BWI-Thurgood Marshall Airport Aircraft Operations and Noise Exposure

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

Monthly Report for November 2022

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

Table of Contents

Introduction

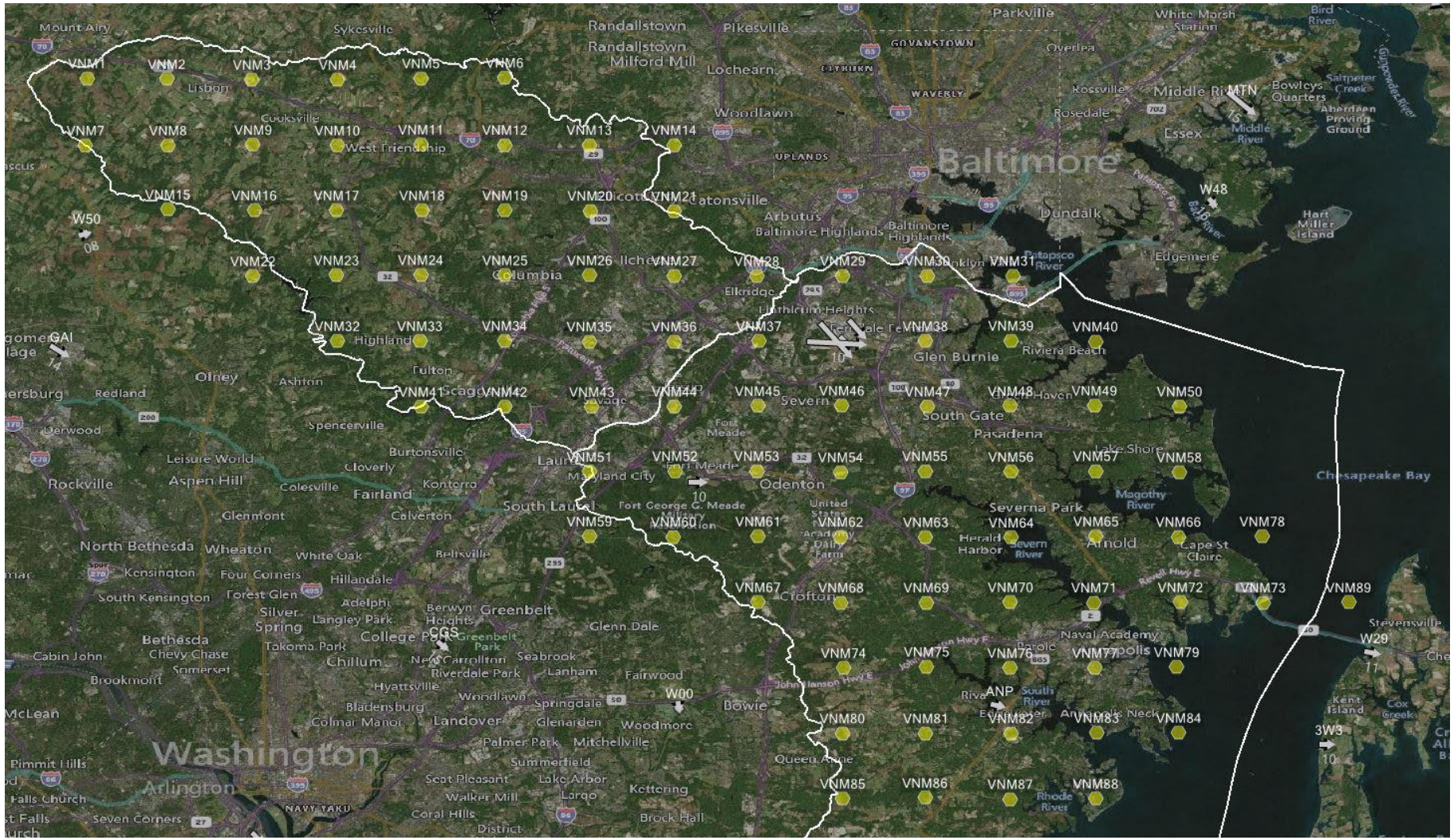
This is a summary of a larger report (the "Monthly Report") prepared by Vianair, Inc. ("Vianair") for the benefit of the DC Metroplex BWI Community Roundtable (the "BWI Roundtable").

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

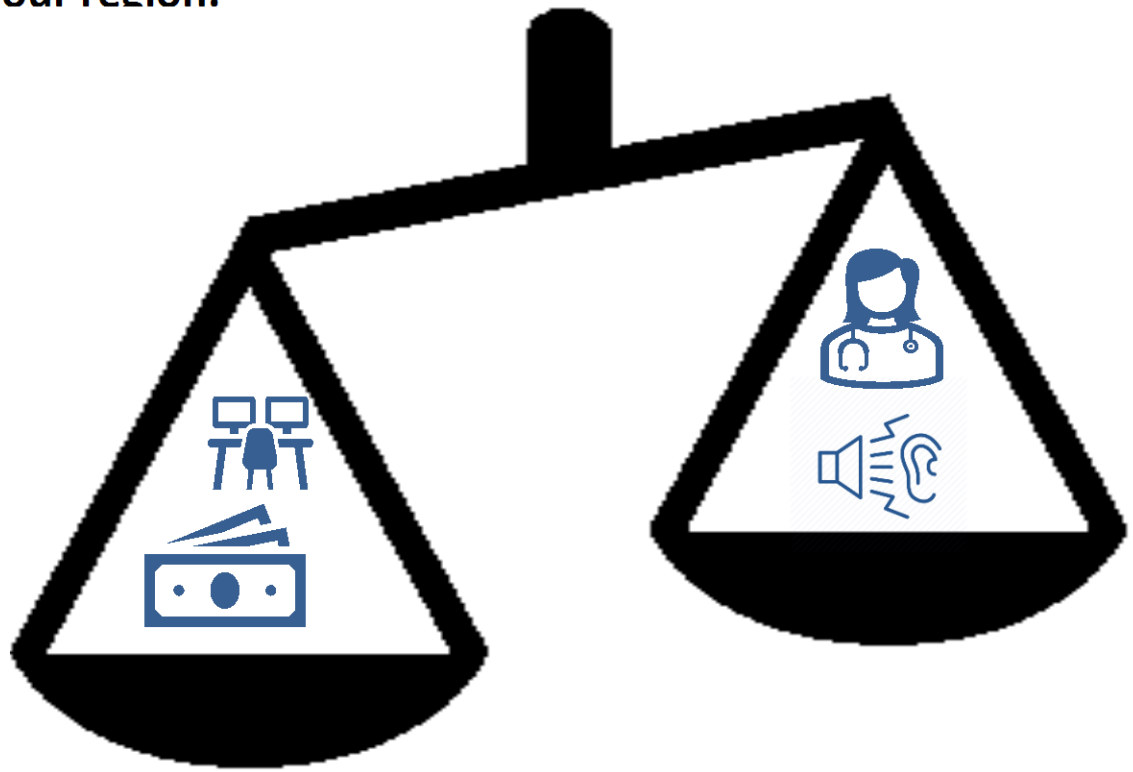
   https://marylandaviation.com/environmental/environmental-compliance-sustainability/quarterly-noise-reports/
   - World Health Organization: Environmental Noise Guidelines for the European Union. 2018

