Long Island North Shore Helicopter Route Environmental Study

This report presents the results of the noise and emissions analysis of helicopter operations along the North Shore Helicopter Route of Long Island, New York performed by the Federal Aviation Administration, with the assistance of the Volpe Center's Environmental Measurement and Modeling group.

Noise

The FAA's Office of Environment and Energy tasked the Volpe Center to conduct an analysis of the noise of helicopters operating under Visual Flight Rules (VFR) along the north shore of Long Island. This analysis examines current helicopter noise along the route. The route is shown below in Figure 1.

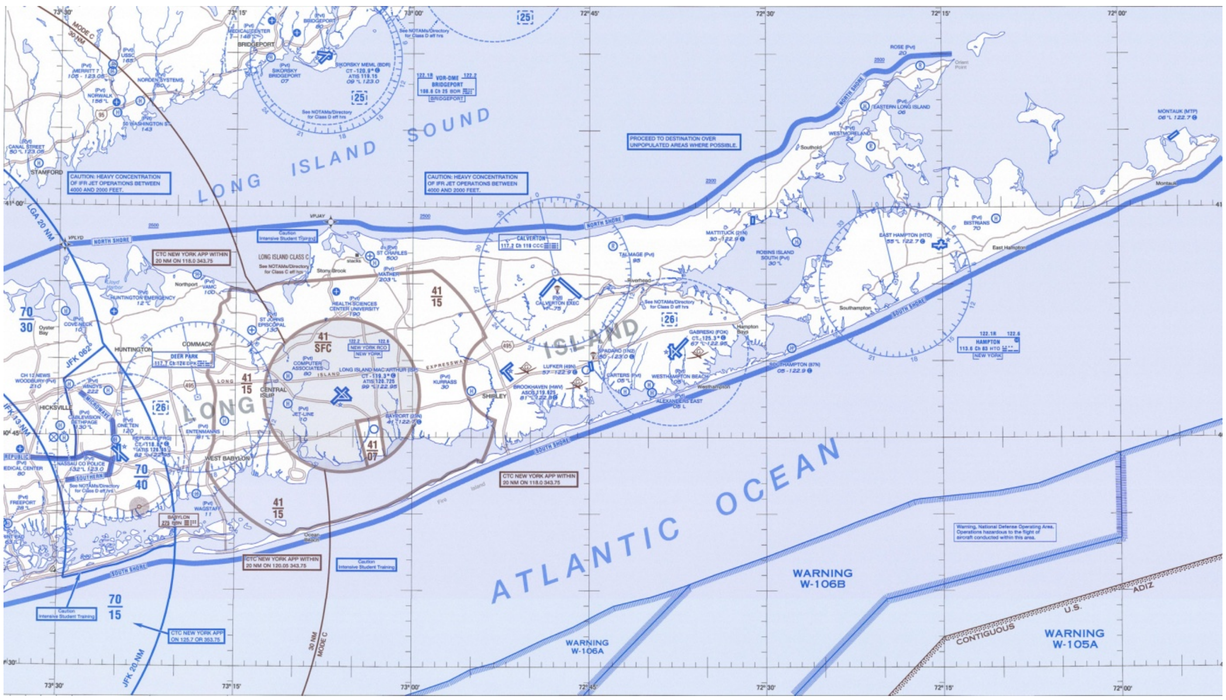

Figure 1. North Shore Helicopter Route

Helicopter Operational Source Data

The ATAC Corporation provided Performance Data Analysis and Reporting System (PDARS) information to the Volpe Center. This PDARS data set included helicopter operations near and over Long Island around Memorial Day, 2011 (May 27 to May 31) and the 4th of July, 2011 (June 30 to July 5). When providing the data, ATAC provided a breakdown of helicopter operations, which is shown in Table 1. Using this peak season holiday data, the analysis assumed an average daily number of 42.8 helicopter operations (40.1 operations during the day and 2.7 operations during nighttime hours).

Table 1. Helicopter operations from PDARS data

Time	5/27	5/28	5/29	5/30	5/31	6/30	7/1	7/2	7/3	7/4	7/5	Total
Day	82	38	24	66	29	42	58	10	10	45	37	441
Night	2	2	1	3	1	3	4	3	2	6	3	30

The FAA's Aviation Environmental Design Tool version 2A (AEDT 2A) was used to model the noise of these operations. U.S. Census Bureau 2010 population data were used to determine the population impacted by these operations.

