Appendix F

Noise

Appendix F Noise

F.1 General Characteristics of Aircraft Noise

Sound, when transmitted through the air and upon reaching our ears, may be perceived as desirable or unwanted. People normally refer to noise as unwanted sound. Because sound can be subjective, individuals have different perceptions, sensitivities, and reactions to noise. Loud sounds may bother some people, while others may be bothered by certain rhythms or frequencies of sound. Sounds that occur during sleeping hours are usually considered to be more objectionable than those that occur during daytime hours.

Aircraft noise originates from both the engines and the airframe of an aircraft, but the engines are by far the more significant source of noise. Meteorological conditions affect the propagation (or transmission) of sound through the air. Wind speed and direction, and the temperature immediately above ground level cause diffraction and displacement of sound waves. Humidity and temperature materially affect propagation of air-to-ground sound through absorption associated with the instability and viscosity of the air.

F.2 Noise Analysis Methodology

The methodology used for this aircraft noise analysis involved: (1) the use of noise descriptors developed for airport noise analyses; (2) development of basic data and assumptions for use as input to a computer model; and (3) the application of the computer model, providing estimates of aircraft noise levels.

F.3 Noise Descriptors

Noise levels are measured using a variety of scientific metrics. As a result of extensive research into the characteristics of aircraft noise and human response to that noise, standard noise descriptors have been developed for aircraft noise exposure analyses. The descriptors used in this noise analysis are described below.

Decibel, dB – Sound is a complex physical phenomenon consisting of complex minute vibrations traveling through a medium, such as air. These vibrations are sensed by the human ear as sound pressure. Because of the vast range of sound pressure or intensity detectable by the human ear, sound pressure level (SPL) is represented on a logarithmic scale known as decibels (dB). A sound level of 0 dB is approximately the threshold of human hearing and is barely audible under extremely quiet (laboratory-type) listening conditions. An SPL of 120 dB begins to be felt inside the ear, and discomfort and pain at approximately 140 dB. Most environmental sounds have SPLs ranging from 30 to 100 dB.

Because decibels are logarithmic, they cannot be added or subtracted directly like other (linear) numbers. For example, if two sound sources each produce 100 dB, when they are operated together they will produce 103 dB, not 200 dB. Four 100 dB sources operating together again double the sound energy, resulting in a total SPL of 106 dB, and so on. In addition, if one source is much louder than another, the two sources operating together will produce the same SPL as if the louder source were operating alone. For example, a 100 dB source plus an 80 dB source produce 100 dB when operating together. Two useful rules to remember when comparing SPLs are: (1) most people perceive a 6 to 10 dB increase in SPL between two noise events to be about a doubling of loudness, and (2) changes in SPL of less than about 3 dB between two events are not easily detected outside of a laboratory.

A-Weighted Sound Pressure Level, dBA: The decibel (dB) is a unit for describing sound pressure level. When expressed in dBA, the sound has been filtered to reduce the effect of very low and very high frequency sounds, much like the human ear does. Frequency, or pitch, is a basic physical characteristic of sound and is expressed in units of cycles per second or hertz (Hz). The normal frequency range of hearing for most people extends from about 20 to 20,000 Hz. Because the human ear is more sensitive to middle and high frequencies (i.e., 1,000 to 4,000 Hz), as compared to low frequencies, a frequency weighting called "A" weighting is applied. With the A-weighting, calculations and sound monitoring equipment approximates the sensitivity of the human ear to sounds of different frequencies.

Some common sounds on the dBA scale are listed in **Table F-1**. As shown in the table, the relative perceived loudness of a sound doubles for each increase of 10 dBA, even though a 10 dBA change corresponds to a change of relative sound energy by a factor of 10. Generally, sounds with differences of 2 dBA or less are not perceived to be noticeably different by most listeners.

Maximum A-Weighted Noise Level, L_{max} – Sound levels vary with time. For example, the sound increases as an aircraft approaches, then falls and blends into the ambient or background as the aircraft recedes into the distance. Because of this variation, it is often convenient to describe a particular noise "event" by its highest or maximum sound level (L_{max}). Note that L_{max} describes only one dimension of an event; it provides no information on the cumulative noise exposure generated by a sound source. In fact, two events with identical L_{max} may produce very different total exposures as one may be of very short duration, while the other may be much longer.

