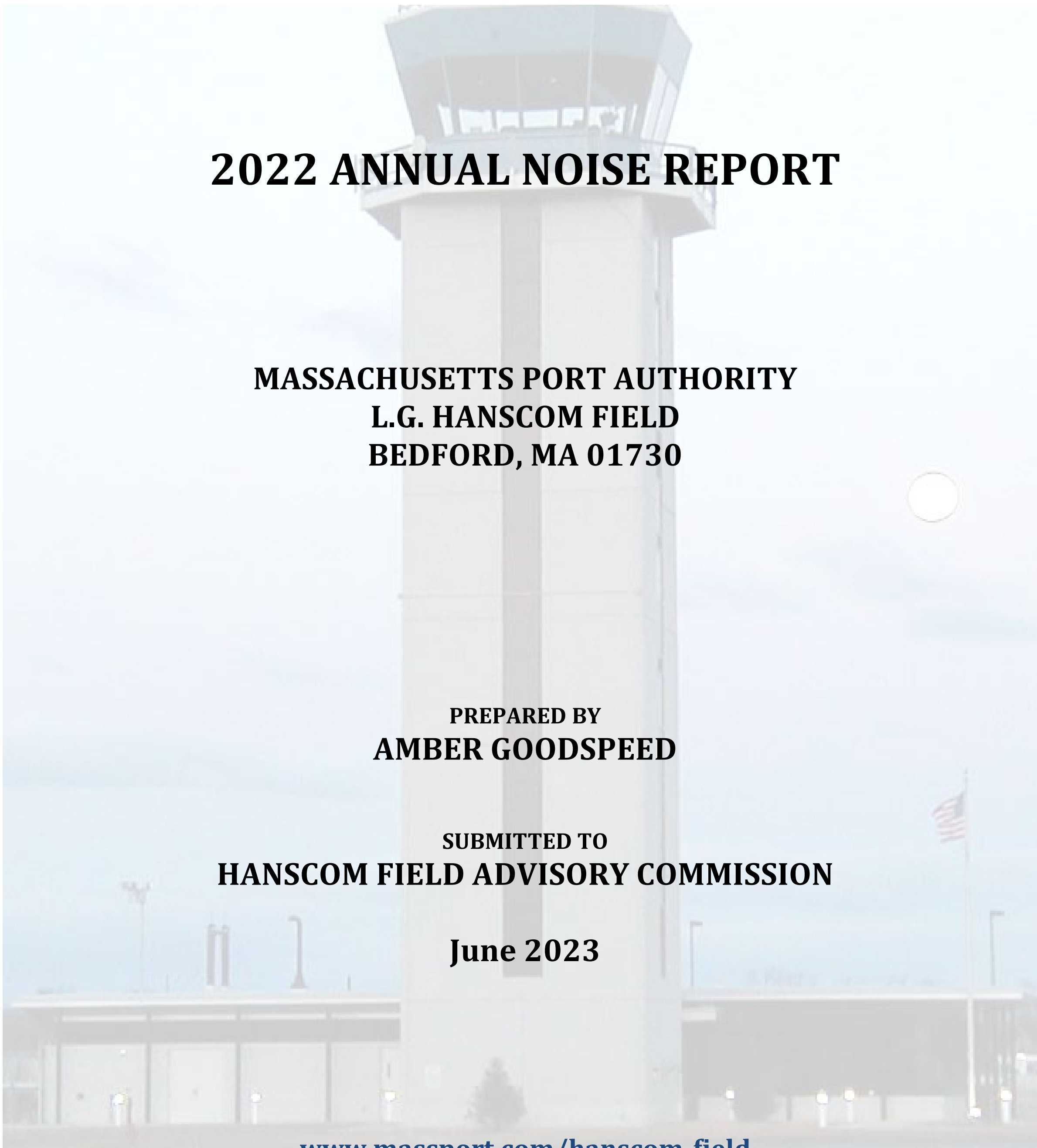
hanscomfield



2022 ANNUAL NOISE REPORT

MASSACHUSETTS PORT AUTHORITY
L.G. HANSCOM FIELD
BEDFORD, MA 01730

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SUBMITTED TO
HANSCOM FIELD ADVISORY COMMISSION

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www.massport.com/hanscom-field

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INTRODUCTION

Each year, the Massachusetts Port Authority (Massport) prepares a noise report for L.G. Hanscom Field (Hanscom Field). This tool is used to report on aircraft activity and the noise environment at the airport. It includes a historical perspective on why and how noise impact reports have been presented since 1982, and continues with data on the numbers and types of operations and overall noise exposure for the most recent calendar year. This report has been prepared to present data on Hanscom Field's 2022 operations. Comparable data from previous study years demonstrate trends in aviation activity and noise levels.

The Massachusetts Port Authority

Massport owns and operates Boston Logan International Airport (BOS), Hanscom Field (BED), Worcester Regional Airport (ORH), as well as a cargo facility and cruise terminal in the Port of Boston. Massport is a public authority whose premier transportation facilities generate billions in economic activity annually and support thousands of direct jobs, which enhance and enable economic growth and vitality in New England. Massport is committed to providing safe, secure and efficient transportation facilities that afford passengers and companies the freedom to travel and conduct business throughout the world while enabling Massachusetts and New England to compete successfully in the global marketplace. No state tax dollars are used to fund operations or capital improvements at Hanscom Field.

L. G. Hanscom Field

In 1941, the Commonwealth of Massachusetts purchased land northwest of Boston for the proposed Boston Auxiliary Airport, and the U.S. Civil Aeronautics Administration oversaw construction of the original runways and facilities. The completed facility was immediately leased by the Army Air Corps for advanced pilot training in support of America's war effort. In 1943, the new airport, geographically bounded by Bedford, Concord, Lexington and Lincoln, was officially dedicated as Laurence G. Hanscom Field.

In 1956, the Massachusetts legislature created the Massachusetts Port Authority and gave it control of Hanscom Field. In 1959, Massport began managing the civil terminal area while the U.S. Air Force leased and operated the airfield for continued use by military and civilian aircraft. In 1974, the Air Force canceled its lease of the airfield, and Massport became responsible for operating and maintaining the airport. Since then, Hanscom Air Force Base has become an important research and development facility for the Air Force. Although military operations at Hanscom have dropped to approximately one percent of the aircraft activity, the airfield continues to be a valuable resource for the Base and must be maintained to current and future military standards.

Today, L. G. Hanscom Field plays an important role in New England's regional aviation system by serving as the premier general aviation (GA) reliever for Logan International Airport. Hanscom Field helps ease congestion at Logan Airport by accommodating business, private pilot training, charter, light cargo, air taxi, medical, and military aircraft activity; all of which serve the diverse flying needs of government entities, corporations, businesses, research and development firms, educational institutions, as well as individuals. This full-service GA facility serves as a vital link to domestic and international destinations for local companies. Additionally, commercial service to select markets has been periodically available at Hanscom in aircraft with no more than 60 seats, consistent with Massport's 1980 *General Rules and Regulations for Laurence G. Hanscom Field*.

On-going improvements to infrastructure and procedures ensure that Hanscom is a well-equipped, safe, and secure facility for serving the diverse needs of its users, while standing ready to support the future economic growth of the region. Massport recognizes the interest that the residential and aviation communities have in the planning and operation of the airport and has a long and well documented history of sharing information with interested parties. Massport is committed to continuing its relationship with the Hanscom Field Advisory Commission (HFAC), a committee consisting of representatives from the surrounding communities, area-wide organizations, airport users, and Ex Officio members from the Federal Aviation Administration (FAA), Hanscom Air Force Base, and Minute Man National Historical Park. The annual noise report is presented to HFAC each year.

CHAPTER 1 SUMMARY

The first noise report for Hanscom Field was prepared in 1982, and it compared data for 1978 and 1981. Annual updates were started in 1984 (based on the previous year's data), making this the forty-first Hanscom Field Noise Report. The first report in 1978 has been used as the base year for evaluating changes in noise exposure. Chapters 2 and 6 review how this has been done, factoring in updates in the noise and performance data used to calculate noise exposure at Hanscom Field. This compilation of data provides a long-term historical perspective on the airport's aircraft activity.

The annual reports focus on the noise generated by civilian aircraft departures, including single engine piston aircraft. This approach evolved from input from aviation and residential representatives as the early noise reports were being developed. EXP, a metric that estimates cumulative noise exposure at Hanscom, is used as the screening tool to evaluate the changes in noise levels. This report presents the supporting data for the EXP calculation: total numbers of operations, fleet mix, operations by time of day, noise levels for military and civilian operations, and arrival as well as departure operations. It includes data from the permanent noise monitoring system for the years 2005, 2010, 2015 and 2020 through 2022.

Massport's EXP system compiles information from a number of sources and includes formulas to develop the operations and noise data discussed in this report. Results of this evaluation show the following:

1. The 2022 Federal Aviation Administration (FAA) Tower count, which includes all arrivals and departure activities between 7 a.m. and 11 p.m., shows 122,216 operations, 2 percent less than in 2021.

2. While military flights represented 1.4 percent of the total activity, they contributed 7 percent of the total departure noise exposure. Military operations increased by 45 percent in 2022, with 1,701 flights as compared to 1,174 flights in 2021.

3. The civilian portion of the FAA tower counts decreased 2.3 percent overall as compared to 2021. Civilian flights contributed 93 percent of the departure noise exposure.

4. There were 84.5 average daily single engine piston (SEP) departures, including touch-and-go training operations. SEP activity represent 50.5 percent of the 2022 operations and indicate a 10.6 percent decrease in SEP activity as compared to 2021.

5. Non-single engine piston (non-SEP) civilian aircraft, which dominate civilian noise levels, averaged 86.7 daily departures in 2022. This represents a 9.7 percent increase in non-SEP activity, as compared to 2021.

6. Jet activity, which represented 30.1 percent of the total activity, increased 10.7 percent in 2022 and contributed 74.4 percent of the civilian departure noise.

7. Turboprop operations, representing 6 percent of the total 2022 activity, increased 5.5 percent.

8. Use of the airfield between 11 p.m. and 7 a.m. also increased, from 2,191 arrivals and departures in 2021 to 2,651 arrivals and departures in 2022.

9. Using the AEDT/EXP Version 2d noise model, the 2022 departure noise exposure for civilian aircraft was calculated at 107.6 decibels (dB), which represents a 0.3 dB increase compared to 2021 civilian noise exposure.

10. This report includes a comparison of 2005, 2010, 2015 and 2020 through 2022 noise levels recorded at six noise-monitoring sites located in the communities and on the airfield. The reported noise levels include civilian and military aircraft noise as well as community noise. Changes in annual average noise levels at the sites, based on available data, range from decreases of 1.6 dB to an increase of 0.1 dB when comparing 2021 to 2022.

In addition to the data analyses, this report discusses policies that have impacted noise levels at Hanscom during the study years. The 1978 *Hanscom Field Master Plan and Environmental Impact Statement* (The Master Plan) and the 1980 *General Rules and Regulations for Laurence G. Hanscom Field,* later promulgated by the Commonwealth as 740 CMR 25, include the policies and regulations that continue to guide Massport as it operates Hanscom Field. Since the adoption of these documents, Massport has worked with the HFAC and the Hanscom Area Towns Committee (HATS), as well as other interested parties, to balance its commitment to regional transportation and the business community with the need to recognize and minimize the airport's impact on the surrounding communities.

CHAPTER 2 HISTORICAL PERSPECTIVE ON THE ANNUAL REPORT AND THE EVALUATION OF NOISE

This chapter of the report discusses the development of measures used to evaluate noise exposure at Hanscom. Each step was discussed with the HFAC, and the current approach was adopted through consensus at the HFAC meetings.

The first noise report was prepared in 1982 by Harris Miller Miller & Hanson Inc. (HMMH), acoustical consultants for Massport, to evaluate the effectiveness of the noise rules that Massport had implemented in 1980. The firm continued to prepare the noise reports until 1987, when Massport assumed the responsibility. Each year, Massport has a qualified consultant review the noise data and annual report. HMMH reviewed the data and report for 2022.

2.1 The Use of Contours to Evaluate Noise Exposure

The most frequently used measure to characterize noise exposure around an airport is referred to as the Day-Night Average Sound Level (DNL), which is most commonly depicted by using contours on a map to connect points of equal noise exposure. Creating DNL contours requires detailed knowledge of the fleet of aircraft using the airport (including the types of aircraft engines and the aircraft climb performance characteristics), as well as information on the frequency of runway use and the flight paths of the aircraft as they depart and approach the field. These data are entered into a computer noise model to produce the contours.

DNL is widely used throughout the United States. It is the metric used by the FAA for assessing noise impacts. DNL is discussed in more depth in Appendix A. Appendix A also includes maps from previous studies showing the 2012 and 2017 DNL contours for Hanscom. The 1978 contours were developed in 1981 using the computerized modeling program called Noisemap. Subsequent contours have been developed using the FAA's most recent noise model at the time. The 2012 contours were developed in 2013 using INM 7.0c. The 2017 contours were developed in 2018 using the Aviation Environmental Design Tool (AEDT) 2d. The contours include the effects of both military and civil aircraft, including touch-and-goes. A touch-and-go operation is when an aircraft lands on the runway, does not stop and takes off again. Noise contours are developed approximately every 5 years within the Hanscom Field *Environmental Status and Planning Report* (ESPR). The ESPR is a comprehensive document that examines operations at Hanscom Field during a particular year and reports on noise as well as multiple additional environmental impacts. The latest ESPR reported impacts based on 2017 operations. The next ESPR is in development and will present updated DNL contours based on 2022 operations.

Time Above is another metric sometimes used to describe the noise experience by reporting the amount of time that noise levels exceed a given threshold. Time Above is also described in Appendix A, which includes the 2012 and 2017 Time Above contours.

2.2 Developing EXP to Evaluate Changes in Noise Exposure

In addition to calculating DNL contours, HMMH defined a metric in the 1982 report for routinely evaluating the effects of changes in the aircraft fleet mix, and numbers of operations. A database management system was developed to calculate the metric (called EXP), which has been used since 1982 as a first-round screening procedure.

EXP provides a tool for comparing civilian noise to military noise while indicating changes in the total annual noise exposure and expected changes in DNL. This is accomplished by having EXP use the same FAA noise data for the aircraft types, and applying the same manner of logarithmically summing noise, as discussed in Appendix A. This includes applying a "noise penalty" of 10 decibels for each nighttime aircraft event to account for its more intrusive nature.

In the calculation of EXP, each aircraft type is assigned to a group, characterized by a similarity of size, the number and type of engine(s), climb performance, and ultimately, noise level characteristics. Using FAA noise and performance data, arrival and departure Sound Exposure Levels (SEL) are assigned to each group. The SELs used for EXP are in A-weighted decibels and represent the amount of noise generated by a departing aircraft 15,000 feet from start of take-off roll. There is additional discussion of SEL in Appendix A.

The total departure noise exposure on an average day is calculated by:

1. Logarithmically multiplying the representative SEL for each group by the average number of daily departures by those aircraft, applying the 10-decibel weighting to nighttime operations, and creating a "partial" departure EXP; and
2. Logarithmically adding all "partial" EXPs for the entire fleet to obtain a single number estimate of departure noise exposure.

2.3 The Significance of Changes in EXP

Because EXP applies the same methodology used for calculating DNL, it continues to be used as a first round procedure to estimate changes in noise levels at Hanscom. In the mid-1980s, HFAC and Massport discussed the significance of changes in EXP, and it was agreed that an increase of 1.5 dB above the 1978 base year noise level would indicate the need for further study.

Although civilian departure EXP has never exceeded the 1978 EXP by 1.5 dB, Massport completed a *Generic Environmental Impact Report* (GEIR) based on 1985 data, an update of the GEIR based on 1995 data, an *Environmental Status and Planning Report* (ESPR) based on 2000 data, and updated ESPR studies based on 2005 data, 2012 data and 2017 data. The GEIRs and ESPRs include noise contours and additional noise metrics, providing comprehensive analyses of noise and other environmental impacts. It is anticipated that updates of the ESPR, with detailed noise analyses, will continue to be produced roughly every 5 years. A new ESPR is currently in preparation using data from 2022.

It is increasingly complex to compare current noise levels to noise levels from 40 years ago because the FAA routinely updates the noise modeling technology which is the basis of calculating EXP. However, EXP still allows for an annual evaluation of changes in the noise level from one year to the next and identifies trends in those changes.

2.4 Upgrading EXP Calculations

Until 1987, the EXP calculations relied primarily on SELs from the U.S Air Force's Noisemap noise and performance database, which was available in 1982 when EXP was developed. In 1987, the FAA released a revised and expanded set of noise and performance data (Version 3.9) for the Integrated Noise Model (INM), and Massport moved from using Noisemap to using the INM.

The FAA continues to maintain the process of updating its aircraft noise and performance data for modeling aircraft noise. Accordingly, Massport has periodically updated the SEL values used in EXP. From 1987 through 1995, EXP Version 3.9 (EXP 3.9) was used. EXP Version 5.1 (EXP 5.1) was used starting in 1996. EXP Version 6.0c (EXP 6.0c) was introduced in the 2002 report for the years starting in 2000, EXP Version 6.1 (EXP 6.1) was introduced in the 2005 report, and EXP Version 7.0c, was introduced in the 2016 report. The numbers in each version link to the INM version that was current at the time, indicating the database used. In early 2019, Hanscom Field upgraded to EXP Version 2d, which utilized SEL values from the FAA's new model at that time, AEDT Version 2d. This 2022 Noise Report utilizes Version 2d. More details regarding AEDT modeling are available in Chapter 6 of this report.

2.5 EXP Comparisons: With Single Engine Piston (SEP) vs. Without SEP, With Military Aircraft vs. Without Military Aircraft, Departure EXP vs. Arrival EXP

When EXP was first developed, it was calculated for civilian and military non-SEP aircraft departures with the capability of using either subgroup for comparisons. SEP operations were excluded from the data for reasons discussed in detail in early reports. When residents became interested in the effect of the noise generated by these small aircraft, a method for estimating their usage was developed for future use and was applied to all the study years retroactively.

In 1988, HFAC members discussed the need to focus on one number when comparing EXP from one year to the next. It was agreed that the emphasis should be on civilian aircraft, and the civilian component should include the estimated SEP operations. It was also agreed that Massport would begin to track arrival EXP. However, the focus on departures would still be used as the best representation of the noise impact because changes in departure EXP more closely reflected changes in DNL than changes in arrival or total EXP. As aircraft noise reduction technology has advanced over time, the noise levels produced by departures have gradually diminished.

2.6 The Report on 2022 Noise Exposure

This report incorporates the results of the agreed-upon methodology for evaluating the noise impact, as it applies to 2022 Hanscom operations. It includes operational data for the study years (1978, 1981 and 1983 through 2022) and analyzes the change in noise exposure since 1978. It focuses on the effect of civilian aircraft departures, including SEP, with supplementary information on FAA tower counts, 11 p.m. to 7 a.m. operations, the noise effects of military activity, and arrival EXP.

In addition to being considered a good indicator of changes in DNL and changes in the general level of total noise exposure generated by the airport, EXP also provides a historical perspective, because comparative data are available for most years since 1978. Data from the permanent noise monitoring system became available during the 1990s, providing information on the measured noise experienced at six locations.

Methods of data collection for determining operations and noise exposure are reviewed in Chapter 3 of this report. A discussion of the 7 a.m. to 11 p.m. operational levels for 2021 is presented in Chapter 4. Chapter 5 focuses on operations conducted between 11 p.m. and 7 a.m. when a nighttime field use fee is in effect. Chapter 6 presents noise exposure levels (using the EXP noise metric). Policies that address aircraft noise and community concerns are reviewed in Chapter 7. Chapter 8 discusses the permanent noise monitoring system and the data collected by the system.

CHAPTER 3 DATA COLLECTION FOR DETERMINING OPERATIONS AND NOISE EXPOSURE

Hanscom Field serves various categories of civilian and military aircraft, and data are compiled to track each category's noise contribution. Massport strives to use the best available data sources to track aircraft operations at Hanscom Field. Input to the files used to develop operations and noise data come from several sources, listed below.

