Appendix H

Noise Study Report

ENVIRONMENTAL IMPACT REPORT NO. 627
JOHN WAYNE AIRPORT
GENERAL AVIATION IMPROVEMENT PROGRAM

APPENDIX H
NOISE ANALYSIS TECHNICAL REPORT

AUGUST 2018

Prepared For:

County of Orange
John Wayne Airport
3160 Airport Way
Costa Mesa CA 92626

Prepared By:

Landrum & Brown

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

PAGE

TABLE OF CONTENTS

PAGE

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS AND DEFINITIONS

A-Weighting
A frequency-weighting network used to account for changes in human auditory sensitivity as a function of frequency.

Abatement
The method of reducing the degree of intensity of noise and the use of such a method.

Airport Environmental Design Tool (AEDT)
The Federal Aviation Administration's (FAA), Office of Environment and Energy (AEE-100) has developed the Airport Environmental Design Tool (AEDT) for evaluating aircraft noise impacts in the vicinity of airports. The AEDT replaced the Integrated Noise Model (INM) and has been the FAA's standard tool since 2015 for determining the predicted noise impact in the vicinity of airports. The FAA requires airports use the INM in assessing environmental impacts for soundproofing, evaluating physical improvements to the airfield, analyzing changes to existing or new procedures and in assessing land use compatibility. AEDT utilizes flight track information, aircraft fleet mix, standard and user defined aircraft profiles and terrain as inputs. AEDT produces noise exposure contours that are used for land use compatibility maps. The AEDT program includes built-in tools for comparing contours and utilities that facilitate easy export to commercial Geographic Information Systems. The model also calculates predicted noise at specific sites such as hospitals, schools or other sensitive locations.

Average Daily Departure (ADD)
ADD means “average daily departure,” which is computed on an annual basis. One ADD authorizes any person requiring ADDs for its operations at JWA to operate 365 (or 366 in any “leap year”) Authorized Departures during each Plan Year. Commercial Air Carrier Class A and permanent Class E departures at JWA are regulated departures and require an ADD allocation.

AIP
Santa Ana Heights Acoustical Insulation Program

ANCA
Airport Noise and Capacity Act of 1990

ANOMS
The Airport Noise and Operations Management System (ANOMS) is a sophisticated, acoustical system which monitors noise levels 24 hours, 7 days a week. ANOMS also, by default, provides aircraft flight tracks and fleet mix.

Annoyance
Any bothersome or irritating occurrence.

Class A ADD – Class A Departure
Class A ADD means an ADD which has been allocated for use by aircraft qualified under Section 10 of the Access Plan, and which continue to operate during each Noise Compliance Period as Class A Aircraft. Class A Departure means a single departure allocated for use by aircraft qualified under Section 10 of the Access Plan as a Class A Aircraft.

Class E ADD – Class E Departure
Class E ADD means an ADD which has been allocated for use by aircraft qualified under Section 10 of the Access Plan, and which continue to operate during each Noise Compliance Period as Class E Aircraft. Class E Departure means a single departure allocated for use by aircraft qualified under Section 10 as a Class E Aircraft.

LIST OF ACRONYMS AND DEFINITIONS

Class A Aircraft

Class A Aircraft means aircraft which: (i) operate at gross takeoff weights at JWA not greater than the Maximum Permitted Gross Takeoff Weight for the individual aircraft main landing gear configuration, as set forth in Section 2.27 of the Access Plan; and (ii) generate actual energy averaged SENEL levels, averaged during each Noise Compliance Period, as measured at the Noise Monitoring Stations, which are not greater than specific values defined in the Access Plan. The noise limits for Class A Aircraft are 7 to 11 dB higher than the limits for Class E Aircraft.

Class E Aircraft

Class E Aircraft means aircraft which: (i) operate at gross takeoff weights at JWA not greater than the Maximum Permitted Gross Takeoff Weight for the individual aircraft main landing gear configuration, as set forth in Section 2.27 of the Access Plan; and (ii) generate actual energy averaged SENEL levels, averaged during each Noise Compliance Period, as measured at the Noise Monitoring Stations, which are not greater than the specific values defined in the Access Plan. The noise limits for Class E Aircraft are 7 to 11 dB lower than the limits for Class A Aircraft.

CNEL

Community Noise Equivalent Level. Used in California and is nearly identical to DNL, except that CNEL includes a 5 dB penalty for the evening time period from 7 pm to 10 pm and a 10 dB penalty for the nighttime hours of 10 pm to 7 am.

Commercial Air Carriers

Commercial Air Carrier or Air Carrier means any person other than a Commuter Air Carrier or Commuter Cargo Carrier who operates Regularly Scheduled Air Service into and out of JWA for the purpose of carrying passengers, freight, cargo, or for any other commercial purpose.

Commercial Cargo Carrier

Commercial Cargo Carrier means any entity which is an Air Carrier, but which conducts its operations at JWA solely for the purpose of carrying Commercial Cargo with aircraft regularly configured with zero (0) Passenger Seats available to the general public, and which does not offer passenger service to the public in connection with its operations at JWA.

Commuter Air Carrier

Commuter Air Carrier or Commuter Carrier means any entity which: (i) operates Regularly Scheduled Air Service into and out of JWA for the purpose of carrying passengers, freight, cargo, or for any other commercial purpose; (ii) with Class E Aircraft regularly configured with not more than seventy (70) passenger seats; and (iii) operating at gross takeoff weights of not more than ninety thousand (90,000) pounds.

Commuter Cargo Carrier

Commuter Cargo Carrier means any entity which is a Commuter Air Carrier, but which conducts its operations at JWA solely for the purpose of carrying Commercial Cargo with aircraft regularly configured with zero (0) Passenger Seats available to the general public, and which does not offer passenger service to the public in connection with its operations at JWA.

LIST OF ACRONYMS AND DEFINITIONS

Day-Night Average Sound Level
(Abbreviation DNL, denoted by the symbol Ldn)

Twenty-four hour average sound level for a given day, after addition of 10 decibels to levels from midnight to 0700 hours and from 2200 hours to midnight. Ldn is computed as follows:
Ldn = LAE + 10*log10(Nday + 10*Nnight) - 49.4 (dB)
where:
LAE = Sound exposure level in dB (also known as SEL);
Nday = Number of noise events between 0700 and 2200 hours;
Nnight = Number of noise events between 2200 and 0700 hours; and
49.4 = A normalization constant which spreads the acoustic energy associated with noise events over a 24-hour period, i.e., 10*log10(86,400 seconds per day) = 49.4 dB.

dBA

The A-weighted Decibel (dBA) is the most common unit used for measuring environmental sound levels. It adjusts, or weights, the frequency components of sound to conform to the normal response of the human ear at conversational levels. dBA is an international metric that is used for assessing environmental noise exposure of all noise sources.

Decibel (dB)

The Decibel (dB) is the unit used to measure the magnitude or intensity of sound. Decibel means 1/10 of Bel (named after Alexander Graham Bell). The decibel uses a logarithmic scale to cover the very large range of sound pressures that can be heard by the human ear. Under the decibel unit of measure, a 10 dB increase will be perceived by most people to be a doubling in loudness, i.e., 80 dB seems twice as loud as 70 dB.

Equivalent Sound Level
(abbreviation TEQ, denoted by the symbol LAeqT or Leq)

Ten times the logarithm to the base ten of the ratio of time-mean-squared instantaneous A-weighted sound pressure, during a stated time interval T, to the square of the standard reference sound pressure. LAeqT is related to LAE by the following equation:
LAeqT = LAE - 10*log10(t2-t1) (dB)
where,
LAE = Sound exposure level in dB

FAA

Federal Aviation Administration

FAR

Federal Aviation Regulation

GIS

Geographic Information Systems. A computer software program to analyze spatial data. Can be especially useful in examining noise distribution over a geographic area.

General Aviation

Non-commercial airline aviation - primarily business aircraft and individuals traveling in private aircraft.

Hertz (Hz)

The Hertz is a unit of measurement of frequency, numerically equal to cycles per second of the measure of the rate of the vibration of the sound. High frequencies can be thought of as having a high pitch; like a whistle; low frequency sounds are more like a rumble of a truck or airplane.

LIST OF ACRONYMS AND DEFINITIONS

Intensity
The sound energy flow through a unit area in a unit time.

LAE
See Sound Exposure Level

Leq or Laeq
See Equivalent Sound Level

Ldn
See Day-Night Average Sound Level

Lmax
See Maximum Noise Level

MAP
Million Annual Passengers

Maximum Noise Level
The maximum noise level, in A-weighted decibels, occurring during an aircraft flyover.

NMS
Noise Monitoring Station (locations).

Noise
1. Unwanted sound. 2. Any sound not occurring in the natural environment, such as sounds emanating from aircraft, highways, industrial, commercial and residential sources. 3. An erratic, intermittent, or statistically random oscillation.

Noise Level
For airborne sound, unless specified to the contrary, the A-weighted sound level.

Noise Contour
A Noise Contour is a line on a map that represents equal levels of noise exposure.

SEL
See Sound Exposure Level

SENEL
Single Event Noise Exposure Level same as Sound Exposure Level

Sound Exposure Level (abbreviation SEL, denoted by the symbol LAE)
Over a stated time interval, T (where T=t2-t1), ten times the base-10 logarithm of the ratio of a given time integral of squared instantaneous A-weighted sound pressure, and the product of the reference sound pressure of 20 micropascals, the threshold of human hearing, and the reference duration of 1 sec. The time interval, T, must be long enough to include a majority of the sound source's acoustic energy. As a minimum, this interval should encompass the 10 dB down points (see Figure). In addition, LAE is related to LAeqT by the following equation:
LAE = LAeqT + 10*log10(t2-t1) (dB)
where, LAeqT = Equivalent sound level in dB (see definition above, also Leq).

Stage 3 and Stage 4 Aircraft
The FAA has undertaken a phase out of older, noisier civil aircraft, resulting in some stages of aircraft no longer being in the fleet. As of December 31, 2015, all civil jet aircraft, regardless of weight, must meet Stage 3 or Stage 4 to fly within the contiguous U.S. Stage 3 and 4 aircraft incorporate the latest technology for suppressing jet-engine noise and, in general, are 10 dB quieter than Stage 2 aircraft. This represents a halving of perceived noise; however, actual noise reduction varies by aircraft. Stage 1 and Stage 2 helicopters are still permitted to fly within the U.S.

1.0 INTRODUCTION

This Technical Appendix includes a detailed analysis of the existing noise environment and conditions that would result from implementation of the General Aviation Improvement Program (GAIP) Proposed Project and alternatives. As such, this appendix contains detailed background information, methodology, assumptions and analysis. The noise section of the EIR, Section 4.6 is a summary of the data contained in this Technical Appendix. The Technical Appendix is the reference source for the EIR and should be used for detailed review of the GAIP noise impacts.

1.1 OUTLINE OF NOISE ANALYSIS

This report is divided into 10 sections:

- Section 1.0 Introduction
- Section 2.0 presents background information on sound, noise, and how noise affects people.
- Section 3.0 describes the methodology used for this study.
- Section 4.0 describes the existing noise in the environs of John Wayne Airport (JWA).
- Section 5.0 presents the thresholds used to determine the significance of the noise impacts.
- Section 6.0 describes potential impacts from the Proposed Project and project alternatives.
- Section 7.0 presents the Future (2026) Project Alternative Scenarios.
- Section 8.0 presents the cumulative impact analysis.
- Section 9.0 Noise Mitigation Measures.
- Section 10.0 presents the list of references.

2.0 BACKGROUND INFORMATION

2.1 INTRODUCTION

This section presents background information on the characteristics of noise and summarizes federal, state and local noise/land use compatibility guidelines. This section also provides the reader with an understanding of the metrics used to assess noise impacts. This section is divided as follows:

- Properties of sound that are important for technically describing sound.
- Acoustic factors influencing human subjective response to sound.
- Potential disturbances to humans and health effects due to sound.
- Sound rating scales used in this study.
- Summary of noise assessment criteria.

2.2 CHARACTERISTICS OF SOUND

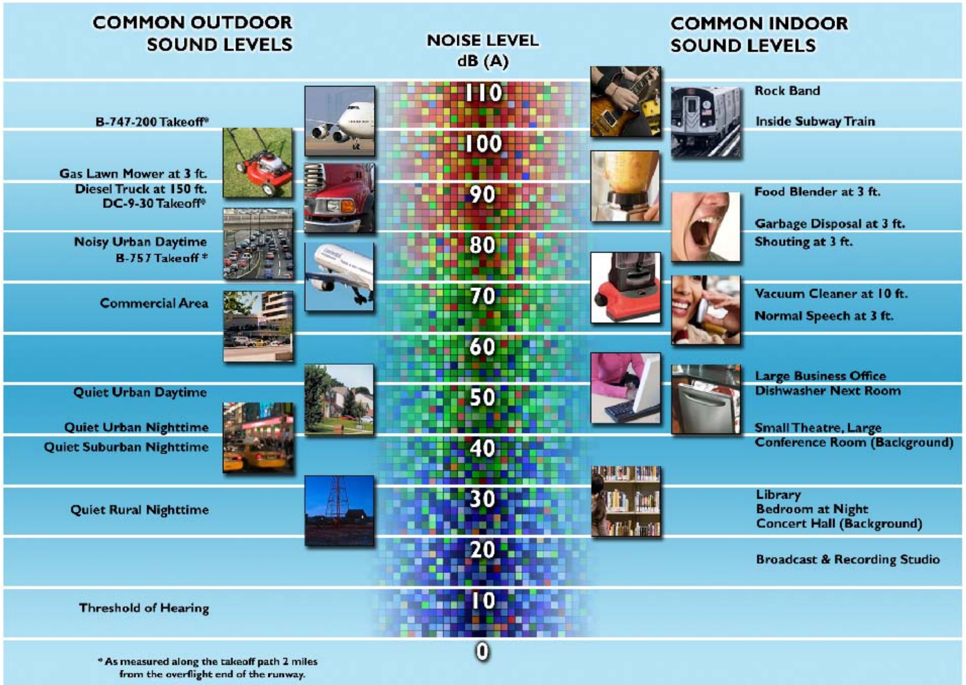
2.2.1 SOUND LEVEL AND FREQUENCY

Sound can be technically described in terms of the sound pressure (amplitude) and frequency (similar to pitch).

Sound pressure is a direct measure of the magnitude of a sound without consideration for other factors that may influence its perception. The range of sound pressures that occur in the environment is so large that it is convenient to express these pressures as sound pressure levels on a logarithmic scale that compresses the wide range of sound pressures to a more usable range of numbers. The standard unit of measurement of sound is the Decibel (dB), which describes the pressure of a sound relative to a reference pressure.

The frequency (pitch) of a sound is expressed as Hertz (Hz) or cycles per second. The normal audible frequency for young adults is 20 Hz to 20,000 Hz. Community noise, including aircraft and motor vehicles, typically ranges between 50 Hz and 5,000 Hz. The human ear is not equally sensitive to all frequencies, with some frequencies judged to be louder for a given signal than others. As a result of this, various methods of frequency weighting have been developed. The most common weighting is the A-weighted noise curve. The A-weighted decibel scale (dBA) performs this compensation by discriminating against frequencies in a manner approximating the sensitivity of the human ear. In the A-weighted decibel, everyday sounds normally range from 30 dBA (very quiet) to 100 dBA (very loud). Most community noise analyses are based upon the A-weighted decibel scale. Examples of various sound environments, expressed in dBA, are presented in Figure 1.

Figure 1 Typical A-Weighted Noise Levels



Source: Landrum & Brown, 1974.