Processing

The Volpe Center converted the PDARS data into a format usable by AEDT 2A. The PDARS data were used to generate track, fleet, and profile (altitude) data which were imported into AEDT 2A. Standard AEDT processes were used for fleet data. Flight specific altitude/speed profiles from the PDARS data were created for the helicopter performance profiles. These profiles were inserted directly into the AEDT fleet database for the respective helicopters being modeled. AEDT 2A was then run to calculate the noise of each of the flights and to generate the total noise impacts presented in this evaluation. Note that the numbers of operations were scaled from seasonal holiday time frames for an average annual day. Given that operation levels were drawn from around Memorial Day and Fourth of July – days when operations are known to be high in number – and the average annual day was created from these numbers, the average annual day reflects a higher level of operations than if a normal average annual day had been used. The assumed higher levels of operations result in higher noise levels than would result from a normal average annual day.

The majority of helicopter operation information did not contain specific helicopter types. Given this gap in the data, each helicopter operation was assigned to one of three helicopter types that have been used over Long Island: light helicopters, represented by the Robinson R-44; medium helicopters, represented by the Eurocopter AS-350; and heavy helicopters, represented by the Sikorsky S-76. Actual altitudes flown were taken from the PDARS data. All operations were modeled as overflights: takeoff and landing flight segments were modeled as climbs and descents at the beginning and end of the track, respectively.

To represent the cumulative helicopter noise environment, all helicopter operations in the vicinity of the route were modeled. This includes helicopters operating to and from MacArthur Airport (ISP) and helicopters which operate exclusively on either the east or west side of Long Island, even though they are not using the North Shore Route. In addition, helicopters that fly the route and fly near the route were also modeled. Figures 2 and 3 illustrate the routes modeled in the analysis.

