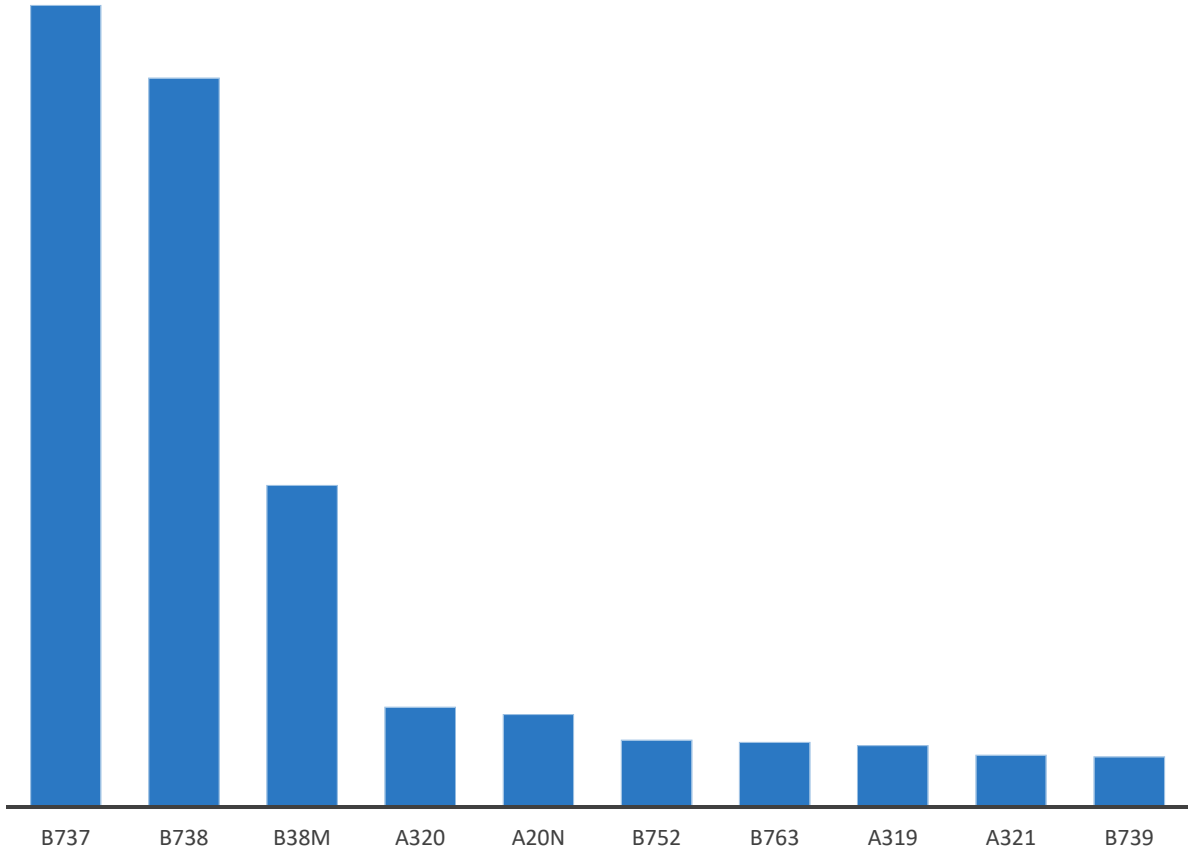
February 2023

Southwest vs. All Other Operations



Total Operations by Aircraft Type

(Top 10 Aircraft)



Aircraft Noise Basics

Noise is defined as “unwanted sound.” There are many ways to measure noise. Two common metrics will be used in these reports: Day-Night Level (DNL) and Number-of-Events-Above (NA).

DNL is the standard metric used by the Federal Aviation Administration as required by federal regulation. Federal guidelines recommend **DNL 65** as the level of aircraft noise exposure that is incompatible with noise-sensitive applications including residential development. A problem with DNL is it is difficult for the public to understand and doesn’t seem to reflect what residents experience on a daily basis.