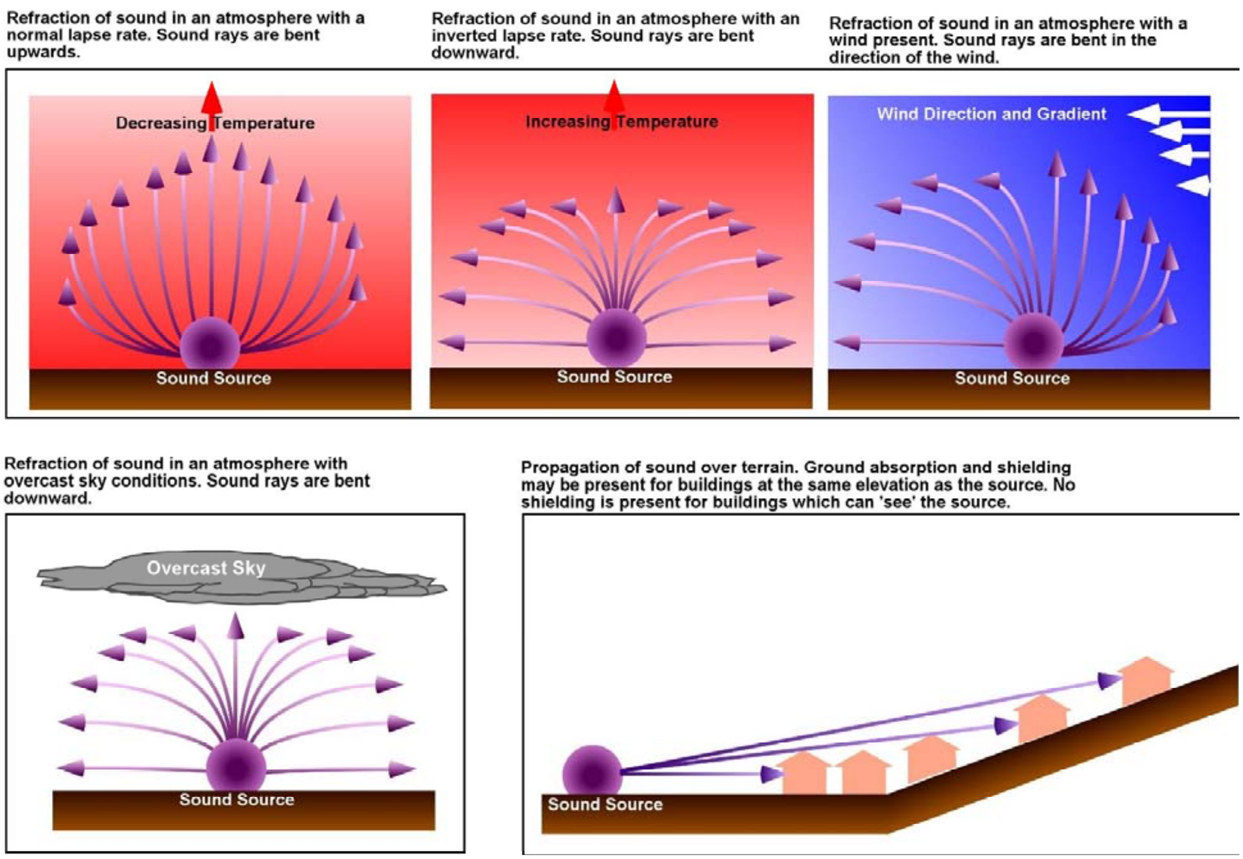
2.2.2 PROPAGATION OF NOISE

Outdoor sound levels decrease as the distance from the source to the receiver increases. This decrease in sound level is a result of wave divergence, atmospheric absorption, and ground attenuation. Sound radiating from a source in an undisturbed manner travels in spherical waves. As the sound wave travels away from the source, the sound energy is dispersed over a greater area, decreasing the sound power of the wave. Spherical spreading of the sound wave reduces the noise level at a rate of 6 dB per doubling of the distance.

Atmospheric absorption also influences the sound levels received by the observer. The greater the distance traveled, the greater the influence of the atmosphere and the resultant fluctuations. Atmospheric absorption becomes important at distances of greater than 1,000 feet. The degree of absorption varies depending on the frequency of the sound, as well as the humidity and temperature of the air. For example, atmospheric absorption is lowest (i.e., sound carries farther) at high humidity and high temperatures. Absorption effects in the atmosphere vary with frequency. Higher frequencies are more readily absorbed than lower frequencies. Over large distances, lower frequencies become the dominant sound as the higher frequencies are attenuated. Turbulence and gradients of wind, temperature, and humidity also play a significant role in determining the degree of attenuation. Certain conditions, such as inversions, can channel or focus the sound waves resulting in higher noise levels than would result from simple spherical spreading. The effects of meteorological conditions on sound levels are illustrated in Figure 2.

In addition to atmospheric absorption, aircraft noise can also be affected by the physical properties of the surrounding terrain. The magnitude of this terrain-related absorption varies with the angle of the aircraft above the horizon as measured from the observer to the aircraft. Lateral attenuation is influenced by ground reflection, refraction, aircraft shielding, and engine aircraft installation effects. In general, the lower an aircraft is, the greater the lateral attenuation. Lateral attenuation is not considered to be a factor if the angle between the observer and aircraft, as measured from the horizon, is greater than 60°. In this case, the aircraft is essentially overhead the observer.

Figure 2 Effects of Weather on Sound



Source: ACRP, *Effects of Aircraft Noise: Research Topic on Selected Topics* (2008).

2.2.3 DURATION OF SOUND

Annoyance from a noise event increases with increased duration of the noise event, i.e., the longer the noise event, the more annoying it is. The "effective duration" of a sound is the time between when a sound rises above the background sound level until it drops back below the background level. Psycho-acoustic studies have determined the relationship between duration and annoyance and the amount a sound must be reduced to be judged equally annoying for increased duration. Duration is an important factor in describing sound in a community setting.

The relationship between duration and noise level is the basis of the equivalent energy principal of sound exposure. Reducing the acoustic energy of a sound by one-half results in a 3 dB reduction. Doubling the duration of the sound increases the total energy of the event by 3 dB. This equivalent energy principal is based upon the premise that the potential for a noise to impact a person is dependent on the total acoustical energy content of the noise. Defined in subsequent sections of this study, noise metrics such as CNEL, DNL, LEQ and SENEL are all based upon the equivalent energy principle.

2.2.4 CHANGE IN NOISE

The concept of change in ambient sound levels can be understood with an explanation of the hearing mechanism's reaction to sound. The human ear is a far better detector of relative differences in sound levels than absolute values of levels. Under controlled laboratory conditions, listening to a steady unwavering pure tone sound that can be changed to slightly different sound levels, a person can just barely detect a sound level change of approximately one decibel for sounds in the mid-frequency region. When ordinary noises are heard, a young healthy ear can detect changes of two to three decibels. A five decibel change is readily noticeable while a 10 decibel change is judged by most people as a doubling or a halving of the loudness of the sound. It is typical in environmental documents to consider a 3 dB change as potentially discernable.

2.2.5 MASKING EFFECT

The ability of one sound to limit a listener from hearing another sound is known as the masking effect. The presence of one sound effectively raises the threshold of audibility for the hearing of a second sound. For a signal to be heard, it must exceed the threshold of hearing for that particular individual and exceed the masking threshold for the background noise.

The masking characteristics of sound depend on many factors including the spectral (frequency) characteristics of the two sounds, the sound pressure levels and the relative start time of the sounds. Masking effect is greatest when the frequencies of the two sounds are similar or when low frequency sounds mask higher frequency sounds. High frequency sounds do not easily mask low frequency sounds.

2.3 FACTORS INFLUENCING HUMAN RESPONSE TO SOUND

Many factors influence sound perception and annoyance. This includes not only physical characteristics of the sound but also secondary influences such as sociological and external factors. Molino, in the Handbook of Noise Control [2] describes human response to sound in terms of both acoustic and non-acoustic factors. These factors are summarized in Table 1.

Sound rating scales are developed in reaction to the factors affecting human response to sound. Nearly all of these factors are relevant in describing how sounds are perceived in the community. Many non-acoustic parameters play a prominent role in affecting individual response to noise. Background sound, an additional acoustic factor not specifically listed, is also important in describing sound in rural settings. Fields [3], in his analysis of the effects of personal and situational variables on noise annoyance, has identified a clear association of reported annoyance and various other individual perceptions or beliefs. In particular, Fields stated:

"There is therefore firm evidence that noise annoyance is associated with: (1) the fear of an aircraft crashing or of danger from nearby surface transportation; (2) the belief that aircraft noise could be prevented or reduced by designers, pilots or authorities related to airlines; and (3) an expressed sensitivity to noise generally."

Thus, it is important to recognize that non-acoustic factors such as the ones described above as well as acoustic factors contribute to human response to noise.

Table 1 Factors that Affect Individual Annoyance to Noise

Primary Acoustic Factors
Sound Level
Frequency
Duration
Secondary Acoustic Factors
Spectral Complexity
Fluctuations in Sound Level
Fluctuations in Frequency
Rise-time of the Noise
Localization of Noise Source
Non-acoustic Factors
Physiology
Adaptation and Past Experience
How the Listener's Activity Affects Annoyance
Predictability of When a Noise will Occur
Is the Noise Necessary?
Individual Differences and Personality

Source: C. Harris, 1979

2.4 SOUND RATING SCALES

The description, analysis, and reporting of community sound levels is made difficult by the complexity of human response to sound and myriad of sound-rating scales and metrics developed to describe acoustic effects. Various rating scales approximate the human subjective assessment to the "loudness" or "noisiness" of a sound. Noise metrics have been developed to account for additional parameters such as duration and cumulative effect of multiple events.

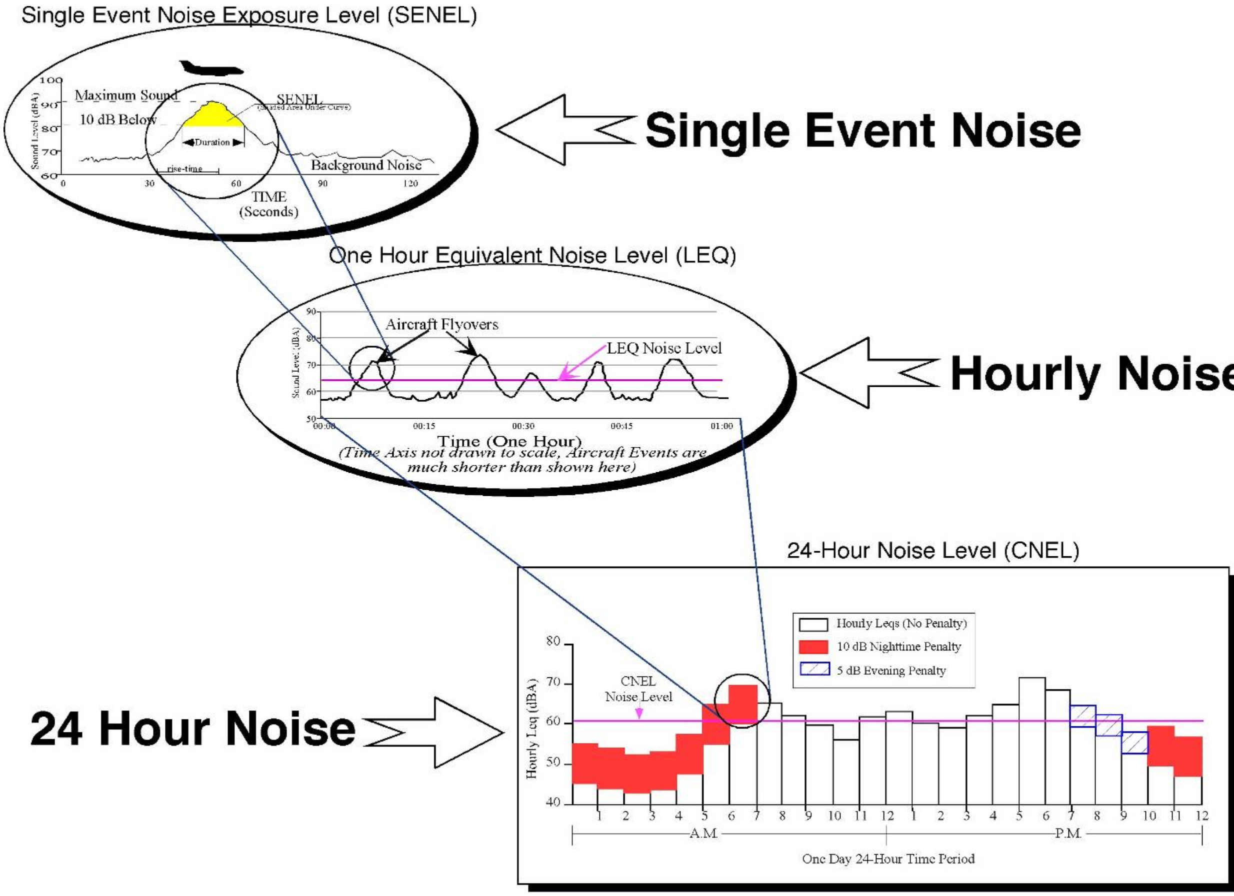
Noise metrics are categorized as single event metrics and cumulative metrics. Single event metrics describe the noise from individual events, such as one aircraft flyover. Cumulative metrics describe the noise in terms of the total noise exposure throughout the day. Noise metrics used in this study are summarized below:

2.4.1 SINGLE EVENT METRICS

- **Frequency Weighted Metrics (dBA).** In order to simplify the measurement and computation of sound loudness levels, frequency-weighting networks have obtained wide acceptance. The A-weighting (dBA) scale has become the most prominent of these scales and is widely used in community noise analysis. Its advantages are that it has shown good correlation with community response and is easily measured. The metrics used in this study are all based upon the dBA scale.
- **Maximum Noise Level.** The highest noise level reached during a noise event is called the "Maximum Noise Level," or Lmax. For example, as an aircraft approaches, the sound of the aircraft begins to rise above ambient noise levels. The closer the aircraft gets the louder it is until the aircraft is at its closest point directly overhead. Then, as the aircraft passes, the noise level decreases until the sound level again settles to ambient levels. Such a history of a flyover is plotted at the top of Figure 3. It is this metric to which people generally instantaneously respond when an aircraft flyover occurs.
- **Single Event Noise Exposure Level (SENEL) or Sound Exposure Level (SEL).** Another metric that is reported for aircraft flyovers is the Single Event Noise Exposure Level (SENEL). This metric is essentially equivalent to the Sound Exposure Level (SEL) metric. It is computed from dBA sound levels. Referring again to the top of Figure 3, the shaded area, or the area within 10 dB of the maximum noise level, is the area from which the SENEL is computed. The SENEL value is the integration of all the acoustic energy contained within the event. Speech and sleep interference research can be assessed relative to Single Event Noise Exposure Level data.

  The SENEL metric takes into account the maximum noise level of the event and the duration of the event. For aircraft flyovers, the SENEL value is typically about 10 dBA higher than the maximum noise level. Single event metrics are a convenient method for describing noise from individual aircraft events. This metric is useful in that airport noise models contain aircraft noise curve data based upon the SENEL metric. In addition, cumulative noise metrics such as LEQ, CNEL and DNL can be computed from SENEL data.

Figure 3 Single & Cumulative Noise Metric Definitions



Source: L&B (2014)

2.4.2 CUMULATIVE METRICS

Cumulative noise metrics assess community response to noise by including the loudness of the noise, the duration of the noise, the total number of noise events and the time of day these events occur in one single number rating scale.