1. **Noise and Operations Monitoring System (NOMS):** provides records of arrivals and departures to and from Hanscom at all times of day. Radar flight data document the exact times of arrival and departure. Identifying information for the aircraft type are matched to each flight using data from the aircraft's transponder and electronic FAA flight plan and aircraft registration databases. Algorithms built into Massport's NOMS more accurately report aircraft data than the simple radar data alone.

2. **FAA Monthly Tower Reports:** provide the number of aircraft operations at Hanscom Field between 7 a.m. and 11 p.m. The Hanscom FAA tower personnel maintain a count of all aircraft that operate at Hanscom when the tower is open. This includes Visual Flight Rules (VFR) and Instrument Flight Rules (IFR) arrivals and departures.[1] The FAA tower count is traditionally used to quantify the activity level for the airport, despite the exclusion of operations between 11 p.m. and 7 a.m., when the FAA tower is closed, and the previous inclusion of over flights.

3. **Estimates of Civilian VFR non-SEP Aircraft:** Used to supplement IFR activity by civilian twin-engine pistons (twins), turboprops (turbos), and helicopters between 7 a.m. and 11 p.m.

Pilots of some turboprops and twin-engine aircraft and most helicopters fly VFR. They communicate with

1 Prior to 1993, the tower counts also included aircraft that flew through the Hanscom air space (over flights) but did not use the airport.

the FAA tower, and the tower tallies the operation, although there is no written record of the aircraft type or specific time of the operation. Algorithms are incorporated within NOMS to identify most aircraft by type, and a representation of the noise generated by civilian non-SEP VFR operations is incorporated into the noise exposure database.

4. **An Estimate of Civilian SEP Activity between 7 a.m. and 11 p.m.** The number of civilian SEP aircraft operations is estimated by subtracting the civilian IFR and estimated flights for jets, helicopters, twins, and turbos from the air traffic control tower counts for non-military operations.

5. **Nighttime Field Use:** Massport third party billing cameras record all operations between the hours of 11:00 p.m. and 7:00 a.m. when the FAA tower is closed. These are used to supplement the NOMS data.

CHAPTER 4 2022 DAILY OPERATIONS, 7 a.m. - 11 p.m.

Table 4.1 presents the annual Hanscom Tower counts since 1978, showing 122,216 operations for 2022.[2] This indicates a 2 percent decrease as compared to 2021. In 1970, tower counts peaked at more than 300,000, and remained consistently over 200,000 until 1993. Counts again exceeded 200,000 from 2000 through 2002. However, from 1993 through 1999, and since 2003, tower counts have remained below 200,000.

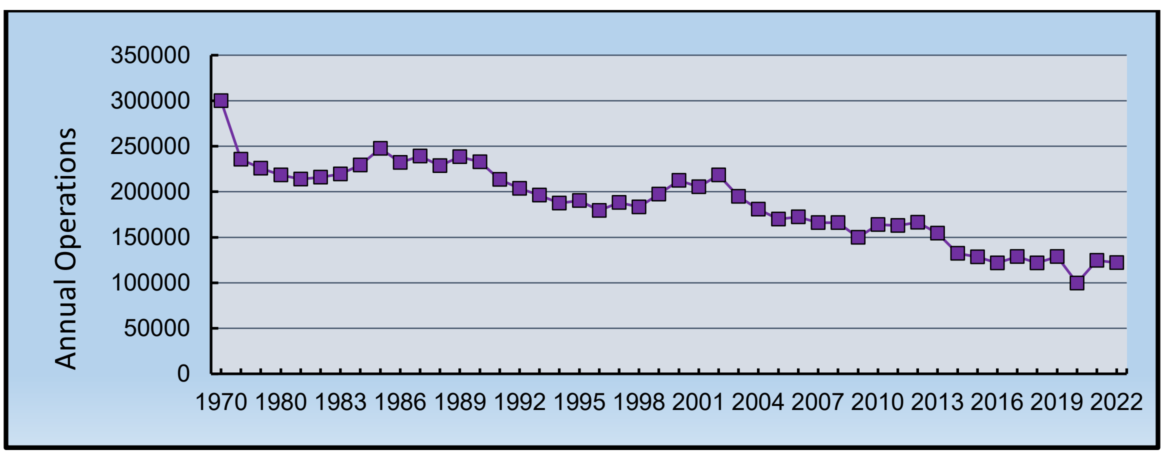
2 As discussed in Chapter 3, the FAA tower counts are used to report the official number of operations for an airport. At Hanscom, they include military operations and, until 1993, an unidentified percentage of overflights. The Air Traffic Control Tower is not open from 11 p.m. to 7 a.m., so the tower counts do not include operations conducted between those hours. That night activity is discussed in Chapter 5.

TABLE 4.1 Annual FAA Tower Counts for 7 a.m. to 11 p.m. Since 1978

Year	Tower Count	Year	Tower Count	Year	Tower Count	Year	Tower Count
1970	300,000+	1989	238,340	2001	205,436	2013	154,251
1978	235,750	1990	232,678	2002	218,248	2014	134,288
1979	225,805	1991	213,637	2003	194,885	2015	128,279
1980	218,502	1992	203,755	2004	180,804	2016	121,786
1981	213,698	1993	196,138	2005	169,955	2017	128,598
1982	215,984	1994	187,550	2006	172,457	2018	121,664
1983	219,466	1995	190,282	2007	165,907	2019	128,671
1984	229,130	1996	179,497	2008	165,889	2020	99,725
1985	247,434	1997	188,087	2009	149,911	2021	124,580
1986	232,110	1998	183,185	2010	163,737	2022	122,216
1987	239,154	1999	197,302	2011	162,999		
1988	228,725	2000	212,371	2012	166,214		

The tower counts in **Table 4.1** have been plotted in **Figure 4.1** to illustrate the annual fluctuations and overall decline since 1978, including the high of 247,434 operations in 1985 and the low of 99,725 operations in 2020. The operations counts by category which follow help provide understanding of the operational changes over the years.

FIGURE 4.1 Annual FAA Tower Counts for 7 a.m. to 11 p.m. Since 1978



The FAA maintains separate tallies for "local" (i.e. touch-and-go) operations and for military activity in its daily counts. A touch-and-go is a flight pattern used to practice landing and departing, most frequently conducted by the flight schools. The aircraft is brought in for a landing, continues along the runway for a departure, circles the field and repeats the procedure without stopping. The FAA tower tallies each touch-and-go as two operations, because there is an arrival and a departure.

Starting in 1987, Massport has recorded and documented the FAA tower counts with the data collected in Hanscom Field's NOMS system in order to estimate the breakdown of 7 a.m. to 11 p.m. civilian activity by aircraft type for both IFR and VFR operations, as shown in **Table 4.2**.

Table 4.2 Annual Estimated Operations by Aircraft Type, 7 a.m. – 11 p.m.

CIVILIAN							MILITARY	TOTAL
Year	Local	Singles	Twin Piston	Turbo	Jet	Heli		
1987	72,999	134,461	5,309	6,443	10,034	7,294	2,613	239,153
1988	66,669	127,233	5,968	8,800	10,216	7,258	2,581	228,725
1989	72,067	132,368	5,697	8,767	9,656	7,294	2,491	238,340
1990	76,732	124,756	5,658	7,582	8,630	7,262	2,058	232,678
1991	80,805	102,478	5,476	6,666	8,368	6,942	2,902	213,637
1992	83,427	92,328	4,940	5,579	8,105	6,834	2,542	203,755
1993	85,872	82,756	4,489	4,571	8,838	6,811	2,801	196,138
1994	86,287	74,294	4,581	4,223	9,345	6,819	2,001	187,550
1995	86,048	76,685	4,589	3,997	9,592	6,804	2,567	190,282
1996	76,735	74,872	4,536	4,250	10,390	6,915	1,799	179,497
1997	76,217	83,515	4,157	3,733	11,248	6,912	2,305	188,087
1998	68,506	81,976	5,797	4,524	13,583	6,878	1,921	183,185
1999	73,483	88,137	5,426	5,697	16,108	6,885	1,566	197,302
2000	75,676	90,323	5,097	12,848	20,226	6,914	1,287	212,371
2001	72,605	84,803	4,858	13,580	22,839	5,499	1,252	205,436
2002	76,849	82,282	5,295	14,598	30,788	7,012	1,424	218,248
2003	71,696	70,912	4,750	9,057	30,352	6,978	1,142	194,887
2004	60,794	63,755	4,818	10,155	33,021	7,066	1,195	180,804
2005	58,535	57,894	4,265	9,008	32,345	7,004	904	169,955
2006	59,222	58,198	4,352	8,828	33,251	7,014	1,592	172,457
2007	56,731	51,776	4,196	10,355	34,522	6,889	1,438	165,907
2008	65,906	50,063	3,988	6,881	30,656	6,805	1,590	165,889
2009	60,263	46,478	3,963	5,588	25,482	6,830	1,307	149,911
2010	66,038	52,631	3,451	5,704	27,293	6,825	1,795	163,737
2011	60,268	56,059	3,542	6,886	27,838	6,987	1,419	162,999
2012	70,196	51,477	3,763	7,050	25,638	7,345	745	166,214
2013	62,141	46,679	3,390	7,288	26,777	7,364	612	154,251
2014	50,274	36,347	3,434	8,189	28,121	7,326	604	134,295
2015	48,057	33,595	2,884	7,207	28,218	7,793	525	128,279
2016	40,566	38,509	2,649	5,908	26,012	7,592	550	121,786
2017	46,028	32,111	3,103	7,889	30,380	8,451	636	128,598
2018	42,280	27,390	3,020	8,524	30,420	9,597	433	121,664
2019	44,607	31,532	3,448	7,194	31,826	9,489	575	128,671
2020	36,483	23,060	3,423	4,957	22,145	9,088	569	99,725
2021	40,332	28,667	4,535	6,970	33,240	9,662	1,174	124,580
2022	**36,370**	**25,336**	**4,890**	**7,351**	**36,808**	**9,760**	**1,701**	**122,216**

Comparing 2022 to 2021, the FAA tower count for military operations increased 45 percent, representing 527 additional operations. As in recent years, military operations represented approximately one percent of the total airport activity (at 1.4 percent) in 2022. The civilian portion of the FAA tower counts, which has consistently represented approximately 99 percent of the total activity during the study years, decreased 2 percent overall as compared to 2021. The data indicate increases in the operational type categories of twin pistons, turboprops, jets and helicopters. There were decreases seen in the operational type categories of single engine pistons and local operations (which are conducted by single engine pistons).

The level of jet activity is particularly relevant because jets dominate the civilian noise exposure. Jet use has traditionally been tied closely to the economic health of the region. As illustrated in **Table 4.2**, Jet activity levels declined around 1990 due to an economic slowdown. This was followed by a steady increase starting in the mid-1990s through 2000 when the economy was recovering and then flourishing. As the economy slumped in 2001, the year started with a decline in jet operations. The events of September 11, 2001 (9/11) created a new factor that impacted aircraft activity, particularly business jet activity levels. Despite the economic downturn, there was a surge in business jet use after 9/11 as businesses began reevaluating the use of commercial airlines for their travel needs. This resulted in a net increase in business jet use in 2001 and an additional 34 percent increase in 2002. Jet operations at Hanscom Field continued to climb from 2002 until 2007, when jets represented 21.0 percent of Hanscom's total activity. The economic recession in 2008 caused business jet activity levels to decrease in 2008 and 2009. In 2010, as the economy showed signs of a recovery, business jet activity increased by 7.1 percent from the previous year. In 2017, jet activity increased primarily due to an influx of business jets during the Logan Airport Runway 4R – 22L and Approach Light Pier Replacement Project. Jet activity in 2019 increased by 4.6 percent from 2018 levels and represented 24.7 percent of total operations. With the emergence of the global pandemic affecting operations in 2020, Hanscom Field saw a decrease in jet operations by 22.2 percent. In 2021, recovery from the COVID pandemic was in process, but jet activity soared due to preference of private aviation over commercial aviation, with an increase of 50.1% in jet activity over the 2020 level. In 2021, jet operatios accounted for 26.7 percent of total activity. In 2022, Jet activity increased 10.7% over 2021 levels, and jets comprised 30.1 percent of the total airport activity.

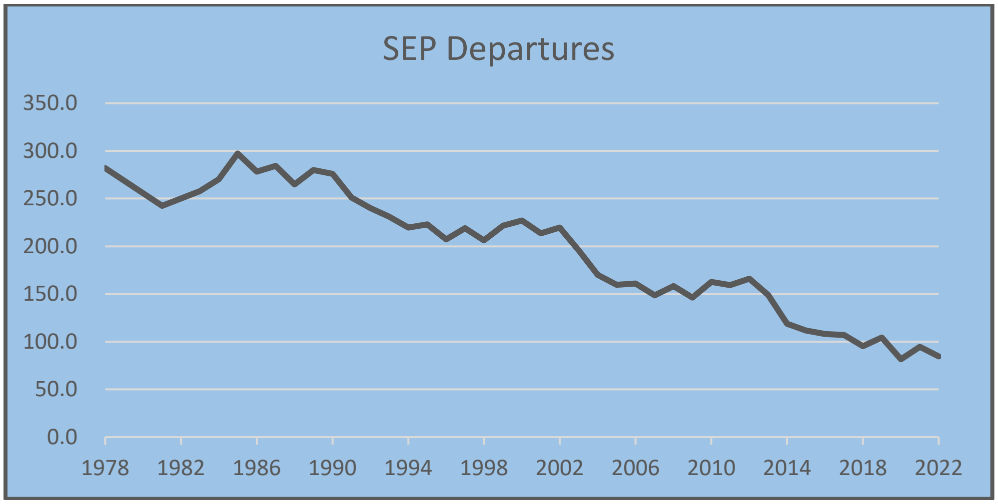
Turboprop operations represented 6 percent of the 2022 total tower counts, increasing by 5.5 percent as compared to 2021. Twin pistons and helicopters are the other non-SEP civilian aircraft that are tracked by Massport. Estimated twin piston aircraft activity in 2022 increased by 7.8 percent as compared to 2021, representing 4 percent of 2022 operations. Estimated helicopter activity in 2022 increased by 1 percent over the previous year, representing 8 percent of the 2022 aircraft operations.

SEP aircraft have always dominated aircraft activity at Hanscom. SEP operations include touch-and-goes (local activity), which peaked in 1978 when the FAA logged 94,641 annual touch-and-goes at Hanscom Field. The touch-and-go operations are included in Massport's estimates for single engine piston aircraft activity for two reasons: 1) since 1980, touch-and-goes have not been allowed in aircraft over 12,500 pounds at Hanscom, and 2) they are mostly conducted by the Hanscom flight schools using SEP aircraft. In recent years, touch-and-go operations have represented 50 to 60 percent of the SEP activity.

In 2022, estimated SEP activity, including touch-and-goes, represented 50.5 percent of the total airport operations and decreased by 10.6 percent as compared to 2021. **Figure 4.2** shows the estimated average daily departures (including local operations) for SEP aircraft between 7 a.m. and 11 p.m. for the study years. There were 84.5 average daily departures in 2022 as compared to 94.5 average daily SEP Departures in 2021. The highest study year for SEP activity was 1985, with 297.3 estimated 7 a.m. to 11 p.m. average daily departures. Average SEP daily departures have remained below 200 since 2003.

Figure 4.2 Average Daily Departures[3], 7am – 11pm by SEP Aircraft

3 Estimated Average Daily Departures = Total Annual Single & Local combined Operations from FAA tower counts divided by two, divided by 365 days.



While the tower counts, along with the influence of the SEP operations on those counts, provide one perspective on Hanscom's activity levels, it is the non-SEP operations, particularly the jets, which are the major source of changes in noise levels. **Table 4.3** shows a summary of the 2022 estimated average daily departures by non-SEP aircraft. These non-SEP departures have been separated by day and night (10 p.m. to 7 a.m.) hours, which are the blocks of time used in noise exposure calculations for DNL and EXP, both of which are discussed in Appendix A. The average daily departures are for the identified and estimated civilian aircraft and the identified military aircraft. They are listed month-by-month to show seasonal variations in activity.

The data show that the busiest month in 2022 for civilian non-SEP activity was June, which averaged 99.25 daily departures, while the low occurred in January with 69.32 daily civilian non-SEP departures. The civilian non-SEP activity averaged 84.37 daily departures during the year. The identified military operations peaked in August with 3.56 average daily departures. The lowest military average was in January with 1.29 average daily departures. Military non-SEP activity averaged 2.33 daily departures in 2022.

TABLE 4.3 2022 Monthly Average Daily Departures by Non-Single Engine Piston Aircraft

Month	CIVILIAN			MILITARY			CIVILIAN & MILITARY		
	DAY	10pm-7am	TOTAL	DAY	10pm-7am	TOTAL	DAY	10pm-7am	TOTAL
Jan	66.71	2.61	69.32	1.29	0.00	1.29	68.00	2.61	70.61
Feb	74.23	2.89	77.13	1.43	0.00	1.43	75.66	2.89	78.55
Mar	79.15	3.52	82.66	2.24	0.00	2.24	81.39	3.52	84.90
Apr	83.78	3.67	87.45	1.58	0.00	1.58	85.37	3.67	89.03
May	90.27	4.65	94.92	1.85	0.00	1.85	92.13	4.65	96.77
Jun	94.05	5.20	99.25	2.20	0.03	2.23	96.25	5.23	101.48
Jul	76.27	3.77	80.05	2.94	0.00	2.94	79.21	3.77	82.98
Aug	81.87	4.00	85.87	3.56	0.00	3.56	85.44	4.00	89.44
Sep	85.18	4.37	89.55	2.47	0.00	2.47	87.65	4.37	92.02
Oct	83.85	4.35	88.21	3.24	0.00	3.24	87.10	4.35	91.45
Nov	79.95	3.60	83.55	3.32	0.00	3.32	83.27	3.60	86.87
Dec	71.45	3.03	74.48	1.76	0.00	1.76	73.21	3.03	76.24
2022	**80.56**	**3.81**	**84.37**	**2.32**	**0.00**	**2.33**	**82.89**	**3.81**	**86.70**

Figure 4.3 shows a plot of the 2022 data in **Table 4.3**, demonstrating the monthly variability of non-SEP departures for both civilian and military activity. It is difficult to distinguish the civilian levels from the combined total for civilian and military activity because of the civilian aircraft dominance. The combined civilian and military level peaked in June, with 101.48 average daily departures. The month with the lowest combined military and civilian daily departures was January, with 70.61 average daily departures. Civilian and military non-SEP activity averaged 86.7 departures throughout the year.

