Chapter 3

AVIATION NOISE

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The purpose of this chapter is to describe the preparation of the noise exposure maps (NEM) for Scottsdale Airport. Noise contour maps are presented for three study years: 2004, 2009, and 2025. The 2004 noise contour map shows the current noise levels based on operations for Calendar Year 2003. The 2009 map is based on levels from the operation forecast outlined in Chapter Two. The 2004 and 2009 maps are the basis for the official "Noise Exposure Maps" required under Title 14, Code of Regulations (CFR), Part 150.

The 2025 noise contour map was developed to present a long term view of potential future noise exposure at Scottsdale Airport. Based on forecasts developed in Chapter Two for the year 2025, these maps can be helpful in providing guidance for long term land use planning which is discussed at a later point in the Part 150 Study process.

These noise contour maps (2004, 2009, and 2025) are considered baseline analyses. They assume operations based on the existing procedures at Scottsdale Airport. No additional noise abatement procedures have been assumed in these analyses. The noise contour maps will serve as baseline conditions against which potential noise abatement procedures will be compared at a later point in the study.

The noise analysis presented in this chapter relies on complex analytical methods and uses numerous technical terms. A ***Technical Information Paper (T.I.P.)*** included in the last section

of this document, ***The Measurement and Analysis of Sound***, presents helpful background information on noise measurement and analysis.

AIRCRAFT NOISE ANALYSIS METHODOLOGY

The standard methodology for analyzing the prevailing noise conditions at airports involves the use of a computer simulation model. The Federal Aviation Administration (FAA) has approved the Integrated Noise Model (INM) for use in Part 150 Noise Compatibility Studies. The latest versions of the INM are quite sophisticated in predicting noise levels at a given location, accounting for such variables as airfield elevation, temperature, headwinds, and local topography. INM Version 6.1 was used to prepare noise exposure maps for the Scottsdale noise analyses.

Inputs to the INM include runway configuration, flight track locations, aircraft fleet mix, stage length (trip length) for departures, terrain, and numbers of daytime and nighttime operations by aircraft type. The INM provides a database for general aviation aircraft that includes aircraft commonly operated at Scottsdale Airport. **Exhibit 3A** depicts the INM input assumptions.

The INM computes typical flight profiles for aircraft operating at the assumed airport location, based upon the field elevation, 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 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 noise monitoring sites.

INM INPUT

AIRPORT AND STUDY AREA DESCRIPTION

The runways were input into the INM in terms of latitude and longitude, as well as elevation. As previously mentioned, the INM computes typical flight profiles for aircraft operating at the airport location, based upon the field elevation, temperature, and flight procedure data provided by aircraft manufacturers. The Scottsdale Airport's field elevation is 1,510 feet above mean sea level (MSL) and its average annual temperature is 72.6 degrees Fahrenheit (F).

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. Topographic data from the U.S. Geographical Survey was used in the development of the noise exposure contours for Scottsdale Airport.

ACTIVITY DATA

Noise evaluations made for the current year (2004) are based on operational counts during 2003 from the Scottsdale ATCT and supplemental data acquired during times when the tower is closed. Five-year (2009) and long-term (2025) contour sets were prepared based upon forecasts presented in Chapter Two, Aviation Demand Forecasts. Existing and forecasted annual operations are summarized in **Table 3A**.

TABLE 3A
Operations Summary
Scottsdale Airport

		FORECASTS	
Operations	**Existing 2004[1]**	**2009[2]**	**2025[2]**
General Aviation			
Itinerant	114,163	134,700	175,300
Local	71,121	77,000	85,000
Total	185,284	211,700	260,600
Air Taxi	10,569	14,400	27,500
Airline	0	6,500	10,700
Military	428	500	500
TOTAL OPERATIONS	196,281	233,100	299,000

[1] Existing operations are based on Calendar Year 2003 operations.
[2] Chapter Two, Table 2R, p. 2-19

DAILY OPERATIONS AND FLEET MIX

For this analysis, current aircraft operations data (takeoffs and landings) and forecasts of future activity (2009 and 2025), prepared as part of an operations forecast update presented previously in Chapter Two, Aviation Activity Forecasts, were used for noise modeling. Average daily aircraft operations were calculated by dividing total annual operations by 365 days.

The selection of individual aircraft types is important to the modeling process because different aircraft types generate different noise levels. The noise footprints presented in **Exhibit 3B** and **Exhibit 3C** illustrate this concept graphically. The footprints represent the noise pattern generated by one departure and one arrival of the given aircraft type. The aircraft illustrated are commonly operated at Scottsdale Airport.

The distribution of these operations among various categories, users, and types of aircraft is critical to the development of the input model data. The business jet, turboprop, and multi-engine piston operation mix were developed using FAA's instrument flight rule (IFR) database, Scottsdale Airport landing fee reports, and nighttime observation logs. The remaining portion of general aviation operation mix was developed using the Scottsdale Airport based aircraft fleet mix.

The future fleet mix for Scottsdale Airport was based upon national aircraft trends. As presented in Chapter Two-Aviation Demand Forecasts, Scottsdale Airport can expect turbine aircraft to show the strongest growth into the future. Piston aircraft growth is going to be affected somewhat by the availability of services, competitive rates and charges, as well as the storage space available. The breakdown of the business jet fleet is also going to continue to transition from Stage 2 aircraft to quieter Stage 3 aircraft. The two primary factors driving this transition are the age of the Stage 2 fleet and the increased hourly operating cost. Stage 2 business jet aircraft were certified prior to December 31, 1974 and will be at least 50 years old by the year 2025. A Stage 2 Gulfstream IIB aircraft that seats 12 people has an hourly operating cost of $3,023 while a Stage 3 Gulfstream IV aircraft that seats 13 people has an hourly operating cost of $1,955 according to CJS Worldwide Jet Search. **Table 3B** lists the annual operations by aircraft type.