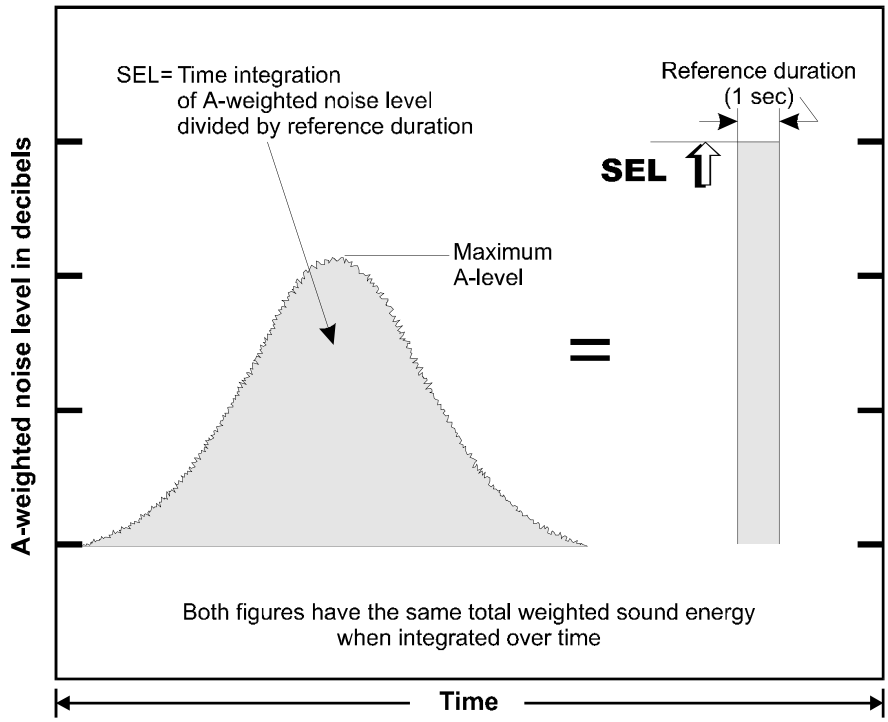
Table F-1 Common Sounds on the A-Weighted Decibel Scale

SOUND	SOUND LEVEL (DBA)	RELATIVE LOUDNESS (APPROXIMATE)	RELATIVE SOUND ENERGY
Rock music, with amplifier	120	64	1,000,000
Thunder, snowmobile (operator)	110	32	100,000
Boiler shop, power mower	100	16	10,000
Orchestral crescendo at 25 feet, noisy kitchen	90	8	1,000
Busy street	80	4	100
Interior of department store	70	2	10
Ordinary conversation, 3 feet away	60	1	1
Quiet automobiles at low speed	50	1/2	.1
Average office	40	1/4	.01
City residence	30	1/8	.001
Quiet country residence	20	1/16	.0001
Rustle of leaves	10	1/32	.00001
Threshold of hearing	0	1/64	.000001

SOURCE: U.S. Department of Housing and Urban Development, Aircraft Noise Impact—Planning Guidelines for Local Agencies, 1972.
PREPARED BY: Ricondo & Associates, Inc., January 2014.

Sound Exposure Level, SEL: Sound exposure level (SEL) is a time integrated measure, expressed in decibels, of the sound energy of a single noise event to a reference duration of one second. The sound level is integrated over the period that the level exceeds a threshold. Therefore, SEL accounts for both the maximum sound level and the duration of the sound. The standardization of discrete noise events into a one-second duration allows the calculation of the cumulative noise exposure of a series of noise events that occur over a period of time. Because of this compression of sound energy, the SEL of an aircraft noise event is typically 7 to 12 dBA greater than the L_{max} of the event. SEL values for aircraft noise events depend on the location of the aircraft relative to the noise receptor, the type of operation (landing, takeoff, or overflight), and the type of aircraft. The SEL concept is depicted on **Exhibit F-1**.

Exhibit F-1 Sound Exposure Level Concept



SOURCE: Brown-Buntin Associates, Inc.
PREPARED BY: Ricondo & Associates, Inc., January 2014.

A-weighted Day-Night Average Sound Level, DNL: DNL, also denoted as L_{dn} is expressed in dBA and represents the noise level over a 24-hour period. DNL includes the cumulative effects of a number of sound events rather than a single event. It also accounts for increased sensitivity to noise during nighttime hours. The DNL values are used to estimate the effects of specific noise levels on land uses. The U.S. Environmental Protection Agency (USEPA) introduced the metric in 1976 as a single number measurement of community noise exposure. The FAA adopted DNL as the noise metric for measuring cumulative aircraft noise under FAR Part 150, *Airport Noise Compatibility Planning*. The Department of Housing and Urban Development, the Veterans Administration, the Department of Defense, the United States Coast Guard, and the Federal Transit Administration have also adopted DNL for measuring cumulative noise exposure.

The calculation of DNL applies a 10-decibel-weighting penalty (equivalent to a ten-fold increase in aircraft operations) for each hour during the nighttime period (10:00 p.m. to 7:00 a.m.) before the 24-hour value is computed. The weighting penalty accounts for the more intrusive nature of noise during the nighttime hours.

DNL is expressed as an average noise level on the basis of annual aircraft operations for a calendar year, not on the average noise levels associated with different aircraft operations. To calculate the DNL at a specific location, SEL values at that location associated with each individual aircraft operation (landing or takeoff) are determined. Using the SEL for each noise event and applying the 10-decibel penalty for nighttime operations as appropriate, a partial DNL value is then calculated for each aircraft operation. The partial DNL values for each aircraft operation are added logarithmically to determine the total DNL.