FIGURE 4.3 Monthly Average Daily Departures by Non-SEP Aircraft, 2022

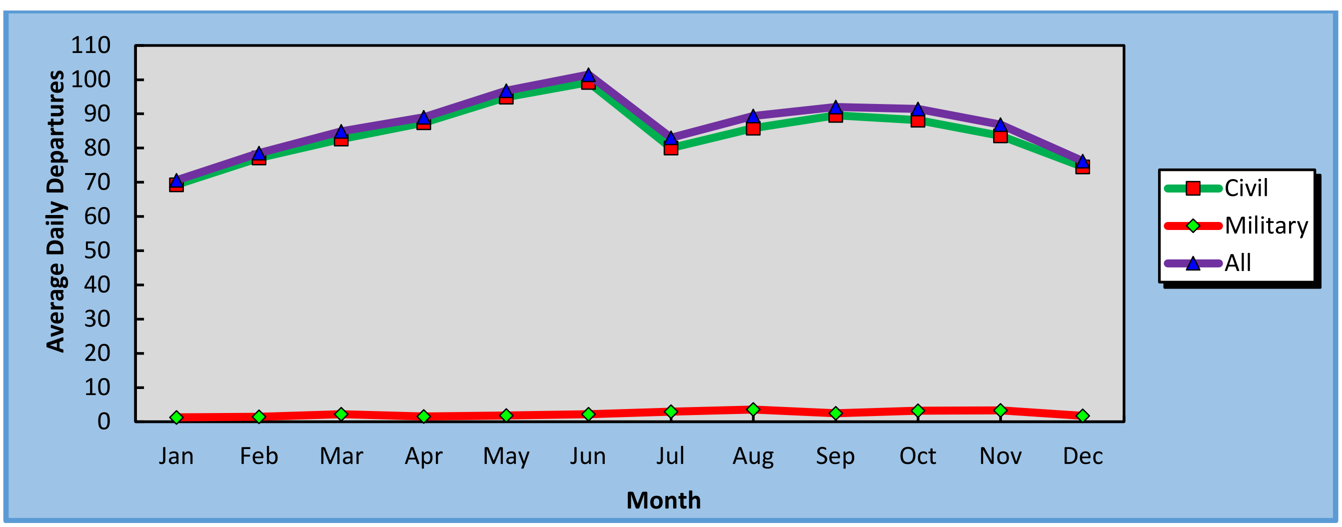
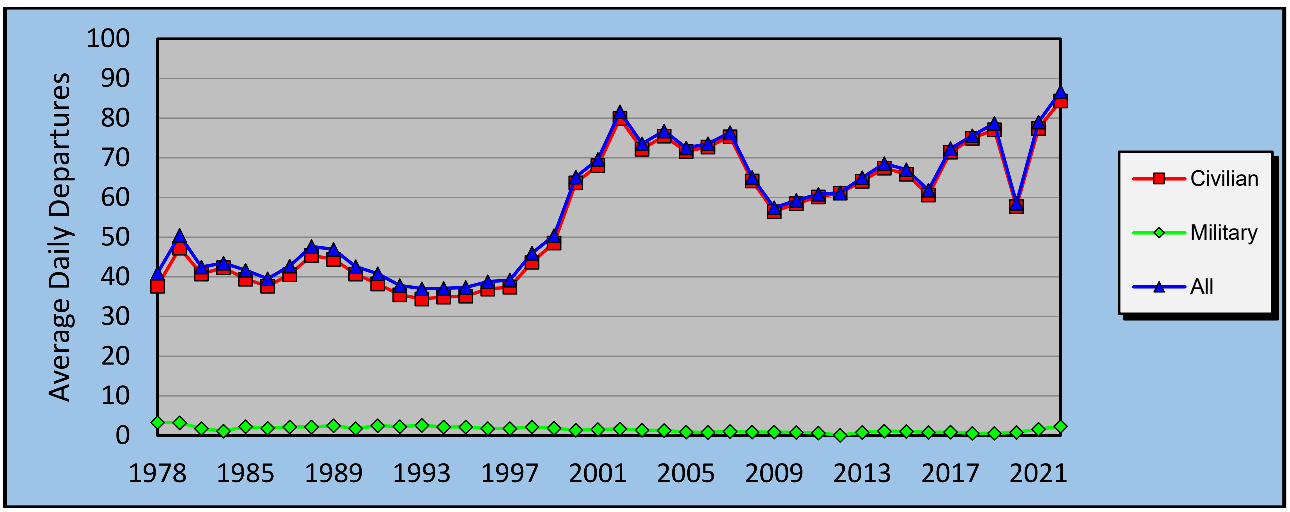


Figure 4.4 plots the annual non-SEP departure activity for the study years from 1978 through 2022, demonstrating the dominance of the civilian activity over the past 41 years. It shows that the non-SEP activity levels remained relatively stable between 1978 and 1998 and then increased to a peak in 2002 with 81.65 average daily civilian and military departures combined. Business jet and turboprop operations comprised the post-1998 non-SEP increases. There were more than 60 average daily non-SEP departures annually between

2000, the first full year after commuter service was re-introduced at Hanscom in turboprop aircraft, and 2008, when the commuter service was terminated. The previous peak year, 2002, was influenced by a 50 percent increase in jet activity during the first twelve months after the events of September 11, 2001. Additionally, it was in 2002 that Hanscom experienced its highest number of commuter operations in turboprops.

There was a 9.7 percent increase in annual civilian non-SEP departure operations at Hanscom Field from 2021 to 2022. 2022 was influenced by continued increases in private aviation attributable to the pandemic increases in private aviation use.

FIGURE 4.4 Annual Variations in Average Daily Departures by Non-SEP Aircraft[4]



CHAPTER 5 11 P.M. to 7 A.M. OPERATIONS

Hanscom Field is a public facility and is open for use 24 hours a day. However, aircraft using the airport between 11 p.m. and 7 a.m. must communicate with the FAA's Boston approach control facility because the Hanscom FAA control tower is closed at that time. Therefore, this activity is not included in the Hanscom FAA tower counts discussed in Chapter 4.

In the summer of 1980, Massport instituted an 11 p.m. to 7 a.m. airfield use fee to help minimize noise exposure by discouraging use of the field between 11 p.m. and 7 a.m. The fee is based on aircraft weight and doubles for aircraft that conduct more than five of those night operations in a calendar year. From 1980 until 1989 the fees were $20 for aircraft weighing 12,500 pounds or less and $150 for aircraft weighing more than 12,500 pounds. Records for activity between 11 p.m. and 7 a.m. were not maintained prior to the institution of the nighttime field use fee.

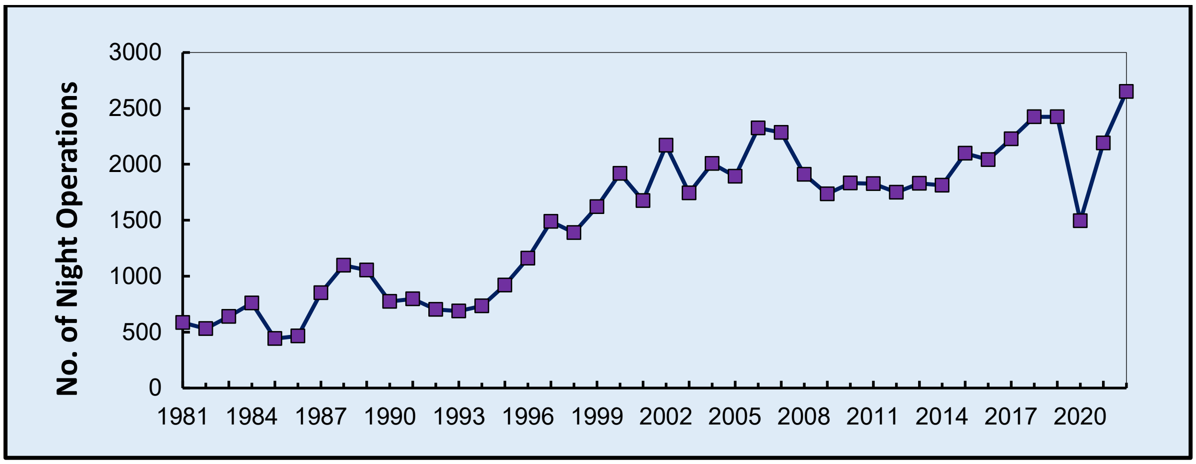
In 1988, Massport reviewed the nighttime field use fee. In 1989, the Massport Board voted to increase the fees to reflect the Consumer Price Index (CPI) increase between 1980 and 1989 and to institute an annual CPI

4 1979, 1980 & 1982 Data Unavailable

increase, effective each July 1. In July 2022, there was an increase in CPI of 8.5 percent, therefore the 2022 fees changed from $66 to $72 for aircraft up to 12,500 pounds and from $477 to $518 for aircraft over 12,500 pounds.

Figure 5.1 shows the history of 11 p.m. to 7 a.m. operations starting with 1981, the first full year they were logged. The graph illustrates the year-to-year fluctuations in activity. Annual 11 p.m. to 7 a.m. operations counts first surpassed 1,000 in 1988 and 1989. In 1990, nighttime activity decreased and subsequently remained below 1,000 annual operations through 1995, a likely reflection of the depressed economy and the fee increases.

FIGURE 5.1 11 p.m. to 7 a.m. Operations Since Nighttime Fee was instituted[5]



Since 1996, the annual number of 11 p.m. to 7 a.m. operations has consistently exceeded 1,000, partially due to night activity by medical air ambulance services, which transport critically ill or injured patients. In 2022, there were 766 night air ambulance service flights, which is a 18.4 percent increase compared to 647 air ambulance services in 2021. Total night operations increased 21 percent from to 2,191 in 2021 to 2,651 in 2022. This peak in 2022 nighttime activity mirrors the pandemic-related flight increases seen in the daytime activity. There were increases in the categories of jet, helicopter and turboprop activity between the hours of 11 p.m. to 7 a.m., and a decrease in the piston aircraft activity.

Table 5.2 provides an overview of the 2022 11 p.m. to 7 a.m. operations by aircraft type, arrivals and departures, and timeframe. It also shows a breakdown of the number of operations by fee amount levied for each category of aircraft. Those aircraft being charged $144 or $1,036 conducted more than five operations in the calendar year.

TABLE 5.2 Breakdown of 2022 11 p.m. to 7 a.m. Operations

5 The Night totals include aircraft operations that are exempt from the fee, with the exception of some missing exemption figures in 1983 and 1984 and possibly in 1981 and 1982. Since exemptions for other years in the 1980s represented a small number of nighttime operations, the totals in the table area are assumed to closely reflect the number of night operations for each year.

TYPE			TIME OF OPERATION			FEE DISTRIBUTION					TOTAL
Aircraft	Arr.	Dep.	11PM to 12 AM	6 to 7 AM	Other	$72	$144	$518	$1,036	Exempt	
Jet	924	693	376	487	754	38	0	1,198	252	129	1,617
Piston	81	73	33	56	65	118	26	0	0	10	154
Turbo	115	92	68	50	89	151	12	25	0	19	207
Helis	379	294	57	129	487	31	7	0	17	618	673
TOTAL	1,499	1,152	534	722	1,395	338	45	1,223	269	776	2,651

Of the 2,651 night operations in 2022, 776 were exempt from the nighttime fee. Medical flights, dominated by the medical evacuation service based at Hanscom, represented 98.7 percent of the exemptions. Exemptions also included operations by military and government aircraft. There were 907 different aircraft that were subject to the nighttime fee. Of those, 54 (6 percent) conducted more than five nighttime operations that were subject to the doubled fee. 56.5 percent of the 11 p.m. to 7 a.m. operations were arrivals; 43.5 percent were departures. 27 percent of the night operations occurred between 6 a.m. and 7 a.m., while 20 percent were between 11 p.m. and midnight. The remaining 53 percent were between midnight and 6 a.m.

Jets conducted the largest number of night operations by a single aircraft category, representing 61 percent of the activity. Helicopters represented 25.4 percent, turboprops represented 7.8 percent and pistons represented 5.8 percent of the night activity.

CHAPTER 6 NOISE EXPOSURE LEVELS AT HANSCOM FIELD

As discussed in Chapter 2, the 1982 HMMH noise study defined a screening metric, referred to as EXP, to use in evaluating changes in noise exposure without resorting to complex noise exposure contours for each application. EXP is the logarithmic sum, in decibels (dB), of the total aircraft noise on an average day for the aircraft that used Hanscom. The departure noise estimate is made for a point on the ground 15,000 feet from brake release for departures. A weighting of 10 dB is applied to operations between 10 p.m. and 7 a.m. to be consistent with the development of DNL noise contours.

6.1 2022 Departure EXP

Noise exposure, represented by the EXP metric, is calculated monthly and annually at Hanscom. As discussed in Section 2.4, EXP version 2d is currently being used to calculate noise exposure. **Table 6.1** presents and compares the monthly departure EXP 2d values, including the effects of SEP aircraft, for 2022. Those portions of the noise attributable to civilian and military aircraft are separated in the table to show the relative contributions of each.

TABLE 6.1 2022 Monthly Variations in Departure EXP

Month	Civilian	Military	Civilian & Military
Jan.	106.5	79.1	106.5
Feb.	107.1	96.1	107.4

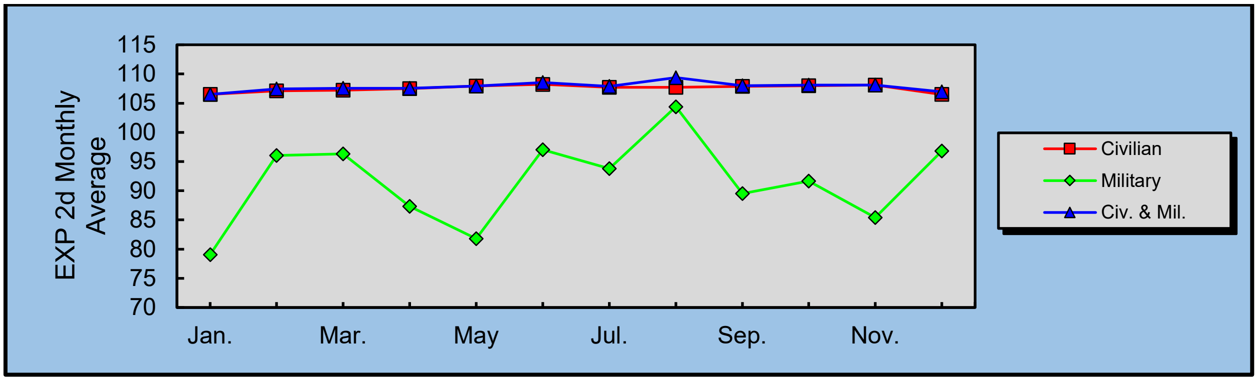
Mar.	107.2	96.3	107.6
Apr.	107.5	87.3	107.6
May	107.9	81.8	107.9
Jun.	108.2	97.0	108.6
Jul.	107.7	93.8	107.9
Aug.	107.7	104.4	109.4
Sep.	107.9	89.5	108.0
Oct.	108.0	91.7	108.1
Nov.	108.1	85.4	108.1
Dec.	106.5	96.8	106.9
2022	**107.6**	**96.2**	**107.9**

Civilian departure EXP 2d for 2022 was 107.6 dB, representing 93 percent of Hanscom's total (civilian and military) departure noise energy. It fluctuated between a low of 106.5 dB in both January and December and a high of 108.2 dB in June. In 2022, the highest period for civilian non-SEP flight activity also occurred in June, as seen in **Table 4.3**. The low for non-SEP aircraft activity was January and December, while corresponding to the lowest noise exposure months. Military EXP shows more variation in departure noise levels than the civilian portion. This is due to the high noise levels of many military aircraft; a few operations by a particularly noisy aircraft can cause EXP to increase significantly. Military aircraft are exempt from the noise abatement measures that are applicable to civilian aircraft and have the highest SEL values of any aircraft that use the airport. Military departure EXP 2d averaged 96.2 dB in 2022, with its lowest level in January and its highest level in August.

In 2022, military aircraft generated 7 percent of Hanscom's total noise energy and represented 1.4 percent of the aircraft activity. Military activity has consistently represented less than two percent of the activity during study years, while its contribution to the noise energy has ranged from 1.8 percent to 47 percent.

The combined civilian and military departure EXP 2d data from **Table 6.1** are plotted in **Figure 6.1,** which demonstrates that military noise levels vary more than the civilian portions. Combined average EXP 2d was 107.9 dB. The highest total (civilian and military) monthly average departure EXP 2d during the year was 109.4 dB in August, which also was the highest civilian EXP during the year. The lowest total departure noise exposure during the year was 106.5 dB in the month of January.

FIGURE 6.1 2022 Monthly Averages in Departure Noise Exposure EXP 2d



Appendix B provides a detailed table of EXP 2d calculations for 2022. It includes the average daily departures and arrivals as well as the departure and arrival SELs for each civilian and military aircraft group. The aircraft types listed for each group are representative of those included in the group, and the partial EXP specifies the noise impact for that group of aircraft. As explained in Chapter 2, changes in departure EXP more closely reflect changes in DNL than do changes in arrival EXP, so this report focuses on civilian departure EXP for primary comparative purposes. However, arrival EXP is also being calculated on a monthly and annual basis and is included in Appendix B. Further discussion and a detailed analysis on the historical changes in Civilian Departure EXP is detailed in Appendix A.

Table 6.2 presents the decibel contribution of several aircraft categories to civilian departure EXP 2d, illustrating the effect of civilian jets. Although civilian jets comprised 30.1 percent of the civilian operations, they had the highest partial departure EXP and represented 74.4 percent of the civilian departure noise energy. This reflects the relatively high SEL values created by jet aircraft. By contrast, single engine piston aircraft comprised 50.5 percent of the civilian activity but contributed only 13.1 percent of the civilian departure noise energy. Each SEPflight has a relatively low SEL but, as a group, SEPs have the second highest partial EXP because of the large number of operations by these aircraft.

TABLE 6.2 Contributions to Civilian Departure EXP for 2022 Operations

Aircraft Category	Partial EXP 2d Contribution to Civilian Departure Noise Exposure
Jets	106.3 dB
Turboprops	89.0 dB
Helicopters	96.9 dB
Twin Engine Pistons	91.5 dB
Single Engine Pistons	98.7 dB
TOTAL CIVILIAN EXP	107.6 dB

CHAPTER 7 HANSCOM FIELD NOISE ABATEMENT POLICIES

The noise levels of the aircraft using Hanscom Field have been influenced by federal and Massport regulations directed at reducing noise exposure for residents both nationally and around Hanscom. Chapter 7 focuses on historical policy and regulatory changes that affect noise at Hanscom Field, as well as the results of those policies on affected communities.

7.1 Historical Perspective

Table 7.1 shows a chronological set of rules governing aircraft noise and emissions at Hanscom Field, many of which also apply to other airports.

Table 7.1 Historical Perspective of Guiding Regulations and Policies for Hanscom Field

Policy/Statute and Year Enacted	Directive
National Environmental Policy Act of 1969	Directed all federal agencies to assess all environmental effects of proposed federal agency actions
Noise Control Act of 1972	Amended the 1968 Act to add the EPA to the rulemaking process for aircraft noise and sonic boom standards. Also added consideration of public health to the NEPA act rules.
14 CFR Part 35 Noise Standards, 1977	Established noise levels and introduced Stage 1, Stage 2 and Stage 3 aircraft types based on noise levels.
Hanscom Field's Master Plan	Guiding document for planning activities at Hanscom Field.
Aviation Safety and Noise Abatement Act of 1979	Directed the FAA to establish a uniform system to measure noise. Introduced identifying appropriate land use compatible with various noise levels
Massachusetts 740 CMR, Subpart F, General Rules for LG Hanscom Field, 1980	Identified Noise abatement operating restrictions, limited Power Unit usage and added a nighttime field use fee as a deterrent for overnight flights
Airport and Airway Improvement Act of 1982	Authorized FAA funding for noise mitigation and compatibility planning projects. Established noise compatibility requirements for FAA-funded airport dvelopment.
Airport Noise and Capacity Act of 1990	Mandated a phase out of Stage 2 jet aircraft over 75,000 pounds and established requirements regarding ariport noise and access restrictions for Stage 2 and Stage 3 aircraft
International Civil Aviation Organization (ICAO) Committee on Aviation Environmental Protection (CAEP), 2004	UN specialized agency developed standards and recommended practices originially in 1983, adopted by the United States in 2004. Standards are aimed at reducing aircraft engine emissions and particulate matter across the globe. CAEP continues to assess and make proposals for improvements today.
Sound Initiative, 2005	Coalition formed to encourage the extension of the 1990 ANCA to phase out Stage 1 and 2 aircraft weighing less than 75,000 pounds.
Touch and Go Program over Minute Man National Historical Park, 2009	Program developed in cooperation with the FAA, Flight Schools and Hanscom staff to measure and reduce touch and go operations over the Park.
CLEEN I Program of 2010	Program developed by the FAA that directed a Public-Private partnership with the goal of developing certifieable aircraft technology to reduce aircraft fuel burn by 33%, Nox emissions by 60%, noise levels by 32 dB and develop alternative renewable aircraft fuels
FAA Modernization and Reform Act, 2012	Included the phase out of <u>all</u> civilian non-stage 3 aircraft by December 31, 2015
CLEEN II Program of 2015	Directed a second phase of emissions reducing development

The FAA first issued noise standards for civil aircraft in 1969, when regulations established that minimum noise performance levels must be demonstrated for new turbojet and transport category large airplane designs. In 1977, more stringent standards were adopted, and Stage 1, 2, and 3 classifications were introduced.

Over the 1980s and 1990s, the FAA also adopted regulations that phased out the use of Stage 1 and 2 aircraft weighing more than 75,000 pounds. However, most jets using Hanscom weigh less than 75,000 pounds, so the impact of those regulations were initially minimal.