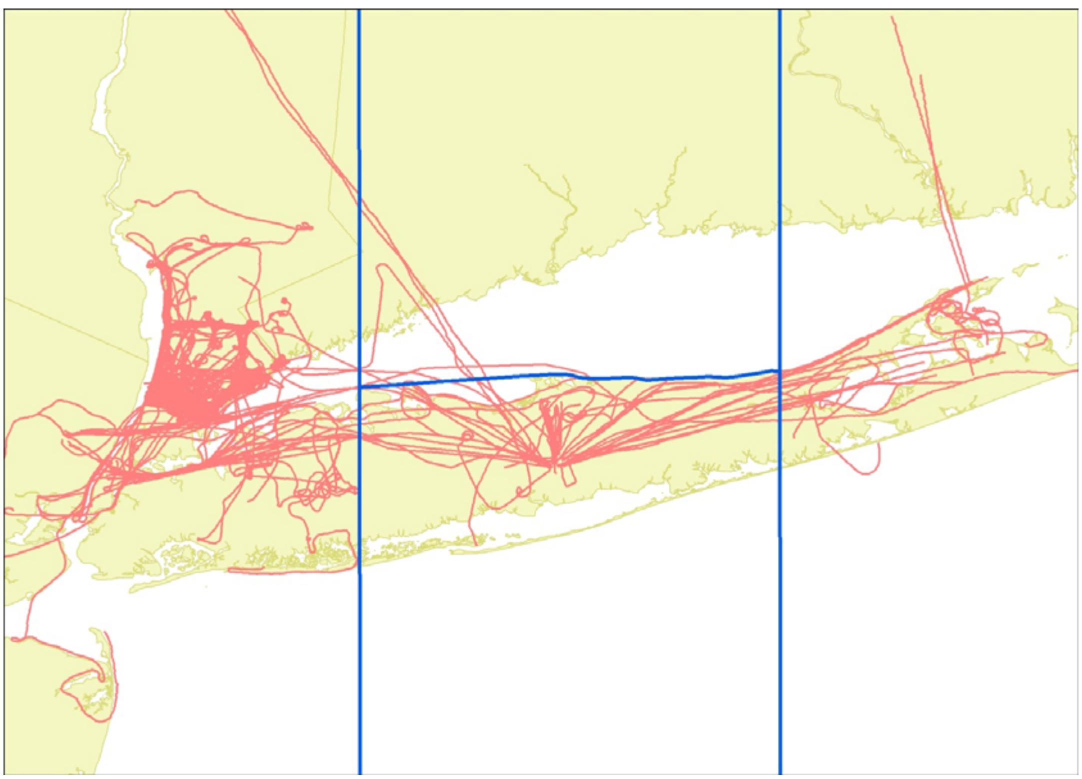

Figure 2. Helicopter operations outside the affected area or flying to/from ISP

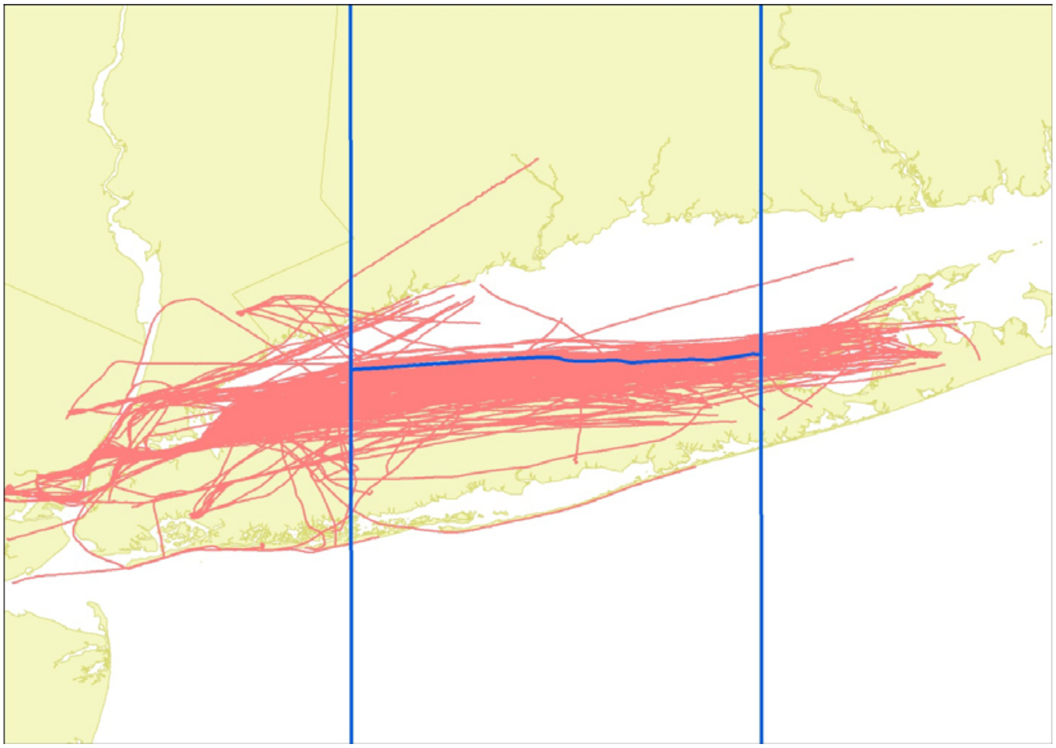

Figure 3. Helicopter operations that are primarily following or paralleling the North Shore route

Results and Analysis

Table 2 below shows the results of the noise analysis. It presents the Day-Night Average Sound Level (DNL) noise levels and the population affected by the modeled helicopter noise. The analysis of the existing condition shows no population exposed to helicopter noise over a level of DNL 45 dB (decibels). To help put the North Shore noise levels in context, the average DNL level in quiet suburban residential areas is 50 dB.[1]

Table 2. Population Exposure at Noise Levels

Noise Level	DNL 30-35 dB	DNL 35-40 dB	DNL 40-45 dB	DNL 45-50 dB
Population	2,992,284	2,329,766	728,665	0

The rule is intended to maximize utilization of the existing North Shore Helicopter Route, which will secure and improve upon the existing low levels of helicopter noise that have to date been voluntarily achieved. In response to some commenters' concerns that the rule might result in a significant noise impact on communities, there is not a reasonable potential for that to occur. To cause a significant noise impact, the rule would have to increase noise by DNL 1.5 dB or more at or above DNL 65 dB over residential areas.[2] Given that existing noise does not exceed DNL 45 dB, it would require thousands of additional daily flights along the North Shore Helicopter Route to produce enough noise to result in a significant noise impact, and this is not a possible outcome of the rule or reasonably foreseeable under any circumstances.

[1] *Federal Agency Review of Selected Airport Noise Analysis Issues*, Federal Interagency Committee on Noise, August 1992.
[2] FAA Order 1050.1E, *Environmental Impacts: Policies and Procedures*, Appendix A, Section 14, June 8, 2004.

Emissions

Context for Emissions Analyses
A commenter to the NPRM estimated that the average helicopter engine burns between 45 and 55 gallons per hour. (For twin engine helicopter, the fuel burn may be doubled). They also alleged that compliance with the rule will increase average flight time by 10 minutes, which they estimated will result in an annual increase of fuel burn of 116,875 gallons.