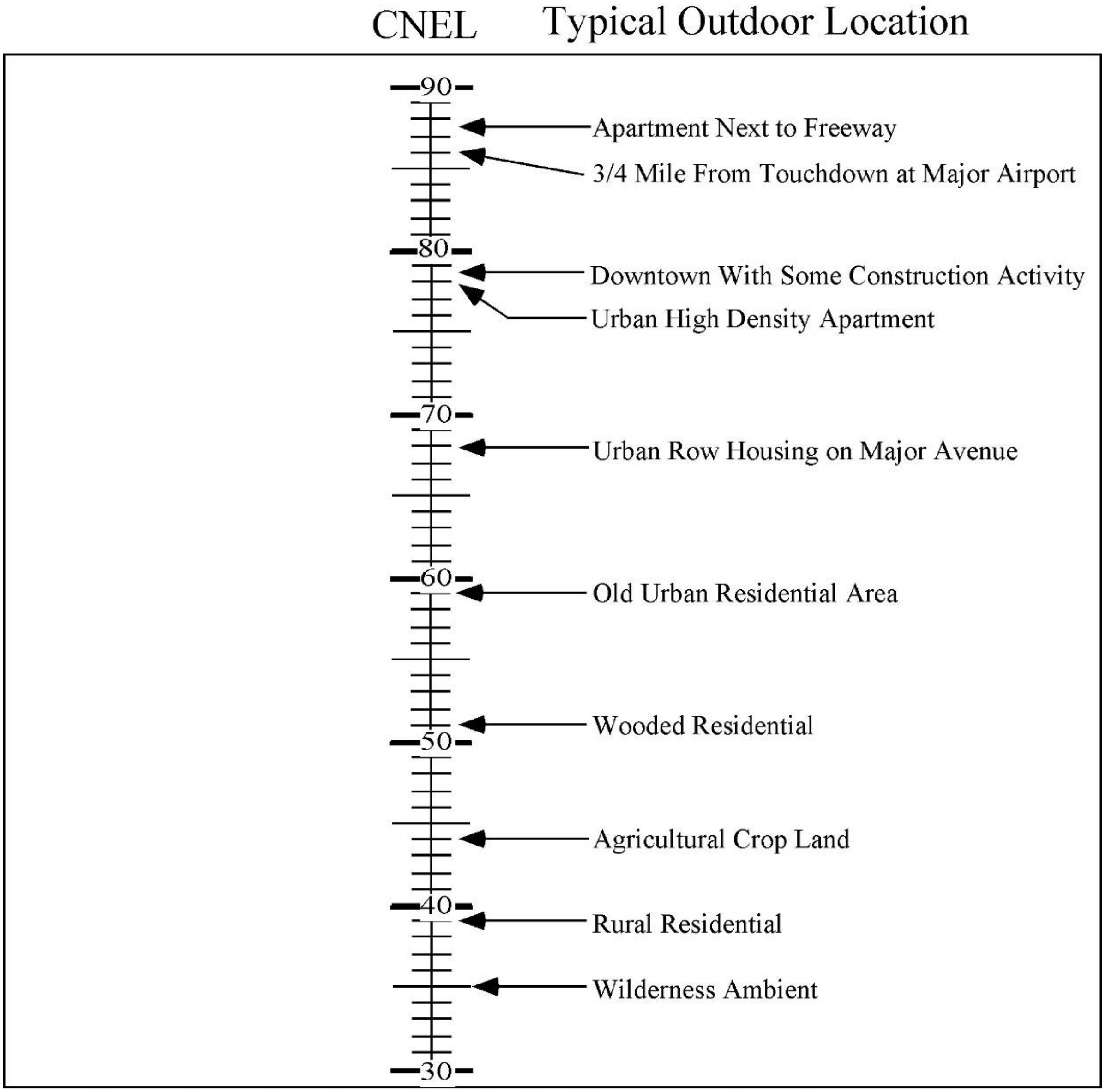
Equivalent Noise Level (Leq). Leq is the sound level corresponding to a steady-state, A-weighted sound level containing the same total energy as several SEL events during a given sample period. Leq is the "energy" average noise level during the time period of the sample. It is based on the observation that the potential for noise annoyance is dependent on the total acoustical energy content of the noise. This is graphically illustrated in the middle graph of Figure 3. Leq can be measured for any time period, but is typically measured for 15 minutes, 1 hour or 24-hours. Leq for a one-hour period is used by the Federal Highway Administration for assessing highway noise impacts. Leq for one hour is called Hourly Noise Level (HNL) in the California Airport Noise Regulations [4] and is used to develop Community Noise Equivalent Level (CNEL) values for aircraft operations.

Community Noise Equivalent Level (CNEL). CNEL is a 24-hour, time-weighted energy average noise level based on the A-weighted decibel. It is a measure of the overall noise experienced during an entire day. The term “time-weighted” refers to the penalties attached to noise events occurring during certain sensitive time periods. In the CNEL scale, noise occurring between the hours of 7 pm and 10 pm is penalized by approximately 5 dB. This penalty accounts for the greater potential for noise to cause communication interference during these hours, as well as typically lower ambient noise levels during these hours. Noise that takes place during the night (10 pm to 7 am) is penalized by 10 dB. This penalty was selected to attempt to account for the higher sensitivity to noise in the nighttime and the expected further decrease in background noise levels that typically occur in the nighttime.

CNEL is graphically illustrated in the bottom of Figure 3. Examples of various noise environments in terms of CNEL are presented in Figure 4. CNEL is specified for use in the California Airport Noise Regulations and is used by local planning agencies in their General Plan Noise Element for land use compatibility planning.

Day Night Noise Level (DNL). The DNL index is very similar to CNEL but does not include the evening (7 pm to 10 pm) penalty that is included in CNEL. It does include the nighttime (10 pm to 7 am) penalty. Typically, DNL is about 1 dB lower than CNEL, although the difference may be greater if there is an abnormal concentration of noise events in the 7 to 10 pm time period. DNL is specified by the Federal Aviation Administration (FAA) for airport noise assessment and by the Environmental Protection Agency (EPA) for community noise and airport noise assessment. The FAA guidelines (described later) allow for the use of CNEL as a substitute to DNL.

Figure 4 Typical Outdoor Noise Levels



Source: Adapted from "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare With an Adequate Margin of Safety", EPA, 1974

2.4.3 EFFECTS OF NOISE ON HUMANS

Noise, often described as unwanted sound, is known to have several adverse effects on humans. From these known adverse effects of noise, criteria have been established to help protect the public health and safety and prevent disruption of certain human activities. These criteria are based on effects of noise on people such as hearing loss (not a factor with typical community noise), communication interference, sleep interference, physiological responses and annoyance. Each of these potential noise impacts on people are briefly discussed in the following narrative:

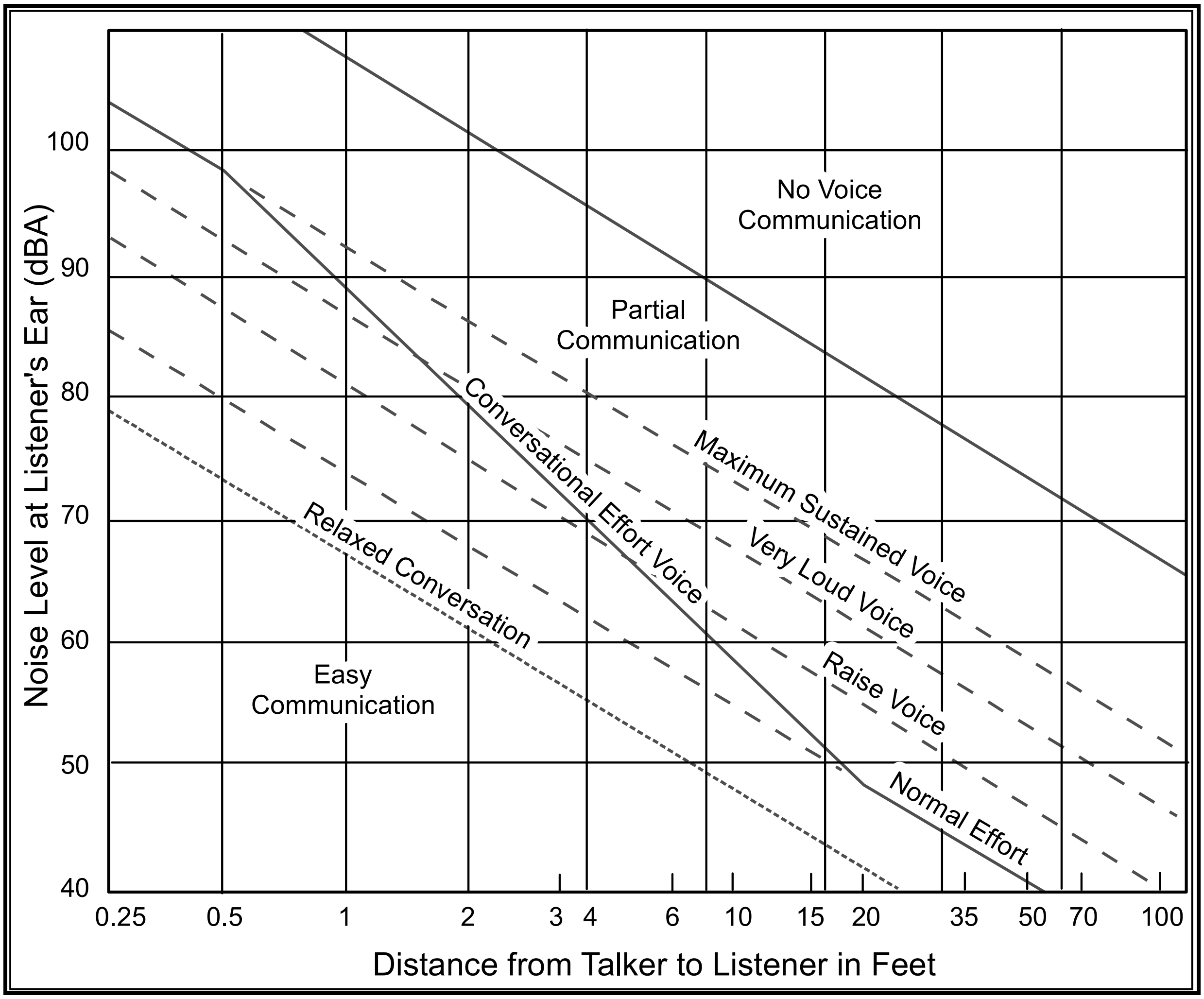
Hearing Loss is generally not a concern in community noise problems, even very near a major airport or a major freeway. The potential for noise induced hearing loss is more commonly associated with occupational noise exposures in heavy industry, very noisy work environments with long term exposure, or certain very loud recreational activities such as target shooting, motorcycle or car racing, etc. The Occupational Safety and Health Administration (OSHA) identifies a noise exposure limit of 90 dBA for 8 hours per day to protect from hearing loss (higher limits are allowed for shorter duration exposures). Noise levels in neighborhoods, even in very noisy neighborhoods, are not sufficiently loud to cause hearing loss.

Communication Interference is one of the primary concerns in environmental noise problems. Communication interference includes speech interference and interference with activities such as watching television. Normal conversational speech is in the range of 60 to 65 dBA and any noise in this range or louder may interfere with speech. There are specific methods of describing speech interference as a function of distance between speaker and listener and voice level. Figure 5 shows the relation of quality of speech communication with respect to various noise levels.

Sleep Interference is a major noise concern in noise assessment and, of course, is most critical during nighttime hours. Sleep disturbance is one of the major causes of annoyance due to community noise. Noise can make it difficult to fall asleep, create momentary disturbances of natural sleep patterns by causing shifts from deep to lighter stages, and cause awakening. Noise may even cause awakening, which a person may, or may not, be able to recall.

Extensive research has been conducted on the effect of noise on sleep disturbance. Recommended values for desired sound levels in residential bedroom space range from 25 to 45 dBA, with 35 to 40 dBA being the norm. Some years ago, the National Association of Noise Control Officials [11] published data on the probability of sleep disturbance with various single event noise levels. Based on laboratory experiments conducted in the 1970s, it was determined that a noise event with an interior noise exposure of 75 dBA interior will cause noise induced awakening in 30 percent of the cases.

Figure 5 Speech Interference Noise Levels



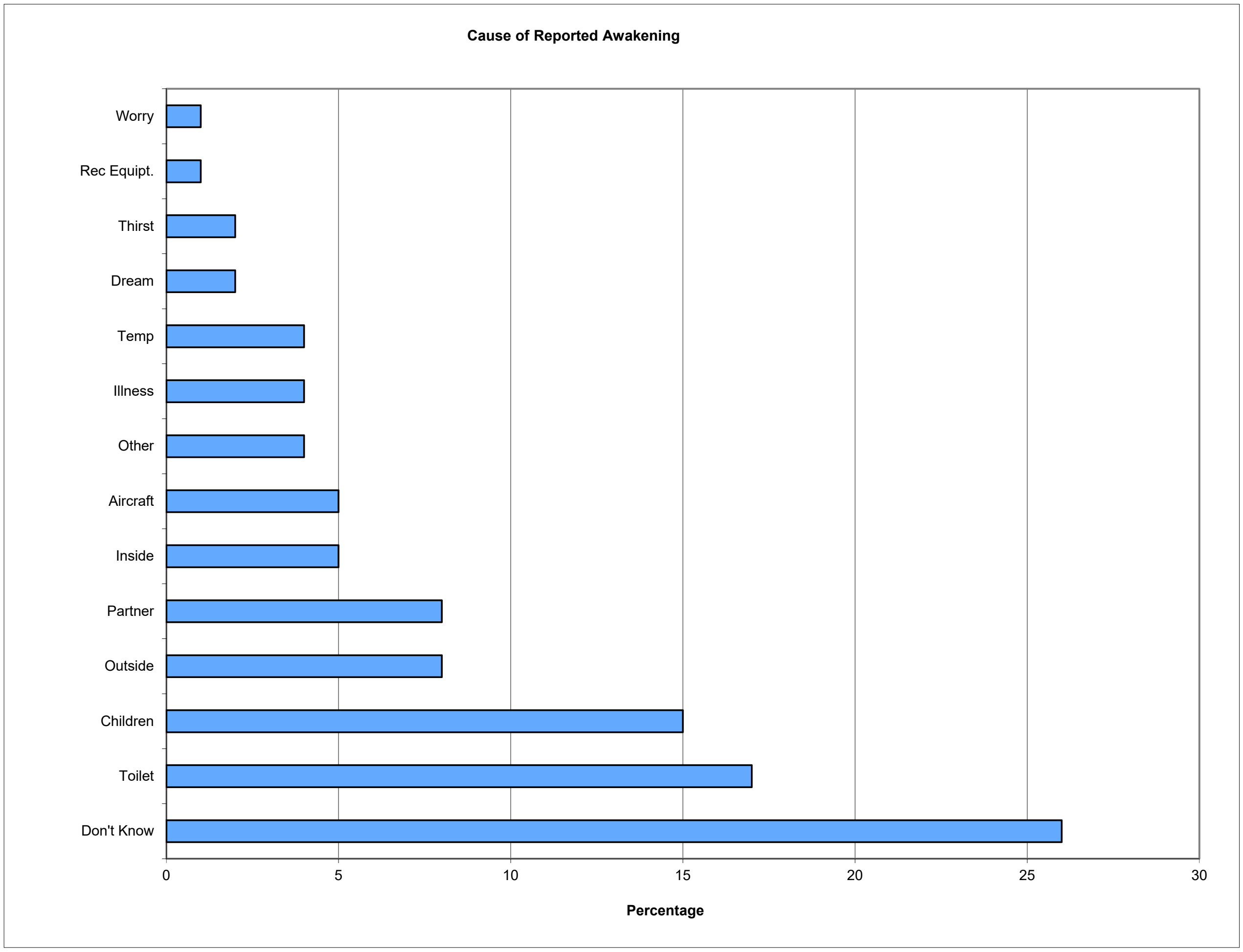
Source: FICON, 1992; from USEPA, 1974.

