PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

Chapter Two
AVIATION NOISE

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AVIATION NOISE

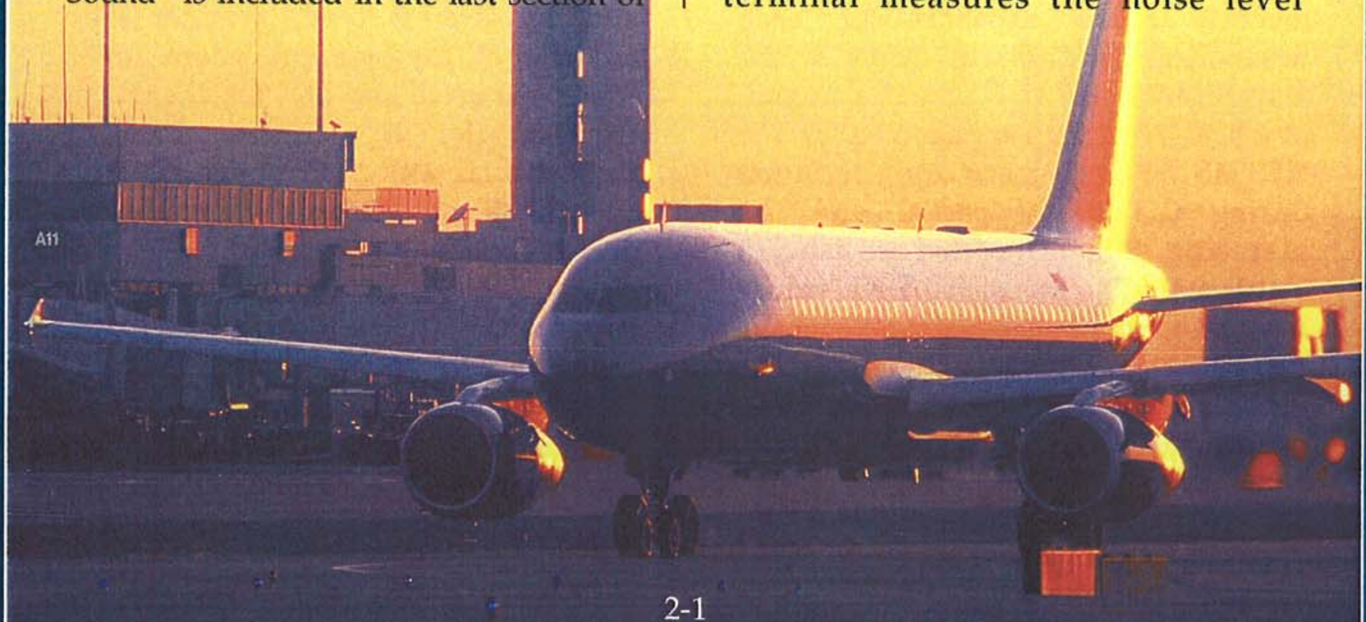
This chapter describes the methods and assumptions used to develop the noise exposure maps for Phoenix Sky Harbor International Airport. Noise exposure maps have been prepared for three study years: 1999, 2004 and 2015. The 1999 noise exposure map is intended to represent current airport operations and is based upon noise and operational data collected over the period of July 1, 1997 to June 30, 1998. The 2004 and 2015 noise exposure maps are based upon the forecast from the 1999 Phoenix Sky Harbor Airport Master Plan. The 1999 and 2004 noise exposure maps are the basis for the official Noise Exposure Maps required under F.A. R. Part 150.

This aircraft noise analysis relies upon complex data and analytical methods, and uses numerous technical terms. A Technical Information Paper (TIP) entitled "The Measurement and Analysis of Sound" is included in the last section of this document. The TIP provides background information which will help the reader to understand the contents of this chapter.

AIRCRAFT NOISE MEASUREMENTS AND OPERATIONS DATA COLLECTION

A Noise and Flight Track Monitoring System (NFTMS) was placed into operation at Phoenix Sky Harbor International Airport on September 1, 1996. The NFTMS collects noise level data from twenty permanent monitoring terminals located in the vicinity of the airport. The locations of the monitoring terminals are shown by **Exhibit 2A**.

Each noise monitoring terminal consists of a microphone and a precision sound level meter with digital memory. Each terminal measures the noise level



continuously at a rate of one sample per second in terms of A-weighted sound pressure levels, and the data are stored internally. The terminals apply a set of programmable parameters to separate and store presumed aircraft noise events from background noise levels. The terminals also calculate hourly statistics for overall noise levels. Once each day, the terminals are downloaded by telephone connection to the NFTMS central computer (located at the Airport), and the data are stored in the central computer.

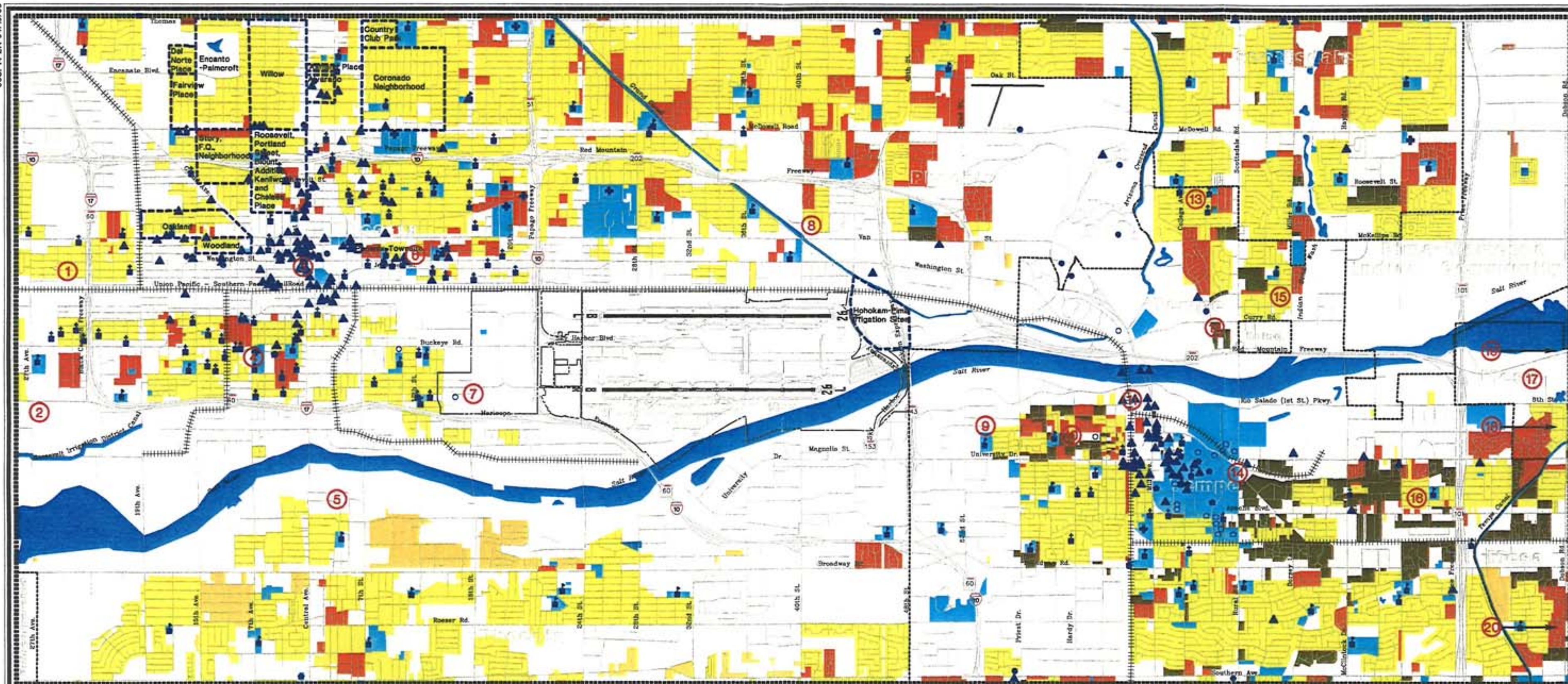
The NFTMS also maintains a connection to the FAA radar tracking system (ARTS) which operates on a continuous basis. These data are downloaded daily, but transmission to the NFTMS is delayed by the FAA for 72 hours. After the radar data for a given day have been downloaded, the NFTMS software correlates the presumed aircraft noise events collected from each noise monitoring terminal with the aircraft operations reported by the FAA. The noise level values for the correlated noise events are stored, and are then used to calculate the daily aircraft noise exposure at each monitoring terminal in terms of the Day-Night Level (DNL). The annual average DNL values reported by the NFTMS for each monitoring terminal during the study period and the preceding 12-month period are listed in **Table 2A**. The measured DNL values have been relatively consistent over the two 12-month periods, with an average difference in measured annual DNL values of 0.1 dB.

The single event noise levels for presumed aircraft operations were stored by the NFTMS and were used to evaluate the relative accuracy of aircraft noise modeling assumptions. This process will be described in the discussion of noise modeling assumptions.

The aircraft operational data collected by the NFTMS includes identification of each IFR aircraft and operator, runway use, navigational fix, and coordinates, altitudes and speeds along each flight track. These data for the last 18-month period are stored in the central computer and may be recovered at any time. The NFTMS also collects similar data on VFR aircraft.

For this analysis, NFTMS data for the study period were collected and rigorously examined. Initially, four data files were created which counted the numbers of departures and arrivals during daytime (7 a.m. to 10 p.m.) and nighttime (10 p.m. to 7 a.m.) hours for each aircraft type reported by the FAA. These counts were further divided by trip length (for departures), runway use and the nearest navigation fix. These data allowed a determination of the total numbers of aircraft operations at Phoenix Sky Harbor in the study period, and, by aircraft type, whether they occurred at day or night, which flight route was used, and how far they were traveling (for departures). Each of these values was used to describe the operations at Phoenix Sky Harbor during the study period.

Because the NFTMS data are collected from the FAA radar system, the data are sometimes incomplete. That is, the radar system is periodically shut down for maintenance, some data are withheld by the FAA in accordance with the Memorandum of Agreement with the airport, and sometimes the transfer of data to the NFTMS is incomplete.



LEGEND

Airport Property	High Density Residential (15+ du/ac)
Municipal Boundaries	Water
Study Area	Noise-Sensitive Institutions
Historic District Boundaries	Place of Worship
Noise Monitor Terminal	School
Rural Residential (0-1 du/ac)	Hospital
Large Lot Residential (1.01-2 du/ac)	Museum
Small Lot Residential (2.01-5 du/ac)	Library
Medium Density Residential (5.01-15 du/ac)	Historic Structure
Residence Halls	Community Center

Source: Coffman Associates and Brown-Buntin Associates Analysis.

NORTH

0 5000 SCALE IN FEET

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

Exhibit 2A
PHOENIX SKY HARBOR INTERNATIONAL AIRPORT
NOISE MONITOR TERMINAL LOCATIONS

Therefore, the NFTMS operations by aircraft type were scaled to match the total operations reported by the FAA Tower at Phoenix Sky Harbor for the study period.

The NFTMS data do not include identification of most general aviation aircraft operating under visual flight rules. Operations assumptions for these aircraft must be derived from historical records and other documents.

TABLE 2A
Annual Average Measured DNL Values
At Permanent Noise Monitoring Terminals
Phoenix Sky Harbor International Airport

Noise Monitor Terminal Number	DNL, dB		Difference, dB
	1996-97[1]	1997-98[2]	
1	60.6	61.2	0.6
2	60.9	60.0	-0.9
3	62.9	63.1	0.2
4	65.1	66.0	0.9
5	61.5	61.9	0.4
6	61.6	62.5	0.9
7	72.2	72.3	0.1
8	58.7	58.2	-0.5
9	65.9	66.7	0.8
10	63.7	64.3	0.6
11	68.1	68.1	0.0
12	66.8	67.5	0.7
13	49.9	48.2	-1.7
14	57.3	57.3	0.0
15	62.0	61.5	-0.5
16	52.6	51.3	-1.3
17	61.6	63.1	1.5
18	57.9	57.1	-0.8
19	52.3	49.9	-2.4
20	50.6	49.2	-1.4

[1] July 1, 1996 to June 30, 1997
[2] July 1, 1997 to June 30, 1998

AIRCRAFT NOISE MODELING METHODOLOGY

The most widely used method for predicting aircraft noise levels in the vicinity of an airport is the FAA Integrated Noise Model (INM), which has been approved by the FAA for use in F.A.R. Part 150 studies. The INM has evolved over a period of more than twenty years to incorporate acoustical and performance data for most of the aircraft in the current U.S. fleet. The INM was primarily designed as a planning tool, and it uses national average values to predict noise levels at any given airport.

The latest versions of the INM are quite sophisticated, accounting for such variables as airfield elevation, temperature, headwinds and local topography in predicting noise levels at a given location. INM Version 5.2a (the latest release at the time of the study) was used to prepare noise exposure maps for the Phoenix Sky Harbor noise analyses.

The INM predicts noise levels at a set of grid points surrounding an airport. The numbers and locations of grid points are established during the INM run to determine noise levels in the areas where operations are concentrated, depending upon the tolerance and level of refinement specified by the user. The noise level values at the grid points are used to prepare noise contours, which connect points of equal noise exposure. INM will also calculate the noise levels at a user-specified location, such as the site of a permanent noise monitoring terminal.

INM INPUT ASSUMPTIONS

AIRPORT AND STUDY AREA DESCRIPTION

Inputs to the INM include runway configuration, flight track locations, aircraft fleet mix, stage length (trip length) for departures, and numbers of daytime and nighttime operations by aircraft type. The INM provides a database for PHX, which locates the runways in terms of latitude and longitude, as well as elevation and temperature. The INM also includes a database for the commercial and military aircraft which commonly operate at PHX. For propeller-driven general aviation aircraft, relatively few aircraft descriptions are available. **Exhibit 2B** depicts the INM input assumptions.

The INM computes typical flight profiles for aircraft operating at the airport location, based upon the field elevation, lapse rate temperature, and flight procedure data provided by aircraft manufacturers. The INM will also accept user-provided input, although the FAA reserves the right to accept or deny the use of such data depending upon its statistical validity. The Phoenix Sky Harbor field elevation is 1,133 feet above mean sea level (MSL). The lapse rate temperature, the change in temperature with height, is calculated by multiplying the International Standard Atmosphere (ISA) temperature lapse rate of 0.003566 degrees Fahrenheit by the airport field elevation (1,133 feet MSL) and subtracting this value from the INM's standard day temperature of 59 degrees. This equates to a lapse rate temperature of 55 degrees Fahrenheit for Phoenix Sky Harbor.

