BALTIMORE/WASHINGTON INTERNATIONAL Thurgood Marshall AIRPORT

Baltimore/Washington International Thurgood Marshall Airport Airport Noise Zone Update

Prepared under Transportation Article, §§5-805, 5-806 and 5-819, Annotated Code of Maryland

Documentation of

Airport Noise Zone Update

2014

December

Prepared for:

Director, Office of Noise, Real Estate & Land Use Compatibility
Maryland Aviation Administration
Baltimore/Washington International Thurgood Marshall Airport

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HMMH Report No. 305160.012
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1 INTRODUCTION

The Maryland Environmental Noise Act of 1974 (the Act) provides for the protection of citizens from the impact of transportation related noise. The Act was codified into the Code of Maryland Regulations (COMAR). The aviation portion of the Act and COMAR require the Maryland Aviation Administration (MAA) to create an Airport Noise Zone (ANZ) to control incompatible land development around Baltimore/Washington International Thurgood Marshall (BWI Marshall) and a Noise Abatement Plan (NAP) to minimize the impact of aircraft noise on people living near the Airport. An ANZ and NAP were first established for BWI Marshall in 1976; and were updated in 1982, 1988, 1993, 1998, and 2007. The latest 2014 ANZ, which is described in this document, became effective December 22, 2014.[1]

MAA is required by COMAR to update the ANZ approximately every five years. Harris Miller Miller & Hanson Inc. (HMMH) and Straughan Environmental Services have been retained by the MAA to assist with preparation of the BWI Marshall ANZ update.

The ANZ, defined in COMAR, is an area defined by noise level contours in terms of Day-Night Average Sound Levels, abbreviated L_{dn}. This ANZ update includes the Level Day-Night (L_{dn})[2] noise contours for the following four conditions:

- Base year (calendar year 2014) conditions;
- Five-year post certification (calendar year 2019) forecast operations with the planned future airport layout;[3]
- Ten-year post certification (calendar year 2024) forecast operations with planned future layout; and
- The Airport Noise Zone, which is the outer extents of the previous three contours.

The ANZ is determined by a composite of the first three aforementioned annual L_{dn} contours. The three sets of contours (years 2014, 2019 and 2024) are overlaid on each other. The largest of the three contours in any area around the Airport determines the Airport Noise Zone thereby offering protection within the largest of the existing or future noise exposure contours. This offers the greatest protection to public health and welfare. This process is performed for each five-decibel increment of noise levels, from 65 L_{dn} to 75 L_{dn}.

This document is the final version of the October 2014 draft. This document includes various editorial updates and a description of MAA's activities after preparation of the October 2014 draft. Those activities lead to the certification of the 2014 Airport Noise Zone which became effective December 22, 2014. None of changes presented in this final document, relative to the October 2014 draft, affect the ANZ contours. The 2014 BWI Marshall Airport Noise Zone, prepared for certification, is presented as Appendix A. The Noise Abatement Plan is presented in Appendix B.

The remaining sections of this report describe the development of this ANZ update. Section 2 of this report describes the methodology used in modeling noise contours. Section 3 describes in detail all of the inputs to the noise model for the three cases and the October 2014 draft has been edited so the reader can identify helicopter operations. Section 4 presents L_{dn} contours for each of the three cases, and ultimately

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[1] Volume 41: Issue 25 Maryland Register, pg. 1485 (Issue Date: December 12, 2014). http://www.dsd.state.md.us/MDRegister/4125.pdf

[2] The Level Day-Night metric defined in COMAR has “"Day-night (average) sound level (L_{dn})" means the average sound level, in decibels, reckoned over a 24-hour day with a 10 decibel weighting applied to the noise occurring during the nighttime period; that is, noise levels occurring at night are treated as though they were 10 dB higher than they actually are.” The Level Day-Night is also known as Day-Night Average Sound Level or DNL in Federal regulations, particularly 14 CFR Part 150.

[3] Certification of this ANZ update was expected to occur in calendar year 2014 at the start of the project. Therefore, the five and ten year forecasts are relative to the 2014 certification year.

the composite Noise Zone contour. Section 5 describes the noise monitoring locations, annual L_{dn} values for each site, and the difference between the measured and modeled L_{dn} aircraft values. Section 6 presents the Noise Abatement Plan. Section 7 discusses the public consultation process undertaken as part of this ANZ update and describes MAA's activities after the preparation of the October 2014 draft.

2 NOISE MODELING METHODOLOGY

The noise environment around an airport is described by contours of equal noise exposure, representing the noise that occurs during an average 24-hour day. The metric of noise exposure used in this report is the Day-Night Average Sound Level, abbreviated L_{dn}. L_{dn} accounts for all sound energy produced by aircraft flight operations in a 24-hour period, with the exception that it treats each aircraft operation occurring in the nighttime (between 10 p.m. and 7 a.m.) as equivalent to ten operations during the daytime.

In 1974, the State of Maryland adopted the Day-Night Average Sound Level (L_{dn}) metric for defining noise exposure around its airports. Subsequently, in 1981, the Federal Aviation Administration (FAA), under requirements of the Aviation Noise and Safety Act of 1979, also adopted the L_{dn} method, and now requires its use by all airports conducting environmental studies.

The Federal Aviation Administration (FAA) Office of Environment and Energy typically approves the use of only one computer model, the Integrated Noise Model (INM), for use in developing airport noise contours. INM Version 7.0d was used in developing the L_{dn} contours for this study.[4] The INM incorporates a comprehensive set of computer routines for calculating noise exposure contours around airports. Use of the INM computer model requires data in two principal categories: (1) aircraft noise and performance data, and (2) aircraft operational data.

INM utilizes the noise curves and performance profiles of the various aircraft types as provided in Version 7.0d of the database. The model uses the noise data to identify how loud specific aircraft types are at different distances between the aircraft and a location on the ground - these distances range from 200 feet to 25,000 feet. Data are provided for several different engine thrust settings used for takeoff and landing operations for a particular aircraft type; the program then interpolates between these values in its calculation process. The thrust values and distances are determined by performance profiles which are influenced by such factors as average annual air temperature, the elevation above sea level of the airport, runway gradients, headwind velocity and humidity. The performance data used by the model define the length of the takeoff roll (based on aircraft takeoff weight), the climb rate, and speeds for each flight segment.

[4] INM 7.0d with Service Update 1 released on 09/24/2013
https://www.faa.gov/about/office_org/headquarters_offices/apl/research/models/inm_model/

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3 NOISE MODEL INPUTS

The 2014, 2019 and 2024 L_{dn} contours were developed using the most recent release of the FAA's Integrated Noise Model (INM), Version 7.0d. The INM requires inputs in the following categories:

- Physical description of the airport layout. The 2014 contours use the existing airport layout while 2019 and 2024 contours use planned future airport layouts;
- Number and mix of aircraft operations;
- Day-night split of operations (by aircraft type);
- Runway utilization rates;
- Representative flight track descriptions and flight track utilization rates;
- Aircraft weight, or stage length;
- Meteorological conditions; and
- Terrain

HMMH developed the 2014, 2019 and 2024 noise contours using INM 7.0d in a manner consistent with section 11.03.03 of COMAR. The contours were developed primarily from flight track data that had been collected and stored by BWI Marshall's EnvironmentalVue system.[5] HMMH has developed a pre-processor named "RealContours™" that converts radar flight tracks to INM tracks, thereby modeling each and every radar flight tracks as an INM flight track. The operations on individual flight tracks are weighted to develop annual average noise modeling inputs. The discussion briefly describes the noise modeling process, associated data sources, including how RealContours™ converts radar tracks into INM modeling inputs.

3.1 AIRPORT PHYSICAL PARAMETERS

BWI Marshall has four runways which are designated 4/22, 10/28, 15R/33L, and 15L/33R. Each pair of numbers corresponds to the name of each runway end.[6] Aircraft can land and takeoff in either direction on a given runway therefore, each runway end has a unique name. The numbers are a shorthand notation that indicates the runway's geographical orientation: the compass heading of the runway, rounded to the nearest ten degrees, with the trailing zero dropped. For example, the magnetic heading of Runway 28 is approximately 284 degrees. The number is rounded to 280, and finally to 28 with the zero dropped; hence, Runway 28. Simple geometry requires that the difference between the designation of each end equals 18 (that is, 180 degrees); hence, Runway 10 is in the opposite direction from Runway 28. There are two runways that are oriented in the same direction, thus both having the 15/33 designation. In order to differentiate one from the other, when facing 150 degrees from the North, the runway to the right is called 15R (for right)/33L, and the other is called 15L (for left)/33R. In this case, 15R/33L is the western-most of the two parallel runways.

COMAR requires that the ANZ include noise contours for conditions five and ten years in the future. This also requires an estimate of what the airfield will look like in the future. The most recently approved Airport Layout Plan (ALP) as approved in August 2012 for BWI Marshall (2012 ALP) describes several changes to the runway layout/geometry which are planned and scheduled for completion by 2024. In

[5] EnvironmentalVue is a product of Exelis Inc. The BWI Marshall noise and operation system did not provide the destination airport for BWI departures or the originating airport for BWI arrivals. Therefore for this analysis, flightplan data were purchased from FlightAware (http://flightaware.com/). Data from FlightAware were associated with the data provided through EnvironmentalVue on a flight by flight basis and provided the city-pair information.

[6] Runway 4/22 was permanently closed on August 6, 2014. However it is included in the 2014 conditions of this ANZ.

addition, the 2012 ALP includes the planned parallel Runway 10R/28L, currently scheduled for 2026 or later. Although the planned parallel Runway 10R/28L is currently scheduled two years after the 10-year ANZ forecast, it is included in the 2024 contours for the purposes of this ANZ because 1) it is a major element that could affect noise 2) it is scheduled reasonably close to the 10-year ANZ forecast period and 3) it has been consistently included in past iterations of the ANZ.

Table 1 presents the Existing Airport and Runway layout used to develop the 2014 contours.

Figure 1 presents the runway layout. In addition to the runways, there is a helicopter landing spot on the east side of the airport, just east of Runway 15L/33R.

The five year conditions (2019) include changes planned on the 2012 ALP, specifically the decommissioning of Runway 4/22, along with changes to certain existing runways to meet the latest federal government design standards. Table 2 presents the airport layout used to develop the 2019 contours. Coordinates, elevations and thresholds that change from the existing 2014 layout are highlighted in *italics*. Table 3 presents the airport layout used to develop the 2024 contours.

Additional details regarding the current and the future runway layout data used for development of the ANZ are presented in the following sections.

3.1.1 EXISTING RUNWAY LAYOUT

Table 1 presents the Existing Airport and Runway layout used to develop the 2014 contours.

Figure 1 presents the runway layout.

Runway 10/28 is 10,502 feet long and 150 feet wide.[7] Runway 10 has an elevation of 139.0 feet and Runway 28 has an elevation of 126.2 feet.

Runway 15L/33R is 5,000 feet long and 100 feet wide. Runway 15L has an elevation of 141.5 feet and Runway 33R has an elevation of 114.1 feet.

Runway 15R/33L is 9,501 feet long and 150 feet wide. Runway 15R has an elevation of 138.6 feet and Runway 33L has an elevation of 129.2 feet.

Runway 4/22 was 6,000 feet long and 150 feet wide. Runway 4/22 was permanently closed on August 6, 2014. However it is included in the 2014 conditions of this ANZ.

Under normal operating conditions, aircraft begin a takeoff roll at the physical end of a runway. On landings, however, they typically will cross over the end of a runway in flight, touching down some distance beyond the threshold, usually about 1,000 feet. The altitude at which aircraft cross over the threshold when landing is the “threshold crossing height”.

In some instances, usually for obstacle clearance, a runway threshold is displaced and the area available for landing is less than that available for takeoff. Runway 10/28 has displaced arrival thresholds that meet FAA Design Standards. The Runway 10 arrival threshold is displaced 550 feet. The arrival threshold for Runway 28 is displaced 500 feet. All aircraft arriving on Runway 10 or Runway 28 use the displaced arrival thresholds for those runways. Aircraft departing on all runways, except Runway 28, begin their takeoff roll at the physical end of the runway. Most aircraft departing on Runway 28 begin their takeoff roll at the intersection with Taxiway C, approximately 500 feet west of the physical end of the runway. Aircraft which have a need (based on weight, length of flight, or other conditions) for a full 10,502 feet of runway may begin their takeoff roll at the physical end of Runway 28.

[7] The width of Runway 10/28 was previously 200 ft. The revised width of 150 feet was published by FAA effective June 27, 2013. The change in runway width does not affect noise calculations

3.1.2 FUTURE AIRPORT LAYOUT 2019

The 2012 ALP for BWI Marshall includes plans for several changes to the runway layout/geometry which are scheduled for completion by 2019 and are included in the development of the 2019 contours. These alterations are depicted on Sheets 3 and 5 of the 2012 ALP. These changes are briefly described below:

- Runway 4/22: The runway would be decommissioned.
- Runway 10/28: The Runway 28 displaced arrival threshold is expected to increase from 500 feet to 700 feet.
- Runway 15L/33R: No physical changes to this runway are planned.
- Runway 15R/33L: The runway would shift 3 feet to the southwest. In addition, the arrival threshold for Runway 15R would be displaced 300 feet and the arrival threshold for Runway 33L would be displaced 500 feet.
- Helicopter pad: The helicopter pad would move approximately 645 feet to the southeast.

Table 2 presents the 2019 runway layout data and Figure 2 presents the 2019 runway layout.

3.1.3 FUTURE AIRPORT LAYOUT 2024

The 2012 ALP for BWI Marshall includes plans for several changes to the runway layout/geometry which are scheduled for completion around 2024 and are included in the development of the 2024 contours. These alterations are depicted on Sheets 3 and 5 of the 2012 ALP. These changes are briefly described below:

- Runway 10/28: No physical changes to this runway are planned.
- Runway 15L/33R: No physical changes to this runway are planned.
- Runway 15R/33L: The runway length would be increased from 9,501 feet to 10,501 feet. The lengthening would occur on the south east end of the runway pavement. This project is schedule for the 2021-2025 timeframe and is included in the 2024 layout for the purpose of this ANZ update.
- Helicopter pad: No physical changes to the helicopter pad are planned relative to the changed 2019 layout.
- Planned Runway 10R/28L: Although this planned runway is currently scheduled for the 2026 timeframe, it is included in the 10-year forecast as a reasonable projection of future usage for the purpose of this ANZ update. The Runway 10R end includes a 500-foot displaced arrival threshold.

Table 3 presents the 2024 runway layout data and Figure 3 presents the 2024 runway layout.[8]

[8] If the future Airport layout does includes a Runway 10R/28L, existing Runway 10/28 would be renamed Runway 10L/28R. However for the purposes of this document, existing Runway 10/28 will be referred to as "Runway 10/28" throughout this document for consistency.

Table 1 Existing Runway Layout Data (2014)

Sources: BWI Marshall 2012 Airport Layout Plan, Sheet 5
Threshold Crossing Height from FAA Form 5010 effective August 22, 2013
Helicopter pad information estimated from BWI Marshall 2012 Airport Layout Plan, Sheet 3

Runway	4	22
Latitude (deg)	39.166878	39.180662
Longitude (deg)	-76.671368	-76.659780
Elevation (ft)	146.0	137.7
Length (ft)	6,000	6,000
Takeoff Threshold (ft)	0	0
Approach Threshold (ft)	0	0
Threshold Crossing Height (ft)	37	47
Runway 4/22 was permanently closed on August 6, 2014. However it is included in the 2014 conditions of this ANZ.		
Runway	**10**	**28**
Latitude (deg)	39.174747	39.172632
Longitude (deg)	-76.689618	-76.652676
Elevation (ft)	139.0	126.2
Length (ft)	10,502	10,502
Takeoff Threshold (ft)	0	500 (typical)
Approach Threshold (ft)	550	500
Threshold Crossing Height (ft)	50	55
Runway	**15L**	**33R**
Latitude (deg)	39.187373	39.176236
Longitude (deg)	-76.663540	-76.653231
Elevation (ft)	141.5	114.1
Length (ft)	5,000	5,000
Takeoff Threshold (ft)	0	0
Approach Threshold (ft)	0	0
Threshold Crossing Height (ft)	47	47
Runway	**15R**	**33L**
Latitude (deg)	39.185366	39.164208
Longitude (deg)	-76.681984	-76.662387
Elevation (ft)	138.6	129.2
Length (ft)	9,501	9,501
Takeoff Threshold (ft)	0	0
Approach Threshold (ft)	0	0
Threshold Crossing Height (ft)	50	55
Helicopter Pad		
Latitude (deg)	39.186529	
Longitude (deg)	-76.660582	
Elevation (ft)	132	

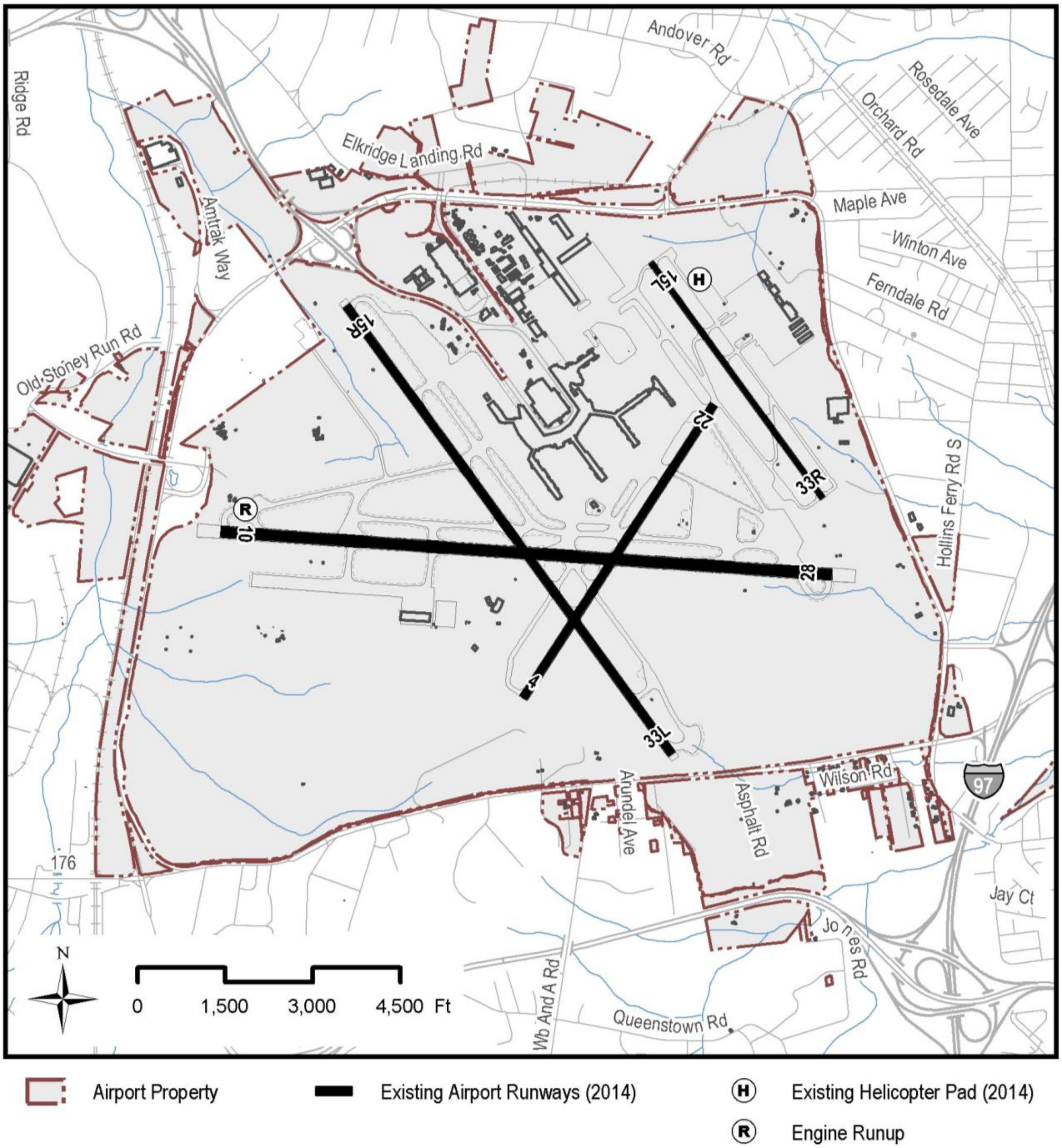

Figure 1 Existing 2014 BWI Marshall Airport Layout

Table 2 Forecast Runway Layout Data (2019)

Sources: BWI Marshall 2012 Airport Layout Plan, Sheet 5

Threshold Crossing Height from FAA Form 5010 effective August 22, 2013, unless otherwise noted as "(anticipated)"
Helicopter pad information estimated from BWI Marshall 2012 Airport Layout Plan, Sheet 3