In 1980, Massport adopted rules to address some of the noise issues being discussed with the communities around Hanscom. These rules included a phase out of Stage 1 civilian jet operations in aircraft over 12,500 pounds, a fee to discourage 11 p.m. to 7 a.m. activity, and restrictions on touch-and-go operations. The 1981 civilian departure EXP decreased 1.2 dB as compared to 1978, the only previous study year. This initial decrease was followed by an upward trend in civilian departure EXP caused by an overall increase in jet activity resulting from a strong economy.

Between 1988 and 1993, the slowing economy resulted in an overall decrease in civilian departure EXP that was influenced by a decline in business jet operations, including fewer Stage 2 jets. From 1993 through 2000, EXP for civilian departures showed an upward trend caused by annual increases in business jet operations.

Starting in 2000, natural attrition of Stage 2 aircraft, as a result of the Airport Noise and Capacity Act, translated into an overall decline in EXP. The turnover from Stage 2 to Stage 3 aircraft helped counteract the noise generated by the overall increases in business jet activity.

As discussed in Chapter 4, an important influence on jet activity levels is the economy. Predictably, the positive economic trends of the mid-to-late 1980s and again in the mid-1990s and into 2000 resulted in increased business jet activity at Hanscom Field. Helping counteract the noise generated by the increases in jet operations in the 1980s was the phase out of most Stage 1 jets at Hanscom Field, and in the 1990s was turnover from Stage 2 to Stage 3 jets as businesses upgraded their equipment. For jets over 75,000 pounds, the upgrades were required nationally by the year 2000. To meet this mandate, some aircraft operators upgraded to new Stage 3 aircraft while others installed hush kits that reduced the noise footprint of a Stage 2 aircraft and brought it below the Stage 3 noise threshold.

In 2012, Congress passed the FAA Modernization and Reform Act, which included the phase out of all non-stage 3 aircraft by December 31, 2015. This mandatory federal phase out of Stage 2 civilian jets that weigh less than 75,000 pounds facilitated more rapid noise reduction at airports nationally. Stage 2 civilian jets are no longer part of the Hanscom Field jet fleet. An analysis of airport use in 2016 initially identified a handful of stage 2 civilian jet operations; further investigation determined, through inquiries with the aircraft owners and the FAA, that the aircraft in question had been previously modified to meet stage 3 noise level requirements. Therefore, all civilian jets utilizing the Hanscom Field meet stage 3 noise level requirements. Military aircraft are not subject to these regulations.

Massport operates Hanscom as a safe and secure, well-equipped, modern airport that serves the diverse needs of its users and accomplishes its role in the regional transportation system, while being sensitive to the concerns of the surrounding communities. Massport encourages meaningful public participation and expends considerable resources in an attempt to strengthen its relationship with its neighbors. Towards this effort, Massport strives to disseminate accurate information on a timely basis, mitigates environmental impacts whenever and wherever possible, and prepares in-depth environmental studies and/or analyses during its planning and project review processes.

In 2009, Massport began a new initiative to reduce noise over the Minute Man National Historical Park. Most touch-and-go operations circle to the south of the airport, potentially taking the aircraft over areas of the Battle Road Trail that are used by the Park for outdoor programs and interpretive talks. In a partnership with the Park, the FAA, the flight schools and Hanscom pilots, it was determined that small aircraft could increase the use of a tight touch-and-go pattern that keeps the aircraft over the airfield rather than over sensitive park areas. In order to promote awareness of the program, pilots requesting a Hanscom airfield badge are required to view the program description and recommended routes. Promotion posters are placed at the flight schools and FBOs. Strategically placed signage is on the airfield as a last-minute reminder to pilots.

This touch-and-go initiative is one of many efforts to minimize aircraft noise that began over 40 years ago. In 1978, the Massport Board adopted the *Hanscom Field Master Plan and Environmental Impact Statement* (The Master Plan). This official policy statement regarding the future development and management of Hanscom Field was developed by Massport staff in conjunction with the Governor's Hanscom Field Task Force. The Task Force, which represented neighboring towns, airport users, state legislators, public interest groups and other stakeholders, was established to ensure that all concerns were considered in a plan that would guide Massport's operation and maintenance of the airport.

The Task Force Plan's 12 policy statements fall under four broad categories, as shown in **Fig 7.1**

FIGURE 7.1 Hanscom Task Force Policy Categories

Growth
1. The character of the airport
2. Airport activity and runway facilities
3. Certified passenger air carrier operations
4. Passenger commuter operations
5. Cargo operations
6. Airport improvements
7. Aircraft noise
Land use
1. Aviation related land use
2. Other Massport properties
Ground access
1. Ground access
Planning process
1. Hanscom Field Advisory Committee
2. Airport System Planning

One outgrowth of The Master Plan was the formation of the Hanscom Field Advisory Commission (HFAC). Another was the Massport Board's adoption of the 1980 *General Rules and Regulations for Laurence G. Hanscom Field*, which was designed to address noise issues. The rules for Hanscom included phasing out the use of most Stage 1 aircraft, limiting touch-and-go operations to aircraft under 12,500 pounds, limiting touch-and-go activity to the hours of 7 a.m. to 11 p.m., limiting scheduled air carrier passenger service to aircraft with no more than 60 seats, and establishing the nighttime field use fee. It also provided parameters for the use of Ground Power Units and updated the definition of commuter aircraft that had been referenced in The Master Plan.

The Master Plan and the 1980 Rules (available in Massport offices and online) continue to guide Massport for Hanscom related decisions. Massport continues its diligent enforcement of the rules, while actively sharing data, plans, and policies with the aviation and residential communities. Massport staff members participate and present reports at all HFAC meetings and attend Hanscom Area Towns Committee (HATS) meetings.

Massport has also completed a series of environmental studies, which guide staff in planning Hanscom's future and provide the communities with extensive data related to the airport, as follows: a Generic Environmental Impact Report (GEIR) based on 1985 activity levels, a GEIR Update based on 1995 activity levels, an Environmental Status and Planning Report (ESPR) based on 2000 activity levels, an ESPR based on 2005 activity levels, an ESPR based on 2012 activity levels, and an ESPR based on 2017 data. The Secretary of Environmental Affairs found all of these documents to adequately comply with the Massachusetts Environmental Policy Act (MEPA).

The GEIR/ESPR documents include a comprehensive analysis of base year noise levels and look at potential future noise levels assuming a series of future scenarios. These reports are available for review in the Massport offices, the Massport website (http://www.massport.com/massport/about-massport/project-environmental-filings/hanscom-field/), and in the libraries of the four contiguous towns.

From 1998 through 2000, Massport staff worked closely with the Noise Working Group, an outgrowth of the 1995 GEIR Update. The group, which included aviation and residential community members, formed two subgroups, one to develop noise abatement/mitigation recommendations and the other to review and recommend metrics to be used to describe the Hanscom Field noise environment. The recommendations were submitted to Massport in late 2000.

In 2001, Massport began taking steps to implement the task force recommendations.[6] EXP is an example of a metric requested by the Noise Working Group. Massport's implementation of the upgraded noise monitoring system and the publication of the ESPRs was in response to some of the other Noise Working Group requests. Massport began actively encouraging quiet flying techniques in the 1980s. The Noise Working Group's initiatives enhanced those efforts. In 2001, Massport distributed "Fly Friendly" videos to all Hanscom pilots, flight schools, and Fixed Base Operators (FBOs). Massport is now requiring all pilots who receive a Hanscom ID badge to view information detailing Hanscom's noise abatement program and quiet flying techniques. These techniques are also described on Massport's website, on posters that are displayed by the flight schools and Air Traffic Control, as well as on handouts that are available for pilots to include with their airport flight materials. Strategically placed airfield signage serves as a reminder to pilots to utilize quiet flying techniques.

Massport was an active participant in Sound Initiative, an organization spearheaded by general aviation airports that supported federal legislation to phase out Stage 2 aircraft operations in the United States. In 2012, Congress passed the FAA Modernization and Reform Act, which included the phase out of all non-stage 3 aircraft by December 31, 2015. Section 506 of the Act prohibits the operation of jets weighing 75,000 pounds or less that do not comply with Stage 3 noise levels within the 48 contiguous states.

The operation of Hanscom Field assists Massport in meeting its responsibilities to the regional transportation system, to the business community and to the economic viability of the region. At the same time, Massport recognizes the issues that are raised by the surrounding communities and strives to work through HFAC to find mutually acceptable mechanisms to minimize and/or mitigate those issues, while remaining compliant with FAA regulations.

7.2 Community Concerns

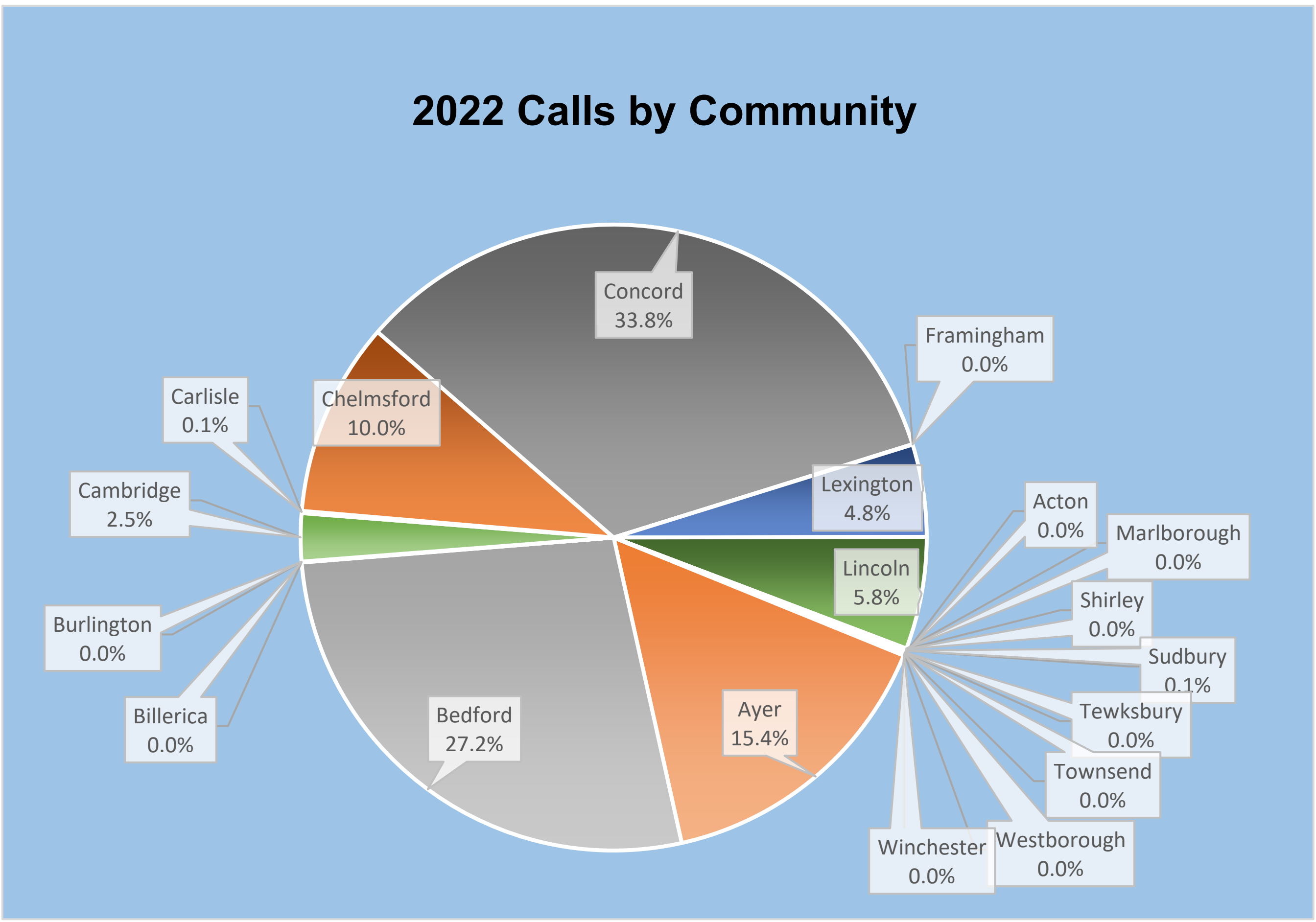
To promote a positive relationship with the community, Massport maintains multiple avenues for community residents to reach out and state concerns they may have with air traffic. Reporting tools for residents include a 24/7 Noise Line to leave a voicemail concern. A Massport employee researches these concerns and responds via email. Massport also maintains a Noise and Operations Monitoring System (NOMS) that includes an internet-based tool for residents to track aircraft operating at and around Hanscom Field. This tracking tool also includes a method to leave a noise concern via the web.

In 2022, 4,409 total "Calls" [7] were made by 85 separate callers, a decrease of 6 percent compared to 4,672 calls in 2021. In **Fig. 7.2** below, an overview of concerns by community that were submitted via any method

6 Some of the recommendations were directed to Hanscom Air Force Base, the Noise Working Group, or the FAA.
7 "Calls" data includes email, web submissions and third party reporting tools as well as phone calls.

shows that 33.8 percent of the Hanscom concerns reported to Massport in 2022 were submitted by residents in the Town of Concord. The Town of Bedford comprised 27.2 percent of the concerns, 5.8 percent were registered from the Town of Lincoln and 4.8 percent from the Town of Lincoln. When comparing 2022 to 2021 for the four contiguous towns abutting Hanscom Field, calls decreased by 4 percent from the Town of Bedford, and by 73 percent from the Town of Lexington. Calls increased 208 percent from the Town of Lincoln and increased 37 percent from the Town of Concord.

Figure 7.2 2022 Calls by Community



CHAPTER 8 NOISE MONITORING SYSTEM

In the late 1980s, Massport and the surrounding communities agreed that a permanent noise monitoring system (NMS) could contribute to a more complete picture of the noise environment around the airport by adding data to the existing EXP metric. In the early 1990s, five noise monitors were installed on and around the airport. A sixth monitor was installed in late 1994. Data for all the monitor sites became available in 1995.

Given the age of Massport's original noise monitoring system and the advancement of technology in this field, in 2004, Massport upgraded its system. In 2019, Massport requested proposals and subsequently selected L3Harris to replace the system's microphones and software again in 2020. New replacement Noise Monitoring Terminals were installed in 2021. An interactive website has been developed for public use and may be accessed here: http://www.massport.com/hanscom-field/about-hanscom/airport-activity-monitor/

The data from the monitors shown in this report are average Day-Night Average Sound Levels (DNL) in A-weighted decibels, both of which are described in Appendix A. These are actual measured levels, so they include military and civilian aircraft as well as community noise.

Table 8.1 shows the readings at the six sites for 2005, 2010, 2015, and 2020 through 2022. Appendix C shows the readings for those years by month. Footnotes in Appendix C identify the number of days included in the data. Appendix C also includes a map showing the locations for the monitors. Data for the years not included in this report can be found in previous annual noise reports, available in Massport's offices.

TABLE 8.1 Measured DNL Levels 2005, 2010, 2015, 2020 – 2022

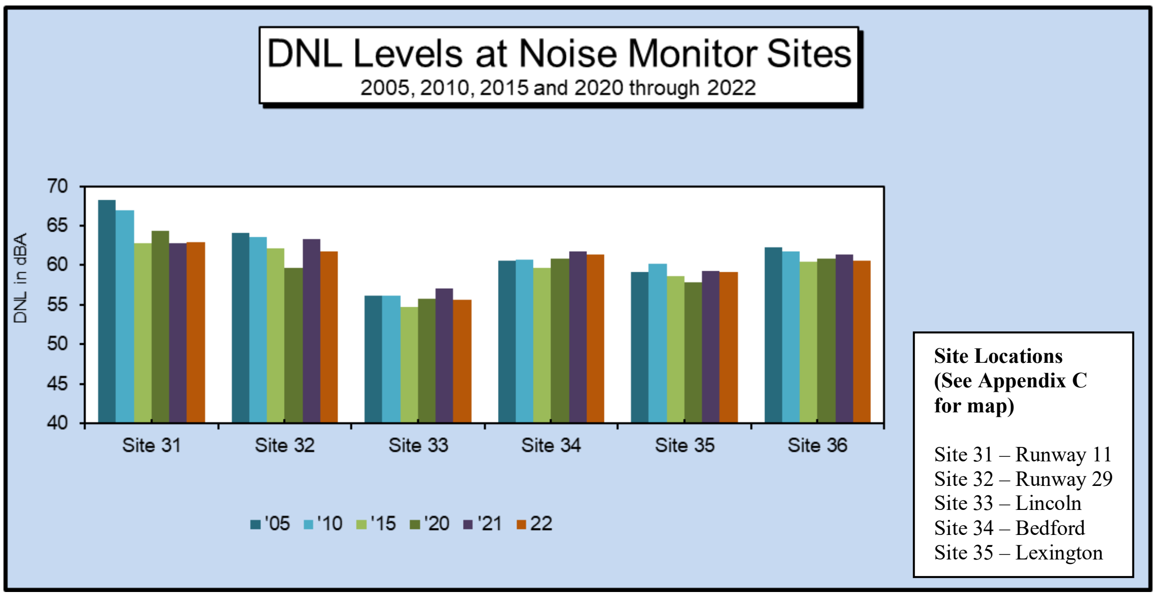
Site No.	2005	2010	2015	2020	2021	2022
31	68.3	66.9	62.8	64.4	62.8	62.9
32	64.1	63.6	62.2	59.7	63.3	61.7
33	56.1	56.1	54.7	55.8	57.1	55.6
34	60.6	60.7	59.7	60.9	61.7	61.4
35	59.2	60.2	58.6	57.9	59.3	59.2
36	62.3	61.8	60.4	60.9	61.4	60.6

A comparison of the 2022 and 2021 annual DNL values shows that in the communities, the changes ranged from an increase of 0.1 dB to a decrease of 1.6 dB. Site 31, which is on airport property, increased 0.1 dB. Site 32, also on the airport, decreased 1.6 dB. Site 33 in Lincoln showed a decrease of 1.5 dB when compared to 2021. Site 34 (Bedford) showed a decrease of 0.3 dB. Site 35 (Lexington), showed a decrease of 0.1 dB and Site 36 (Concord) showed a decrease of 0.8 dB.

The measured changes must be looked at carefully for both aviation and non-aviation influences. Aviation influences include the noise levels generated by specific aircraft and runway use, which determines which monitors are impacted by a particular flight. Military aircraft activity can cause particularly high readings because of the high noise levels of some military aircraft, such as fighter jets. Some months are influenced by military events that result in increased military activity at Hanscom. DNL results also reflect non-aviation noise sources. Construction noise and wildlife activity has resulted in increased readings and damage to microphones in the past. Site 36 is also regularly influenced by noise from the near-by wastewater treatment facility, which produces background noises that contribute to the readings.

The data in **Table 8.1** are plotted in **Figure 8.1**, which demonstrates the fluctuations in measured noise at the six sites for 2005, 2010, 2015, and 2020 through 2022. Sites 31 and 32 typically have the highest readings because they are located on the airport at the ends of the busiest runway, 11/29. Wildlife and construction activity aside, they are typically the least likely to be influenced by community noise.

FIGURE 8.1 Measured DNL Values 2005, 2010, 2015 and 2020 through 2022



A copy of this report is available on file in the Massport offices, and on the Massport website.