DATABASE SELECTION

The INM provides aircraft data for most of the aircraft that operate at Scottsdale Airport. FAA provides a substitution list for aircraft not specifically identified in the INM.

The FAA aircraft substitution list indicates that the general aviation single-engine variable pitch propeller model, the GASEPV, represents a number of single-engine general aviation aircraft. Among others these include the Beech Bonanza, Cessna 177 and 180, Piper Cherokee Arrow, Piper PA-32, and the Mooney. The general aviation single-engine fixed pitch propeller model, the GASEPF, also represents several single-engine general aviation aircraft. These include the Cessna 150 and 172, Piper Archer, Piper PA-28-140 and 180, and the Piper Tomahawk.

The FAA's substitution list recommends the BEC58P, the Beech Baron, to represent the light twin-engine aircraft such as the Piper Navajo, Beech Duke, Cessna 310, and others. The CNA441 effectively represents light turbo-prop and twin-engine piston aircraft such as the Cessna 402, Gulfstream Commander, and others. In addition, the DCH6 is recommended for use in modeling the Merlin Metroliner and King Air turboprop aircraft.

The INM provides data for most of the business turbojet aircraft in the national fleet. The LEAR25 represents the Lear 20 series aircraft that make up the majority of small Stage 2 business jet category. The CNA55B effectively represents the Cessna 550 and 560 series aircraft that dominate the small Stage 3 business jet category. The FAL20 represents the aircraft in the medium Stage 2 business jet category. Aircraft such as the Lear 30, 40, 50, and 60 series, in addition to the Hawker 800 and 1000, are effectively represented by the LEAR35 designator in medium Stage 3 business jet category. The CNA750 designator, representing the Cessna Citation X series aircraft, was

TABLE 3B
Operational Fleet Mix Projections

Aircraft Type	INM Designator	Existing 2004[1]	2009[2]	2025[2]
Airline				
Small Multi-Engine	BEC58P	0	6500	2140
Medium Turboprop	DHC6	0	0	1605
Large Turboprop	EMB120	0	0	4280
Regional Jet	CL601	0	0	2675
Total Airline		***0***	***6500***	***10700***
Air Taxi				
Single-engine				
Variable	GASEPV	460	550	850
Fixed	GASEPF	459	550	850
Twin-engine				
Beech Baron/Piper 31	BEC58P	750	900	1200
Merlin Metroliner	DCH6	800	1200	2600
Business Jet				
Small Stage 2	LEAR25	50	100	0
Small Stage 3	CNA55B	3400	4800	10000
Medium Stage 2	FAL20	380	300	0
Medium Stage 3	CNA750	3380	4500	8000
Large Stage 2	GIIB	80	100	0
Large Stage 3	CL600	810	1400	4000
Total Air Taxi		***10569***	***14400***	***27500***
General Aviation – Itinerant				
Single-engine				
Variable	GASEPV	34181	39250	48650
Fixed	GASEPF	34181	39250	48650
Twin-engine				
Beech Baron/Piper 31	BEC58P	15000	15200	15500
King Air	CAN441	6800	9000	14500
Business Jet				
Small Stage 2	LEAR25	639	600	0
Small Stage 3	CNA55B	7039	10600	19000
Medium Stage 2	FAL20	1917	1800	0
Medium Stage 3	LEAR35	4864	6800	13000
Large Stage 2	GIIB	998	900	0.00
Large Stage 3	CL600	2544	4500	8000
Helicopter	SA355F	6000	6800	8000
Total General Aviation – Itinerant		***114163***	***134700***	***175300***
General Aviation – Local				
Single-engine				
Variable	GASEPV	29510	31850	35150
Fixed	GASEPF	29511	31850	35150
Twin-engine				
Beech Baron/Piper 31	BEC58P	8500	9000	9500
King Air	CAN441	600	900	1200
Helicopter	H500D	3000	3400	4000
Total General Aviation – Local		***71121***	***77000***	***85000***
Military				
Fighter Jet	F16A	100	100	100
Helicopter	S70	328	400	400
Total Military		428	500	500
TOTAL OPERATIONS		**196281**	**233100**	**299000**

1 Existing operations are based on Calendar Year 2003 operations. Aircraft fleet mix developed from airport based aircraft lists and interviews with fixed base operators.
2 Chapter Two, Table 2R, p. 2-19

also used to represent medium Stage 3 business jet category. The GIIB designator represents the Gulfstream II and III series in the large Stage 2 business jet category. The Canadair Challenger 600 is modeled using the CL600 designator in the large Stage 3 business jet category.

The BEC58P and DHC6 designators represent the Cessna 421 and Beech 1900 aircraft in the airline fleet mix, respectively. The Embraer 120 and Regional Jet aircraft in the airline fleet mix are represented by the EMB120 and CL601 designators, respectively.

Three types of helicopters commonly operating at Scottsdale Airport are also modeled. The Robinson-22 and Hughes -500 are modeled using the H500 designator. The Aerospatiale Helicopter is effectively modeled using the SA355F designator.

Military aircraft in the Scottsdale fleet mix were represented by two aircraft types. The fighter jet aircraft were modeled using the F16A designator. The military helicopter activity was modeled with the S70 designator.

All substitutions are commensurate with published FAA guidelines.

