Multi-level Noise Analysis for an Airport Expansion Project

Paper 2012-A-547-AWMA

Robert Mentzer Jr.
Harris Miller Miller & Hanson Inc., 77 South Bedford Street, Burlington, MA 01803

INTRODUCTION

Harris Miller Miller & Hanson Inc. (HMMH) was retained as a subcontractor to Vanasse Hangen Brustlin, Inc. (VHB) to conduct the noise elements of an Environmental Impact Statement (EIS) to access the potential for environmental impacts associated with the T.F. Green Airport (PVD) in Rhode Island Airport Improvement Program. The proposed improvements include extending the main runway, runway safety area improvements on the crosswind runway, relocation of the cargo facility, and local roadway upgrades and realignments.

The project spanned six years and included both aircraft and roadway noise measurements, modeling, and analysis of the proposed improvements, including noise associated with aircraft flight and ground activity, and with surface vehicle traffic. This project provides an example of the diverse range of noise-related issues that might require assessment as a result of on- and off-airfield improvements. The Draft EIS was released in July of 2010, the Final EIS was released in June 2011, and the Record of Decision (ROD) was issued by the Federal Aviation Administration (FAA) on September 23, 2011.

The project included two updates of the aviation activity forecast and three versions of the Integrated Noise Model (INM). The project also included a detailed off airport roadway analysis and a cargo area noise analysis utilizing a spreadsheet noise model approved by FAA for use in this project only. The reports include three forecast years and seven different runway configurations, some of which were developed during the EIS process, as many of the options in the original master plan were eliminated due to environmental impacts. Consultation with many state and federal agencies were required as part of this effort. Mitigation recommended as part of the ROD include residential land acquisition, residential sound insulation, and relocation of the public ball fields, additional school sound insulation and road noise barriers.

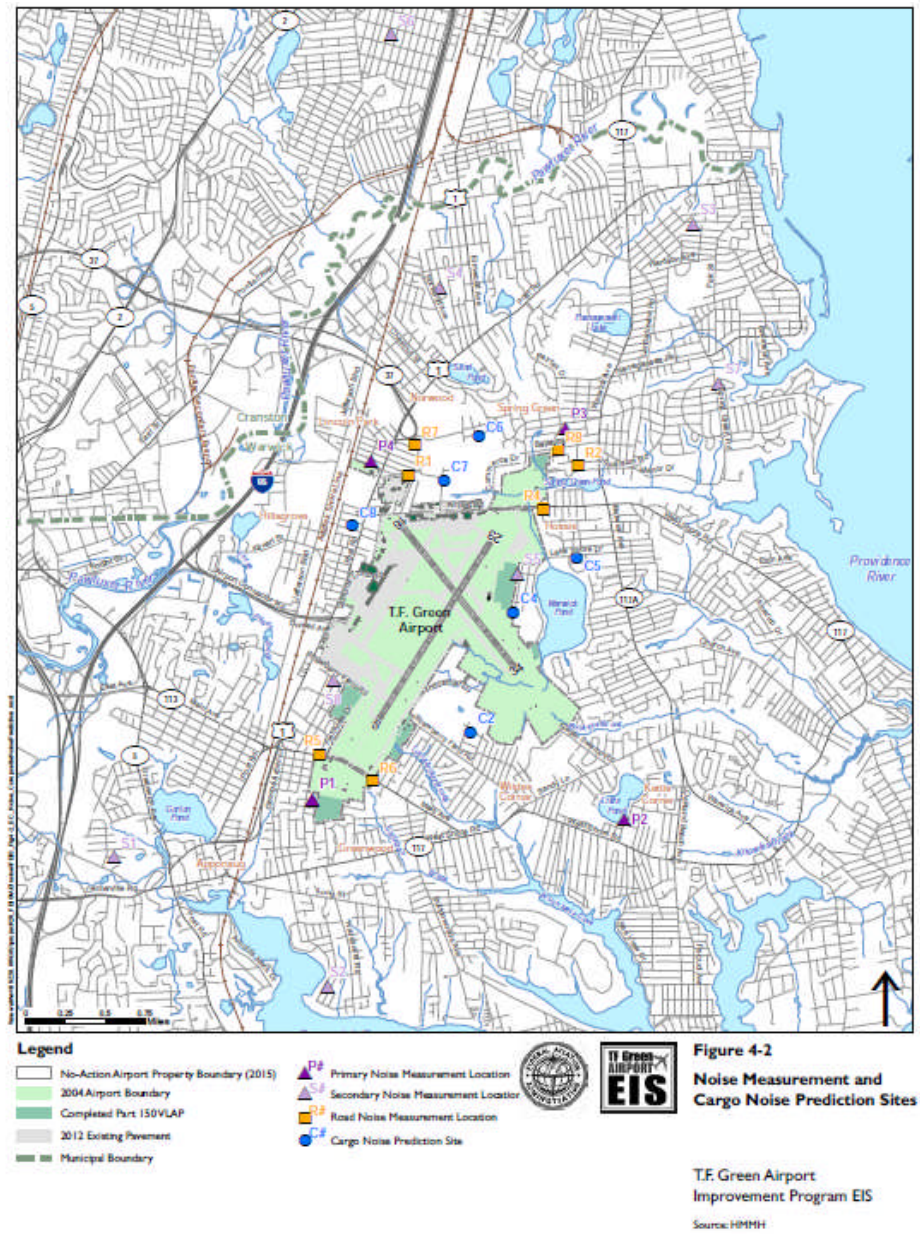
This extended abstract will discuss some of the methods, measurements, inputs and results developed during this environmental analysis process. This EIS evaluated three sources of project related noise, aircraft flight noise, aircraft cargo ramp noise and vehicle roadway noise. All three were evaluated separately and impacts were reported along with a composite analysis of all three.

