

# APPENDIX B

## FIELD NOISE MEASUREMENTS AND NOISE COMPLAINTS

This appendix provides the results of temporary monitoring conducted to provide information to the development of noise contour modeling and the complaints about aircraft noise documented by the airport's management staff.

### B.1 NOISE MEASUREMENTS

A noise measurement program was conducted the weeks of June 19, 2006 and June 4, 2007, following Federal Aviation Regulations (FAR) Part 150 Guidelines. This field measurement program was intended to provide numerous measurements of individual aircraft overflight events. The measurements were compared with pre-existing database information related to aircraft noise level and performance characteristics. The information collected during the measurement program included acoustical output, as measured at known locations, as well as flight trajectory data (the aircraft's three-dimensional location) relative to the noise measurement site.

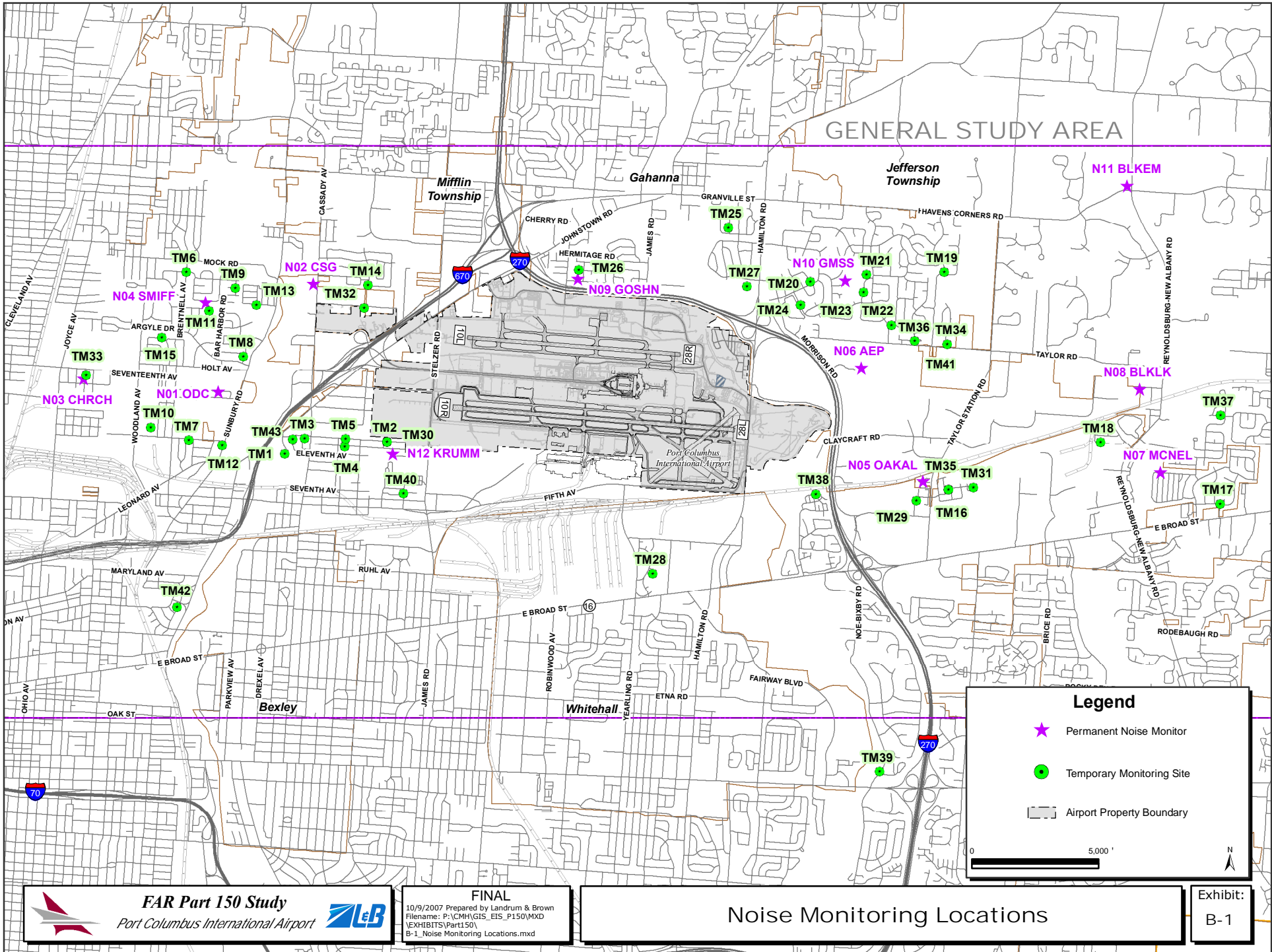
Measurements made for short periods are unique to that one period, and may not represent the average of the events that would occur at that location over a longer period of time. The relationship between field measurements and computer-modeled average noise levels is comparable to that between a book and its cover. While the cover (single-event measurements) may indicate something of the character of a book, and receive inordinate attention based on its color or graphics, the total story (average noise level) is in all the words that constitute the story. It is on the total story that the critic makes his assessment. In other words, the modeling process simulates overall average annual conditions (the book) while field measurements (the cover) reflect only a small part of the whole story.