The logarithmic addition process, whereby the partial DNL values are combined, can be approximated by the following guidelines:

When two DNLs differ by:	Add the following amount to the higher value:
0 or 1 dBA	3 dBA
2 or 3 dBA	2 dBA
4 to 9 dBA	1 dBA
10 dBA or more	10 dBA

For example:

70 dBA + 70 dBA (difference: 0 dBA) = 73 dBA
60 dBA + 70 dBA (difference: 10 dBA) = 70 dBA

Adding the noise from a relatively quiet event (60 dBA) to a relatively noisy event (70 dBA) results in a value of 70 dBA because the quieter event has only 1/10 of the sound energy of the noisier event. As a result, the quieter noise event is "drowned out" by the noisier one, and there is no increase in the overall noise level as perceived by the human ear.

DNL is used to describe existing and predicted noise exposure in communities in an airport environs based on the average daily operations over the year and the average annual operational conditions at the airport. Therefore, at a specific location near an airport, the noise exposure on a particular day is likely to be higher or lower than the annual average exposure, depending on the specific operations at the airport on that day. DNL has been widely accepted as the best available method to describe aircraft noise exposure and is the noise descriptor required by FAA for aircraft noise exposure analyses and land use compatibility planning under Federal Aviation Regulations Part 150, *Airport Noise Compatibility Planning*, and for environmental assessments for airport improvement projects.

F.3.1 DNL AND NOISE EXPOSURE RANGES

Noise exposure criterion levels of 65 dB, 70 dB, and 75 dB were used for the analysis, in accordance with FAA Order 1050.1E. The three noise exposure ranges used were 1) DNL 65 to 70 dB, 2) DNL 70 to 75 dB, and DNL 75+ dB. Noise exposure maps for 2012 existing conditions and for 2015 and 2020 future conditions for both the Proposed Action and No Action Alternative were prepared for this Environmental Assessment. The DNL 65 dB contour was examined for each of the alternatives to identify noise sensitive areas where noise would increase by DNL 1.5 dB or greater, when compared to the DNL 65 dB contour for the No Action Alternative for the same timeframe. In addition, the DNL 65 dB contour was also examined for the during the runway closure period of the Proposed Action Alternative construction phase, when compared to the DNL 65 dB contour for the normal operations in the same timeframe.

F.3.2 GRAPHIC REPRESENTATION

To graphically represent DNL, contour lines that connect points of equal DNL values are drawn on a map. For example, a contour may be drawn to connect all points with a DNL of 70 dB; another may be drawn to connect all points with a DNL of 65 dB; and so forth. Aircraft noise exposure contours were drawn at 5-DNL intervals to reflect the ranges in DNL values from 65 to 75 dB.

F.3.3 THE DNL DESCRIPTOR

The validity and accuracy of DNL calculations depend on the basic information used in the calculations. For future airport activities, the reliability of DNL calculations is affected by a number of uncertainties:

- Future aviation activity levels—the forecast number of aircraft operations, the types of aircraft serving the airport, the times of operation (daytime, evening, and nighttime), and aircraft flight tracks—are estimates. Achievement of the estimated levels of activity cannot be assured.
- Acoustical and performance characteristics of future aircraft are also estimates. When new aircraft designs are involved, aircraft noise data and flight characteristics must be estimated.
- The noise descriptors used as the basis for calculating DNL represent typical human response (and reaction) to aircraft noise. Because people vary in their responses to noise and because the physical measure of noise accounts for only a portion of an individual's reaction to that noise, DNL can be used only to obtain an average response to aircraft noise that might be expected from a community.
- Single flight tracks used in computer modeling represent a wider band of actual flight tracks.

These uncertainties aside, DNL mapping was developed as a tool to assist in land use planning around airports. The mapping is best used for comparative purposes rather than for providing absolute values. That is, DNL calculations provide valid comparisons between different projected conditions, as long as consistent assumptions and basic data are used for all calculations.

Thus, sets of DNL calculations can show anticipated changes in aircraft noise exposure over time, or differences in noise exposure associated with different airport development alternatives or operational procedures. However, a line drawn on a map does not imply that a particular noise condition exists on one side of that line and not on the other. DNL calculations provide a means for comparing noise exposure under different scenarios.

Nevertheless, DNL contours can be used to (1) highlight an existing or potential aircraft noise problem that requires attention, (2) assist in the preparation of noise compatibility programs, and (3) provide guidance in the development of land use controls, such as zoning ordinances, subdivision regulations, and building codes. DNL is considered to be the best noise metric available for expressing aircraft noise exposure.

F.3.4 EVALUATION OF THE ADEQUACY OF THE DNL DESCRIPTOR

In order to address concerns related to methods of aircraft noise measurement, and to reach a national consensus, the Federal Interagency Committee on Noise (FICON) was created to assess the manner in which noise exposure and its effects are evaluated and the usefulness of DNL to describe the effects of aircraft noise on people. The committee included representatives of all of the federal agencies involved in environmental noise studies, including staff from the USEPA, the Council on Environmental Quality (CEQ), the Departments of Treasury, Defense (DOD), Housing and Urban Development (HUD), Veterans Affairs, and Transportation, as well as technical advisors from the Committee on Hearing and Biomechanics.