TIME-OF-DAY

The time-of-day at which operations occur is important as input to the INM due to the 10 decibel weighting of nighttime (10:00 p.m. to 7:00 a.m.) flights. In calculating airport noise exposure, one operation at night has the same noise emission value as 10 operations during the day by the same aircraft. While Scottsdale Airport does have an ATCT, it is closed between 9:00 p.m. and 6:00 a.m. Specific counts for nighttime activity were acquired by an individual posted at the airport during the hours in which the tower was closed. These counts recorded the time of aircraft operations in addition to aircraft type, operation type, and runway use. Data obtained from this count was used to account for nighttime aircraft operations (between 10:00 p.m. and 7:00 a.m. All events that occur during this time period are assigned a 10 decibel penalty due to the increased annoyance.) for modeling the 2004 noise exposure contours. This percentage of operations was applied to both future forecast scenarios.

RUNWAY USE

Runway usage data is another essential input to the INM. For modeling purposes, wind data analysis usually determines runway use percentages. Aircraft will normally land and takeoff into the wind. However, wind analysis provides only the directional availability of a runway and does not consider pilot selection, primary runway operations, or local operating conventions. At Scottsdale Airport, the single runway configuration offers only two directions of choice.

The runway usage at Scottsdale Airport was established through discussions with the ATCT manager. In addition, a supplemental wind analysis was conducted which supported that wind conditions are consistent for runway use as stated by ATCT. **Table 3C** summarizes the runway use percentages for the existing and future conditions.

TABLE 3C Runway Use Percentages by Aircraft Type					
Arrivals and Departures				Touch-and-Go	
Runway	Business Jet	Turboprop/ Multi-Engine	Single Engine Piston	Turboprop/ Multi-Engine	Single Engine Piston
3	55	55	55	55	55
21	45	45	45	45	45
Source: Scottsdale Airport Traffic Control Tower (2003).					

FLIGHT TRACKS

A review of local and regional air traffic control procedures, as well as an assessment of actual radar flight tracks, were used to develop consolidated flight tracks. The resulting analysis is a series of consolidated flight tracks describing the average corridors that lead to and from Scottsdale Airport. For developing the flight tracks for input into the INM, radar data from October 20-26, 2003 were used. Scottsdale Airport does not have an on-airport radar facility. The FAA Phoenix TRACON provided radar flight track data from the Williams Gateway facility. The coverage area is similar to the coverage areas provided by previous studies. **Exhibit 3D** depicts the radar flight track data provided by the FAA TRACON for the Scottsdale area.

As seen on **Exhibit 3D**, there are two corridors where the radar flight track data are heavily concentrated: straight north-northwest of the airport and straight south-southwest of the airport. More dispersed flight tracks are depicted east and southeast of the airport. A number of aircraft overflights can also be seen, particularly over airport. These flight tracks depict aircraft transitioning through the area. Since the radar flight track data acquired depicts only aircraft at or below 5,500 feet MSL, a large number of additional aircraft overflights that occurred above this altitude are not shown.

Exhibit 3E depicts the consolidated departure flight tracks developed for input into the INM. INM consolidated flight tracks are developed by plotting the centerline of a concentrated group of tracks and then dispersing the consolidated track into multiple sub-tracks that conform to the radar flight track data. The thin pink colored lines on **Exhibit 3E** are the radar track data. The wider dark blue lines represent the centerline or spine of each group of radar track data. The light blue lines represent the dispersion of each group of departure tracks.

Arrival tracks at Scottsdale Airport are generally concentrated on the runway centerline due to the precision needed to safely land an aircraft. However, the small general aviation aircraft are able to make shorter approaches to the airport. **Exhibit 3F** depicts the arrival stream and consolidated flight tracks at Scottsdale Airport. The thin pink colored lines on **Exhibit 3F** are the visual flight rule (VFR) and the thin purple lines are the instrument flight rule (IFR) radar track data. The wider dark blue lines represent the centerline or spine of each group of arrival radar track data. The light blue lines represent the dispersion of each group of arrival tracks.

Exhibit 3G depicts the consolidated touch-and-go tracks in dark green and light green developed for input into the INM. Typically, Scottsdale Airport utilizes a left-hand traffic pattern for Runway 3 and a right-hand traffic pattern for Runway 21. The series of concentric oval-shaped tracks represent the radar flight track and observed variances in the size of the training pattern at Scottsdale Airport. **Exhibit 3G** also illustrates the military fighter jet overhead approach tracks and the helicopter flight tracks developed for this analysis.

The helicopter routes represent an average of those observed and published, and depict both arrival and departure traffic. Tracks defining typical arrival and departure routes for helicopters are depicted in dark blue and light blue on **Exhibit 3G**.

ASSIGNMENT OF FLIGHT TRACKS

The final step in developing input data for the INM model is the assignment of aircraft to specific flight tracks. Prior to this step, specific flight tracks, runway utilization, and operational statistics for the various aircraft models using Scottsdale Airport were evaluated. The radar flight track data was used to determine flight track percentages for each aircraft type. The radar flight tracks that formed the consolidated tracks and sub-tracks were first counted. Then each consolidated track was assigned a percentage based on the total number of tracks for each runway.

To determine the specific number of aircraft assigned to any one flight track, a long series of calculations was performed. This included a number of specific aircraft of one group, factored by runway utilization and flight track percentage. A detailed breakdown of the flight track assignments can be found in **Appendix D**.

ENGINE MAINTENANCE RUN-UPS

Version 6.1 of the INM provides for the computation of noise levels due to airplane engine run-up operations. At Scottsdale Airport, routine maintenance is done by several operators at the airport. Run-ups are currently prohibited from 10:00 p.m. to 7:00 a.m. at Scottsdale Airport. Therefore, run-ups were programmed into the INM for the daytime only. The designated aircraft run-up area is located on the northwest side of the airport.