It is also possible to incorporate a topographic database into the INM, which allows the INM to account for the changes in distances from aircraft in flight to elevated receiver locations. However, the topographic data, while obtained from the U.S. Geographical Survey, are of relatively low resolution, and experience has shown that these data can produce erroneous results in predicting noise levels where airports are located on relatively flat terrain. Thus the topographic database was not employed for this study, as the terrain surrounding Phoenix Sky Harbor is essentially level where most people live. Exceptions may occur for homes located

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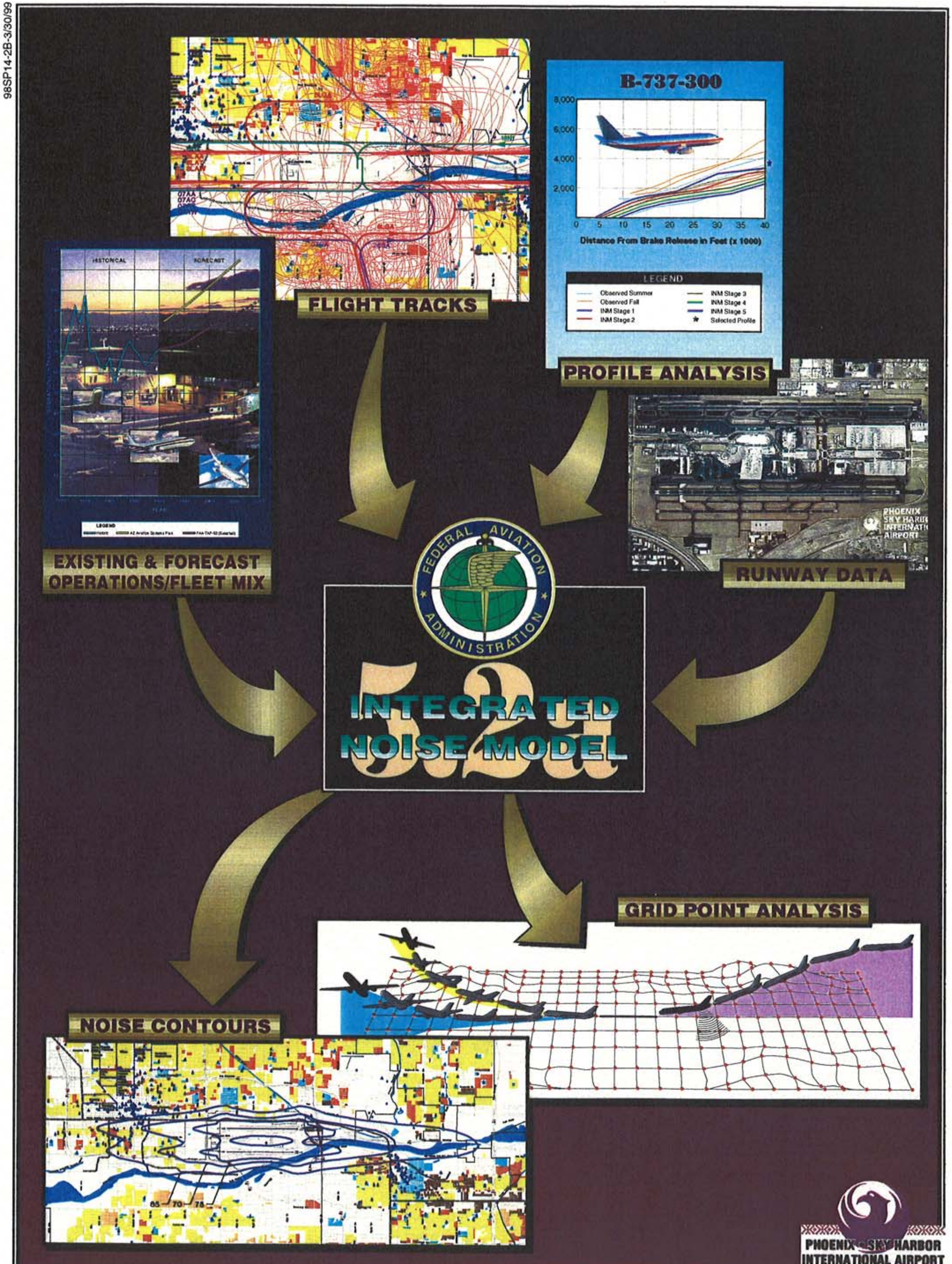

Exhibit 2B
INM PROCESS

on hills, but the magnitude of the expected differences in noise levels at those receivers is expected to be less than 1 dB.

ACTIVITY DATA

Noise evaluations were made for the current year based on actual operations from July 1, 1997 to June 30, 1998. Five-year (2004) and long-term (2015) contour sets were also prepared. Existing and forecast operations are summarized in **Table 2B**.

The airline category in **Table 2B** generally consists of air carrier, commuter, and cargo turbojet operations. Commuter turboprop, cargo turboprop, and charter operations generally make up the air taxi category.

TABLE 2B
Existing and Forecast Annual Operations
Phoenix Sky Harbor International Airport

Operation Type	1999[1]	2004[2]	2015[3]
Airline	366,208	485,300	602,000
Air Taxi	72,354	92,165	86,000
Military	5,192	9,500	10,000
General Aviation	76,444	81,000	75,000
Grand Total	520,198	667,965	773,000

Sources:
1 Air Traffic Control Tower Records July 1, 1997 to June 30, 1998
2 Draft Phoenix Sky Harbor International Airport Master Plan and Coffman Associates analysis.
3 Draft Phoenix Sky Harbor International Airport Master Plan

OPERATIONS AND FLEET MIX

To prepare the operations fleet mix assumptions for the existing condition (1999), the operations data collected by the NFTMS for the entire study period were used. As described above, four data files were created which counted the numbers of departures and arrivals during daytime (7 a.m. to 10 p.m.) and nighttime (10 p.m. to 7 a.m.) hours for each aircraft type reported by the FAA. These counts were further divided by trip length (for departures), runway use and the nearest navigation fix. For use in the INM, the FAA aircraft type designations were combined by the consultant into generalized INM aircraft designations. These data allowed a determination of the total numbers of aircraft operations at Phoenix Sky Harbor in the study period, and, by aircraft type, whether they occurred at day or night, which generalized flight track was used, and how far they were traveling (for departures). Travel distance is an important variable since it accounts for the increased aircraft weight due to the additional fuel required to fly longer distances. Each of these values was used to describe the operations by aircraft type at Phoenix Sky Harbor during the study period.

The reported distributions of aircraft operations by generalized INM aircraft type, time of day and runway use are summarized in **Appendix C**.

As noted above, the NFTMS operations counts derived from the FAA radar data are representative of the distribution of operations by aircraft types. To match the NFTMS counts to the FAA counts for commercial aircraft operations, a factor of 106% was applied to the counts reported by the NFTMS.

Military aircraft operations were reviewed, and the aircraft types were combined as appropriate for the noise emission characteristics of each type. Again, the total numbers of military operations were reconciled with the FAA tower counts. The total number of operations by general aviation aircraft was derived from the FAA tower counts. The distribution of general aviation aircraft types was developed from a review of historical data and records of instrument flight rule (IFR) operations, and is identical to the assumptions used in preparing the Draft Airport Master Plan which is currently under development.

Table 2C lists the assumed numbers of operations by aircraft type, after applying the correctional factors described above.

For the prediction of future aircraft noise levels, it was necessary to consider the predicted future operations at Phoenix Sky Harbor, as well as the planned configuration of the airport. To provide a forecast of average daily operations by aircraft type, recent operational fleet mix information was reviewed and compared to "Growth Scenario" projections which were included in the Draft Phoenix Sky Harbor International Airport Master Plan, prepared by Leigh Fisher Associates (LFA). The forecast years included in the draft master plan were for 2005 and 2015. For purposes of the F.A.R. Part 150 Noise Compatibility Program Update, it will be necessary to use 2004 and 2015 as the forecast years. Therefore, current operational activity was initially compared to an interpolated forecast year of 1998 from the master plan. Average day operations for 1997-1998 (July to July period) were slightly below the 1998 draft master plan forecast, but only in the air taxi and general aviation categories. The scheduled airline and air cargo activity compared very favorably (within 4 percent). Consequently, the draft master plan forecasts for average daily operations were considered appropriate for the noise study. However, future operational mix assumptions were reviewed for their appropriateness.

For the draft master plan, air carrier operations were assumed to increase from 66 percent of total operations in 1995 to 74 percent of operations by 2015. Air taxi and commuter operations were forecast to increase through the period, although their share of total operations was forecast to decrease slightly. Military activity was projected at a static level. The average daily seats per departure for scheduled air carriers in 2005 was 149, increasing to 157 by 2015.

Review of the America West and Southwest fleet mix, the dominant airlines serving the airport, indicates a slightly higher percentage of B737-300 aircraft in each airline's mix, with Southwest beginning to phase in the B737-700. This aircraft will figure prominently in Southwest's future mix, with all of their current orders or options in this aircraft type. America West has placed orders, with options,

TABLE 2C
Existing and Forecast Daily Operations
Phoenix Sky Harbor International Airport

Aircraft Class	INM Designator	1999[1]	2004[2]	2015[2]
Commercial Stage 2 Jets				
B727 - Stage 2	727D17	30	0	0
B727 - Stage 2	727Q15	<1	0	0
B737 - Stage 2	737QN	89	0	0
DC9 - Stage 2	DC9Q9	10	0	0
Commercial Stage 3 Jets				
B727-Hushkit - Stage 3	727EM2	18	29	0
B737-Hushkit - Stage 3	737N17	28	40	0
B737-300	737300	523	379	388
B737-400	737400	5	59	120
B737-500	737500	18	100	53
B737-700	737400	3	166	241
B747	747200	1	5	7
B757	757RR	82	108	218
B767	767JT9	5	69	131
DC10	DC1030	9	1	0
DC8	DC870	7	30	83
A300	A300	1	30	83
A310	A310	2	10	31
A319	A320	<1	46	67
A320	A320	84	133	134
F70, F100	F10062	<1	16	0
L1011	L1011	<1	1	0
MD11	MD11PW	<1	13	13
MD80 (series)	MD83	70	71	27
MD90	MD9028	5	0	0
Regional Jet	CL601	15	50	84
Commercial Turboprop				
Turboprop	SF340	101	118	83
Military				
Twin	CNA441	3	8	8
Turboprop	C130	2	4	5
KC135/C-141	707320	7	8	8
Small Jet (Fighter)	A7D	2	6	6
General Aviation				
Single Engine Piston	COMSEP	190	138	127
Twin Engine Piston	BEC58P	46	83	95
Twin Turboprop	CNA441	31	46	44
Jet - Small- Stage 3	CNA500	2	2	2
Jet - Small - Stage 2	LEAR25	1	1	0
Jet - Medium Size	LEAR35	6	16	16
Helicopter	B206	31	45	43
Total		1425	1830	2118

Sources:
[1] Air Traffic Control Tower Records July 1, 1997 to June 30, 1998
[2] Draft Phoenix Sky Harbor International Airport Master Plan and Coffman Associates analysis.
[3] Draft Phoenix Sky Harbor International Airport Master Plan

for additional A320s and the new A319. Each airline appears (based upon current orders) to continue to operate in the future with fleets which are predominantly in the 125-150 seat category. Therefore, assumptions made in the master plan with regard to fleet mix distribution appear to remain valid, although the distribution between aircraft types will be revised. Fleet mix assumptions will need to include the A319, which is not reflected in the master plan. The commuter airline's future fleet mix also needs to be adjusted to reflect the higher utilization of regional jets in future years. The air cargo companies continue to operate with a mix of small and medium narrow-body, and medium and large wide-body aircraft. The small-size category is dominated by the 727, while the medium narrow-body fleet is dominated by older generation aircraft, such as the 707 and DC-8, but with increasing numbers of 757 freighters. Carriers are turning to a variety of medium-sized wide-body aircraft as replacements for older 707s and DC-8s. These medium-sized wide-body aircraft include the DC-10-30 and converted 40 series, the MD-11 and the A300/310s. Reasonable estimates were included in the master plan for the future air cargo mix, with the possible exception of not including the converted DC-10s and A300 freighters in the fleet, each of which are already in the current fleet mix. These assumptions, summarized in **Table 2C**, were used as inputs to the noise modeling process.

DATABASE SELECTION

To select the proper aircraft from the INM database, a review of the current fleet mix for each airline and user group at Phoenix Sky Harbor was conducted. The INM describes several different versions of the B-737 and MD-80 aircraft. The B-737 aircraft is the most common one at the airport. The model's 737QN was used for the 737-100/200, with the 737300 used for B-737-300, the 737400 used for the B-737-400, and the 737500 was used for the B-737-500 series. The INM approved substitute 7373B2 was used to model the B-737-600. Hushkitted B-737 aircraft were modeled with the 737N17. The 747200, 757RR, and 767JT9 designators were used to represent the B-747, B-757, and B-767 aircraft in the fleet mix respectively.

Stage 2 B-727 aircraft operations are modeled using the 727D17 and 727Q15 INM designator. The 727EM2 INM designator represents the B-727 hushkitted aircraft in the Phoenix Sky Harbor fleet mix.

The MD83 and MD9028 were used to represent the MD-80 and MD-90 aircraft at Phoenix Sky Harbor. Stage 2 DC-9 aircraft operations are modeled using the DC9Q9 INM designator. DC-8 and DC-10 aircraft operations are modeled using the DC870 and DC1030 INM designators. L-1011 and MD-11 aircraft operations are represented in the model by the L1011 and MD11PW.

The A300, A310, and A320 designators were used to represent the A-300, A-310 and A-320 aircraft operations respectively. The A320 designator is also an approved substitute for the A-319. The F-70 and F-100 aircraft operations are modeled with the F10065 INM designator. Regional jet and turboprop aircraft in the commuter fleet are represented by the INM designators CL601 and SF340. These selections are commensurate with the Approved Substitution List.

Military operations at Phoenix Sky Harbor is distributed between five generalized aircraft types. The small and large turboprop military aircraft are modeled with INM designators CNA441 and C130. The small military fighter jets are represented in the model by the INM designator A7D. The C-141 and KC- 135 aircraft are modeled with the 707320 aircraft from the model.

General aviation operations were modeled with COMSEP representing the small single engine piston aircraft. The BEC58P was chosen for the twin pistons and CNA441 for the twin turboprops.

The INM provides data for most of the business turbojet aircraft in the national fleet. The CNA500 and LEAR35 effectively represent the small and medium Stage 3 business jets in the Phoenix Sky Harbor fleet. The LEAR25 designator effectively represents the Stage 2 business jets.

Helicopter operations are modeled using the B206. The B206 helicopter data was extracted from the FAA Publication, *Helicopter Noise Curves For Use In Environmental Assessments* (Reference 2).

All substitutions depicted on **Table 2C** are commensurate with published FAA guidelines.

Single Event Analysis

Measured single event noise levels were used to verify and refine noise modeling assumptions for existing and future conditions at Phoenix Sky Harbor. Because the noise exposures in these conditions are typically dominated by departures of B727, B737-100/200, B737-300 (series) and MD-80 aircraft types, most of the attention concerning single event noise levels was devoted to these aircraft. The single event noise level comparisons were performed for monitoring site 7 which provide clear line of sight from the noise monitoring terminal to the aircraft, and where the aircraft are relatively high above the horizon. This eliminates the influence of the INM sideline attenuation algorithm, which will affect calculations of noise levels for aircraft below an angle of elevation of 60 degrees above the horizon.

Exhibits 2D, 2E, 2F, and **2G** show the range of measured and Sound Exposure Level (SEL) values in August 1997 at permanent monitoring Site 7, for the B-727, B-737-100/200, B-737-300, and MD-80 aircraft types. It should be noted that Stage 2 or hushkitted Stage 3 B-727 or B-737-100/200 which means there may be large differences between noise levels produced by presumably identical aircraft. Other factors that should be noted include:

- Differences in distances from the aircraft to the monitor;
- Differences in specific aircraft configurations within the general aircraft type;
- Substitution of aircraft types by the carrier after flight plans are filed, and;
- Incorrect aircraft type designations entered by the carrier or the FAA.

In order to compare the INM with the permanent noise monitoring and flight track system at Phoenix Sky Harbor, an estimate of the distance between the aircraft and noise monitoring sites is necessary. This distance, referred to as the slant range distance, (the straight line distance from the measurement site to the aircraft), can be calculated by geometric principles from radar flight track "X" and "Y" coordinates and associated altitudes. **Exhibit 2C** shows the method of calculation. The time track from the radar flight track data can then be used to correlate noise events from monitoring Site 7.