The FICON evaluated the threshold for acceptable noise levels (threshold of significance) and whether the DNL 65 was the proper threshold. The committee's findings were released in the *Federal Register* (FR 44223, September 24, 1992). Some of the committee's conclusions were:

- Continue using the DNL to measure airport noise;
- Complaints are an inadequate indicator of the full extent of noise effects on a population;
- Noise predictions and interpretations are frequently less reliable below DNL 65— predictions below this level should take into account the inaccuracy of prediction models at large distances from the airport;
- No definitive evidence of non-auditory health effects from aircraft noise exist, particularly below DNL 70;
- Every change in the noise environment does not necessarily affect public health and welfare.

FICON also recommended that a new federal interagency committee be formed with a mandate to provide a forum for debate of future aviation noise research needs.

In March 1993, the FAA requested public comments concerning the FICON report released in 1992.[1] The request for comment coincided with a study that was prepared by the FAA in accordance with the Safety, Capacity, Noise Improvement, and Intermodal Transportation Act of 1992.[2] Later in 1993 the Federal Interagency Committee on Aviation Noise (FICAN) was formed. FICAN has provided a forum for soliciting input from interested members of the aviation profession and communities. FICAN members have worked with researchers to develop individual agency priorities for research to address noise issues, and have published technical papers on aviation noise topics, including a 1997 study of the effects of aviation noise on sleep.[3] One of the findings of FICAN was that the use of supplemental metrics provides valuable information

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1 *Federal Register*, FR16569, March 29, 1993.

2 Section 123 of the Airport and Airway Safety, Capacity, Noise Improvement, and Intermodal Transportation Act of 1992 (49 U.S.C. app 2102, PL 102-581) required the FAA to conduct a noise study and report the results to Congress not later than October 31, 1993. The study analyzed the social, economic, and health effects of airport noise within the DNL 55, 60, and 65 dBA contours to determine the actual level at which noise adversely impacts populations. It also included an evaluation of single event analysis on populations.

3 *Effects of Aviation Noise on Awakenings from Sleep*, Federal Interagency Committee on Aviation Noise, June 1997.

that is not easily captured by DNL. However, both FICON and FICAN validated the use of the DNL metric as the acceptable metric to identify significant aircraft noise impacts.

F.4 Integrated Noise Model

In 1978, the FAA released the first version of a computer simulation model designed to assess aircraft noise exposure. Known as the Integrated Noise Model or INM, it has become the standard tool used for modeling airport noise. The INM generates noise exposure contours and noise levels at individual locations and provides a graphical image of aircraft noise levels for a selected geographic area.

The INM computes DNL using an internal database that includes performance characteristics and noise data for a wide variety of civilian and military aircraft. Noise exposure levels are calculated from airport-specific data that are input into the model. The input includes runway coordinates, flight tracks, fleet mix, activity levels, runway and flight track utilization, average local temperatures, time of day, and departure trip length data. The INM correlates these data with the internal aircraft database using a series of algorithms that calculate noise exposure. The INM database incorporates detailed information about each aircraft type, including departure profiles for different trip lengths, approach profiles, and SEL noise curves based on distances and various thrust settings. The outputs of these calculations include plots of points that connect to form noise contours. The INM is typically used to model average annual aircraft noise exposure, that is, the average sound level over an average 24-hour period of both busy and quiet times for the airport.

Other output from the INM include the area within each contour, noise measurements at locations (referred to as grid points), and SEL curves or values for specific aircraft types. The SEL curves can be used to estimate SEL for a specific aircraft type depending on how far the aircraft is from a listening point or observer and the estimated thrust setting. Since the introduction of the INM, newer versions have been released by the FAA with an updated aircraft database to reflect changes in the existing and projected aircraft fleet mixes of airports throughout the National Airspace System and to incorporate enhanced algorithms for calculating aircraft noise at specific locations and propagation of noise.

Version 7.0d of INM was used for the noise analysis documented in this EA, which was the latest approved version of the model at the time the analysis was done. Version 7.0d is an accepted, state-of-the-art tool for determining the total effect of aircraft noise at and around airports. The aircraft database contains a representation of commercial, general aviation, and military aircraft powered by turbojet, turbofan, turboprop, or piston-driven engines.

Noise exposure maps were generated using INM for existing and future conditions using a slightly different aircraft fleet mix and runway usage for the years included in the study (2012, 2015 and 2020). As both the Proposed Action and No Action Alternatives do not affect airport operations, DNL contours for both alternatives are assumed equal. During construction of the Proposed Action Alternative, Runway 6L-24R must be closed for approximately 4 months and shortened to a usable length of 7,000 feet for approximately 2 months. During the runway closure period, operations must be shifted to other runways at LAX. Additionally, operations by ADG IV aircraft or higher must also be shifted to other runways during the 2-month reduced runway length period. Operations for the construction period were annualized and the contour compared to the normal operations of the same year. The noise exposure maps derived from the INM for the alternatives in this study are based on the DNL noise metric.