Aircraft noise measurements concentrated on the collection of a variety of single overflight noise information, with emphasis on the noise generated by air carrier aircraft during arrival and departure east and west of the airport. Measurements occurred during all times that the airport was operating.

#### B.1.2 NOISE MEASUREMENT SITES

Noise monitoring sites were chosen at 43 locations based on their proximity to the airport, the flow of aircraft operations during the measurement program, and areas of historic noise concerns. **Exhibit B-1, *Noise Measurement Sites***, illustrates the location of the noise measurement sites. General sites were selected on the basis of ambient noise level (or more specifically, the absence of loud ambient noise), locations of flight tracks derived from preliminary early analysis of Aircraft Noise

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and Operations Monitoring System (ANOMS) <sup>1</sup> information, locations of noise complaints received by the airport, and the locations of concentrations of residential use in overflowed areas. Specific locations were selected through application of consultant experience. Criteria for the selection of specific locations included:

- Emphasis on areas of numerous aircraft noise events according to earlier evaluations.
- Representative sampling of all major types of operations and aircraft using the Port Columbus International Airport (CMH).
- Screening of each site for local noise sources or unusual terrain characteristics, which could affect measurements.
- Location in or near areas from which complaints about aircraft noise were received, or where there are concentrations of people exposed to numerous aircraft overflights.

While there is no end to the number of locations available for monitoring, the selected sites fulfill the above criteria and provide a representative sampling of the varying aircraft noise conditions in the vicinity of the airport. Information collected during the noise measurement program included single-event peak decibel (dB) levels (Lmax), Sound Exposure Levels (SEL), event duration, time of occurrence and aircraft type.<sup>2</sup>

### **B.1.3 ACOUSTICAL MEASUREMENTS**

This section provides a technical description of the acoustical measurements that were performed for this Part 150 study. Described here are the instrumentation that was employed, calibration procedures followed, and related data collection items and procedures.

#### **B.1.3.1 Instrumentation**

Three sets of acoustical instrumentation and analysis equipment were used in order to obtain acoustical data to compare with standard data associated with aircraft noise. The major instrumentation that was used is listed in **Table B-1, *Acoustical Measurement Instrumentation***.

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<sup>1</sup> The CMH ANOMS system collects radar data for operations arriving, departing and enroute through CMH airspace. The data collected includes runway use, aircraft type, operation type, time of arrival or departure, airline, and flight track location.

<sup>2</sup> Lmax refers to the maximum A-weighted noise level recorded for a single noise event. SEL is a logarithmic expression of the all the sound energy for a single noise event compressed into one second. Durations are expressed in seconds and the identification of aircraft types was done visually from the ground as the aircraft passed over head.

**Table B-1  
ACOUSTICAL MEASUREMENT INSTRUMENTATION  
Port Columbus International Airport**

<b>NUMBER</b>	<b>INSTRUMENT TYPE</b>
2	Larson Davis 814 Type 1 Integrating Sound Level Meter/Real-Time Analyzer
2	Larson Davis ½" PRM902 w/ Windscreens
2	Type 1 Precision Microphone Calibrator, 94 or 114 db output, 1kHz, ½" opening

Source: Landrum & Brown, 2007.