Runway	4	22
	Permanently closed / decommissioned as a runway effective August 6, 2014	
Runway	**10**	**28**
Latitude (deg)	39.174747	39.172632
Longitude (deg)	-76.689618	-76.652676
Elevation (ft)	139.0	126.2
Length (ft)	10,502	10,502
Takeoff Threshold (ft)	0	500 (typical)
Approach Threshold (ft)	550	*700*
Threshold Crossing Height (ft)	50	*50 (anticipated)*
Runway	**15L**	**33R**
Latitude (deg)	39.187373	39.176236
Longitude (deg)	-76.663540	-76.653231
Elevation (ft)	141.5	114.1
Length (ft)	5,000	5,000
Takeoff Threshold (ft)	0	0
Approach Threshold (ft)	0	0
Threshold Crossing Height (ft)	47	47
Runway	**15R**	**33L**
Latitude (deg)	*39.185361*	*39.164203*
Longitude (deg)	*-76.681993*	*-76.662393*
Elevation (ft)	138.6	129.2
Length (ft)	9,501	9,501
Takeoff Threshold (ft)	0	0
Approach Threshold (ft)	*300*	*500*
Threshold Crossing Height (ft)	50	*50 (anticipated)*
Helicopter Pad		
Latitude (deg)	*39.185181*	
Longitude (deg)	*-76.659115*	
Elevation (ft)	*129*	

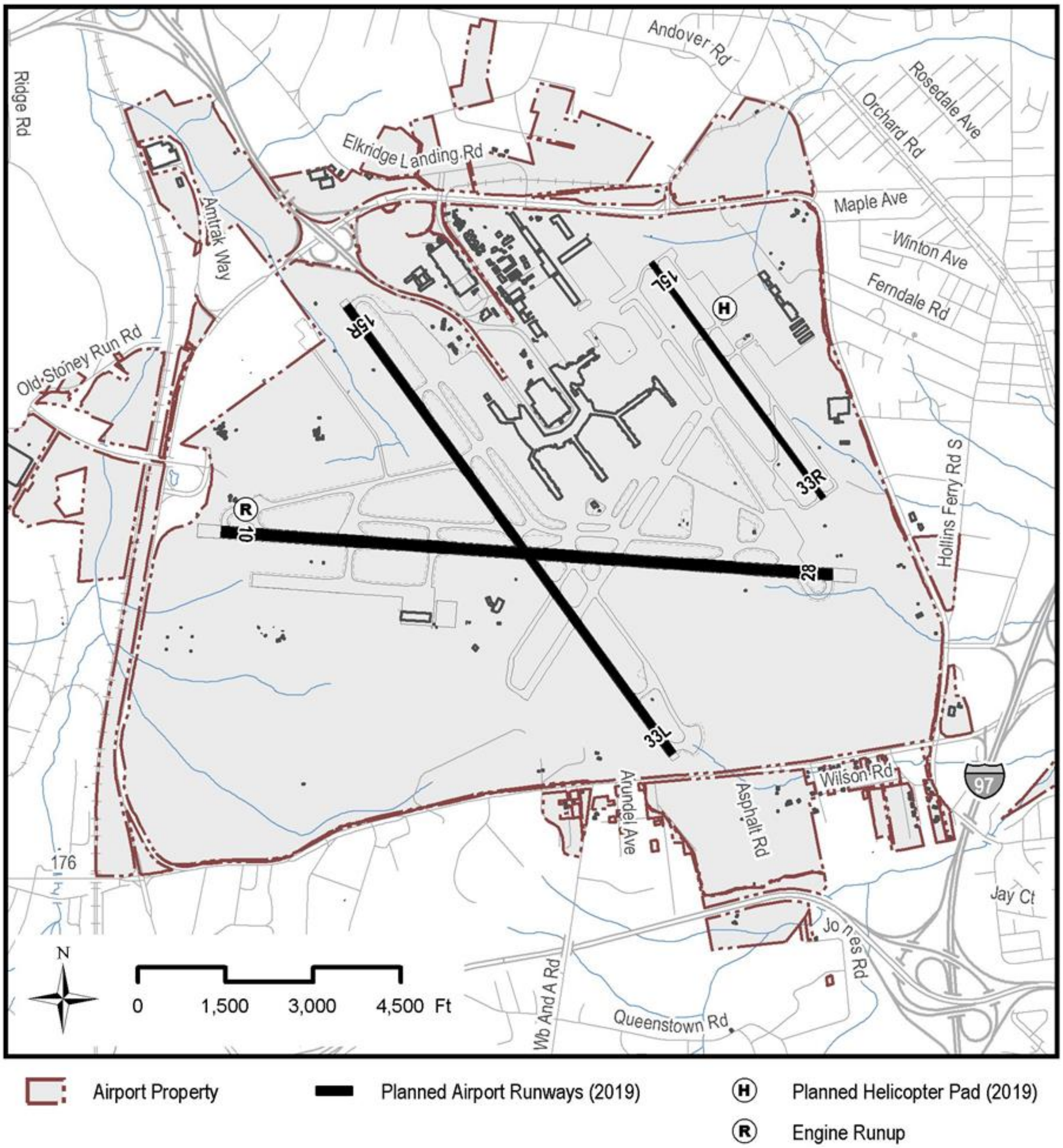

Figure 2 Future 2019 BWI Marshall Airport Layout

Table 3 Forecast Runway Layout Data (2024)

Sources: BWI Marshall 2012 Airport Layout Plan, Sheet 5

Threshold Crossing Height from FAA Form 5010 effective August 22, 2013, unless otherwise noted as "(anticipated)"

Helicopter pad information estimated from BWI Marshall 2012 Airport Layout Plan, Sheet 3

Runway	**4**	**22**
	Permanently closed / decommissioned as a runway effective August 6, 2014	
Runway	**10**	**28**
Latitude (deg)	39.174747	39.172632
Longitude (deg)	-76.689618	-76.652676
Elevation (ft)	139.0	126.2
Length (ft)	10,502	10,502
Takeoff Threshold (ft)	0	500 (typical)
Approach Threshold (ft)	550	*700*
Threshold Crossing Height (ft)	50	*50 (anticipated)*
Runway	**10R**	**28L**
Latitude (deg)	*39.167757*	*39.165944*
Longitude (deg)	*-76.687725*	*-76.656068*
Elevation (ft)	*140.0*	*130.0*
Length (ft)	*9,000*	*9,000*
Takeoff Threshold (ft)	*0*	*0*
Approach Threshold (ft)	*500*	*0*
Threshold Crossing Height (ft)	*50 (anticipated)*	*50 (anticipated)*
Runway	**15L**	**33R**
Latitude (deg)	39.187373	39.176236
Longitude (deg)	-76.663540	-76.653231
Elevation (ft)	141.5	114.1
Length (ft)	5,000	5,000
Takeoff Threshold (ft)	0	0
Approach Threshold (ft)	0	0
Threshold Crossing Height (ft)	47	47
Runway	**15R**	**33L**
Latitude (deg)	*39.185361*	*39.161976*
Longitude (deg)	*-76.681993*	*-76.660330*
Elevation (ft)	138.6	129.2
Length (ft)	*10,501*	*10,501*
Takeoff Threshold (ft)	0	0
Approach Threshold (ft)	0	0
Threshold Crossing Height (ft)	50	*50 (anticipated)*
Helicopter Pad		
Latitude (deg)	39.185181	
Longitude (deg)	-76.659115	
Elevation (ft)	129	

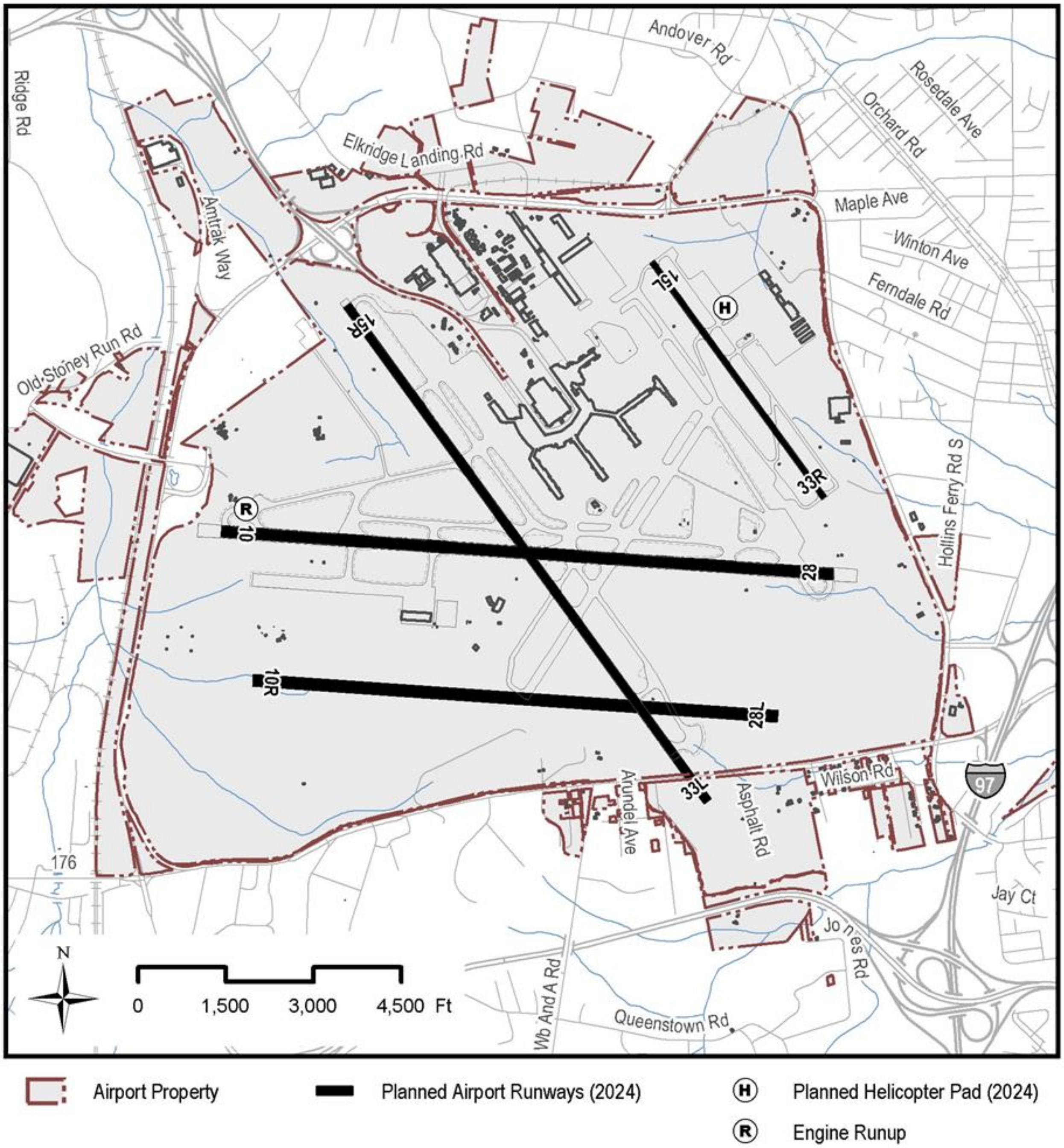

Figure 3 Future 2024 BWI Marshall Airport Layout

3.2 AIRCRAFT OPERATIONS

The MAA used the January 2013 issue of the FAA's Terminal Area Forecast (TAF) for aircraft operational activity levels. The TAF reports aircraft operational activity levels in one of four categories listed below.

- Air Carrier - Operations by aircraft capable of holding 60 seats or more and are flying using a three letter company designator;
- Air Taxi - Operations by aircraft less than 60 seats and are flying using a three letter company designator or the prefix "Tango";
- Military - all classes of military operations;
- General Aviation - Civil (non-military) aircraft operations not otherwise classified under air carrier or air taxi.

Table 4 presents the modeled 2014 and 2019 and 2024 operations by TAF category along with the modeled aircraft operations. For 2014, 263,530 annual operations were represented with 722.0 average annual day operations. For 2019, 292,253 annual operations were represented with 800.7 average annual day operations. For 2024, 319,464 annual operations were represented with 875.2 average annual day operations.

Table 4 Summary of FAA Terminal Area Forecast (TAF) Operations Activity Levels at BWI Marshall and Modeled Operations for the 2014, 2019 and 2024

Sources: FAA TAF 2013, HMMH December 2013

FAA Operational Category[1]	2014 Operations		2019 Operations		2024 Operations[4]	
	2014 Forecast – Issued January 2013	2014 Average Annual Day Modeled Operations	2019 Forecast – Issued January 2013	2019 Average Annual Day Modeled Operations	2024 Forecast – Issued January 2013	2024 Average Annual Day Modeled Operations
Air Carrier	208,969	572.5	240,831	659.8	269,829	739.3
Air Taxi and Commuter	38,329	105.0	34,359	94.1	31,697	86.8
GA (Itinerant + Local)[2]	15,272	41.8	16,103	44.1	16,978	46.5
Military	960	2.6	960	2.6	960	2.6
Total[3]	**263,530**	**722.0**	**292,253**	**800.7**	**319,464**	**875.2**

Notes:
1 Operational Categories used in the TAF are those defined in FAA Order 7210.3Y at Chapter 9, Section 9-1-2 (April 2, 2014). http://www.faa.gov/air_traffic/publications/atpubs/FAC/Index.htm
2 General Aviation activity levels presented in "Itinerant" operations include Civil "Local" operations. The TAF forecasts 268 civilian local operations for 2014, 2019 and 2024.
3 Totals may not match exactly due to rounding.
4 2024 Average annual day operations were developed assuming 365 days. The TAF does not make adjustments for leap years

Flight tracking data for April 2012 through March 2013 (inclusive) were scaled to the 2014, 2019 and 2024 annual operation totals presented in Table 4. The scaling process considered recent and on-going aircraft fleet changes at several airlines and expected aircraft retirements to represent 2014, 2019 and 2024 operations. Details of the forecast are presented in an April 25, 2014 memorandum and presented in this report as Appendix C.

Detailed modeled average daily aircraft operations for each aircraft type included in the study years 2014 and 2019 and 2024 are given in, Table 5, Table 6 and Table 7 respectively. Any discrepancies between the total number of operations and the number of operations presented in Table 8 are due to rounding.

The "Day" time operations are between 7 AM to 10 PM and "Night" time operations are between 10 PM to 7 AM. The "Day" and "Night" periods correspond to the L_{dn} noise metric (Section 2.1.6).

Table 5 2014 Modeled Average Daily Aircraft Operations

Source: HMMH, May 2014

Aircraft Category	INM Aircraft Type	Arrivals		Departures		Total
		Day	Night	Day	Night	
Air Carrier	*DC86	0.2	<0.1	0.2	<0.1	0.5
	717200	28.3	2.3	28.7	1.9	61.3
	727EM2	<0.1	0.0	<0.1	0.0	<0.1
	737300	39.7	3.7	39.7	3.6	86.6
	7373B2	2.6	0.2	2.5	0.3	5.6
	737400	3.2	0.1	3.3	<0.1	6.7
	737500	5.8	0.6	5.7	0.7	12.8
	737700	119.8	12.1	119.4	12.4	263.7
	737800	11.0	3.8	12.4	2.5	29.8
	737N17	<0.1	0.0	<0.1	0.0	<0.1
	74720A	<0.1	0.0	<0.1	0.0	<0.1
	74720B	<0.1	<0.1	<0.1	<0.1	<0.1
	747400	0.2	<0.1	0.2	<0.1	0.5
	757300	<0.1	0.0	<0.1	0.0	<0.1
	757PW	2.6	1.4	3.2	0.8	8.0
	757RR	1.4	1.3	2.3	0.4	5.4
	767300	1.5	0.8	1.4	1.0	4.6
	767400	<0.1	0.0	<0.1	0.0	<0.1
	767CF6	0.1	0.7	<0.1	0.7	1.5
	767JT9	<0.1	0.0	0.0	<0.1	<0.1
	777200	0.1	<0.1	<0.1	<0.1	0.2
	A300-622R	0.2	1.2	0.7	0.7	2.7
	A310-304	<0.1	0.0	0.0	<0.1	<0.1
	A319-131	5.0	1.7	5.0	1.8	13.5
	A320-211	2.8	1.5	4.0	0.3	8.6
	A320-232	4.2	1.8	5.1	0.8	11.9
	A321-232	0.6	0.4	1.0	<0.1	2.1
	A330-301	<0.1	<0.1	<0.1	<0.1	<0.1
	CRJ9-ER	1.2	<0.1	1.2	<0.1	2.6
	CRJ9-LR	0.3	0.0	0.3	<0.1	0.5
	DC1010	0.5	0.1	0.1	0.5	1.3
	DC1030	0.1	<0.1	<0.1	0.1	0.3
	DC93LW	<0.1	0.0	0.0	<0.1	<0.1
	DC95HW	0.6	<0.1	0.6	<0.1	1.2
	EMB170	<0.1	0.0	<0.1	<0.1	0.1
	EMB175	<0.1	0.0	<0.1	<0.1	0.2
	EMB190	4.3	0.5	3.9	0.9	9.6
	F10062	<0.1	0.0	<0.1	<0.1	0.1
	MD11GE	<0.1	<0.1	0.1	<0.1	0.3
	MD11PW	0.3	0.1	0.3	0.1	0.9
	MD81	<0.1	0.0	<0.1	0.0	<0.1
	MD82	2.6	0.7	3.3	<0.1	6.6
	MD83	7.8	1.3	8.5	0.6	18.3

Aircraft Category	INM Aircraft Type	Arrivals		Departures		Total
		Day	Night	Day	Night	
	MD9025	1.3	<0.1	1.3	<0.1	2.7
	MD9028	0.7	<0.1	0.7	<0.1	1.5
Air Carrier Subtotal		**249.6**	**36.7**	**255.5**	**30.8**	**572.5**
	*BE36	<0.1	0.0	<0.1	0.0	<0.1
	*COL4	<0.1	0.0	<0.1	0.0	<0.1
	*E50P	<0.1	<0.1	<0.1	<0.1	0.2
	*E55P	0.2	<0.1	0.2	<0.1	0.5
	*LJ40	0.2	<0.1	0.2	<0.1	0.5
	*TBM8	0.0	0.0	<0.1	0.0	<0.1
	BEC58P	0.7	1.4	1.3	0.8	4.2
	CIT3	<0.1	0.0	<0.1	0.0	<0.1
	CL600	1.2	0.1	1.3	<0.1	2.6
	CL601	7.8	1.4	7.0	2.3	18.5
	CNA172	<0.1	0.0	<0.1	0.0	<0.1
	CNA182	<0.1	0.0	<0.1	0.0	<0.1
	CNA206	<0.1	0.0	<0.1	0.0	<0.1
	CNA208	4.3	2.3	4.1	2.5	13.2
	CNA441	0.0	0.1	0.0	0.1	0.3
	CNA510	<0.1	0.0	<0.1	0.0	<0.1
	CNA525C	0.2	0.0	0.2	0.0	0.4
	CNA55B	0.2	<0.1	0.1	<0.1	0.3
	CNA560E	0.5	<0.1	0.5	<0.1	1.0
	CNA560XL	2.2	0.1	2.2	0.1	4.6
	CNA680	0.8	<0.1	0.8	<0.1	1.7
	CNA750	0.9	<0.1	0.9	<0.1	1.9
	CVR580	<0.1	0.0	<0.1	0.0	<0.1
	DHC6	0.0	<0.1	0.0	<0.1	<0.1
	DHC8	5.7	1.2	6.1	0.8	13.8
	DHC830	4.1	0.6	4.1	0.6	9.4
	DO228	<0.1	0.0	<0.1	0.0	<0.1
	ECLIPSE500	<0.1	<0.1	<0.1	0.0	<0.1
	EMB145	3.4	0.5	3.2	0.7	7.8
	EMB14L	7.6	1.2	7.4	1.3	17.4
	GASEPV	0.1	<0.1	0.1	<0.1	0.3
	GIIB	<0.1	0.0	<0.1	0.0	<0.1
	GIV	<0.1	<0.1	0.1	0.0	0.2
	GV	<0.1	0.0	<0.1	0.0	0.1
	IA1125	<0.1	0.0	<0.1	0.0	<0.1
	LEAR35	1.4	0.1	1.4	0.1	3.0
	MU3001	0.6	<0.1	0.6	<0.1	1.3
	SD330	0.7	<0.1	0.7	<0.1	1.4
Air Taxi Subtotal		**43.0**	**9.5**	**42.8**	**9.7**	**105.0**
General Aviation Fixed Wing	*B350	0.2	<0.1	0.2	<0.1	0.4
	*BE36	0.1	0.0	<0.1	<0.1	0.2
	*COL3	<0.1	0.0	<0.1	0.0	<0.1
	*COL4	<0.1	0.0	<0.1	0.0	<0.1
	*DA40	<0.1	0.0	<0.1	0.0	<0.1
	*E50P	<0.1	<0.1	<0.1	<0.1	<0.1