F.5 Basic Data and Assumptions

To determine aircraft noise exposure levels under existing and forecasted conditions, aircraft operations attributed to an average annual day are used in INM. For this EA, noise exposure was analyzed for operational years 2012 (existing conditions), 2015, and 2020. Additionally, noise exposure during the temporary closure and runway shortening of Runway 6L-24R during construction was analyzed.

The primary data required to develop noise exposure maps using INM Version 7.0d includes:

- The existing and forecasted number of aircraft operations accounted for by time of day, type of aircraft, and stage length (nonstop departure trip length from LAX).
- Operational information including runway use, location and use of flight tracks (the paths that pilots fly to arrive at and depart from an airport), departure profiles, existing noise abatement procedures, etc.

F.5.1 AIRCRAFT OPERATIONS

Individual daily aircraft operations at LAX for 2012 were obtained from LAWA. 2015 aircraft operations were calculated based on the LAWA Specific Plan Amendment Study (SPAS) Passenger forecast. However, the operations in the EA were changed to represent the 2013 FAA TAF for 2015. The TAF for 2015 has approximately 2,570 less annual operations (0.4 percent) than the extrapolated SPAS forecast; therefore, the 2015 SPAS forecast was still used for the analysis as this represents a more conservative approach. The future noise environment for LAX for 2020 was analyzed based on FAA TAF forecasted operational conditions for 2020. As operations are the same for the No Action and Proposed Action Alternatives, published data was used for the 2020 CNEL contours. Annual flight operations data for 2012, 2015 and 2020 are shown in **Table F-2**.

Table F-2 Existing and Forecast LAX Aircraft Flight Operations

AIRCRAFT CATEGORY	ANNUAL FLIGHT OPERATIONS		
	EXISTING 2012	2015 1/	TAF 2020
Air Carrier (AC)	481,338	509,967	575,366
Air Taxi (AT)	103,159	87,209	106,727
General Aviation (GA)	18,334	19,130	20,867
Military (MIL)	2,649	2,672	2,321
Total Operations	**605,480**	**618,978**	**705,281**

NOTE:

1/ The 2015 annual operations were extrapolated based on the numbers of forecasted passengers identified in the SPAS Passenger Forecast, a peak month-to-year ratio for July 2012 and the resulting numbers of peak month average day operations for each year between 2009 and 2025.

SOURCES: Existing (2012) data is based on data provided by Los Angeles World Airports (2014). Terminal Area Forecast (TAF) data is from FAA, http://aspm.faa.gov/main/taf.asp, accessed March 9, 2012.

PREPARED BY: Ricondo & Associates, Inc., January 2014.

F.5.2 AIRCRAFT FLEET MIX

Aircraft noise levels can vary greatly based on the aircraft type. This is due to differences in the noise emissions of the various airframe/engine combinations and aircraft performance characteristics. For this reason, it is very important to determine the precise mix of aircraft operating from the airport. LAWA's Aircraft Noise and Operations Monitoring System (ANOMS) data were used to determine the existing 2012 INM fleet mix at LAX. The Design Day Flight Schedule was used to determine the 2015 fleet mix. As there is no difference in fleet mix between the No Action and Proposed Action Alternative in 2020, previously published data was used for this operational year.

Table F-3 presents the different INM aircraft types modeled for LAX. For noise modeling purposes, aircraft are assigned an aircraft type from the INM database. While INM aircraft types provide representative noise characteristics for a large variety of aircraft, the database is not exhaustive. When selecting INM aircraft type, it is often appropriate to combine aircraft with similar characteristics (e.g., engine types, number of engines, weight, performance characteristics, and noise exposure characteristics) under the same INM aircraft type.

Table F-3 LAX Fleet Mix

INM DESIGNATION	ANNUAL OPERATIONS		
	2012	2015	2020
7478	-	2,356	-
727200	-	-	149
737300	30,349	17,723	31,590
737400	4,384	6,817	7,404
737500	2,698	-	5,917

INM DESIGNATION	ANNUAL OPERATIONS 2012	2015	2020
737700	82,282	89,294	79,062
737800	37,093	61,346	65,140
747200	-	-	659
747400	12,794	12,248	22,565
757300	14,495	10,561	8,099
767300	19,887	25,208	20,016
767400	-	-	102
777200	16,827	12,588	14,402
777300	10,099	13,603	15,765
1900D	2,333	6,135	5,707
707QN	-	-	10
727EM1	-	-	46
727EM2	-	-	10
737N17	-	-	19
74710Q	-	-	212
74720B	674	681	-
757PW	40,115	38,838	70,037
757RR	15,506	21,463	-
767CF6	-	-	10,817
7878R	673	1,701	-
A300-622R	2,697	1,363	2,440
A300B4-203	-	1,362	1,550
A310-304	-	681	111
A319-131	21,246	29,310	39,047
A320-211	45,861	20,107	62,758
A320-232	16,861	39,875	
A321-232	10,787	10,220	11,190
A330-301	2,022	3,406	6,023
A330-343	1,348	-	290
A340-211	2,691	3,400	3,188
A340-642	2,692	2,720	4,453
A380-841	3,297	4,712	1,778
BEC58P	-	-	233
C130E	776	680	-
CIT3	-	-	146