### **B.1.3.2 MEASUREMENT PROCEDURES**

Aircraft noise levels were recorded using the equipment indicated in the above table for each of the 43 sites. ANOMS data was obtained from CMH for the time period when measurements were conducted. The noise-monitoring program was designed to provide a sampling of single events throughout the study area. It was not designed to record cumulative noise levels. The monitors were attended while active to ensure that only aircraft noise events were recorded. The monitoring procedure called for the operator to record information such as aircraft type, airline, if the operation was an arrival or departure, and duration (as available) when a noise event first became audible. The start and end time of when the event was audible was also recorded.

Noise measurement programs must be conducted for relatively long sampling periods (at least one week per location several times a year), and at a large number of dispersed locations before they can be used to define the location of Day-Night Average Sound Level (DNL) noise contours. Even then, a computer-generated set of noise contours is necessary and long-term measurement data is used to adjust these contours. As applied at CMH, the noise contours were not created by or adjusted to reflect long-term measured data.

The CMH program provided for the collection of a large number of single-event measurements at a variety of locations throughout the community at distances ranging from several hundred feet to several miles between the aircraft and the monitoring site. This information, when correlated with the ANOMS data and operating schedules, allowed the determination of applicable noise curves and performance characteristics within the Integrated Noise Model (INM) database for the most significant aircraft and operators. The measured data generally reflected the noise levels within the INM database for those aircraft operated by the jet operators at the airport. Therefore no data was identified to support modification of any noise curves or standard operational data.

### **B.1.3.3 Weather Information**

The noise measurements taken during this study were obtained during a period that saw typical sky and wind conditions. The measurements were recorded during both clear and overcast sky conditions and during both easterly and westerly winds.

### **B.1.3.4 Measurement Results Summary**

The noise measurement program revealed a wide range of noise exposure levels from aircraft activity within the airport environs. The measured noise levels from departing aircraft tended to produce SEL and peak dB levels several dB higher than those of arriving aircraft. This difference is caused by two characteristics of the separate operations. First, exposure to noise above the background levels from arriving aircraft is typically shorter than from departing aircraft, resulting in less cumulative energy to be factored into the SEL exposure level. Second, the power settings used during approach are less than those necessary to climb during the takeoff, resulting in lower sound levels that are several dB lower than measured at similar locations during departure.

An evaluation of the SEL and peak dB (L<sub>max</sub>) levels measured at the various locations indicates that the SEL always runs several dB louder than the L<sub>max</sub>. When the L<sub>max</sub> is low, the SEL may be as much as 10 to 15 dB higher than the peak level, but when the L<sub>max</sub> is high, the SEL is typically only 6 to 12 dB louder. Again, this characteristic is the result of longer exposure to noise levels above background levels during takeoff events. **Table B-2, Temporary Noise Monitoring Results**, provides a synopsis of the measurements.

During the daytime (7:00 a.m. to 9:59 p.m.), the airport is operated in one of two operating configurations—west flow (75 percent of the time) or east flow (25 percent of the time). When the airport operated in west flow, aircraft arrive from the east heading west and depart to the west on Runways 28L and 28R. During east flow operations, aircraft arrive from the west heading east and depart to the east on Runways 10L and 10R. Therefore, the majority of the measurements taken to the west of the airport recorded departure operations; whereas measurements taken on the east side of the airport recorded arrivals, which tend to be quieter than departure operations. Measurements recorded to the west of the airport in Columbus and Mifflin Township resulted in L<sub>max</sub> noise levels ranging from the middle 46 to 93 dB. To the east in Columbus, Gahanna and Truro Township, lower L<sub>max</sub> noise levels were recorded, ranging from 45 to 85 dB.

Measurement sites were also selected to the north in Gahanna and to the south in Whitehall. Both arrival and departure operations were recorded at these sites. The L<sub>max</sub> noise levels at the sites to the north ranged from 54 to 62 dB and the noise levels at the sites to the south ranged from 50 to 62 dB.