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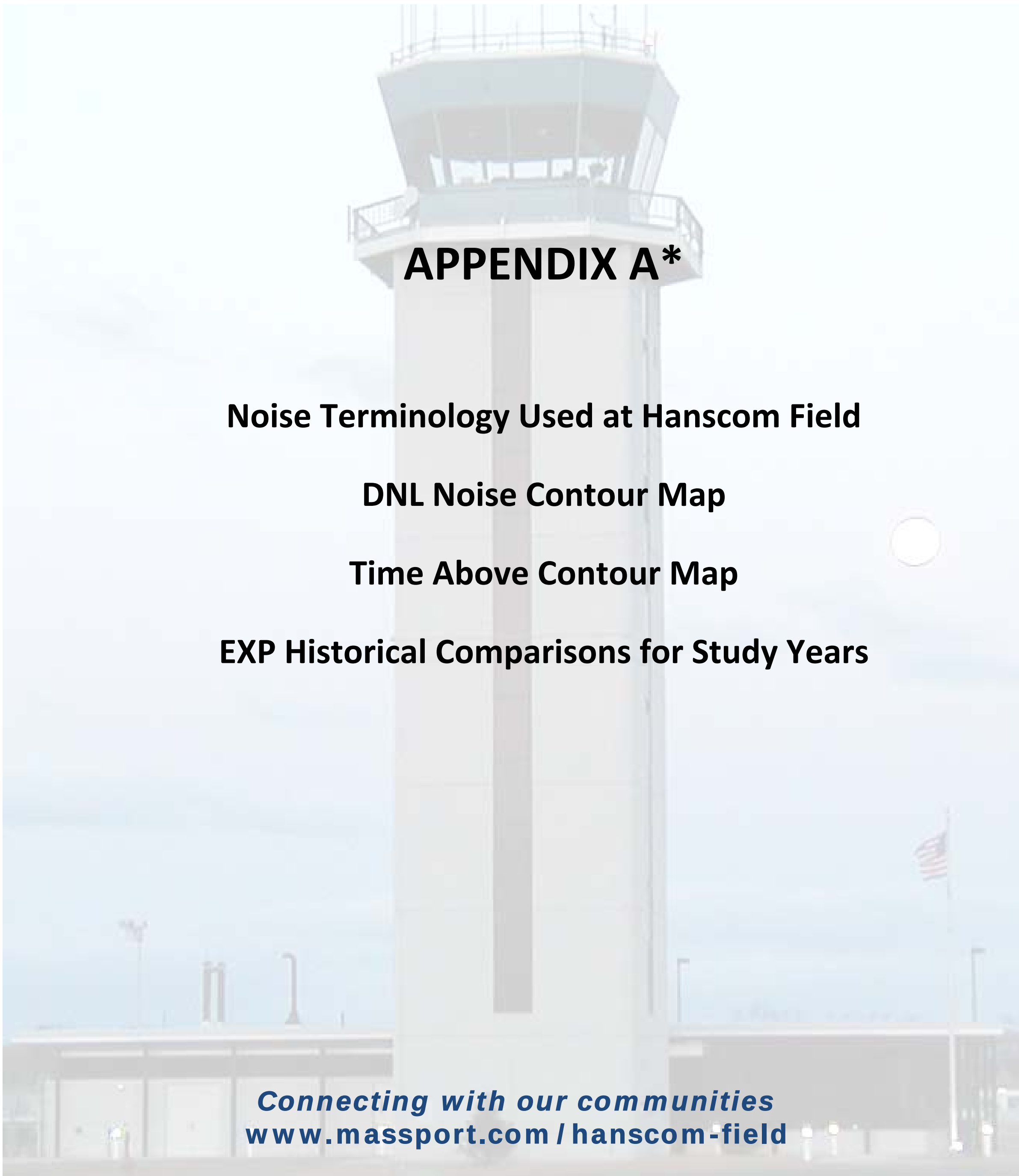


APPENDIX A*

Noise Terminology Used at Hanscom Field

DNL Noise Contour Map

Time Above Contour Map

EXP Historical Comparisons for Study Years

Connecting with our communities
www.massport.com / hanscom-field

* Excerpts from 2017 L.G. Hanscom Field Environmental Status and Planning Report

7.1 Key Findings Since 2012

Overall operations have decreased in at Hanscom Field over the last several years, and operations remain well below historical peaks. Noise also remains well below historical peaks, with the Day-Night Sound Level (DNL) 65 decibel (dB) contour entirely within Hanscom Field property.[90] However, there have been some increases in jet operations and nighttime flights. Forecast increases in general aviation (GA) jet activity contribute to the projected growth in operations to approximately 142,000 annual operations in 2035, driving a modest projected increase in overall noise levels as compared to today. These recent and projected trends align with Hanscom Field's role in New England's regional aviation system as the premier GA reliever for Logan International Airport.

Massport has continued to pursue measures to reduce noise impacts, including an initiative begun in 2009 to reduce noise over the Minute Man National Historical Park (MMNHP). Previously, touch-and-go operations circled to the south of the airport often taking the aircraft over areas of the Battle Road Trail that are used by the Park for outdoor programs and interpretive talks. A partnership of Massport, National Park Service (NPS), the FAA, the flight schools and Hanscom pilots determined that small aircraft could increase the use of a tight touch-and-go pattern that keeps the aircraft over the airfield rather than over sensitive park areas. Using radar data, Massport staff monitors the number of touch-and-go operations over the MMNHP. This data is a critical part of ongoing quarterly meetings between Massport, FAA air traffic control tower, and flight school staff to review touch-and-go flight paths. Since the initiation of this program, flights over MMNHP have been reduced by 22 percent.

Key noise statistics since 2012 analysis:

- **The total population exposed to DNL greater than 65 dB remains at zero in 2017 (from zero in 2012), which is a decrease from 17 in 2005 (which were all in Bedford).**
- **The total population in the four towns exposed to DNL values of 55 dB or greater increased from 1,041 residents in 2012 (down from 2,953 in 2005) to 1,271 in 2017 (see Table 7-1).**
- **In all future scenarios, there are no residents exposed to noise levels exceeding 65 dB DNL.**

Massport's Fly Friendly program at Hanscom Field continues to support quiet arrival and departure procedures, including supporting the use of the National Business Aviation Association's (NBAA's) noise abatement procedures for jet aircraft, publicizing the Aircraft Owners and Pilot Association's (AOPA's) noise abatement procedures for piston aircraft, and by developing and publicizing quiet flying procedures for helicopters. Part of this effort included the development of a multi-faceted publicity program that results in pilots

[90] FAA land use compatibility guidelines generally consider aircraft noise greater than 65 dB DNL to be incompatible with residential and other noise-sensitive land uses. No residential land uses were exposed to a DNL value above the FAA land use compatibility recommendation of 65 dB in 2017.

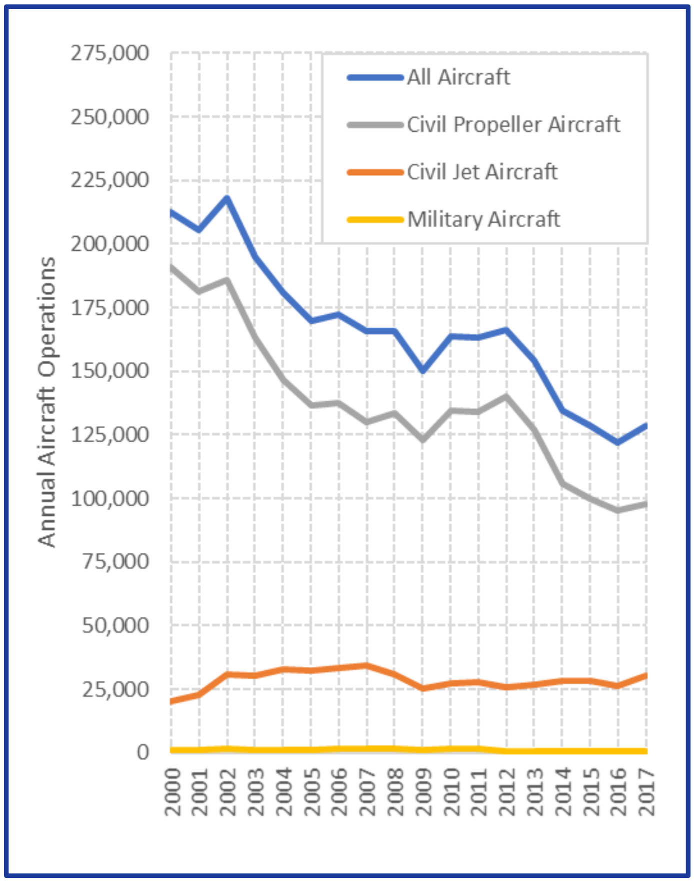
being exposed and re-exposed to the importance and understanding of the quiet-flying techniques (see Section 7.9.7 for additional discussion of the Fly Friendly Program).

The noise analysis for this ESPR utilized the FAA's next-generation airport noise software, the Aviation Environmental Design Tool (AEDT). AEDT combines the FAA's legacy tools for airport noise, emissions, and fuel burn into a single package to ensure consistency across the analyses. The database structure of this new tool allows for the use of a nearly unlimited number of aircraft flight paths and operations to model the full detail of operations at an airport. Several new aircraft types have been added to AEDT relative to the Integrated Noise Model (INM), which was used for the *2012 ESPR*, and some noise and performance computation algorithms have been updated. However, the current AEDT aircraft noise and performance database and algorithms are largely the same as the most recent versions of the INM and the change in noise model had little impact on the differences in computed noise levels between 2012 and 2017.

Comparison of year 2017 DNL noise contours to 2012 contours shows that overall noise levels have increased somewhat. Though total operations decreased between 2012 and 2017 (see Figure 7-1), operations by jet aircraft and the number of nighttime flights increased. The shape of the 2017 noise contours reflect increased operations on Runway 5/23 due to the closure of Runway 11/29 for repaving during the month of August. Additionally, construction at Boston Logan International Airport in 2017 caused some additional aircraft to operate out of Hanscom Field.

Modeled noise values for 2005 are also included in this section and demonstrate a longer-term trend of decreasing noise. This is largely due to overall lower activity levels and the elimination of activity by Stage 2 GA jets. FAA land use compatibility guidelines generally consider aircraft noise greater than 65 dB DNL to be incompatible with residential and other noise-sensitive land uses. No residential land uses were exposed to a DNL value above the FAA land use

Figure 7-1 Historical Aircraft Operations Trends



Source: Massport 2017 Hanscom Annual Noise Report compatibility recommendation of 65 dB in 2017, as the DNL 65 dB contour does not extend beyond Massport property.

With the forecasted level of aircraft operations, noise is anticipated to increase in 2025 over 2017 and then again in 2035. However, noise in 2025 and 2035 is projected to remain lower than what was experienced in 2005.

Table 7-1 presents population estimates within the 65 and 55 DNL contours for 2005, 2012, 2017, and the forecasted 2025 and 2035 scenarios.

Table 7-1 Summary of U.S. Census Population Counts within DNL Contours

Year/Scenario	Population[1]	
	65 dB or Greater[2]	55 dB or Greater[3]
2000	26	2,848
2005	17	2,953
2012	0	1,041
2017	0	1,271
2025	0	1,675
2035	0	2,047

Notes:
1. Based on the 2010 U.S. Census except for 2000 and 2005 which were computed for the *2000 and 2005 ESPRs* using the 2000 U.S. Census
2. These population estimates fall within the 65 and 70 DNL contours.
3. These population estimates include population within the 55, 60, 65, and 70 DNL contours
Source: HMMH 2018

In addition to noise contours, the *2017 ESPR* includes detailed noise results at noise analysis locations throughout the four towns and MMNHP.

- No historic sites were within the 60 DNL contour for the *2012 ESPR* or the *2017 ESPR*. There are only two historic sites that have DNL values greater than 55 dB in 2017 and noise levels decreased at both sites in 2017 relative to 2012:
  - The Deacon John Wheeler/Capt. Jonas Minot Farmhouse (NC-18) in Concord; and,
  - The Wheeler-Meriam House (NC-19) in Concord.
- No noise analysis locations in the four town are predicted to experience a DNL value greater than 60 dB under the 2025 or 2035 scenarios. The Deacon John Wheeler/Capt. Jonas Minot Farmhouse in Concord, the Wheeler-Meriam House in Concord, and Simonds Tavern (NLX-1) in Lexington are the only three sites with a projected DNL of 55 dB or greater in these scenarios.
- No portion of the MMNHP is located within the 60 DNL contour in 2017 or in the forecasted 2025 and 2035 planning scenarios. The 2017 and forecast future 55 DNL contours do extend into MMNHP.

- One site in MMNHP, Noah Brooks Tavern (MM-13) experienced a DNL of 55 dB in 2017 due to higher than typical use of Runway 5/23 during the closure of Runway 11/29 for repaving. Though the 55 dB DNL contours do extend into the park, no identified noise analysis sites in the MMNHP are projected to experience a DNL value of 55 dB or greater for any future scenario.

7.2 Noise Terminology

Noise, often defined as unwanted sound, is an environmental issue associated with aircraft operations. Aircraft are not the only sources of noise in an urban or suburban environment where interstate and local roadway traffic, rail, industrial, and neighborhood sources intrude on the everyday quality of life. Nevertheless, aircraft are readily identified by their noise and are typically singled out for special attention and criticism. Consequently, aircraft noise often dominates analyses of environmental impacts. To help understand and interpret these impacts, it is important to be familiar with the various metrics that are used to describe the noise from an aircraft and from the collection of noise events that comprise an airport noise environment. This introductory section describes those commonly used noise metrics, in increasing complexity.

The *2017 ESPR* reports noise levels at Hanscom Field in terms of these metrics, including SELs for typical individual events, and Time Above contours and DNL contours for typical 24-hour exposure periods. All three of these metrics utilize A-weighted Sound Levels as their basic unit of measurement. The *2017 ESPR* uses the highlighted metrics (i.e., SEL, EXP, and TA) to supplement DNL contours and DNL values at noise analysis locations. Appendix D provides a discussion of the effects of aircraft noise on people.

Commonly used noise metrics include:

- **Decibel (dB);**
- **A-weighted decibel, or sound level (dBA);**
- **Sound Exposure Level (SEL);**
- **Equivalent Sound Level (Leq);**
- **Day-Night Sound Level (DNL);**
- **Total Noise Exposure (EXP);**
- **Time Above (TA).**

7.2.1 The Decibel (dB)

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air, and are sensed by the human ear. Whether that sound is interpreted as pleasant (e.g., music) or unpleasant (e.g., jackhammer) depends largely on the listener's current activity, experience, and attitude toward the source of that sound. It is often true that one person's music is another person's noise.

The loudest sounds the human ear can comfortably hear have one trillion (1,000,000,000,000) times the acoustic energy of sounds the ear can barely detect. Because of this vast range, any attempt to represent the intensity of sound using a linear scale becomes unwieldy. As a result, a logarithmic unit called the decibel is used to represent the intensity of sound. This representation is called Sound Pressure Level.

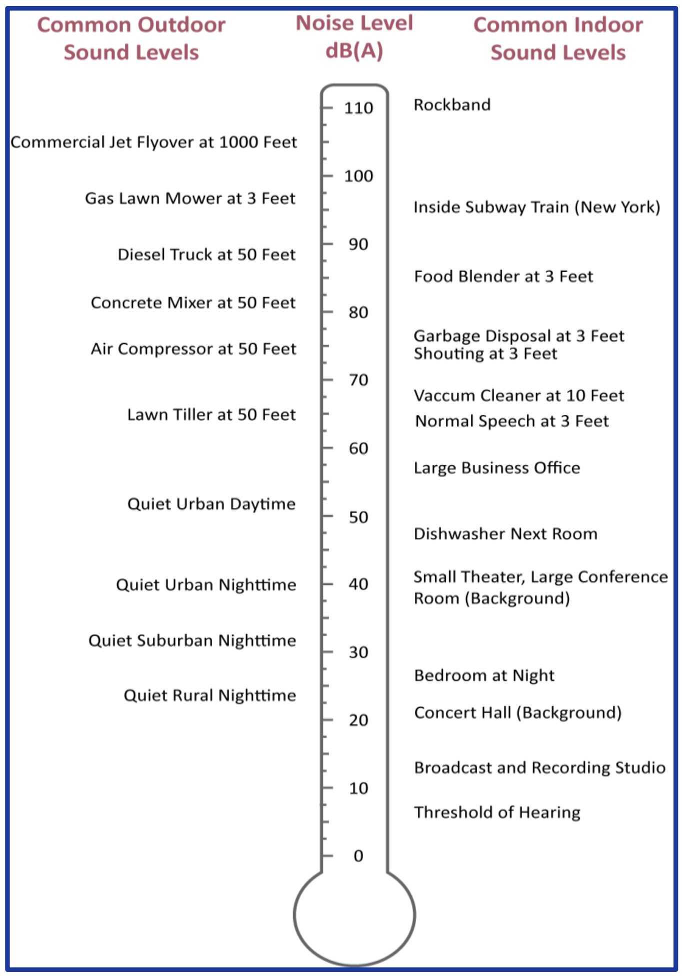
A Sound Pressure Level of less than 10 dB is approximately the threshold of human hearing and is barely audible under extremely quiet conditions. Normal conversational speech has a sound pressure level of approximately 60 to 65 dB. Sound pressure levels above 120 dB begin to be felt inside the human ear as discomfort and eventually pain at still higher levels.

7.2.2 A-Weighted Sound Level (dBA)

Additionally, not all sound pressures are heard equally well by the human ear. Some tones are easier to detect than others are, and are perceived as being louder or noisier. Thus, in measuring community noise, frequency dependence is taken into account by adjusting the very high and very low frequencies to approximate the human ear's reduced sensitivity to those frequencies. This adjustment is called "A-weighting" and is commonly used in measurements of environmental noise.

A-weighted Sound Levels for some common sounds are shown in Figure 7-2. In this document, all Sound Pressure Levels are A-weighted and, as is customary, are referred to simply as "Sound Levels," where the adjective "A-weighted" has been omitted. Sound Levels are designated in terms of A-weighted decibels, abbreviated dBA. With A-weighting, a noise source having a higher Sound Level than another is generally perceived as louder. Also, the minimum change in Sound Level that people can detect outside of a laboratory environment is on the order of 3 dB. A change in Sound Level of 10 dB is usually perceived by

Figure 7-2 Common A-weighted Sound Levels



Source: HMMH, 2016

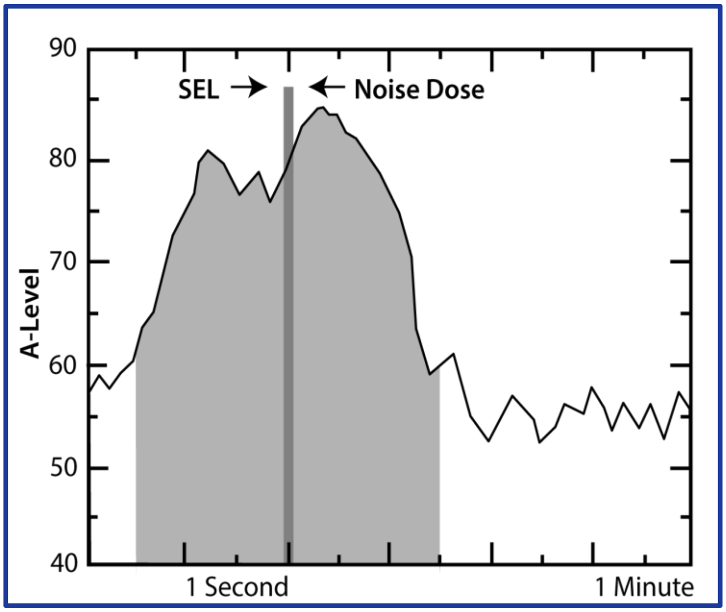
the average person as a doubling (or halving) of the sound's loudness, and this relationship remains so for loud sounds as well as for quieter sounds.

7.2.3 Sound Exposure Level (SEL)

A further complexity in judging the impact of a sound is how long it lasts. Long duration noises are generally more annoying than short ones. The period over which a noise is heard is accounted for in noise measurements and analyses by integrating sound pressures over time. In the case of an individual aircraft flyover, this can be thought of as accounting for the increasing noise of the airplane as it approaches, reaches a maximum, and then falls away to blend into the background (see Figure 7-3). The total noise dose, or exposure, resulting from the time-varying sound is normalized to a one-second duration so that exposures of different durations can be compared on an equal basis. This time-integrated level is known as the Sound Exposure Level, measured in A-weighted decibels.

Because aircraft noise events last longer than one second, the time-integrated SEL always has a value greater in magnitude than the maximum sound level of the event – usually about 7 to 10 dB higher for most airport environments. SELs are used in this study as a means of comparing the noise of several significant aircraft types; they are also correlated with sleep disturbance, an impact that is discussed in Appendix D.