BACKGROUND

PVD is a medium hub primary commercial airport serving approximately 3.9 million passengers with over 220 daily aircraft operations in 2010[1]. PVD is owned and operated by the Rhode Island Airport Corporation (RIAC) and is the primary airport for the State of Rhode Island. PVD is also an integral part of the regions aviation network serving commercial passenger, cargo and general aviation interests. PVD is located in the City of Warwick six miles south of Providence, RI. As shown in Figure 1 below, the area is a dense urban area surrounded by residential and commercial properties. The airport is bounded to the north by Airport Road, Industrial Drive to the east, Main Ave. (State Route 113) to the south and Post Road (U.S. Route 1) to the west.

The airport has two primary runways Runway 5-23 (7,166 feet) which runs approximately north-south and Runway 16-34 (6,081 feet) known as the 'crosswind runway' which runs east-west with associated taxiways and ramps. The terminal has 22 commercial gates and associated vehicle roadways and parking structures.

Figure 1 - T.F Green Airport and Measurement Locations



The Airport Improvement Program was a result of the master planning process which RIAC had undertaken from 1999 to 2002. As a result of this effort, it was determined by the FAA that several of the proposed improvements had the potential to cause significant environmental impacts and an EIS must be prepared.

The Airport Improvement Program has several improvements which will affect noise levels in and around the airports location. The largest and main feature of the program is the extension of Runway 5-23 to accommodate long haul (non-stop west coast flights) and some international flights. The proposed alternatives for the extension involved relocated roadways, new roadways or a tunnel under the runway for Main Ave. Modifications to Runway 16-34 included shifting the runway to the northwest to allow the runway safety areas to meet FAA guidelines and the relocation of cargo operations into an integrated cargo facility.

The EIS process spanned seven years and resulted in a ROD for the preferred alternative which includes a runway extension to 8,700' for Runway 5-23, Runway 16-34 RSA improvements, the construction of an integrated cargo facility on the north side of the airport and the relocation of Main Avenue along the south side of the airport. The City of Warwick filed a lawsuit against RIAC and FAA but reached an agreement with RIAC on March 1st, 2012 to drop the lawsuit.

METHODS

While an EIS includes several sections, two of the sections typically include analysis of possible impacts to environmental resources. These two main technical sections are the Affected Environment (AE), which is a report on the current conditions at the airport and the Environmental Consequences (EC) which reports on the future no-action and proposed action conditions. Noise is just one of the twenty three categories that must be evaluated as part of an EIS. The EIS process typically begins with scoping meetings between the parties involved including the public. These meetings were held and helped to focus the analysis of information to be presented in the EIS. The scoping meetings resulted in a noise analysis which focused on the required elements needed for an EIS but also information on some supplemental noise metrics and the inclusion of a noise measurement program.