Aircraft Category	INM Aircraft Type	Arrivals		Departures		Total
		Day	Night	Day	Night	
	*E55P	<0.1	0.0	<0.1	<0.1	0.2
	*FA7X	<0.1	0.0	<0.1	0.0	<0.1
	*H25C	<0.1	<0.1	<0.1	0.0	<0.1
	*KODI	<0.1	<0.1	<0.1	0.0	<0.1
	*LJ40	<0.1	0.0	<0.1	<0.1	<0.1
	*P46T	0.4	<0.1	0.4	<0.1	0.7
	*TBM8	<0.1	0.0	<0.1	0.0	0.1
	1900D	<0.1	<0.1	0.1	0.0	0.2
	737700	0.1	<0.1	0.1	<0.1	0.3
	737800	<0.1	0.0	<0.1	0.0	<0.1
	757RR	<0.1	<0.1	<0.1	0.0	<0.1
	767300	0.0	<0.1	<0.1	0.0	<0.1
	767CF6	<0.1	<0.1	<0.1	0.0	<0.1
	BEC58P	0.8	<0.1	0.7	<0.1	1.6
	CIT3	0.2	0.0	0.2	<0.1	0.4
	CL600	0.9	<0.1	0.9	<0.1	1.9
	CL601	1.0	<0.1	1.1	<0.1	2.3
	CNA172	1.1	<0.1	1.1	<0.1	2.4
	CNA182	0.4	<0.1	0.4	<0.1	0.8
	CNA206	0.1	<0.1	0.2	0.0	0.3
	CNA208	0.6	<0.1	0.7	<0.1	1.3
	CNA20T	<0.1	0.0	<0.1	0.0	<0.1
	CNA441	0.8	<0.1	0.8	<0.1	1.6
	CNA500	0.2	<0.1	0.2	<0.1	0.3
	CNA510	<0.1	0.0	<0.1	<0.1	<0.1
	CNA525C	0.7	<0.1	0.7	<0.1	1.4
	CNA55B	0.6	<0.1	0.6	<0.1	1.3
	CNA560E	0.5	<0.1	0.5	<0.1	1.1
	CNA560U	<0.1	0.0	<0.1	<0.1	0.2
	CNA560XL	0.6	<0.1	0.6	<0.1	1.2
	CNA680	0.3	<0.1	0.3	<0.1	0.8
	CNA750	0.4	<0.1	0.4	<0.1	0.8
	CRJ9-ER	<0.1	0.0	<0.1	0.0	<0.1
	DHC8	0.4	0.1	0.5	<0.1	1.0
	DO228	0.2	0.0	0.2	<0.1	0.5
	ECLIPSE500	<0.1	0.0	<0.1	0.0	<0.1
	EMB145	<0.1	0.0	<0.1	<0.1	<0.1
	F10062	0.4	<0.1	0.4	<0.1	0.9
	GASEPF	<0.1	0.0	<0.1	<0.1	<0.1
	GASEPV	2.4	<0.1	2.3	<0.1	4.8
	GIIB	<0.1	0.0	<0.1	<0.1	0.1
	GIV	0.6	<0.1	0.6	<0.1	1.3
	GV	0.5	<0.1	0.6	<0.1	1.3
	HS748A	<0.1	0.0	<0.1	<0.1	<0.1
	IA1125	0.3	<0.1	0.3	<0.1	0.5
	LEAR25	<0.1	<0.1	<0.1	<0.1	<0.1
	LEAR35	2.1	0.2	2.1	0.2	4.7
	MU3001	0.8	<0.1	0.8	<0.1	1.8
	PA28	0.2	<0.1	0.2	<0.1	0.5

Aircraft Category	INM Aircraft Type	Arrivals		Departures		Total
		Day	Night	Day	Night	
	PA30	<0.1	0.0	<0.1	0.0	<0.1
	PA31	0.2	<0.1	0.2	<0.1	0.3
	PA42	<0.1	<0.1	<0.1	<0.1	<0.1
	SD330	<0.1	0.0	<0.1	0.0	<0.1
General Aviation Fixed Wing Subtotal**		***19.0***	***1.4***	***19.2***	***1.2***	***40.8***
General Aviation Helicopter	A109	<0.1	0.0	<0.1	0.0	<0.1
	B206L	<0.1	0.0	<0.1	0.0	<0.1
	B212	<0.1	0.0	<0.1	0.0	<0.1
	B407	<0.1	<0.1	<0.1	<0.1	0.2
	B429	<0.1	0.0	0.0	<0.1	<0.1
	B430	<0.1	0.0	<0.1	0.0	<0.1
	EC130	<0.1	<0.1	<0.1	<0.1	<0.1
	R22	<0.1	<0.1	<0.1	0.0	0.2
	R44	<0.1	0.0	<0.1	0.0	<0.1
	S76	0.1	<0.1	0.1	0.0	0.2
	SA330J	<0.1	0.0	<0.1	0.0	<0.1
	SA365N	<0.1	0.0	<0.1	0.0	<0.1
General Aviation Helicopter Subtotal**		***0.5***	***<0.1***	***0.5***	***<0.1***	***1.0***
General Aviation All Aircraft Subtotal		**19.5**	**1.5**	**19.7**	**1.2**	**41.8**
Military	737800	<0.1	0.0	<0.1	0.0	<0.1
	C130	0.1	0.0	0.1	0.0	0.2
	CNA441	1.0	0.0	1.0	0.0	2.0
	DHC6	<0.1	0.0	<0.1	0.0	<0.1
	SD330	0.1	<0.1	0.1	<0.1	0.3
Military Subtotal		**1.3**	**<0.1**	**1.3**	**<0.1**	**2.6**
Total		**313.3**	**47.7**	**319.3**	**41.7**	**722.0**

Notes:
*Non-standard substitution or user defined INM aircraft type. See Section 3.3 for additional information.
Totals and sub-totals may not match exactly due to rounding.
**General Aviation Helicopter and General Aviation Fixed Wing aircraft are reported separately for clarity. This is an editorial change relative to the October 2014 draft of this document.

Table 6 2019 Modeled Average Daily Aircraft Operations

Source: HMMH, May 2014

Aircraft Category	INM Aircraft Type	Arrivals		Departures		Total
		Day	Night	Day	Night	
Air Carrier	*DC86	0.2	0.1	0.2	<0.1	0.6
	717200	0.6	<0.1	0.6	<0.1	1.2
	727EM2	<0.1	0.0	<0.1	0.0	<0.1
	737300	24.2	2.2	24.2	2.2	52.9
	7373B2	1.6	0.1	1.6	0.2	3.4
	737400	<0.1	0.0	<0.1	<0.1	<0.1
	737500	0.3	0.1	0.3	0.1	0.8
	737700	176.3	18.2	177.1	17.4	389.0
	737800	30.7	9.6	34.7	5.6	80.6
	737N17	<0.1	0.0	<0.1	0.0	<0.1
	74720A	<0.1	0.0	<0.1	0.0	<0.1
	74720B	<0.1	<0.1	<0.1	<0.1	<0.1
	747400	0.3	<0.1	0.2	0.2	0.7
	757300	<0.1	0.0	<0.1	0.0	<0.1
	757PW	<0.1	0.3	0.3	<0.1	0.6
	757RR	1.2	0.9	1.8	0.3	4.2
	767300	3.0	2.0	1.9	3.0	9.8
	767400	<0.1	0.0	<0.1	0.0	<0.1
	767CF6	<0.1	<0.1	<0.1	0.0	<0.1
	767JT9	<0.1	0.0	0.0	<0.1	<0.1
	777200	0.4	<0.1	<0.1	0.3	0.7
	A300-622R	0.2	1.2	0.7	0.7	2.7
	A310-304	<0.1	0.0	0.0	<0.1	<0.1
	A319-131	5.0	1.7	5.0	1.8	13.5
	A320-211	2.8	1.5	4.0	0.3	8.6
	A320-232	4.3	1.8	5.3	0.8	12.3
	A321-232	8.7	1.5	9.3	0.9	20.4
	A330-301	<0.1	<0.1	<0.1	<0.1	<0.1
	CRJ9-ER	1.4	<0.1	1.4	<0.1	3.0
	CRJ9-LR	0.3	0.0	0.3	<0.1	0.6
	DC93LW	<0.1	0.0	0.0	<0.1	<0.1
	EMB170	<0.1	0.0	<0.1	<0.1	0.1
	EMB175	7.6	1.5	7.5	1.5	18.1
	EMB190	4.9	0.6	4.5	1.0	11.1
	F10062	<0.1	0.0	<0.1	<0.1	0.1
	MD11GE	<0.1	<0.1	0.1	<0.1	0.3
	MD11PW	0.3	0.1	0.3	0.1	0.9
	MD81	<0.1	0.0	<0.1	0.0	<0.1
	MD82	1.1	0.3	1.3	<0.1	2.6
	MD83	7.1	1.0	7.5	0.6	16.2
	MD9025	1.3	<0.1	1.3	<0.1	2.7
	MD9028	0.7	<0.1	0.7	<0.1	1.5
Air Carrier Subtotal		**284.8**	**45.1**	**292.6**	**37.3**	**659.8**
Air Taxi	*BE36	<0.1	0.0	<0.1	0.0	<0.1
	*COL4	<0.1	0.0	<0.1	0.0	<0.1
	*E50P	<0.1	<0.1	<0.1	<0.1	0.2

Aircraft Category	INM Aircraft Type	Arrivals		Departures		Total
		Day	Night	Day	Night	
	*E55P	0.2	<0.1	0.2	<0.1	0.5
	*LJ40	0.2	<0.1	0.2	<0.1	0.5
	*TBM8	0.0	0.0	<0.1	0.0	<0.1
	BEC58P	0.8	1.5	1.4	0.9	4.6
	CIT3	<0.1	0.0	<0.1	0.0	<0.1
	CL600	1.3	0.1	1.4	<0.1	2.9
	CL601	8.6	1.6	7.7	2.5	20.3
	CNA172	<0.1	0.0	<0.1	0.0	<0.1
	CNA182	<0.1	0.0	<0.1	0.0	<0.1
	CNA206	<0.1	0.0	<0.1	0.0	<0.1
	CNA208	4.7	2.5	4.5	2.7	14.4
	CNA441	0.0	0.1	0.0	0.1	0.3
	CNA510	<0.1	0.0	<0.1	0.0	<0.1
	CNA525C	0.2	0.0	0.2	0.0	0.4
	CNA55B	0.2	<0.1	0.1	<0.1	0.3
	CNA560E	0.5	<0.1	0.5	<0.1	1.0
	CNA560XL	2.4	0.1	2.4	0.1	5.0
	CNA680	0.8	<0.1	0.8	<0.1	1.7
	CNA750	1.0	<0.1	1.0	<0.1	2.1
	CVR580	<0.1	0.0	<0.1	0.0	<0.1
	DHC6	0.0	<0.1	0.0	<0.1	<0.1
	DHC8	5.7	1.2	6.1	0.8	13.8
	DHC830	4.1	0.6	4.1	0.6	9.4
	DO228	<0.1	0.0	<0.1	0.0	<0.1
	ECLIPSE500	<0.1	<0.1	<0.1	0.0	<0.1
	EMB145	0.8	<0.1	0.8	0.1	1.8
	EMB14L	3.7	0.4	3.4	0.7	8.1
	GASEPV	0.1	<0.1	0.1	<0.1	0.3
	GIV	0.1	<0.1	0.2	0.0	0.3
	GV	<0.1	0.0	<0.1	0.0	0.1
	IA1125	<0.1	0.0	<0.1	0.0	<0.1
	LEAR35	1.4	0.1	1.4	0.1	3.0
	MU3001	0.6	<0.1	0.6	<0.1	1.3
	SD330	0.7	<0.1	0.8	<0.1	1.5
Air Taxi Subtotal		**38.3**	**8.7**	**38.1**	**9.0**	**94.1**
General Aviation Fixed Wing	*B350	0.2	<0.1	0.2	<0.1	0.5
	*BE36	0.1	0.0	<0.1	<0.1	0.2
	*COL3	<0.1	0.0	<0.1	0.0	<0.1
	*COL4	<0.1	0.0	<0.1	0.0	0.1
	*DA40	<0.1	0.0	<0.1	0.0	<0.1
	*E50P	<0.1	<0.1	<0.1	<0.1	0.1
	*E55P	<0.1	0.0	<0.1	<0.1	0.2
	*FA7X	<0.1	0.0	<0.1	0.0	<0.1
	*H25C	<0.1	<0.1	<0.1	0.0	<0.1
	*KODI	<0.1	<0.1	<0.1	0.0	<0.1
	*LJ40	<0.1	0.0	<0.1	<0.1	<0.1
	*P46T	0.4	<0.1	0.4	<0.1	0.8
	*TBM8	<0.1	0.0	<0.1	0.0	0.1

Aircraft Category	INM Aircraft Type	Arrivals		Departures		Total
		Day	Night	Day	Night	
	1900D	<0.1	<0.1	0.1	0.0	0.2
	737700	0.1	<0.1	0.1	<0.1	0.3
	737800	<0.1	0.0	<0.1	0.0	<0.1
	757RR	<0.1	<0.1	<0.1	0.0	<0.1
	767300	0.0	<0.1	<0.1	0.0	<0.1
	767CF6	<0.1	<0.1	<0.1	0.0	<0.1
	BEC58P	0.8	<0.1	0.8	<0.1	1.8
	CIT3	0.2	0.0	0.2	<0.1	0.4
	CL600	1.0	<0.1	1.0	<0.1	2.1
	CL601	1.1	<0.1	1.2	<0.1	2.5
	CNA172	1.2	<0.1	1.2	<0.1	2.6
	CNA182	0.4	<0.1	0.4	<0.1	0.9
	CNA206	0.1	<0.1	0.2	0.0	0.3
	CNA208	0.7	<0.1	0.7	<0.1	1.5
	CNA20T	<0.1	0.0	<0.1	0.0	<0.1
	CNA441	0.8	<0.1	0.8	<0.1	1.6
	CNA500	0.2	<0.1	0.2	<0.1	0.3
	CNA510	<0.1	0.0	<0.1	<0.1	<0.1
	CNA525C	0.7	<0.1	0.7	<0.1	1.5
	CNA55B	0.6	<0.1	0.6	<0.1	1.3
	CNA560E	0.5	<0.1	0.5	<0.1	1.1
	CNA560U	<0.1	0.0	<0.1	<0.1	0.2
	CNA560XL	0.6	<0.1	0.6	<0.1	1.3
	CNA680	0.3	<0.1	0.3	<0.1	0.8
	CNA750	0.4	<0.1	0.4	<0.1	0.9
	CRJ9-ER	<0.1	0.0	<0.1	0.0	<0.1
	DHC8	0.4	0.1	0.5	<0.1	1.0
	DO228	0.3	0.0	0.2	<0.1	0.5
	ECLIPSE500	<0.1	0.0	<0.1	0.0	<0.1
	EMB145	<0.1	0.0	<0.1	<0.1	<0.1
	F10062	0.4	<0.1	0.4	<0.1	0.9
	GASEPF	<0.1	0.0	<0.1	<0.1	<0.1
	GASEPV	2.6	<0.1	2.5	<0.1	5.2
	GIV	0.7	<0.1	0.7	<0.1	1.6
	GV	0.6	0.1	0.7	<0.1	1.4
	HS748A	<0.1	0.0	<0.1	<0.1	<0.1
	IA1125	0.3	<0.1	0.3	<0.1	0.5
	LEAR35	2.1	0.3	2.2	0.2	4.8
	MU3001	0.8	<0.1	0.8	<0.1	1.8
	PA28	0.2	<0.1	0.3	<0.1	0.6
	PA30	<0.1	0.0	<0.1	0.0	<0.1
	PA31	0.2	<0.1	0.2	<0.1	0.3
	PA42	<0.1	<0.1	<0.1	<0.1	<0.1
	SD330	<0.1	0.0	<0.1	0.0	<0.1
General Aviation Fixed Wing Subtotal**		***20.0***	***1.5***	***20.3***	***1.2***	***43.0***
General Aviation Helicopter	A109	<0.1	0.0	<0.1	0.0	<0.1
	B206L	<0.1	0.0	<0.1	0.0	<0.1
	B212	<0.1	0.0	<0.1	0.0	<0.1

Aircraft Category	INM Aircraft Type	Arrivals		Departures		Total
		Day	Night	Day	Night	
	B407	<0.1	<0.1	<0.1	<0.1	0.2
	B429	<0.1	0.0	0.0	<0.1	<0.1
	B430	<0.1	0.0	<0.1	0.0	<0.1
	EC130	<0.1	<0.1	<0.1	<0.1	<0.1
	R22	<0.1	<0.1	<0.1	0.0	0.2
	R44	<0.1	0.0	<0.1	0.0	<0.1
	S76	0.1	<0.1	0.1	0.0	0.3
	SA330J	<0.1	0.0	<0.1	0.0	<0.1
	SA365N	<0.1	0.0	<0.1	0.0	<0.1
General Aviation Helicopter Subtotal*		***0.5***	***<0.1***	***0.5***	***<0.1***	***1.1***
General Aviation All Aircraft Subtotal		**20.5**	**1.5**	**20.8**	**1.2**	**44.1**
Military	737800	<0.1	0.0	<0.1	0.0	<0.1
	C130	0.1	0.0	0.1	0.0	0.2
	CNA441	1.0	0.0	1.0	0.0	2.0
	DHC6	<0.1	0.0	<0.1	0.0	<0.1
	SD330	0.1	<0.1	0.1	<0.1	0.3
Military Subtotal		**1.3**	**<0.1**	**1.3**	**<0.1**	**2.6**
Total		**344.9**	**55.4**	**352.8**	**47.5**	**800.7**

Notes:
*Non-standard substitution or user defined INM aircraft type. See Section 3.3 for additional information.
Totals and sub-totals may not match exactly due to rounding.
**General Aviation Helicopter and General Aviation Fixed Wing aircraft are reported separately for clarity. This is an editorial change relative to the October 2014 draft of this document.