Interviews with operation managers and maintenance staff indicated that several types of aircraft are run-up on a regular basis. Aircraft range from the Cessna 152 and Piper Arrow to the Business Jet aircraft. Based upon the list of aircraft provided, the GASEPF, GASEPV, and LEAR25 from the INM database were selected to represent the aircraft for this analysis. The GASEPV was programmed to run-up 1.4 times per day at 75 percent thrust, the GASEPF was programmed to run-up

0.4 times per day at 100 percent thrust, and the LEAR25 was programmed to run-up 0.8 times per day at 100 percent thrust. This run-up activity was projected to remain the same for 2009. The LEAR25 was replaced by the LEAR35 in the long range 2025 noise exposure contours due to the national fleet transition to quieter Stage 3 aircraft over the long term.

INM OUTPUT

Output data selected for calculation by the INM were annual average noise contours in DNL (day-night sound level). Part 150 requires that 65, 70, and 75 DNL contours must be mapped in the official Noise Exposure Maps. The 55 and 60 DNL contours were mapped for land use planning are considered to have a marginal effect of noise-sensitive land uses. (See Chapter Four, Noise Impacts, p. 4-4 for more information.) This section presents the results of the contour analysis for current and forecast noise exposure conditions, as developed from the INM.

2004 NOISE EXPOSURE CONTOURS

Exhibit 3H presents the plotted results of the INM contour analysis for 2004 conditions using input data described in the preceding pages. The areas within each contour are presented in **Table 3D**.

TABLE 3D
Comparative Areas Of Noise Exposure
Scottsdale Airport

	Area In Square Miles		
DNL Contour	**2004**	**2009**	**2025**
55	3.56	3.99	3.80
60	1.58	1.75	1.64
65	0.77	0.83	0.76
70	0.43	0.45	0.40
75	0.24	0.25	0.21

The shape and extent of the contours reflect the underlying flight track assumptions. The contours to the north bend slightly to the west reflecting the IFR turn to the BANYO intersection. (BANYO is a point located 9.4 miles northwest of the airport.) The predominant use of Runway 3 for departures is evident as the contours are long and slender to the north, and bowed and pointed to the south.

The outermost contour on **Exhibit 3H** represents the 55 DNL contour. To the north, the contour extends approximately 8,000 feet and approximately 5,500 feet from airport property to the south. Slight bulges in the contour to the east and west are a result of helicopters arriving to and departing from the airport. The bulge to the north is due to the aircraft maintenance run-ups. To the east and west, the contours extend approximately 2,000 feet from the airport.

The 60 DNL contour is smaller than the 55 DNL contour. The long slender shape of the contour to the north is a result of departures, and the pointed and bowed shape of the contour to the south is a result of both approaches and departure run-up spools. To the north, the contour extends approximately 4,500 feet and approximately 1,500 feet to the south.

The 65 DNL contour extends approximately 1,800 feet to the north and remains on airport property to the south. For the most part, the contour remains on airport property to the east. To the west, the contour extends approximately 500 feet from airport property. The 70 and 75 DNL noise contours remain close to the runway. These contours are mostly on airport property or within the commercial and industrial areas adjacent to the airport.

2009 NOISE EXPOSURE CONTOURS

The 2009 noise contours depicted on **Exhibit 3J** are similar in shape to their 2004 counterparts. The contours are slightly larger in size primarily due to the forecasted increase in operations at the airport. The areas within the 2009 contour are presented in **Table 3D**. The flight track assumptions for the 2009 contours reflect the introduction of Area Navigation (RNAV) departure procedure that will direct IFR traffic to follow a corridor along Cactus Road to the west. It is assumed that 50 percent of IFR traffic departing to the southwest will utilize this departure procedure by 2009. The 2009 analysis provides a near term baseline which can be used to judge the effectiveness of proposed noise abatement procedures.

The 55 DNL contour, at its longest point, extends approximately 8,100 feet from airport property to the north and 6,300 feet to the south. In all other directions, the contour mirrors what was described for the 2004 55 DNL noise contour. The 60 DNL contour, at its longest point, extends approximately 5,500 feet from airport property to the north and 2,000 feet to the south. To the east and west, the contour is very similar to what was described for the 2004 noise condition.

The 65 DNL contour is slightly larger than the 2004 65 DNL contour. It primarily remains on airport property to the south and east, extends over adjoining compatible land uses to the west, and extends approximately 2,100 feet to the north. The 70 and 75 DNL contours remain on airport property for the most part to the north, south, and west and extend off airport property to the east over airport-adjacent commercial and industrial land uses.

2025 NOISE EXPOSURE CONTOURS

The 2025 noise contours represent the estimated noise conditions based on the forecasts of future operations. As with the 2009 noise contours, the flight track assumptions for the 2025 contours continue to reflect use of an RNAV departure that directs IFR traffic to follow a corridor along Cactus Road to the west. It is assumed that 90 percent of IFR traffic departing to the southwest will utilize this departure procedure by 2025. This analysis provides a long term future baseline which can also be used to judge the effectiveness of proposed noise abatement procedures and land use planning recommendations. **Exhibit 3K** presents the plotted results of the INM contour analysis for 2025 conditions using input data described in the preceding pages. Due to the reduction of Stage 2 business jet aircraft by 2025, the 2025 noise contours are slightly smaller than the 2009 noise contours. As previously mentioned, the reduction in Stage 2 business jets is primarily due to the age and high cost to operate these aircraft. These aircraft were certified at or prior to December 31, 1974. The surface areas of the 2025 noise exposure are presented for comparison in **Table 3D**.

The 55 DNL contour extends approximately 8,500 feet to the north and approximately 7,000 feet to the south. The 60 DNL contour is similar in shape to the 2004 and 2009 60 DNL noise contours, extending approximately 5,500 feet from the airport to the north and approximately 2,500 feet to the south. The contours mirror the previous years' contours to the east and west.