The loudest aircraft event recorded was a McDonnell-Douglas DC-9 departure. Other loud aircraft monitored included McDonnell-Douglas MD-80 series aircraft and Boeing 737-300's.

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**Table B-2  
TEMPORARY NOISE MONITORING RESULTS  
Port Columbus International Airport**

Site Number	Location	Ambient Noise Level (dB)	Date Monitored	Time Monitored	Type of Events	Lmax (loudest noise event)	Loudest aircraft	SEL Range
TM1	Lutheran Village	48.7	06/19/06	10:10 AM - 11:00 AM	Departures	80.2	A320	67.4 - 88.9
TM2	3193 E. 13th Avenue	50.4	06/19/06	10:10 AM - 11:15 AM	Departures	82.2	Business Jet	51.7 - 89.9
TM3	2715 Kenilworth Avenue	52.0	06/19/06	11:05 AM - 12:02 PM	Departures	76.9	MD-80	70.2 - 85.4
TM4	2978 E. 12th Avenue	56.5	06/19/06	11:05 AM - 12:05 PM	Departures	74.7	737-300	66.4 - 82.9
TM5	2985 E. 13th Avenue	42.8	06/19/06	11:25 AM - 12:25 PM	Departures	93.7	DC-9	65.6 - 102.3
TM6	Delavan Dr. & Brentnell	56.5	06/19/06	2:25 PM - 3:25 PM	Departures	78.6	A320	59.5 - 87.9
TM7	Woodward Road	45.0	06/19/06	2:30 PM - 3:30 PM	Departures	75.4	A319	68.8 - 84.3
TM8	1551 Thames Drive	46.9	06/19/06	2:30 PM - 3:30 PM	Departures	82.9	737-300	74.4 - 90.2
TM9	Brocton Road & Brocton Court	48.9	06/19/06	3:28 PM - 4:30 PM	Departures	77.6	EMB-145	74.4 - 82.9
TM10	Eastlawn Cemetery	39.0	06/19/06	3:30 PM - 4:15 PM	Departures	74.6	EMB-170	63.5 - 84.5
TM11	South Mifflin Elementary	35.8	06/19/06	3:40 PM - 4:40 PM	Departures	88.8	MD-80	62.0 - 96.5
TM12	1095 Sunbury Road	50.0	06/19/06	4:30 PM - 5:45 PM	Departures	83.7	MD-80	67.9 - 91.9
TM13	Sunset Park Drive & Sparrow Hill Drive	44.6	06/19/06	4:33 PM - 5:30 PM	Departures	80	737-300	83.1 - 89.7
TM14	Lone Spruce Drive & Mountain Oak Drive	54.0	06/19/06	5:35 PM - 6:10 PM	Departures	79.9	737-300	65.2 - 79.9
TM15	1704 Marina Drive	56.5	06/19/06	5:10 PM - 6:20 PM	Departures	82.4	MD-80	72.0 - 91.9