INM DESIGNATION	ANNUAL OPERATIONS 2012	2015	2020
CL600	3,886	3,407	3,521
CL601	21,759	43,609	37,754
CNA172	-	-	27
CNA182	-	-	18
CNA206	-	-	17
CNA208	-	-	256
CNA441	3,847	-	642
CNA500	-	-	806
CNA55B	-	-	2,373
CNA750	1,476	1,363	1,775
CRJ9-ER	58,652	62,006	37,315
DC1010	2,023	2,040	-
DC1030	-	-	3,301
DC1040	-	-	2
DC3	-	-	5
DC870	-	681	718
DC910	-	-	15
DC93LW	-	-	17
DC95HW	-	-	5
DHC6	1,477	1,363	194
DHC8	-	-	9,005
DHC830	6,997	6,817	2
EMB120	38,483	33,401	44,940
EMB145	31,551	1,363	39,901
EMB190	-	3,407	-
EMB19C	5,056	-	-
F10062	-	-	1,170
GASEPF	-	-	13
GASEPV	-	-	171
GII	-	-	177
GIIB	777	681	375
GIV	2,332	2,044	3,341
GV	1,554	1,363	2,332
IA1125	-	-	272
LEAR25	-	-	94

INM DESIGNATION	ANNUAL OPERATIONS 2012	2015	2020
LEAR35	4,663	4,089	3,237
MD11GE	2,693	2,722	-
MD11PW	-	-	4,644
MD81	3,372	3,067	15
MD82	6,070	-	5,922
MD83	6,070	5,112	8,564
MD9028	-	-	73
MU3001	2,254	2,044	639
PA28	-	-	26
PA30	-	-	1
PA31	-	-	35
SD330	-	-	632

SOURCE: URS Corporation, 2013; Ricondo & Associates, Inc., January 2014.
PREPARED BY: Ricondo & Associates, Inc., January 2014.

F.5.3 TIME OF DAY

The Time of Day aircraft operations occur is important for determining cumulative noise exposure. In the CNEL metric, aircraft noise levels are weighted based on the time of day they occur. In determining CNEL, each aircraft operation occurring during the nighttime, between the hours of 10:00 p.m. and 7:00 a.m., is treated as if it were 10 operations in terms of noise exposure. Similarly, operations taking place during the evening period, between the hours of 7:00 and 10:00 p.m., are treated as if they were three operations. Logarithmically, these multipliers are the equivalent of adding 10 dB to the noise level of each nighttime operation and 4.77 dB to the noise level of each evening operation. These noise level penalties are intended to correspond to the drop in background noise level which studies have found takes place naturally from daytime to evening and nighttime in a typical community. The evening and nighttime decrease in ambient sound levels—from both outdoor and indoor sources—is commonly considered to be the principal explanation for people’s heightened sensitivity to noises during these periods. CNEL is designed to account for this increased sensitivity. **Tables F-4** through **F-6** summarize operations by time of day for 2012 (existing), 2015, and 2020. Time of day operations by aircraft category do not differ between the No Action and Proposed Action Alternatives.

Table F-4 Summary of Operations by Time of Day (2012)

AIRCRAFT CATEGORY	ANNUAL FLIGHT OPERATIONS DAY (7 A.M. – 7 P.M.)	EVENING (7 P.M. – 10 P.M.)	NIGHT (10 P.M. – 7 A.M.)
Large Narrow-Body	10.9%	11.2%	17.8%
Large Wide-Body and New Large Aircraft	8.5%	8.9%	17.4%
Non-Jet	9.8%	8.5%	5.3%
Small Jet	24.2%	24.9%	13.3%
Small Narrow-Body	41.9%	41.9%	37.5%
Small Wide-Body	4.7%	4.6%	8.7%

SOURCES: Existing (2012) data is based on data provided by Los Angeles World Airports (2014).
PREPARED BY: Ricondo & Associates, Inc., January 2014.

Table F-5 Summary of Operations by Time of Day (2015)

AIRCRAFT CATEGORY	ANNUAL FLIGHT OPERATIONS DAY (7 A.M. – 7 P.M.)	EVENING (7 P.M. – 10 P.M.)	NIGHT (10 P.M. – 7 A.M.)
Large Narrow-Body	12.2%	14.4%	18.8%
Large Wide-Body and New Large Aircraft	9.1%	8.8%	12.3%
Non-Jet	8.8%	5.3%	5.7%
Small Jet	21.3%	21.6%	12.2%
Small Narrow-Body	44.3%	46.0%	41.5%
Small Wide-Body	4.3%	3.9%	9.5%

SOURCES: Ricondo & Associates, Inc., January 2014.
PREPARED BY: Ricondo & Associates, Inc., January 2014.