Table 7 2024 Modeled Average Daily Aircraft Operations

Source: HMMH June 2014

Aircraft Category	INM Aircraft Type	Arrivals		Departures		Total
		Day	Night	Day	Night	
Air Carrier	*DC86	0.2	<0.1	0.2	<0.1	0.6
	717200	0.6	<0.1	0.6	<0.1	1.2
	727EM2	<0.1	0.0	<0.1	0.0	<0.1
	737300	24.2	2.2	24.2	2.2	52.9
	7373B2	1.6	0.1	1.6	0.2	3.4
	737400	<0.1	0.0	<0.1	<0.1	<0.1
	737500	0.3	0.1	0.3	0.1	0.8
	737700	200.2	20.7	201.1	19.7	441.7
	737800	37.4	12.1	42.3	7.2	98.9
	737N17	<0.1	0.0	<0.1	0.0	<0.1
	74720A	<0.1	0.0	<0.1	0.0	<0.1
	74720B	<0.1	<0.1	<0.1	<0.1	<0.1
	747400	0.3	0.1	0.2	0.2	0.9
	757300	<0.1	0.0	<0.1	0.0	<0.1
	757PW	<0.1	0.3	0.3	<0.1	0.6
	757RR	1.2	0.9	1.8	0.3	4.3
	767300	3.4	2.3	2.2	3.6	11.5
	767400	<0.1	0.0	<0.1	0.0	<0.1
	767CF6	<0.1	<0.1	<0.1	0.0	<0.1
	767JT9	<0.1	0.0	0.0	<0.1	<0.1
	777200	0.4	<0.1	0.1	0.3	0.8
	A300-622R	0.2	1.2	0.7	0.7	2.7
	A310-304	<0.1	0.0	0.0	<0.1	<0.1
	A319-131	5.0	1.7	5.0	1.8	13.5
	A320-211	2.8	1.5	4.0	0.3	8.7
	A320-232	4.4	1.9	5.5	0.8	12.7
	A321-232	11.2	2.0	12.0	1.2	26.4
	A330-301	<0.1	<0.1	<0.1	<0.1	<0.1
	CRJ9-ER	1.6	<0.1	1.6	<0.1	3.3
	CRJ9-LR	0.3	0.0	0.3	<0.1	0.7
	DC93LW	<0.1	0.0	0.0	<0.1	<0.1
	EMB170	<0.1	0.0	<0.1	<0.1	0.1
	EMB175	8.5	1.6	8.4	1.7	20.3
	EMB190	5.5	0.7	5.1	1.1	12.4
	F10062	<0.1	0.0	<0.1	<0.1	0.2
	MD11GE	<0.1	<0.1	0.1	<0.1	0.3
	MD11PW	0.3	0.1	0.3	0.1	0.9
	MD81	<0.1	0.0	<0.1	0.0	<0.1
	MD83	6.6	0.8	6.8	0.6	14.9
	MD9025	1.3	<0.1	1.3	<0.1	2.7
	MD9028	0.7	<0.1	0.7	<0.1	1.5
Air Carrier Subtotal		**318.9**	**50.7**	**327.1**	**42.6**	**739.3**
Air Taxi	*BE36	<0.1	0.0	<0.1	0.0	<0.1
	*COL4	<0.1	0.0	<0.1	0.0	<0.1
	*E50P	<0.1	<0.1	<0.1	<0.1	0.2
	*E55P	0.2	<0.1	0.2	<0.1	0.5

Aircraft Category	INM Aircraft Type	Arrivals		Departures		Total
		Day	Night	Day	Night	
	*LJ40	0.2	<0.1	0.2	<0.1	0.5
	*TBM8	0.0	0.0	<0.1	0.0	<0.1
	BEC58P	0.7	1.3	1.2	0.8	3.9
	CIT3	<0.1	0.0	<0.1	0.0	<0.1
	CL600	1.1	0.1	1.2	<0.1	2.5
	CL601	7.4	1.3	6.6	2.1	17.5
	CNA172	<0.1	0.0	<0.1	0.0	<0.1
	CNA182	<0.1	0.0	<0.1	0.0	<0.1
	CNA206	<0.1	0.0	<0.1	0.0	<0.1
	CNA208	4.0	2.2	3.9	2.3	12.4
	CNA441	0.0	0.1	0.0	0.1	0.3
	CNA510	<0.1	0.0	<0.1	0.0	<0.1
	CNA525C	0.2	0.0	0.2	0.0	0.4
	CNA55B	0.2	<0.1	0.1	<0.1	0.3
	CNA560E	0.5	<0.1	0.5	<0.1	1.0
	CNA560XL	2.0	0.1	2.0	0.1	4.3
	CNA680	0.8	<0.1	0.8	<0.1	1.7
	CNA750	0.8	<0.1	0.8	<0.1	1.8
	CVR580	<0.1	0.0	<0.1	0.0	<0.1
	DHC6	0.0	<0.1	0.0	<0.1	<0.1
	DHC8	5.7	1.2	6.1	0.8	13.8
	DHC830	4.1	0.6	4.1	0.6	9.4
	DO228	<0.1	0.0	<0.1	0.0	<0.1
	ECLIPSE500	<0.1	<0.1	<0.1	0.0	<0.1
	EMB145	0.8	<0.1	0.8	0.1	1.8
	EMB14L	3.6	0.4	3.4	0.7	8.0
	GASEPV	0.1	<0.1	0.1	<0.1	0.3
	GIV	0.1	<0.1	0.1	0.0	0.3
	GV	<0.1	0.0	<0.1	0.0	0.1
	IA1125	<0.1	0.0	<0.1	0.0	<0.1
	LEAR35	1.4	0.1	1.4	0.1	3.0
	MU3001	0.6	<0.1	0.6	<0.1	1.3
	SD330	0.6	<0.1	0.7	<0.1	1.3
Air Taxi Subtotal		**35.5**	**7.9**	**35.3**	**8.1**	**86.8**
General Aviation Fixed Wing	*B350	0.3	<0.1	0.2	<0.1	0.5
	*BE36	0.1	0.0	0.1	<0.1	0.3
	*COL3	<0.1	0.0	<0.1	0.0	<0.1
	*COL4	<0.1	0.0	<0.1	0.0	<0.1
	*DA40	<0.1	0.0	<0.1	0.0	<0.1
	*E50P	<0.1	<0.1	<0.1	<0.1	0.1
	*E55P	<0.1	0.0	0.1	<0.1	0.2
	*FA7X	<0.1	0.0	<0.1	0.0	<0.1
	*H25C	<0.1	<0.1	<0.1	0.0	<0.1
	*KODI	<0.1	<0.1	<0.1	0.0	<0.1
	*LJ40	<0.1	0.0	<0.1	<0.1	<0.1
	*P46T	0.4	<0.1	0.6	<0.1	1.0
	*TBM8	<0.1	0.0	<0.1	0.0	0.1
	1900D	<0.1	<0.1	0.1	0.0	0.2

Aircraft Category	INM Aircraft Type	Arrivals		Departures		Total
		Day	Night	Day	Night	
	737700	0.2	<0.1	0.1	<0.1	0.3
	737800	<0.1	0.0	<0.1	0.0	<0.1
	757RR	<0.1	<0.1	<0.1	0.0	<0.1
	767300	0.0	<0.1	<0.1	0.0	<0.1
	767CF6	<0.1	<0.1	<0.1	0.0	<0.1
	BEC58P	0.9	<0.1	0.9	<0.1	1.9
	CIT3	0.2	0.0	0.2	<0.1	0.4
	CL600	1.1	<0.1	1.1	<0.1	2.3
	CL601	1.2	0.1	1.3	<0.1	2.7
	CNA172	1.3	<0.1	1.3	<0.1	2.8
	CNA182	0.5	<0.1	0.5	<0.1	1.0
	CNA206	0.1	<0.1	0.2	0.0	0.3
	CNA208	0.8	<0.1	0.6	<0.1	1.4
	CNA20T	<0.1	0.0	<0.1	0.0	<0.1
	CNA441	0.8	<0.1	0.8	<0.1	1.6
	CNA500	0.2	<0.1	0.2	<0.1	0.3
	CNA510	<0.1	0.0	<0.1	<0.1	<0.1
	CNA525C	0.8	<0.1	0.8	<0.1	1.7
	CNA55B	0.6	<0.1	0.6	<0.1	1.3
	CNA560E	0.5	<0.1	0.5	<0.1	1.1
	CNA560U	<0.1	0.0	<0.1	<0.1	0.2
	CNA560XL	0.7	<0.1	0.7	<0.1	1.4
	CNA680	0.3	<0.1	0.3	<0.1	0.8
	CNA750	0.4	<0.1	0.5	<0.1	1.0
	CRJ9-ER	<0.1	0.0	<0.1	0.0	<0.1
	DHC8	0.4	0.1	0.5	<0.1	1.0
	DO228	0.3	0.0	0.3	<0.1	0.5
	ECLIPSE500	<0.1	0.0	<0.1	0.0	<0.1
	EMB145	<0.1	0.0	<0.1	<0.1	<0.1
	F10062	0.4	<0.1	0.4	<0.1	0.9
	GASEPF	<0.1	0.0	<0.1	<0.1	<0.1
	GASEPV	2.8	<0.1	2.8	<0.1	5.8
	GIV	0.8	<0.1	0.8	<0.1	1.7
	GV	0.6	0.1	0.7	<0.1	1.5
	HS748A	<0.1	0.0	<0.1	<0.1	<0.1
	IA1125	0.3	<0.1	0.3	<0.1	0.5
	LEAR35	2.1	0.3	2.2	0.2	4.8
	MU3001	0.8	<0.1	0.8	<0.1	1.8
	PA28	0.3	<0.1	0.3	<0.1	0.6
	PA30	<0.1	0.0	<0.1	0.0	<0.1
	PA31	0.2	<0.1	0.2	<0.1	0.3
	PA42	<0.1	<0.1	<0.1	<0.1	<0.1
	SD330	<0.1	0.0	<0.1	0.0	<0.1
General Aviation Fixed Wing Subtotal*		***21.1***	***1.5***	***21.4***	***1.3***	***45.3***
General Aviation Helicopter	A109	<0.1	0.0	<0.1	0.0	<0.1
	B206L	<0.1	0.0	<0.1	0.0	0.1
	B212	<0.1	0.0	<0.1	0.0	<0.1
	B407	0.1	<0.1	0.1	<0.1	0.2

Aircraft Category	INM Aircraft Type	Arrivals		Departures		Total
		Day	Night	Day	Night	
	B429	<0.1	0.0	0.0	<0.1	<0.1
	B430	<0.1	0.0	<0.1	0.0	<0.1
	EC130	<0.1	<0.1	<0.1	<0.1	<0.1
	R22	<0.1	<0.1	<0.1	0.0	0.2
	R44	<0.1	0.0	<0.1	0.0	0.1
	S76	0.1	<0.1	0.1	0.0	0.3
	SA330J	<0.1	0.0	<0.1	0.0	<0.1
	SA365N	<0.1	0.0	<0.1	0.0	<0.1
General Aviation Helicopter Subtotal		***0.5***	***<0.1***	***0.6***	***<0.1***	***1.2***
General Aviation All Aircraft Subtotal**		**21.7**	**1.6**	**22.0**	**1.3**	**46.5**
Military	737800	<0.1	0.0	<0.1	0.0	<0.1
	C130	0.1	0.0	0.1	0.0	0.2
	CNA441	1.0	0.0	1.0	0.0	2.0
	DHC6	<0.1	0.0	<0.1	0.0	<0.1
	SD330	0.1	<0.1	0.1	<0.1	0.3
Military Subtotal		**1.3**	**<0.1**	**1.3**	**<0.1**	**2.6**
Total		**377.4**	**60.2**	**385.6**	**52.0**	**875.2**

Notes:
*Non-standard substitution or user defined INM aircraft type. See Section 3.3 for additional information.
Totals and sub-totals may not match exactly due to rounding.
**General Aviation Helicopter and General Aviation Fixed Wing aircraft are reported separately for clarity. This is an editorial change relative to the October 2014 draft of this document.

3.3 AIRCRAFT NOISE AND PERFORMANCE CHARACTERISTICS

Specific noise and performance data must be entered for each aircraft type operating at the Airport. Noise data is included in the form of sound exposure level at a range of distances (from 200 feet to 25,000 feet) from a particular aircraft with engines at a specific thrust level. Performance data includes thrust, speed and altitude profiles for takeoff and landing operations. The INM database contains standard noise and performance data for over one hundred different fixed wing aircraft types, most of which are civilian aircraft. The program automatically accesses the applicable noise and performance data for departure and approach operations by those aircraft.

This study included many different aircraft types. While many aircraft could be modeled by direct assignments from the standard INM database, others were not in the INM database. For those aircraft types not in the INM standard database, FAA approved substitutions were used to model the aircraft with a similar type that was in the database, or a user-defined aircraft was created for that specific aircraft type. FAA approved substitutions came from the following two sources:

- INM Version 7.0d which includes the current list of standard FAA substitutions;
- A specific request to the FAA for non-standard substitutions and user-defined aircraft made by MAA staff in conjunction with a concurrent, ongoing 14 CFR Part 150 study. The September 11, 2013 request and FAA's October 1, 2013 approval are documented in Appendix C.

3.4 RUNWAY UTILIZATION

A major input to the noise modeling process is the average annual runway utilization, which is the percentage use of each runway end. Runway utilization depends on several factors, including wind conditions, runway length and heading, aircraft type and performance, flight purpose (origin/destination), terrain, and noise abatement procedures. The runway-end utilization rates used in the computer modeling process for the 2014 contours were developed directly from historical data from the BWI Marshall operations database that contains a record of each flight detected by passive radar in the MAA's EnvironmentalVue system. Each record in the database contains the date and time of the flight and the runway used. From these records, overall runway usage tables for 2014, 2019, and 2024 were compiled by arrival or departure, day or night, and aircraft type.

The modeled air carrier, air taxi, general aviation and military runway utilization rates that HMMH developed for this study are presented below in Table 8 through Table 11 for 2014, Table 12 through Table 15 for 2019, and Table 16 through Table 19 for 2024. "H" refers to the helicopter pad.[9]

The runway use for the 2024 layout, which includes the planned parallel 10R/28L runway, originates from the 2011 BWI Marshall Master Plan Technical Report.[10] For the purposes of the 2024 analysis, model tracks and operations from the existing Runway 10/28 were copied (and moved) to the planned Runway 10R/28L. Then the operations of the two runways were adjusted to represent 2024 operations, as discussed in Appendix C.

It should be noted that the purpose of the analysis described above, and further described in Appendix C, is to prepare an estimation of average annual runway use for the purpose of the ANZ and does not consider in detail all of the considerations that aircraft operators use to select a particular runway for a particular flight. Ultimate authority to operate an aircraft safely resides with the pilot.

Table 8 2014 Runway Use: Air Carrier

Source: HMMH, May 2014

Runway	Arrivals		Departures	
	Day	Night	Day	Night
4	0.0%	0.0%	0.0%	0.0%
22	< 0.1%	0.0%	0.0%	0.0%
10	26.6%	26.4%	< 0.1%	0.4%
28	2.8%	4.2%	70.5%	69.0%
15L	< 0.1%	< 0.1%	< 0.1%	0.0%
33R	< 0.1%	0.0%	< 0.1%	< 0.1%
15R	1.1%	3.1%	28.0%	27.7%
33L	69.5%	66.3%	1.4%	2.9%
H	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%

[9] This is an editorial change relative to the October 2014 draft of this document.

[10] Landrum & Brown "BALTIMORE/WASHINGTON INTERNATIONAL THURGOOD MARSHALL AIRPORT MASTER PLAN TECHNICAL REPORT" Final 2011. The specific runway used for this analysis came from a Landrum & Brown analysis prepared to support the noise contour developed for the BWI Marshall 2011 Master Plan/ALP. The relevant ALP contours are depicted in Exhibit 7.4-1, 2030 ALP Noise Exposure Contour (described in Section 7.4, and specifically Section 7.4.1.2, of the Final Master Plan Technical Report) and in Appendix K "ENVIRONMENTAL EVALUATION OF ALTERNATIVES", (Sec. 2.6.2.2.3 Alternative 2c and Exhibit 2-5).

Table 9 2014 Runway Use: Air Taxi

Source: HMMH, May 2014

Runway	Arrivals		Departures	
	Day	Night	Day	Night
4	< 0.1%	0.0%	< 0.1%	0.0%
22	0.0%	0.0%	0.0%	0.0%
10	15.4%	9.3%	0.2%	0.4%
28	2.4%	6.2%	38.3%	39.8%
15L	11.5%	19.1%	13.8%	12.7%
33R	33.0%	36.3%	33.2%	35.1%
15R	1.0%	2.3%	13.6%	9.5%
33L	36.7%	26.7%	0.8%	2.5%
H	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%

Table 10 2014 Runway Use: General Aviation

Source: HMMH, May 2014

Runway	Arrivals		Departures	
	Day	Night	Day	Night
4	0.0%	0.0%	< 0.1%	0.0%
22	0.0%	0.0%	< 0.1%	0.0%
10	11.1%	13.2%	0.3%	0.0%
28	4.7%	2.8%	15.1%	13.6%
15L	14.8%	12.7%	20.6%	20.2%
33R	49.6%	39.8%	55.3%	56.6%
15R	0.8%	2.3%	5.9%	4.1%
33L	16.5%	24.7%	0.3%	3.4%
H	2.3%	4.5%	2.5%	2.0%
Total	100.0%	100.0%	100.0%	100.0%

Table 11 2014 Runway Use: Military

Source: HMMH, May 2014

Runway	Arrivals		Departures	
	Day	Night	Day	Night
4	0.0%	0.0%	0.0%	0.0%
22	0.0%	0.0%	0.0%	0.0%
10	2.6%	0.0%	0.0%	0.0%
28	2.6%	100.0%	13.2%	0.0%
15L	21.1%	0.0%	27.0%	0.0%
33R	63.2%	0.0%	59.7%	100.0%
15R	0.0%	0.0%	0.0%	0.0%
33L	10.5%	0.0%	0.0%	0.0%
H	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%

Table 12 2019 Runway Use: Air Carrier

Source: HMMH, May 2014

Runway	Arrivals		Departures	
	Day	Night	Day	Night
10	26.9%	26.1%	< 0.1%	0.4%
28	2.8%	4.6%	70.3%	69.5%
15L	< 0.1%	< 0.1%	< 0.1%	0.0%
33R	< 0.1%	0.0%	< 0.1%	< 0.1%
15R	1.1%	3.6%	28.2%	27.2%
33L	69.1%	65.7%	1.4%	2.9%
H	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%

Table 13 2019 Runway Use: Air Taxi

Source: HMMH, May 2014

Runway	Arrivals		Departures	
	Day	Night	Day	Night
10	13.3%	7.0%	0.2%	0.4%
28	2.3%	6.2%	32.7%	33.8%
15L	13.5%	22.0%	16.2%	14.7%
33R	38.8%	42.0%	39.2%	40.7%
15R	0.9%	1.8%	10.9%	7.8%
33L	31.2%	20.9%	0.7%	2.6%
H	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%

Table 14 2019 Runway Use: General Aviation

Source: HMMH, May 2014

Runway	Arrivals		Departures	
	Day	Night	Day	Night
10	11.0%	13.1%	0.3%	0.0%
28	4.8%	2.9%	14.9%	13.4%
15L	14.9%	12.6%	20.6%	20.2%
33R	49.7%	39.7%	55.5%	56.7%
15R	0.8%	2.3%	5.8%	4.2%
33L	16.3%	24.7%	0.3%	3.4%
H	2.4%	4.7%	2.6%	2.1%
Total	100.0%	100.0%	100.0%	100.0%

Table 15 2019 Runway Use: Military

Source: HMMH, May 2014

Runway	Arrivals		Departures	
	Day	Night	Day	Night
10	2.6%	0.0%	0.0%	0.0%
28	2.6%	100.0%	13.2%	0.0%
15L	21.1%	0.0%	27.0%	0.0%
33R	63.2%	0.0%	59.7%	100.0%
15R	0.0%	0.0%	0.0%	0.0%
33L	10.5%	0.0%	0.0%	0.0%
H	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%

Table 16 2024 Runway Use: Air Carrier

Source: HMMH, June 2014

Runway	Arrivals		Departures	
	Day	Night	Day	Night
10	4.0%	20.5%	14.0%	0.7%
28	3.0%	2.7%	42.9%	46.2%
10R	28.5%	13.7%	3.5%	0.5%
28L	1.0%	1.8%	30.3%	30.8%
15L	< 0.1%	< 0.1%	< 0.1%	0.0%
33R	< 0.1%	0.0%	< 0.1%	< 0.1%
15R	2.0%	1.2%	6.9%	20.0%
33L	61.5%	60.1%	2.3%	1.8%
H	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%

Table 17 2024 Runway Use: Air Taxi

Source: HMMH, June 2014

Runway	Arrivals		Departures	
	Day	Night	Day	Night
10	3.1%	9.8%	4.3%	0.1%
28	2.4%	2.5%	25.4%	18.0%
10R	12.0%	6.5%	1.4%	< 0.1%
28L	0.8%	1.8%	12.6%	12.0%
15L	14.6%	17.9%	8.5%	18.8%
33R	37.2%	40.6%	42.8%	41.0%
15R	1.3%	1.0%	3.5%	7.9%
33L	28.6%	19.9%	1.4%	2.1%
H	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%

Table 18 2024 Runway Use: General Aviation

Source: HMMH, June 2014

Runway	Arrivals		Departures	
	Day	Night	Day	Night
10	2.8%	12.2%	9.0%	0.0%
28	2.1%	0.8%	8.7%	22.3%
10R	8.8%	8.2%	1.8%	0.0%
28L	0.7%	0.6%	6.1%	12.6%
15L	17.0%	13.1%	14.2%	12.7%
33R	47.3%	26.6%	54.6%	42.3%
15R	1.4%	0.3%	2.2%	7.7%
33L	17.4%	33.3%	1.0%	0.2%
H	2.4%	4.9%	2.6%	2.2%
Total	100.0%	100.0%	100.0%	100.0%

Table 19 2024 Runway Use: Military

Source: HMMH, June 2014

Runway	Arrivals		Departures	
	Day	Night	Day	Night
10	3.2%	0.0%	0.0%	0.0%
28	2.4%	50.0%	12.6%	0.0%
10R	1.6%	0.0%	0.0%	0.0%
28L	0.8%	50.0%	8.4%	0.0%
15L	25.5%	0.0%	6.4%	0.0%
33R	55.9%	0.0%	72.6%	100.0%
15R	0.0%	0.0%	0.0%	0.0%
33L	10.5%	0.0%	0.0%	0.0%
H	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%

3.5 FLIGHT TRACK GEOMETRY

Flight tracks represent the ground projection of "average" paths flown by aircraft at an airport. The development of a set of flight tracks, which provide a reasonable description of the broad range of operations and conditions actually operating on the annual average day, is a complex task at any airport.

Appendix D includes all radar developed model tracks and INM input files from RealContours™ in electronic format. The L_{dn} contours were based on a total of 150,149 individual model tracks for 2014, 132,860 model tracks for 2019 and 172,179 model tracks for 2024. The changes year over year are due to aircraft retirements in 2019 and 2024 as discussed in Section 3.2, as well as the inclusion of additional model tracks to the planned Runway 10R/28L in 2024.