   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

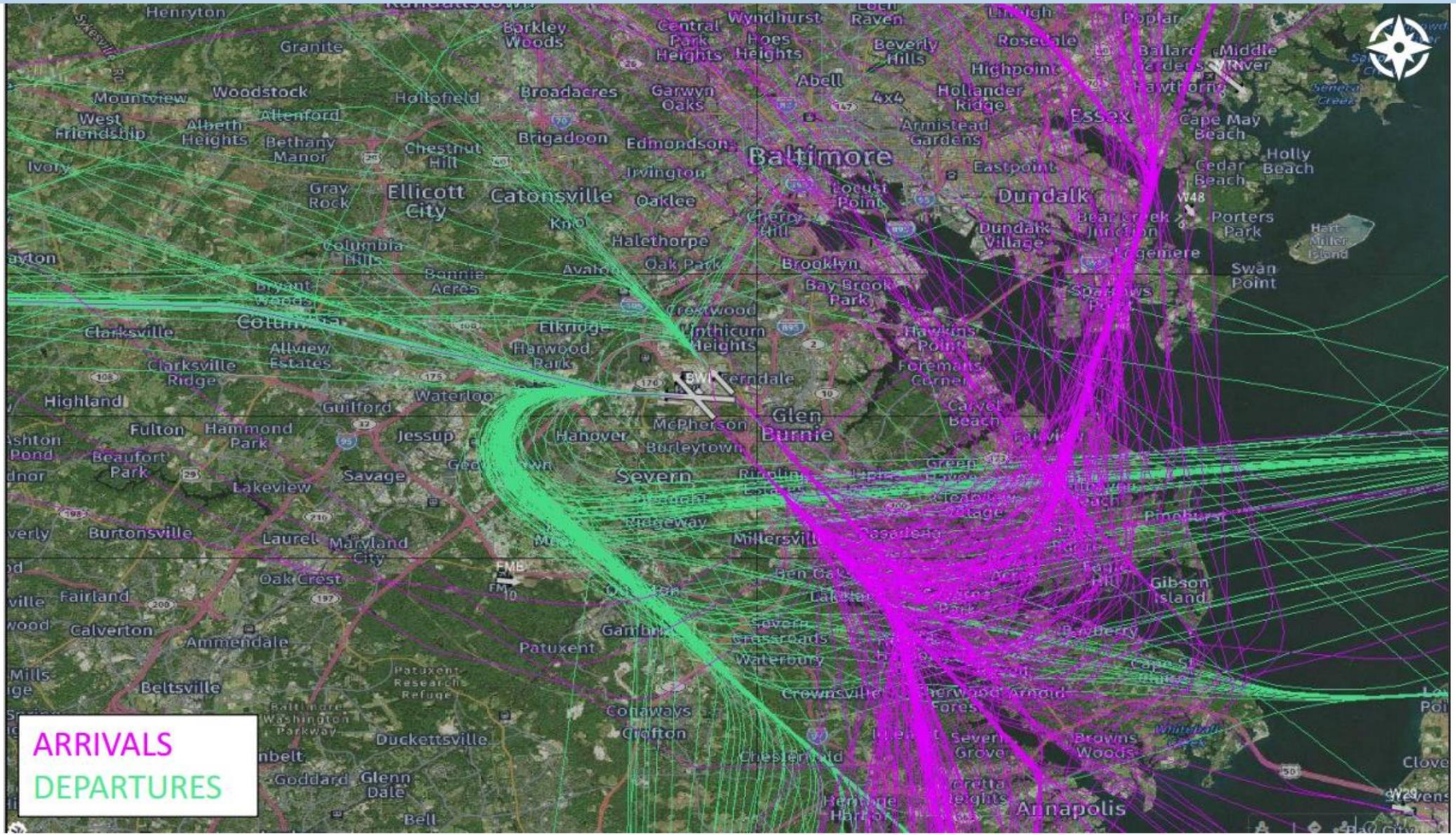
Prevailing wind speed, direction and weather factors determine the direction of air traffic flow from BWI-Marshall airport. Aircraft usually take off and land into the wind to meet safety and operational requirements.

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

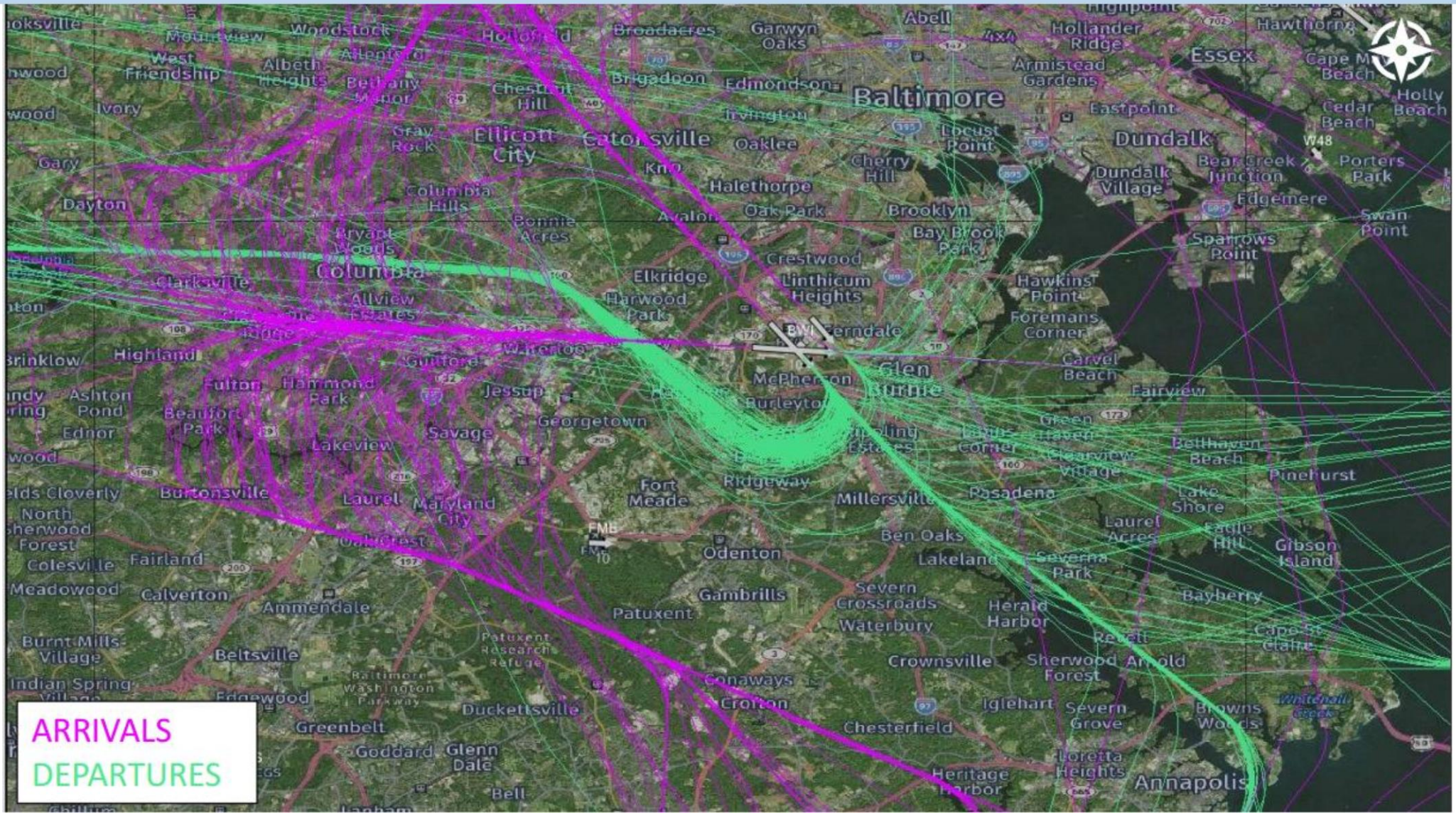
During **WEST FLOW** conditions (winds from the north or west), aircraft arrive and depart toward the west. This includes runways 33L, 33R, and 28. The following slides are intended to illustrate arrival and departure flight paths across the region during sample EAST and WEST flows days.

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

November 2022 – Both East and West Flow Operations

Name	Description	Number-of-Events-Above 55 dBA (Total)	Daily Average	DNL
AAR_VNM1	RAVNN	97	3	26.6
AAR_VNM2	JETNA	168	6	30.8
AAR_VNM3	Arden on the Severn	4,998	167	60.5
AAR_VNM4	London Public House	1,421	47	41.3
AAR_VNM5	Annapolis Middle School	631	21	42.3
AAR_VNM6	West Annapolis Elementary	1,307	44	50.8
AAR_VNM7	Herald Harbor	60	2	30.1
AAR_VNM8	Eastport Terrace	653	22	42.6
AAR_VNM9	Truxton Park	740	25	44.5
AAR_VNM10	Shipley's Choice Elementary	6,403	213	74.5
AAR_VNM11	Robinwood	531	18	40.8
AAR_VNM12	Wardour Bluffs	1,195	40	49.5
AAR_VNM13	Millersville Elementary School	970	32	50.0
AAR_VNM14	Sherwood Forest	2,035	68	54.3
ARR_VNM15	Brookeville, Montgomery County	141	5	33.9
AAR_VNM16	Rolling Knolls	2,226	74	50.8
ARR_VNM17	Maryland State House	1,051	35	47.6
ARR_VNM18	I-97 and MD 178 Crownsville	903	30	49.9

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 over 50, there were an average of 44 flight per day over 55 decibels **(11,649 such flights year-to-date since March).**