The AE section included an analysis of the current conditions at the airport at the start of the EIS which was for calendar year 2004. Figure 1 presents the locations of long term (Primary) and short term (Secondary) aircraft noise measurement sites in the community and roadway noise measurements in the project study area. HMMH used our RealContours™ software to assist in the development of the 2004 Day Night Average Sound Level (DNL) contours. RealContours™ is a pre-processor to the FAA's Integrated Noise Model (INM) version 6.1 which converts the actual radar data into INM inputs which results in a set of DNL contours representative of the actual conditions at the airport. Several community members were concerned that flight track deviations from the airport noise abatement corridors would not be included in the analysis. By developing the noise contours using this method those deviations were accounted for. Modeled results were also developed for each of the noise monitoring sites and all of the noise sensitive sites (schools, churches, hospitals, and libraries), parks and historic areas within a 27 mile radius of the airport. The study team had to evaluate possible Air Traffic changes due to the proposed alternatives using these sites. Arrivals from the most common aircraft in the fleet mix take 27 miles to descend from 7,000' to the runway (evaluating arrivals from 7,000' is an Air Traffic

requirement and the INM only contains arrival profiles from 6,000' so the FAA Office of Environment and Energy (AEE) had to approve extending the profiles in the INM from 6,000 to the 7,000').

Existing roadway noise levels were modeled using the Federal Highway Administration (FHWA) Traffic Noise Model (TNM) for the affected roadway alignments within the project area. This included Main Avenue to the south of the airport, Post Road to the west, segments of Warwick Avenue to the east and Airport Road to the north.

Noise from the existing cargo facility (aircraft on the cargo ramps) was developed using a spreadsheet model approved by the FAA for use on this project. The INM model while allowing the user to model maintenance run-ups does not take into account shielding from the existing and proposed buildings. The model also does not take into account noise for Auxiliary Power Units (APU's) and Ground Power Units (GPU's) which due to the nature of cargo operations frequently being at night may affect nearby residents. Therefore, HMMH proposed to FAA to use a spreadsheet model based on reference measured data of aircraft ramp operations for the noise levels and included a simple shielding method along with the reduction of noise due to distance. Noise exposure from cargo operations were computed using detailed descriptions of operations provided by cargo operators, taking into account geometry of the facility and relation to receptors and average weather conditions. Since detailed information was not available for the cargo buildings, the shielding assumptions were as follows:

- 0 dB when direct propagation path was unbroken
- 5 dB when propagation path went through a corner of the building (i.e. two adjacent sides)
- 15 dB when propagation path went through the full width of the building (i.e. two non-adjacent sides)

Sound propagation was modeled based upon geometric spherical divergence (i.e. -6 dB per distance doubling). This is a worst case assumption as it assumes no excess attenuation due to ground effects or shielding. Cargo prediction noise sites (typically the closest residential location and displayed in Figure 1) were chosen to be modeled.

A composite noise level consisting of the aircraft flight noise, aircraft cargo noise and roadway noise levels was developed at all of the measurement sites to reflect the existing noise level from the three existing conditions elements.

The EC section of the report focuses on the future conditions and allows for the comparison of each no-action year to each year of the proposed actions. The original proposed actions consisted of five options to extend Runway 5-23 to 9,350 feet along with different options for the integrated cargo facility and roadway alignments.

- IP Option A designed to avoid impacts to the north of the Airport; includes a Main Avenue tunnel
- IP Option B designed to avoid impacts to the south of the airport; includes a full relocation of Airport road from Warwick Avenue with a connection to Route 37
- IP Option C designed to avoid Buckeye brook channel; includes a Main Avenue tunnel and partially relocates the west end of Airport Road
- IP Option D designed to minimize impacts to Buckeye Brook and minimize Airport road relocation; includes a Main Avenue tunnel and partial relocates the east end of airport road
- IP Option E designed to avoid Buckeye Brook and minimize Airport road relocation; includes a main Avenue tunnel and partially relocates the east end of Airport Road

All five of these options (also known as the Level 4 screening) were evaluated for environmental impacts and cost. Four of the options were eliminated (all of the options with the Main Avenue tunnel) and only Option B was carried forward for further analysis[2].

Option B was reevaluated for different runway lengths through an iterative process. Four more possible alternatives (for a total of five alternatives) were evaluated (known as the Level 5 screening) and two of these options were carried forward for further analysis.

- Option B became Option B1 – with a 9,350' runway length
- Option B2 has an 8,700' runway length extended to the north and south
- Option B3 North has an 8,300' runway length extended to the north
- Option B4 has an 8,700' runway length extended to the south
- Option B3 South has an 8,300' runway length extended to the south

The 8,700 runway length was the best option to meet the purpose and need of the project and the two options carried forward use an 8,700 extension.