Figure 4 and Figure 5 present samples of the 2014 model tracks. Figure 4 presents a sample of 1,544 arrival model tracks and Figure 5 presents a sample of 1,460 departure model tracks.

Figure 6 and Figure 7 present samples of the 2024 model tracks. Figure 6 presents a sample of 1,688 arrival model tracks Figure 7 presents a sample of 1,702 departure model tracks.

3.6 AIRCRAFT STAGE LENGTH

Within the INM database, aircraft takeoff or departure profiles are usually defined by a range of trip distances identified as “stage lengths.” A longer trip distance or higher stage length is associated with a heavier aircraft due to the increase in fuel requirements for the flight. For this study, city pair distances were determined for each departure flight track and used in most cases to define the specific stage length using the INM standard definitions.

INM uses stage length as a means to estimate the aircraft weight on departure. Aircraft weight is required to determine the climb performance profile of the aircraft on departure. Stage length is the term used in INM to refer to the length or distance of the complete nonstop flight planned for each departure operation from origin to destination. The flight distance influences the take-off weight of the aircraft as more fuel is required to go greater distances. Aircraft weight is a factor in the aircraft’s thrust and performance. The great-circle distance is used to calculate a stage length for each aircraft operation. Great-circle distance is the shortest distance between any two points on the surface of a sphere (earth) measured along the path on the surface of the earth. Nine categories for departure stage length are used in INM.

The stage-length of each individual flight was calculated based on the destination airport on the flight plan.[11] RealContours™ compares each flight’s city-pair great-circle distance to the available stage-

[11] See footnote 5 for a discussion of the data sources.

lengths available in the default INM database and makes an appropriate selection.[12] INM does not have all stage lengths available for all aircraft. In cases where the stage length was not available or exceeded the maximum stage-length profile available for that runway (i.e., the aircraft would not over run the runway on departure), the maximum stage length available without overrunning the runway was selected. If a particular INM aircraft has multiple available default profiles in INM for a given stage-length, RealContours™ compares the flight track's altitude profile to the available default INM profiles, and assigns a default INM profile based on the closest match.[13]

Table 20 presents the nine categories for departure stage length used in INM and the respective number of departures modeled for 2014, 2019 and 2024.

Table 20 Stage Length, Trip Length and Modeled Departures for 2014, 2019 and 2024

Source FAA INM 7.0 Technical Manual, FlightAware, HMMH, 2014

Stage Length Number	Trip Length (nmi)	2014 Departures		2019 Departures		2024 Departures	
		Day	Night	Day	Night	Day	Night
D-1	0 – 500	191.5	27.9	195.7	30.3	219.8	32
D-2	500 – 1,000	83.1	8.7	88.7	10.7	89.7	12.6
D-3	1,000 – 1,500	27.0	2.2	37.0	2.8	38.2	3.3
D-4	1,500 – 2,500	16.7	2.6	30.3	3.3	36.8	3.6
D-5	2,500 – 3,500	0.8	0.3	1.0	0.4	1.1	0.5
D-6	3,500 – 4,500	0.1	0.1	0.1	0.1	0.1	0.1
D-7	4,500 – 5,500	0.0	0.0	0.0	0.0	<0.1	0
D-8	5,500 – 6,500	<0.1	0.0	<0.1	0.0	219.8	32
D-9	Greater than 6,500	0.0	0.0	0.0	0.0	0.0	0.0
Total		**319.3**	**41.7**	**352.8**	**47.5**	**385.6**	**52.0**
NOTE: Totals may not match exactly due to rounding							

3.7 METEOROLOGICAL CONDITIONS

The INM has several settings that account for the effects that meteorological conditions have on aircraft performance profiles and sound propagation. INM's meteorological settings include average temperature, barometric pressure, relative humidity, and wind direction and speed. Data spanning a ten-year period from 2003 to 2012 were obtained from the National Climatic Data Center (NCDC) Integrated Surface Database (ISD) [14] for BWI Marshall (WBAN number 93721) and analyzed. Based on analysis of the NCDC data, the following are the average conditions for BWI Marshall and were used in the INM for noise modeling:

- Temperature: 56.6^{o} Fahrenheit;
- Sea level pressure: 30.02 inches of Mercury (in-Hg);
- Relative humidity: 66.3 percent; and
- Average headwind speed: INM default of 8.0 knots.

[12] The stage-length lookup table is defined in Section 9.6.3 of the INM 7.0 User's Guide.
[13] This process is INM aircraft type specific. The term "default INM profiles" refers to a profile that is included in the INM database (as opposed to user-defined; there are no user-defined profiles in this analysis). INM can include multiple default profiles for commercial aircraft including "STANDARD", "ICAO A" or "ICAO B". Additional discussion regarding the different default profiles is provided in the INM 7.0 Technical Manual, Section 6. Some general aviation aircraft in INM may also include multiple profiles. Aircraft specific documentation is included in the respective INM release notes at the time of introduction of that aircraft or modification of the default profiles between versions of the INM.
[14] http://www.ncdc.noaa.gov/oa/climate/isd/

3.8 TERRAIN

Terrain data describe the elevation of the ground surrounding the airport and on airport property. The INM uses terrain data to adjust the ground level under the flight paths. The terrain data do not affect the aircraft's performance or emitted noise levels, but do affect the vertical distance between the aircraft and a "receiver" on the ground. This in turn affects the noise levels received at a particular point on the ground. The terrain data were obtained from the United States Geological Survey (USGS) National Map Viewer.[15] Terrain data were not included in the previous ANZ for BWI Marshall.

3.9 AIRCRAFT MAINTENANCE ENGINE RUN-UPS

MAA maintains evening engine run-up logs for aircraft affected by the BWI Marshall Maintenance Engine Run-up Policy. Run-ups are permitted in the holding block of Runway 10, with the nose of the aircraft positioned on a magnetic heading between 190^{o} and 220^{o}, or as an overflow in the holding block of Runway 33L, with the nose of the aircraft positioned on a magnetic heading between 140^{o} and 160^{o}. During the 2016 – 2020 timeframe, the holding block at Runway 10 will be demolished. MAA is considering a new area that will allow run-ups on the same portion of the airfield. Any interruption to service at the existing site would be temporary/brief and occur only as the new site is under construction.

Using the calendar year 2008 through 2012 (inclusive) evening run-up logs as a basis, daily run-up operations were projected for the base year 2014 and forecast years 2019 and 2024. The five-year average was about 19 run-ups per year. For modeling purposes at this time, all future run-ups are modeled at the holding block at Runway 10. This location is depicted in Figure 1 through Figure 3.

The sound levels from these operations were then included in the computation of each contour. Run-up operations have minimal effect on the overall contours, only slightly affecting the north-west region of the airport near the Runway 10 holding block.

[15] Data downloaded from http://viewer.nationalmap.gov/viewer/ on 05/31/2013 in 1/3 Arc-second GridFloat format.

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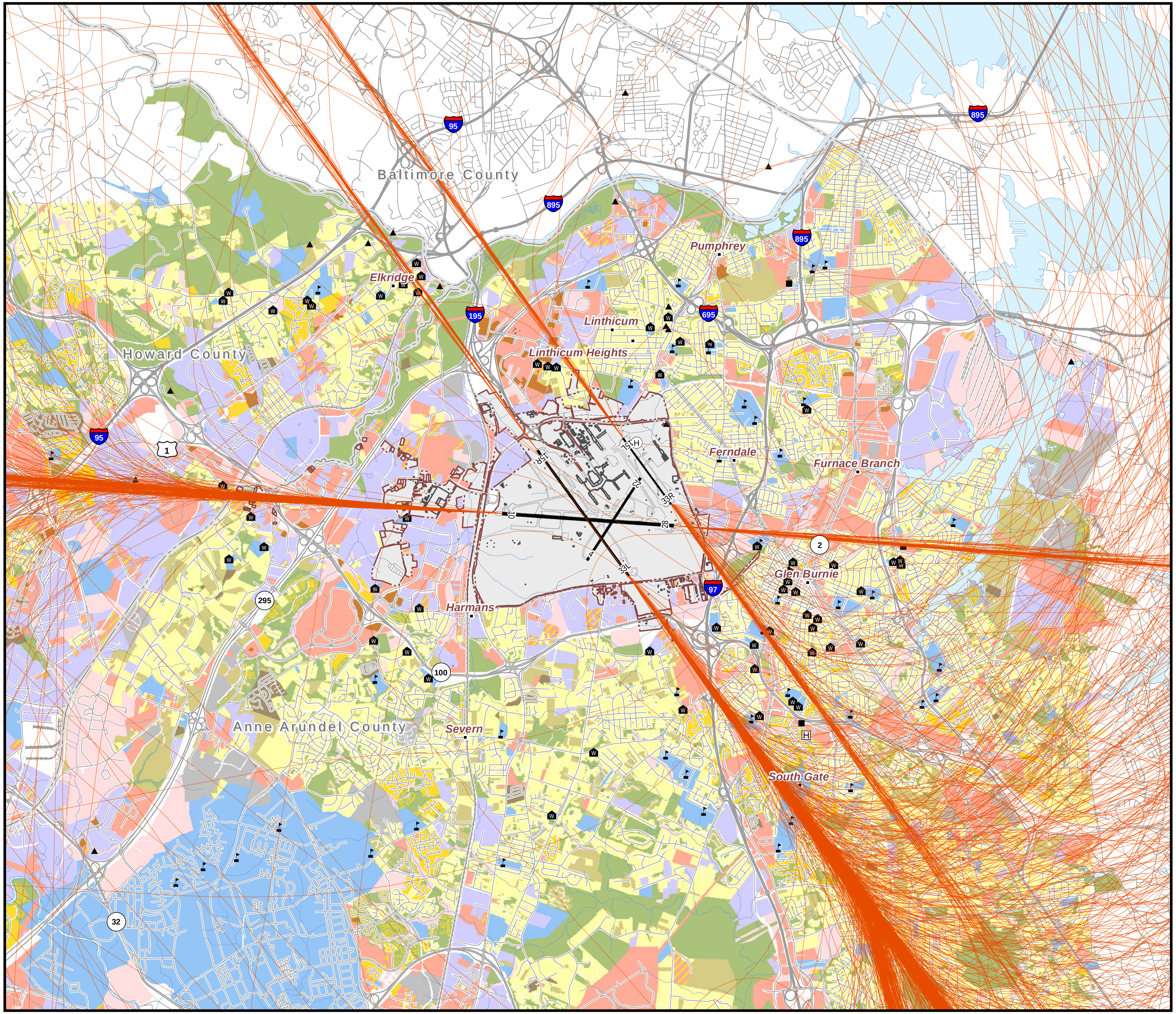

BALTIMORE/WASHINGTON INTERNATIONAL Thurgood Marshall AIRPORT

Representative Modeled Flight Tracks for Existing Condition Arrivals
Figure 4

Model Arrival Tracks

BWI Airport Property

Existing Airport Runways

Existing Helicopter Pad

Land Use

Residential	Public Use
Multi-Family Residential	Commercial
Transient Lodging	Exempt Commercial
Mobile Home	Manufacturing and Production
Mixed Use Residential	Recreational Open Space
Undeveloped Residential	Vacant / Undefined
Roads	River or Stream
County Boundary	Water
School	Place of Worship
Nursing Home	Historic Site
Hospital	

Data Sources: Maryland Aviation Administration; Maryland State Highway Administration; Anne Arundel & Howard County; Maryland Department of Planning; Environmental System Research Group, Inc.

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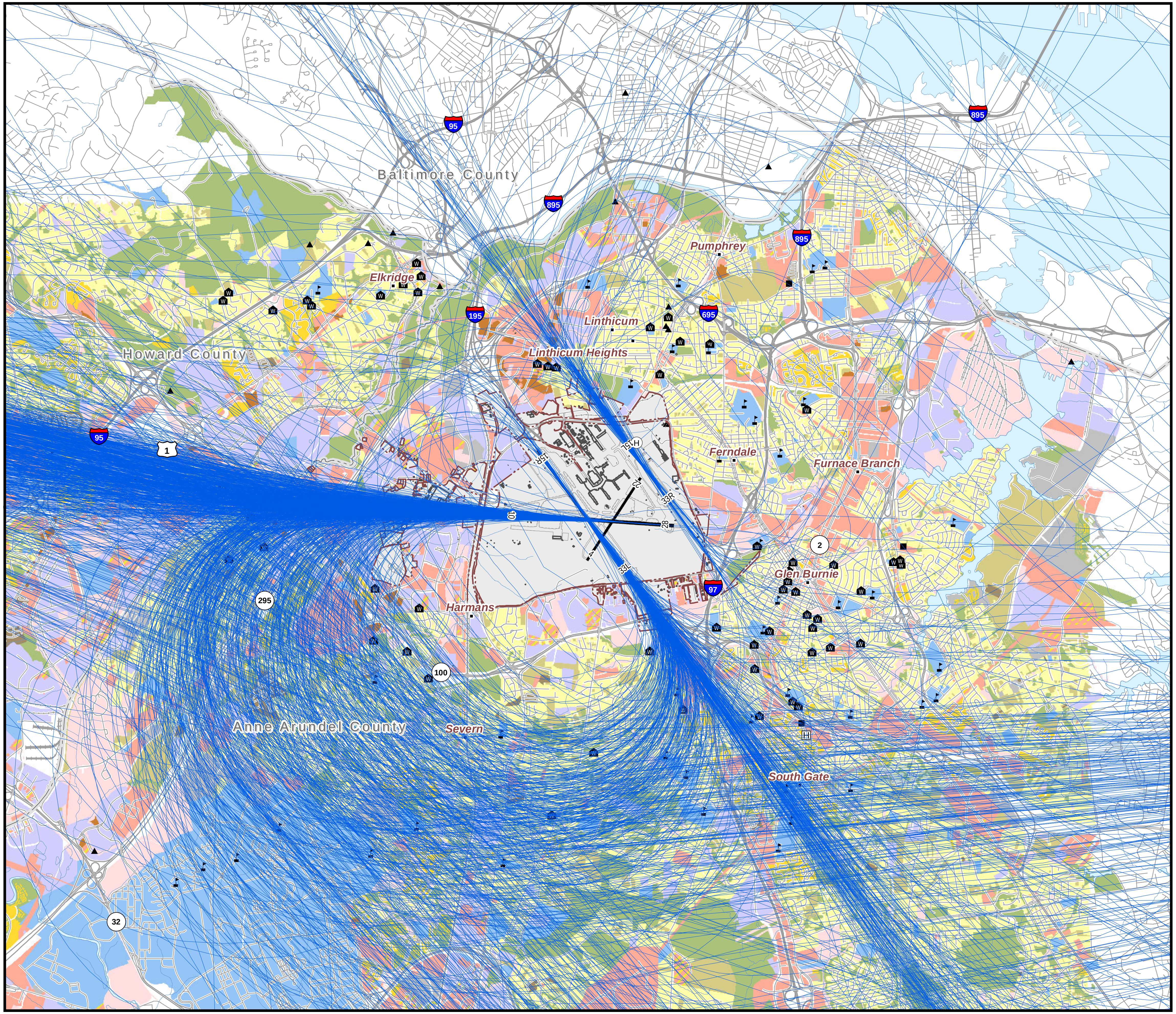

BWI
BALTIMORE/WASHINGTON INTERNATIONAL Thurgood Marshall AIRPORT

Representative Modeled Flight Tracks for Existing Condition Depatures
Figure 5

Model Departure Tracks
BWI Airport Property
Existing Airport Runways
Existing Helicopter Pad

Land Use
Residential
Multi-Family Residential
Transient Lodging
Mobile Home
Mixed Use Residential
Undeveloped Residential
Public Use
Commercial
Exempt Commercial
Manufacturing and Production
Recreational Open Space
Vacant / Undefined
Roads
River or Stream
County Boundary
Water
School
Nursing Home
Hospital
Place of Worship
Historic Site

Data Sources: Maryland Aviation Administration; Maryland State Highway Administration; Anne Arundel & Howard County; Maryland Department of Planning; Environmental System Research Group, Inc.

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BALTIMORE/WASHINGTON INTERNATIONAL Thurgood Marshall AIRPORT

Representative Modeled Flight Tracks for Future Condition (2024) Arrivals
Figure 6

Model Arrival Tracks

BWI Airport Property

Planned Airport Runways

Planned Helicopter Pad

Land Use

Residential	Public Use
Multi-Family Residential	Commercial
Transient Lodging	Exempt Commercial
Mobile Home	Manufacturing and Production
Mixed Use Residential	Recreational Open Space
Undeveloped Residential	Vacant / Undefined
Roads	River or Stream
County Boundary	Water
School	Place of Worship
Nursing Home	Historic Site
Hospital	

Data Sources: Maryland Aviation Administration; Maryland State Highway Administration; Anne Arundel & Howard County; Maryland Department of Planning; Environmental System Research Group, Inc.

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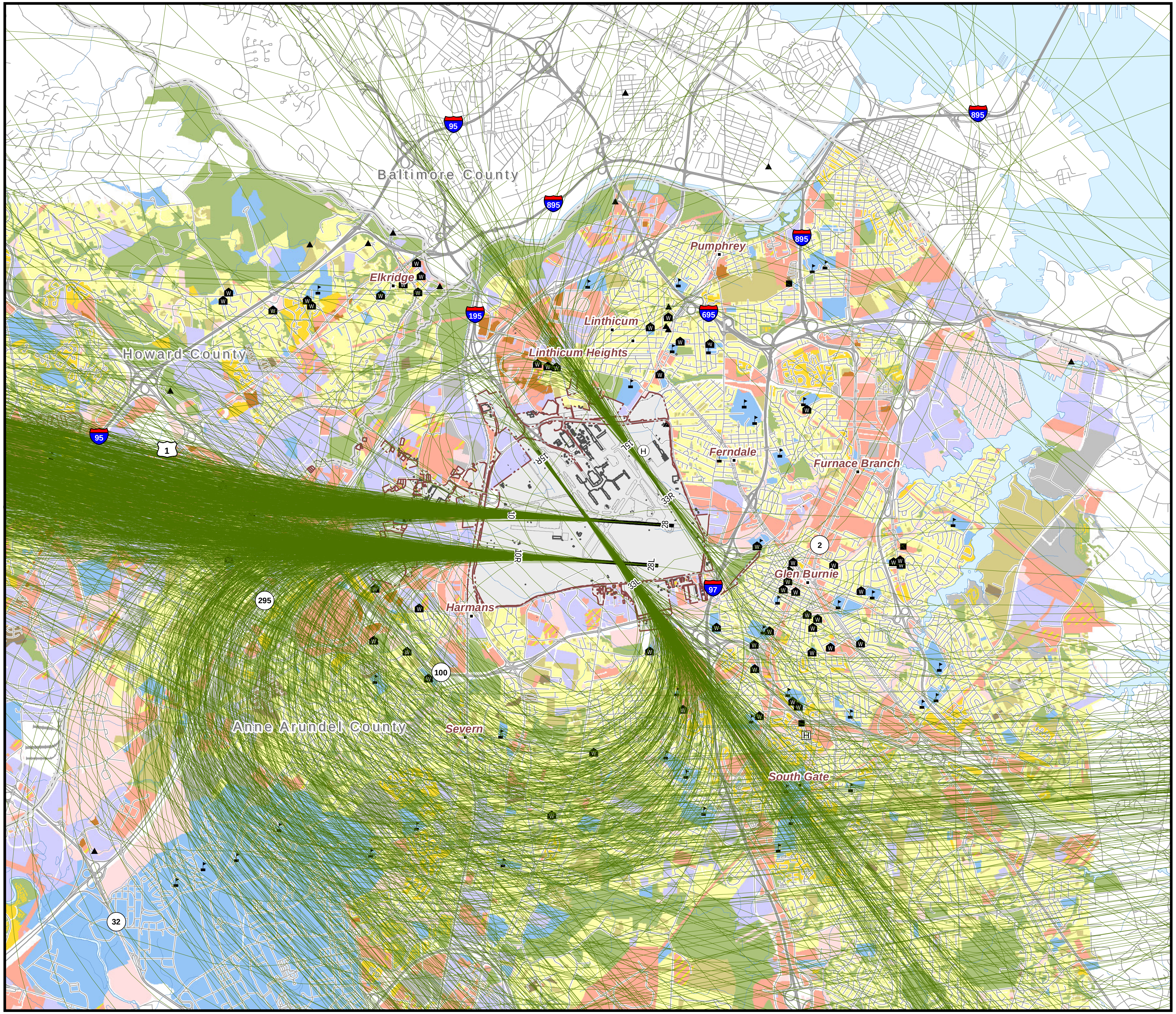

BALTIMORE/WASHINGTON INTERNATIONAL Thurgood Marshall AIRPORT

Representative Modeled Flight Tracks for Future Condition (2024) Departures
Figure 7

Model Departure Tracks

BWI Airport Property

Planned Airport Runways

Planned Helicopter Pad

Land Use

Residential

Multi-Family Residential

Transient Lodging

Mobile Home

Mixed Use Residential

Undeveloped Residential

Public Use

Commercial

Exempt Commercial

Manufacturing and Production

Recreational Open Space

Vacant / Undefined

Roads

River or Stream

County Boundary

Water

School

Nursing Home

Hospital

Place of Worship

Historic Site

Data Sources: Maryland Aviation Administration; Maryland State Highway Administration; Anne Arundel & Howard County; Maryland Department of Planning; Environmental System Research Group, Inc.