A detailed INM grid point analysis using the 1999 Noise Exposure Map noise run was completed to develop similar slant range distance and associated noise level data at monitoring Site 7. Data from these two sources can then be plotted on a graph for comparison.

The B-727 measured and INM data comparison is depicted on **Exhibit 2D**. The 727D17 and 727Q15 INM designators were used to represent the B-727 in the noise model. The B-727 INM data depicted on **Exhibit 2D** generally falls at the top range of the measured data. A majority of the measured data for the B727 falls between 0 and 1,500 feet from the monitor and registers between 100 and 110 dBA. Small clusters of B-727 INM data points fall above the measured data at comparable distances (between 1,500 and 2,000 feet) from monitoring Site 7.

Exhibit 2E depicts the B-737-100/200 measured and INM data comparison. The 737QN INM designator was used to represent the B-737-100/200 in the noise model. The B-737 measured data depicted on **Exhibit 2E** generally ranges from 101 dBA at 500 feet down to 91 dBA at 2,000 feet. The INM data falls at the top range of the measured data at comparable distances (between 1,600 and 2,100 feet) from monitoring Site 7.

The B-737-300 measured and INM data comparison is depicted on **Exhibit 2F**. The 737300 INM designator was used to represent the B-737-300 in the noise model. A majority of the measured data for the B-737-300 falls between 250 and 2,750 feet from the monitor and registers between 82 and 95 dBA. The B-737-300 INM data depicted on **Exhibit 2F** generally falls at the upper range of the measured data at comparable distances (between 1,400 and 2,300 feet) from monitoring Site 7.

Exhibit 2G depicts the MD-80 measured and INM data comparison. The MD83 INM designator was used to represent the MD-80 in the noise model. The MD-80 measured data depicted on **Exhibit 2G** generally ranges from 101 dBA at 250 feet down to 90 dBA at 2,200 feet. The MD-80 INM data falls at the top range of the measured data at comparable distances (between 1,200 and 2,100 feet) from monitoring Site 7.

The examples above illustrate that INM aircraft selections for the B-727, B-737-100/200 and MD-80 correlate well and tend to slightly over-predict noise for these aircraft. The INM aircraft selection for B-737-300 also correlates well, falling within the upper range of measured data.

Time of Day

The time of day of operations is important in determining the aircraft noise exposure in terms of the Day-

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$$S = \sqrt{A^2 + H^2}$$

S - Slant Range Distance (Calculated)

A - Altitude Above Ground Projected Track (Radar Readout)

H - Shortest Distance from Ground Projected Track to Noise Monitor (Distance)

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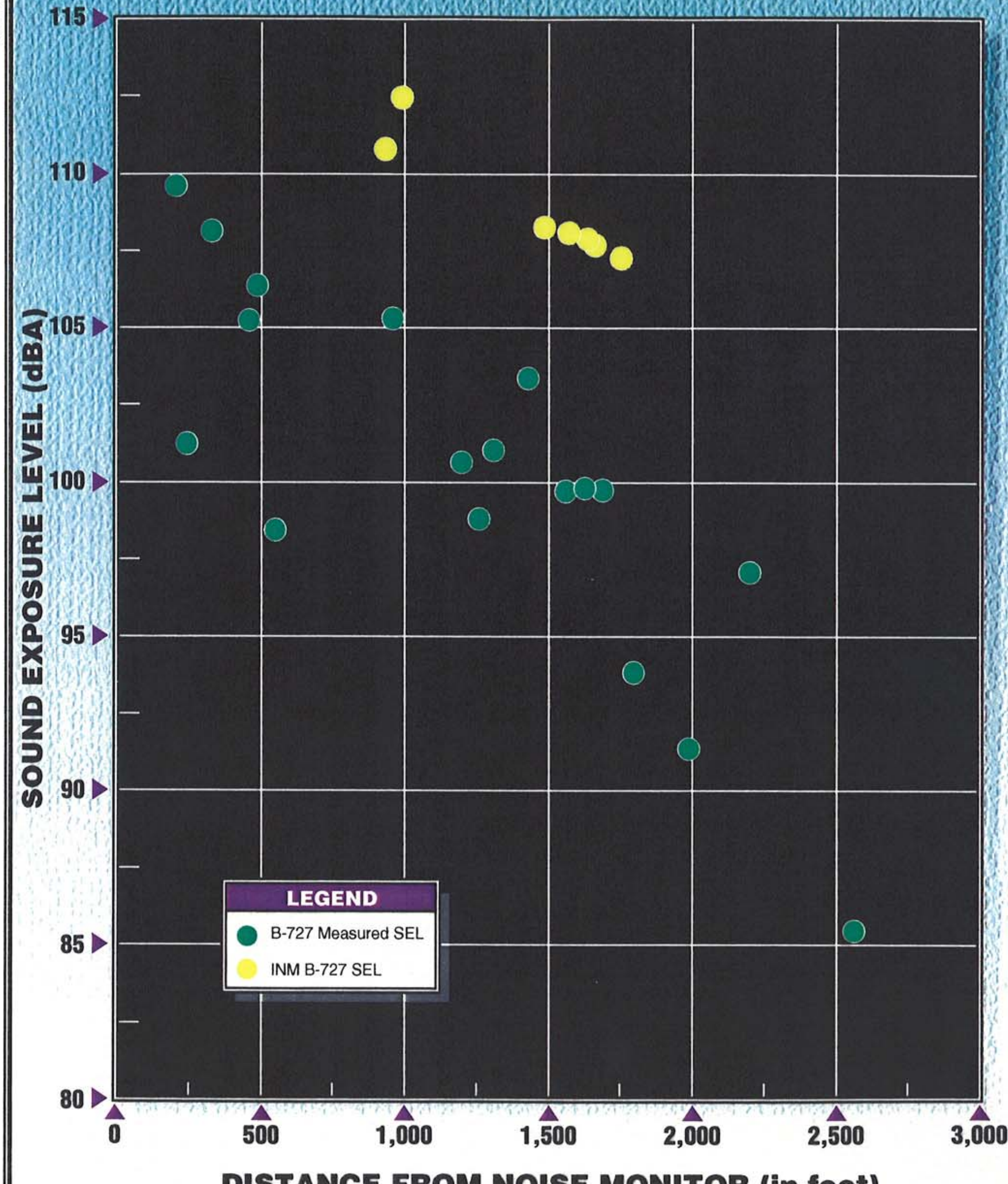
INTERNATIONAL AIRPORT

Exhibit 2C
TYPICAL SLANT RANGE
DISTANCE CALCULATION

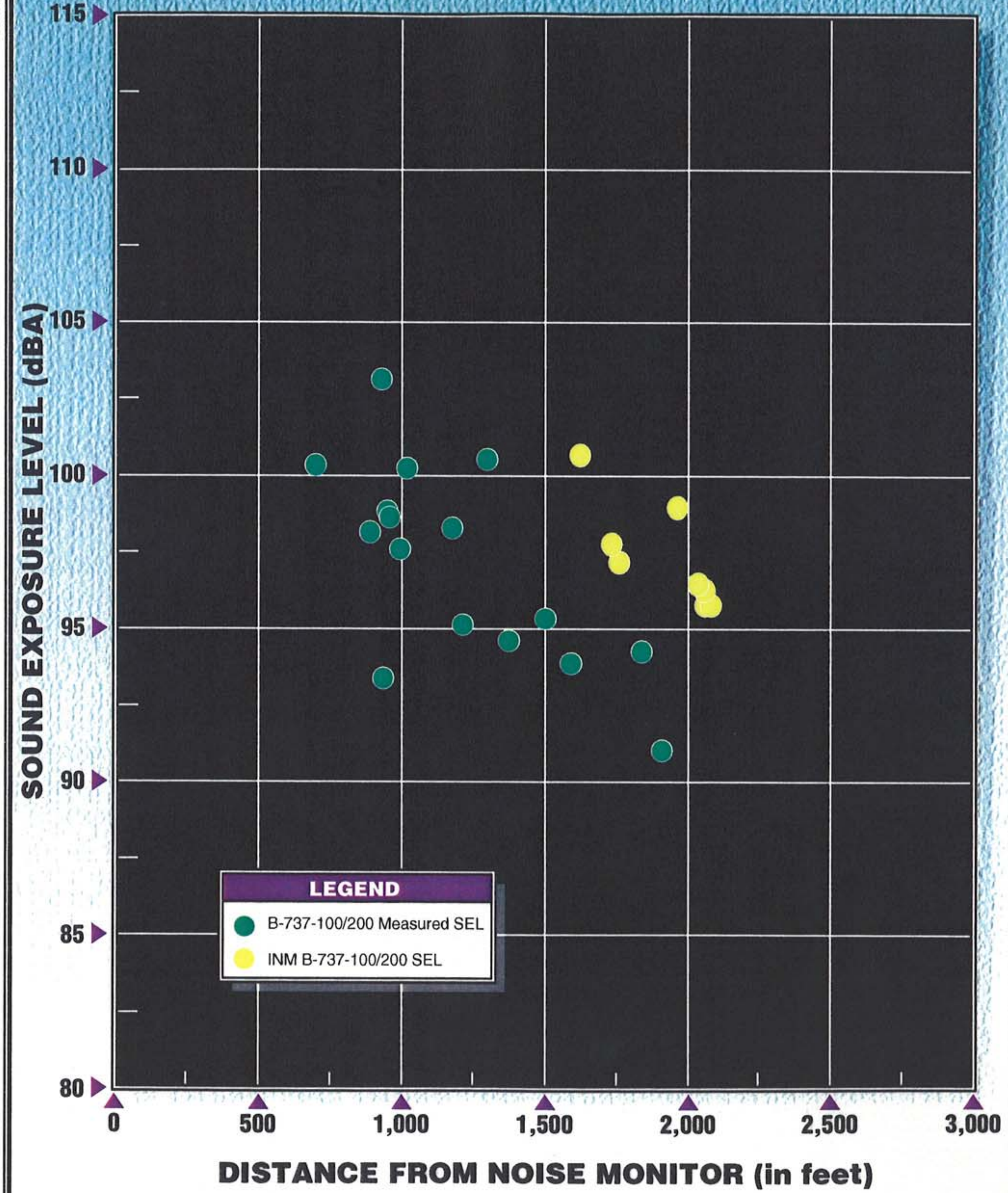
98SP14-2D-3/30/99



Notes:
Observations at noise monitor terminal Site 7 on August 18-22, 1997.

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

Exhibit 2D
B-727 MEASURED AND INM SOUND EXPOSURE LEVEL COMPARISON



Notes:
Observations at noise monitor terminal Site 7 on August 21, 1997.

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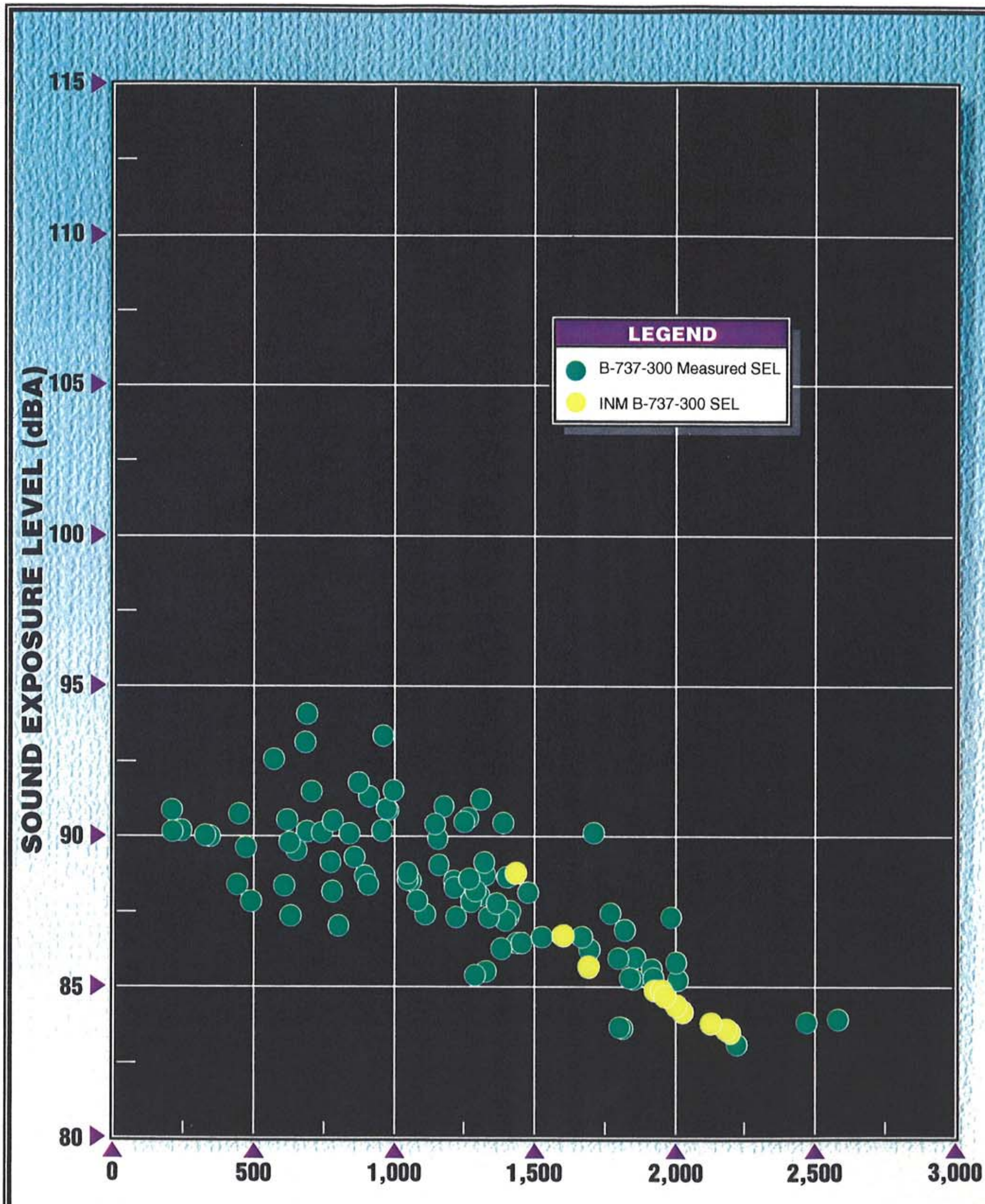
Exhibit 2E
B-737-100/200 MEASURED AND INM
SOUND EXPOSURE LEVEL COMPARISON



Notes:
Observations at noise monitor terminal Site 7 on August 21, 1997.

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

Exhibit 2F
B-737-300 MEASURED AND INM SOUND EXPOSURE LEVEL COMPARISON

Night Level (DNL), as nighttime operations are weighted by a factor of ten. The assumed day/night distribution of aircraft operations at Phoenix Sky Harbor was derived from the NFTMS data for the study period, as reported in **Appendix C**. The overall day/night distribution of operations by aircraft class is summarized by **Table 2D**.

In 1995, the percentage of operations occurring in nighttime hours was assumed to be 9 percent. Based upon current data, the percentage is slightly less at 8.3 percent. The draft master plan assumed that nighttime operations would increase to 10 percent by 2005 and 13 percent by 2015 to accommodate the forecast operation increase. Stage length assumptions were assumed to remain constant through the planning period.

TABLE 2D
Day/Night Distribution of Aircraft Operations
Phoenix Sky Harbor International Airport
1997-98

Aircraft Class	Percent of Arrivals		Percent of Departures	
	Day	Night	Day	Night
Commercial	89.5	10.5	91.0	9.0
Commuter	92.1	7.9	95.0	5.0
GA	91.7	8.3	82.3	17.7
Military	97.1	2.9	92.7	7.3

Source: Sky Harbor Permanent Noise and Flight Track Monitoring System.