**Table B-2, Continued  
TEMPORARY NOISE MONITORING RESULTS  
Port Columbus International Airport**

Site Number	Location	Ambient Noise Level (dB)	Date Monitored	Time Monitored	Type of Events	Lmax (loudest noise event)	Loudest aircraft	SEL Range
TM16	358 Hoskins Drive	48.7	06/19/06	9:27 PM - 10:27 PM	Arrivals	76.3	MD-80	64.9 - 83.6
TM17	Tayside Drive	41.0	06/20/06	10:00 AM - 11:00 AM	Arrivals	74.6	MD-80	64.5 - 83.7
TM18	6932 Onyx Bluff Drive	43.3	06/20/06	10:00 AM - 11:00 AM	Arrivals	82.1	Turbo Prop	74.1 - 89.5
TM19	1117 Caroway Drive	39.1	06/20/06	11:30 AM - 12:15 PM	Arrivals	66.5	Business Jet	51.1 - 73.3
TM20	631 Dunoon Drive	50.0	06/20/06	11:30 AM - 12:30 PM	Arrivals	58.2	MD-80	63.9 - 69.2
TM21	Gahanna Middle School South	44.0	06/20/06	12:30 PM - 1:45 PM	Arrivals	60.3	Cessna 150	48.5 - 68.3
TM22	510 Sutterton Drive	50.0	06/20/06	12:35 PM - 1:35 PM	Arrivals	66.9	EMB-170	70.4 - 73.9
TM23	Shady Spring Drive	40.0	06/20/06	1:50 PM - 2:50 PM	Arrivals & Departures	62.9	737-300	55.6 - 72.7
TM24	Havelock Drive	51.8	06/20/06	2:15 PM - 2:55 PM	Arrivals & Departures	63.5	EMB-170	60.4 - 71.4
TM25	Sierra Drive	37.4	06/20/06	3:00 PM - 4:00 PM	Departures	61.8	737-300	51.5 - 69.2
TM26	Goshen Elementary School	54.0	06/20/06	3:10 PM - 4:10 PM	Departures	62.3	GA Prop	66.7 - 74.5
TM27	Shepherd Church Of The Nazarene	53.7	06/20/06	4:06 PM - 5:10 PM	Arrivals & Departures	74.3	MD-88	66.2 - 81.4
TM28	Emerick Court	49.2	06/21/06	6:21 AM - 6:51 AM	Departures	59.5	737-300	62.0 - 69.3
TM29	Directory Drive	57.5	06/21/06	8:00 AM - 9:00 AM	Departures	83.3	MD-80	67.6 - 94.9
TM30	3193 E. 13th Avenue	48.4	06/21/06	9:29 AM - 10:30 AM	Arrivals & Departures	79.6	EMB-145	64.5 - 88.9

**Table B-2, Continued  
TEMPORARY NOISE MONITORING RESULTS  
Port Columbus International Airport**

Site Number	Location	Ambient Noise Level (dB)	Date Monitored	Time Monitored	Type of Events	Lmax (loudest noise event)	Loudest aircraft	SEL Range
TM31	Lakes At Taylor Crossing	52.0	06/21/06	9:30 AM - 10:30 AM	Departures	70.2	EMB-145	76.0 - 81.3
TM32	2765 Drake Road	55.1	06/21/06	10:45 AM - 11:40 AM	Arrivals & Departures	80.9	Business Jet	66.8 - 88.4
TM33	1548 Wentworth Road	52.5	06/21/06	12:45 PM - 1:45 PM	Arrivals	80.7	Business Jet	71.1 - 88.3
TM34	Taylor Road	49.0	06/21/06	2:25 PM - 3:20 PM	Departures	82.8	737-300	70.4 - 90.4
TM35	358 Hoskins Way	53.5	06/21/06	2:45 PM - 3:45 PM	Departures	76.6	EMB-170	70.7 - 85.9
TM36	Howland Drive	49.0	06/21/06	3:30 PM - 4:15 PM	Departures	79.8	A320	72.9 - 85.2
TM37	7690 Sherridon Drive	47.7	06/21/06	4:05 PM - 5:05 PM	Departures	85.5	MD-80	59.0 - 92.8
TM38	466 Winding Woods Blvd.	52.5	06/22/06	9:10 AM - 10:10 AM	Arrivals & Departures	66.6	A320	61.8 - 74.0
TM39	Noe-Bixby Road	46.0	06/23/06	9:20 AM - 10:20 AM	Departures	62.9	EMB-135	65.8 - 72.1
TM40	Krumm Avenue & Sterling Court	51.9	06/24/06	12:20 PM - 1:45 PM	Departures	75.8	GA Prop	63.9 - 82.0
TM41	5969 Taylor Road	46.5	06/05/07	3:00 PM - 6:00 PM	Arrivals	85.5	A319	57.7 - 91.9
TM42	272 Sherborne Drive	48.6	06/06/07	6:00 AM - 10:00 AM	Departures	79.5	MD80	60.6 - 87.0
TM43	2702 Roxbury Road	44.9	06/06/07	3:00 PM - 6:00 PM	Departures	86.0	DC-9	62.5 - 93.5

DBA = A-Weighted Decibels

Lmax = Maximum Noise Level

SEL = Sound Exposure Level

1. Ambient Noise levels were recorded at each site and include noises other than aircraft events such as traffic, birds, and lawnmowers.