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4 L_{DN} CONTOURS

4.1 BASE CASE (2014)

Figure 7 presents the Annual L_{dn} contours for BWI Marshall for 2014. The contours were created with the following information:

- Airfield geometry is described in Section 3.1.1 and Table 1;
- Operations data described in Section 3.2 and Table 5;
- Aircraft noise and performance characteristics as described in Section 3.3;
- Runway use data described in Section 3.4 and Table 8 through Table 11;
- Flight track geometry as described in Section 3.5;
- Aircraft Stage Length as described in Section 3.6;
- Meteorological Data described in Section 3.7;
- Terrain data as described in Section 3.8; and
- Aircraft Maintenance Engine Run-ups as described in Section 3.9.

The predominant use of Runway 28 and 15R for departures is reflected in the extended lobes of the contours to the west and to the southeast, respectively as compared to the opposite ends of these same runways. The use of Runway 33R for departures by corporate jets and propeller aircraft results in an extended lobe to the northwest of the runway. The bulges in the contours to the east of Runway 10/28 and to the northwest of Runway 15R/33L are generated by start-of-takeoff-roll noise generated predominantly by air carrier and corporate jet aircraft.

Table 21 presents the acreage, the population and the number of housing units that are within each contour interval for 2014. These data were calculated based upon the 2010 U.S. Census, augmented with current mapping and population statistics for the areas adjacent to the Airport.[16]

Table 21 Population and Acreage within Base Case L_{dn} Contours

L_{dn} Contour Interval	Acreage	Estimated[17] Housing Units	Estimated Population
65 to 70 dB	1,791	615	1,547
70 to 75 dB	693	14	38
75 dB and greater	438	0	0
Total	2,922	629	1,585

[16] Additional data sources include: Maryland Aviation Administration; Maryland State Highway Administration; Anne Arundel County; Howard County; Maryland Department of Planning

[17] Population estimates assume 2.7 people per single-family house and 2.2 people per multi-family unit. Both estimates are from analysis of U.S. Census 2010 data.

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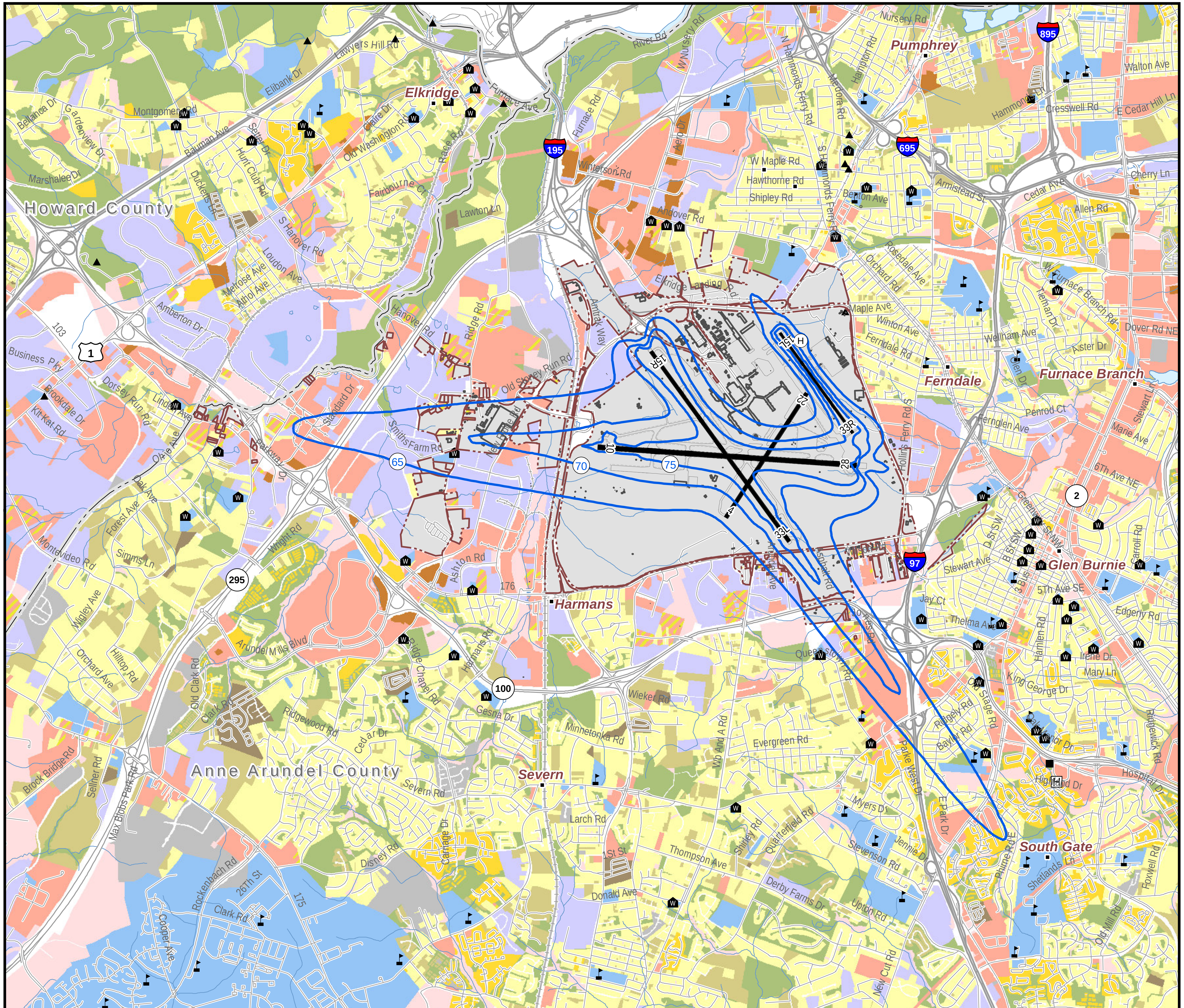

BALTIMORE/WASHINGTON INTERNATIONAL Thurgood Marshall AIRPORT

2014 Annual Ldn Contour
Figure 8

- 2014 Annual Ldn Contour
- BWI Airport Property
- Existing Airport Runway Layout (2014)
- Existing Helicopter Pad (2014)

Land Use

Residential	Public Use
Multi-Family Residential	Commercial
Transient Lodging	Exempt Commercial
Mobile Home	Manufacturing and Production
Mixed Use Residential	Recreational Open Space
Undeveloped Residential	Vacant / Undefined
Roads	River or Stream
County Boundary	Water
School	Place of Worship
Nursing Home	Historic Site
Hospital	

Data Sources: Maryland Aviation Administration; Maryland State Highway Administration; Anne Arundel & Howard County; Maryland Department of Planning; Environmental System Research Group, Inc.

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4.2 FIVE-YEAR AND TEN-YEAR FORECAST CASES: 2019 AND 2024

Figure 9 and Figure 10 present the BWI Marshall annual L_{dn} contours for the Five-Year (2019) and Ten-Year (2024) Forecast cases, respectively. The contours were created with the following information:

- Airfield geometry is described in
  - For 2019 Section 3.1.2 and Table 2;
  - For 2024 Section 3.1.3 and Table 3;
- Operations data described in Section 3.2 and
  - For 2019 Table 6;
  - For 2024 Table 7;
- Aircraft noise and performance characteristics as described in Section 3.3;
- Runway use data described in Section 3.4 and
  - For 2019 Table 12 through Table 15;
  - For 2024 Table 16 through Table 19;
- Flight track geometry as described in Section 3.5;
- Aircraft Stage Length as described in Section 3.6;
- Meteorological Data described in Section 3.7;
- Terrain data as described in Section 3.8; and
- Aircraft Maintenance Engine Run-ups as described in Section 3.9.

The use of existing Runway 10/28, as seen in the 2014 and 2019 cases, would be replaced by the division of traffic to the west between existing Runways 10/28 and planned Runway 10R/28L in year 2024. Additionally, both 2019 and 2024 contours depict a large lobe southeast of the airport due to the forecasted increase of arrival operations to Runway 33L. Other than the shape of the contours to the west, the overall shape of the contours in 2019 and 2024 are similar.

Table 22 presents the acreage, the population and the number of housing units that are within each contour interval for both 2019 and 2024. These data were calculated based upon the 2010 U.S. Census, augmented with current mapping and population statistics for the areas adjacent to the Airport. The 2019 and 2024 data are presented together so that direct comparisons can be made between the similar contours.

Table 22 Population and Acreage within 2019 and 2024 L_{dn} Contours

L_{dn} Contour Interval	2019 Annual Contour			2024 Annual Contour		
	Acreage	Estimated Housing Units	Estimated Population	Acreage	Estimated Housing Units	Estimated Population
65 to 70 dB	2,163	1,060*	2,618*	2,469	1,431*	3,461*
70 to 75 dB	880	17	46	1,149	24	64
75 dB and greater	529	0	0	673	0	0
Total	3,572	1,077*	2,664*	4,291	1,452*	3,525*

Note: * Two additional housing units, with an estimated total population of 5 people, were identified after the October 2014 draft of this document.

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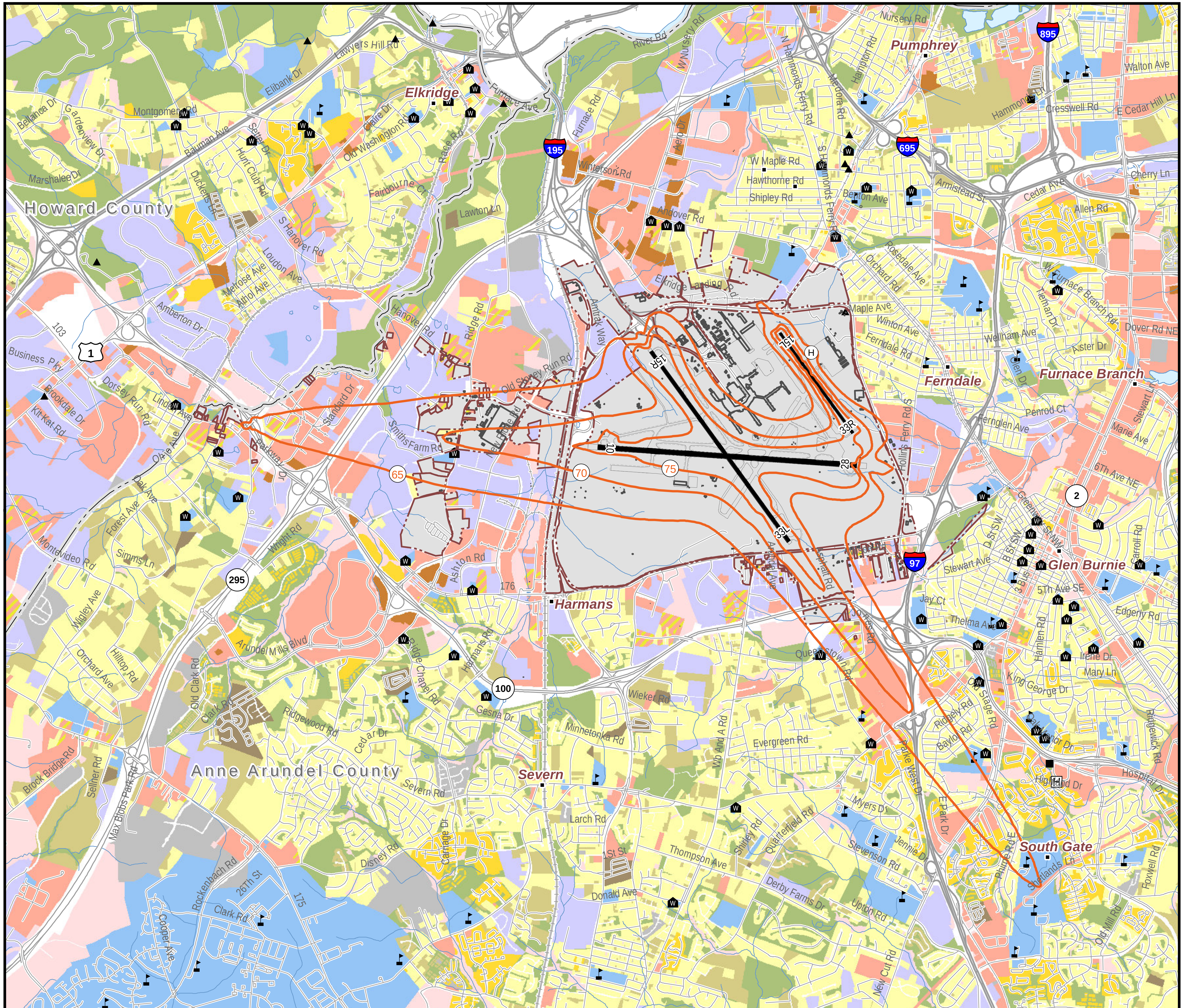

![BWI Baltimore/Washington International Thurgood Marshall Airport]

BALTIMORE/WASHINGTON INTERNATIONAL *Thurgood Marshall* AIRPORT

2019 Annual Ldn Contour
Figure 9

- 2019 Annual Ldn Contour
- BWI Airport Property
- Planned Airport Runway Layout (2019)
- Planned Helicopter Pad (2019)

Land Use

Residential	Public Use
Multi-Family Residential	Commercial
Transient Lodging	Exempt Commercial
Mobile Home	Manufacturing and Production
Mixed Use Residential	Recreational Open Space
Undeveloped Residential	Vacant / Undefined
Roads	River or Stream
County Boundary	Water
School	Place of Worship
Nursing Home	Historic Site
Hospital	

Data Sources: Maryland Aviation Administration; Maryland State Highway Administration; Anne Arundel & Howard County; Maryland Department of Planning; Environmental System Research Group, Inc.

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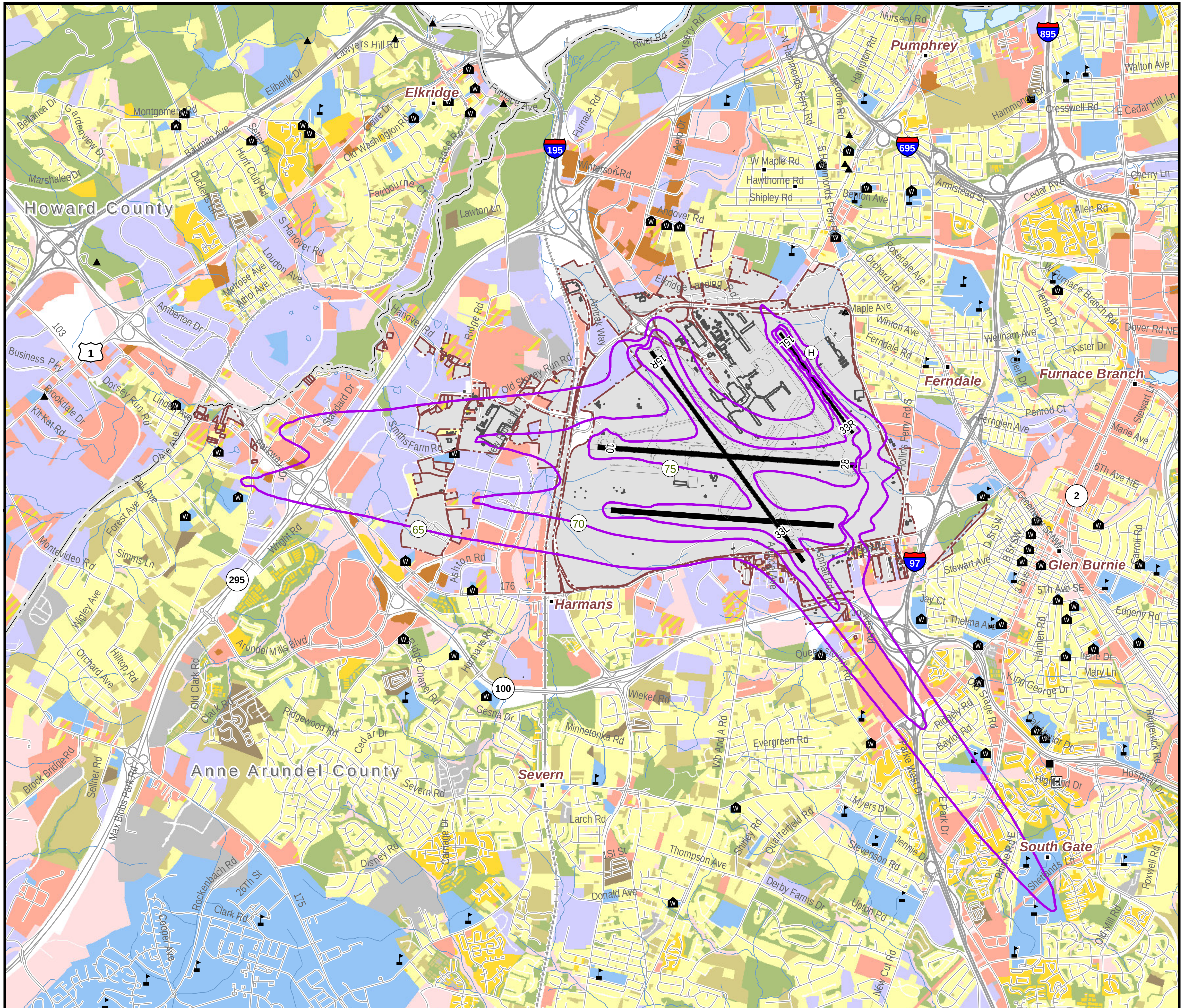

BALTIMORE/WASHINGTON INTERNATIONAL Thurgood Marshall AIRPORT

2024 Annual Ldn Contour
Figure 10

- 2024 Annual Ldn Contour
- BWI Airport Property
- Planned Airport Runway Layout (2024)
- Planned Helicopter Pad (2024)

Land Use

Residential	Public Use
Multi-Family Residential	Commercial
Transient Lodging	Exempt Commercial
Mobile Home	Manufacturing and Production
Mixed Use Residential	Recreational Open Space
Undeveloped Residential	Vacant / Undefined
Roads	River or Stream
County Boundary	Water
School	Place of Worship
Nursing Home	Historic Site
Hospital	

Data Sources: Maryland Aviation Administration; Maryland State Highway Administration; Anne Arundel & Howard County; Maryland Department of Planning; Environmental System Research Group, Inc.

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4.3 2014 AIRPORT NOISE ZONE CONTOUR

Figure 11 presents the 2014 BWI Marshall Airport Noise Zone contour over a land use map. As described in Chapter 1 of this report, the ANZ is a composite of three contour sets (the 2014 contour set as presented in Figure 8, the 2019 contour set as presented in Figure 9, and the 2024 contour set as presented in Figure 10). The largest of the three contours in any area around the Airport determines the Airport Noise Zone thereby offering protection within the largest of the existing or future noise exposure contours.

As shown in the graphic, the ANZ contour has traits of all three contributing contours. Table 23 below presents the acreage, population and the number of housing units that are within each contour interval of the ANZ.

The 2014 BWI Marshall Airport Noise Zone, overlaid on tax maps and prepared for certification, is presented as Appendix A.

Table 23 Population and Acreage within the 2014 Airport Noise Zone

L_{dn} Contour Interval	Acreage	Estimated Housing Units	Estimated Population
65 to 70 dB	2,564	1,458*	3,530*
70 to 75 dB	1,201	25	66
75 dB and greater	748	0	0
Total	4,513	1,483*	3,596*

Note: * Two additional housing units, with an estimated total population of 5 people, were identified after the October 2014 draft of this document.