The 65 DNL contour mirrors the previous years' contours in shape and extends approximately 2,250 feet to the north while remaining on airport property to the south. The 70 and 75 DNL contours primarily remain on airport property to the north, south, and west and extend over adjoining compatible land uses to the east.

AIRCRAFT NOISE MEASUREMENT PROGRAM

A noise measurement program was conducted over an 11-day period from October 20, 2003 through October 30, 2003. The field measurement program was designed and undertaken to provide real data for comparison with the computer-predicted values. These comparisons provide insight into the actual noise conditions around the airport and can serve as a guide for evaluating the assumptions developed for computer modeling.

It must be recognized that field measurements made over a 24-hour period are applicable only to that period of time and may not and in fact, in many cases do not, reflect the average conditions present at the site over a much longer period of time. The relationship between field measurements and computer-generated noise exposure forecasts is similar to the relationship between weather and climate. While an area may be characterized as having a cool climate, many individual days of high temperatures may occur. In other words, the modeling process derives overall average annual conditions (climate), while field measurements reflect daily fluctuations (weather).

Information collected during the noise monitoring program included 48-hour and 7-day measurements for comparison with computer-generated DNL values. DNL is a measure of cumulative sound energy during a 24-hour period. All noise occurring from 10:00 p.m. to 7:00 a.m. is assigned a 10 decibel (dB) penalty because of the greater annoyance typically caused by nighttime noise. Use of the DNL noise metric in airport noise compatibility studies is required by Part 150. Additional information collected on single-event measurements is used as an indicator of typical dB and Sound Exposure Levels (SEL) within the study area as well as comparative ambient noise measurements in areas affected by aircraft noise. All procedures and equipment involved in the aircraft noise measurement program were performed pursuant to guidelines set forth by Part 150, Section A150.3.

ACOUSTICAL MEASUREMENTS

This section provides a technical description of the acoustical measurements which were performed for the Scottsdale Airport Part 150 Noise Compatibility Study. Described here are the instrumentation, measurement procedures, weather information, and noise measurement sites.

Instrumentation

Four sets of acoustical instrumentation, the components of which are listed in **Table 3E**, were used to measure noise. Each set consisted of a high quality microphone connected to a 24-hour environmental noise monitor unit. Each unit was calibrated to assure consistency between measurements at different locations. A calibrator, with an accuracy of 0.5 decibels (dB), was used for all measurements. At the completion of each field measurement, the calibration was rechecked, the accumulated output data was downloaded to a portable computer, and the data memories were cleared before the unit was placed at a new site. The equipment listed in the table was supplemented by accessory cabling, windscreens, tripods, security devices, etc., as appropriate to each measurement site.

TABLE 3E
Acoustical Measurement Instrumentation

4	Larson Davis 820 Portable Noise Monitors and Pre-amplifiers
4	Larson Davis Model 2559 - ½-inch Microphones
1	Model CA250 Sound Level Calibrator
1	Portable Computer

Measurement Procedures

Two methods were used to attempt to minimize the potential for non-aircraft noise sources to unduly influence the results of the measurements. First, for single-event analysis, minimum noise thresholds of 5 to 10 dB greater than background noise levels were programmed into the monitor. This procedure resulted in the requirement that a single noise event exceed a threshold of 60 dB at each site. Second, a minimum event duration, longer than the time associated with ambient single events above the threshold (for example, road traffic), was set (at five seconds). The combination of these two factors limited the single events analyzed in detail to those which exceeded the present threshold for longer than the preset duration. These measures reduce the potential for contamination of single event data.

Selected single events were specially retained and analyzed to consider all noise present at the site, regardless of its level, and provide hourly summations of Equivalent Noise Levels (Leq). Additionally, the equipment optionally provides information on the hourly maximum decibel level, SEL values for each event which exceeds the preset threshold and duration, and distributions of decibel levels throughout the measurement period.

Weather Information

The noise measurements taken during this study were obtained during a period of above average, hot weather for the Scottsdale area. For the first few days of the monitoring period, there were record temperatures. Daily highs for this time period were in the low 100's and the average low was in the lower 70's. During the latter half of the monitoring period, temperatures fell to their normal October highs of mid-80's. Daily highs were in the lower 90's to mid-80's with an average low in the mid-60's. There was no precipitation during the monitoring period; therefore, weather conditions were considered to be adequate for aircraft using visual flight rules (VFR). Winds on average were at about 6 knots with occasional gusts up to 24 knots.

MEASUREMENT RESULTS SUMMARY

The noise data collected during the measurement period is presented in **Table 3F**. The information includes the average 24-hour Leq for each site. The Leq metric is derived by accumulating all noise during a given period and logarithmically averaging it. It is similar to the DNL metric except that no extra weight is attached to nighttime noise. The DNL(24) value represents the DNL from all noise sources. The DNL(24t) is developed only from noise exceeding the loudness and duration thresholds defined at each measurement site. The DNL(24t) is a reasonable approximation of the DNL attributable to aircraft noise alone. Aircraft noise events are usually the only ones exceeding these thresholds if the sites and thresholds are carefully selected. As most aircraft overflights last between five to 60 seconds, the DNL(24t) is developed by removing noise events that last longer than 60 seconds. It is this DNL(24t) value which modeled noise may be compared to assess the adequacy of the computer predictive model in describing actual conditions. In addition, L(50) values for each site are presented. These values represent sound levels above which 50 percent of the samples were recorded.