The project began with an operations forecast developed in 2004 and in 2009 as the analysis moved forward towards the Draft EIS (DEIS), the FAA determined that the forecasts were outside of the acceptable difference between the original forecast and the FAA Terminal Area Forecast (TAF). The forecast must be within 10 percent for a five year future year and 15 percent for a ten year or greater future year. Therefore, the analysis developed for the DEIS (known as the Level 6 analysis) included an updated forecast and a change to the latest version of the INM (version 7.0a) at that time.

Another, factor considered was the years evaluated for each of the options. The EIS needs to consider the year of implementation and five years plus the year of implementation. The original evaluations considered the future years 2020 and 2025 and the new options due to an expedited construction schedule considered 2015 and 2020. For the DEIS and Final EIS (FEIS) all three future years were evaluated with 2020 being the common year for comparison.

For the FEIS, the forecast was updated again along with the INM version (version 7.0b). The FEIS evaluated both alternatives using the new information and the FAA reached the same preferred proposed action as it did with the DEIS.

RESULTS AND DISCUSSION

For a NEPA analysis, the FAA considers an increase of 1.5 dB over noise sensitive areas within the DNL 65 dB contour as a significant impact. They also consider a 3.0 dB increase between the DNL 60 dB and DNL 65 dB contour and a 5.0 dB increase between DNL 45 dB and DNL 60 dB as a slight to moderate impact. The FAA provides resources for mitigation from a NEPA project for areas with significant impact which may include property acquisition or sound insulation.

Using the INM we developed noise contours for each of the EIS options and then compared the areas of change between alternatives for each year. We also developed modeled results at over 3,000 individual sites including the monitoring sites, noise sensitive sites, parks and historic locations. These were also evaluated for significant impact and changes in noise levels. Areas of significant impact were identified and mitigation was suggested for those areas. These areas included residential land use and a local school. Table 1 below lists the number housing units and population exposed to significant impacts for each year and alternative.

Table 1 - Alternatives B2 and B4: Summary of Significant Noise Impacts

	2015		2020		2025	
Type	Alt B2	Alt B4	Alt B2	Alt B4	Alt B2	Alt B4
Housing Units	--	184	74	174	49	108
Population	--	432	174	409	115	254
Non-Residential Noise Sensitive Sites	--	2	0	2	0	3