Monthly Noise Exposure – Howard County Landmark Locations

November 2022 – Both East and West Flow Operations

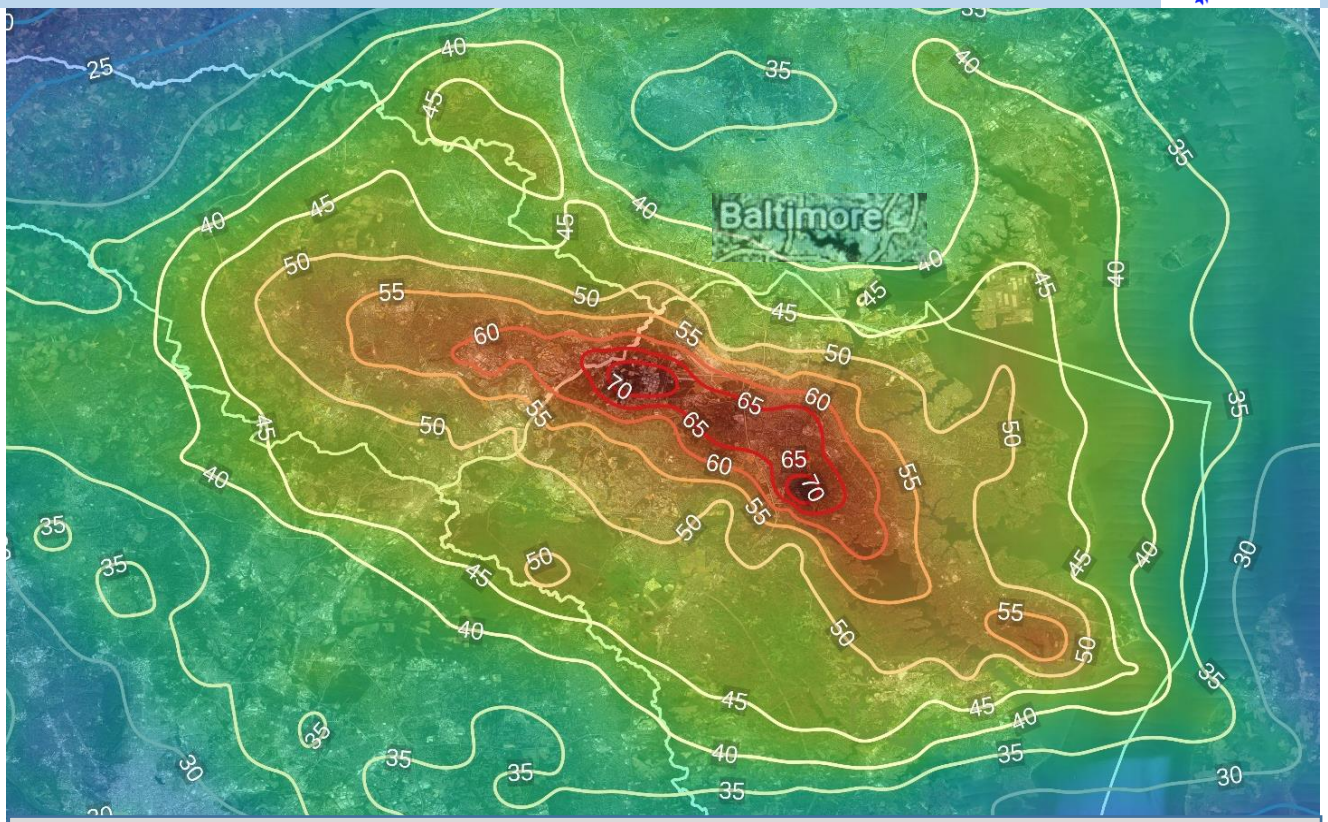
Name	Description	Number-of-Events-Above 55 dBA (Total)	Daily Average	DNL
HOCO_VNM1	Howard Square Apartments	8,483	283	58.8
HOCO_VNM2	HCPSS Administration Campus	4,242	141	52.2
HOCO_VNM3	Centennial Park	3,938	131	51.9
HOCO_VNM4	HoCo General Hospital	5,231	174	55.8
HOCO_VNM5	Merriweather Post Pavilion	5,479	183	57.2
HOCO_VNM6	Oakland Mills HS	5,678	189	58.1
HOCO_VNM7	Long Reach HS	5,729	191	58.9
HOCO_VNM8	Troy Park	6,869	229	61.6
HOCO_VNM9	Harwood Park N'hood	6,877	229	60.6
HOCO_VNM10	Abiding Savior Lutheran	5,413	180	55.3
HOCO_VNM11	Tridelphia Ridge ES	363	12	40.6
HOCO_VNM12	Atholton HS	4,904	163	58.1
HOCO_VNM13	Christ Church Episcopal	6,709	224	60.8
HOCO_VNM14	Mayfield Woods MS	5,873	196	61.4
HOCO_VNM15	Manor Woods ES	384	13	43.3
HOCO_VNM16	Gateway Site	6,847	228	61.2
HOCO_VNM17	Oxford Square Neighborhood	9,889	330	67.7
HOCO_VNM18	St. Louis Catholic	3,204	107	50.8

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 over 58, there were an average of 189 flight per day over 55 decibels **(51,951 such flights year-to-date since March).**

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

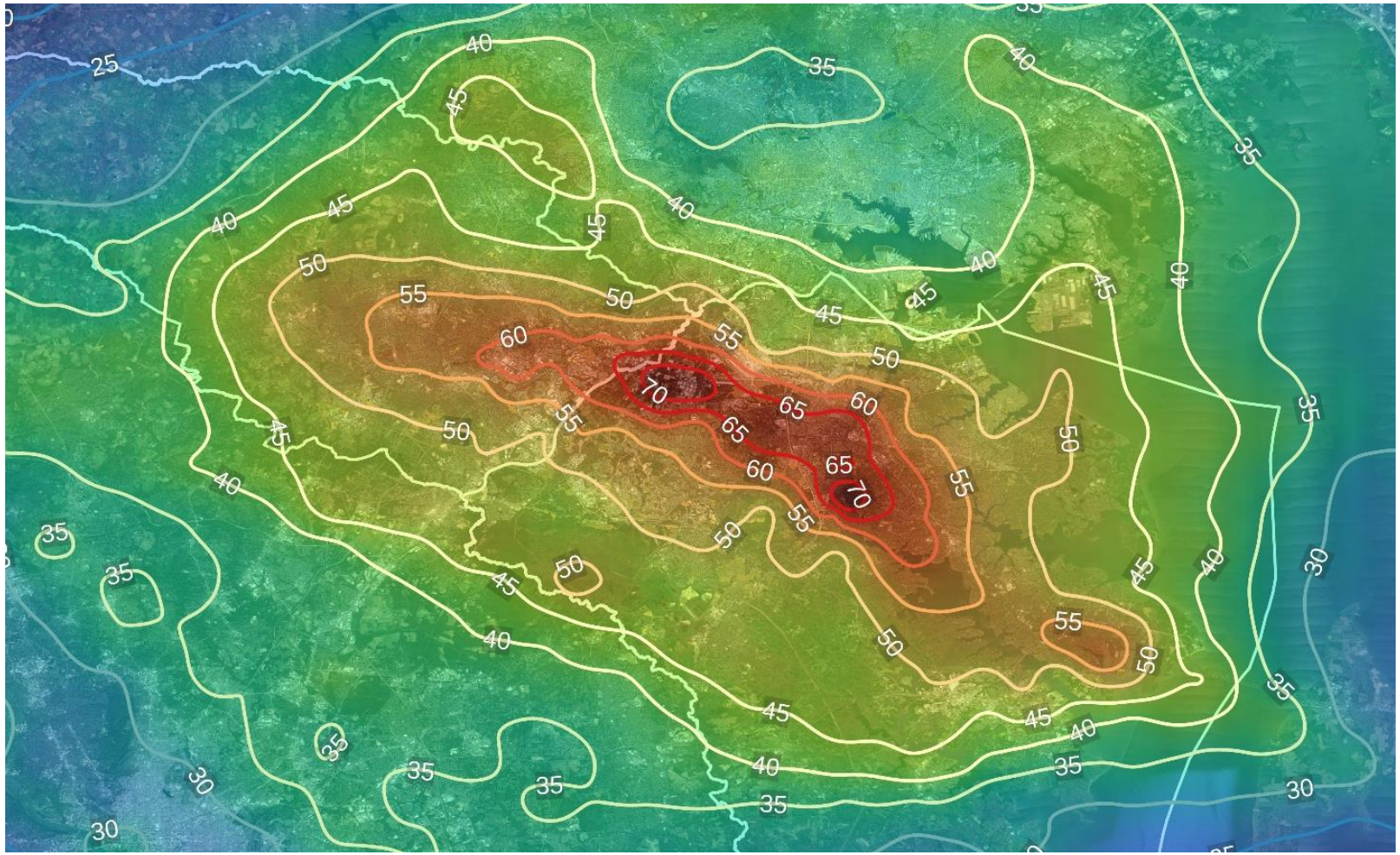


Vianair, Inc. modeled *actual daily* flights for Nov 2022 for the Monthly Aircraft Operations and Noise Exposure Report of the DC Metroplex BWI Community Roundtable