Source: Landrum & Brown, 2007.

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## **B.1.4 FLIGHT PROCEDURES AND TAKEOFF PROFILES**

The INM includes standard flight procedure data for each aircraft that represents each phase of flight to or from an airport. Information related to aircraft speed, altitude, thrust settings, flap settings, and distance are available and used by the INM to calculate noise levels on the ground. Standard aircraft departure profiles are supplied from the runway (field elevation) up to 10,000 feet above field elevation (AFE). Aircraft arrival profiles are supplied from 6,000 feet AFE down to the runway including the application of reverse thrust and rollout. The Federal Aviation Administration (FAA) requires that these standard arrival and departure profiles be used unless there is evidence that they are not applicable.

The INM uses a distance of flight as a surrogate for assigning departure profiles that determine aircraft weight, as well as speed, thrust, and altitude during different stages of flight.<sup>3</sup> The INM groups trip lengths into seven categories; these categories are:

<b><u>Category</u></b>	<b><u>Stage Length</u></b>
1	0-500 nautical miles
2	500-1000 nautical miles
3	1000-1500 nautical miles
4	1500-2500 nautical miles
5	2500-3500 nautical miles
6	3500-4500 nautical miles
7	4500+ nautical miles

An analysis of the departures at CMH was conducted in which actual flight profiles and noise levels were compared with flight profiles and predicted noise levels generated by the INM. The results of the analysis indicated that several aircraft were consistently lower in altitude on departure and produced higher noise levels than what was predicted by the noise model for those particular aircraft based upon the distance method. For example, a 737-300 departing to the Nashville International Airport (BNA) would be assigned a Stage 1 profile based upon the flight distance of 293 nautical miles. However, based upon observations made during the noise measurement program, it was noted that a 737-300 en-route to BNA more closely matched a higher stage profile (stage 2). Therefore all 737-300 aircraft departing to BNA were assigned a stage profile of 2 rather than 1. **Table B-3, Selection of Departure Profiles**, shows the changes that were made to those aircraft and destination combinations where the distance method was found to be inaccurate.

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<sup>3</sup> INM standard stage length assumptions are described on page 8-19 of the INM 6.0 Users Guide.

**Table B-3**  
**SELECTION OF DEPARTURE PROFILES**  
**Port Columbus International Airport**

INM AIRCRAFT ID	DESTINATION AIRPORT	DISTANCE FROM CMH TO DESTINATION	INM ASSIGNED STAGE	INM STAGE WEIGHT	OBSERVED STAGE <sup>1</sup>	OBSERVED STAGE WEIGHT
737300	BNA	293	1	108,800	2	114,100
737300	BWI	292	1	108,800	2	114,100
737300	MDW	245	1	108,800	2	114,100
737300	TPA	721	2	114,100	3	119,900
A319	ORD	256	1	128,800	4	141,100
MD82	ORD	256	1	117,000	2	124,000
MD83	ATL	388	1	125,000	4	158,000
MD83	CVG	100	1	125,000	4	158,000
MD83	DFW	803	2	133,000	4	158,000

<sup>1</sup>. Observed stage reflects the INM flight profile and noise level that most closely aligned with the observed flight profile and noise levels collected in the field. The observed weight is the INM assigned weight according to its stage length.

### B.1.5 PERMANENT NOISE MONITORING SYSTEM

CMH has 12 permanent noise monitors located at various sites to the north, south, east, and west of the airport. Monthly noise reports are produced for each of the permanent monitors. The reports provide the number of noise events, the number of hourly summaries, airport DNL, community DNL, and total DNL for each monitor. **Exhibit B-2, Permanent Noise Monitor Locations**, shows the location of the 12 monitors currently in use in the vicinity of CMH.