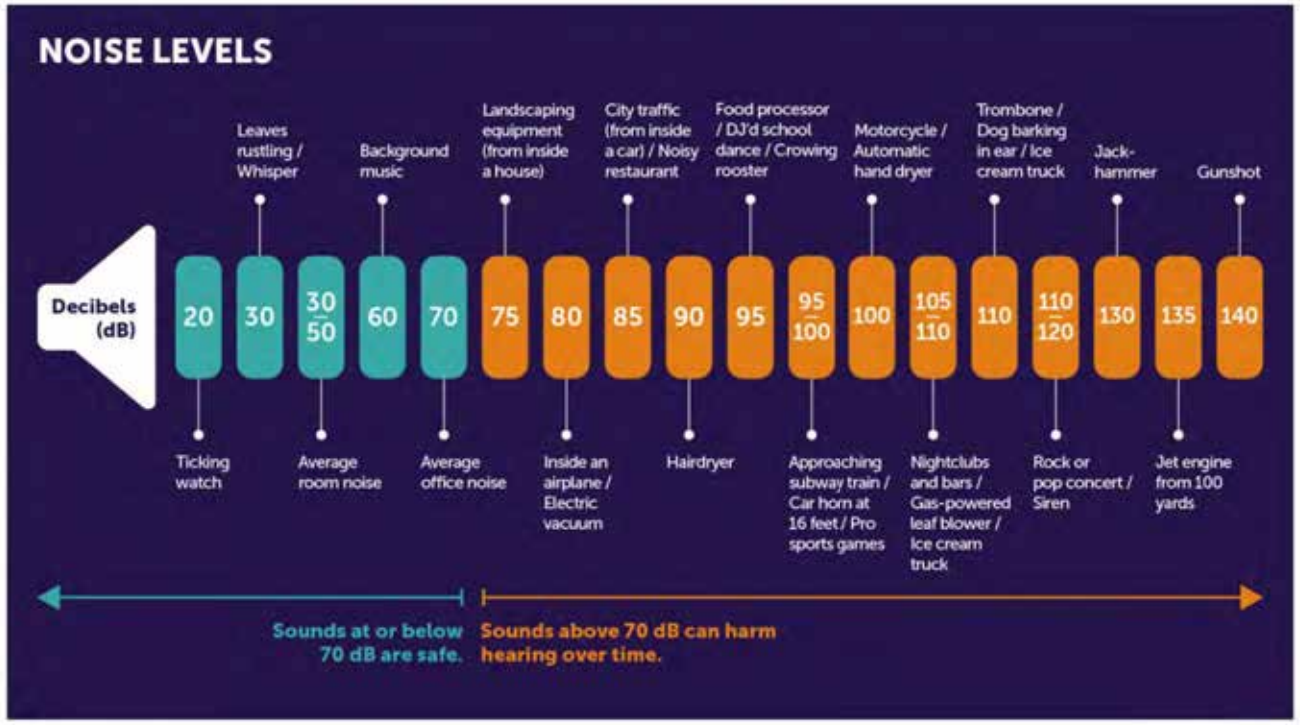
The NA noise metric counts the number of times the noise level exceeds a specific threshold. In this report, the Number-of-Events-Above 55 metric (NA55) is calculated. NA55 quantifies the number of aircraft events resulting in noise exposure of 55 decibels or higher at each location depicted.

Noise Basics

The scale below is intended to provide a basic understand of noise levels which are expressed in A-weighted decibels (dB or dBA). The purpose of the chart is to provide examples of noise/sound level associated with common events. This is intended to provide the reader with a basic understanding or context of "how loud" 55, 65, 75, etc., decibels is.

It is worth noting that noise (sound) exposure and noise annoyance are different. Noise exposure is based on acoustics and represents a measure of sound energy a person is exposed to. Sound exposure at a specific level (i.e. 65 db) may be perceived differently based on the source of the noise (i.e. music at 65 decibels vs. aircraft noise at 65 decibels). The source of the sound and the individual's perception of the source is one of the many factors that contribute to our reaction.

Annoyance (annoyed, highly annoyed, not annoyed, etc.) is based on an individual's multi-factored response to noise exposure and varies by individual. However, aircraft noise consistently generates greater levels of high annoyance among surveyed populations than other types of transportation noise. **Of note for this report, high noise annoyance has been scientifically associated with disease.**



Source: Hearing Health Foundation, http://hearinghealthfoundation.org/

Why the DNL metric is controversial

In September 2021, the General Accounting Office of the United States Government (GAO) published a review of the FAA's implementation of the precision flight path component of NextGen, which is call Performance Based Navigation (PBN). That analysis showed that because DNL combines the effects of several components of noise into a single metric, it does not provide a clear picture of the flight activity or associated noise levels at a given location. For example, 100 flights per day can yield the same DNL as one flight per day at a higher decibel level, due to the averaging effect of FAA's metric.

Flights per day, by decibel (dB) level	Day-Night Average Sound Level
1 flight per day at 114.4 dB	65 dB
100 flights per day at 94.4 dB	65 dB

Note: For more details, see fig. 1 in GAO-22-105844.

Source: GAO analysis of Federal Aviation Administration information. | GAO-22-105844

The GAO's analysis and other research demonstrate the limitations of FAA relying solely on DNL to identify potential noise problems. This illustrates why communities often view DNL as a "permissive" measure, designed to allow increased airplane operations.

For More Information …

For more information about the contents of this report or
for questions about the DC Metroplex BWI Community Roundtable

Please visit:

https://marylandaviation.com/environmer roplex-bwi-community-roundtable/

Jesse to update