According to the commenter, the total number of helicopter operations (to and from the East End airports) historically has been approximately 15,000 annually. Based on the commenter's assumption that North Shore Route usage is 85% of the total (12,750 operations), then the added 10 minutes per flight would equate to 127,500 minutes (2,125 hours). Therefore, at a rate of 55 gallons per hour, the commenter calculated that 116,875 additional gallons of fuel will be consumed.

No specific factual basis for the alleged 10-minute increase in flight time was provided by the commenter. The rule does not mandate entry or exit points for helicopters using the route, nor does it require operators to fly any specific route to or from the North Shore Helicopter Route. Therefore, it is not possible to quantify any increase in fuel consumption that might occur as a result of the rule. Based on the FAA's analysis of PDARS data, fuel burn under current voluntary conditions along the North Shore Helicopter Route is roughly 453,000 gallons per year. The commenter's estimated increase of 117,000 gallons per year would amount to a 25 percent increase in fuel burn. The FAA does not regard this as a reasonable potential result of the rule, considering the reported high level of compliance with the voluntary route, the commenter's apparent assumption that even those flights currently in compliance with the route would fly 10 minutes longer as a result of the rule, and the absence of mandates in the rule that would substantially increase fuel burn.

For the purposes of this emissions evaluation, the commenter's data is helpful insofar as it provides an upper bound for fuel consumption that can be used to show that the rule could not result in noncompliance with applicable emissions requirements. Therefore, this emissions analysis provides calculations based on the commenter's assumptions to demonstrate regulatory compliance with applicable emissions regulations.

Emissions Analysis
First, calculations (Equation 1 through 4) were performed using a worst case fuel consumption based on the commenter's assumptions, as follows:

- Rotorcraft Type: S76, B430, AW139, and AS365
- Annual increase in fuel burn: 117,000 gallons
- Annual increase in flight time: 2,125 hours

The commenter suggested the S76, B430, AW139, and AS365 as acceptable two engine helicopters to operate over water. From this list of rotorcraft, the AW139 and AS365 appear to be primarily used by the U.S. Coast Guard. The B430 was not specifically identified in EDMS (Emissions Dispersion Modeling System), but a comparable rotorcraft, the B407 with the same engine, was available for analysis. In addition, the S76 was found in EDMS as a viable commercial/private rotorcraft for use in this evaluation. The S76 and B407 emissions information was extracted from EDMS. Due to limited rotorcraft operations data at Long Island landing sites, the emissions indices were selected from EDMS based on the highest rate of emissions regardless of flight segment for the Sikorsky S-76 Spirit (See Table 3). These selected indices provide a more conservative emissions estimate.

Table 1 lists the conversion factors and emission factors/indices utilized in estimating an emissions inventory based on the commenter's assumption of 117,000 gallons of fuel being consumed. The emission indices for Sulfur Dioxide (SO_2), Total Hydrocarbons (THC), and Oxides of Nitrogen (NO_X) are multiplied by the total fuel consumption to determine the total emissions. The Particulate Matter (PM_{10}) emission factor is multiplied by the number of hours operating to determine total PM_{10} emissions. The number of additional hours of aircraft operation is estimated to be 2,125 hours. A conversion factor is applied to THC to obtain Volatile Organic Compounds (VOCs). Table 2 lists the worst case emissions inventory presented in U.S. Short tons based on this conservative emissions inventory methodology.

Table 1. Conversion Factors and Emissions Rates

Factor/Emission Rate	Description
Specific Weight of Fuel	6.8 lbs/gal of jet fuel
Mass Conversion	2.2 lbs per kg
U.S Short Ton Conversion	907.18 kg per U.S. Short Ton
THC Emission Index	56.67 g/kg - Sikorsky S-76 Spirit; T700-GE-700 Idle Emission Rate
THC to VOC Conversion	1.15 VOC to THC - FAA/EPA *RECOMMENDED BEST PRACTICE FOR QUANTIFYING SPECIATED ORGANIC GAS EMISSIONS FROM AIRCRAFT EQUIPPED WITH TURBOFAN, TURBOJET, AND TURBOPROP ENGINES Version 1.0 5/27/2009*
NO_X Emission Index	8.61 g/kg - Sikorsky S-76 Spirit; T700-GE-701 Take-off Emission Rate
PM_{10} Emission Rate	0.3633 kg/hr – U.S. Environmental Protection Agency (EPA), *EPA's Procedure for Emission Inventory Preparation, Vol. IV, Mobile Sources. 1992*
SO_2 Emission Rate	Based on a 98% conversion to SO_2 with jet fuel having 0.068% sulfur content - Coordinating Research Council, Inc., *Handbook of Aviation Fuel Properties, Third Edition*, CRC Report No. 635, Alpharetta, GA., 2004.