Runway Use

The NFTMS data were used to determine the distribution of aircraft operations to runways, including consideration of day and night operations. The detailed allocations of aircraft operations by runway are shown in **Appendix C**. **Table 2E** summarizes these data by general aircraft class.

Planned changes to the airport configuration in the future include the extension of Runway 08L-26R by 900 feet to the west with a relocation of the eastern threshold 410 feet to the west, and the construction of a new Runway 07-25, parallel and south of the existing runways. These changes to the airfield configuration were added to the INM study prior to preparing the future noise exposure maps.

The addition of Runway 07-25 is expected to result in some operational changes at Phoenix Sky Harbor. According to the FAA Record of Decision and supporting environmental documentation, Runway 07-25 is primarily intended for air carrier and small aircraft. Runway 07-25 will also be used occasionally for air carrier departures during peak departure

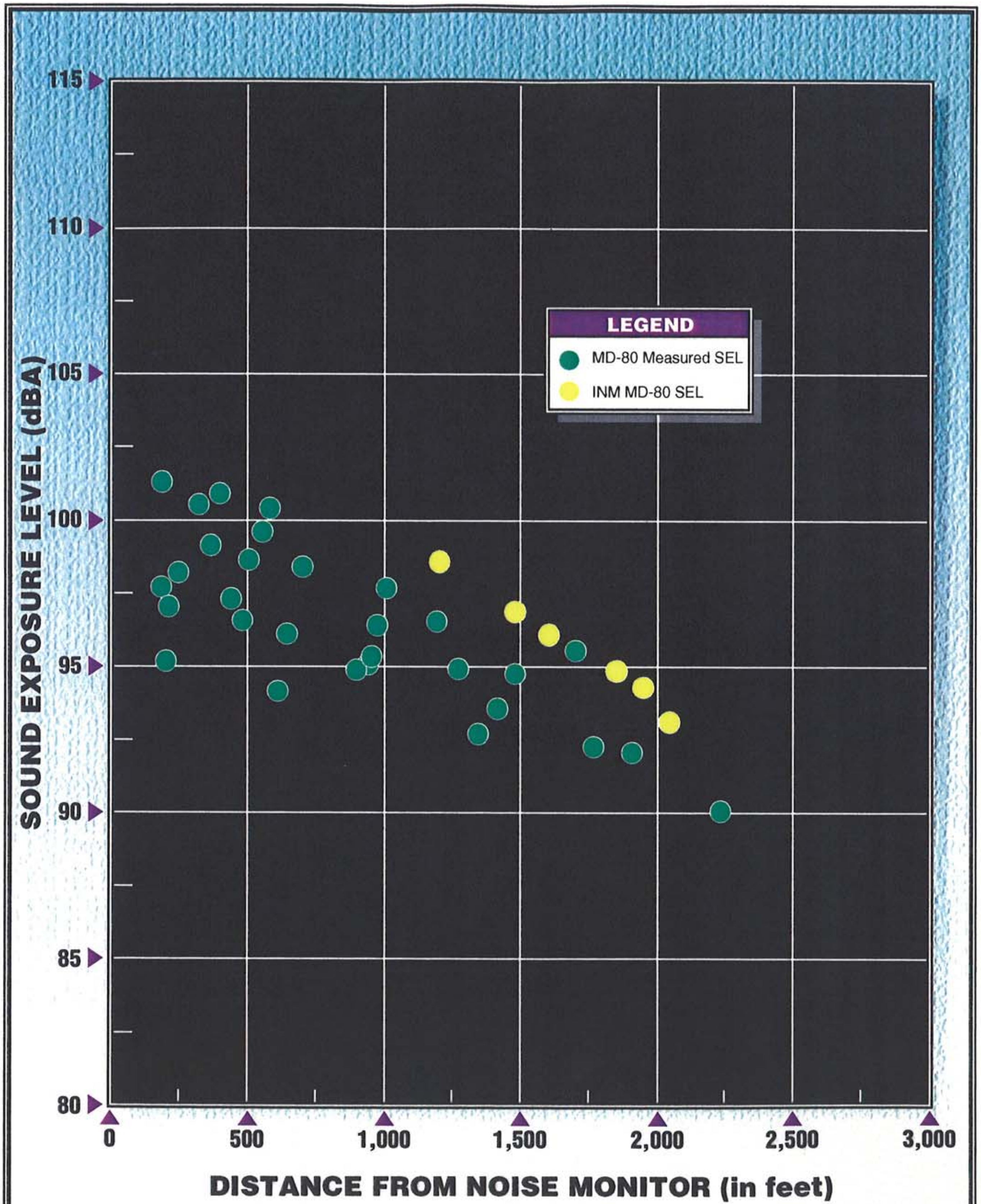
TABLE 2E AVERAGE ANNUAL RUNWAY USE BY AIRCRAFT CLASS Year 1997-98 Phoenix Sky Harbor International Airport						
Departure Runway Use						
	% Daytime			**% Nighttime**		
Runway	**Commercial**	**Commuter**	**General Aviation**	**Commercial**	**Commuter**	**General Aviation**
8R	14%	2%	40%	33%	5%	53%
8L	20%	33%	16%	23%	21%	19%
26R	37%	44%	20%	24%	49%	13%
26L	29%	21%	24%	20%	25%	15%
07	0%	0%	0%	0%	0%	0%
25	0%	0%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%	100%
Arrival Runway Use						
8R	20%	11%	13%	20%	12%	22%
8L	13%	24%	10%	18%	70%	24%
26R	32%	49%	28%	32%	16%	32%
26L	35%	16%	49%	30%	2%	22%
07	0%	0%	0%	0%	0%	0%
25	0%	0%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%	100%
Source: The Noise and Flight Track Monitoring System as reported by Brown-Buntin Associates.						

periods or when an existing runway is closed for maintenance. For this analysis, annual average runway use factors for Runway 07-25 were the same as those used in the 1993 Final Environmental Impact Statement. These assumptions are listed in **Table 2F**.

Flight Tracks

The analysis of aircraft operations over the period of July 1, 1997 - June 30, 1998 revealed that air carrier, cargo, commuter and large general aviation aircraft departures predominantly occurred on seven Standard Instrument Departure routes (SIDs). Some exceptions were noted, such as the additional SIDs frequently used by commuters and the military KC-135 aircraft. Arrivals by air carrier, cargo, commuter and large general aviation aircraft were primarily distributed among four Standard Terminal Approach Routes (STARs). Small general aviation aircraft typically used different SIDs and STARs.

98SP14-2G-3/30/99



Notes:
Observations at noise monitor terminal Site 7 on August 18-22, 1997.

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

Exhibit 2G
MD-80 MEASURED AND INM SOUND EXPOSURE LEVEL COMPARISON

TABLE 2F
AVERAGE ANNUAL RUNWAY USE BY AIRCRAFT CLASS
Years 2004 and 2015
Phoenix Sky Harbor International Airport

Runway	% Daytime			% Nighttime		
	Commercial	Commuter	General Aviation	Commercial	Commuter	General Aviation
Departure Runway Use						
8R	30%	30%	10%	25%	25%	10%
8L	15%	15%	20%	20%	20%	20%
26R	20%	20%	20%	25%	25%	20%
26L	25%	25%	5%	20%	20%	5%
07	5%	5%	20%	5%	5%	20%
25	5%	5%	25%	5%	5%	25%
Total	100%	100%	100%	100%	100%	100%
Arrival Runway Use						
8R	5%	5%	5%	5%	5%	5%
8L	25%	25%	25%	25%	25%	25%
26R	25%	25%	25%	25%	25%	25%
26L	5%	5%	5%	5%	5%	0%
07	20%	20%	20%	20%	20%	20%
25	20%	20%	20%	20%	20%	25%
Total	100%	100%	100%	100%	100%	100%

Source: Final Environmental Impact Statement, November 1993.

To determine the locations of flight tracks which would represent the appropriate SIDs and STARs, the consultant reviewed more than fifty plots of the flight track data collected by the NFTMS, displayed as a function of type of operation (arrival/departure), runway and navigational fix. Samples of operations over several weekly periods provided descriptions of the flight patterns used for each runway. It was found that the routes for the SIDs and STARs were identical to the radar flight track data near the airport; therefore, these could be combined together. In addition, the plots showed that departures and arrivals by small general aviation aircraft could be well represented by generalized general aviation departure and arrival routes. Other exceptions were observed for commuter aircraft and helicopters, and separate routes for those operations were incorporated into the modeling assumptions.

The large number of plots of operations for individual SIDs and STARs by runway cannot be practically shown in this report. However, representative samples of departures and arrivals were collected from the NFTMS, and are shown by **Exhibits 2H, 2J, 2K, 2L, 2M,** and **2N**, with the locations of the INM flight tracks. Note that these exhibits cannot practically show all of the observed variations in operations, but are intended to illustrate the type of information used to prepare the generalized flight tracks used in the INM. The flight tracks used for the INM were developed as single tracks approximating the geometric centers of representative radar tracks for each route.

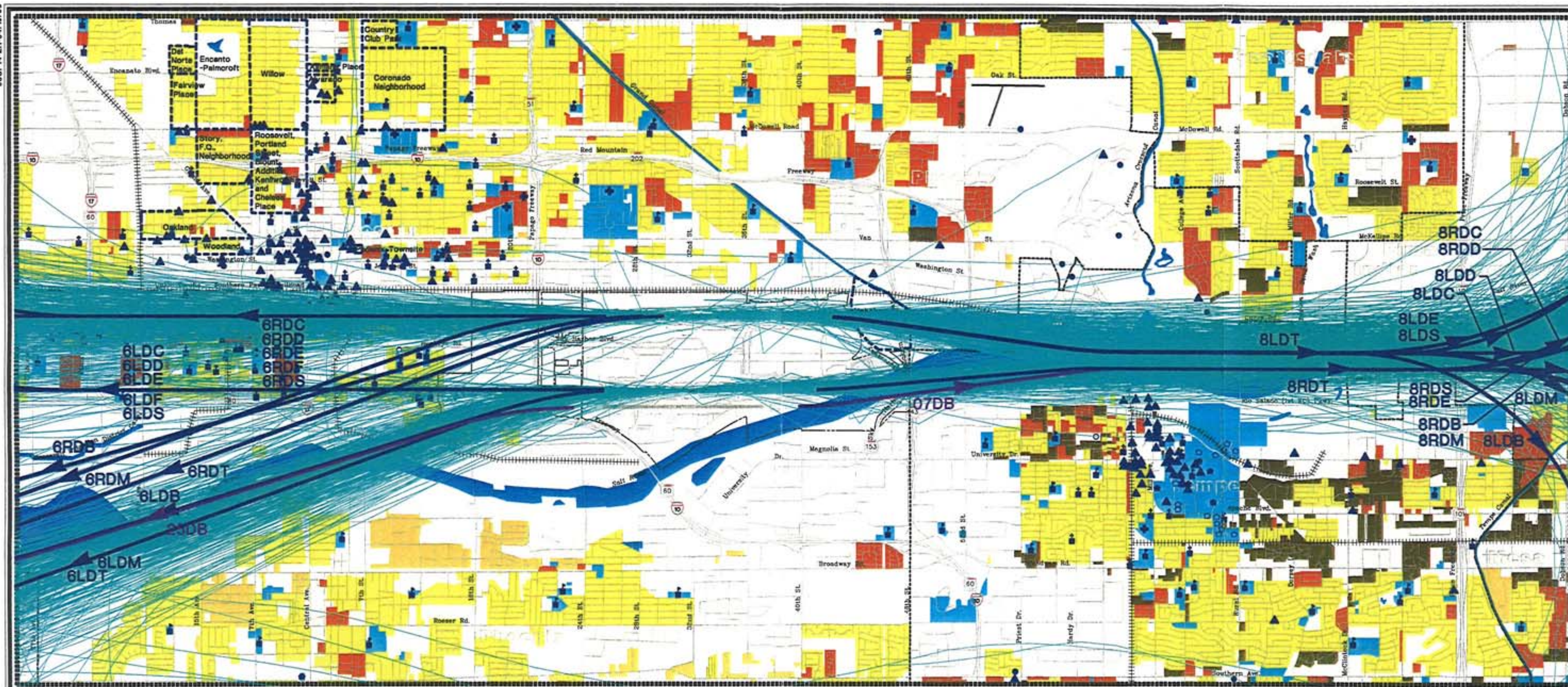
Most of the flight track names in **Exhibits 2H - 2N** follow a convention of a number and letter representing the runway (6L for Runway 26L, 6R for Runway 26R, 8L for Runway 08L, and 8R for Runway 08R), followed by A or D for arrival or departure, then an abbreviation for the SID or STAR. The SIDs used were the BXK (B), Cholla (C), Drake (D), Eagul (E), FER (F), St. John (S), Mobie (M),and TFD (T). The STARs used were the ARL (A), COO (C), Tonopah (T), and WIC (W). As noted before, operations on some other SIDs and STARs were combined into these categories where it was appropriate. Commuter departure tracks to the east differed enough from those used by air carrier aircraft to warrant three specific flight tracks for the Mobie and Drake SIDs on Runways 08L and 08R. These are shown by the 8LCD, 8LCM, and 8RCM flight tracks.

Although INM provides a method of dispersing flights over a range on either side of the flight track centerline, this approach was not used for this analysis, as it was important to be able to consistently control all aspects of the assumed aircraft operations to ensure accurate prediction of single event and cumulative noise levels at the permanent noise monitoring sites.

Flight Profiles

One of the variables which affects single event noise levels at a given measurement location is the actual flight profile of the aircraft as it passes over the measurement site. In the INM, a flight profile is comprised of three parameters: thrust, speed and altitude. The thrust value bears a direct linear relationship to the expected noise level, as the INM contains tables of noise levels as a function of thrust values for each aircraft type. The speed of the aircraft affects the Sound Exposure Level by affecting the duration of the noise event; *i.e.*, the slower the aircraft, the longer the noise event, and the higher the SEL value. The INM applies a standard correction for speed differences using a logarithmic function. Altitude affects the predicted noise levels in that an aircraft which is closer to an observer is generally louder than an aircraft which is farther away. The INM tables of noise levels and thrust values are also tied to specific distances, from which the INM interpolates the noise level at the observer, again using a logarithmic function. In general, the small variations in speeds and altitudes typically observed close to the airport have relatively small effects on predicted noise levels. Differences in thrust settings can have more pronounced effects.

There are no data currently available which report the thrust values used by



98SP14-2H-04/19/99

LEGEND

- Airport Property
- Municipal Boundaries
- Study Area
- Historic District Boundaries
- Consolidated Departure Track
- Consolidated Future Departure Track
- Radar Track Data
- 6RDB Flight Track Designator
- Rural Residential (0-1 du/ac)
- Large Lot Residential (1.01-2 du/ac)
- Small Lot Residential (2.01-5 du/ac)
- Medium Density Residential (5.01-15 du/ac)
- High Density Residential (15+ du/ac)
- Water
- Noise-Sensitive Institutions
- Place of Worship
- School
- Hospital
- Museum
- Library
- Historic Structure
- Residence Halls
- Community Center

Source: Coffman Associates and Brown-Buntin Associates Analysis.