**Table B-4, Permanent Noise Monitors**, shows the recorded aircraft DNL (during the period of June 2, 2006 through September 30, 2006) compared to the INM modeled DNL for the Existing (2006) Baseline for each of the 12 monitoring sites. The period of June 2, 2006 through September 30, 2006 was used in the comparison because it is the period that most closely matched the conditions modeled for the Existing (2006) Baseline operating period. The operating levels for the Existing (2006) Baseline period were developed from Official Airline Guide (OAG) data, landing fee reports, and the ANOMS data for the period from May 2005 through April 2006. Runway use for the Existing (2006) Baseline period was derived for all aircraft categories except large jets from ANOMS data from April 2005 through March 2006. Runway use for large jets was derived from ANOMS data from June 2, 2006 through September 16, 2006 to include changes that occurred when Southwest Airlines relocated their operations from Concourse C (on the north side of the airport) to Concourse B (on the south side of the airport). This move resulted in increased use of the south runway (Runway 10R/28L).

The comparison shows that at eleven of the twelve permanent noise monitor locations INM modeled noise levels were within approximately 2.0 dB of the monitored noise levels at each of the locations. The average noise level across all of the sites was modeled to be 60.3 DNL, while the average monitored noise level

was 57.9 DNL. Because a difference of 1.2 dB is generally imperceptible to the human ear, it was determined that the modeled and monitored noise levels are within an acceptable tolerance. The INM modeled noise levels are higher at most sites due to the number of operations in the average-annual day being higher than the average number of operations during the time period of monitored levels. Because the Existing (2006) Baseline condition is comprised of various types of data from several different time periods, it is impossible for the modeled DNL and the monitored DNL to match exactly.

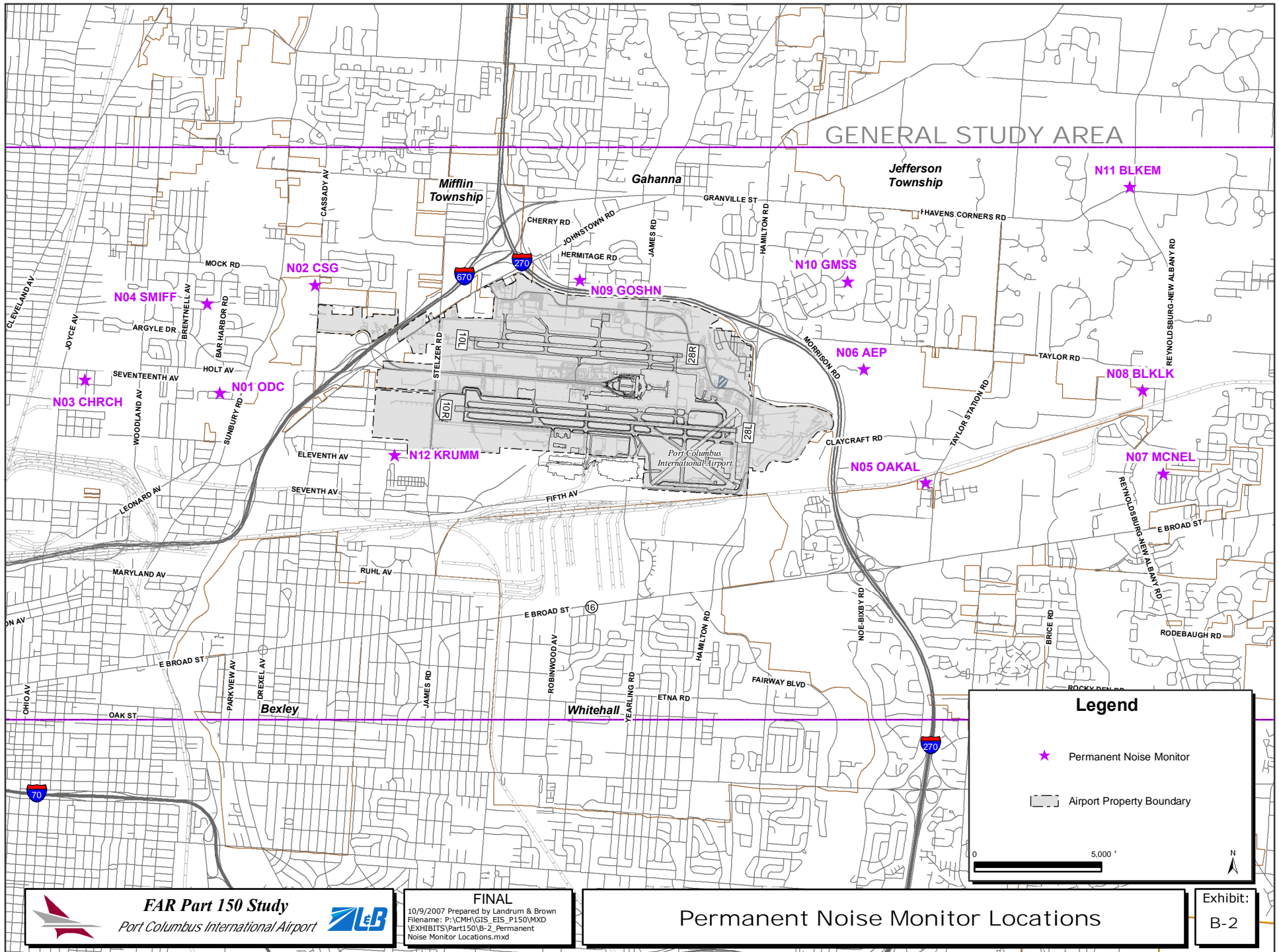
**Table B-4  
NOISE LEVELS AT PERMANENT NOISE MONITOR SITES  
PORT COLUMBUS INTERNATIONAL AIRPORT**