Table F-6 Summary of Operations by Time of Day (2020)

AIRCRAFT CATEGORY	ANNUAL FLIGHT OPERATIONS DAY (7 A.M. – 7 P.M.)	ANNUAL FLIGHT OPERATIONS EVENING (7 P.M. – 10 P.M.)	ANNUAL FLIGHT OPERATIONS NIGHT (10 P.M. – 7 A.M.)
Large Narrow-Body	11.8%	11.8%	11.8%
Large Wide-Body and New Large Aircraft	27.5%	27.5%	27.5%
Non-Jet	9.8%	9.8%	9.8%
Small Jet	14.1%	14.1%	14.1%
Small Narrow-Body	24.6%	24.6%	24.6%
Small Wide-Body	12.1%	12.1%	12.1%

SOURCES: URS Corporation, 2013.
PREPARED BY: Ricondo & Associates, Inc., January 2014.

F.5.4 RUNWAY USE

Runway utilization refers to the percentage of operations that utilize a given runway. Aircraft generally take off and land into the wind. As a result, runway utilization is largely determined by prevailing wind conditions. At LAX, prevailing winds are westerly. For operational efficiency, aircraft departures generally occur from the inboard runways, Runway 24L and Runway 25R, and arrivals are to the outboard runways, Runway 24R and Runway 25L. Radar data via the ANOMS were used to determine the existing runway utilization at LAX. Existing (2012) runway utilization is shown in **Table F-7**.

Table F-7 LAX 2012 Operational Runway Utilization

RUNWAY	ARRIVALS DAY	ARRIVALS EVENING	ARRIVALS NIGHT	ARRIVALS TOTAL	DEPARTURES DAY	DEPARTURES EVENING	DEPARTURES NIGHT	DEPARTURES TOTAL
06L	0.7%	0.3%	2.3%	0.8%	0.1%	0.0%	0.0%	0.1%
06R	0.0%	0.0%	12.9%	2.0%	0.5%	0.2%	0.2%	0.4%
07L	0.0%	0.0%	8.3%	1.3%	0.9%	0.3%	0.8%	0.8%
07R	0.8%	0.3%	2.8%	1.0%	0.0%	0.0%	0.1%	0.1%
24L	1.8%	3.1%	1.8%	2.1%	40.7%	40.5%	25.2%	37.4%
24R	44.5%	45.1%	29.9%	42.4%	2.0%	1.1%	1.3%	1.7%
25L	50.1%	47.6%	39.7%	48.1%	3.8%	5.3%	5.7%	4.3%
25R	2.0%	3.7%	2.3%	2.4%	52.0%	52.6%	66.7%	55.1%

SOURCE: Los Angeles International Airport, 2012; Ricondo and Associates INM Input File, January 2014.
PREPARED BY: Ricondo & Associates, Inc., January 2014.

Runway utilization will not change as a result of the Proposed Action. However, as no construction would occur under the No Action Alternative, LAX would not incur an extended 6L-24R closure or shortened runway period. **Table F-8** depicts the runway utilization for the No Action Alternative in 2015. The runway utilization for the Proposed Action Alternative is shown in **Table F-9**. Annual operations were normalized to include 183 days of normal operations (No Action Alternative), 122 days of the Runway 6L-24R closure, and 60 days of a shortened Runway 6L-24R. Runway utilization for both the No Action and Proposed Action Alternatives were developed from airport simulation models (SIMMOD). These data are discussed in **Appendix G – Air Quality**.

Table F-8 2015 No Action Alternative Runway Utilization

	ARRIVALS				DEPARTURES			
RUNWAY	DAY	EVENING	NIGHT	TOTAL	DAY	EVENING	NIGHT	TOTAL
06L	0.7%	0.3%	2.3%	0.9%	0.1%	0.0%	0.0%	0.1%
06R	0.0%	0.0%	12.6%	2.2%	0.5%	0.2%	0.2%	0.4%
07L	0.0%	0.0%	8.0%	1.4%	0.9%	0.3%	0.9%	0.8%
07R	0.8%	0.3%	2.7%	1.0%	0.0%	0.0%	0.1%	0.1%
24L	1.8%	3.0%	1.8%	2.0%	41.7%	43.6%	26.7%	39.0%
24R	45.2%	45.1%	31.5%	42.8%	1.9%	1.0%	1.3%	1.7%
25L	49.5%	47.7%	38.7%	47.3%	3.6%	5.2%	5.8%	4.2%
25R	2.0%	3.6%	2.3%	2.3%	51.3%	49.6%	64.9%	53.7%

SOURCE: Los Angeles International Airport, 2012; Ricondo and Associates INM Input File, March 2014.
PREPARED BY: Ricondo & Associates, Inc., March 2014.