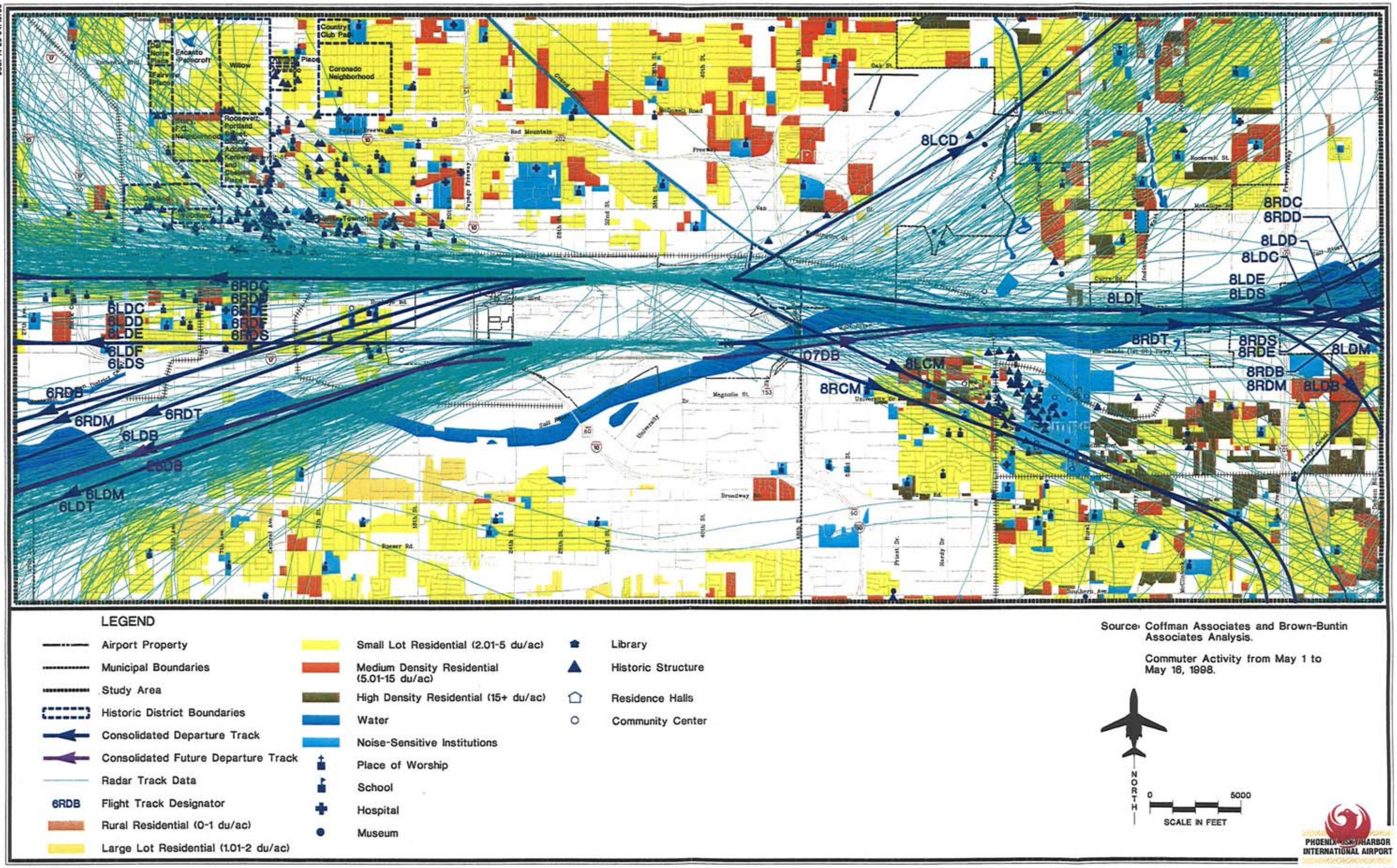
Air Carrier Activity for August 20, 1998.

NORTH

0 5000
SCALE IN FEET

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

Exhibit 2H
CONSOLIDATED AIR CARRIER DEPARTURE TRACKS & RADAR TRACK DATA



Source: Coffman Associates and Brown-Buntin Associates Analysis.

Commuter Activity from May 1 to May 16, 1998.

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

Exhibit 2J
CONSOLIDATED COMMUTER DEPARTURE TRACKS & RADAR TRACK DATA

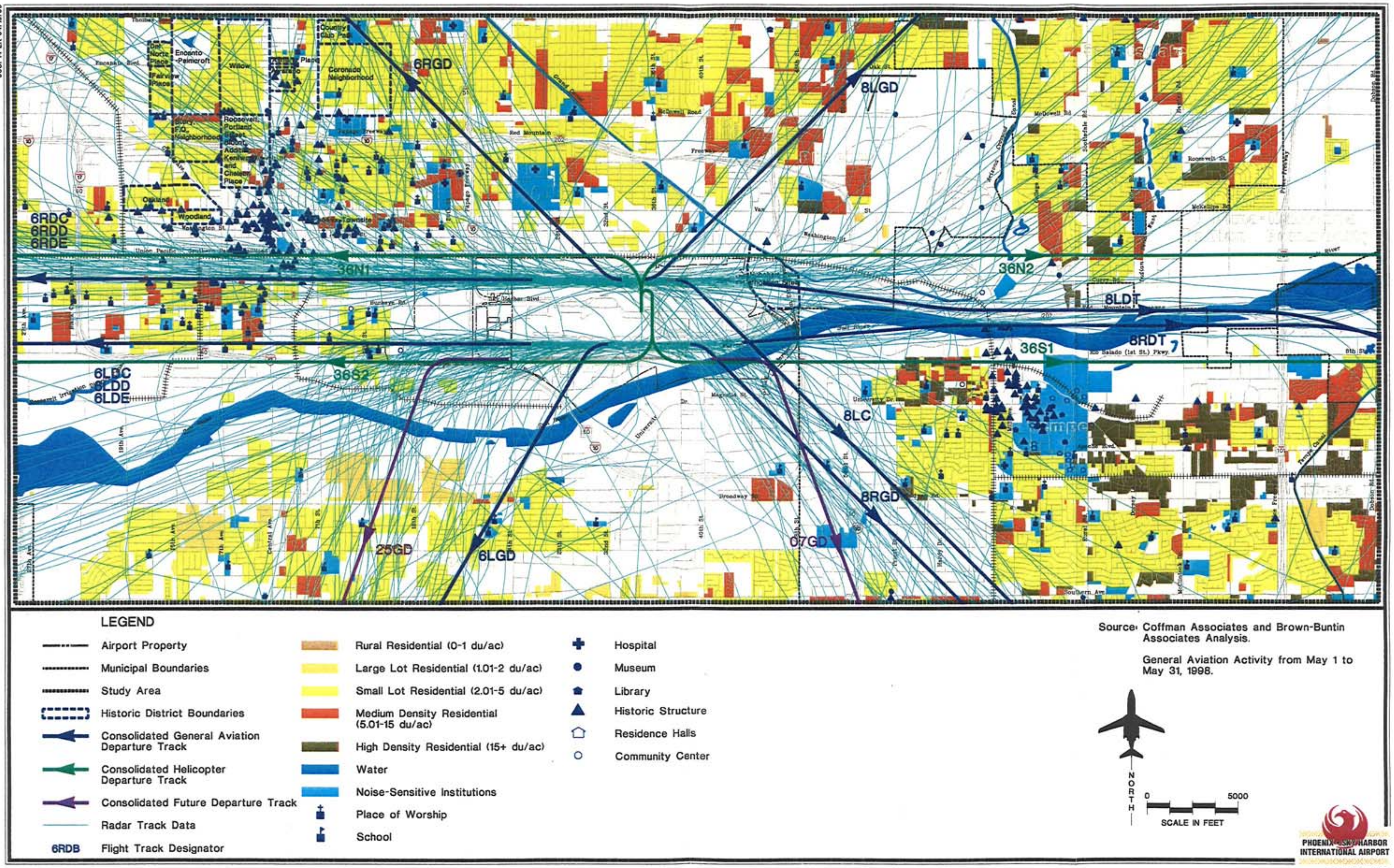
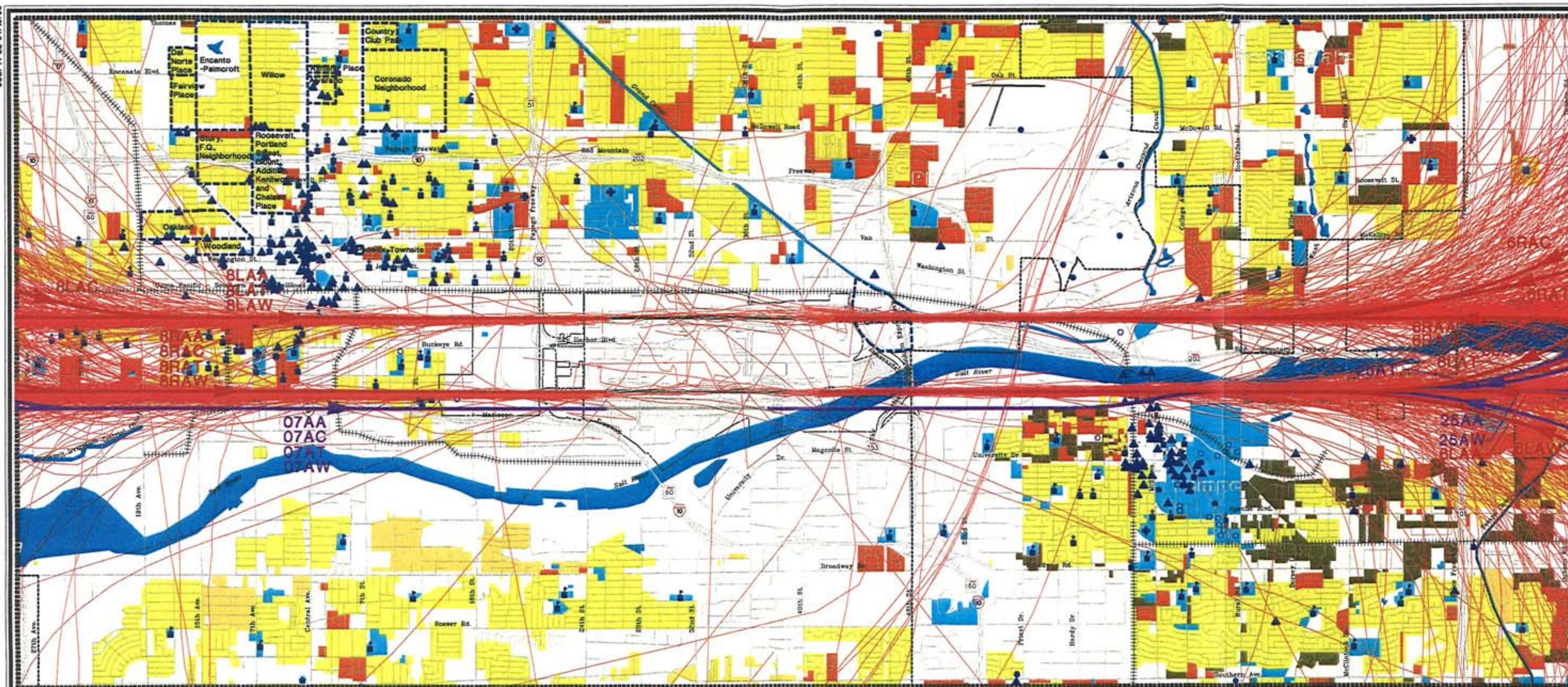


Exhibit 2K
CONSOLIDATED GENERAL AVIATION & HELICOPTER DEPARTURE TRACKS AND RADAR TRACK DATA



LEGEND

- Airport Property
- Municipal Boundaries
- Study Area
- Historic District Boundaries
- Consolidated Arrival Track
- Consolidated Future Arrival Track
- Radar Track Data
- 6RDB Flight Track Designator
- Rural Residential (0-1 du/ac)
- Large Lot Residential (1.01-2 du/ac)
- Small Lot Residential (2.01-5 du/ac)
- Medium Density Residential (5.01-15 du/ac)
- High Density Residential (15+ du/ac)
- Water
- Noise-Sensitive Institutions
- Place of Worship
- School
- Hospital
- Museum
- Library
- Historic Structure
- Residence Halls
- Community Center

Source: Coffman Associates and Brown-Buntin Associates Analysis.

Air Carrier Activity for August 20, 1998.

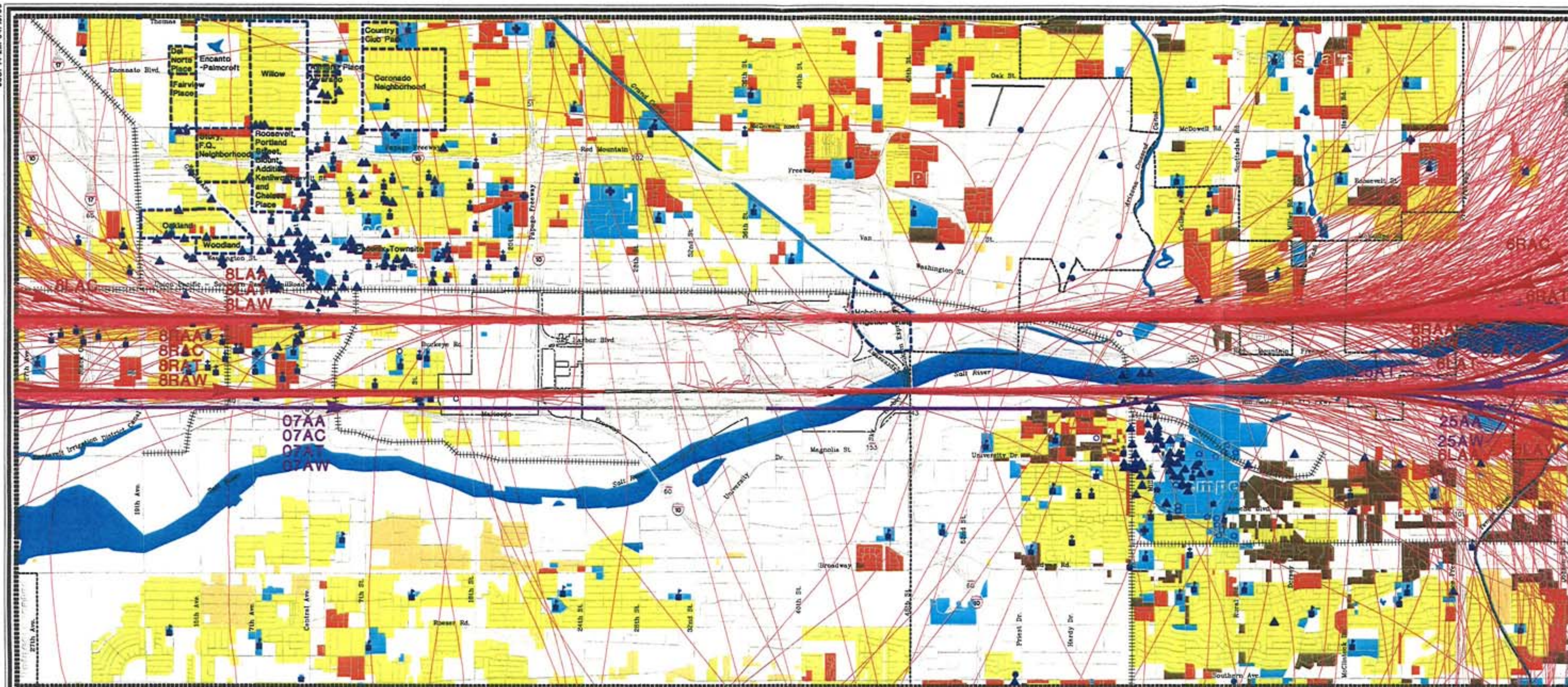
NORTH

0 5000
SCALE IN FEET

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

Exhibit 2L
CONSOLIDATED AIR CARRIER ARRIVAL TRACKS & RADAR TRACK DATA

98SP14-2L-04/19/99



LEGEND

- Airport Property
- Municipal Boundaries
- Study Area
- Historic District Boundaries
- Consolidated Arrival Track
- Consolidated Future Arrival Track
- Radar Track Data
- 6RDB Flight Track Designator
- Rural Residential (0-1 du/ac)
- Large Lot Residential (1.01-2 du/ac)
- Small Lot Residential (2.01-5 du/ac)
- Medium Density Residential (5.01-15 du/ac)
- High Density Residential (15+ du/ac)
- Water
- Noise-Sensitive Institutions
- Place of Worship
- School
- Hospital
- Museum
- Library
- Historic Structure
- Residence Halls
- Community Center

Source: Coffman Associates and Brown-Buntin Associates Analysis.