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

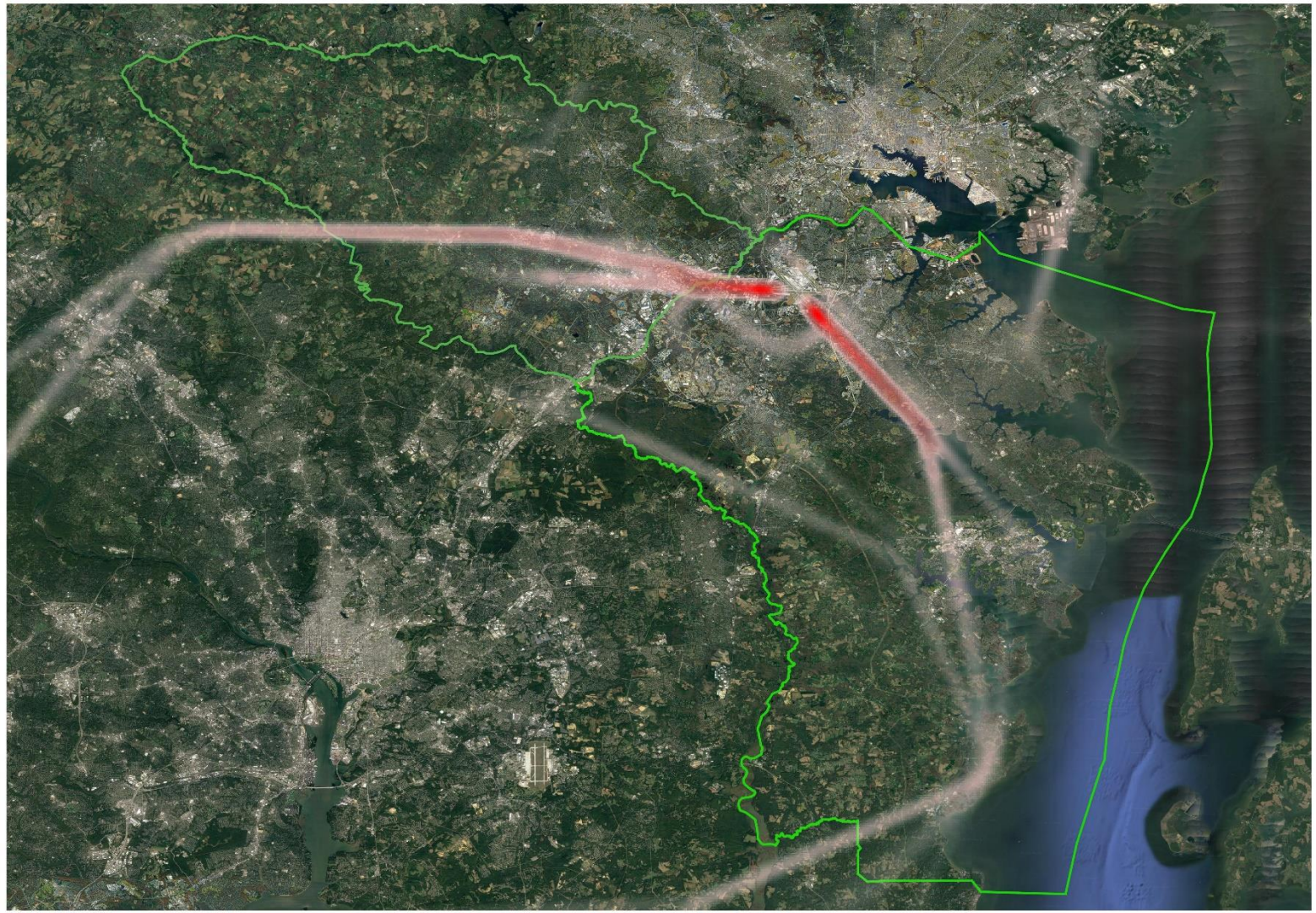


In this Vianair-generated map, noise is expressed in DNL contours. For reference, the **50 DNL** contour stretches westward to encompass the approximate boundaries of **Columbia/ Clarksville**, eastward to **Fort Smallwood/Lake Shore/ Annapolis** and south to **Crownsville /Millersville/Fort Meade**.

The World Health Organization has identified adverse health effects at this noise level.

vianair

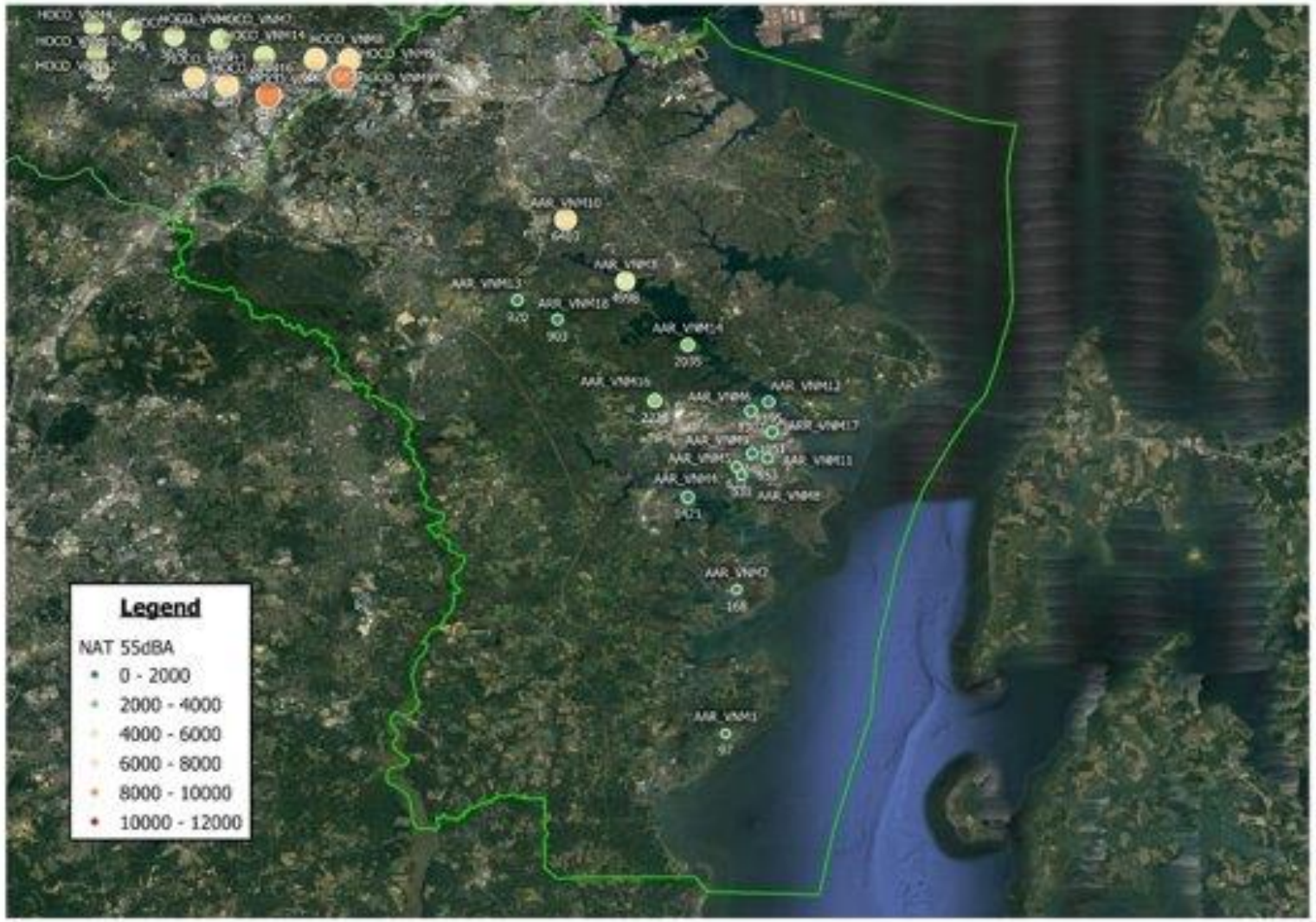
Flight Track Density – Heat Map of Anne Arundel and Howard Counties