Results and Analysis

The North Shore helicopter route is located entirely within Suffolk County, New York. This area has been designated by the Environmental Protection Agency (EPA) under the Clean Air Act as a nonattainment area for particulate matter (PM-2.5) and a moderate nonattainment area for ozone.[3] In addition, the state of New York is within the Ozone Transport Region established in section 184(a) of the Clean Air Act, 42 USC § 7511c(a). EPA has determined that for such nonattainment areas, emissions of less than 50 tons per year of volatile organic compounds and 100 tons per year of nitrogen oxides, PM-2.5, or sulfur dioxide are *de minimis*.[4]

Using the methodology described above, the analysis indicates that emissions of these pollutants from combustion of an additional 117,000 gallons of fuel would be well below levels determined by the EPA to be *de minimis*.

Table 2. Emissions Inventory Results Demonstrating Compliance below the 50 and 100 Tons per Year *de minimis* Thresholds (All values are in tons per year)

VOC	NO_X	PM_{10}	SO_2
25.98	3.43	0.85	.27

Note: The PM10 estimate can be used as a surrogate for $PM_{2.5}$ emissions.

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[3] See U.S. Environmental Protection Agency (EPA), "Currently Designated Nonattainment Areas for All Criteria Pollutants," available at http://www.epa.gov/oaqps001/greenbk/ancl.html.

[4] 40 CFR § 93.153(b)(1).

Equation 1

$$? \, US\ Short\ Ton\ VOC = \frac{56.67\ g\ THC}{kg\ fuel} \times \left(117{,}000\ gal\ fuel \times \left(\frac{6.8\ lb}{1\ gal}\right) \times \left(\frac{1\ kg}{2.2\ lb}\right)\right) \times \left(\left(\frac{1\ US\ Short\ Ton}{907.18\ kg}\right) \times \left(\frac{1\ kg}{1{,}000\ g}\right)\right) \times \left(\frac{1.15\ VOC}{1\ THC}\right) = 25.98\ Ton\ VOC$$

Equation 2

$$? \, US\ Short\ Ton\ NOx = \frac{8.18\ g\ NOx}{kg\ fuel} \times \left(117{,}000\ gal\ fuel \times \left(\frac{6.8\ lb}{1\ gal}\right) \times \left(\frac{1\ kg}{2.2\ lb}\right)\right) \times \left(\left(\frac{1\ US\ Short\ Ton}{907.18\ kg}\right) \times \left(\frac{1\ kg}{1{,}000\ g}\right)\right) = 3.26\ Ton\ NOx$$

Equation 3

$$? \, US\ Short\ Ton\ PM_{10} = \frac{0.3633\ kg\ PM}{hr} \times \left(\left(\frac{1\ US\ Short\ Ton}{907.18\ kg}\right) \times \left(\frac{1\ kg}{1{,}000\ g}\right)\right) \times 2{,}125\ hr = 0.85\ Ton\ PM$$

Equation 4

$$? \, US\ Short\ Ton\ SOx = \left(\left(117{,}000\ gal\ fuel \times \left(\frac{6.8\ lb}{1\ gal}\right) \times \left(\frac{1\ kg}{2.2\ lb}\right) \times \left(\frac{1\ US\ Short\ Ton}{907.18\ kg}\right)\right) \times 0.068\%\right) \times 98\% = 0.27\ Ton\ SOx$$

Table 3. EDMS Emissions Indices for Specific Pollutants and Modes of Operation for T700-GE-700 and 250B17B Engines. (All values are in g of pollutant per kg of fuel. The most conservative values are shaded to indicate the highest values used in this analysis.)

Aircraft Type	EDMS Equivalent Type	EDMS Equivalent Engine	THC Take Off	THC Climb Out	THC Approach	THC Idle	NOx Take Off	NOx Climb Out	NOx Approach	NOx Idle
S76	Sikorsky S76 Spirit	T700-GE-700	0.39	0.49	0.37	56.67	8.61	8.18	7.56	2.78
B430	Bell 407	250B17B	0.30	0.40	5.20	20.00	6.60	5.96	2.20	1.00
AW139	No information in EDMS; Researched suggested Coast Guard Helicopter									
AS365	No information in EDMS; Researched suggested Coast Guard Helicopter									