Table F-9 2015 Proposed Action Alternative Runway Utilization

	ARRIVALS				DEPARTURES			
RUNWAY	DAY	EVENING	NIGHT	TOTAL	DAY	EVENING	NIGHT	TOTAL
06L	0.5%	0.2%	1.5%	0.6%	0.0%	0.0%	0.0%	0.0%
06R	0.2%	0.1%	13.4%	2.5%	0.6%	0.2%	0.3%	0.5%
07L	0.0%	0.0%	8.0%	1.4%	0.9%	0.3%	1.1%	0.8%
07R	0.8%	0.3%	2.7%	1.0%	0.0%	0.0%	0.2%	0.1%
24L	13.3%	13.4%	13.6%	13.4%	43.3%	43.6%	30.6%	40.9%
24R	29.6%	29.8%	19.5%	27.9%	1.1%	0.6%	0.8%	1.0%
25L	51.1%	50.4%	37.5%	48.6%	2.7%	3.9%	4.9%	3.3%
25R	4.6%	5.7%	3.7%	4.6%	51.3%	51.3%	62.2%	53.4%

SOURCE: Los Angeles International Airport, 2012; Ricondo and Associates INM Input File, March 2014.
PREPARED BY: Ricondo & Associates, Inc., March 2014.

As there is no difference in runway utilization between the No Action and Proposed Action Alternative in 2020, previously published data was for this operational year.

Table F-10 LAX 2020 Operational Runway Utilization

	ARRIVALS				DEPARTURES			
RUNWAY	DAY	EVENING	NIGHT	TOTAL	DAY	EVENING	NIGHT	TOTAL
06L	0.6%	0.3%	2.6%	0.8%	0.0%	0.0%	0.0%	0.0%
06R	0.0%	0.0%	12.3%	1.6%	0.4%	0.3%	0.2%	0.4%
07L	0.0%	0.0%	10.2%	1.3%	0.7%	0.4%	0.9%	0.7%
07R	0.6%	0.3%	1.8%	0.7%	0.0%	0.0%	0.1%	0.0%
24L	1.0%	1.4%	0.5%	1.0%	46.4%	49.9%	22.5%	42.3%
24R	47.5%	47.3%	25.4%	44.6%	1.6%	0.9%	1.1%	1.4%
25L	49.0%	48.5%	46.1%	48.5%	3.0%	5.4%	3.6%	3.4%
25R	1.3%	2.2%	1.1%	1.4%	47.8%	43.2%	71.5%	51.8%

SOURCE: City of Los Angeles, Los Angeles World Airports, Final Environmental Assessment for Los Angeles International Airport (LAX) Runway 7L/25R Runway Safety Area (RSA) and Associated Improvements Project, August 2013.
PREPARED BY: Ricondo & Associates, Inc., January 2014.

F.5.5 AIRCRAFT FLIGHT TRACKS

The existing and assumed future uses of the runways and flight tracks to and from the Airport are important in determining where aircraft are flying and, consequently, where noise is generated in the Airport environs. Generalized flight tracks (the geographical spread of aircraft operations in terms of overflight density) for LAX for arrivals and departures are available in the Final Environmental Assessment for Los Angeles International Airport (LAX) Runway 7L-25R Runway Safety Area (RSA) and Associated Improvements Project.

F.5.6 DEPARTURE TRIP LENGTH (STAGE LENGTH)

Departure trip length, commonly referred to as stage length (unrelated to "Stage" classifications of aircraft for FAR Part 36 noise certification), refers to the non-stop distance an aircraft travels after departure. This information is needed to determine average gross takeoff weights for different aircraft types. The noise generated by departures of a specific aircraft type will vary depending on the takeoff weights of the particular operations. For example, a fully loaded aircraft departing on a long flight will weigh more on departure than the same fully loaded aircraft departing on a shorter flight because the longer flight requires more fuel on board. It usually takes the heavier aircraft longer to reach its takeoff velocity, thereby using more runway length and climbing at a slower rate than a lighter aircraft, particularly on hot days. Therefore, more land area will be exposed to higher levels of aircraft noise by departures of heavier aircraft than departures of the same aircraft with lighter loads.

Table F-11 shows the nine different stage length categories included in INM that have been established to represent different departure trip length distances. The INM uses the stage length category for each operation to determine which profile to use for a specific aircraft departure. In most cases, using the published departure distances to determine the stage length and therefore the departure profile to be used provides good correlation between noise levels estimated by the INM and measured noise levels.

Table F-11 INM Departure Stage Length Categories

STAGE LENGTH CATEGORY	RANGE OF DEPARTURE TRIP LENGTH (NAUTICAL MILES)
1	0 – 500
2	500 – 1,000
3	1,000 – 1,500
4	1,500 – 2,500
5	2,500 – 3,500
6	3,500 – 4,500
7	4,500 – 5,500
8	5,500 – 6,500
9	6,500+

SOURCE: Federal Aviation Administration, *INM User's Guide*.
PREPARED BY: Ricondo & Associates, Inc., January 2014.