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

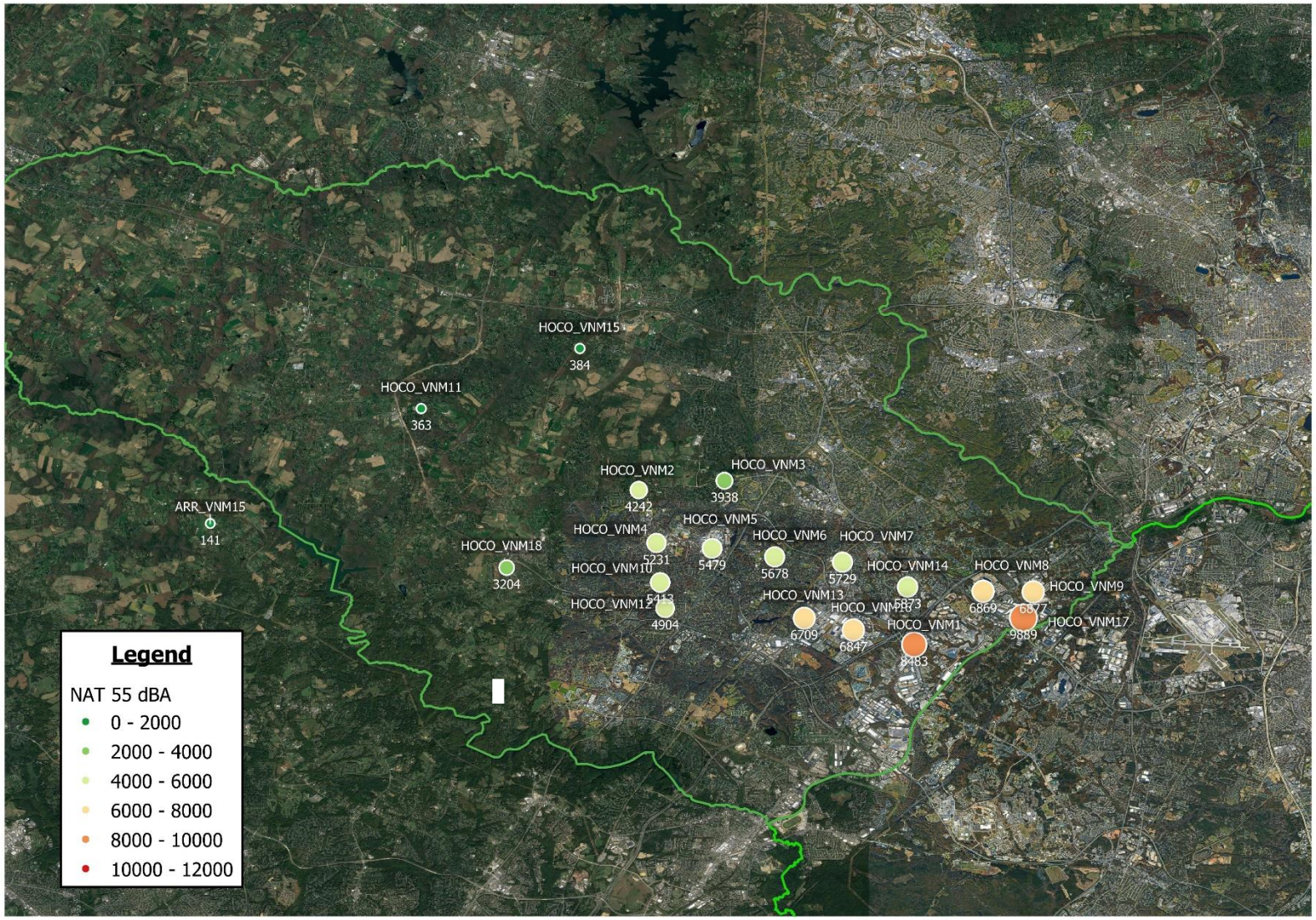


This map shows the Number of Events (single flights) at the local Landmarks during the month above the 55 decibel Threshold (NAT) for Anne Arundel County.

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

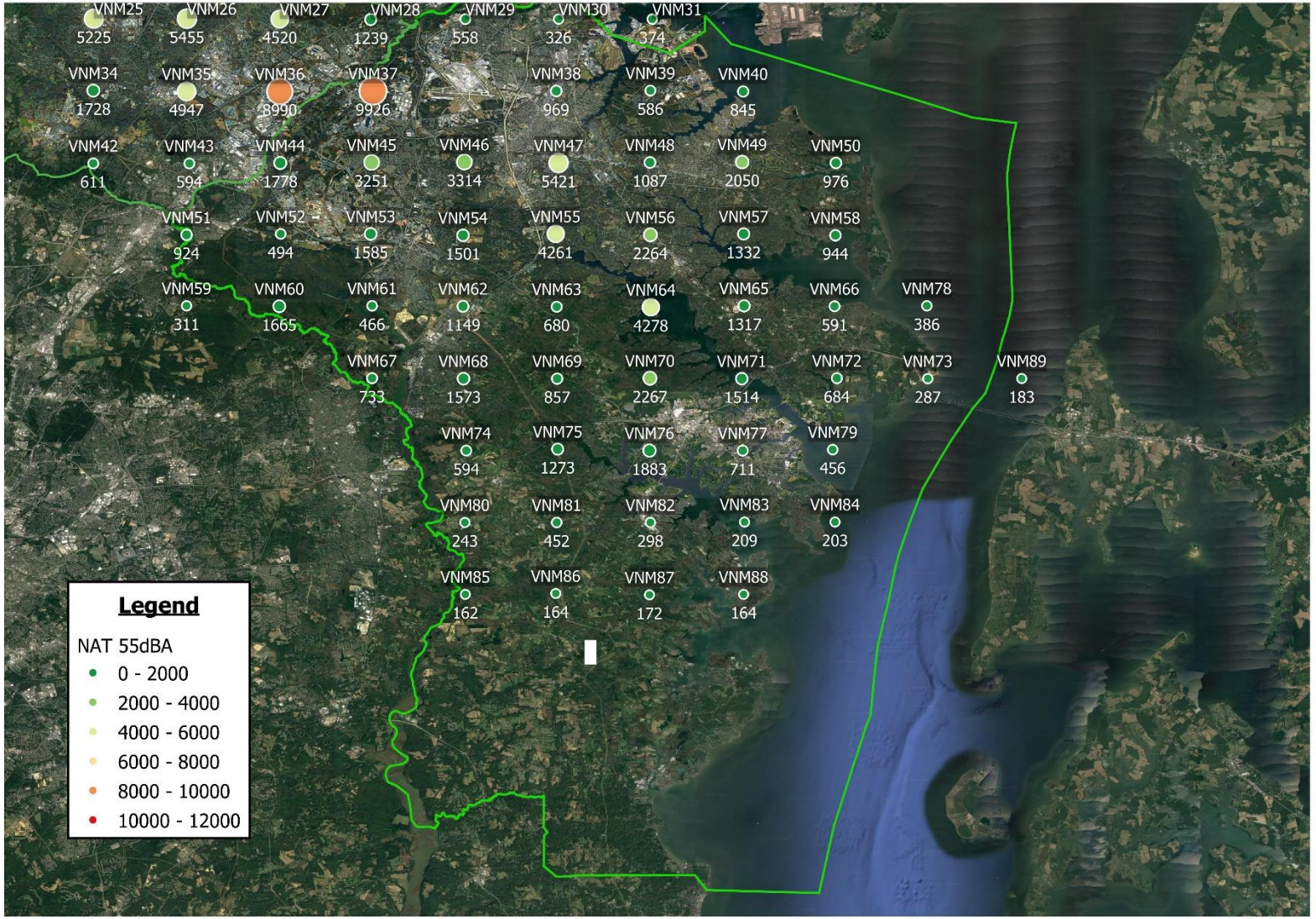


This map shows the Number of Events (single flights) at the local Landmarks during the month above the 55 decibel Threshold (NAT) for Howard County.