Commuter Activity from May 1 to May 16, 1998.

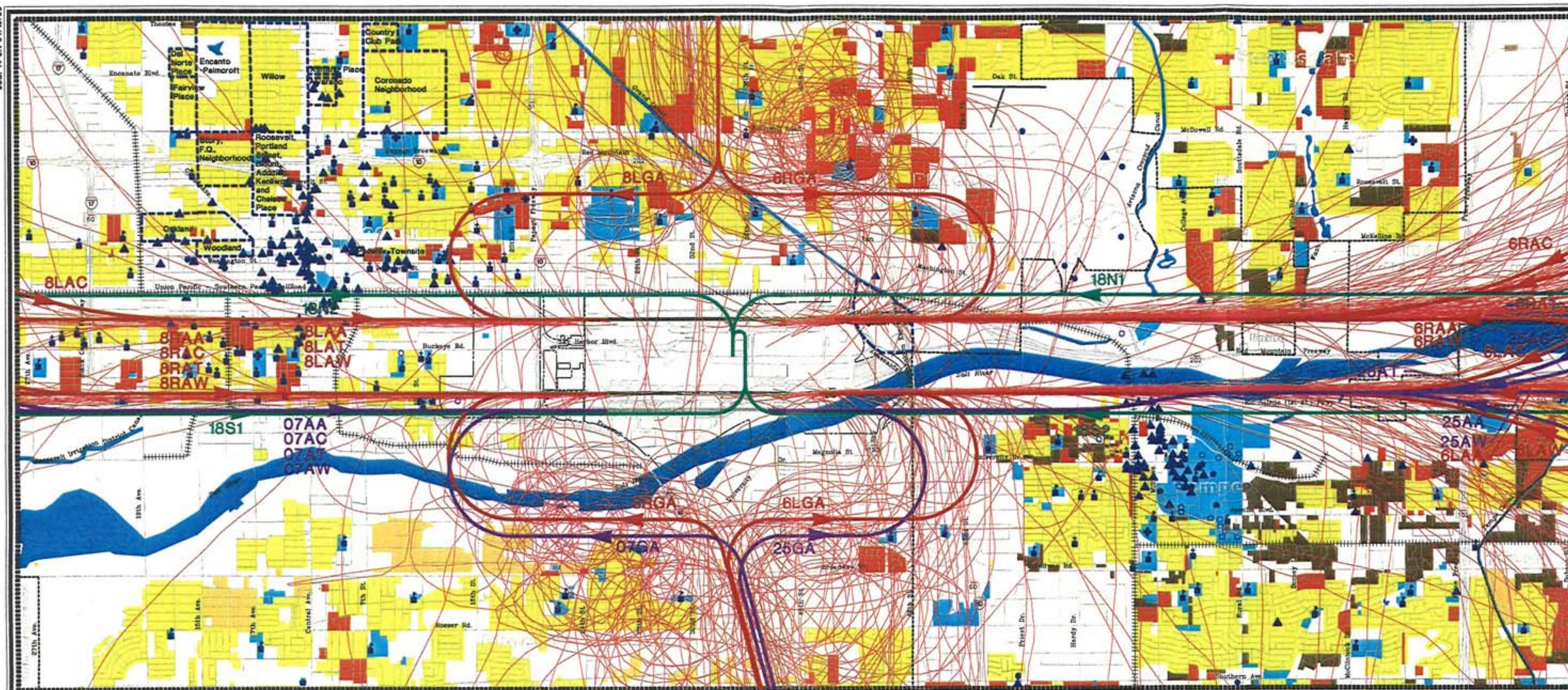
NORTH

0 5000
SCALE IN FEET

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

Exhibit 2M
CONSOLIDATED COMMUTER ARRIVAL TRACKS & RADAR TRACK DATA

98SP14-2M-04/19/99



LEGEND

	Airport Property	6RDB	Flight Track Designator		School
	Municipal Boundaries		Rural Residential (0-1 du/ac)		Hospital
	Study Area		Large Lot Residential (1.01-2 du/ac)		Museum
	Historic District Boundaries		Small Lot Residential (2.01-5 du/ac)		Library
	Consolidated General Aviation Arrival Tracks		Medium Density Residential (5.01-15 du/ac)		Historic Structure
	Consolidated Helicopter Arrival Tracks		High Density Residential (15+ du/ac)		Residence Halls
	Consolidated Future General Avaition Arrival Tracks		Water		Community Center
	Radar Track Data		Noise-Sensitive Institutions		
			Place of Worship		

Source: Coffman Associates and Brown-Buntin Associates Analysis.

General Aviation Activity from May 1 to May 31, 1998.

NORTH

0 5000
SCALE IN FEET

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

Exhibit 2N
CONSOLIDATED GENERAL AVIATION & HELICOPTER ARRIVAL TRACKS AND RADAR TRACK DATA

a given aircraft at a given location. The INM estimates the thrust settings from standard flight procedures reported by the aircraft manufacturers. Actual thrust settings may vary significantly as a result of specific local conditions during a flight, such as load, weather and airline-specific flight procedures.

The NFTMS can be used to collect speed and altitude information for a set of flights by specific aircraft types. This process was used at Phoenix Sky Harbor for samples of departures on all runways in August 1997 and May 1998, by B727, B737-100/200, B737-300 series, and MD-80 series aircraft. Comparisons of the observed takeoff profiles to the takeoff profiles calculated by the INM for representative aircraft types are shown by **Exhibits 2P** and **2Q**. These data indicate that, for the most noise-significant aircraft operating at Phoenix Sky Harbor, the takeoff profiles calculated by the INM are reasonably representative of actual conditions, assuming that the appropriate INM aircraft type is selected.

Therefore, the flight profile inputs to the INM for all aircraft types were based upon the aircraft types and stage lengths reported by the NFTMS, with one exception. The exception was that B-727 departures from Runway 26L on the St. John SID were modeled using the INM 727Q15 designator, at a stage length of 1,500 miles or more. This assumption provided better agreement between the measured and predicted DNL values at permanent monitoring site 4, without affecting the accuracy of the INM in predicting noise levels at other monitoring locations.

A current procedure which could affect departure flight profiles at Phoenix Sky Harbor is the published altitude restriction for aircraft to stay below 3,000 feet MSL until they are past the VORTAC in order to minimize interference with the Biltmore Transition. This restriction was established to minimize interference of departures with general aviation flights on the Biltmore Transition, which passes over the center of the airfield. Since November 1998, the Biltmore Transition has been relocated to an area at the arrival end of the runway in use. The 3,000 foot altitude restriction has been eliminated as a result. It should be noted that while the 3,000-foot altitude restriction has been eliminated, not all operators have changed their standard procedures.

To determine whether it would be necessary to account for a change in departure procedures, and possibly flight profiles, which might be implemented as a result of the elimination of the altitude restrictions, the NFTMS was used to determine the altitudes of aircraft as they departed over the 4 DME location east of the airport. For this analysis, a sample was collected of Boeing 737-series aircraft departing on Runways 08L and 08R on May 1, 1998. For the 132 aircraft represented by this sample, the average altitude at the 4 DME was 4,970 feet. The lowest altitude observed was 3,374 feet, and the highest altitude observed was 7,199 feet. The INM departure profiles on **Exhibit 2Q** show that the B-737-300 altitudes are in this range at the 4 DME, which is about 40,000 feet from start of takeoff roll. Therefore, no correction was applied to account for the change in published flight procedures resulting from the relocation of the Biltmore Transition.

Assignment of Aircraft to Tracks

The NFTMS data included the numbers of arrivals and departures by aircraft type, by runway, SID, STAR and time of day. These data were used to allocate operations to the selected flight tracks. A detailed listing of these assumptions is provided in **Appendix C.**

INM OUTPUT

1999 NOISE EXPOSURE CONTOURS

Based upon the data and assumptions described above, the Integrated Noise Model (INM) was used to prepare a noise exposure map representing existing conditions. **Exhibits 2R** show the locations of the 65, 70 and 75 DNL contours calculated by the INM for the base year (1999). **Table 2G** lists the land areas calculated by the INM as included within the 65, 70 and 75 DNL contours in the base year.

The shape and size of the contours reflect the underlying flight track and runway use assumptions. The outermost noise contour represents the 65 DNL noise contour. The 65 DNL noise contour is lobe-shaped to the east reflecting the narrowing of the departure and arrival tracks along the Salt River. To the west, the 65 DNL contour has three distinct lobes. The two lobes in the 65 DNL to the far west are caused by departure activity to the west. The small lobe to the southwest is due to departures turning to the southwest over the Salt River.

TABLE 2G
Calculated Land Areas Within DNL Contours
Phoenix Sky Harbor International Airport

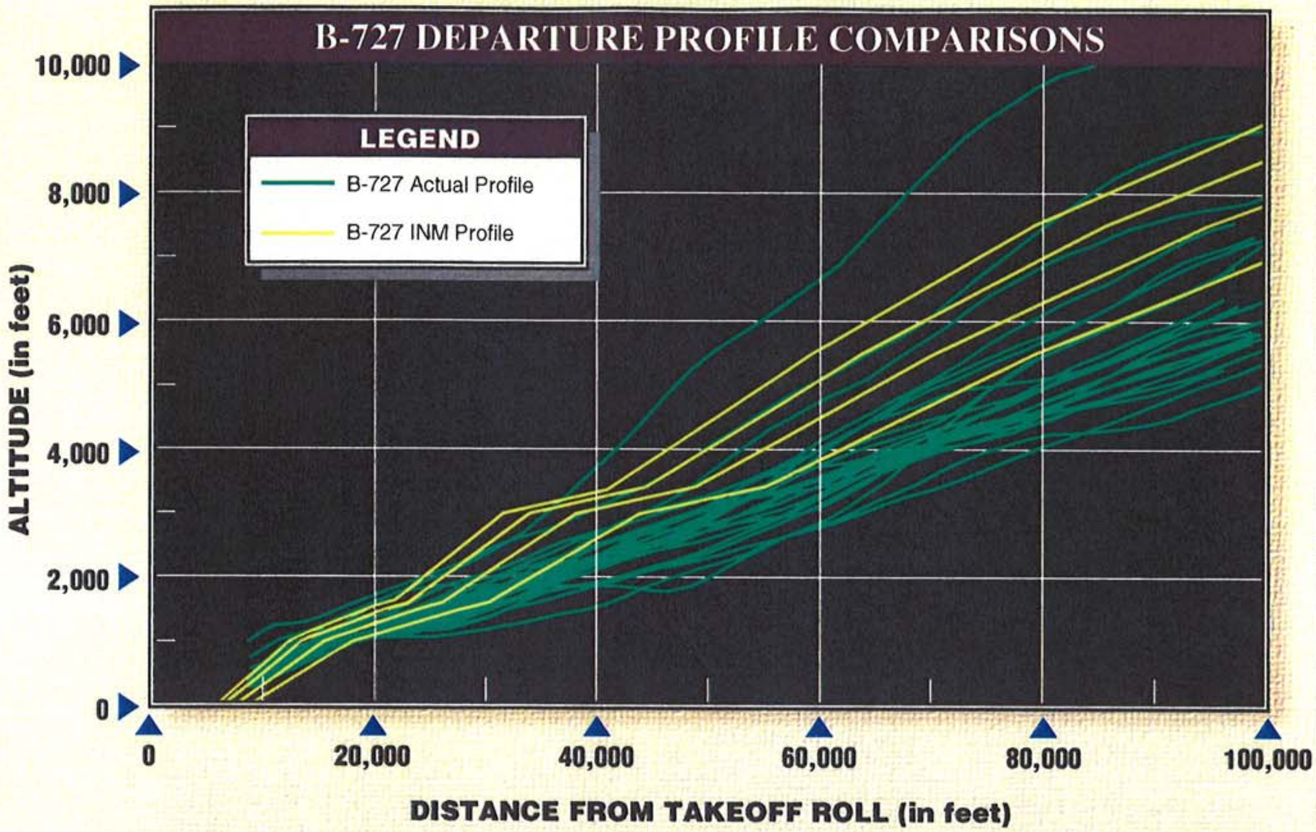
DNL Contour Value, dB	Area (Square Miles)		
	1999	2004	2015
65	15.32	11.93	12.39
70	7.91	5.35	5.31
75	3.64	2.17	2.14

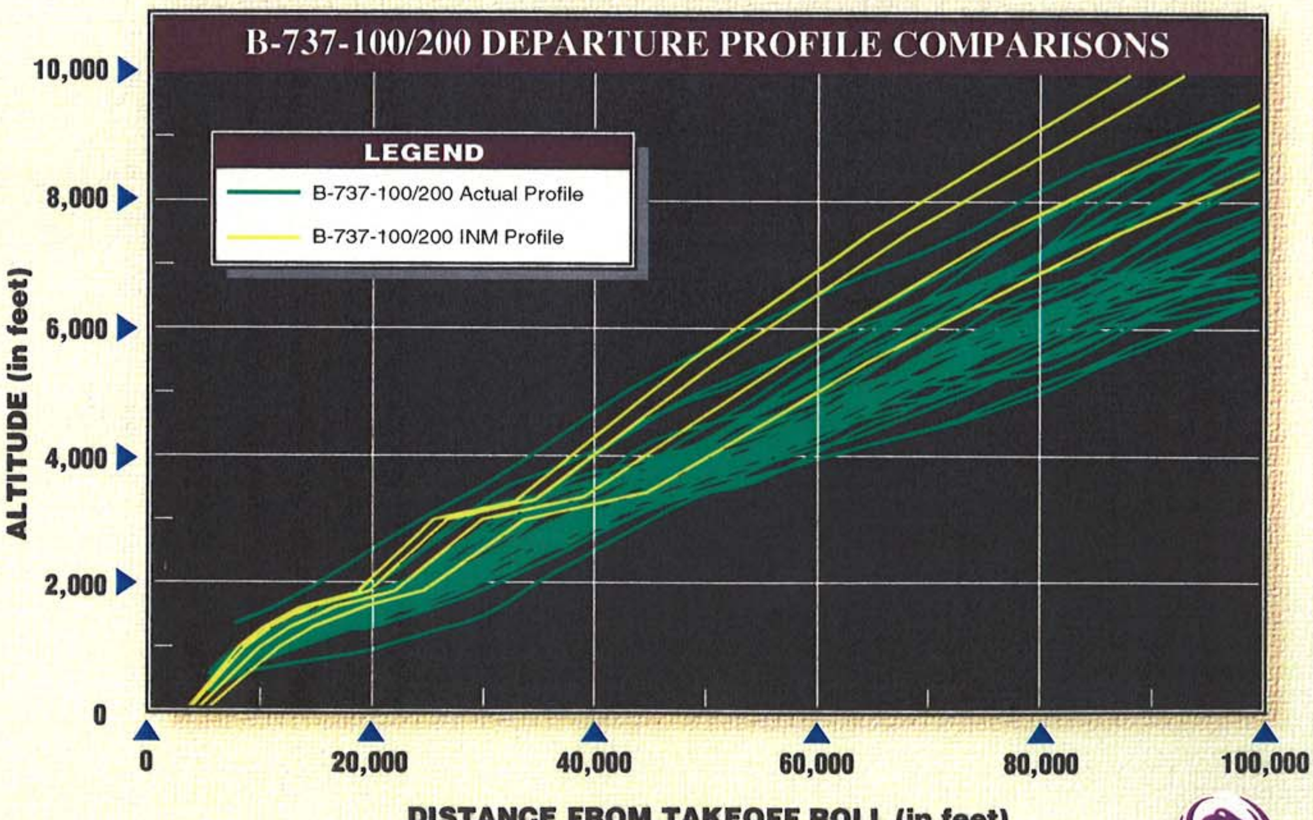
Source: Brown Buntin Analysis

The 70 DNL contour has the same general shape as the 65 DNL except smaller. The 75 DNL contour is generally the same shape but smaller to the west of the airport as the 65 and 70 DNL noise contours. To the east, however, the 75 DNL contour splits forming two distinct spikes. These two spikes are caused by the separation of the runways and corresponding flight tracks.