Figure 7-3 Illustration of Sound Exposure Level



Source: HMMH, 2016

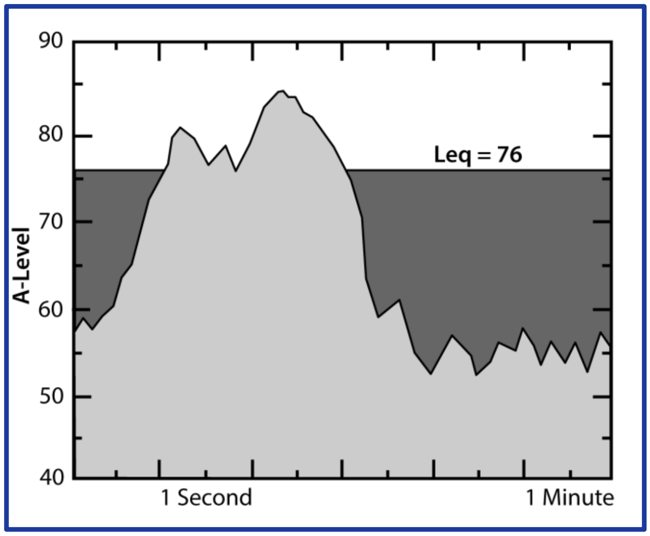
The remaining noise metrics discussed in this section refer to the accumulation of exposure caused by multiple noise events over time. While such metrics are often viewed as downplaying the importance of individual aircraft operations, they are extremely good indicators of community annoyance with complex noise environments, and they have become widely accepted as the most appropriate means of evaluating land use planning decisions.

7.2.4 Equivalent Sound Level (Leq)

The most basic measure of cumulative exposure is the Equivalent Sound Level. It is a measure of exposure resulting from the accumulation of A-weighted Sound Levels over a particular period (as opposed to an event) of interest such as an hour, an eight-hour school day, nighttime, a single 24-hour period, or an average 24-hour period. Because the length of the period can differ, the applicable period should always be identified or clearly understood when discussing the metric. Such durations are often identified through a notation, for example Leq (8) or Leq (24).

Conceptually, the Leq may be thought of as the constant sound level occurring over the designated period of interest and having as much sound energy as that created by the actual rising and falling sound pressures from multiple noise sources as they become more or less pronounced. This is illustrated in Figure 7-4 for the same representative one-minute of exposure shown earlier in Figure 7-3. Both the dark and light gray shaded areas have a one-minute Leq value of 76 dBA. It is important to recognize, however, that the two representations of exposure (the constant one and the time-varying one) would sound very different from each other were they to occur in real life.

Figure 7-4 Illustration of Equivalent Sound Level



Source: HMMH, 2016

Often the Leq is referred to as an "average" sound level. This can be confusing since a simple average of the Sound Levels over the period will not yield the correct Leq. Because decibels are logarithmic quantities, loud events contain much more sound energy than quieter events and dominate the calculation of the Leq. For example, if an aircraft produced a constant sound level of 85 dBA for 30 seconds of a minute then immediately disappeared, leaving only ambient noise sources to produce a level of 45 dBA for the remaining 30 seconds, the Leq for the full minute would be 82 dBA – just 3 dBA below the maximum caused by the aircraft, not the 65 dBA suggested by normal averaging.

More typical timeframes of interest are daytime, nighttime, and annual average 24-hour exposure levels, but all of these same principles of combining sound levels apply to those periods as well. Loud noise events occurring during any timeframe are going to have the greatest influence on the overall exposure for the period.

7.2.5 The Day-Night Sound Level (DNL)

The most widely used cumulative noise metric is a variant of the 24-hour Leq known as the Day-Night Sound Level, or DNL, a measure of noise exposure that is highly correlated with community annoyance. The long-term (yearly) average DNL is also associated with a variety of FAA land use guidelines that suggest where incompatibilities are expected to exist between the noise environment and various human activities. Because of these strengths, the metric is required to be used for airport noise studies funded by the FAA. The FAA's recommended guidelines for noise/land use compatibility evaluation, found in 14 CFR Part 150, are based on a compilation of extensive scientific research and state that DNL values of 65 dB and lower are compatible with all land uses including residential land use.

In simple terms, DNL is the Leq for a 24-hour period, modified so that noises occurring at night (defined specifically as 10:00 PM to 7:00 AM) are artificially increased by 10 dB. This "penalty" reflects the added intrusiveness of nighttime noise events as community activity subsides and ambient noise levels get quieter. The penalty is mathematically equivalent to multiplying the number of nighttime noise events by a factor of ten.

The U.S. Environmental Protection Agency (EPA) identified DNL as the most appropriate means of evaluating airport noise based on its criteria, as follows:[91]

- The measure should be applicable to the evaluation of pervasive long-term noise in various defined areas and under various conditions over long periods of time.
- The measure should correlate well with known effects of the noise environment and on individuals and the public.
- The measure should be simple, practical and accurate. In principal, it should be useful for planning as well as for enforcement or monitoring purposes.
- The required measurement equipment, with standard characteristics, should be commercially available.
- The measure should be closely related to existing methods currently in use.
- The single measure of noise at a given location should be predictable, within an acceptable tolerance, from knowledge of the physical events producing the noise.
- The measure should lend itself to small, simple monitors, which can be left unattended in public areas for long periods of time.

Despite DNL meeting these criteria, the lay public often criticizes the use of DNL as an inaccurate representation of community annoyance and land use compatibility with aircraft noise. Much of that criticism stems from a lack of understanding of the measurement or calculation of DNL. One frequent criticism is based on the feeling that people react more to single noise events than to "meaningless" time-average sound levels. In fact, DNL takes into account both the noise levels of all individual events occurring during a 24-hour period and the number of times those events occur. The logarithmic nature of the decibel causes noise levels of the loudest events to control the 24-hour average, just as they were shown to do in the previous discussion of shorter-term Leqs.

Most federal agencies dealing with noise have formally adopted DNL, though they also encourage the use of supplemental noise metrics to aid the public in understanding the complex noise environment of an airport. For example, Massport frequently uses the SEL,

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[91] U.S. Environmental Protection Agency. September 1974. *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, U.S EPA Report No. 550/9-74-004.

Maximum Sound Level, or Time Above threshold sound levels to help describe the environments around Hanscom Field and Logan International Airport.

Even so, the Federal Interagency Committee on Noise (FICON), comprising of member agencies such as the FAA, Department of Defense (DoD), U.S. EPA, Department of Housing and Urban Development (HUD), National Aeronautics and Space Administration (NASA), Council on Environmental Quality (CEQ), and the Department of Veterans Affairs, reaffirmed the appropriateness of DNL in 1992. The FICON summary report stated, "There are no new descriptors or metrics of sufficient scientific standing to substitute for the present DNL cumulative noise exposure metric".[92] The Federal Interagency Committee on Aviation Noise (FICAN) more recently supported the use of supplemental metrics in its statement that "supplemental metrics provide valuable information that is not easily captured by DNL".[93]

DNL can be measured or estimated. Measurements are practical only for obtaining DNL values for a relatively limited number of points, and, except in the case of a permanently installed noise monitoring system, only for relatively short time periods. The vast majority of airport noise studies are based on computer-generated DNL estimates, depicted in terms of equal-exposure noise contours, much as topographic maps have contours of equal elevation.

7.2.6 Total Noise Exposure (EXP)

The EXP metric was developed in 1982 as a screening tool for Massport to assess changes in the fleet mix of aircraft operating at Hanscom Field over time. Although EXP does not show how noise levels change in specific communities, it does indicate changes in total noise exposure and expected resultant changes in DNL, without the need to prepare noise contours. The 2017 EXP uses the FAA aircraft noise database from the most recent version of the AEDT, Version 2d. This is an upgrade over INM 7.0c, which had been used to compute EXP since the *2012 ESPR*.

EXP is calculated by logarithmically summing the representative SELs for each departure of an airplane assuming it flies over a single point on the ground. EXP uses the same summation formula as DNL: logarithmic summation of all noise events over a 24-hour day, with a 10 dB penalty applied to events occurring between 10:00 PM and 7:00 AM. Similar aircraft types are grouped together in the calculations, creating a "partial EXP" for the group. Partial EXP values for each group are then summed to obtain a single number estimate of departure noise exposure at that reference location. Separate computations are performed for civil and military operations. Similar calculations are performed for arrival operations.

Historically, departure noise has been the largest contributor to the DNL contours and Massport has used civil departure EXP as the annual tracking metric for changes in noise

[92] Federal Interagency Committee on Noise. August 1992. *Federal Agency Review of Selected Airport Noise Analysis Issues*.

[93] Federal Interagency Committee on Aviation Noise. February 2002. *The Use of Supplemental Noise Metrics in Aircraft Noise Analyses*.

exposure at Hanscom Field. Over time, aircraft manufacturers have made significant decreases in aircraft engine noise and thus departure noise levels. Arrival noise has not decreased at the same rate due to its lower proportion of engine noise and higher proportion of airframe noise from deployed flaps, slats, and landing gear. The increased relative importance of arrival noise means that changes in EXP may not align with changes in DNL contours in areas where arrivals provide a large share of the total aircraft noise.

7.2.7 Time Above a Threshold (TA)

Because analyses of decibels are complex and often unfamiliar to the public, the FAA has developed a supplemental noise metric that is non-logarithmic: the amount of time (in minutes or seconds) that the noise source of interest exceeds a given A-weighted Sound Level threshold. Every time a noise event goes above a given threshold, the number of seconds is accumulated and added to any previous periods that the noise exceeded the threshold. These time-above-thresholds, or Time Above, are usually reported for a 24-hour period.

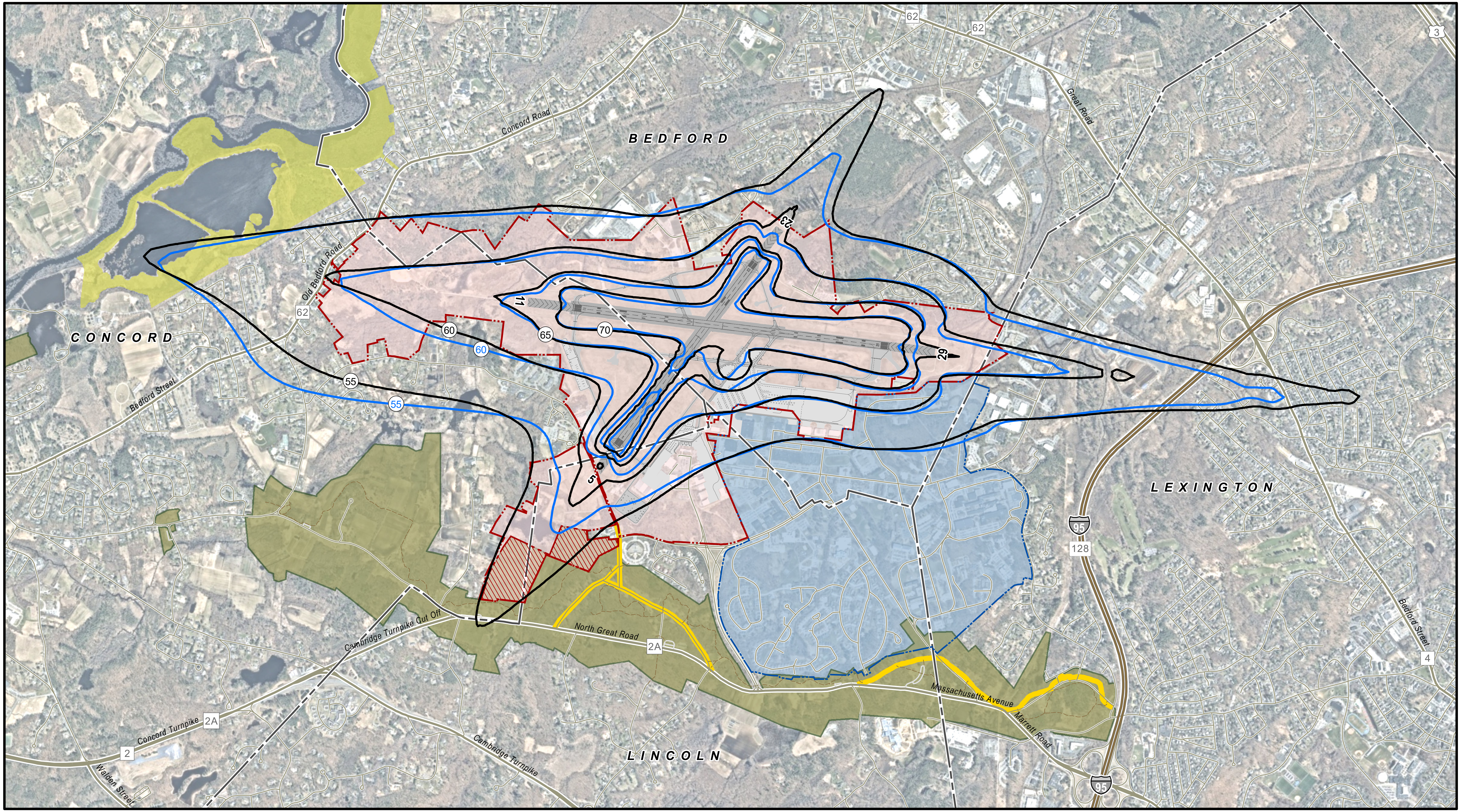
Note that Time Above does not tell the loudness of the various noise events. Just as a single value of the A-weighted Sound Level ignores the dimension of time, so the Time Above ignores the dimension of loudness. Nevertheless, Time Above can be helpful in better understanding a noise environment.

This section documents the noise prediction methodology for preparing the DNL and Time Above calculations for the *2017 ESPR* and discusses changes in the AEDT. The AEDT is a complex computer program that calculates aircraft noise levels around an airport from user input data and an extensive internal database of aircraft noise and performance statistics. Outputs can include DNL and Time Above in the form of contours and values at specific points.

7.3 Noise Prediction Methodology

The FAA developed the AEDT as the primary tool for analyzing and evaluating noise impacts from aircraft operations. Its use is prescribed for all FAA-sponsored projects requiring environmental evaluation. The AEDT contains a set of noise and profile databases, which can be altered by the analyst to enable input of data for new aircraft and engine types, and account for specific changes in flight procedures. The FAA requires that any changes to these databases be approved prior to use on any FAA-related project.

The AEDT interprets all inputs and computes the noise exposure around an airport as a grid of values for many different metrics including the DNL. The grid information is the input for the development of noise contours. This study used the most recent version of the AEDT at the time of analysis, Version 2d (AEDT 2d).



North

0 2,000 4,000 Feet

2017 DNL Noise Contour
2012 DNL Noise Contour
Hanscom Field Property Boundary
Massport Property within MMNHP Congressional Boundary
Hanscom AFB Property Boundary
Municipal Boundary
MMNHP Boundary
Great Meadows
Historic Road
Interstate
Highway
Road
Trail

Data Sources: Massport (ALP) October 24, 2017; MassGIS (Roads, Rail), July 30, 2018; MassGIS (Bike Trails, Tracks and Trails), July 30, 2018; MassGIS (Community Boundaries), July 30, 2018; MassGIS (DEP Wetlands), July 30, 2018; NPS (Park Boundary), July 30, 2018; NPS (Streets and Trails), July 30, 2018; MassGIS (Building Footprints), July 30, 2018; NearMap USA (Aerial) July 30, 2018

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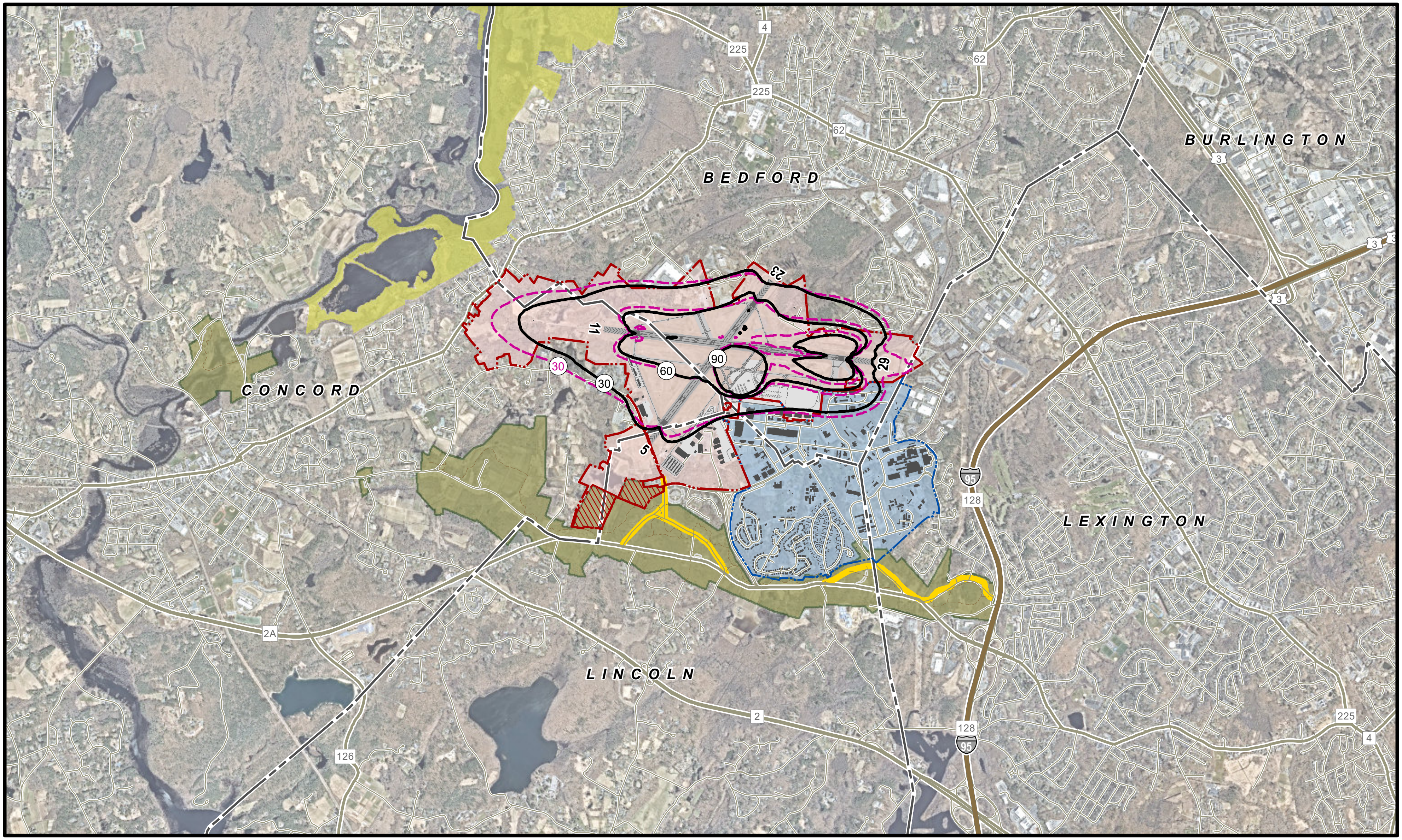
2017 Environmental Status & Planning Report

2012 and 2017 DNL Noise Contour Comparison

Figure 7-10



North

0 2,000 4,000 Feet

Data Sources: Massport (ALP) October 24, 2017; MassGIS (Roads, Rail), July 30, 2018; MassGIS (Bike Trails, Tracks and Trails), July 30, 2018; MassGIS (Community Boundaries), July 30, 2018; MassGIS (DEP Wetlands), July 30, 2018; NPS (Park Boundary), July 30, 2018; NPS (Streets and Trails), July 30, 2018; MassGIS (Building Footprints), July 30, 2018; NearMap USA (Aerial) July 30, 2018

2017 Time Above 65 dBA Contours (Minutes)
2025 Time Above 65 dBA Contours (Minutes)
Hanscom Field Property Boundary
Massport Property within MMNHP Congressional Boundary
Hanscom AFB Property Boundary
Municipal Boundary
Historic Road
Interstate
Highway
Road
MMNHP Boundary
Great Meadows

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2017 Environmental Status & Planning Report

2017 and 2025 Forecast Time Above 65 dBA Contour Comparison

Figure 7-19

EXP Historical Comparisons for Study Years, 1978-2021

Massport has incorporated periodic upgrades of the noise and performance data used to produce EXP. Because the importance of EXP is not in its specific value, but rather in the change in EXP from one year to the next, methods have been developed to incorporate the upgrades while presenting a reasonable representation of the changes in noise levels since 1978.