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

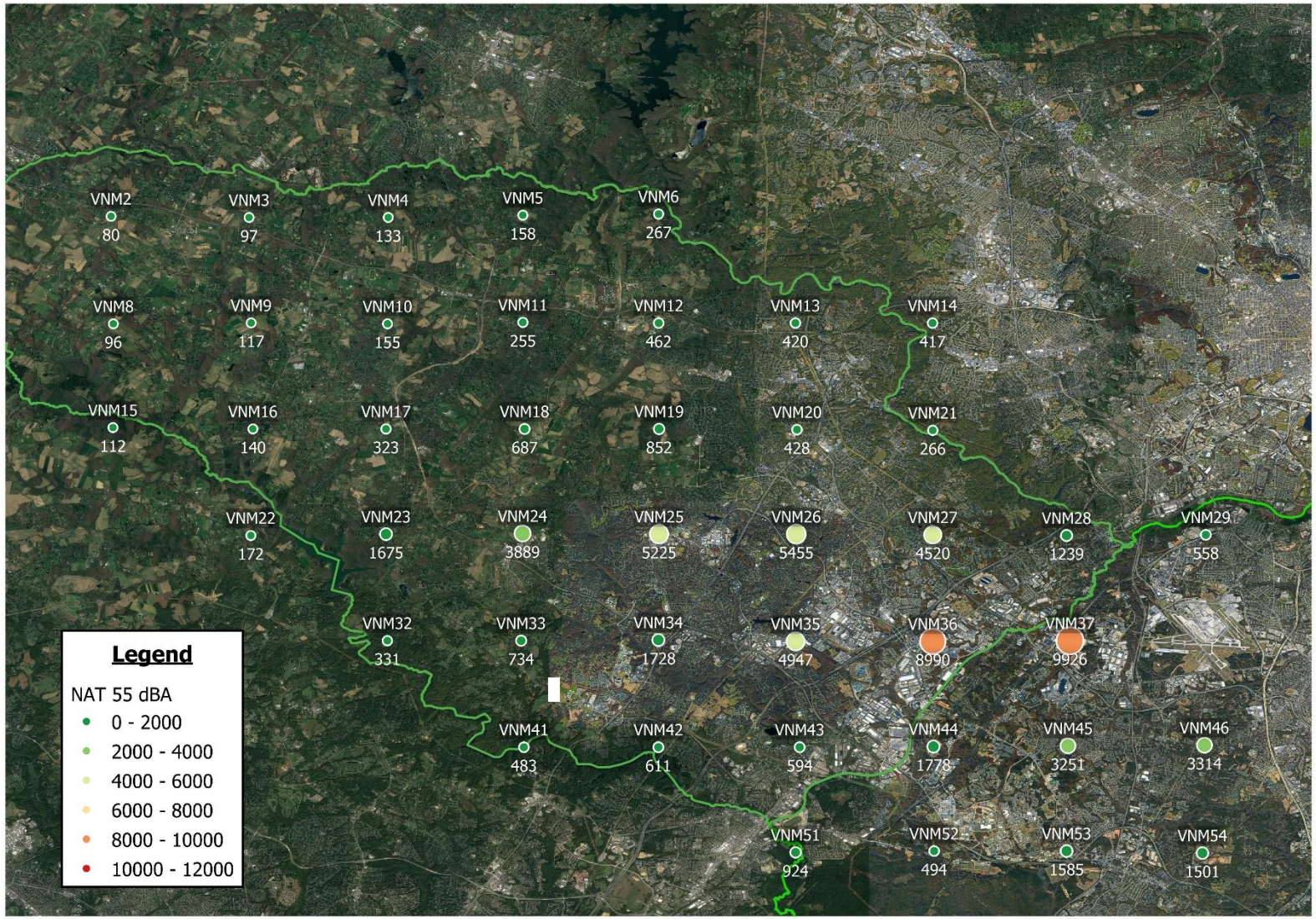


This map shows the Number of Events (single flights) during the month above the 55 decibel Threshold (NAT) for the total grid of Virtual Noise Monitors in Anne Arundel County.

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

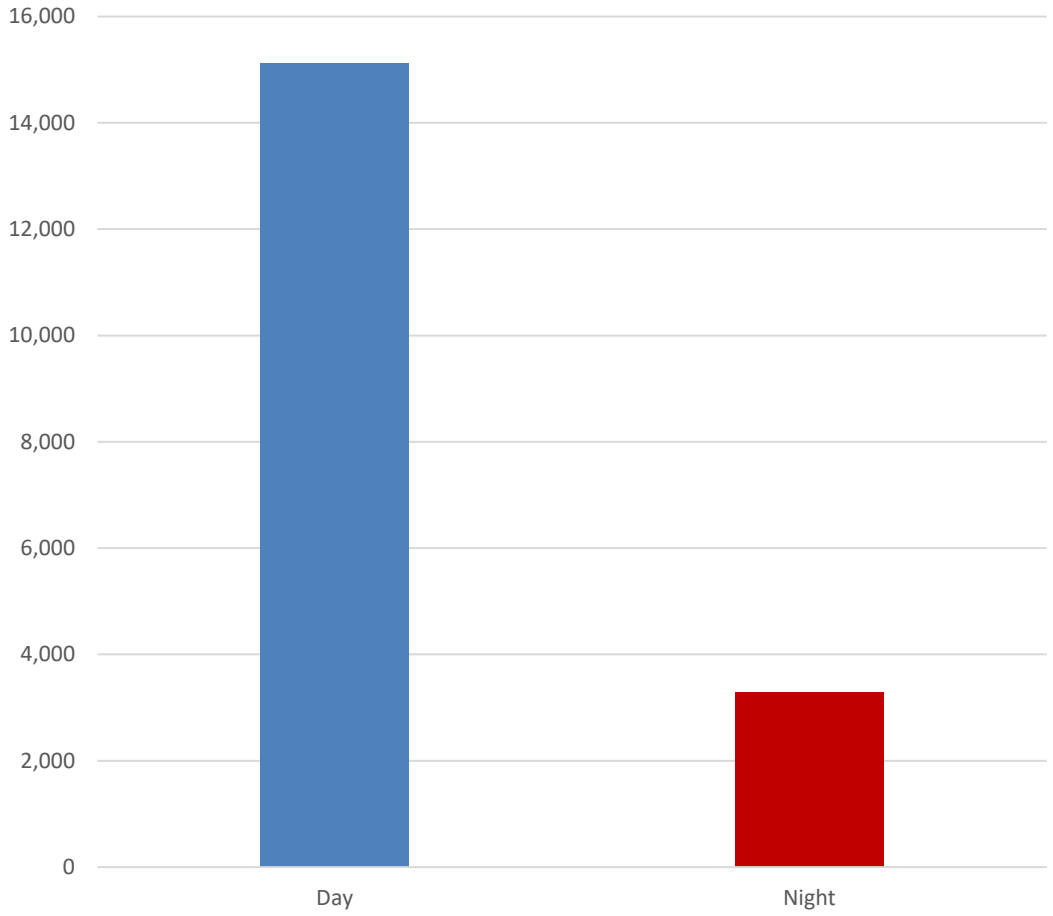
Name	Number-of-Events-Above 55 dBA (Total)	Daily Average	DNL
VNM1	59	2	22.4
VNM2	80	3	25.5
VNM3	97	3	28.5
VNM4	133	4	29.3
VNM5	158	5	33.4
VNM6	267	9	39.3
VNM7	76	3	27.3
VNM8	96	3	27.1
VNM9	117	4	27.2
VNM10	155	5	32.6
VNM11	255	9	39.5
VNM12	462	15	44.0
VNM13	420	14	42.8
VNM14	417	14	48.3
VNM15	112	4	32.9
VNM16	140	5	34.4
VNM17	323	11	41.3
VNM18	687	23	47.3
VNM19	852	28	47.8
VNM20	428	14	45.4
VNM21	266	9	44.1
VNM22	172	6	35.1
VNM23	1,675	56	44.7
VNM24	3,889	130	52.5
VNM25	5,225	174	55.8
VNM26	5,455	182	56.6
VNM27	4,520	151	53.6
VNM28	1,239	41	52.2
VNM29	558	19	48.6
VNM30	326	11	44.2