Source: HMMH, U.S. Census data 2000

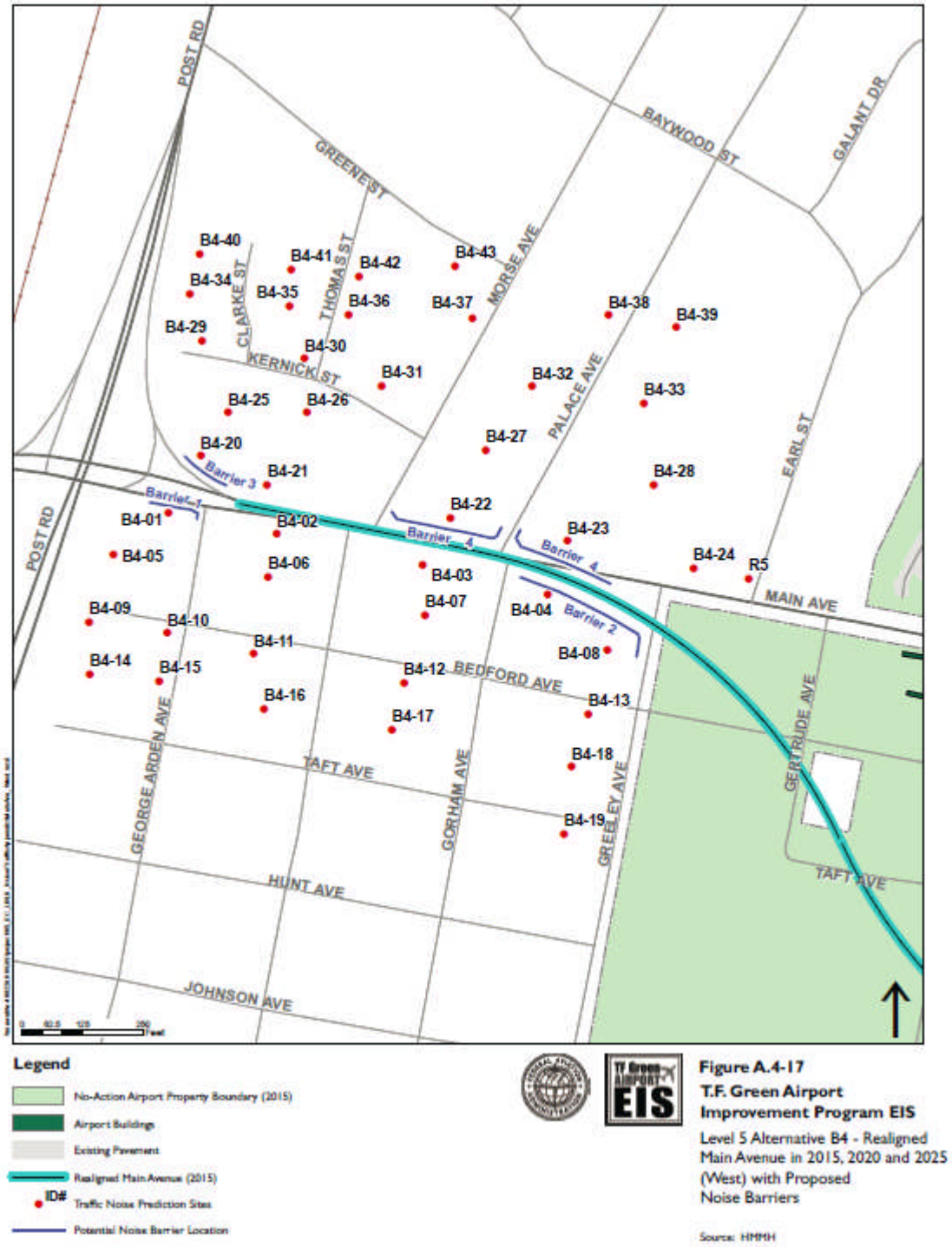
Note: Alternative B2 was not evaluated for impacts in 2015 due to the construction schedule.

Project mitigation in the form of property acquisition will be available for residential units within the DNL 70 dB contour. Residential units exposed to a significant noise impact will be eligible for sound insulation and all residential units within the DNL 65 dB will be eligible for sound insulation under the airports on-going Part 150 Noise Compatibility Program (NCP).

For the roadway analysis, the TNM was used to model each of the roadway alignments associated with each alternative and year. FHWA and Rhode Island Department of Transportation (RIDOT) guidelines were followed to determine impacts and for traffic impacts the proposed action was compared to the existing conditions. Impacts were identified for each alternative and noise walls/berms were modeled for each of the identified locations which met FHWA and RIDOT criteria. Noise barriers or berms appear to be feasible at six locations along

the realigned Main Avenue. Also, consideration will be given for installing open graded asphaltic concrete pavement, or other quiet pavement as part of reconstructing the roadway.

Figure 2 – TNM modeled locations and Example of Proposed Noise Barriers



The cargo noise was modeled at each of the modeled sites and was evaluated for impacts. No impacts were determined from the cargo facility changes.

A composite noise analysis was developed at each of the measured and modeled sites. This analysis combined the DNL results from all three analyses by logarithmically summing the noise contributions and then comparing the change from the composite noise at each site. Table 2 displays the composite noise levels at each of the measured sites for 2020 Alternative B4 and the 2020 No-action Alternative. No new sites were identified with significant impacts as the aircraft flight noise dominated the contributions at most sites.

The project also produced supplemental noise metrics for the aircraft flight operations. The maximum A-weighted value (LA_{max}), Number of Events above 70 LA_{max} and 90 LA_{max}, and Time Above a specified level (TA) at each of the modeled grid points were developed and reported in the EIS for public information.