However, research first published in Britain in the 1990s [12][13] has shown that the probability for sleep disturbance, when measured in an in-home setting is much less than what had been reported in earlier research that was based on laboratory studies. This research showed that once a person was asleep, it is much more unlikely that they will be awakened by a noise. The significant difference in the British studies is the use of actual in-home sleep disturbance patterns as opposed to laboratory data that had been the historic basis for predicting sleep disturbance. Some of this research has been criticized because it was conducted in areas where subjects had become habituated to aircraft noise. On the other hand, some of the earlier laboratory sleep studies had been criticized because of the extremely small sample sizes of most laboratory studies and because the laboratory was not necessarily a representative sleep environment. A 1994 British sleep study compared the various causes of sleep disturbance using in-home sleep studies. This field study assessed the effects of nighttime aircraft noise on sleep in 400 people (211 women and 189 men; 20-70 years of age; one per household) habitually living at eight sites adjacent to four U.K. airports, with different levels of nighttime flying. The main finding was that only a minority of aircraft noise events affected sleep, and, for most subjects, that domestic and other non-aircraft factors had much greater effects. As shown in the Figure 6, aircraft noise was a minor contributor among a host of other factors that lead to awakening response.

The Federal Interagency Committee on Noise (FICON) in 1992, in a document entitled Federal Interagency Review of Selected Airport Noise Analysis Issues [14], recommended an interim dose-response curve for sleep disturbance based on laboratory studies of sleep disturbance. In June of 1997, the Federal Interagency Committee on Aviation Noise (FICAN) updated the FICON recommendation with an updated curve based on the more recent in-home sleep disturbance studies which show lower rates of awakening compared to the laboratory studies [15]. The FICAN recommended a curve based on the upper limit of the data presented and therefore considers the curve to represent the "maximum percent of the exposed population expected to be behaviorally awakened," or the "maximum awakened." The FICAN recommendation is shown on Figure 7.

In 2008, the American National Standards Institute (ANSI) published a standard method of estimating sleep disturbance [16], and this method was adopted by FICAN to replace the curve shown in Figure 7. The ANSI standard divided the population into 2 groups, based on their habituation to the noise source. For a population that has not been habituated to a nighttime noise, i.e., a new nighttime noise, the FICAN curve shown in Figure 7 is recommended for estimating awakenings due to noise. For communities habituated to a noise, the rate of awakening is considerably lower as shown in Figure 7. Figure 7 shows that, for a habituated population, the rate of awakening for a given indoor noise level is substantially lower than for a population newly exposed to nighttime noise.

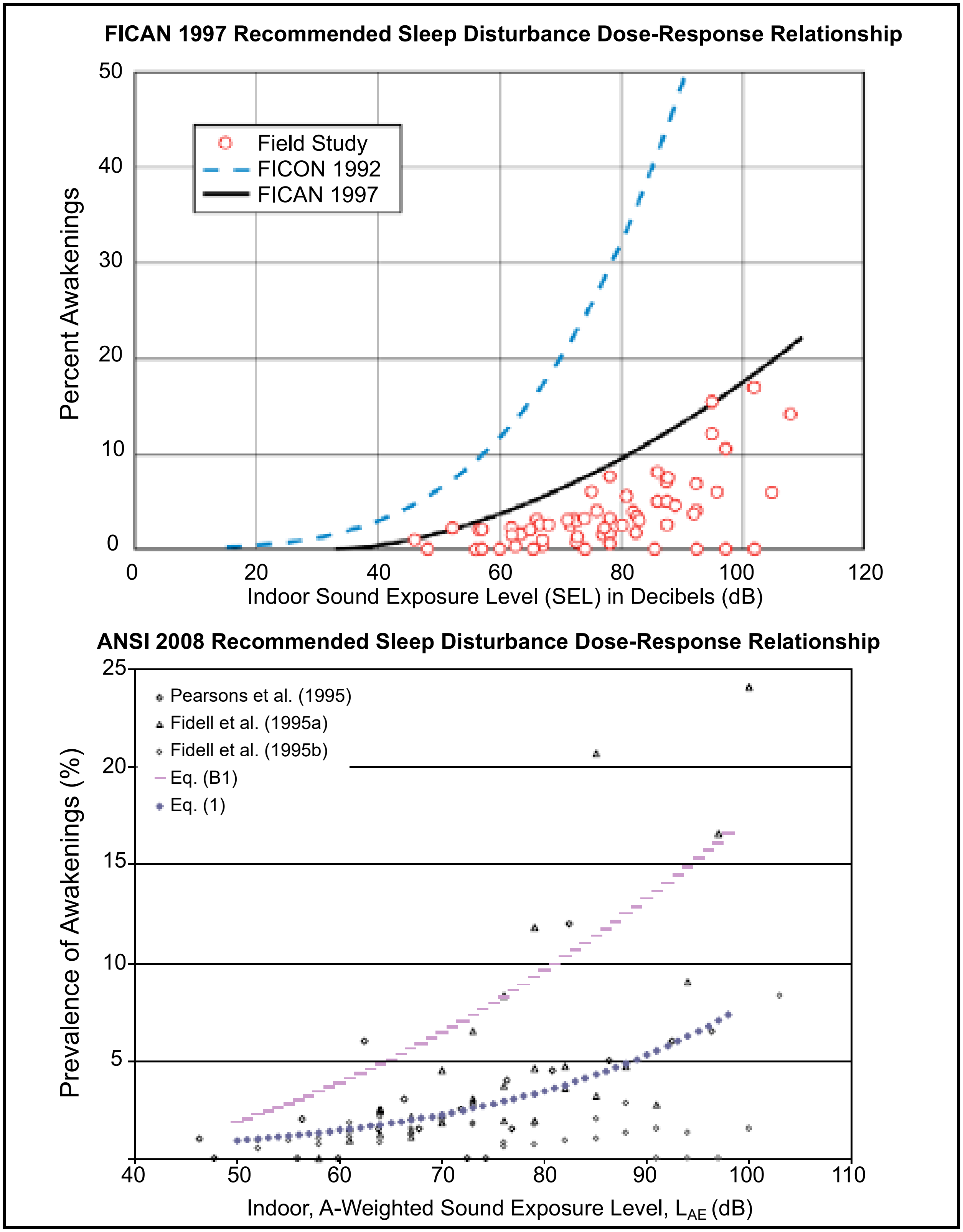
Figure 6 Causes and Prevalence of All Awakenings



(Total awakenings = 6,457. Each subject could have reported more than one awakening each night.)

Source: Horne JA (1994)

Figure 7 Sleep Disturbance vs. Noise Level FICAN vs. ANSI



Source: Federal Interagency Committee on Aviation (FICAN), 1997. American National Standards Institute, 2008.

Physiological Responses are those measurable effects of noise on people, which are realized as changes in pulse rate, blood pressure, etc. While such effects can be induced and observed, the extent is not known to which these physiological responses cause harm or are a sign of harm. Generally, physiological responses are a reaction to a loud short-term noise such as a rifle shot or a very loud jet over flight.

Health effects from noise have been studied around the world for nearly thirty years. Scientists have attempted to determine whether high noise levels can adversely affect human health—apart from auditory damage—which is amply understood. These research efforts have covered a broad range of potential impacts from cardiovascular response to fetal weight and mortality. Yet, while a relationship between noise and health effects seems plausible, it has remained a difficult effect to quantify--that is, shown in a manner that can be repeated by other researchers while yielding similar results.

While annoyance and sleep/speech interference have been acknowledged, health effects are also associated with a wide variety of other environmental stressors, including air pollution. Isolating the effects of aircraft noise alone as a source of long-term physiological change has proved to be almost impossible as the effects associated with noise are also the same well-known effects of air pollution. In a review of 30 studies conducted worldwide between 1993 and 1998 [17], a team of international researchers concluded that, while some findings suggest that noise can affect health, improved research concepts and methods are needed to verify or discredit such a relationship. They called for more study of the numerous environmental and behavioral factors than can confound, mediate or moderate survey findings. In 2008, the Airport Cooperative Research Board (ACRP), a part of the National Academies, published a synthesis on the effects of aircraft noise [18]. The ACRP synthesis concluded, “Despite decades of research, including review of old data and new research efforts, health effects of aviation noise continues to be an enigma. Most, if not all, current research concludes that it is yet impossible to determine causal relations between health disorders and noise exposure, despite well-founded hypotheses."

In October 2013, two studies on cardiovascular disease associated with aircraft noise were published in the British Medical Journal [19][20]. The first was done in the UK around Heathrow Airport in London, and the second was done in the US as part of a multi-airport retrospective study led by researchers from Boston University and the Harvard School of Public Health as part of the Partnership for Air Transportation Noise and Emissions Reduction (PARTNER) program sponsored by the FAA. The US study focused on Medicare patients and the British study was based on the total population living around Heathrow.

The British study concluded in part:

> **"Main outcome measures** Risk of hospital admissions for, and mortality from, stroke, coronary heart disease, and cardiovascular disease, 2001-05." (Abstract, Page 1)
>
> **"Conclusion** High levels of aircraft noise were associated with increased risks of stroke, coronary heart disease, and cardiovascular disease for both hospital admissions and mortality in areas near Heathrow airport in London. As well as the possibility of causal associations, alternative explanations such as residual confounding and potential for ecological bias should be considered." (Abstract, Page 2)
>
> "Our results suggest that high levels of aircraft noise are associated with an increased risk of stroke, coronary heart disease, and cardiovascular disease. As well as the possibility of causal associations, alternative explanations should be considered. These include the potential for incompletely controlled confounding and ecological bias, as we did not have access to individual level confounder data such as ethnicity and smoking. Further work to understand better the possible health effects of aircraft noise is needed, including studies clarifying the relative importance of nighttime compared with daytime noise, as this may affect policy response." (Conclusions Section, Page 5)

The US study concluded:

> "**Results** Averaged across all airports and using the 90th centile noise exposure metric, a zip code with 10 dB higher noise exposure had a 3.5 percent higher (95 percent confidence interval 0.2 percent to 7.0 percent) cardiovascular hospital admission rate, after controlling for covariates.
>
> **Conclusions** Despite limitations related to potential misclassification of exposure, we found a statistically significant association between exposure to aircraft noise and risk of hospitalization for cardiovascular diseases among older people living near airports." (Abstract, Page 1)
>
> **"Limitations of this study** Our analysis has limitations. Although Medicare data covers nearly the entire US older population, this database was developed for administrative purposes and has been shown to be subject to misclassification and geographic variability in evaluation and management. We only used primary diagnosis, which should reduce misclassification of outcomes, and our analyses of combined cardiovascular disease outcomes are unlikely to have significant misclassification.
>
> Other limitations of the Medicare data include limited individual data on risk factors. For example, we were not able to control for smoking and diet, strong risk factors for cardiovascular disease. These variables would only confound the association between aircraft noise and hospitalization for cardiovascular disease if there were significant correlations between aircraft noise exposures and these risk factors. Noise contours display fairly sharp gradients and skew as a function of

> prevailing wind directions, given runway orientation, and arrival and departure patterns, which may limit spatial confounding …" (Limitations of this Study Section, Page 5)
>
> **"Conclusions and future research** We found that aircraft noise, particularly characterized by the 90th centile of noise exposure among census blocks within zip codes, is statistically significantly associated with higher relative rate of hospitalization for cardiovascular disease among older people residing near airports. This relation remained after controlling for individual data, zip code level socioeconomic status and demographics, air pollution, and roadway proximity variables. Our results provide evidence of a statistically significant association between exposure to aircraft noise and cardiovascular health, particularly at higher exposure levels. Further research should refine these associations and strengthen causal interpretation by investigating modifying factors at the airport or individual level." (Conclusions and Future Research Section, Page 6)

These very recent British and US studies provide more correlation linking noise to cardiovascular disease, but still fall short of providing the definitive noise dose, response relationship that defines at what noise level these effects start and what is the rate of increase in response as noise level increases.

The recent cardiovascular studies follow a series of reports from Europe that support the hypothesis that cardiovascular effects are linked to noise exposure. None of these studies, including the most recent, provide information on the level of noise at which such effects occur.

The current noise standards used in California (65 CNEL) and by the FAA (65 DNL) were adopted with full knowledge that noise effects include physiological responses that include cardiovascular effects. However, as of yet, there is insufficient data on the dose/response relationship to determine whether any revision to the adopted noise standards is warranted. Further, it is not yet clear that the effects that are being attributed to noise are not, in fact, the effects of air pollution. A great deal more research is necessary to fully understand the relationship between noise and cardiovascular health. As such, no applicable regulatory agency has established standards specific to physiological response for the purpose of CEQA, NEPA, or any other environmental compliance/assessment law. The absence of such regulations can be attributed, at least in part, to the uncertainty of the science.

Section 15145 of the CEQA Guidelines directs Lead Agencies who find a particular impact too speculative after a thorough investigation to note this conclusion and terminate discussion of the impact. The discussion above shows that, at this time, the effects of noise on cardiovascular health at noise levels below 65 CNEL are too speculative for evaluation.

However, one of the authors of the U.S. Study, Jonathan Levy, suggested what could be done in the interim to protect human health.

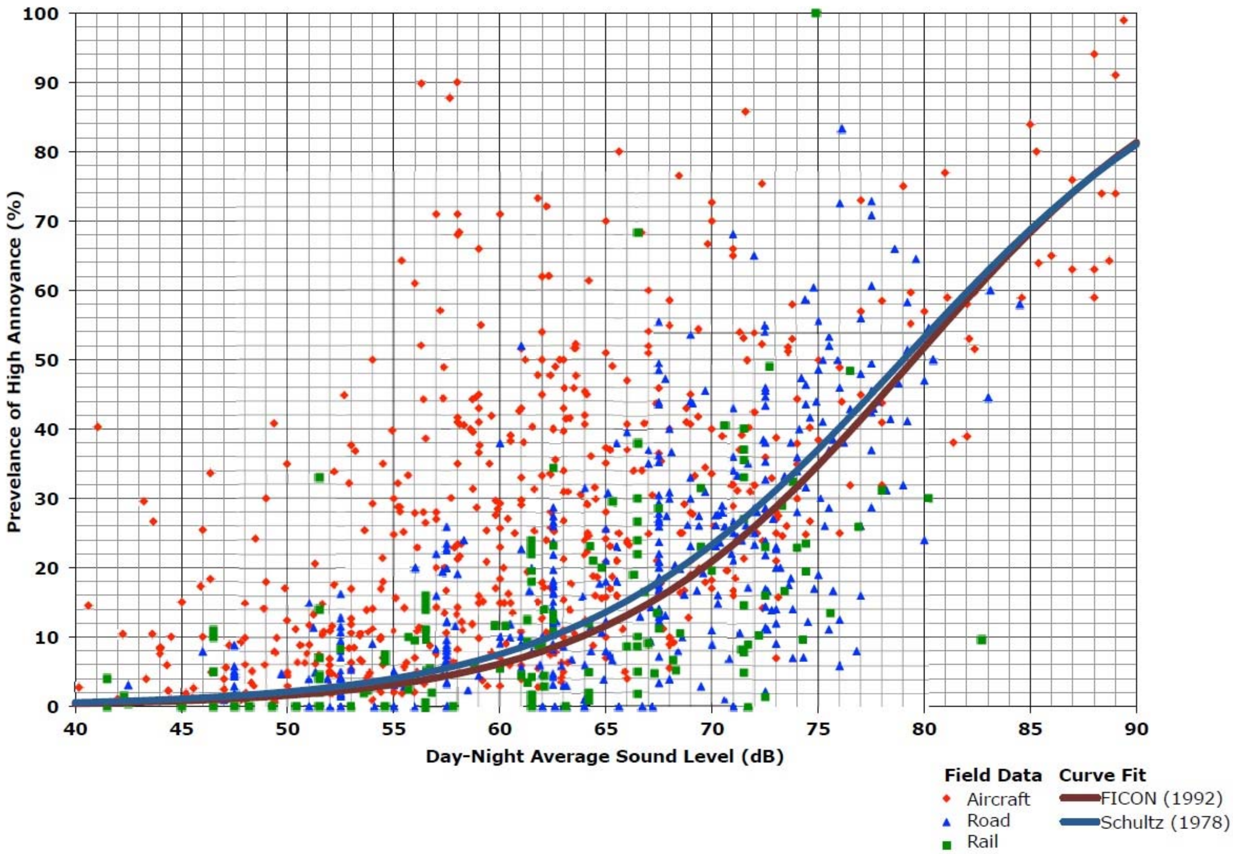
> “Our study emphasizes that interventions that reduce noise exposures could reduce cardiovascular risks among people living near airports. This can be done through improved aircraft technology and optimized flight paths, by using runways strategically to avoid when possible residential areas when people are sleeping, and by soundproofing of homes and other buildings.” (Source: http://www.hsph.harvard.edu /news/press-releases/aircraft-noise-linked-with-heart-problems)

All of the interventions specifically mentioned by the study author are already underway at JWA. Despite the lack of standards or thresholds, the County has taken action to minimize and/or reduce the physiological effects of noise on the surrounding population.