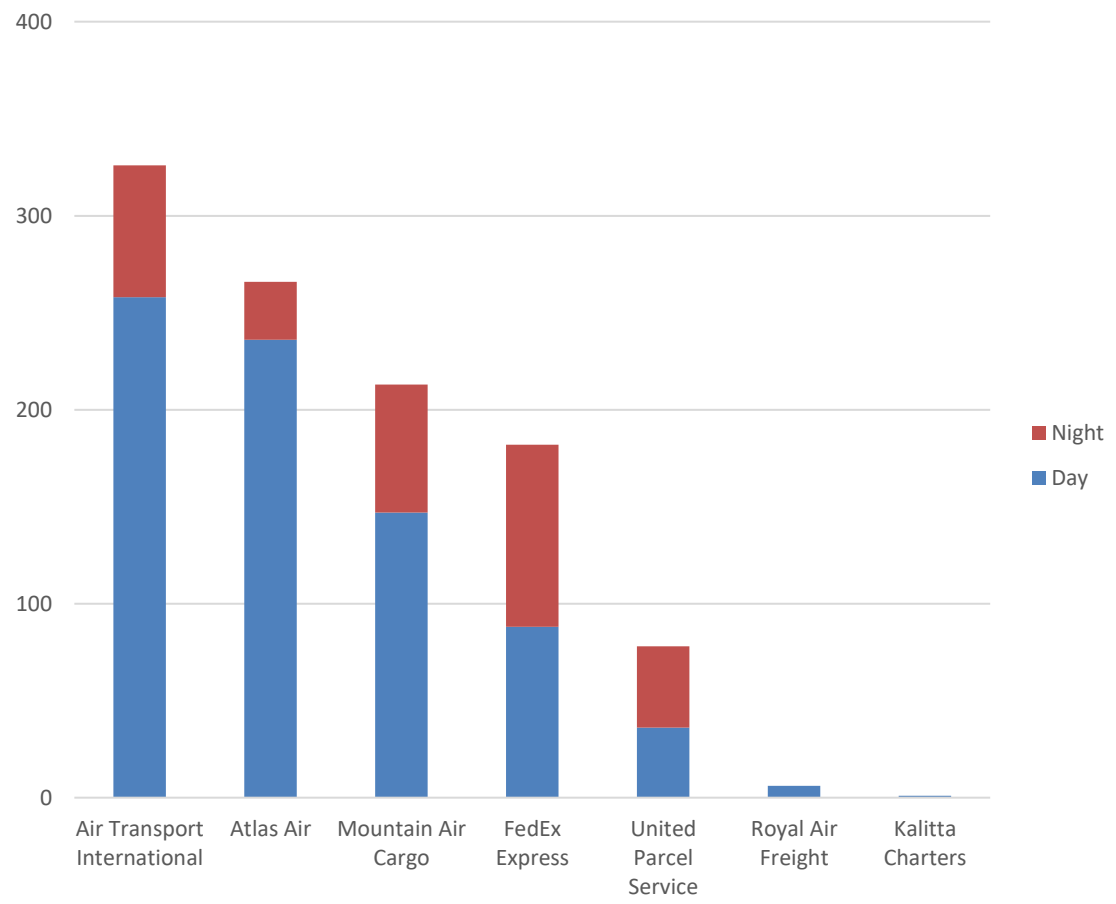
Name	Number-of-Events-Above 55 dBA (Total)	Daily Average	DNL
VNM31	374	12	42.4
VNM32	331	11	42.2
VNM33	734	24	48.8
VNM34	1,728	58	52.9
VNM35	4,947	165	56.0
VNM36	8,990	300	60.7
VNM37	9,926	331	72.7
VNM38	969	32	53.2
VNM39	586	20	51.4
VNM40	845	28	47.3
VNM41	483	16	46.5
VNM42	611	20	47.4
VNM43	594	20	50.3
VNM44	1,778	59	53.8
VNM45	3,251	108	55.5
VNM46	3,314	110	64.4
VNM47	5,421	181	66.8
VNM48	1,087	36	56.6
VNM49	2,050	68	51.0
VNM50	976	33	47.2
VNM51	924	31	48.3
VNM52	494	16	45.9
VNM53	1,585	53	52.2
VNM54	1,501	50	50.2
VNM55	4,261	142	61.6
VNM56	2,264	75	59.8
VNM57	1,332	44	50.8
VNM58	944	31	48.2
VNM59	311	10	42.8
VNM60	1,665	56	51.1

Name	Number-of-Events-Above 55 dBA (Total)	Daily Average	DNL
VNM61	466	16	45.5
VNM62	1,149	38	49.0
VNM63	680	23	49.5
VNM64	4,278	143	57.1
VNM65	1,317	44	52.9
VNM66	591	20	47.5
VNM67	733	24	44.9
VNM68	1,573	52	48.3
VNM69	857	29	46.1
VNM70	2,267	76	51.6
VNM71	1,514	50	53.5
VNM72	684	23	58.4
VNM73	287	10	43.0
VNM74	594	20	43.7
VNM75	1,273	42	46.4
VNM76	1,883	63	47.5
VNM77	711	24	44.8
VNM78	386	13	40.4
VNM79	456	15	40.3
VNM80	243	8	36.3
VNM81	452	15	37.4
VNM82	298	10	37.3
VNM83	209	7	32.2
VNM84	203	7	31.3
VNM85	162	5	31.4
VNM86	164	5	30.6
VNM87	172	6	28.1
VNM88	164	5	31.0
VNM89	183	6	31.9