The 65 DNL contour extends about 24,500 feet east of the airport property. To the west, the longest lobe of the 65 DNL contour extends about 17,500 feet

98SP14-2P-3/30/99

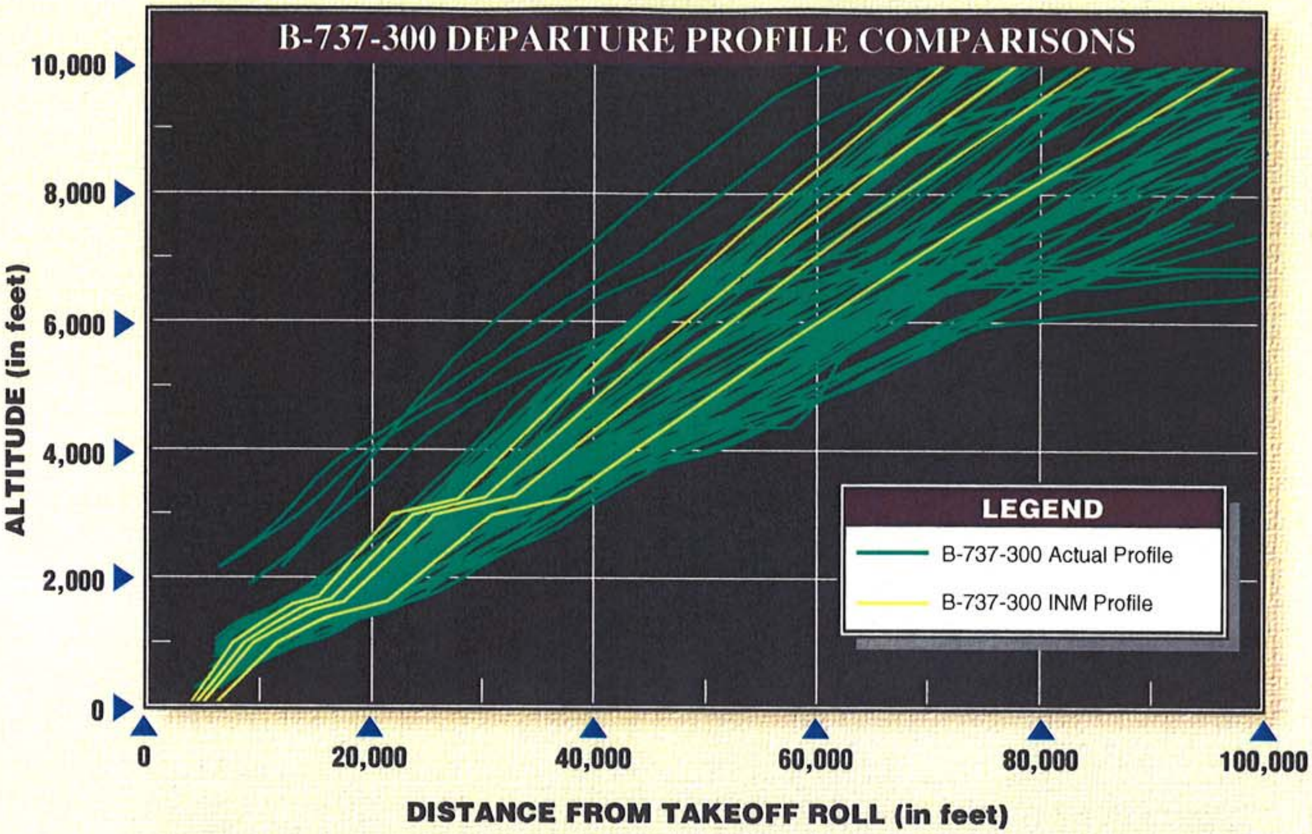


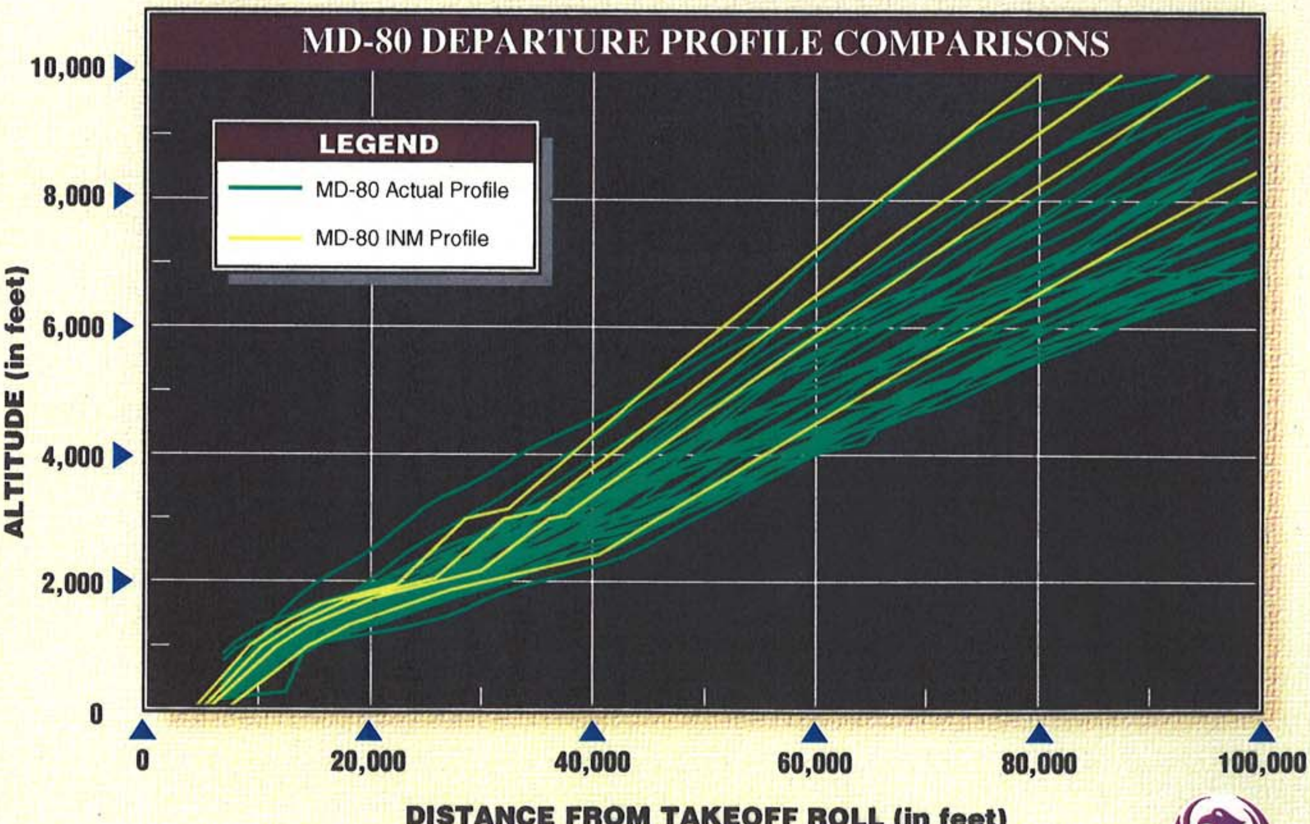


Notes:
Observations from August 1997 and May 1998

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

Exhibit 2P
B-727 AND B-737-100/200
DEPARTURE PROFILE COMPARISONS





Notes:
Observations from August 1997 and May 1998

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

Exhibit 2Q
B-737-300 AND MD-80
DEPARTURE PROFILE COMPARISONS

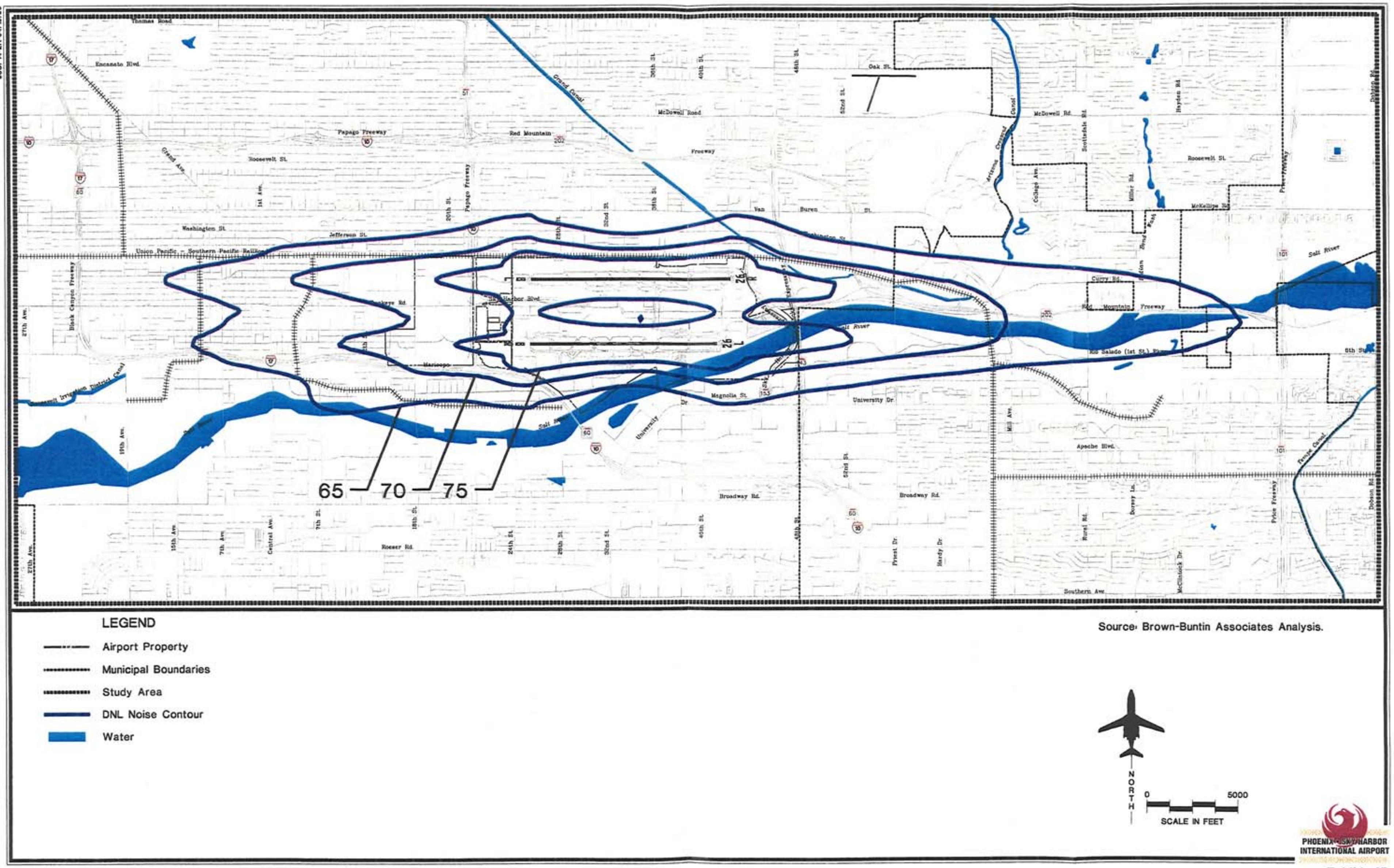


Exhibit 2R
PHOENIX SKY HARBOR INTERNATIONAL AIRPORT
1999 NOISE EXPOSURE MAP

to 15th Avenue. To the north, the 65 DNL contour bows out just short of Van Buren Street. To the southeast, the 65 DNL contour bows out to University Avenue. The 65 DNL contour bows out past the Salt River to the Southwest.

The 70 DNL contour extends about 11,400 feet east of the airport property to Mill Avenue. To the west, the longest lobe of the 70 DNL contour extends about 10,500 feet to 2nd Street. To the north, the 70 DNL contour bows out just short of Jefferson Street. To the southeast, the 70 DNL contour bows approximately 400 feet beyond airport property. The 70 DNL contour bows out to Interstate 17 to the Southwest.

The majority of the 75 DNL contour remains on airport property. Spikes off each runway extend from 1,500 to 3,000 feet to the east and west. To the north, the 75 DNL contour lies approximately 300 feet beyond the Union Pacific/Southern Pacific Railroad tracks. The 75 DNL noise contours remain on airport property to the south.

Comparative Measurement Analysis

This analysis compares the INM-predicted average daily DNL values with actual noise measured at each noise monitor terminal site. The noise level data collected from each permanent noise monitoring terminal site were used to calculate the annual average DNL at each site for the period from July 1, 1997 to June 30, 1998. The INM was used to calculate the DNL value at each of those sites for annual average operations, based upon the inputs previously described. A comparison of the measured and predicted (by INM) DNL values at each monitoring site is presented in **Table 2H** and is illustrated on **Exhibit 2S**.

A difference of two to three DNL is generally not considered a significant deviation between measured and calculated noise, particularly at levels above 65 DNL. Additional deviation is expected at levels below 65 DNL. As seen on **Table 2H**, the agreement between measured and predicted DNL values was within 1.5 dB in the vicinity of the 65 DNL contour, which is considered to be within the allowable deviation and standard tolerances of the noise measurement equipment. Deviations below 60 DNL are slightly higher, ranging from 1.4 to 4.5 dB, but all are over predictions by the INM with the exception of Site 14 (-0.2 dB).

FORECAST 2004 NOISE EXPOSURE CONTOURS

The 2004 noise contours represent the estimated noise conditions based on the forecasts of future operations and with Runway 07-25 opened. Operational procedures for this runway were taken from the 1993 Final Environmental Impact Statement previously discussed. This analysis provides a near-future baseline that can subsequently be used to judge the effectiveness of potential noise abatement alternatives later in the study. **Exhibit 2T** presents the plotted results of the INM contour analysis results for 2004 conditions using input data described previously.