Table A-1 shows civilian departure EXP for the study years from 1978 through 2001. It also identifies the different EXP versions that were used and the changes in EXP for each year as compared to the base year. Between 1978 and 1987, Noisemap was used to calculate the SEL values for EXP. The findings for the first year and the last year of that timeframe both resulted in 112.5 dB for civilian aircraft departures. This equal noise exposure allowed 1987 to serve as an alternate base year for future comparisons. Applying EXP Version 3.9 to 1987 data showed EXP for civilian departures was 112.0 dB. From 1988 to 1995, EXP 3.9 was calculated, and the difference from 112.0 dB indicated the year-to-year difference from the base year.

TABLE A-1 Civilian Departure EXP Comparisons, 1978-2001

		Annual EXP	Base Year EXP	Difference from Base Year
Noisemap	**1978**	**112.5**	**Original Base Year**	
	1981	**111.3**	112.5	-1.2
	1983	**111.8**	112.5	-0.7
	1984	**112.2**	112.5	-0.3
	1985	**111.9**	112.5	-0.6
	1986	**111.8**	112.5	-0.7
	1987	**112.5**	**112.5**	0.0
Version 3.9	**1987**	**112.0**	**Alternate Base Year**	
	1988	**112.4**	112.0	0.4
	1989	**111.6**	112.0	-0.4
	1990	**110.8**	112.0	-1.2
	1991	**110.7**	112.0	-1.3
	1992	**111.4**	112.0	-0.6
	1993	**110.6**	112.0	-1.4
	1994	**111.4**	112.0	-0.6
	1995	**111.6**	112.0	-0.4
Version 5.1	**1987**	**112.1**	**Alternate Base Year**	
	1996	**112.0**	112.1	-0.1
	1997	**112.3**	112.1	0.2
	1998	**113.1**	112.1	1.0
	1999	**113.0**	112.1	0.9
	2000	**113.4**	112.1	1.3
	2001	**112.5**	112.1	0.4

The 1996 transition to EXP 5.1 was facilitated by re-calculating the 1987 level using EXP 5.1. **Table 6.3** shows the civilian departure EXP 5.1 for 1987 was 112.1 dB, and from 1996 to 2001 the differences between EXP 5.1 for those years and EXP 5.1 for 1987 were calculated. Because 1987 noise levels had been determined to be equal to 1978 levels using the Noisemap version, this allowed for a continued ability to represent the annual change in EXP as compared to 1978.

Past methodologies were not practical for the transition to EXP 6.0c that occurred in 2000. EXP 5.1 was applied to the data for 2000 and 2001 but neither equaled EXP 5.1 in 1987, and there was a risk in assuming that EXP 6.0c SELs, which were developed for 2000 flying procedures and aircraft, could be accurately applied to 15 year-old data. Consequently, it was determined that EXP 5.1 and prior versions would illustrate the changes from 1978 to 2001 while future versions would illustrate changes from 2000 forward.

EXP 6.0c was used to track changes in noise between 2000 and 2005, as seen in **Table A2**. EXP 6.1 was introduced in 2005, and **Table A2** shows civilian departure EXP 6.1 for the year 2000, as well as for the years 2005 through 2012. As discussed in *2005 Noise Exposure Levels at Hanscom Field*, the differences in SEL levels for civilian aircraft groups between EXP version 6.0c and 6.1 were minimal. As a result, the annual civilian departure EXP was not affected by the version that was used. This is demonstrated in **Table A2** by the equal EXP level for 2000, using Versions 6.0c and 6.1 for both years, and again for 2005, using Versions 6.0c and 6.1 for both years. Consequently, it is reasonable to compare the results of either version to the other for the civilian component without further adjustments.

EXP 7.0c was used to track noise changes beginning in 2016. Also 2016 was the first year in which the Stage 3 requirement[1] for all aircraft became effective. As a result, Massport investigated aircraft that were previously recorded in the EXP data management system as being Stage 2. Updates from the FAA showed that the aircraft SEL values in the EXP data management program for those aircraft were not up to date because the aircraft had been either retrofitted with a hushkit or new engines to comply with Stage 3 noise limits. The database correction contributed to the 1.0 dB decrease in EXP calculated between 2016 and 2017.

In 2018, Massport transitioned from using SEL values from FAA's legacy modeling software, the Integrated Noise Model (INM), to SEL values from FAA's next-generation software, AEDT. AEDT is the required model for noise studies seeking FAA approval. While the Massachusetts Environmental Policy Act (MEPA) ESPR process does not require FAA approval, Massport performs the noise analysis to FAA modeling standards.

Changes from version 7.0c to AEDT 2d show a difference between the two versions is 0.1 dB in annual civilian departure EXP. The updated methodology also includes updated SEL values, additional aircraft types, and review of aircraft groupings.

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1 The classifications of Stage 3 and Stage 2 refer to the national regulations for aircraft noise described in Chapter 7

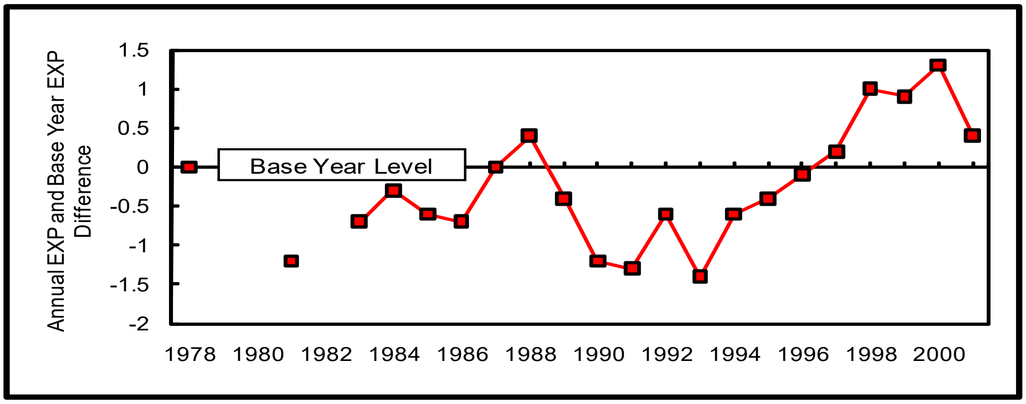
TABLE A-2 Civilian Departure EXP Comparisons, 2000-2022

		Annual Departure EXP	Difference from 2000	Difference from 2001	Difference from Previous Year
Version 5.1	**2000**	**113.4**			
	2001	112.5	-0.9	n/a	-0.9
Version 6.0c	**2000**	**112.3**			
	2001	111.6	-0.7	n/a	-0.7
	2002	112.4	0.1	0.8	0.8
	2003	111.9	-0.4	0.3	-0.5
	2004	111.9	-0.4	0.3	0.0
	2005	111.4	-0.9	-0.2	-0.5
Version 6.1	**2000**	**112.3**			
	2005	111.4	-0.9	-0.2	-0.5
	2006	111.0	-1.3	-0.6	-0.4
	2007	111.3	-1.0	-0.3	0.3
	2008	110.2	-2.1	-1.4	-1.1
	2009	109.2	-3.1	-2.4	-1.0
	2010	109.2	-3.1	-2.4	0.0
	2011	109.1	-3.2	-2.5	-0.1
	2012	108.5	-3.8	-3.1	-0.6
	2013	108.6	-3.7	-3.0	0.1
	2014	108.2	-4.1	-3.4	-0.4
	2015	108.0	-4.3	-3.6	-0.2
	2016	107.8	-4.5	-3.8	-0.2
Version 7.0c	**2016**	**106.8**	-5.5	-4.8	-1.2
	2017	107.0	-5.3	-4.6	0.2
	2018	107.1	-5.2	-4.5	0.1
AEDT Version 2d	**2018**	**107.0**	-5.3	-4.6	-0.1
	2019	107.3	-5.0	-4.3	0.3
	2020	105.8	-6.5	-5.8	-1.5
	2021	107.2	-5.1	-4.4	1.4
	2022	107.6	-4.8	-4.1	0.3

Because the upgrades in FAA noise data that are used to generate EXP make it difficult to make a direct comparison of current noise levels to the 1978 noise experience, it has been determined that identifying a range to represent the increase or decrease in civilian departure EXP is a reasonable alternative. **Table 6.3** shows a 0.4 dB increase in noise between 1978 and 2001, and **Table A2** shows a 4.1 dB decrease in noise between 2001 and 2022, implying that civilian departure EXP for 2020 is 6.5 dB less than 1978. Alternatively, **Table A1** shows a 1.3 dB increase in noise between 1978 and 2000, and **Table A2** shows a 5.1 dB decrease between 2000 and 2022, implying that civilian departure EXP for 2022 is 4.4 dB less than 1978. In other words, 2022 civilian departure EXP ranges from 2.8 to 4.4 dB less than the noise exposure in 1978.

The EXP differences from the base year for the study years 1978 through 2001 shown in **Table A2** are plotted in **Figure A2** to demonstrate the way EXP changed through 2001. **Figure A2** illustrates a decrease in civilian departure EXP between 1978 and 1981, a subsequent general upward trend through 1988, a decline in the early 1990s, followed by a consistent increase from 1993 through 1998. From 1998 to 2001, EXP fluctuated at levels between 0.4 dB and 1.3 dB above the 1978 base year. **Figure A2** also demonstrates that 2000 was the study year with the highest civilian departure EXP, while 1993 was the lowest of those study years.

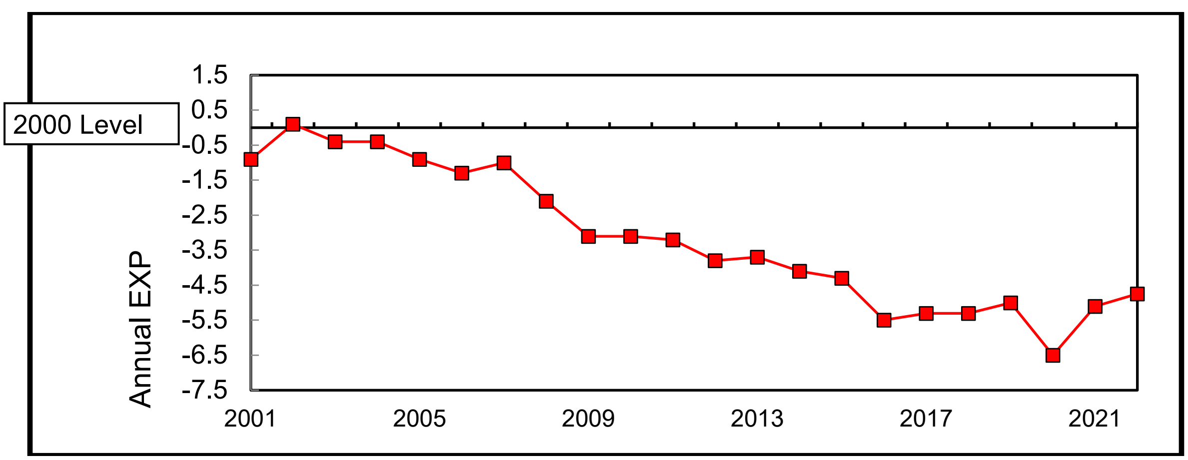
FIGURE A-2 Differences Between Civilian Departure EXP for Study Years 1978-2001



Note: 1979, 1980 and 1982 data unavailable

The EXP differences from 2000 for the study years 2001 through 2022, as shown in **Table A3,** are plotted in **Figure A3** to demonstrate the way EXP has changed since 2000. As in **Figure A2, Figure A3** illustrates the decrease in EXP between 2000 and 2001 as the negative value for 2001. It also shows an increase from 2001 to 2002, when 2002's EXP value exceeded 2000's EXP value by a tenth of a decibel, making 2002 the study year with the highest civilian departure EXP in the past twenty years. Since 2002, there has been a general decrease in civilian departure noise exposure, leveling off in recent years.

FIGURE A3 Differences Between Civilian Departure EXP for Study Years 2000-2022



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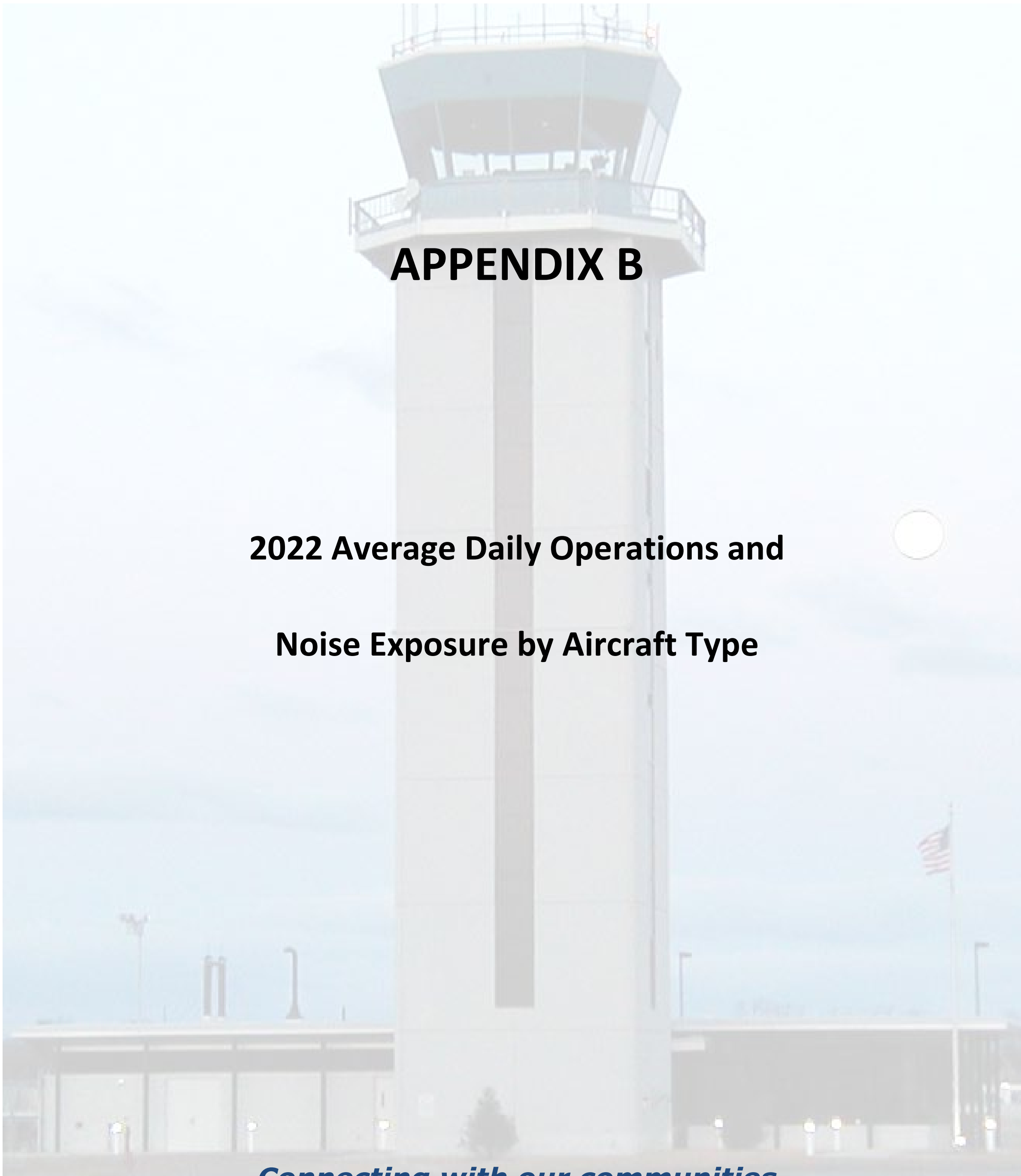

APPENDIX B

2022 Average Daily Operations and

Noise Exposure by Aircraft Type

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AVERAGE DAILY DEPARTURES, ARRIVALS, AND EXP 2d FOR 2022

Aircraft Group	Representative Types	Reference Dep. SEL: 15,000 ft. from Brake Release (in dB)	DEPARTURES Day	Night 10pm-7am	Total	Departure EXP 2d	Reference Arr. SEL: 8,000 ft from Landing Threshold (in dB)	ARRIVALS Day	Night 10pm-7am	Total	Arrival EXP 2d
1	C525, C500	87.10	2.36	0.20	2.56	93.47	85.50	2.31	0.25	2.56	92.34
2	C560	89.00	1.44	0.04	1.48	91.62	86.60	1.44	0.05	1.49	89.33
2M	UC-35 (MILITARY)	89.00	0.01	0.00	0.01	68.15	86.60	0.01	0.00	0.01	65.75
3	LJ35, LJ45, H25B, H25C	91.10	6.74	0.46	7.20	101.64	88.20	6.56	0.64	7.20	99.32
3M	C-21 (MILITARY)	91.10	0.03	0.00	0.03	76.27	88.20	0.03	0.00	0.03	73.37
4	DA02	95.50	0.00	0.00	0.00	0.00	98.90	0.00	0.00	0.00	0.00
4M	HU25 (MILITARY)	95.50	0.00	0.00	0.00	0.00	98.90	0.00	0.00	0.00	0.00
5	LJ25, LJ24, H25A	104.90	0.08	0.00	0.08	95.19	99.80	0.08	0.00	0.08	90.09
5M	T- 37, T -38 (MILITARY)	104.90	0.04	0.00	0.04	90.74	99.80	0.04	0.00	0.04	85.64
6	BAC-111	96.10	0.00	0.00	0.00	0.00	99.90	0.00	0.00	0.00	0.00
7	GLF3	81.80	0.02	0.00	0.02	68.48	88.20	0.02	0.00	0.02	74.88
7M	GLF3 (MILITARY)	81.80	0.00	0.00	0.00	0.00	88.20	0.00	0.00	0.00	0.00
8	GLF4	81.80	3.46	0.15	3.61	88.74	88.20	3.34	0.27	3.61	96.02
8M	C20B, GLF4 (MILITARY)	81.80	0.00	0.00	0.00	0.00	88.20	0.00	0.00	0.00	0.00
9	CL60, FT2H, GALX	86.60	6.75	0.26	7.01	96.31	87.60	6.52	0.49	7.01	98.17
10	CL61, CL30, CARJ	84.30	0.98	0.06	1.04	86.30	88.40	0.91	0.13	1.04	91.82
11	Unknown/Misc. Jets (G.A.)	95.80	0.09	0.01	0.10	87.42	88.70	0.08	0.01	0.09	81.59
11M	Unknown/Misc. Jets (MILITARY)	100.20	0.00	0.00	0.00	0.00	92.20	0.00	0.00	0.00	0.00
14	DC-9	94.60	0.00	0.01	0.01	81.99	92.30	0.01	0.00	0.01	69.69
14M	C9, T-43 (MILITARY)	99.20	0.01	0.00	0.01	76.59	94.20	0.01	0.00	0.01	71.59
15M	C-5A, KC-135, C137 (MIL)	103.50	0.02	0.00	0.02	85.66	107.80	0.02	0.00	0.02	89.96
17	HELICOPTERS (G.A.)	83.50	13.32	0.85	14.17	96.89	87.90	13.00	1.18	14.18	101.83
17M	HELICOPTERS (MIL)	89.40	0.11	0.00	0.11	79.80	89.20	0.11	0.00	0.11	79.60
18	G159, HVY TURBOS	92.50	0.03	0.00	0.03	76.88	95.80	0.03	0.00	0.03	80.18
18M	C130 - P3 (MIL)	92.50	0.07	0.00	0.07	80.86	95.80	0.07	0.00	0.07	85.49
19	C441, TWIN TURBOS	75.30	0.45	0.00	0.45	72.08	84.10	0.45	0.00	0.45	80.88
19M	C12 (MIL TURBOS)	75.30	0.02	0.00	0.02	59.22	84.10	0.02	0.00	0.02	68.02
20	TWIN PISTON	82.70	6.61	0.10	6.71	91.52	85.90	6.57	0.13	6.70	94.90
20M	TWIN PISTON (MIL)	82.70	0.00	0.00	0.00	0.00	85.90	0.00	0.00	0.00	0.00
21	SINGLES - INC. LOCALS	78.90	91.51	0.43	91.94	98.72	81.90	91.16	0.79	91.95	101.86
21M	SINGLES (MIL)	78.90	1.31	0.00	1.31	80.16	81.90	1.30	0.01	1.31	83.40
22	ASTR, G150, G280	90.80	1.20	0.10	1.30	94.14	84.80	1.19	0.11	1.30	88.33
24M	A-10, EA6, F-16 (MIL)	116.00	0.01	0.00	0.01	93.39	93.40	0.01	0.00	0.01	70.79
25	C650	88.60	0.18	0.01	0.19	82.32	84.90	0.18	0.01	0.19	79.05
26	F900, FA50, FA7X	81.70	4.24	0.16	4.40	89.38	92.30	4.13	0.28	4.41	100.70
28M	DC3 (MILITARY)	94.80	0.00	0.00	0.00	0.00	98.10	0.00	0.00	0.00	0.00
29	B190, E120, D238	76.50	0.07	0.01	0.08	69.01	89.60	0.08	0.00	0.08	79.77
30	SF34	77.30	0.07	0.00	0.07	65.83	86.20	0.07	0.00	0.07	74.73
32	B727 ST3	103.40	0.00	0.00	0.00	77.78	97.00	0.00	0.00	0.00	71.38
33	BE20, BE30, DHC6, SW	82.10	3.06	0.14	3.20	88.56	93.50	3.03	0.17	3.20	100.20
34	B737 (Hushkit)	95.50	0.01	0.00	0.01	74.65	93.80	0.01	0.00	0.01	72.95
35	DH8	70.70	0.03	0.00	0.03	55.87	82.80	0.03	0.00	0.03	67.97
36	A319, A320, A321	86.90	0.09	0.04	0.13	83.68	93.10	0.09	0.04	0.13	89.88
37	GLF5, GLF6	86.20	2.60	0.22	2.82	93.03	88.70	2.53	0.29	2.82	96.05
37M	C37, GLF5 (MIL)	86.20	0.01	0.00	0.01	65.35	88.70	0.01	0.00	0.01	67.85
39	GLF2	97.10	0.06	0.00	0.06	85.09	92.70	0.06	0.00	0.06	80.69
40	C750, GALX, HA4T, J32	81.70	2.86	0.09	2.95	87.52	92.30	2.79	0.16	2.95	98.82
41	B737	89.50	0.54	0.14	0.68	92.50	94.40	0.49	0.20	0.69	98.27
42	B757	88.20	0.12	0.07	0.19	87.55	93.40	0.12	0.08	0.20	92.99
43	E55P, C550, PRM1	83.00	4.02	0.10	4.12	90.00	90.00	3.94	0.19	4.13	97.61
44	C56X	81.40	4.68	0.09	4.77	88.85	91.20	4.56	0.21	4.77	99.44
45	BE40, MU30	91.70	1.19	0.03	1.22	93.53	87.10	1.20	0.03	1.23	88.86
46	C680	84.60	2.80	0.06	2.86	89.89	88.20	2.73	0.14	2.87	94.29
47	E135, E145	79.70	0.27	0.02	0.29	76.12	89.30	0.28	0.01	0.29	84.92
48	BD70, GL5T, GLEX	78.90	2.28	0.15	2.43	84.75	90.10	2.22	0.22	2.44	96.52
49	C510, E500, E50P	82.90	0.10	0.00	0.10	73.90	85.70	0.10	0.00	0.10	75.76
50	EA50	74.50	0.25	0.01	0.26	69.70	79.00	0.24	0.02	0.26	75.08
TOTALS											
	CIVILIAN W/O SINGLES		73.09	3.58	76.67	106.94		71.39	5.29	76.68	110.43
	CIVILIAN W/SINGLES		164.60	4.01	168.61	107.55		162.54	6.08	168.62	111.00
	MILITARY		1.63	0.00	1.63	96.19		1.62	0.01	1.63	93.19
	TOTAL W/O SINGLES		73.41	3.58	76.99	107.28		71.70	5.29	76.99	110.50
	TOTAL W/SINGLES		166.23	4.01	170.24	107.85		164.16	6.09	170.25	111.07