Monthly Operations – Daytime versus Nighttime

November 2022



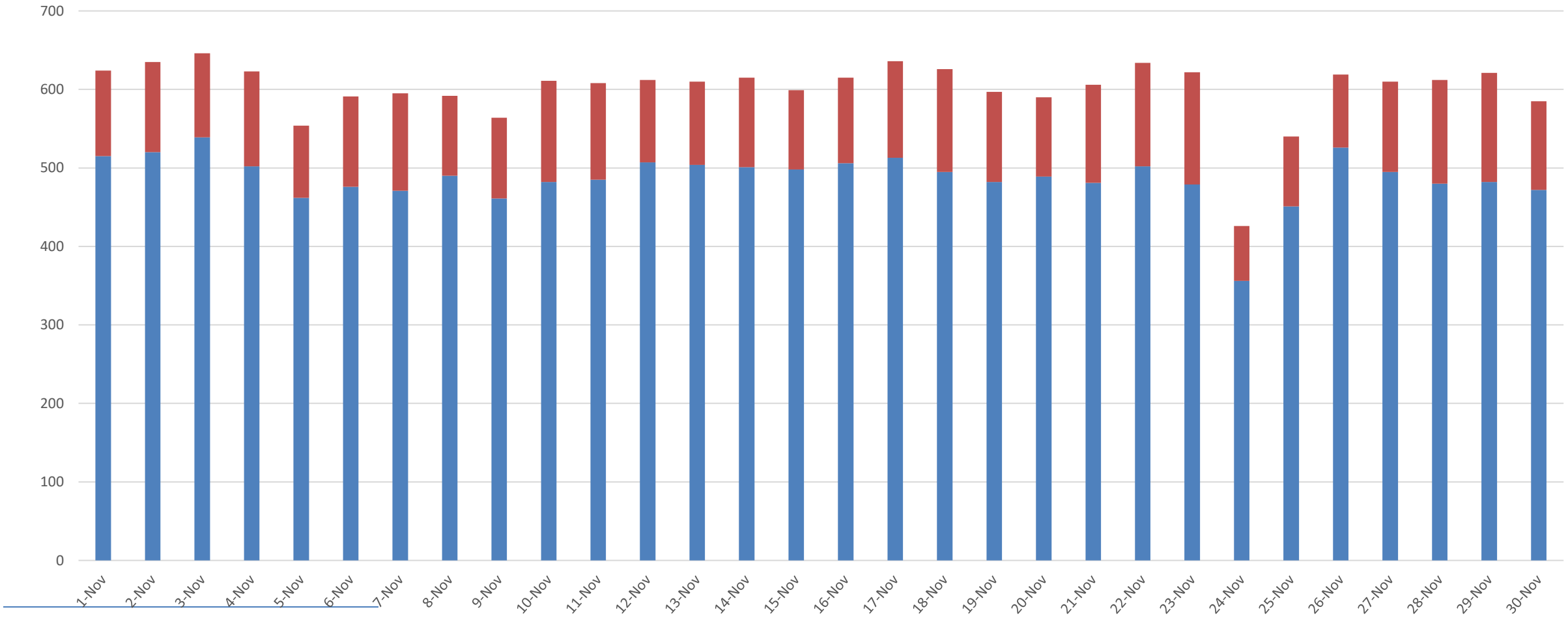


RED represents Nighttime flights. "Nighttime Hours" are from 10PM - 7AM

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

Monthly Operations

November 2022

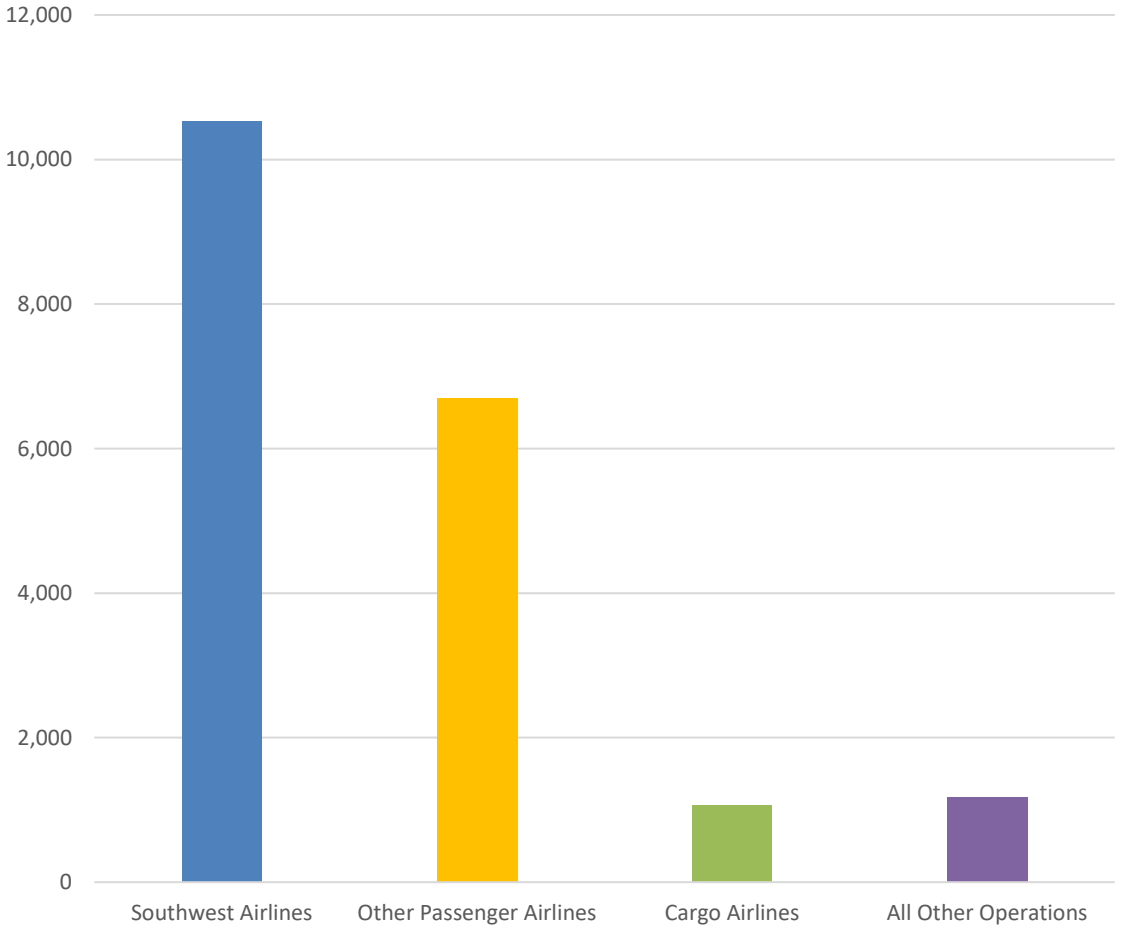


RED represents Nighttime flights. "Nighttime Hours" are from 10PM - 7AM

Aircraft Operations

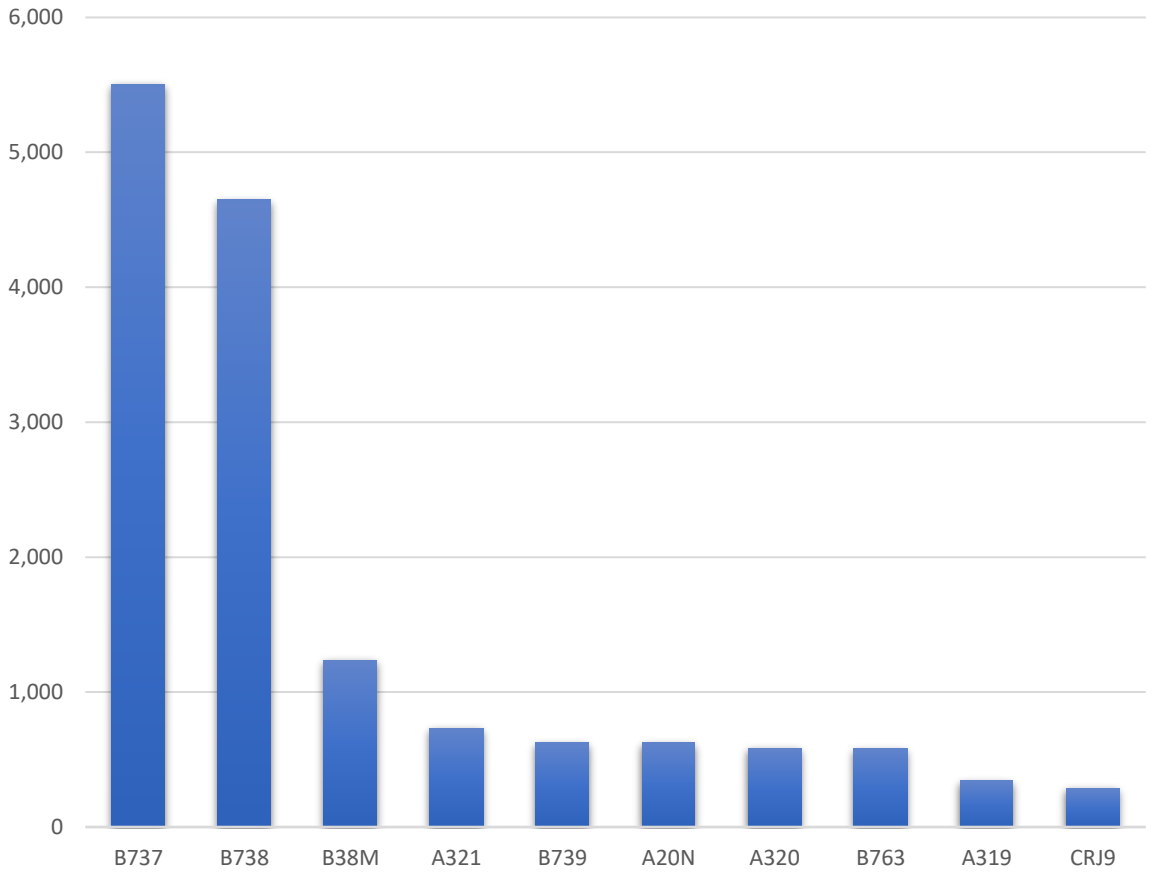
November 2022

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.

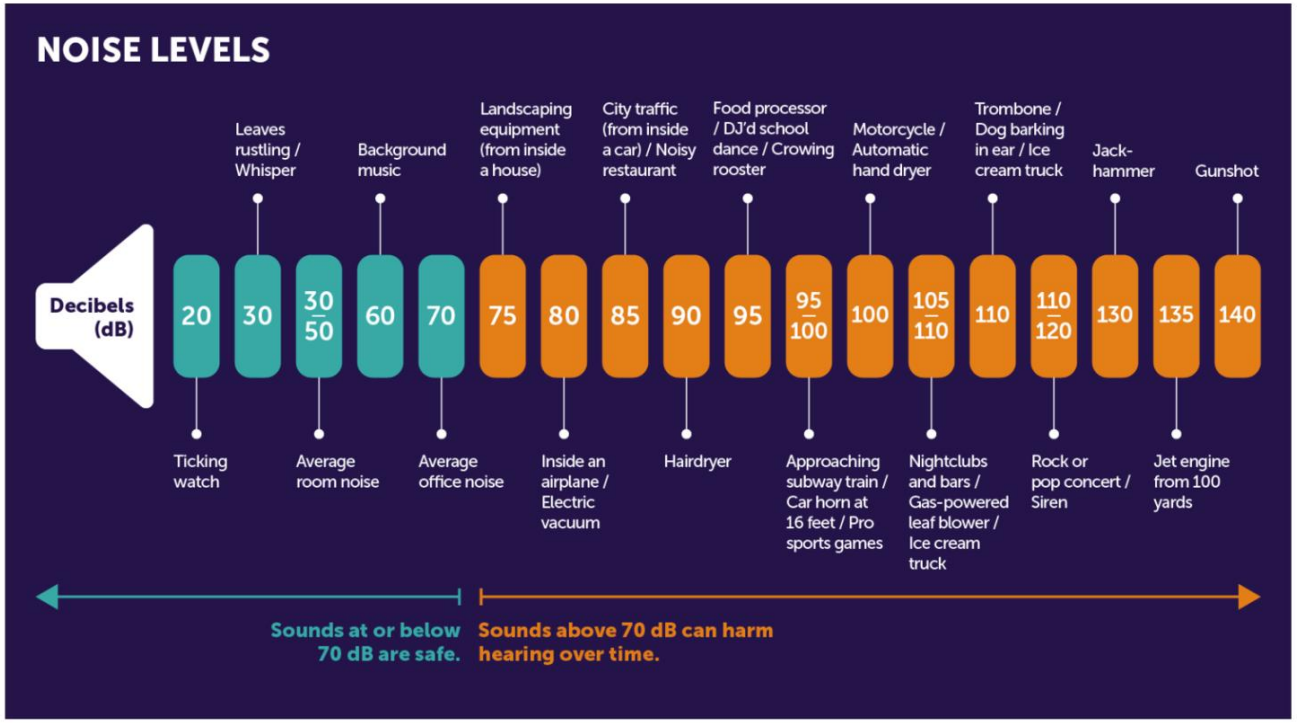
The NA noise metric counts the number of times the noise level exceeds a specific threshold. In this report, the Number-of-Events-Above 55 metric (NA55) is calculated. NA55 quantifies the number of aircraft events resulting in noise exposure of 55 decibels or higher at each location depicted.

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/environmental/environmental-compliance-sustainability/dc-metroplex-bwi-community-roundtable/