Annoyance is the most difficult of all noise responses to describe. Annoyance is a very individual characteristic and can vary widely from person to person. What one person considers tolerable can be quite unbearable to another of equal hearing capability. The level of annoyance, of course, depends on the characteristics of the noise (i.e.; loudness, frequency, time, and duration), and how much activity interference (e.g. speech interference and sleep interference) results from the noise. However, the level of annoyance is also a function of the attitude of the receiver. Personal sensitivity to noise varies widely. It has been estimated that 2 to 10 percent of the population is highly susceptible to annoyance from any noise not of their own making, while approximately 20 percent are unaffected by noise. Attitudes are affected by the relationship between the person and the noise source (Is it our dog barking or the neighbor's dog?). Whether we believe that someone is trying to abate the noise will also affect the level of annoyance.

Annoyance levels have been correlated to CNEL levels. Figure 8 relates DNL noise levels to community response from two of these surveys. One of the survey curves presented in Figure 8 is the well-known Schultz curve, developed by Theodore Schultz [14]. It displays the percent of a populace that can be expected to be annoyed by various DNL (CNEL in California) values for residential land use with outdoor activity areas. At 65 dB DNL, the Schultz curve predicts approximately 14 percent of the exposed population reporting themselves to be “highly annoyed.” At 60 dB DNL, this decreases to approximately 8 percent of the population. However, Figure 8 shows that the data used to determine the Schultz curve and updates have a very wide range of scatter, with communities near some airports reporting much higher percentages of population highly annoyed at these noise exposure levels. Annoyance levels have never been correlated statistically to single event noise exposure levels in airport-related studies.

Figure 8 Percent of Population Highly Annoyed as a Function of DNL



Source: Schultz (1978) & FICON (1992)

In recent years, there has been the suggestion in Europe and by researchers in the US that the noise dose, response curve for annoyance from aircraft noise is different for aviation noise than it is for road and rail noise [21][22][23]. In these studies, it has been suggested that the percentage of the population highly annoyed at 65 DNL is closer to 30 percent of the population and not the 14 percent as suggested by the Schultz curve. The US studies go on further to describe that communities form unique attitudes about noise and differing communities show a wide range of annoyance response for the same noise exposure that can be attributed to non-acoustic factors.

School Room Effects. Interference with classroom activities and learning from aircraft noise is an important consideration and the subject of much recent research. Studies from around the world indicate that vehicle traffic, railroad, and aircraft noise can have adverse effects on reading ability, concentration, motivation, and long term learning retention. A complicating factor in this research is the extent of background noise from within the classroom itself. The studies indicating the most adverse effects examine cumulative noise levels equivalent to 65 CNEL or higher and single event maximum noise levels ranging from 85 to 95 dBA. In other studies, the level of noise is unstated or ambiguous. According to these studies, a variety of adverse school room effects can be expected from interior noise levels equal to or exceeding 65 CNEL, and/or 85 dBA SEL.

Some interference with classroom activities can be expected with noise events that interfere with speech. As discussed in other sections of this report, speech interference begins at 65 dBA, which is the level of normal conversation. Typical construction attenuates outdoor noise by 20 dBA with windows closed and 12 dBA with windows open. Thus, some interference of classroom activities can be expected at outdoor levels of 77 to 85 dBA, the latter being the noise level for the SENEL contours shown in Attachment A.

2.5 NOISE/LAND USE COMPATIBILITY GUIDELINES

Noise metrics quantify community response to various noise exposure levels. The public reaction to different noise levels has been estimated from extensive research on human responses to exposure of different levels of aircraft noise. Noise standards generally are expressed in terms of the DNL 24-hour averaging scale based on the A-weighted decibel. Utilizing these metrics and surveys, agencies have developed standards for assessing the compatibility of various land uses with the noise environment. There are no single event noise based noise/land use compatibility criteria that have been adopted by the Federal Government or the State of California.

This section presents information regarding noise and land use criteria useful in the evaluation of noise impacts. The FAA has a long history of publishing noise/land use assessment criteria for airports. These laws and regulations provide the basis for local development of airport plans, analyses of airport impacts, and the enactment of compatibility policies. Other agencies including the EPA, the Department of Defense, the State of California, the County of Orange and most cities have developed noise/land use compatibility criteria. A summary of some of the more pertinent regulations and guidelines are presented in the following paragraphs.

2.5.1 FEDERAL AVIATION ADMINISTRATION

Airport and Airway improvement Act of 1982, as amended (Public Laws 91-258 and 94-353).

This act establishes the Federal requirements for funding of airport planning under the Planning Grant Program (PGP) and airport development under the Airport Development Aid Program (ADAP). An Airport and Airway Trust Fund is created to pay for these programs and operations of the Federal aviation system. The general types of projects eligible for Federal funding are indicated. Additionally, the act directs the preparation of a National Airport System Plan (NASP), which lists the location of airports in the national system of airports and the recommended development of each.

Among the conditions for Federal funding are two requirements involving airport/land use compatibility. As a condition to the receipt of ADAP funds, the airport sponsor (owner) must, among other things, give assurances regarding land uses in the airport environs that:

> "The aerial approaches to the airport will be adequately cleared and protected by removing, lowering, relocating, marking, lighting or otherwise mitigating existing airport hazards and by preventing the establishment or creation of future airport hazards;
>
> [and that:]
>
> Appropriate action, including the adoption of zoning laws, has been or will be taken to the extent reasonable, to restrict the use of land adjacent to or in the immediate vicinity of the airport to activities and purposes compatible with normal airport operations, including landing and takeoff of aircraft."

Federal Aviation Regulations, Part 36, "Noise Standards: Aircraft Type and Airworthiness Certification".

Originally adopted in 1960, FAR Part 36 prescribes noise standards for issuance of new aircraft type certificates. Part 36 prescribes limiting noise levels for certification of new types of propeller-driven, small airplanes as well as for transport category, large airplanes. Subsequent amendments extended the standards to certain newly produced aircraft of older type designs. Other amendments have at various times extended the required compliance dates. Aircraft may be certificated as Stage 1, Stage 2, Stage 3 or Stage 4 aircraft based on their noise level, weight, number of engines and in some cases number of passengers. Stage 1 and Stage 2 aircraft are no longer permitted to operate in the U.S. As of December 31, 2015, all civil jet aircraft, regardless of weight were required to meet Stage 3 or Stage 4 to fly within the contiguous U.S. Although, aircraft meeting Part 36 standards are noticeably quieter than many of the older aircraft, the regulations make no determination that such aircraft are acceptably quiet for operation at any given airport.

U.S. Department of Transportation/FAA Aviation Noise Abatement Policy.

This policy, adopted in 1976, sets forth the noise abatement authorities and responsibilities of the Federal Government, airport proprietors, State and Local governments, the air carriers, air travelers and shippers, and airport area residents and prospective residents. The basic thrust of the policy is that the FAA's role is primarily one of regulating noise at its source (the aircraft) plus supporting local efforts to develop airport noise abatement plans. The FAA will give high priority in the allocation of ADAP funds to projects designed to ensure compatible use of land near airports, but it is the role of State and Local governments and airport proprietors to undertake the land use and operational actions necessary to promote compatibility.

Aviation Safety and Noise Abatement Act of 1979.

Further weight was given to the FAA's supporting role in noise compatibility planning by congressional adoption of this legislation. Among the stated purposes of this act is "To provide assistance to airport operators to prepare and carry out noise compatibility programs". The law establishes funding for noise compatibility planning and sets the requirements by which airport operators can apply for funding. This is also the law by which Congress mandated that FAA develop an airport community noise metric which would be used by all federal agencies assessing or regulating aircraft noise. The result was DNL. Because California already had a well-established airport community noise metric in CNEL, and because CNEL and DNL are so similar, FAA expressly allows CNEL to be used in lieu of DNL in noise assessments performed for California airports. The law does not require any airport to develop a noise compatibility program.

Federal Aviation Regulations, Part 150, "Airport Noise Compatibility Planning".

As a means of implementing the Aviation Safety and Noise Abatement Act, the FAA adopted Regulations on Airport Noise Compatibility Planning Programs. These regulations are spelled out in FAR Part 150. As part of the FAR Part 150 Noise Control program, the FAA published noise and land use compatibility charts to be used for land use planning with respect to aircraft noise. An expanded version of this chart appears in Aviation Circular 150/5020-1 (dated August 5, 1983) and is reproduced in Table 2.

These guidelines represent recommendations to local authorities for determining acceptability and permissibility of land uses. The guidelines recommend a maximum amount of noise exposure (in terms of the cumulative noise metric DNL) that might be considered acceptable or compatible to people in living and working areas. These noise levels are derived from case histories involving aircraft noise problems at civilian and military airports and the resultant community response. Note that residential land use is deemed acceptable for noise exposures up to 65 dB DNL. Recreational areas are also considered acceptable for noise levels above 65 dB DNL (with certain exceptions for amphitheaters). However, the FAA guidelines indicate that ultimately "the responsibility for determining the acceptability and permissible land uses remains with the local authorities."

Table 2 Federal Aviation Regulation Part 150 Land Use Guidelines

Land Use	Yearly Day-Night Average Sound Level (Ldn dBA) <65	65-70	70-75	75-80	80-85	>85
Residential						
Residential, other than mobile homes and transient lodgings	Y	N[1]	N[1]	N	N	N
Mobile home parks	Y	N	N	N	N	N
Transient lodgings	Y	N[1]	N[1]	N[1]	N	N
Public Use						
Schools	Y	N[1]	N[1]	N	N	N
Hospitals and nursing homes	Y	25	30	N	N	N
Churches, auditoriums, and concert halls	Y	25	30	N	N	N
Governmental services	Y	Y	25	30	N	N
Transportation	Y	Y	Y[2]	Y[3]	Y[4]	Y[4]
Parking	Y	Y	Y[2]	Y[3]	Y[4]	N
Commercial Use						
Offices, business and professional	Y	Y	25	30	N	N
Wholesale and retail—building materials, hardware and farm equipment	Y	Y	Y[2]	Y[3]	Y[4]	N
Retail trade—general	Y	Y	25	30	N	N
Utilities	Y	Y	Y[2]	Y[3]	Y[4]	N
Communication	Y	Y	25	30	N	N
Manufacturing and Production						
Manufacturing, general	Y	Y	Y[2]	Y[3]	Y[4]	N
Photographic and optical	Y	Y	25	30	N	N
Agriculture (except livestock) and forestry	Y	Y[6]	Y[7]	Y[8]	Y[8]	Y[8]
Livestock farming and breeding	Y	Y[6]	Y[7]	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
Recreational						
Outdoor sports arenas and spectator sports	Y	Y[5]	Y[5]	N	N	N
Outdoor music shells, amphitheaters	Y	N	N	N	N	N
Nature exhibits and zoos	Y	Y	N	N	N	N
Amusements, parks, resorts and camps	Y	Y	Y	N	N	N
Golf courses, riding stables and water recreation	Y	Y	25	30	N	N

Table Key

Y (Yes) =Land Use and related structures compatible without restrictions.
N (No) =Land Use and related structures are not compatible and should be prohibited.
NLR =Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
25, 30, or 35 = Land use and related structures generally compatible; measures to achieve NLR of 25, 30, or 35 dB must be incorporated into design and construction of structure.

(Table Continued on Next Page)

Notes

(1) Where the community determines that residential or school uses must be allowed, measures to achieve outdoor to indoor Noise Level Reduction (NLR) of at least 25 dB and 30 dB should be incorporated into building codes and be considered in individual approvals. Normal residential construction can be expected to provide a NLR of 20 dB, thus, the reduction requirements are often stated as 5, 10 or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year round. However, the use of NLR criteria will not eliminate outdoor noise problems.
(2) Measures to achieve NLR 25 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.
(3) Measures to achieve NLR of 30 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.
(4) Measures to achieve NLR 35 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal level is low.
(5) Land use compatible provided special sound reinforcement systems are installed.
(6) Residential buildings require an NLR of 25.
(7) Residential buildings require an NLR of 30.
(8) Residential buildings not permitted.

Disclaimer

The designations contained in this table do not constitute a Federal determination that any use of land covered by the program is acceptable or unacceptable under Federal, State, or local law. The responsibility for determining the acceptable and permissible land uses and the relationship between specific properties and specific noise contours rests with the local authorities. FAA determinations under part 150 are not intended to substitute federally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving noise compatible land uses.

Federal Aviation Orders 5050.4 and 1050.1F for Environmental Analysis of Aircraft Noise Around Airports.

The FAA has developed guidelines (Order 5050.4B) for the environmental analysis of airports. Specific policies and procedures for evaluating environmental impacts are described in Order 1050.1F CHG 1 Effective Date March 20, 2006. The noise analysis related policies and procedures are presented in Section 14 of the Appendix A of the Order. The Significant Impact thresholds are presented in Section 14.3.

> *"A significant noise impact would occur if analysis shows that the proposed action will cause noise sensitive areas to experience an increase in noise of DNL 1.5 dB or more at or above DNL 65 dB noise exposure when compared to the no action alternative for the same timeframe. For example, an increase from 63.5 dB to 65 dB is considered a significant impact."*

Section 14.4c specifies that impacts to receptors with noise exposures between 60 and 65 DNL should be examined in accordance with the 1992 FICON (Federal Interagency Committee on Noise) Recommendations.

> *"In accordance with the 1992 FICON (Federal Interagency Committee on Noise) recommendations, examination of noise levels between DNL 65 and 60 dB should be done if determined to be appropriate after application of the FICON screening procedure (FICON p.3-5). If screening shows that noise sensitive areas at or above DNL 65 dB will have an increase of DNL 1.5 dB or more, further analysis should be conducted to identify noise-sensitive areas between DNL 60-65 dB having an increase of DNL 3 dB or more due to the proposed action. The potential for mitigating noise in those areas should be considered, including consideration of the same range of mitigation options available at DNL 65 dB and higher and eligibility for federal funding. This is not to be interpreted as a commitment to fund or otherwise implement mitigation measures in any particular area. (FICON p. 3-7)."*

Section 14.5e specifies the supplemental analysis that should be performed for projects with study areas that are larger than the immediate vicinity of the airport.