TABLE 2H
Comparison of Measured and INM-Predicted DNL Values at Permanent Noise Monitoring Terminals

Noise Monitor Terminal Number	DNL, dB		Difference, dB
	Measured[1]	1999 INM Prediction[2]	
1	61.2	59.9	-1.3
2	60.0	60.3	0.3
3	63.1	62.2	-0.9
4	66.0	64.5	-1.5
5	61.9	61.7	-0.2
6	62.5	62.3	-0.2
7	72.3	72.6	0.3
8	58.2	61.4	3.2
9	66.7	66.5	-0.2
10	64.3	63.4	-0.9
11	68.1	68.4	0.3
12	67.5	67.2	-0.3
13	48.2	52.7	4.5
14	57.3	57.1	-0.2
15	61.5	63.3	1.8
16	51.3	54.4	3.1
17	63.1	62.7	-0.4
18	57.1	58.5	1.4
19	49.9	51.8	1.9
20	49.2	51.9	2.7

[1] Measured Data from July 1, 1997 to June 30, 1998
[2] Brown Buntin Analysis

The 2004 noise contours are more spike shaped and smaller than the 1999 noise contours. This is primarily due to the complete phase-out of Stage 2 aircraft and the opening of Runway 07-25. **Table 2G** lists the land areas calculated by the INM as included within the 65, 70 and 75 DNL contours

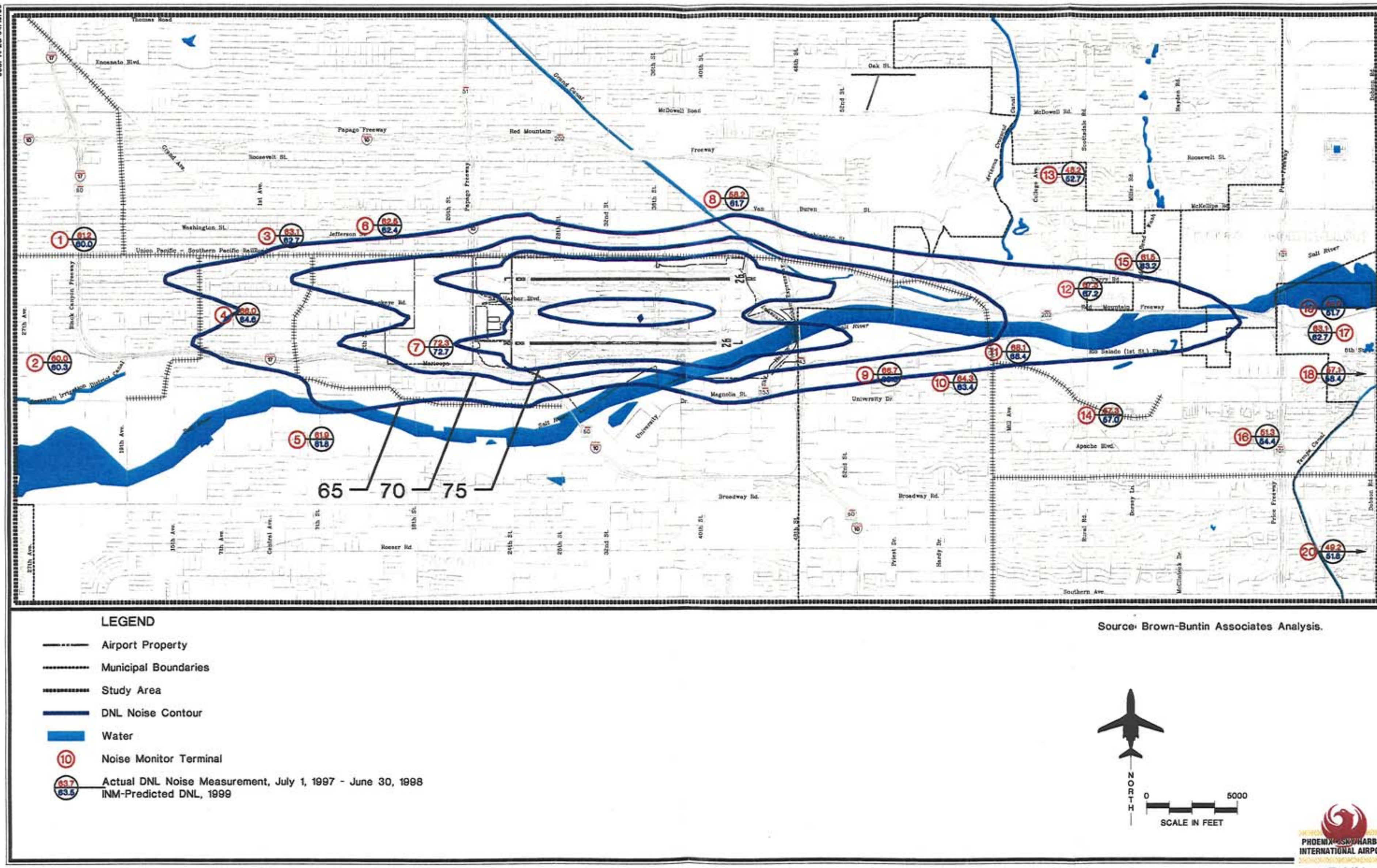


Exhibit 2S
PHOENIX SKY HARBOR INTERNATIONAL AIRPORT
1999 NOISE EXPOSURE AND MEASUREMENT SITES

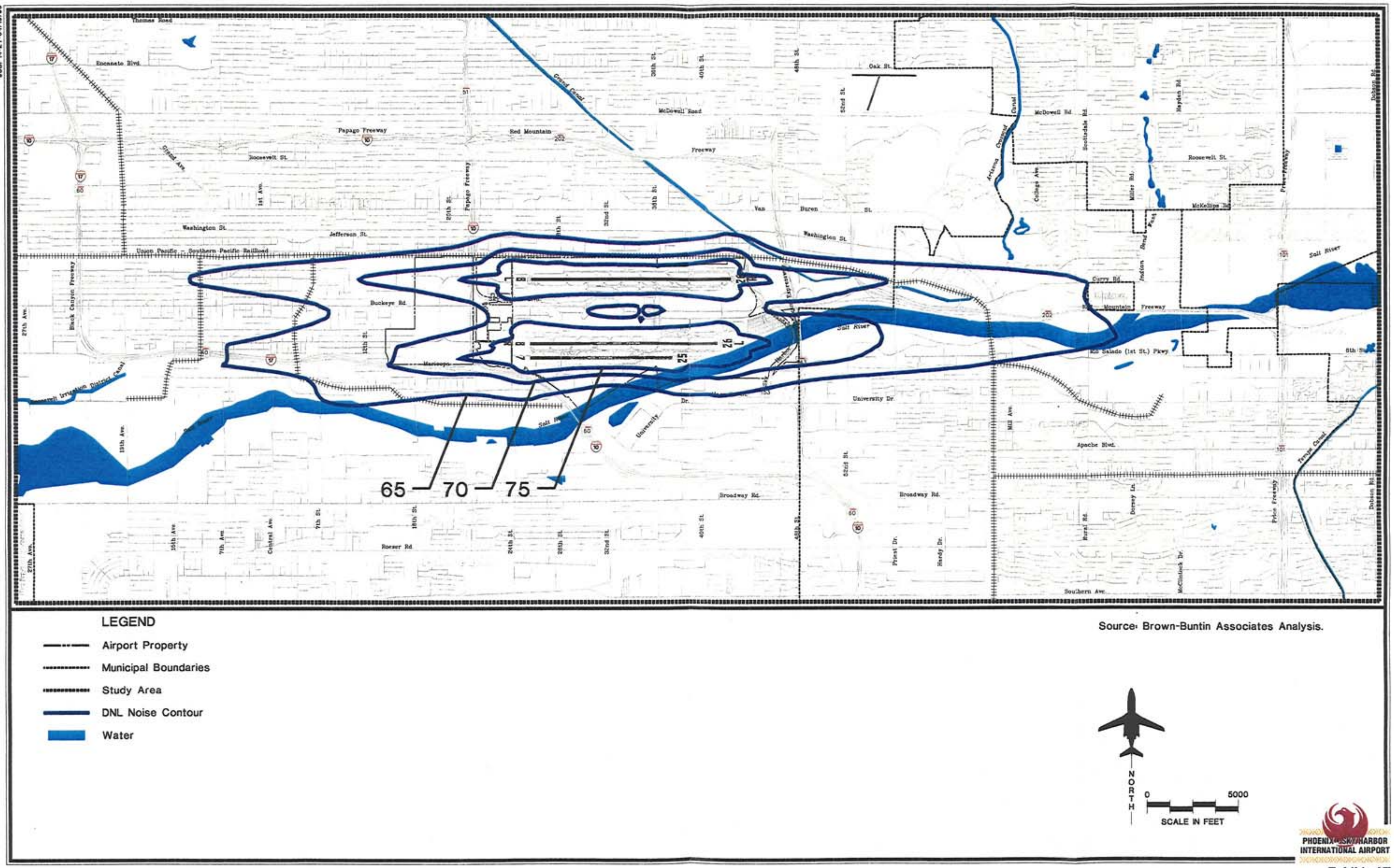


Exhibit 2T
PHOENIX SKY HARBOR INTERNATIONAL AIRPORT
2004 NOISE EXPOSURE MAP

for the year 2004. The land area within the 65 DNL contour is expected to decrease in 2004 by about 22% as compared to the 1999 base year.

The longest spike of the 65 DNL contour extends about 17,500 feet east of the airport property. To the west, the longest spike of the 65 DNL contour extends about 15,500 feet to 12th Avenue. To the north, the 65 DNL contour bows out just short of Washington Street. To the southeast, the 65 DNL contour bows out to Magnolia Street. The 65 DNL contour bows out to the edge of the Salt River to the Southwest.

The 70 DNL contour extends about 5,000 feet east of the airport property to Priest Drive. To the west, the longest lobe of the 70 DNL contour extends about 6,200 feet to 12th Street. To the north, the 70 DNL contour lies approximately 300 feet beyond the Union Pacific/Southern Pacific Railroad tracks. To the southeast, the 70 DNL contour remains on airport property. The 70 DNL contour bows out to Interstate 17 to the Southwest. The 75 DNL contour remains on airport property.

FORECAST 2015 NOISE EXPOSURE CONTOURS

The 2015 noise contours represent the estimated noise conditions based on the forecasts of future operations. The analysis provides a long term future baseline that can also be used to judge the effectiveness of proposed noise abatement procedures and land use planning recommendations. **Exhibit 2U** presents the plotted results of the INM contour analysis for 2015 conditions.

The 2015 noise contours are very similar in shape to the 2004 noise contours. The contours are slightly larger than the 2004 contours due to the forecast increase in operations. The land area within the 65 DNL 2015 noise contour is expected to increase by about 4% as compared to the year 2004. This is a decrease of about 19% as compared to the 1999 base year. **Table 2G** lists the land areas calculated by the INM as included within the 65, 70 and 75 DNL contours for the year 2015.

SUMMARY

Noise Exposure Maps have been prepared for Phoenix Sky Harbor International Airport for the study years 1999, 2004 and 2015. The noise exposure maps were prepared using the FAA Integrated Noise Model, Version 5.2a, based upon data obtained from the Airport's Noise and Flight Track Monitoring System, FAA tower counts, and forecasts of future airport operations from the current Airport Master Plan. This methodology is accepted by the FAA for F.A.R. Part 150 studies.

The noise exposure map which describes existing conditions (1999) reasonably represents actual measured noise levels in the period from July 1, 1997 to June 30, 1998 in terms of both single event and cumulative noise levels. The predictions of future noise levels account for the planned changes in airfield configuration and expected changes in aircraft operations.

The noise exposure maps indicate that the overall aircraft noise exposure in the vicinity of the airport will be significantly reduced in the year 2004, primarily as a result of the phase-out of F.A.R. Part 36 Stage 2 aircraft by the year 2000. Overall, noise levels are then expected to increase in 2015 due to increases in aircraft operations, although the overall area of noise exposure will remain smaller than the 1999 baseline noise contours.

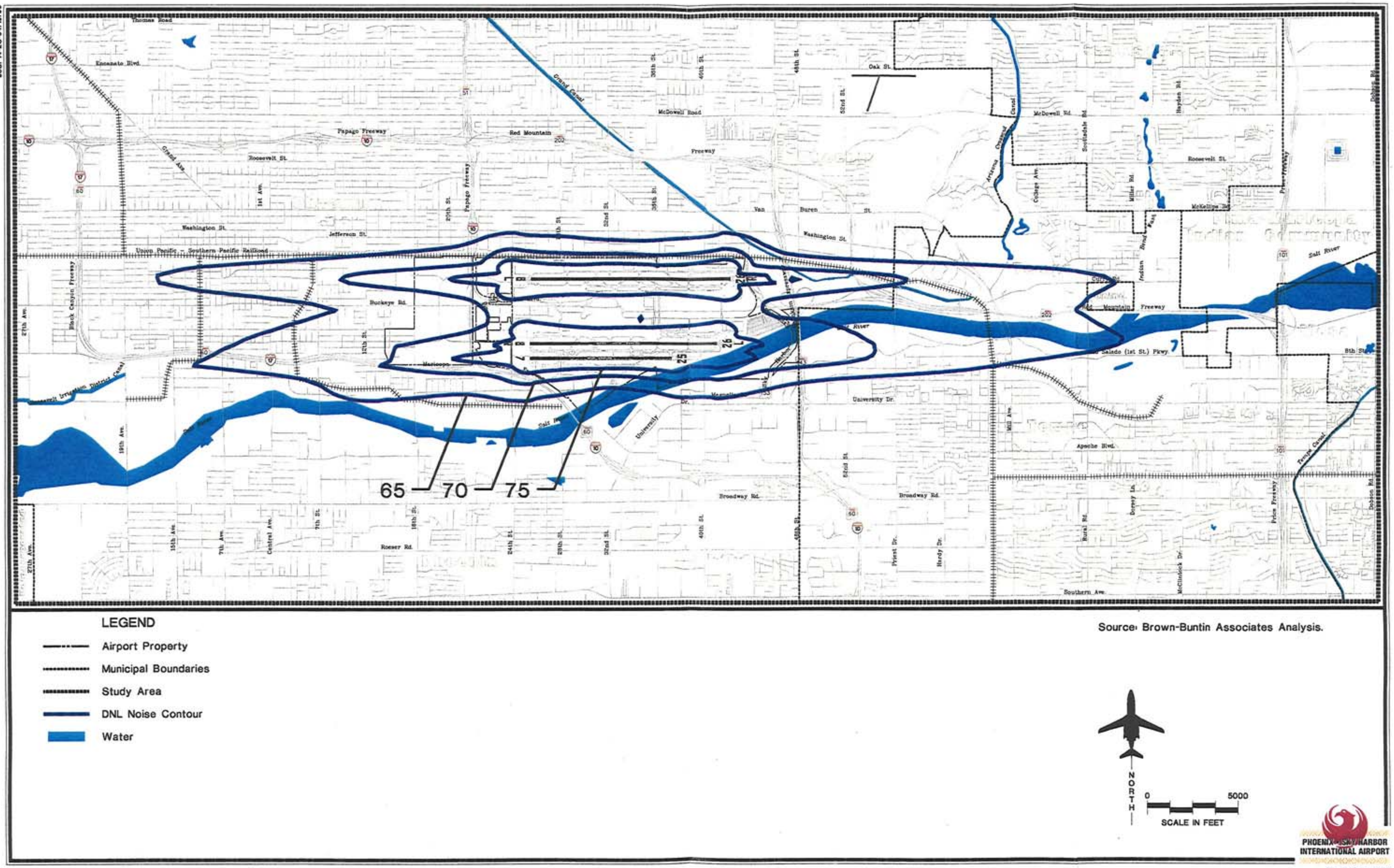


Exhibit 2U
PHOENIX SKY HARBOR INTERNATIONAL AIRPORT
2015 NOISE EXPOSURE MAP

References

Integrated Noise Model (INM), Version 5.2a. Federal Aviation Administration, Office of Environment and Energy (AEE-120), March 1998.

Helicopter Noise Exposure Curves for Use in Environmental Impact Assessment, Report No. FAA-EE-82-16, Federal Aviation Administration, Office of Environment and Energy (AEE-120), November 1982.