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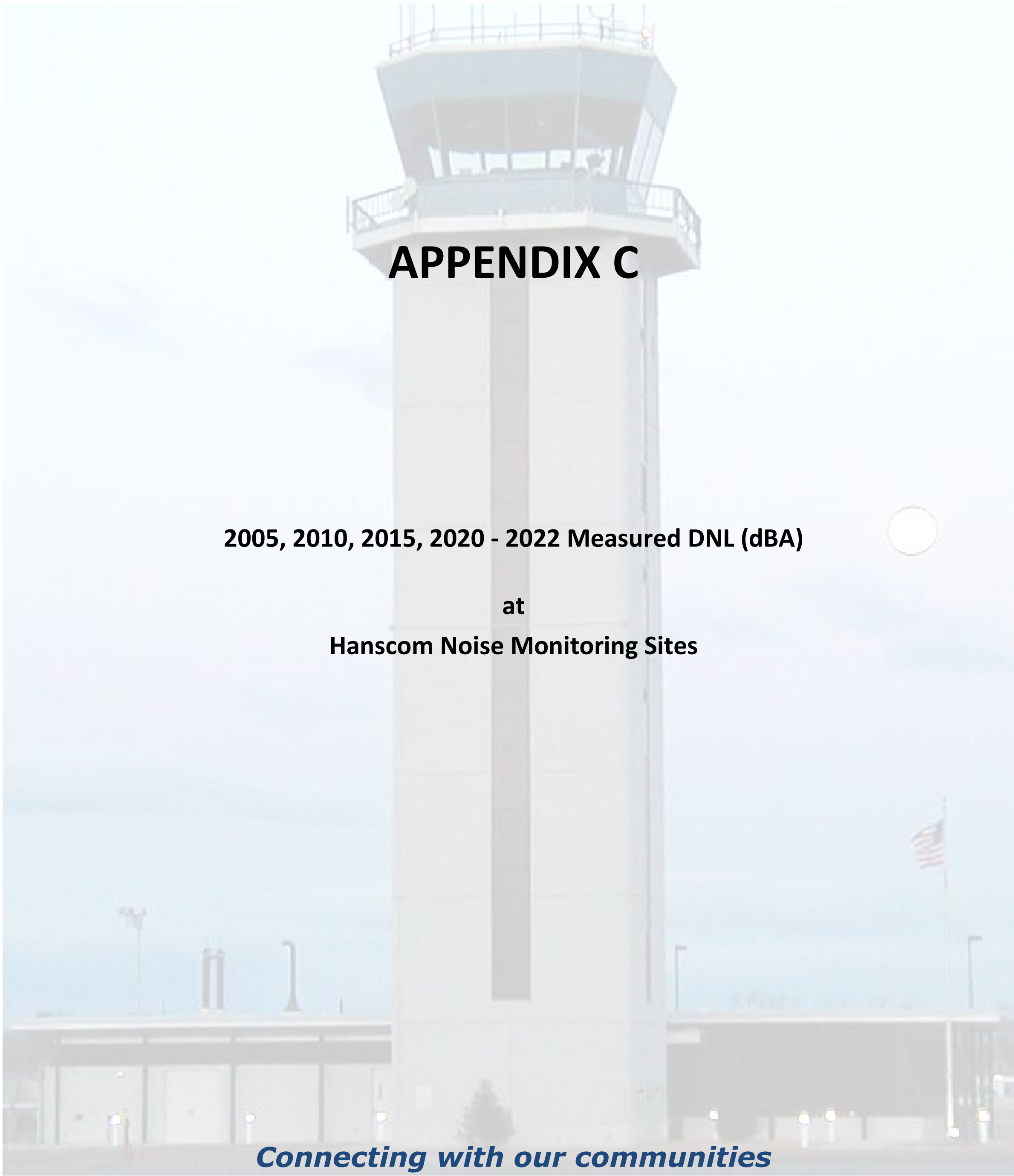

APPENDIX C

2005, 2010, 2015, 2020 - 2022 Measured DNL (dBA)

at

Hanscom Noise Monitoring Sites

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APPENDIX C

2005, 2010, 2015, 2020-2022 Measured DNL (dBA) at Hanscom Noise Monitoring Sites

RMS ID	Location Description	Jan '05	Feb '05	Mar '05*	Apr '05**	May '05	Jun '05	Jul '05	Aug '05	Sep '05	Oct '05***	Nov '05***	Dec '05***	2005
31	Concord Localizer	65.7	63.5	64.3	68.4	66.2	64.9	63.1	67.2	67.0	70.7	70.4	73.6	68.3
32	Bedford Localizer	63.8	60.9	64.4	65.4	64.9	66.4	61.9	62.2	64.4	64.1	62.9	62.9	64.1
33	Lincoln--Brooks Rd	53.6	53.3	54.2	55.2	56.9	55.0	55.5	60.2	57.9	55.8	56.0	54.2	56.1
34	Bedford--DeAngelo	59.5	59.4	58.8	60.2	62.1	59.8	60.3	62.3	60.6	61.2	62.4	58.7	60.6
35	Lexington--Preston	58.7	57.3	58.5	59.0	57.9	59.1	57.8	60.4	59.9	60.6	60.2	60.5	59.2
36	Concord Wastewater	61.7	61.9	62.6	64.0	62.2	61.6	60.1	62.0	61.6	63.0	62.3	63.2	62.3

*Site 35 was not operational March 4-16, 2005 due to power issues
** Military aircraft operated for Red Sox Opening Day
***Construction noise (demolition and reconstruction) from Hartwell Rd., Bedford, impacted Site 31

RMS ID	Location Description	Jan '10	Feb '10	Mar '10	Apr '10**	May '10	Jun '10***	Jul '10	Aug '10****	Sep '10	Oct '10	Nov '10	Dec '10	2010
31	Concord Localizer	62.4	62.0	65.7	68.7	65.8	67.5	64.1	71.5	67.0	67.3	66.9	64.1	66.9
32	Bedford Localizer	65.0	62.2	64.6	62.9	63.2	63.1	61.8	62.5	61.8	64.8	63.7	65.1	63.6
33	Lincoln--Brooks Rd	54.5	55.2	57.3	55.9	56.4	57.5	57.1	55.4	55.1	55.7	55.7	56.1	56.1
34	Bedford--DeAngelo*	n/a	n/a	n/a	n/a	n/a	60.4	60.9	60.9	60.6	60.7	61.3	59.7	60.7
35	Lexington--Preston	60.0	59.1	60.5	60.9	60.5	60.4	59.3	59.7	58.8	60.3	60.6	61.0	60.2
36	Concord Wastewater	61.2	61.1	63.5	63.1	62.3	62.8	61.7	61.4	61.2	61.3	60.6	60.7	61.8

* Monitor equipment hit by a truck April 09; site evaluation needed before reinstalling Bedford site.
** Military fighter jets operated for Red Sox Opening Day on April 11 and Marine Week at the end of April
*** Site 34 reinstalled, operational 6/27-6/30
**** Site 31 nearby construction by FAA

RMS ID	Location Description	Jan '15	Feb '15	Mar '15	Apr '15	May '15	Jun '15	Jul '15	Aug '15	Sep '15	Oct '15	Nov '15	Dec '15	2015
31	Concord Localizer	62.4	60.0	63.5	63.7	64.0	64.4	63.0	63.1	62.3	63.6	61.6	61.9	62.8
32	Bedford Localizer	63.3	62.3	63.9	63.6	62.6	63.4	62.1	61.6	62.2	61.3	60.6	60.6	62.2
33	Lincoln--Brooks Rd	54.6	51.9	51.9	55.1	56.3	56.6	55.2	55.3	55.8	55.2	55.2	54.9	54.7
34	Bedford--DeAngelo	57.7	60.2	56.6	59.0	59.3	60.2	60.4	60.6	60.1	61.3	60.6	57.9	59.7
35	Lexington--Preston	58.7	57.7	58.1	58.5	58.3	57.4	57.6	58.3	60.0	58.9	60.4	58.0	58.6
36	Concord Wastewater	60.5	55.2	61.1	62.4	61.3	61.3	57.6	60.6	60.7	60.4	60.1	60.1	60.4

* Site 33 was not operational January 9-12, February 16-28 & March 1-2, but data was later recovered.
** Site 35 was not operational November 25.
***Site 31 was affected by wildlife activity in May and June

RMS ID	Location Description	Jan '20	Feb '20	Mar '20	Apr '20	May '20	Jun '20	Jul '20	Aug '20	Sep '20	Oct '20	Nov '20	Dec '20	2020
31	Concord Localizer	62.7	63.3	60.6	59.2	60.1	66.2	63.9	62.7	62.5	66.9	69.2	57.8	64.4
32	Bedford Localizer	61.0	61.6	57.0	58.8	59.1	58.9	59.5	60.2	60.5	60.4	59.6	60.4	59.7
33	Lincoln--Brooks Rd	55.7	54.9	54.4	55.0	53.5	56.6	55.7	58.7	57.2	54.7	55.0	55.3	55.8
34	Bedford--DeAngelo	59.7	60.3	60.4	60.6	60.5	60.9	61.5	61.3	61.5	60.9	61.8	58.3	60.9
35	Lexington--Preston	58.2	57.7	56.8	57.8	56.4	56.6	56.3	57.9	58.5	58.7	60.1	57.7	57.9
36	Concord Wastewater	60.1	60.2	59.8	60.7	61.0	59.9	59.4	60.8	63.7	61.7	60.3	61.2	60.9

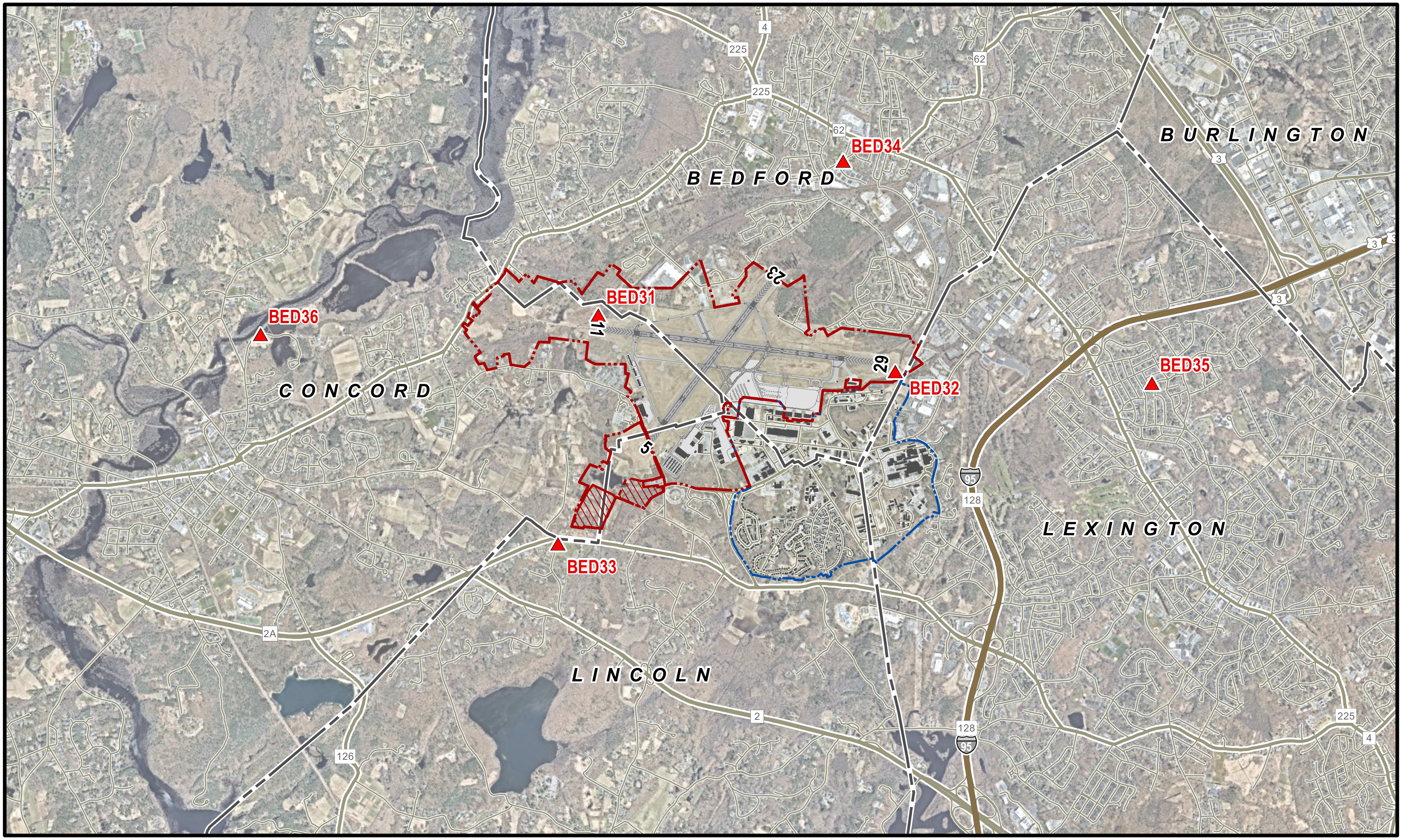
*Site 31 was affected by a damaged windscreen November through December
*Site 34 had a defective power cable in December

RMS ID	Location Description	Jan '21	Feb '21	Mar '21	Apr '21	May '21	Jun '21	Jul '21	Aug '21	Sep '21	Oct '21	Nov '21	Dec '21	2021
31	Concord Localizer	60.5	59.9	63.1	62.1	63.2	68.1	63.3	63.9	63.7	63.8	67.1	62.2	62.8
32	Bedford Localizer	61.6	61.8	70.3	60.6	-	59.7	61.5	61.8	62.2	62.5	62.2	61.7	63.3
33	Lincoln--Brooks Rd	53.8	51.9	59.3	54.9	55.0	57.3	56.4	62.2	57.9	56.0	56.0	54.6	57.1
34	Bedford--DeAngelo	59.1	59.1	61.0	61.7	61.4	62.3	62.1	62.9	63.0	62.3	62.6	61.5	61.7
35	Lexington--Preston	61.4	56.9	58.9	58.8	58.9	59.6	56.1	58.6	59.9	59.9	60.5	59.2	59.3
36	Concord Wastewater	61.1	59.7	61.7	60.3	61.3	60.8	62.0	62.1	63.6	61.8	61.2	60.4	61.4

Site 32 was affected by a dmaged windscreen March & April, then was out of service April through June
Site 34 had a loose power cable January through February 2
Site 35 lost power supply July 16 & 19-29
All sites were replaced in July & August

RMS ID	Location Description	Jan '22	Feb '22	Mar '22	Apr '22	May '22	Jun '22	Jul '22	Aug '22	Sep '22	Oct '22	Nov '22	Dec '22	2022
31	Concord Localizer	61.1	62.0	63.7	62.8	62.8	64.9	61.9	62.6	62.7	63.6	62.3	63.2	62.9
32	Bedford Localizer	60.7	61.3	63.3	61.8	61.8	62.6	59.2	62.5	62.4	62.1	60.4	61.0	61.7
33	Lincoln--Brooks Rd	53.6	54.5	54.3	55.7	56.2	56.0	55.3	57.5	56.2	55.7	55.7	55.5	55.6
34	Bedford--DeAngelo	61.2	61.0	60.8	61.4	62.8	61.4	61.6	62.0	60.9	60.9	61.4	60.6	61.4
35	Lexington--Preston	58.3	58.7	58.6	59.5	58.4	58.9	58.2	58.9	59.9	59.6	61.2	59.3	59.2
36	Concord Wastewater	59.5	59.7	60.5	60.5	60.3	60.2	60.1	61.5	62.5	60.1	59.3	61.9	60.6

Sites were down for calibration on April 16 & December 4, 2022



North

0 2,000 4,000 Feet

Noise Monitoring Locaitons

Hanscom Field Property Boundary

Massport Property within MMNHP Congressional Boundary

Hanscom AFB Property Boundary

Municipal Boundary

Interstate

Highway

Road

massport

L. G. Hanscom Field

2017 Environmental Status & Planning Report

Noise Monitoring Locations

Data Sources: Massport (ALP) October 24, 2017; MassGIS (Roads, Rail), July 30, 2018; MassGIS (Bike Trails, Tracks and Trails), July 30, 2018; MassGIS (Community Boundaries), July 30, 2018; NearMap USA (Aerial) July 30, 2018

Figure **7-11**