Table 2 – Composite Noise Levels for Alternative B4 in 2020

		No-Action Alternative 2020				Alternative B4 2020				
Site	Location	Aircraft Flight Operations	Aircraft Ground/ Cargo Operations	Vehicle/ Roadway Traffic	Combined Noise Level	Aircraft Flight Operations	Aircraft Ground/ Cargo Operations	Vehicle/ Roadway Traffic	Combined Noise Level	Net Change in DNL Noise Level
C2	Norfolk Road	59.0	39.1	--[1]	59.0	58.8	39.5	--[1]	58.9	-0.2
C4	Wilbur Avenue	63.5	50.7	--[1]	63.7	64.3	51.0	--[1]	64.5	0.8
C5	Lake Shore Drive	59.5	48.2	--[1]	59.8	59.8	47.9	--[1]	60.1	0.3
C6	Grotto Avenue	61.7	51.3	0.0	62.1	61.1	48.2	0.0	61.3	-0.8
C7	Evergreen Avenue	62.3	58.7	54.6	64.4	62.4	58.4	56.3	64.6	0.2
C8	Haverford Road	60.4	49.4	58.8	62.9	60.7	50.3	58.9	63.1	0.3
P1	Gertrude Avenue	67.8	30.2	45.2	67.8	68.0	30.7	49.5	68.1	0.2
P2	Glen Drive	60.3	--[3]	--[1]	60.3	60.7	--[3]	--[1]	60.7	0.4
P3	Commodore Ave.	69.0	45.2	--[1]	69.0	69.2	43.0	--[1]	69.2	0.2
P4	Louisiana Avenue	61.7	49.0	60.5	64.3	61.8	49.5	60.7	64.4	0.2
R1	Senator Street	61.5	54.4	51.3	62.6	61.7	55.0	52.1	62.9	0.3
R2	Astral Street	62.7	46.6	--[1]	62.8	62.0	45.9	--[1]	62.1	-0.7
R4	Airport Road	65.8	53.1	--[1]	66.0	65.1	52.5	--[1]	65.3	-0.7
R5	Main Avenue	66.6	33.7	74.0	74.7	69.1	34.1	64.7	70.4	-4.3
R6	Gladys Court	66.3	33.5	70.9	72.2	70.1	34.0	--[2]	71.6	-0.6
R7	Alabama Street	58.9	51.1	59.0	62.3	59.0	51.1	59.1	62.4	0.1
R8	Bellevue Avenue	68.0	--[3]	--[1]	68.0	68.0	--[3]	--[1]	68.0	0.0
S1	Winman Court	58.2	--[3]	--[1]	58.2	58.5	--[3]	--[1]	58.5	0.3
S2	Alice Avenue	54.1	--[3]	--[1]	54.1	54.6	--[3]	--[1]	54.6	0.5
S3	Rosegarden Street	61.6	--[3]	--[1]	61.6	62.1	--[3]	--[1]	62.1	0.5
S4	Manolia Avenue	55.3	35.8	--[1]	55.3	55.0	33.8	--[1]	55.0	-0.3
S5	Wilbur Street	66.9	54.9	--[1]	67.2	67.2	54.9	--[1]	67.4	0.3
S6	Grace Street	52.8	--[3]	--[1]	52.8	52.7	--[3]	--[1]	52.7	-0.1
S7	Spring Green Drive	53.4	31.5	--[1]	53.4	53.3	30.9	--[1]	53.3	-0.1
S8	Collingwood Drive	64.1	39.6	--[1]	64.1	63.8	40.2	--[1]	63.8	-0.3

Source: HMMH, 2011.
Note: Shaded values indicate levels which exceed FAA guidelines for land use compatibility (65 dB).
1 Per RIDOT Noise Abatement Policy, "highway noise impacts beyond 500 feet from the roadway will not be considered in determining the need for, the dimensions of, and the cost of a noise barrier." Therefore traffic noise levels are only reported for prediction sites in the vicinity of a proposed roadway alternative where traffic is expected to be a significant contributor to the overall noise environment.
2 Included in acquisition due to airport construction, Project noise or Part 150 Noise mitigation acquisitions.
3 Computed sound levels below 30 dB are below background sound levels and therefore are not reported.

SUMMARY

The FAA developed an EIS over a seven year period which resulted in a ROD in September 23, 2011 for the Airport Improvement Program at PVD. The EIS considered nine different runway layouts and other related changes resulting in the environmentally preferred alternative being approved for development at the airport. Noise impacts were identified and appropriate

mitigation was identified as part of the ROD including property acquisitions, sound insulation and roadway noise berms or walls.

ACKNOWLEDGEMENTS

The author would like to thank Richard Doucette from the New England office of the FAA and Ann Clarke from RIAC for permission to prepare this paper.

REFERENCES

1. *T.F. Green Airport – Monthly Airport Passenger Activity Summary*, RIAC, December 2010
2. *T.F. Green Airport Improvement Program – FEIS Executive Summary*, FAA, July 2011

KEYWORDS

Airport Noise, Noise, Environmental Impact Statement, Traffic Noise