> *"For air traffic airspace actions where the study area is larger than the immediate vicinity of an airport, incorporates more than one airport, or includes actions above 3,000 feet AGL, noise modeling will be conducted using Noise Integrated Routing System (NIRS). For those types of studies, NIRS will be used to determine noise impacts from the ground to 10,000 feet AGL. This noise analysis will focus on the change in noise levels as compared to populations and demographic information at population points throughout the study area. Noise contours will not be prepared for the NIRS analysis. However, NIRS will be used to produce change-of-exposure tables and maps at population centroids using the following criteria:*
>
> *DNL 60-65 dB ± 3 dB*
> *DNL 45-60 dB ± 5 dB"*

Airport Noise and Capacity Act of 1990

The Airport Noise and Capacity Act of 1990 (PL 101-508, 104 Stat. 1388), also known as ANCA or the Noise Act, established two broad directives to the FAA: (1) establish a method to review aircraft noise, airport use, or airport access restrictions proposed by airport proprietors, and (2) institute a program to phase-out Stage 2 aircraft over 75,000 pounds by December 31, 1999. Stage 2 aircraft are older, noisier aircraft (B-737-200, B-727 and DC-9); Stage 3 aircraft are newer, quieter aircraft (B-737-300, B-757, MD80/90). To implement ANCA, FAA amended Part 91 and issued a new Part 161 of the Federal Aviation Regulations. Part 91 addresses the phase-out of large Stage 2 aircraft and the phase-in of Stage 3 aircraft. Part 161 establishes a stringent review and approval process for implementing use or access restrictions by airport proprietors.

The amended Part 91 required that all Stage 2 commercial aircraft, over 75,000 pounds, be out of the domestic fleet by December 31, 1999. The State of Hawaii and Alaska are not affected by this regulation. Since 2000, the domestic commercial airline fleet has been all Stage 3 or Stage 4 aircraft. In July 2005, the FAA adopted more stringent Stage 4 standards for certification of aircraft, effective January 1, 2006. Any aircraft that meets Stage 4 standards will meet Stage 3 standards. Accordingly, policies for review of noise restrictions affecting Stage 3 aircraft may be applied to Stage 4 aircraft as well.

Part 161 sets out the requirements and procedures for implementing new airport use and access restrictions by airport proprietors. Proprietors must use the DNL metric to measure noise effects and the Part 150 land use guideline table, including 65 dB DNL as the threshold contour to determine compatibility, unless there is a locally adopted standard more stringent. CNEL would be an acceptable surrogate for DNL.

The regulation identifies three types of use restrictions and treats each one differently: (1) negotiated restrictions, (2) Stage 2 aircraft restrictions and (3) Stage 3 aircraft restrictions. Generally speaking, any use restriction affecting the number or times of aircraft operations will be considered an access restriction. Even though the Part 91 phase-out does not apply to aircraft under 75,000 pounds, FAA has determined that Part 161 limitations on proprietors' authority applies to the smaller aircraft as well.

Negotiated restrictions are more favorable from the FAA's standpoint, but still require unwieldy procedures for approval and implementation. In order to be effective, the agreements normally must be agreed to by all airlines using the airport.

Stage 3 restrictions are even more difficult to implement. A Stage 3 restriction involves considerable additional analysis, justification, evaluation and financial discussion. In addition, a Stage 3 restriction must result in a decrease in noise exposure of the 65 dB DNL to noise sensitive land uses (residences, schools, places of worship, parks). The regulation requires both public notice and FAA approval.

ANCA applies to all new local noise restrictions and amendments to existing restrictions proposed after October 1990. Here, the existing noise regulations and access restrictions established and approved by the County of Orange at JWA were approved prior to the 1990 deadline in ANCA and grandfathered under ANCA. The amendments made to allow for the revised JWA noise abatement departure procedures, and other amendments since adoption in 1990 including, but not limited to, updating the noise monitoring system, have been approved by the County. The FAA provided a "legal opinion letter" for these amendments prior to approval indicating that the amendments would not jeopardize the FAA grandfathered status of the noise regulations and access restrictions at the Airport.

2.5.2 ENVIRONMENTAL PROTECTION AGENCY NOISE ASSESSMENT GUIDELINES

Environmental Protection Agency, "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety".

In March 1974, in response to a federal statutory mandate, the EPA published this document describing 55 dB DNL as the requisite level with an adequate margin of safety for areas with outdoor uses, including residences and recreational areas. This document is intended to "provide State and Local governments as well as the Federal Government and the private sector with an informational point of departure for the purpose of decision-making". Note that these levels were developed for suburban type uses. In some urban settings, the noise levels will be significantly above this level, while in some wilderness settings, the noise levels will be well below this level. The EPA "levels document" does not constitute a standard, specification or regulation, but identifies safe levels of environmental noise exposure without consideration for achieving these levels or other potentially relevant considerations. These EPA guidelines have not been adopted or recommended for use by the FAA, the State of California, or the County's Board of Supervisors.

Federal Interagency Committee on Noise (FICON) Report of 1992 [14]

The use of the CNEL or DNL metric and the 65 dB CNEL criteria have been reviewed by various interest groups in order to assess its usefulness in assessing aircraft noise impacts. At the direction of the EPA and the FAA, the Federal Interagency Committee on Noise (FICON) was formed to review specific elements of the assessment of airport noise impacts and to make recommendations regarding potential improvements. FICON includes representatives from the Departments of Transportation, Defense, Justice, Veterans Affairs, Housing and Urban Development, the Environmental Protection Agency, and the Council on Environmental Quality.

FICON was formed to review Federal policies used to assess airport noise impacts and on the manner in which noise impacts are determined. This included whether aircraft noise impacts are fundamentally different from other transportation noise impacts; the manner in which noise impacts are described; and the extent to which impacts outside of 65 DNL should be reviewed in federal environmental impact statements.

The committee determined that there are no new descriptors or metrics of sufficient scientific standing to substitute for DNL. The DNL noise exposure metric and the dose-response relationships used to determine noise impact were determined to be proper for assessing noise from civil and military aviation in the general vicinity of airports. The report supported agency discretion in the use of supplemental noise analysis. The report recommended improvement in public understanding of the DNL, supplemental methodologies and aircraft noise impacts.

The report endorsed and expanded traditional FAA environmental screening criteria for potential airport noise impacts. FICON recommended that if screening analysis determines noise-sensitive areas at or above 65 dB DNL show an increase of DNL 1.5 dB or more, then further analysis should be conducted of noise sensitive areas between DNL 60-65 dB having an increase of DNL 3 dB or more, consistent with the most recent FAA guidelines 1050.1F.

2.6 STATE OF CALIFORNIA

California Airport Noise Regulations are enforced by the Aeronautics Division of the California State Department of Transportation (Caltrans). These regulations establish 65 dB CNEL as a noise impact boundary (contour) within which there shall be no incompatible land uses. The noise impact boundary shall be validated by measurements made by noise monitors and be within a tolerance of plus or minus 1.5 dB CNEL. This requirement is based, in part, upon the determination in the Caltrans regulations that 65 dB CNEL is the level of noise which should be acceptable to "...a reasonable man residing in the vicinity of an airport." Airports are responsible for achieving compliance with these regulations. Compliance can be achieved through noise abatement measures, land acquisition, land use conversion, land use restrictions, or sound insulation of structures. Airports not in compliance can operate under variance procedures established within the regulations.

California Noise Insulation Standards [24][25] apply to all multi-family dwellings built in the State. Single-family residences are exempt from these regulations. With respect to community noise sources, the regulations require that all multi-family dwellings with exterior noise exposures greater than 60 dB CNEL must be sound insulated such that the interior noise level will not exceed 45 dB CNEL. These requirements apply to all roadway, rail, and airport noise sources.

General Plan Noise Element. The State of California requires that all municipal General Plans contain a Noise Element [25]. The requirements for the Noise Element of the General Plan include describing the noise environment quantitatively using a cumulative noise metric such as CNEL or DNL, establishing noise/land use compatibility criteria, and establishing programs for achieving and/or maintaining compatibility. Noise elements shall address all major noise sources in the community including mobile and stationary sources.

Airport Land Use Commissions were created by State Law [26] for the purpose of establishing a regional level of land use compatibility between airports and their surrounding environs. The Orange County Airport Land Use Commission has adopted Airport Environs Land Use Plans (AELUPs) for Orange County airports including JWA, Los Alamitos Joint Forces Training Base, and Fullerton Municipal Airport. The AELUPs establish noise/land use acceptability criteria for sensitive land uses at 65 dB CNEL for outdoor areas and 45 dB CNEL for indoor areas of residential land uses. These criteria are compatible with the criteria used by the County of Orange.

2.6.1 COUNTY OF ORANGE

The General Plan Noise Element of the County of Orange establishes noise/land use planning criteria for the unincorporated areas of the County. These noise guidelines and standards cover roadway noise, rail noise, and airport noise including military and civilian airports. The County has adopted noise standards for various land uses in terms of CNEL and Leq. These standards are reproduced here as Tables 3 and 4. For residential land uses the County has established a maximum exterior noise level standard of 65 dB CNEL for private outdoor living areas and an interior standard of 45 dB CNEL. The County of Orange uses the 60 dB CNEL contour as a threshold for review of projects in order to screen projects and ensure that the 65 dB CNEL exterior and 45 dB CNEL interior criteria are met. In other words, projects located within the 60 dB CNEL contour are required to submit detailed acoustical studies ensuring compliance with the County noise standards.

Table 3 County of Orange Compatibility Matrix

Type of Use	> 65 dB CNEL	60 to 65 dB CNEL
Residential	3a, b, e	2a, e
Commercial	2c	2c
Employment	2c	2c
Open Space		
Local	2c	2c
Community	2c	2c
Regional	2c	2c
Educational Facilities		
Schools K-12	2c, d, e	2c, d, e
Preschool, college, other	2c, d, e	2c, d, e
Places of Worship	2c, d, e	2c, d, e
Hospitals		
General	2a, c, d, e	2a, c, d, e
Convalescent	2a, c, d, e	2a, c, d, e
Group Quarters	1a, b, c, e	2a, c, e
Hotels/Motels	2a, c	2a, c
Accessory Uses		
Executive Apartments	1a, b, e	2a, e
Caretakers	1a, b, c, e	2a, c, e

Table 4 County of Orange Compatibility Matrix –Explanations and Definitions

Action Required to Ensure Compatibility Between Land Use and Noise from External Sources	
1=	Allowed if interior and exterior community noise levels can be mitigated.
2=	Allowed if interior levels can be mitigated.
3=	New residential uses are prohibited in areas within the 65 dB CNEL contour from any airport or air station; allowed in other areas of interior and exterior community noise levels can be mitigated. The prohibition against new residential development excludes limited "infill" development within an established neighborhood.

Standards Required for Compatibility of Land Use and Noise	
a=	Interior Standard: CNEL of less than 45 dB (habitable rooms only).
b=	Exterior Standard: CNEL of less than 65 dB from any source in outdoor living areas.
c=	Interior standard: Leq (H)=45 to 65 decibels interior noise level, depending on interior use.

Typical Use	Leq (h)*
Private Office, Church Sanctuary, College, Preschool, Schools (Grade K-12) Board Room, Conference Room, etc.	45
General Office, Reception, Clerical, etc.	50
Other Schools and Colleges	52
Bank Lobby, Retail Store, Restaurant, Typing Pool, etc.	55
Manufacturing, Kitchen, Warehousing, etc.	65

d=	Exterior Standard: Leq(h) of less than 65 dB in outdoor living areas.
e=	Interior Standard: As approved by the Board of Supervisors for sound events of short duration such as aircraft flyovers or individual passing railroad trains.

Additionally, the County of Orange provides insurance that the 45 dB CNEL interior noise limit for habitable rooms of residential units is met with windows open or windows closed (not necessarily both). Specifically, homes with windows closed will provide at least a 20 dB outdoor to indoor noise reduction (based on typical pre-1981 construction practice and Uniform Building Code requirements, newer homes provide additional noise reduction). Homes with windows open will provide a 12 dB outdoor to indoor noise reduction (largely independent of date of construction). The County, therefore, requires that new homes with exterior noise exposure greater than 57 dB CNEL (45 dB plus 12 dB) provide some means of mechanical ventilation in order to ensure that residents are able to close windows and obtain fresh air at a rate specified in the Uniform Building Code. New homes subject to this requirement are typically air-conditioned or supplied with a fresh air switch as part of the forced air heating unit.

The County of Orange has historically restricted nighttime operations at JWA. Air carriers are not permitted to depart JWA before 7 am on Monday through Saturday, 8 am on Sundays, or after 10 pm on any day. Air carriers are not permitted to arrive at JWA before 7 am on Monday through Saturday, 8 am on Sundays, or after 11 pm on any day. General aviation aircraft are permitted to operate at night provided that they meet strict nighttime noise limits. These nighttime restrictions predate the 1985 Settlement Agreement and the Phase 2 Commercial Airline Access Plan and Regulation.

The Phase 2 Commercial Airline Access Plan and Regulation at John Wayne Airport [27] was adopted by the County of Orange, in its capacity as the proprietor and certificated operator of JWA, and under the authority of federal law, and the laws of the State of California, which designate the County as the proper local entity to balance the needs of the Orange County community for adequate commercial air transportation facilities, and the desire of the local community for environmentally responsible air transportation operations at JWA. The Access Plan contains the rules and regulations for commercial, cargo, and commuter carrier operations at the Airport.

The General Aviation Noise Ordinance (GANO) [28] adopted by the County of Orange establishes noise limits and other restrictions for aircraft operating at JWA. Generally, general aviation operations are permitted 24 hours a day subject to daytime and nighttime noise limits.

2.6.2 GENERAL PLAN FOR NEARBY CITIES

The following paragraphs discuss the noise policies of cities adjacent to JWA:

Newport Beach – The City of Newport Beach adopted its current General Plan on July 25, 2006. The City has established 65 and 45 CNEL as the outdoor and indoor noise compatibility criteria for residential land uses (See Table N2 of the Noise Element). This table also presents noise land use compatibility guidelines and noise standards for a variety of land use types. Policy N 1.8 establishes criteria for significant noise impacts.

Policy N 1.8: Significant Noise Impacts; Require the employment of noise mitigation measures for existing sensitive uses when a significant noise impact is identified. A significant noise impact occurs when there is an increase in the ambient CNEL produced by new development impacting existing sensitive uses. The CNEL increase is shown in the table below.

CNEL (dBA)	dBA increase
55	3.0
60	2.0
65	1.0
70	1.0
Over 75	Any increase is considered significant

Goal N 3 of the City's Noise Element is, "Protection of Newport Beach residents from the adverse noise impacts of commercial air carrier operations at JWA as provided in the City Council Airport Policy."

N 3.1 New Development; Ensure new development is compatible with the noise environment by using airport noise contours no larger than those contained in the 1985 JWA Master Plan, as guides to future planning and development decisions.

N 3.2 Residential Development; Require that residential development in the Airport Area be located outside of the 65 dBA CNEL noise contour no larger than shown in the 1985 JWA Master Plan and require residential developers to notify prospective purchasers or tenants of aircraft overflight and noise.

N 3.3 Avigation Easement; Consider requiring the dedication of avigation easements in favor of the County of Orange when noise sensitive uses are proposed in the JWA planning area, as established in the JWA Airport Environs Land Use Plan (AELUP).

N 3.4 Existing Noise Restrictions; Take any action necessary to oppose any attempt to modify the existing noise restrictions, including the existing curfew and the General Aviation Noise Ordinance.

N 3.5 Additional Facilities at John Wayne Airport; Take any action necessary to oppose any attempt to construct a second air carrier runway including the acquisition of land necessary to provide required separation of the existing air carrier runway and any proposed facility.