4.3.1 COMPARISON OF 2007 NOISE ZONE WITH 2014 NOISE ZONE

Figure 12 presents a graphical comparison of the previous 2007 ANZ with the 2014 ANZ. In general, the contours are similar in shape, but vary in some locations due to a number of operational details: changes in fleet mix and differences in number of operations, slight changes in flight tracks modeled, changes in runway utilization, and updates that have been made by the FAA in the INM and its databases.[18]

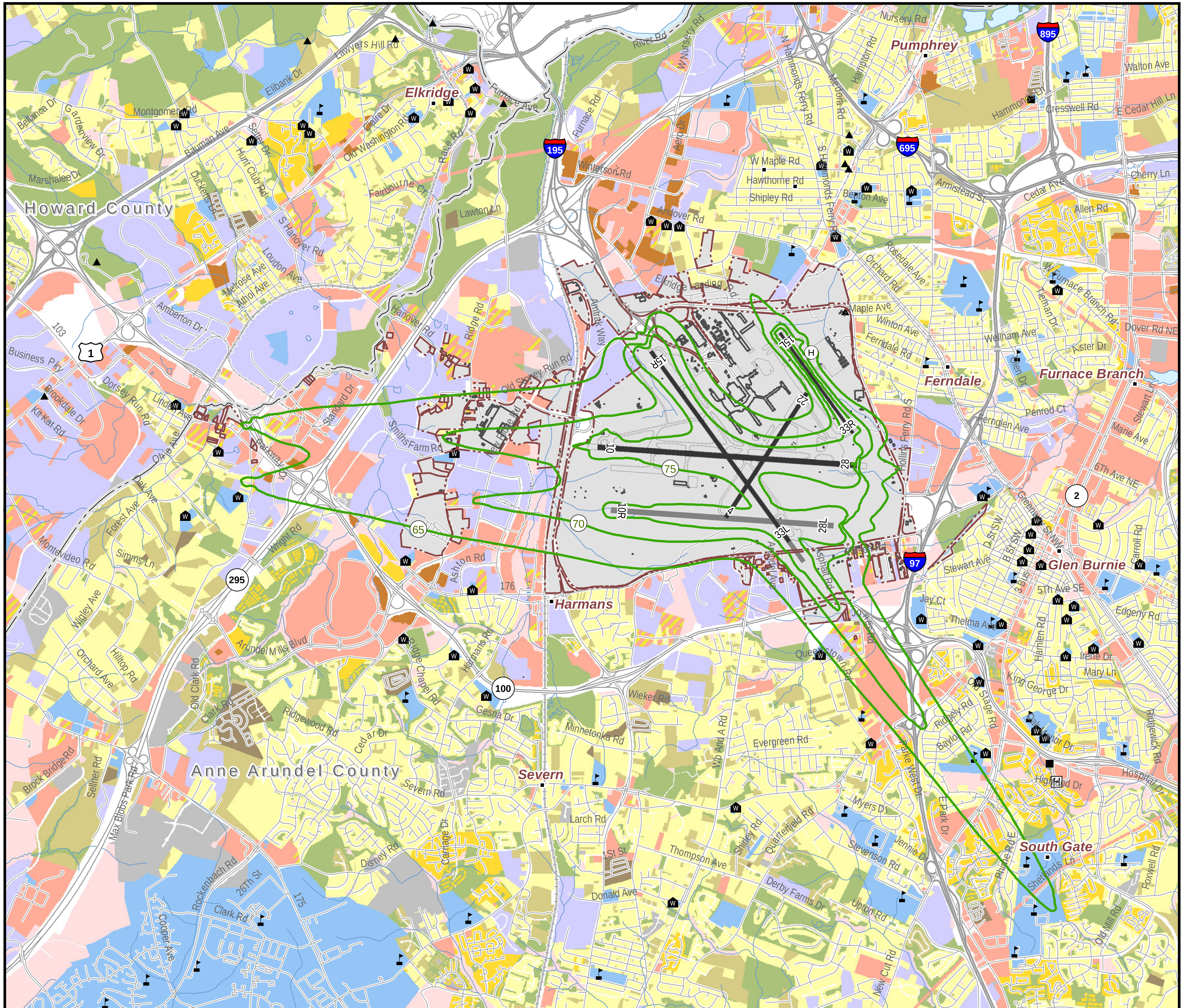
The 2012 ALP defines an updated location for the planned Runway 10R/28L compared to the data available during preparation of the 2007 ANZ. The most recent version of the Runway 10R/28L lengthens the runway and places it approximately 900 feet farther to the north than the location used for the previous 2007 ANZ. While in most places the 2014 ANZ is smaller or comparable to the previous 2007 ANZ, the 2014 ANZ contours do extend to a small region further to the west along the planned Runway 10R/28L. This change is due to an increased use of Runway 10R/28L and the updated length and position for the 2014 ANZ compared to the planned Runway 10R/28L that was used for the previous 2007 ANZ.

Table 24 presents a comparison of acreage, population, and housing unit counts for the 2014 ANZ and the previous 2007 ANZ. As shown, there is a decrease in total acreage within the 2014 ANZ of 659 acres (approximately 13%), however there is a slight increase (approximately 5%) in housing units and people from the previous 2007 ANZ to the 2014 ANZ. The overall extent over residential areas of the previous 2007 ANZ and 2014 ANZ contours remain nearly unchanged, however small differences in the contours result in these changes in noise exposure.

[18] Documentation of the 2007 ANZ is provided in the Baltimore/Washington International Thurgood Marshall Airport, Airport Noise Zone Update, August 2007. HMMH Report No. 301960.003

Table 24 Comparison of Noise Exposure for the 2014 ANZ with Previous 2007 ANZ

Airport Noise Zone	Acreage	Estimated Housing Units	Estimated Population
Previous 2007*	5,172	1,406	3,429
2014	4,513	1,483**	3,596**
Changes	-659	77**	167**
Note: *Data presented for the previous 2007 is from the supporting August 2007 documentation ** Two additional housing units, with an estimated population of 5 people, were identified within the 2014 ANZ after the October 2014 draft of this document.			



BWI

BALTIMORE/WASHINGTON INTERNATIONAL *Thurgood Marshall* AIRPORT

2014 Airport Noise Zone Contour
Figure 11

- 2014 Airport Noise Zone
- BWI Airport Property
- Existing Airport Runway Layout (2014)
- Planned Airport Runway Layout (2024)
- Planned Helicopter Pad (2024)

Land Use

Residential	Public Use
Multi-Family Residential	Commercial
Transient Lodging	Exempt Commercial
Mobile Home	Manufacturing and Production
Mixed Use Residential	Recreational Open Space
Undeveloped Residential	Vacant / Undefined
Roads	River or Stream
County Boundary	Water
School	Place of Worship
Nursing Home	Historic Site
Hospital	

Data Sources: Maryland Aviation Administration; Maryland State Highway Administration; Anne Arundel & Howard County; Maryland Department of Planning; Environmental System Research Group, Inc.

0 2,000 4,000 8,000 Feet

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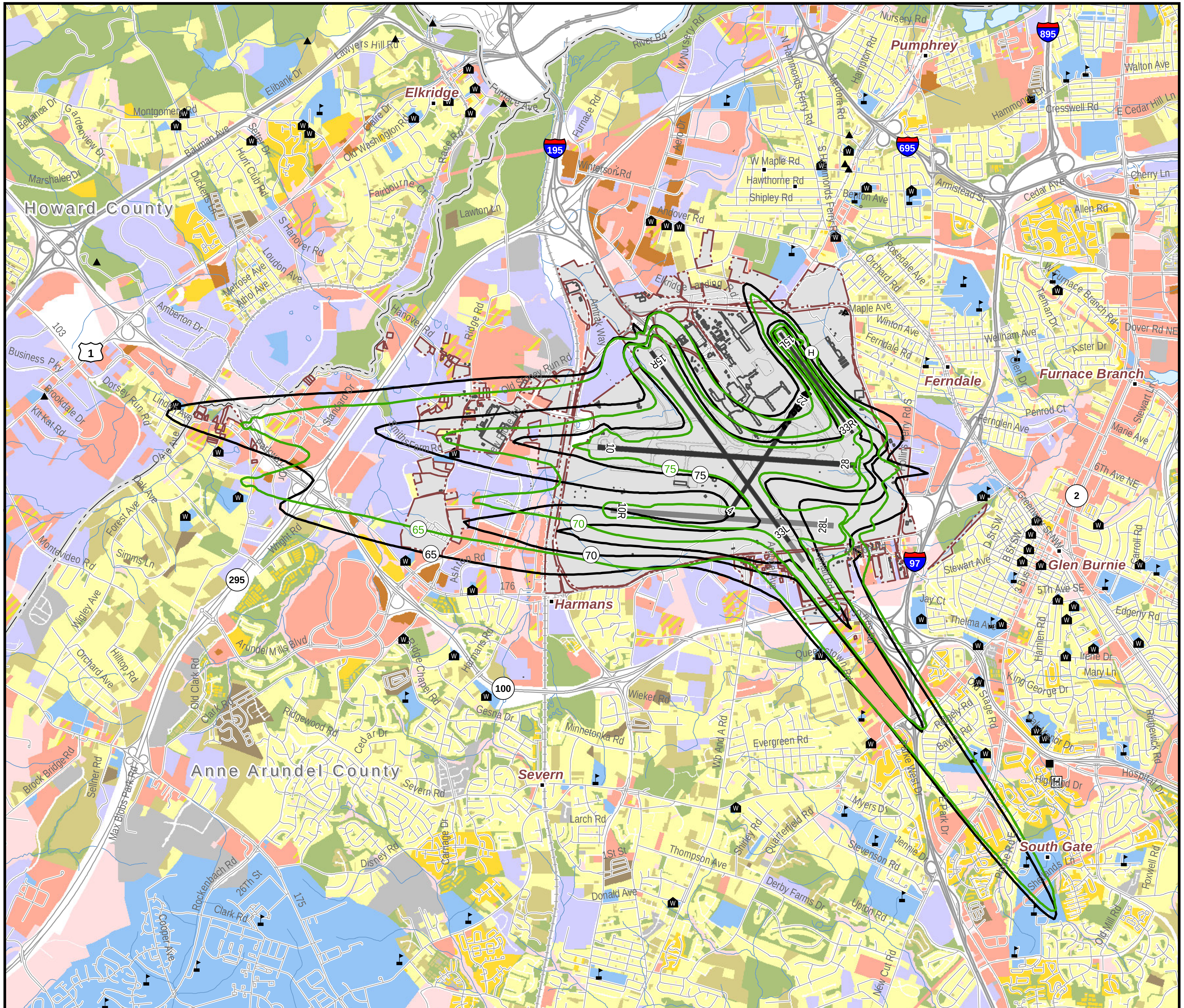

BWI BALTIMORE/WASHINGTON INTERNATIONAL Thurgood Marshall AIRPORT

Comparison of 2014 Airport Noise Zone Contour to 2007 Airport Noise Zone Contour
Figure 12

- 2014 Airport Noise Zone
- 2007 Airport Noise Zone
- BWI Airport Property
- Existing Airport Runway Layout (2014)
- Future Airport Runway Layout (2024)
- Future Helicopter Pad (2024)

Land Use

- Residential
- Multi-Family Residential
- Transient Lodging
- Mobile Home
- Mixed Use Residential
- Undeveloped Residential
- Public Use
- Commercial
- Exempt Commercial
- Manufacturing and Production
- Recreational Open Space
- Vacant / Undefined
- Roads
- River or Stream
- County Boundary
- Water
- School
- Place of Worship
- Nursing Home
- Historic Site
- Hospital

Data Sources: Maryland Aviation Administration; Maryland State Highway Administration; Anne Arundel & Howard County; Maryland Department of Planning; Environmental System Research Group, Inc.

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5 NOISE MEASUREMENTS

BWI Marshall has a permanent noise and operations monitoring system with eighteen[19] operational remote noise-monitoring terminals. The system originally had 23 noise monitors; however five have been decommissioned over the years for various reasons. The monitoring system collects flight track data to provide the MAA with information on historical flight paths and aircraft identification. The system collects noise measurements, determines noise events and matches these events with the flight track data. MAA staff members can then query the operations data to respond to noise complaints. The system provides the MAA with information on single event and cumulative noise exposure information from aircraft operations in the vicinity of BWI Marshall.

The existing noise monitoring system has become outdated and is in need of updated equipment to ensure effective noise measuring capability and to better incorporate the data into current and future noise studies. Several pieces of equipment have failed and replacement parts are no longer available. The system has served beyond its useful life. MAA has plans to upgrade and/or replace the system.

Table 25 presents historical annual data for 2003 through 2013 and Figure 13 shows the location of the existing monitoring sites.

[19] Nineteen sites are shown in Figure 1, however Site 15 was decommissioned in July of 2014

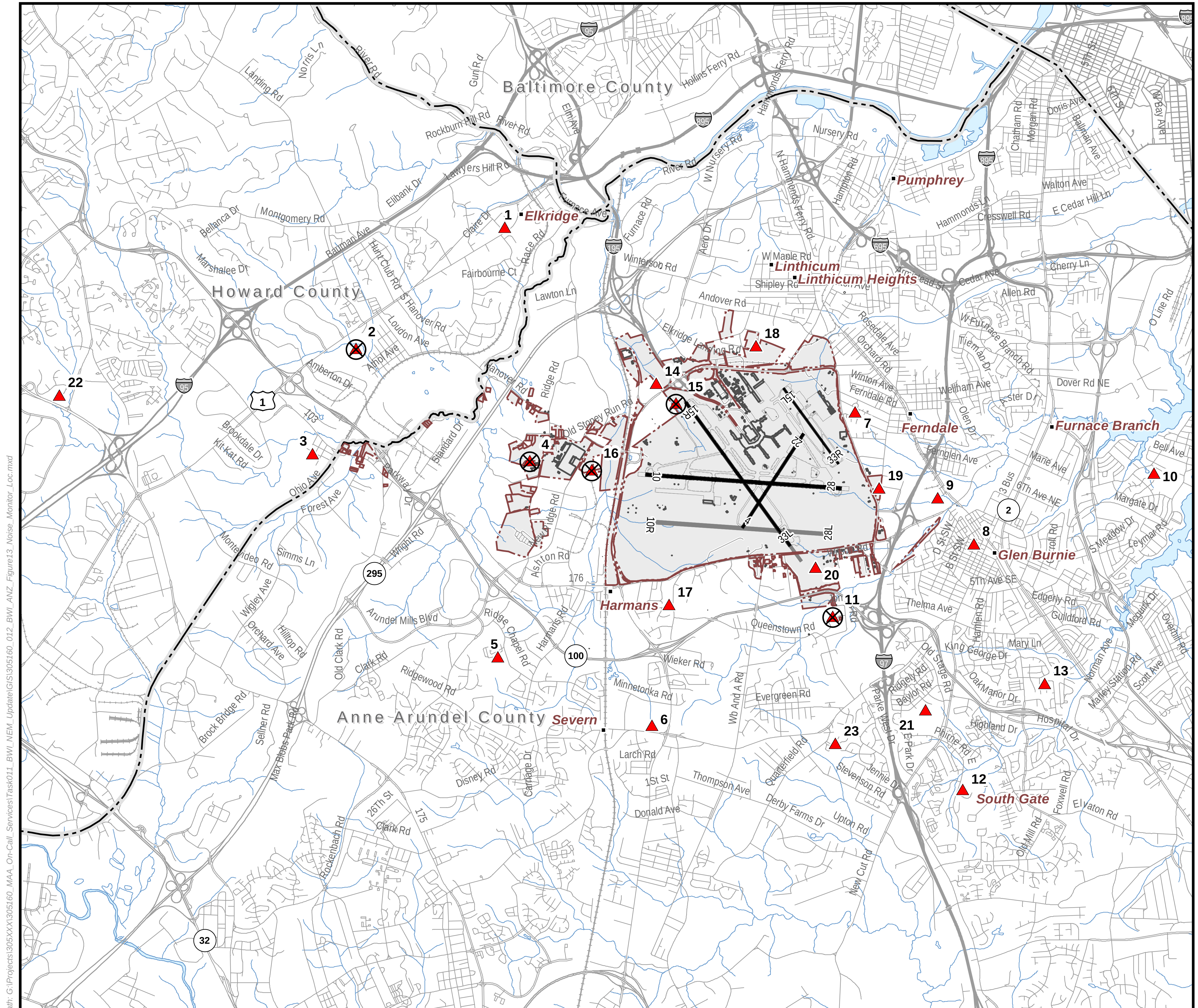
Table 25 Annual Ldn Values and Days of Reported data at Permanent Noise Monitoring Locations, 2005-2013

Site	Annual L_{dn} dB (Days of Reported Data)								
	2005	2006	2007	2008	2009	2010	2011	2012	2013
RMS01	49 (350)	50 (363)	48 (364)	51 (365)	47 (344)	53 (350)	55 (362)	56 (363)	49 (363)
RMS02	--	--	--	--	--	--	--	--	--
RMS03	65 (358)	65 (361)	64 (363)	64 (362)	64 (365)	63 (364)	64 (364)	61 (363)	64 (326)
RMS04	--	--	--	--	--	--	--	--	--
RMS05	53 (327)	54 (343)	53 (345)	53 (339)	52 (189)	--	49 (3)	NANR (31)	NANR (1)
RMS06	54 (341)	53 (356)	53 (351)	53 (359)	53 (362)	52 (357)	53 (361)	52 (363)	52 (363)
RMS07	60 (365)	59 (357)	62 (293)	59 (306)	57 (359)	56 (365)	58 (363)	53 (363)	57 (360)
RMS08	55 (362)	54 (353)	53 (365)	53 (364)	53 (365)	53 (365)	59 (364)	51 (215)	--
RMS09	57 (365)	60 (352)	56 (364)	54 (352)	55 (355)	55 (205)	55 (282)	54 (357)	56 (67)
RMS10	49 (354)	49 (363)	49 (364)	48 (330)	46 (360)	53 (364)	NANR (364)	NANR (295)	NANR (1)
RMS11	--	--	--	--	--	--	--	--	--
RMS12	63 (360)	63 (361)	63 (365)	63 (364)	62 (360)	63 (365)	62 (364)	61 (362)	62 (364)
RMS13	51 (364)	51 (345)	51 (364)	51 (365)	49 (358)	49 (365)	56 (295)	--	--
RMS14	61 (361)	61 (363)	59 (365)	64 (365)	59 (361)	60 (336)	59 (50)	58 (84)	64 (58)
RMS15*	69 (361)	67 (362)	66 (356)	69 (364)	66 (345)	66 (364)	67 (361)	71 (364)	67 (364)
RMS16	--	--	--	--	--	--	--	--	--
RMS17	50 (354)	50 (355)	53 (364)	53 (358)	55 (355)	52 (252)	50 (51)	51 (322)	56 (194)
RMS18	61 (348)	62 (350)	59 (346)	61 (337)	60 (340)	60 (329)	60 (310)	56 (363)	59 (364)
RMS19	64 (329)	62 (363)	62 (365)	61 (365)	60 (339)	61 (356)	72 (353)	66 (302)	74 (90)
RMS20	72 (355)	71 (359)	71 (361)	71 (344)	71 (360)	69 (354)	68 (360)	61 (251)	--
RMS21	63 (361)	62 (359)	63 (363)	63 (361)	62 (354)	62 (344)	63 (361)	62 (234)	61 (164)
RMS22	58 (347)	57 (309)	57 (250)	57 (347)	55 (345)	56 (271)	56 (164)	55 (223)	62 (112)
RMS23	60 (357)	58 (357)	57 (350)	57 (363)	59 (358)	58 (328)	61 (83)	--	--

Notes:
The Ldn values are presented to the left and the number of days monitored right in parenthesis.
NANR = No Aircraft Noise Reported – the monitor was active, but the system did not identify aircraft noise sources.
- =No data available
*RMS15 was decommissioned July 2014

Monitors 4, 11, and 16 have been decommissioned since 2001. Monitor 2 was decommissioned in 2003. Monitor 15 was decommissioned in July 2014. These monitors have been dismantled. MAA is considering a system upgrade and may relocate or replace these monitors during that process.

Several noise monitors are active, but because of the age of the equipment, are unable to communicate their data to the central system for processing. During calendar year 2013, only seven monitors (monitors 1, 3, 6, 7, 12, 15 and 18) provided the equivalent of 10 months or more data to the central system for processing. Four additional monitors (17, 19, 21, and 22) provided the equivalent of three to six months to the central system for processing and sites 9 and 14 approximately two months of data.



BALTIMORE/WASHINGTON INTERNATIONAL Thurgood Marshall AIRPORT

Noise Monitor Locations
Figure 13

- RMS# Noise Monitor Location
- RMS# Former Noise Monitor Location; Equipment has been dismantled and will be relocated.
- BWI Airport Property
- Existing Airport Runways
- Planned Airport Runways (2024)
- Roads
- River or Stream
- County Boundary
- Water

Data Sources: Maryland Aviation Administration; Maryland State Highway Administration; Anne Arundel & Howard County; Maryland Department of Planning; Environmental System Research Group, Inc.

0 0.5 1 2 Miles

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Table 26 presents the measured versus modeled annual data for the 2014 base and the 2019 and 2024 forecast cases.