<b>Monitor Number</b>	<b>Location</b>	<b>Latitude</b>	<b>Longitude</b>	<b>INM Modeled DNL</b>	<b>Monitored DNL<sup>1</sup></b>	<b>Difference</b>
PM1	ODC	39.99724	-82.94329	64.1	62.3	1.8
PM2	CSG	40.00895	-82.92997	61.6	60.4	1.2
PM3	CHRCH	39.99862	-82.96229	61.3	59.8	1.5
PM4	SMIFF	40.00689	-82.94512	61.8	61.5	0.3
PM5	OAKAL	39.98789	-82.84401	57.3	55.0	2.3
PM6	AEP	40.00011	-82.85276	63.4	62.6	0.8
PM7	MCNEL	39.98893	-82.81061	58.9	58.1	0.8
PM8	BLKLK	39.99796	-82.81354	58.4	57.7	0.7
PM9	GOSHN	40.00963	-82.89276	54.2	54.6	-0.4
PM10	GMSS	40.00961	-82.85506	50.6	50.4	0.2
PM11	BLKEM	40.01944	-82.81861	43.7	47.1	-3.4
PM12	KRUMM	39.99083	-82.91972	61.5	59.3	2.2
<b>AVERAGE</b>				<b>60.3</b>	<b>59.1</b>	<b>1.2</b>

<sup>1</sup>. Actual Average Aircraft DNL Value Recorded by Permanent Noise Monitor from 6/1/2006 to 9/30/2006

Source: Columbus Regional Airport Authority & Landrum & Brown Analysis, 2007

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## B.1.6 NOISE COMPLAINT HISTORY

Noise complaint records dating back to 1996 were gathered in a database format for analysis in this study. **Table B-5 Summary of Noise Complaints** provides a summary of the number of noise complaints received each year. **Exhibit B-3, Location of Noise Complaints (2005 through 2006)**, illustrates the geographic locations of the noise complaints from January 2005 through December 2006.

**Table B-5**  
**SUMMARY OF NOISE COMPLAINTS**  
**Port Columbus International Airport**

Year	Number of Noise Complaints
1996	155
1997	187
1998	268
1999	231
2000	159
2001	120
2002	169
2003	113
2004	116
2005	88
2006	40

Source: Columbus Regional Airport Authority, 2007

On average the total annual number of noise complaints has decreased from 1998 when the airport received the most noise complaints, 268. The decline in complaints since 2002 has coincided with the reduction in operations due to America West's downsizing at CMH and AirNet's relocation to Rickenbacker International Airport. Other factors that may have led to a reduction in complaints included industry trends toward operating quieter aircraft and the continued implementation of the Residential Sound Insulation Program. The largest number of complaints occurred in the Columbus and Gahanna areas.

The noise complaint database was used to assist in the identification of noise concerns and in the development of mitigation and noise abatement measures.

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