N 3.6 Existing Level of General Aviation Operations; Support any plan or proposal that maintains, and oppose any plan or project that proposes any significant changes to the existing level of general aviation operations and general aviation support facilities.

N 3.7 Remote Monitoring Systems (Noise Monitoring Stations); Support preservation or enhancement of the existing Remote Monitoring Systems (RMS) or Noise Monitoring Stations (NMS) and the public reporting of the information derived from the RMS/NMS.

N 3.8 Meeting Air Transportation Demand; Support means of satisfying some of Orange County's air transportation demand at airports other than JWA or through alternative means of transportation.

N 3.9 John Wayne Airport Amended Settlement Agreement; Take all steps necessary to preserve and protect the validity of the John Wayne Airport Amended Settlement Agreement, including the following:

- Oppose, or seek protection from any federal legislative or regulatory action that would or could affect or impair the County's ability to operate John Wayne Airport consistent with the provisions of the John Wayne Airport Amended Settlement Agreement or the City's ability to enforce the Amended Settlement Agreement.
- Approving amendments of the John Wayne Airport Settlement Agreement to ensure continued validity provided amendments are consistent with the City Council Airport Policy, do not materially impair the quality of life, and are in the long-term best interests of Newport Beach residents.
- Continuing to monitor possible amendment of the Airport Noise and Capacity Act of 1990, as well as various FAA Regulations and Advisory Circulars that relate to aircraft departure procedures.

Costa Mesa – The Noise Element of the 2000 General Plan, dated January 2002 establishes 65 and 45 CNEL as the outdoor and interior noise compatibility for residential uses (See Tables N3 and N4 and Objective N-1A.2). The Noise Element also includes two policies related to John Wayne Airport;

Policy N-1A.7; "Discourage sensitive land uses from locating in the 65 CNEL noise contour of the John Wayne Airport. Should it be deemed by the City as appropriate and/or necessary for a sensitive land use to locate in the 65 CNEL noise contour, ensure that appropriate interior noise levels are met and that minimal outdoor activities are allowed."

Policy N-1A.8; "Support alternative methods for the reduction of noise impacts at John Wayne Airport while continuing to maintain safety and existing limitations on aircraft daily departures."

Irvine – The City of Irvine adopted its most recent General Plan on May 8, 2012 with a Supplement adopted on July 8, 2012 (Council Resolution 12-60). The General Plan Noise Element of the City of Irvine contains noise/land use compatibility guidelines consistent with those in use by the County of Orange, i.e., 65 dB CNEL for noise sensitive outdoor areas and 45 dB CNEL for indoor areas of residential uses (See Tables F-1 and F-2).

The City of Irvine has also adopted a single event noise standard that applies to the interior of residential units located within a 60 dB CNEL contour. That requirement is that the Maximum Noise Level for the 10th percentile of the noise events shall not exceed 55 dBA, i.e., only the loudest 10 percent may exceed 55 dBA.

At the same time as the General Plan, the City also adopted a CEQA manual that provides guidance in preparing CEQA documents for the City including guidance on significance thresholds. The manual's guidance for determining the significance of traffic noise increases is as follows:

> "Consequently, the noise threshold for increase in traffic noise levels is based on the potential for traffic noise to become considerably louder than the ambient noise level. In general, noise levels must increase by 10 dBA in order to double ambient noise levels. An increase of 5 dBA is readily perceptible to the public and a 3 dBA increase is barely perceivable to the average healthy human ear."

Tustin – The City of Tustin's Noise Element is dated June 17, 2008. The noise/land use compatibility guidelines presented in the City's Noise Element are consistent with those in use by the County of Orange, i.e., 65 dB CNEL for noise sensitive outdoor areas and 45 dB CNEL for indoor areas of residential uses (see Tables N-2 and N-3 of the Noise Element). Aircraft noise is identified as a noise-related issue with three bullet points:

- Noise from John Wayne Airport, while generally below accepted CNEL guidelines for residential uses, produces annoyance among Tustin residents due to repetitive occurrence.
- The activities and opportunities at John Wayne Airport should be monitored as needed to protect the planning area from unwanted aircraft noise.
- Citizen involvement in committees that will influence future aircraft operations at John Wayne Airport needs to be encouraged.

The Noise Element contains four policies related to aircraft noise under Goal 1, "Use noise control measures to reduce the impact from transportation noise sources." These Policies are:

> **Policy 1.3:** Encourage John Wayne Airport to set up noise control procedures and to consider methods to reduce and minimize noise exposure due to aircraft flyovers within the Tustin Planning Area.
>
> **Policy 1.4:** Continue to monitor all John Wayne Airport activities to minimize noise impacts within the Tustin Planning Area resulting from airport operations, and oppose legislation promulgated by the FAA that could eliminate local flight restrictions.
>
> **Policy 1.5:** Work to reduce risks and noise impacts resulting from aircraft operations by (a) participating in and monitoring the planning process for John Wayne Airport and (b) continuing to discourage commercial or general aviation activities which increase noise exposure.
>
> **Policy 1.6:** Encourage Tustin citizen participation and City involvement on committees that would influence future aircraft operations in Orange County.

The City has included two implementation items related to aircraft noise from John Wayne Airport. Both are ongoing projects for the Community Development Department. These two items are:

1. Aviation Noise: Work to reduce noise impacts resulting from aircraft operations at John Wayne Airport by: (a) participating and monitoring the planning process for John Wayne Airport; (b) continuing to discourage general and commercial aviation activities which increase noise exposure to sensitive land uses.
2. Aviation Monitoring: The City shall continue to review and report on the noise reports received concerning John Wayne Airport to identify any of the areas of the City where negative impacts exist in order to implement mitigation efforts, which could include lobbying of the FAA and related agencies for tighter restrictions on aircraft types.

3.0 METHODOLOGY

The methods used here for describing existing noise and forecasting the future noise environment rely heavily on computer noise modeling. The noise environment is commonly depicted in terms of lines of equal noise levels, or noise contours. These noise contours are supplemented with specific noise data for selected points on the ground. The computer noise models used are described below.

3.1 AIRCRAFT NOISE MODELING

Noise contour modeling is a key element of this noise study. Generating accurate noise contours is largely dependent on the use of a reliable, validated, and updated noise model. It is imperative that these contours be accurate for the meaningful analysis of airport and roadway noise impacts. The computer model can then be used to predict the changes to the noise environment as a result of any of the alternatives under consideration.

The FAA's Aviation Environmental Design Tool (AEDT) version 2d was used to model aircraft operations at JWA. AEDT has an extensive database of civilian and military aircraft noise characteristics and incorporates advanced plotting features. Noise contour files from AEDT were loaded into the ArcView™ Geographic Information System (GIS) software for plotting and land use analysis.

Airport noise contours were generated in this study using the AEDT Version 2d. [29] The original AEDT was released in 2015. The latest version, AEDT Version 2d, was released for use in September 2017 and is the state-of-the-art in airport noise modeling. AEDT is a complex computer program developed to model noise and environmental characteristic for airports. AEDT uses a database with standard aircraft noise and performance data for over 5,000 civilian aircraft types and engine combinations that can be tailored to the characteristics of the airport in question, as well as a database of military aircraft types. AEDT has the ability to include run-ups in the computations, the ability to include topography in the computations, and the ability to vary aircraft altitude profiles in an automated fashion.

One of the most important factors in generating accurate noise contours is the collection of accurate operational data. AEDT requires the input of the physical and operational characteristics of the airport. Physical characteristics include runway coordinates, airport altitude, and temperature, and optionally, topographical data. Operational characteristics include various types of aircraft data. This includes not only the aircraft types and flight tracks, but also departure procedures, arrival procedures and stage lengths (flight distance) that are specific to the operations at the airport. Aircraft data needed to generate noise contours include:

- Number of aircraft operations by type
- Types of aircraft
- Day/Evening/Night time distribution by type
- Flight tracks

- Flight track utilization by type
- Flight profiles
- Typical operational procedures
- Average Meteorological Conditions

The significance of noise impacts attributable to the Proposed Project and its alternatives is evaluated based on the County of Orange significance threshold criteria provided in Section 5.2.

3.2 TRAFFIC NOISE MODELING

The significance of traffic noise impacts attributable to the Proposed Project and its alternatives is evaluated based on two criteria:

1. The change in traffic noise (increase or decrease) attributable to traffic generated by the Proposed Project or an alternative, and
2. The absolute traffic noise level that results with inclusion of traffic from the Proposed Project or the alternative being evaluated in combination with other vehicle traffic.

Both criteria must be exceeded for a significant impact to occur.

With respect to criterion (1), changes in traffic noise levels resulting from traffic volume increases can be calculated exactly based on the changes in traffic volumes. The increase in traffic noise over existing conditions is calculated by taking ten times the base 10 logarithm of the ratio of the future traffic volume to the existing traffic volume. Similarly, the increase due to the Proposed Project or Alternative can be calculated by taking ten times the base 10 logarithm of the ratio of the future traffic volume with the Project/Alternative to the future traffic volume without the Project/Alternative. In this case, traffic volumes used to calculate traffic noise level changes were provided by the traffic consultant for the Project, Austin Transportation Consulting.

The calculation of relative noise levels contains an inherent assumption that the mix of traffic, autos and trucks, is the same in the two scenarios being compared. However, there is no reason to believe that future changes in the traffic mix would considerably affect the calculated traffic noise level changes. This is because automobiles dominate the traffic noise along arterials when calculated using the standard vehicle mix developed by the County based on traffic surveys at 22 arterial intersections. Relative truck volumes would need to change by more than a factor of two for the noise level change to vary by 0.4 dB over the assumption that they remain constant. There is no evidence that relative truck volumes would change by even this amount based on the project elements of the two GAIP alternatives being analyzed in this document. This difference is much less than the expected accuracy of the standard traffic noise model. Therefore, the noise level changes calculated with this assumption are accurate within noise level prediction tolerances.

With respect to criterion (2), absolute noise levels can be difficult to predict accurately over a wide area because it is not only dependent on the roadway characteristics (width, posted speed limit, traffic volume) but it is also dependent on intervening structures and topography between the road and the receptor. Nonetheless, noise modeling software is available to allow for accurate predictions in this regard.

To determine traffic noise impacts as a result of the project, the FHWA (Federal Highway Administration) noise model was used. The FHWA noise model utilizes various traffic-flow parameters (e.g. traffic volume, speed, mix, etc.) to predict noise levels that result from the operation of motor vehicles on the roadways.

4.0 EXISTING NOISE ENVIRONMENT

4.1 EXISTING JOHN WAYNE AIRPORT NOISE

John Wayne Airport (JWA) serves both general aviation and scheduled commercial passenger airline and cargo operations. The use of JWA is heavily regulated as a result of its limited area and facilities, environmental sensitivity of the local area, and because of a long history of airport related litigation extending back at least to 1969.

JWA has a long history of noise analysis. Extensive data from its noise monitoring system and from a myriad of other studies relating to aircraft operations and noise levels enables precise modeling and prediction of noise levels. Radar tracks and sophisticated use of noise monitoring stations has produced very accurate depictions of flight tracks and aircraft noise. The noise levels of all commercial aircraft operations and many general aviation operations are recorded at 10 permanent NMS around the Airport. Both CNEL and SENEL are monitored and calculated for each day and each aircraft. In accordance with State of California Airport Noise standards, a detailed report is compiled every three months summarizing this information, and each year an annual CNEL contour is computer modeled and included in the fourth quarter report. Noise complaint data is also meticulously recorded and analyzed. The aircraft operational data, noise measurements and contours for JWA are among the most accurate of any in the world. All of the data for the past three decades is contained in the Noise Abatement Quarterly Reports, which are obtainable from the JWA Access and Noise Office. For this analysis, 2016 is the baseline year as it was the most recent full year of data available when the Notice of Preparation was published, March 30, 2017.

4.1.1 EXISTING (2016) OPERATIONS DATA

In 2016, there were 284,246 aircraft operations at JWA. Of these operations, 91,522 were large and regional jets, 9,798 were turbo prop aircraft, 31,712 were business jets, and 3,862 were helicopter. The remaining 147,352 were propeller driven aircraft. In summary, there are 91,522 commercial operations and 192,724 general aviation operations at JWA.

4.1.2 EXISTING (2016) FLEET MIX DATA

The number of operations and fleet mix included in the 2016 noise exposure contour is based on John Wayne's Access/GANO software system database data collected from January 2016 through December 2016, the most recent full year of data that was available when the noise modeling began. Specific aircraft types and times of operation were also obtained from the 2016 John Wayne Access/GANO software system database. Table 5 provides a summary of the annual operations and fleet mix at JWA, organized by AEDT aircraft type, operation type, and during the daytime (7:00 a.m.–6:59 p.m.), evening (7:00 p.m.-9:59 p.m.) nighttime (10:00 p.m.–6:59 a.m.) periods.

4.1.3 EXISTING (2016) RUNWAY AND FLIGHT TRACK UTILIZATION

The annual runway end utilization was derived from John Wayne Airport's Access/GANO software system database data from January 2016 through December 2016. Table 6 summarizes the percentage of use by each aircraft category and time of day on each JWA runway.

The flight tracks at JWA are well established to take advantage of the runway configuration and prevailing wind conditions. Runway 20R/02L is approximately 5,700 feet long and is the only runway suitable for larger commercial aircraft. With winds predominantly coming from the ocean, aircraft typically depart to the southwest and arrive from the northeast about 95 percent of the time with slight variations from year to year. The reverse (depart to northeast and arrive from southwest) occurs primarily when Santa Ana wind conditions occur, but there are times where winds aloft, or other weather conditions may cause operations to go into reverse. During the existing conditions, the Airport operated in south flow 95.7 percent of the time. Departures to the southwest proceed one (1) nautical mile and turn left approximately 20 degrees to generally follow Newport Bay. Arrivals use a straight in approach from the northeast to Runway 20R, generally lining up with the runway centerline over Anaheim Hills. Additionally, aircraft arriving from the northwest arrive from the ocean over Huntington Beach on a downwind path that is parallel to JWA after which a right base leg turn to Runway 20R begins. This turn begins anywhere over a wide area starting near South Coast Plaza extending to the Riverside Freeway. Table 6 shows the Runway end utilization and Figure 9 shows the combined flight tracks for general aviation and air carrier aircraft for a peak day in August.