Table 26 Measured vs. Modeled Annual Aircraft L_{dn} Values

Site	Measured Annual Ldn dB (Days of Reported Data) Calender Year 2013	Modeled Annual Aircraft L_{dn}		
		2014 Base Case (365)	2019 Forecast (365)	2024 Forecast (356)
RMS01	49 (363)	49	50	49
RMS02	--	--	--	--
RMS03	64 (326)	63	64	63
RMS04	--	--	--	--
RMS05	NANR (1)	54	55	55
RMS06	52 (363)	53	54	53
RMS07	57 (360)	58	59	59
RMS08	--	53	54	56
RMS09	56 (67)	58	59	60
RMS10	NANR (1)	48	49	52
RMS11	--	--	--	--
RMS12	62 (364)	65	66	66
RMS13	--	51	52	52
RMS14	64 (58)	61	63	62
RMS15	67 (364)	74	75	73
RMS16	--	--	--	--
RMS17	56 (194)	55	56	59
RMS18	59 (364)	63	63	62
RMS19	74 (90)	63	64	65
RMS20	--	70	71	72
RMS21	61 (164)	65	66	66
RMS22	62 (112)	56	57	58
RMS23	--	57	58	56

Notes: RMS 2, 4, 11, and 16 were decommissioned prior to 2013 and therefore measured data is not available. RMS 15 was decommissioned July 2014
NANR = No Aircraft Noise Reported – the monitor was active, but the system did not identify aircraft noise sources.
- =No data available

As previously stated, either through formal decommissioning or degradation, approximately half of the established, permanent noise monitoring locations did not provide data adequate for comparison. These monitors include sites 2, 4, 5, 8, 10, 11, 13, 16, 19, 20 and 23.

Some observations about the measured data at active locations, compared to the modeled data, are presented below.

- Site 15 is located on Airport property, but at the bottom of a steep incline. This hill provides considerable shielding from aircraft noise events, which is why the measured values have been historically lower than the modeled value at this site.

- At Site 18, located directly off the northern end of Runway 33R, the 4 dB difference in noise levels between computed and measured values is likely due to the limited number of corporate jet types available in the INM data base. The largest contributors to the noise level at Site 18 are corporate jets. Several different types of corporate jets use this runway, and some must be modeled using equivalent aircraft types that have been judged by FAA to be similar in noise characteristics. It is likely that some of the actual corporate jets using Runway 33R are quieter than their approved equivalents.

- Site 21 is located under the extended flight path for Runway 15L departures and Runway 33R arrivals. There is an approximately 4 dB difference in noise levels between modeled and measured values. Note that modeled results are based on average annual day operations, while only 164 days of data were collected at this monitor in 2013. Discrepancies in the measured versus modeled noise exposure may therefore be attributable to seasonal variability between the differing measured and modeled sampling periods.

- Site 22 is located under the extended flight path for Runway 28 departures and Runway 10 arrivals. There is an approximately 6 dB difference in noise levels between modeled and measured values. Note that modeled results are based on average annual day operations, while only 112 days of data were collected at this monitor in 2013. Discrepancies in the measured versus modeled noise exposure may therefore be attributable to seasonal variability between the differing measured and modeled sampling periods.

6 STATUS OF NOISE ABATEMENT PLAN

BWI Marshall has an extensive Noise Abatement Plan (NAP), presented in Appendix B, which the Airport staff and other MAA staff have developed over several decades, through extensive cooperative efforts with citizens and users. The Noise Compatibility Program (NCP) represents the portion of the NAP that has received FAA approval and therefore can be considered for federal grants. While operational measures receive the most public attention, the program is well rounded, and includes complementary compatible land use measures and other measures that focus on program implementation, communication, monitoring, and updating. This cooperative airport, citizen, and user effort has been, and will continue to be, the key to the success of the noise abatement program. Citizens provide critical input related to the identification of needs and program effectiveness. Users provide critical input related to the development, communication, and implementation of practical measures.

The Noise Abatement Plan fulfills State requirements under the provisions of Sections 5-805, 5-806 and 5-819 of the Transportation Article, Annotated Code of Maryland. These sections require airport operators to develop a noise abatement plan, in conjunction with an airport noise zone, to reduce or eliminate the impacted land use area. In general, those are residential areas, schools, hospitals, rest homes, homes for the aged, nursing homes, libraries and churches within the ANZ subject to 65 L_{dn} or greater.

As noted above, the Noise Abatement Plan includes the federal Noise Compatibility Program prepared under Title 14 of the Code of Federal Regulations Part 150 (14 CFR Part 150, or Part 150).[20] Part 150 requires U.S. airports to develop and obtain FAA approval of a noise compatibility program in order to secure federal funding for noise mitigation programs and to gain federal approval to implement certain noise abatement procedures. Part 150 has two components, the Noise Exposure Maps (NEM) and the Noise Compatibility Program (NCP). In many areas the Noise Abatement Plan and the NCP overlap, though there are some differences due to the different state and federal requirements.

MAA prepared an NCP update in 2007, which included a public review process. The MAA submitted the NCP update to FAA in August 2007 and FAA provided a Record of Approval (ROA) for the NCP on February 26, 2008. The 2007 NCP changes, as they affected the NAP, were discussed in the 2007 ANZ document and are summarized below in Section 6.1. The MAA submitted a NEM update to the FAA in December 2014 for 2014 and 2019 conditions. The 2019 contours for the NEM update and this ANZ update (Figure 9) are identical.

The BWI Marshall Noise Abatement Plan includes measures to monitor and reduce impacted land use to the extent feasible, while maintaining efficient airport operations. In developing and monitoring the NAP, MAA works closely with the BWI Marshall Neighbors Committee, which consists of representatives from eleven communities neighboring the Airport.

The Noise Abatement Plan is divided into two areas dealing with noise abatement elements and land use elements. Specific elements are outlined below in Table 27, and described in detail in Appendix B.

6.1 CHANGES TO THE NAP

MAA's 2007 NCP update, and FAA's February 26, 2008 ROA modified the NCP. The following are the Noise Abatement Plan elements that were updated since the 2007 Airport Noise Zone.[21]

[20] Portions of Title 14 of the Code of Federal Regulations are also known as the Federal Aviation Regulations (FAR)
[21] The following three elements of the NAP essentially reference the respective NCP measures as approved by FAA.

6.1.1 UPDATE NOISE RULE FOR RUNWAY 15L/33R

The FAA approved the MAA's proposal to modify the existing Noise Rule for Runway 15L/33R by changing the aircraft noise level criteria and source. References to using 90 dB SEL as modeled in the FAA Integrated Noise Model (INM) will be replaced with a value of 87.0 EPNdB that is determined by averaging the take-off and sideline 14 CFR Part 36 certification measurements (or international equivalent data). All other criteria and exceptions pertaining to this element will remain unchanged.

6.1.2 VOLUNTARY RESIDENTIAL PROPERTY ACQUISITION

The FAA approved the MAA's proposal to modify its existing Voluntary Residential Property Acquisition Program to expand eligibility to the 65 dB L_{dn} contour as defined by the current NEMs.[22] All other portions of this existing program element will remain the same.

Participation in the program is voluntary. Property owners are paid full market value for their property at its highest and best use, and provided relocation assistance in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

As of September 2014, the concurrent Noise Exposure Map update identified 49 single family properties (22 to the west of the Airport and 27 to the southeast of the Airport) for consideration for this program. Properties were identified by using the 2019 NEM contours (same as the 2019 L_{dn} contours presented in this document), the current land use inventory and the properties zoning classification. These properties have been zoned by local government to transition from residential to a noise compatible use. Individual properties will be reviewed, relative to federal and state guidelines, before being considered eligible. If additional noise sensitive properties are discovered within the noise contours at a later date, they would still be considered a candidate for mitigation.

6.1.3 HOMEOWNERS ASSISTANCE PROGRAM

The FAA approved the MAA's proposal to modify its existing Homeowners Assistance Program to expand eligibility to the 65 dB L_{dn} contour as defined by the current NEMs. All other elements of the existing program will remain the same.

The Homeowners Assistance Program offers financial assistance to homeowners residing in the 65 dB L_{dn} contour as defined by the current NEM, and who are not eligible for the Voluntary Residential Property Acquisition Program. Following completion of the ongoing NEM update, MAA intends to continue this program, in particular, the soundproofing option.

The MAA will assist eligible homeowners in making modifications to their houses, with a goal of reducing interior noise levels to an average of 45 L_{dn} (or 45 DNL). The type and extent of the improvements are dependent upon the noise reduction capabilities of the existing structure. Fresh air ventilation and air conditioning are installed to allow windows to remain closed. The homeowner enters into a contract with the MAA, committing the MAA to: 1) pay for the agreed upon noise reduction modifications; and 2) monitor the construction and assure its quality. The homeowner is then required to sign an avigation easement.

As of September 2014, the concurrent Noise Exposure Map update identified 172 single family properties and 488 multi-family units (located in five complexes) for consideration for this program. Properties were identified by using the 2019 NEM contours (same as the 2019 L_{dn} contours presented in this

[22] Historically the Noise Abatement Plan called this program the "Voluntary Land Program" while the federal Noise Compatibility Program called this program the "Voluntary Residential Property Acquisition Program." Since these are the same programs, MAA will refer to this as the "Voluntary Residential Property Acquisition Program" in the future.

document), current land use inventory, and consideration of properties not eligible for the Voluntary Residential Property Acquisition Program. Individual properties will be reviewed, relative to federal and state guidelines, before being considered eligible. If additional noise sensitive properties are discovered within the noise contours at a later date, they would still be considered a candidate for mitigation.

6.1.4 RUNWAY 4/22 DECOMMISSIONING

Runway 4/22 was permanently closed / decommissioned as a runway effective August 6, 2014. The NAP will be modified by adding the text "Runway 4/22 was permanently closed / decommissioned as a runway effective August 6, 2014."

Table 27 Noise Abatement Plan Elements

Noise Abatement Elements	
Aircraft Noise Abatement Departure Procedures	• Noise abatement flight tracks on all runways • Limited use of Runway 4
Aircraft Noise Abatement Arrival Procedures	VFR noise abatement arrival procedures
Preferential Runway Use System	• West operations are preferred for noise abatement. • Runway 10/28 is the preferred runway for noise abatement between the hours of 2300 and 0500 local time. • Limitation on use of Runway 33R from 2300 to 0500 local time. • Practice landings and approaches by jet and turboprop aircraft are prohibited on all runways from 2300 to 0700 local time. • Noise Rule for Runway 15L/33R
Continued Restricted Use of Runway 4/22	Runway 4/22 was permanently closed / decommissioned as a runway effective August 6, 2014.
Control of Ground Based Noise Sources	• Powerback Restrictions • Engine Maintenance Runup Restrictions • Tree Buffer Along East Airport Boundary
Cooperative Airline/Airport Program	Encourage Stage 2 phaseout; now complete.
Continued Monitoring	• Noise Hotline • Quarterly Report • Airport Noise and Operations Monitoring System
Land Use Elements	
Control of Incompatible Development	• Airport Noise Zone • Board of Airport Zoning Appeals (BAZA) • Noise Zone Notification in Real Estate Transactions *
Noise Assistance Programs	• Voluntary Land Acquisition Program • Homeowners Assistance Program • School Soundproofing Program • Ridgewood Mobile Home Park
Note: * The addendums to contract of sale for improved properties for Anne Arundel County and Howard County can be found in Appendix E.	

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7 PUBLIC CONSULTATION

The MAA conducted this Airport Noise Zone update with extensive consultation with all members of the airport public, including airport users, fixed based operators, pilots, potentially affected residents of the airport environs, and local, state, and federal officials.

The MAA and its consultants used several mechanisms in pursuing these external consultations:

- Two meetings were held with the BWI Marshall Neighbors Committee which were open to the public and agendas were provided in advance.
- One Airport Noise Zone Community Advisory Committee meeting was held and written background material was provided in advance.
- A public hearing was held for the entire community to attend and to provide opportunity for public comment.
- A public comment period for the October 2014 draft of this document was from October 3, 2014 to November 3, 2014.

Table 28 presents a summary of the public outreach, these consultations and COMAR process. The individual consultations are described in the following sections. The 2014 ANZ became effective December 22, 2014.

Table 28 Public Outreach and COMAR Process

Date	Event
April 23, 2013	**BWI Marshall Neighbors Committee Meeting** Discussion of Airport Noise Zone Update
May 22, 2013	**Maryland Airport Commission** Decision Paper - MAA received approval to update the BWI Marshall Airport Noise Zone, publish in the Maryland Register the proposed amendments to COMAR and to hold a public hearing
March 18, 2014	**BWI Marshall Neighbors Committee Meeting** Discussion of Airport Noise Zone Update
May 14, 2014	**Community Advisory Committee Meeting No. 1** Discussion of Airport Noise Zone Update and contours
October 3, 2014	**Published Notice in Maryland Register of Proposed Action to incorporate by reference in COMAR the new certified Baltimore/Washington International Thurgood Marshall Airport Noise Zone, reflecting the new base year of 2014 and new future years of 2019 and 2024.** **Notice also included the opportunity for public comment.**
October 3, 2014 – November 3, 2014	**30 day comment period**
October 21, 2014	**Public Hearing**
November 19, 2014	**Maryland Aviation Commission adopted amendments to regulations under COMAR** Decision Paper – Addresses comments received and summarized results of the public hearing. The Commission approves moving forward to adopt regulations, i.e. Airport Noise Zone Update becomes incorporated in COMAR
December 12, 2014	**Published Notice in Maryland Register of Final Action for Amendments to the Airport Noise Zone Regulations in COMAR Effective date December 22, 2014**
December 22, 2014	**Effective date of the 2014 Airport Noise Zone**

7.1 BWI MARSHALL NEIGHBORS COMMITTEE

The BWI Marshall Neighbor's Committee was established in 1983 by the MAA in response to neighbor's concerns about aircraft noise and future airport growth and development. The Committee serves as a liaison between the Airport and the surrounding communities to ensure continuing and timely discussion of mutual Airport and community interests. These interests include:

- Highway access and local traffic;
- Long-range plans;
- Operational changes;
- Noise;
- Parking; and
- Land use.

The Neighbors Committee meets one to two times a year at the MAA offices in Linthicum. MAA staff gave presentations on the status of the Airport Noise Zone Update at two Neighbors Committee meetings: April 23, 2013 and March 18, 2014 (See Appendix F). The Office of Noise, Real Estate and Land Use Compatibility sent out a meeting notice and an agenda to all Committee members. Copies also go to local elected officials, local county planning representatives, additional community representatives, and to individuals from the community who have requested to be on the mailing list. Materials related to these two Neighbors Committee meetings are presented in Appendix F.

The BWI Marshall Neighbors Committee formed the basis of the Community Advisory Committee for this study (Section 7.3).

7.2 MARYLAND AIRPORT COMMISSION

MAA staff presented a Decision Paper to the Maryland Airport Commission on May 22, 2013. That Decision Paper is presented in Appendix G and discussed the update of the ANZ and NAP. At that meeting, the Maryland Airport Commission approved that the MAA can proceed with the update to the ANZ and NAP.

MAA staff presented a second Decision Paper to the Maryland Airport Commission on November 19, 2014. The Decision Paper is presented in Appendix G and discussed the results of the ANZ update; comments received and summarized the public hearing. It also recommended approving the adoption of regulations establishing the updated ANZ and/or making revisions to the NAP. The Maryland Airport Commission approved the BWI Marshall Airport Noise Zone and Noise Abatement Plan as proposed.

7.3 COMMUNITY ADVISORY COMMITTEE

The MAA established the Community Advisory Committee, specifically for this ANZ update and the concurrent NEM update, made up of neighborhood representatives, aviation representatives, elected officials, and local, state, and federal officials, to provide input and make recommendations to the staff and consultants. Committee members helped disseminate information on the study to the rest of the community and aviation industry and solicit their input. Table 29 lists the Community Advisory Committee members.

The Community Advisory Committee met May 14, 2014, during the ANZ update. MAA sent background information to the Committee prior to the meeting and requested that the Committee review. The meeting included a presentation followed by a general discussion. The Community Advisory Committee members were invited by mail and follow-up phone calls.

Appendix F lists the Community Advisory Committee membership, summarizes meeting and topics, and presents copies of background material, minutes, and sign-in sheets for the meeting. The background materials were sent to the Committee before the meeting and the complete transmittal and mailing is in the appendix.

Table 29 Community Advisory Committee Members

Source MAA, HMMH, October 2014

Organization	Representing	Representative
Neighbors Committee Members	The Greater Elkridge Community Association Elmhurst Improvement Association Glen Burnie Improvement Association Harmans Civic Association Linthicum-Shipley Improvement Association Severn Improvement Association Timber Ridge Improvement Association Ferndale-Linthicum Area Community Council	Edward Huber Eric Jordan Nancy Brown (Chairman) Rusty Bristow Ken Glendenning Melvin Kelly (Chairman) Richard Hanna Liz Wagner
Elected Officials	Senate of Maryland	Senator James E. DeGrange, Sr.
Federal Aviation Administration	BWI Tower Potomac Consolidated TRACON Washington Airports District Office	Stephen M. Batchelder* Stephen Smith Marcus Brundage
Aviation Representatives	National Business Aviation Association Aircraft Owners and Pilots Association Southwest Airlines Signature Flight Support BWI Business Partnership	Greg Voos Craig Fuller Bert Seither Jerome Fernandez** Linda Greene
Public Planning Agencies	Howard County Office of Planning and Zoning Anne Arundel County Office of Planning and Zoning	Brian Muldoon Lynn Miller
Maryland Aviation Administration	Director, Office of Noise, Real Estate & Land Use Compatibility Assistant Attorney General Director, Office of Planning and Environmental Services Chief Engineer, Facilities Development and Engineering	Ellen Sample Louisa Goldstein Wayne Schuster Paul Shank

Notes:
*BWI Tower is now represented by Stephen M. Batchelder; the previous representative was Ed Donaldson.
**Signature Flight Support is now represented by Jerome Fernandez; the previous representatives were Dave Fitzgerald and Robert Grant

7.4 PROJECT NEWSLETTERS

The study team prepared and distributed one Executive Summary during the ANZ Update process, as part of the draft ANZ release announcement. Appendix F presents a copy of the Executive Summary.

7.5 PUBLIC HEARING

A public hearing for the Airport Noise Zone, and a public workshop for the concurrent Noise Exposure Map Update, was held October 21, 2014 at Maryland Aviation Administration's Offices in Linthicum. A Public Workshop and Public Hearing Notice were published in four different local area newspapers and in the Maryland Register October 3, 2014.[23] The notices were also delivered to 12 area public libraries along with the ANZ Maps and Executive Summary. The notices also discussed the associated comment period (which is discussed in Section 7.6).

[23] Volume 41: Issue 20 Maryland Register, pg. 1168 (Issue Date: October 3, 2014). http://www.dsd.state.md.us/MDRegister/4120.pdf

The newspaper publication and respective dates are listed below.

- The Baltimore Sun, Friday October 3, 2014
- The Baltimore Sun, Saturday October 11, 2014
- The Baltimore Sun, Sunday October 19, 2014
- Howard County Times, October 9, 2014
- Howard County Times, October 16, 2014
- The Capital, October 11, 2014
- The Capital, October 19, 2014
- Maryland Gazette, October 8, 2014
- Maryland Gazette, October 18, 2014

The 12 area public libraries are listed below.

Anne Arundel County

- Linthicum Branch
- Severn Community Branch
- Brooklyn Park Branch
- Riviera Beach Branch
- Glen Burnie Regional Branch
- Severna Park Branch

Howard County

- East Columbia Branch
- Central Branch
- Elkridge Branch
- Miller Branch
- Savage Branch

Baltimore County

- Arbutus Branch

The full ANZ document and related maps and materials were made available at the MAA offices at 991 Corporate Boulevard in Linthicum, Maryland and on the MAA Community Relations website.[24]

Prior to the hearing, the Chief Executive Officers, Zoning Boards and Planning Directors of Anne Arundel, Howard and Baltimore Counties were given an opportunity to comment. Additionally, a direct mail notice was sent out to our Advisory Committee, Neighbors Committee, community associations and interested parties on our mailing list.

The public hearing and workshop included boards and was attended by MAA staff and the contractor team. In addition, there was a rolling presentation. Copies of the September 2014 Executive Summary were available as handouts. The complete document and ANZ maps were available on display for review. Comment cards were available in the event attendees wanted to provide written comments.

Appendix H provides copies of materials related to the public workshop notification and the workshop materials that were presented.

7.6 COMMENTS

Public comments were accepted from October 3, 2014 until November 3, 2014. The notification for the comment period, and the location of the ANZ document, was the same as the notification for the public hearing. That notification process is documented in Section 7.5 and Appendix F. The notification included the locations in which the public could review the October 2014 draft of this document.

Three written comments were received by mail. No formal written or oral comments were received at the Public Hearing. MAA responded to each commenter individually with letters dated December 12, 2014.

Appendix I present the comments received and MAA's respective responses.

[24] http://www.maacommunityrelations.com/