TABLE 3F
Measurement Result Summary
Scottsdale Airport

	Site 1		Site 2		Site 3		Site 4		Site 5	
	Day 1	**Day 2**	**Day 1**	**Day 2**	**Day 1**	**Day 2**	**Day 1**	**Day 2**	**Day 1**	**Day 2**
Measurement Dates	**10/20 to 10/22**		**10/20 to 10/22**		**10/27 to 10/29**		**10/22 to 10/24**		**10/27 to 10/29**	
Cumulative Data										
LEQ(24)	48.5	39.9	54.2	53.5	44.0	43.2	45.8	49.9	51.2	54.9
DNL(24)	49.3	42.9	54.4	53.8	47.5	47.6	46.9	51.0	52.4	61.2
DNL(24t)	49.3	42.9	53.2	53.8	47.5	47.6	46.9	51.0	52.2	56.0
L(50)	45.1	45.1	42.2	42.2	48.9	48.9	47.5	47.5	45.5	45.5
Single Event Data										
L(max)	85.6	73.9	92.5	90.3	81.6	72.5	77	86.3	83.9	90.7
SEL(max)	94.2	81.5	99.2	98.8	85.6	81.9	84.8	95.3	91.9	98.7
Max Duration (sec)	46	24	74	55	38	43	29	32	65	92
Number of Single Events above 60 dB (Lmax)	44	21	78	70	51	53	78	93	114	197
Number of Single Events Above										
SEL 70 dB	32	12	49	38	66	36	56	68	76	123
SEL 80 dB	8	2	18	15	10	6	6	5	24	48
SEL 90 dB	1	0	2	3	0	0	0	2	2	2
SEL 100 dB	0	0	0	0	0	0	0	0	0	0

TABLE 3F (Continued)
Measurement Result Summary
Scottsdale Airport

	Site 6		Site 7						
	Day 1	**Day 2**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**
Measurement Dates	**10/22 to 10/24**		**10/21 to 10/28**						
Cumulative Data									
LEQ(24)	49.6	51.8	56.6	56.4	56.7	54.9	52.1	54.4	56.7
DNL(24)	49.6	52.7	61.9	62.2	61.2	59.4	53.4	57.1	58.9
DNL(24t)	49.4	50.2	54.7	54.5	55.6	56.9	53.2	56.6	57.4
L(50)	43.8	43.8	53.1	53.1	53.1	53.1	50.1	50.1	50.1
Single Event Data									
L(max)	91.6	85.7	79.8	83.1	86.7	88.3	81.7	64.3	61.8
SEL(max)	92.5	96.3	98.4	99.3	96.5	94	92.5	94.2	99.6
Max Duration (sec)	156	441	3112	3075	2728	192	87	83	109
Number of Single Events above 60 dB (Lmax)	96	78	399	444	413	372	176	257	267
Number of Single Events Above									
SEL 70 dB	70	58	252	311	266	250	89	158	182
SEL 80 dB	10	9	50	48	53	48	33	56	42
SEL 90 dB	2	3	7	4	7	3	2	1	6
SEL 100 dB	0	0	0	0	0	0	0	0	0

TABLE 3F (Continued)
Measurement Result Summary
Scottsdale Airport

	Site 8						
	Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**
Measurement Dates	**10/20 to 10/27**						
Cumulative Data							
LEQ(24)	65.5	47.9	49.7	53.7	49.1	46.0	46.8
DNL(24)	65.6	49.5	50.4	55.5	52.1	49.1	50.1
DNL(24t)	52.9	49.5	50.4	55.3	52.1	49.1	50.1
L(50)	44.5	44.5	44.5	44.5	44.5	44.5	44.5
Single Event Data							
L(max)	98.1	81.1	88.4	89.8	85.3	75.9	77.4
SEL(max)	114.6	90.1	95.8	100	93	81	85.5
Max Duration (sec)	1745	36	32	149	59	24	25
Number of Single Events above 60 dB (Lmax)	132	94	84	121	112	85	72
Number of Single Events Above							
SEL 70 dB	86	64	57	86	71	71	49
SEL 80 dB	18	11	9	20	10	8	11
SEL 90 dB	3	1	1	2	1	0	0
SEL 100 dB	1	0	0	1	0	0	0

TABLE 3F (Continued)
Measurement Result Summary
Scottsdale Airport

	Site 9			Site 10			Site 11		Site 12	
	Day 1	**Day 2**	**Day 3**	**Day 1**	**Day 2**	**Day 3**	**Day 1**	**Day 2**	**Day 1**	**Day 2**
Measurement Dates	**10/24 to 10/27**			**10/24 to 10/27**			**10/27 to 10/29**		**10/27 to 10/29**	
Cumulative Data										
LEQ(24)	42.7	42.9	41.9	47.4	39.7	41.9	47.6	49.1	50.1	43.7
DNL(24)	47.3	44.0	41.9	48.0	43.1	41.9	48.7	57.4	51.9	47.3
DNL(24t)	47.3	44.0	41.9	48.0	43.1	41.9	48.4	48.6	46.8	47.3
L(50)	41.6	41.6	41.6	45.0	45.0	45.0	44.4	44.4	43.2	43.2
Single Event Data										
L(max)	73.5	71.7	74.6	94.1	75.4	77.4	82.4	85.5	80.8	73.6
SEL(max)	81.2	80.6	83.5	94.8	81.7	83.1	92.9	96	93.7	82.6
Max Duration (sec)	30	56	42	39	20	42	190	91	1215	41
Number of Single Events above 60 dB (Lmax)	55	70	43	57	36	42	56	49	141	93
Number of Single Events Above										
SEL 70 dB	34	47	27	39	28	31	30	33	73	47
SEL 80 dB	4	3	3	2	1	2	7	3	8	3
SEL 90 dB	0	0	0	1	0	0	1	2	3	0
SEL 100 dB	0	0	0	0	0	0	0	0	0	0

The table also presents data on other measures of noise that may be useful for comparisons. These included:

- Maximum recorded noise level in dB (Lmax);

- Maximum recorded sound exposure level (SELmax);
- Longest single-event duration in seconds (Max Duration); and
- Number of single events above SEL 60, 70, 80, 90, and 100.

For comparative purposes, normal conversation is generally at a sound level of 60 dB while a busy street is approximately 70 dB along the adjacent sidewalk.

A total of 4,717 single events were recorded during the program and 876 average hourly sound levels were calculated and recorded.

Aircraft Noise Measurement Sites

Noise measurement sites are shown on **Exhibit 3L**. They were selected on the basis of background information including previous sites from the 1995 Part 150 Noise Compatibility Study. Information collected by the airport management was also used to identify potential sites based on noise complaint history.

Specific selection criteria include the following:

- Emphasis on areas of marginal aircraft noise exposure according to earlier evaluations.
- Screening of each site for local noise sources or unusual terrain characteristics which could affect measurements.
- Location in or near areas from which a substantial number of complaints about aircraft noise were received, or where there are concentrations of people exposed to significant 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 noise conditions in the airport vicinity. Two sites were monitored for 168 hours; two sites were monitored for 72 hours; and eight sites were monitored for periods of 48 hours.

Site 1 is located at 9186 East Siesta Lane in the Ironwood subdivision, approximately two miles northeast of the airport. The location is situated within a quiet, secluded residential neighborhood that is located almost directly northeast of the extended centerline of Runway 3-21. This site was selected because of its close proximity to a site used in the previous noise compatibility study and because of frequent noise complaints from the residents.

The monitor was placed in the backyard of the residence an equal distance from the house and privacy walls. During the equipment set-up, numerous aircraft overflights were observed.

Site 2 is located at 6211 East Cortez within Equestrian Manor Estates, a gated community, approximately 2.25 miles southwest of the airport. The area is a quiet residential community with large homes and very little automobile traffic. This site receives frequent arrival and departure overflights as it is located almost directly on the extended centerline of Runway 3-21.

This site was selected as a result of numerous noise complaints by the homeowners and close proximity to the extended runway centerline. The 24-hour Leq for the first day at Site 2 was 54.2 and 53.5 for the second day. The computed DNL(24) for the first day was 54.4 and 53.8 for the second day.

Site 3 is located at 11802 North Miller Street south of the airport approximately 1.5 miles. The area is a single-family residential subdivision. The equipment was set up in the large backyard, away from the house and privacy walls. This site was chosen because of its close proximity to a monitoring site used for the previous noise monitoring study. The 24-hour Leq at Site 3 was 44.0 for the first day and 43.2 on the second day. The computed DNL(24) for the first day was 47.5 and 47.6 for the second day.

Site 4 is located at 9381 East Rockwood Drive in Ironwood subdivision, northwest of the airport, a few blocks away from Site 1. This site is approximately 2.1 miles from the airport and is located almost directly off the extended centerline. As stated previously, this is a secluded neighborhood with very little automobile traffic noise. The equipment was set up in the backyard. There was no automobile traffic observed during set-up; however, numerous aircraft operations were observed. The 24-hour Leq for the first day at Site 4 was 45.8 and 49.9 for the second day. The computed DNL(24) for the first day was 46.9 and 51.0 for the second day.

Site 5 is located at 6843 East Sheena Drive approximately 0.65 miles west of the southern airport property boundary. This site is located in a single family residential neighborhood. The equipment was set up in the backyard of the residence. The 24-hour Leq for the first day at Site 5 was 51.2 and 54.9 for the second day. The computed DNL(24) for the first day was 52.6 and 61.2 for the second day.

Site 6 is located at 6132 East Redfield Drive approximately 1.6 miles west of airport property. This site was monitored in the previous noise compatibility study. The equipment was set up in the backyard of the residence away from the home and privacy walls. Aircraft noise was not observed during set-up; however, the homeowner reports frequent noise resulting from arrivals and departures at the airport. The 24-hour Leq for the first day at Site 6 was 49.6 and 51.83 for the second day. The computed DNL level for the first day was 49.6 and 52.7 for the second day.

Site 7 is located at 8515 Anderson Road approximately 0.8 miles northeast of the airport. This site was monitored in the previous noise compatibility study. Since the previous study, the land use of the area has changed from open space to a business park. In addition, the 101 Freeway has been constructed since the previous study and is located in close proximity to Site 7.

The equipment was set up approximately 20 feet from a road that experiences light automobile traffic throughout the day and increasing traffic during morning and evening rush hour traffic. Automobile traffic from the 101 Freeway was not audible. This site was one of two sites that was monitored for a 7-day time period. The 24-hour Leq was 56.6 for the first day, 56.4 for the second day, 56.7 for the third day, 54.9 for the fourth day, 52.1 for the fifth day, 54.4 for the sixth day, and 56.7 for the seventh day. The computed DNL(24) for the first day was 61.9, 62.2 for the second day, 61.2 for the third day, 59.4 for the fourth day, 53.4 for the fifth day, 57.1 for the sixth day, and 58.9 for the seventh day.

Site 8 was originally located at 12602 North 68th Place. This site is located southeast of the airport approximately 1.3 miles in a single-family residential neighborhood. This site is situated on the extended centerline and experiences frequent arrival and departure overflights, several overflights were observed during equipment set up. The equipment was set up in the backyard of the residence. This site was planned for a 7-day observation period; however, the site was relocated at the homeowners request on October 22 at 10:45 a.m. and placed directly across the street at 12601 N. 68th Place. The 24-hour Leq was 65.5 for the first day, 47.9 for the second day, 49.7 for the third day, 53.7 for the fourth day, 49.1 for the fifth day, 46.0 for the sixth day, and 46.8 for the seventh day. The DNL(24) was computed at 65.6 for the first day, 49.5 for the second day, 50.4 for the third day, 55.5 for the fourth day, 52.1 for the fifth day, 49.1 for the sixth day, and 50.1 for the seventh day.

Site 9 is located at 6754 East Sandra Terrace approximately one mile northwest of the airport in a single-family neighborhood. This location was chosen because it was monitored in the previous noise compatibility program and because of noise complaints from the homeowner. The equipment was set up in the backyard. Aircraft traffic, most notably helicopter traffic, was observed during the set up of the equipment. The 24-hour Leq was 42.7 for first day, 42.9 for the second day, and 41.9 on the third day. The computed DNL(24) for the first day was 47.3, 44.0 for the second day, and 41 on the third day.

Site 10 is located at 9215 East Aster Drive approximately 1.9 miles southeast of the airport. This location was chosen because of numerous noise complaints from the homeowner. This area is a single-family residential neighborhood and is located in close proximity to 101 Highway.

The equipment was set up in the backyard of the residence. No aircraft noise was observed; however, automobile traffic from the 101 Freeway was noticeable. A weather event occurred during the evening of the second monitoring day, turning the microphone on its side. The homeowner noticed the turned microphone on the morning of the third day and stood it upright. The 24-hour Leq for Site 10 was 47.4 for the first day, 39.7 for the second day, and 41.9 for the third day. The computed DNL(24) for the first day was 48.0, 43.1 for the second day, and 41.9 for the third day.

Site 11 is located at 7691 East Phantom Way approximately 2.7 miles north of the airport. This location was chosen to represent the new development that has been occurring in this area since the previous noise compatibility study.

The equipment was set up in the backyard of the residence. During the set-up of the equipment, a twin turbo overflight was noted. The 24-hour Leq for Site 11 was 47.6 for the first day and 49.1 for the second day. The computed DNL(24) for the first day was 48.7 and 57.4 for the second day.

Site 12 is located at 7647 East Whispering Wind Drive approximately 5.5 miles north of the airport. As stated previously within the Site 11 description, this site was chosen to represent new residential development that has recently occurred in the area.

The equipment was set-up on top of the garage on a viewing platform approximately 30 feet above the ground. During equipment set up a single engine overflight was noted. The 24-hour Leq for Site 12 was 50.1 for the first day and 43.7 for the second day. The computed DNL(24) for the first day was 51.9 and 47.3 for the second day.

COMPARATIVE MEASUREMENT ANALYSIS

A comparison of the measured versus the computer-predicted cumulative DNL noise values for each measurement site has been developed. In this case, it is important to remember what each of the two noise levels indicates. The computer-modeled DNL contours are analogous to the climate of an area and represent the noise levels on an average day of the period under consideration. In contrast, the field measurements reflect only the noise levels on the specific days of measurement. Additionally, the field measurements consider all the noise events that exceed a prescribed threshold and duration while the computer model only calculates the noise due to aircraft events. As previously discussed, the field measurements can easily be contaminated by ambient noise sources other than aircraft around the measurement sites. With this understanding in mind, it is useful to evaluate the comparative aircraft DNL levels of the measurement sites. The DNL(24t) was used as it is a reasonable approximation of the DNL attributable to aircraft noise alone.

DNL Comparison

This analysis provides a direct comparison of the measured and predicted values for each noise measurement site. In order to facilitate such a comparison, it is necessary to ensure that the computer model input is representing the observed reality as accurately as possible within the capabilities of the model.

A difference of three to four 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. In this case, all 12 of the noise monitor sites fall outside the 65 DNL noise contour. The measured and predicted 2004 noise exposure contours for the annual average condition are presented for each aircraft noise measurement site on **Exhibit 3L** and **Table 3G**.

As seen in **Table 3G**, in all but two cases (Sites 3 and 12), the predicted noise levels were within three DNL. Site 3 is located approximately 1.5 miles south of the airport and Site 12 is located approximately 5.5 miles northwest of the airport. Measured and predicted noise DNL levels for both sites are in the mid 40s.

TABLE 3G
Noise Measurement vs. Predicted DNL Values
Scottsdale Airport

Monitor Site	Measured (DNL[24t])	Predicted 2004[1]	Difference
1	47.2	50.0	2.8
2	53.2	50.8	-2.4
3	46.1	41.4	-4.7
4	49.4	48.8	-0.6
5	54.5	54.0	-0.5
6	50.2	48.3	-1.9
7	55.8	56.6	0.8
8	51.9	54.7	2.8
9	45.0	47.2	2.2
10	45.2	44.2	-1.0
11	48.5	47.1	-1.4
12	47.1	43.0	-4.1

Source: Coffman Associates Analysis

[1] 2004 noise exposure contours.

SUMMARY

The information presented in this chapter defines the noise patterns for current and future aircraft activity, without additional abatement measures, at Scottsdale Airport. It does not make an attempt to evaluate or otherwise include that activity over which the airport has no control -- such as other aircraft transiting the area and not stopping at the airport.

The current (2004) noise contours are based on operational counts during 2003 from the Scottsdale ATCT and supplemental data acquired during times when the ATCT was closed. The 2009 and 2025 contours are based on forecasts detailed in Chapter Two. The noise exposure levels around the airport can be expected to increase slightly as the airport becomes busier in the future. However, the reduction in the size of the long range contours can be attributed to the continued introduction and use of newer, quieter aircraft.

It is stressed that DNL contour lines drawn on a map do not represent absolute boundaries of acceptability or unacceptability in personal response to

noise, nor do they represent the actual noise conditions present on any specific day, but rather the conditions of an average day derived from annual average information.