Table 5 Existing (2016) Distribution of Annual Operations by Aircraft Type

Aircraft Type	AEDT Type	Arrival			Departures			Total
		Day	Eve	Night	Day	Eve	Night	
LARGE AIRCRAFT								
Airbus 319-131	A319-131191_A	2,194	853	83	2,856	247	27	6,260
Airbus 320-232	A320-232202_A	816	393	122	1,299	17	15	2,662
Airbus 320-211	A320-211201_A	784	107	2	713	179	2	1,786
Airbus 321-232	A321-232212_A	174	114	3	274	6	12	582
Airbus 300-662R	A300-622RF46_A	274	6	0	1	279	0	560
Boeing 737-700	737700377_E	9,935	2,542	936	10,959	2,441	13	26,828
Boeing 737-700	737700377_A	8,965	2,294	845	10,260	1,725	119	24,208
Boeing 737-800	737800378_A	6,673	1,726	297	7,914	741	41	17,392
Boeing 756-PW	757PW572_A	719	492	77	1,091	190	7	2,576
REGIONAL JETS								
Bombardier CRJ900	CRJ9-ER9ER_E	1,015	472	161	1,567	66	16	3,298
Embraer 170	EMB170	2,060	611	14	2,164	518	3	5,370
BUSINESS JETS								
Twin Engine Regional Jet	CNA55B	1,777	236	161	1,948	145	80	4,346
Twin Engine Regional Jet	CL600	1,427	201	39	1,544	92	31	3,334
Twin Engine Regional Jet	CNA525C	1,378	158	52	1,439	108	41	3,176
Twin Engine Regional Jet	LEAR35	1,335	125	40	1,357	87	56	3,000
Twin Engine Regional Jet	GIV	1,205	183	42	1,288	110	32	2,860
Twin Engine Regional Jet	CNA560XL	1,019	114	25	1,049	79	30	2,316
Twin Engine Regional Jet	CL601	866	95	10	909	48	14	1,942
Twin Engine Regional Jet	GV	785	115	37	831	92	12	1,872
Twin Engine Regional Jet	CNA750	673	80	8	722	36	2	1,520
Twin Engine Regional Jet	CNA560U	580	109	37	652	45	29	1,452
Twin Engine Regional Jet	MU3001	586	83	55	623	38	63	1,448
Twin Engine Regional Jet	CNA680	491	62	15	520	22	26	1,136
Twin Engine Regional Jet	F10062	418	50	12	448	23	8	958
Twin Engine Regional Jet	CNA510	364	44	11	367	20	32	838
Twin Engine Regional Jet	CIT3	359	30	5	366	26	2	788
Twin Engine Regional Jet	IA1125	208	28	9	226	15	4	490
Twin Engine Regional Jet	ECLIPSE500	102	12	4	93	6	19	236
TURBOPROPS								
Commuter Prop	DHC6	1,246	153	46	1,297	39	109	2,890
Commuter Prop	CNA441	1,277	125	42	1,269	120	55	2,888
Commuter Prop	DO228	156	22	2	149	27	4	360
Commuter Prop	CNA208	1,044	121	87	1,079	112	61	2,504
Commuter Prop	DHC830	578	0	0	577	1	0	1,156
GENERAL AVIATION PROPS								
GA Prop	GASEPF	13,647	1,662	218	14,407	751	369	31,054
GA Prop	CNA172	4,482	401	74	4,469	293	195	9,914
GA Prop	GASEPV	3,056	309	92	3,184	172	100	6,912
GA Prop	BEC58P	1,393	120	16	1,408	77	46	3,060
GA Prop	CNA182	999	127	16	1,032	71	40	2,286
GA Prop	CNA206	691	55	4	723	17	10	1,500
GA Prop	PA28	439	36	8	432	42	9	966
GA Prop	PA31	139	12	1	144	6	1	302
HELICOPTER								
Helicopter	R44	1,343	110	43	1,358	95	43	2,992
Helicopter	SA350D	255	70	111	358	24	53	870
Touch and Go Ops								91,358
TOTAL ANNUAL OPS								284,246

Note: 1. Day = 7:00 a.m. to 6:59 p.m., Eve = 7:00 p.m. to 9:59 p.m., Night = 10:00 p.m. to 6:59 a.m.

2. The AEDT Type column includes aircraft type suffixes that represent the User-defined profile names.

Source: John Wayne Airport Access/GANO Software System Database Data, January 2016-December 2016; Landrum & Brown, 2017.

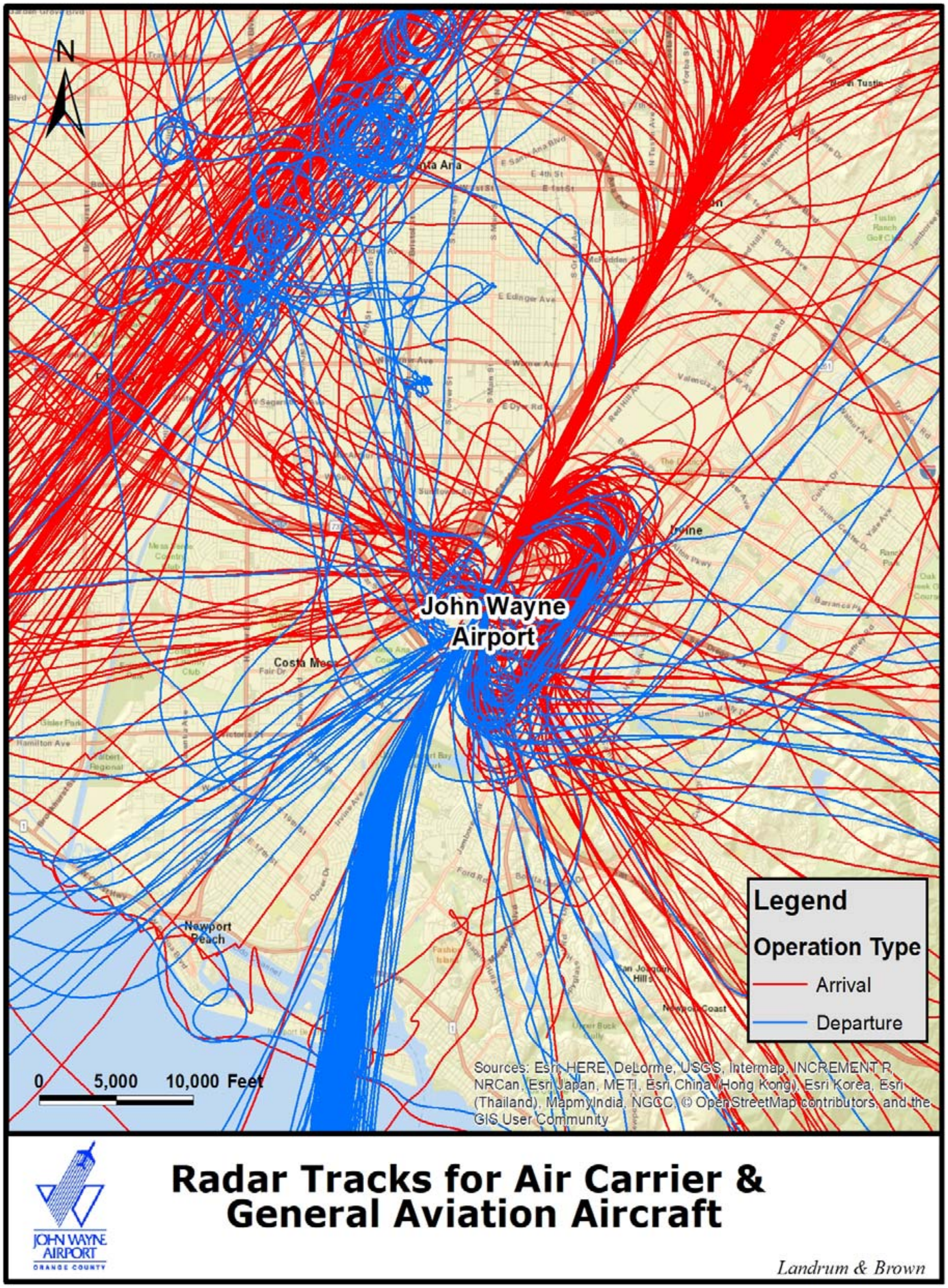
Table 6 Existing (2016) Runway End Utilization

DAYTIME ARRIVALS				
AIRCRAFT CATEGORY	**02L**	**02R**	**20L**	**20R**
Large Jets	2.62%	0.00%	0.00%	97.38%
Regional Jets	2.59%	0.00%	0.00%	97.41%
Business Jets	2.40%	0.00%	0.00%	97.60%
Turboprops	2.55%	0.14%	1.97%	95.35%
General Aviation Props	0.89%	1.10%	48.34%	49.67%
DAYTIME DEPARTURES				
AIRCRAFT CATEGORY	**02L**	**02R**	**20L**	**20R**
Large Jets	3.42%	0.00%	0.00%	96.58%
Regional Jets	2.76%	0.00%	0.00%	97.24%
Business Jets	2.66%	0.00%	0.00%	97.34%
Turboprops	2.29%	0.12%	1.77%	95.82%
General Aviation Props	1.88%	0.64%	44.86%	52.62%
EVENING ARRIVALS				
AIRCRAFT CATEGORY	**02L**	**02R**	**20L**	**20R**
Large Jets	3.21%	0.00%	0.00%	96.79%
Regional Jets	3.67%	0.00%	0.00%	96.33%
Business Jets	2.70%	0.00%	0.00%	97.30%
Turboprops	2.67%	0.38%	0.00%	96.95%
General Aviation Props	1.03%	0.59%	35.23%	63.16%
EVENING DEPARTURES				
AIRCRAFT CATEGORY	**02L**	**02R**	**20L**	**20R**
Large Jets	3.06%	0.00%	0.00%	96.94%
Regional Jets	1.15%	0.00%	0.00%	98.85%
Business Jets	2.27%	0.00%	0.00%	97.73%
Turboprops	2.08%	0.64%	4.05%	93.22%
General Aviation Props	1.91%	0.37%	45.93%	51.79%
NIGHTTIME ARRIVALS				
AIRCRAFT CATEGORY	**02L**	**02R**	**20L**	**20R**
Large Jets	5.80%	0.00%	0.00%	94.20%
Regional Jets	2.99%	0.00%	0.00%	97.01%
Business Jets	4.88%	0.00%	0.00%	95.12%
Turboprops	3.68%	0.00%	2.43%	93.89%
General Aviation Props	2.69%	2.06%	15.46%	79.79%
NIGHTTIME DEPARTURES				
AIRCRAFT CATEGORY	**02L**	**02R**	**20L**	**20R**
Large Jets	6.67%	0.00%	0.00%	93.33%
Regional Jets	0.00%	0.00%	0.00%	100.00%
Business Jets	26.54%	0.00%	0.00%	73.46%
Turboprops	71.65%	3.88%	0.00%	24.47%
General Aviation Props	27.16%	0.38%	21.70%	50.75%

Note: Day = 7:00 a.m. to 6:59 p.m., Eve = 7:00 p.m. to 9:59 p.m., Night = 10:00 p.m. to 6:59 a.m.

Source: John Wayne Airport Access/GANO Software System Database Data, January 2016-December 2016; Landrum & Brown, 2017.

Figure 9 Existing Radar Tracks for Air Carrier & General Aviation Aircraft



Source: John Wayne Airport Access/GANO Software System Database Data, Radar Tracks are for August 15, 2016; Landrum & Brown, 2017.

4.1.4 EXISTING (2016) JOHN WAYNE AIRPORT CNEL CONTOURS AND LAND USE IMPACTS

The CNEL contours used to depict existing noise exposure at JWA are derived from the 2016 conditions. They are depicted on Figure 10. The contours were developed by calibrating the results of AEDT modeling to the measurements from the 10 permanent NMS. The locations of the 10 permanent NMS are shown in Figure 11. Three (3) of the NMS are located in Santa Ana Heights (1S, 2S, and 3S), which has been annexed by the City of Newport Beach, four are located in the City of Newport Beach (4S, 5S, 6S, and 7S), one in Irvine (8N), one in Santa Ana (9N), and one in Tustin (10N).

A description of the geographic parameters of the Existing Conditions (2016) contours, as well as their inclusion of any noise sensitive land uses, follows:

- 70 CNEL contour: 582.4 acres/0.91 square miles, including one (1) place of worship but no other noise sensitive land uses. This place of worship is considered compatible as it has been sound attenuated.
- 65 to 70 CNEL contour: 953.6 acres/1.49 square miles, including 247 residential dwellings with approximately 401 residents and three (3) places of worship but no other noise sensitive land uses. These three places of worship and 247 dwelling units are considered compatible as they have been sound attenuated or offered sound attenuation.
- 60 to 65 CNEL contour: 2,150.4 acres/3.36 square miles, including 1,365 residential dwellings with approximately 2,772 residents, five (5) places of worship, and six (6) schools. All residential dwellings within the 60 to 65 CNEL are considered compatible.

This information is also provided in Table 13. In addition to the CNEL contours, specific CNEL values are calculated for each NMS shown on Figure 11. Table 7 displays CNEL values at each of the NMS from the noise modeling of existing conditions.

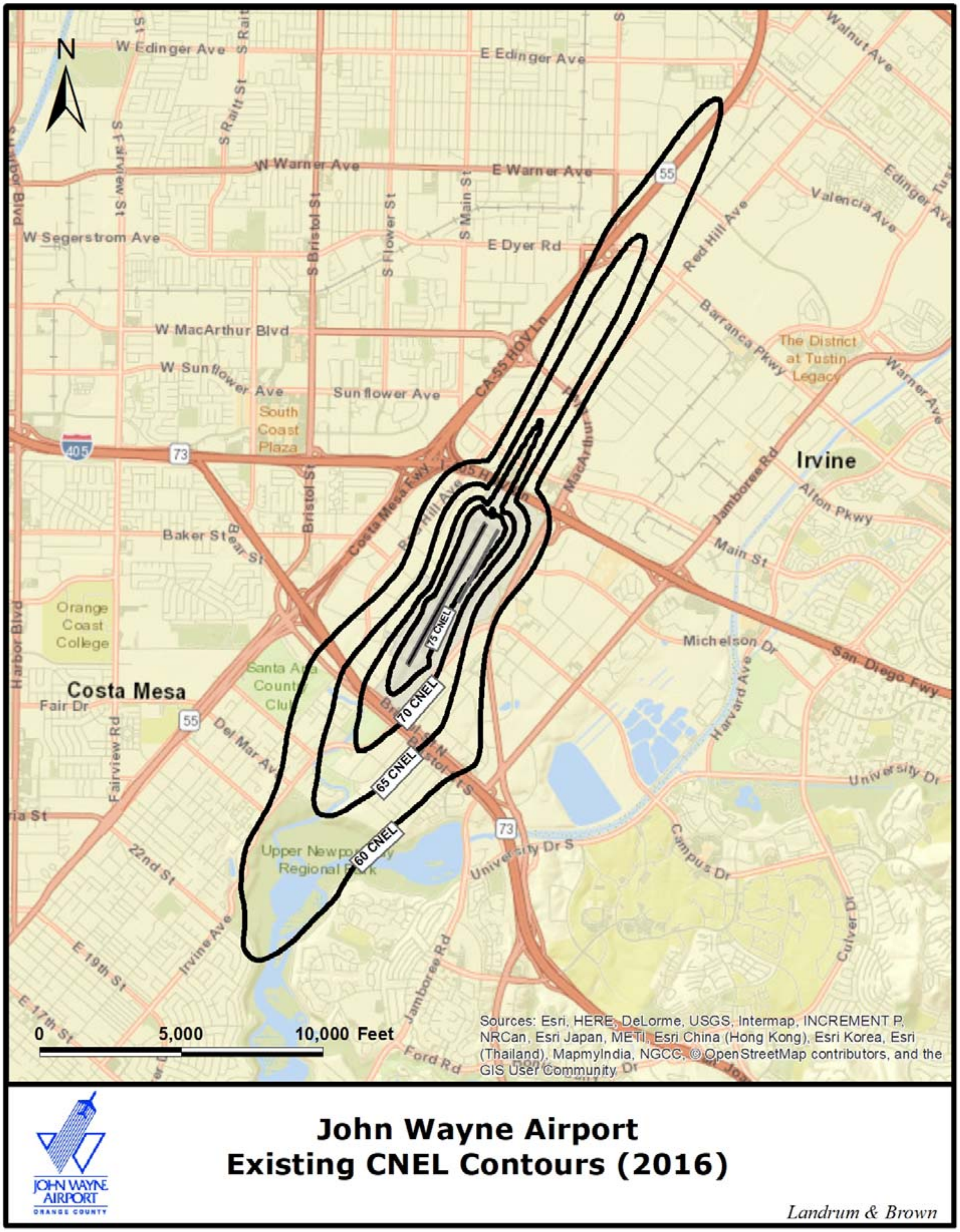
Table 7 Existing (2016) CNEL at Noise Monitoring Stations (NMS)

NMS:	1S	2S	3S	4S	5S	6S	7S	8N	9N	10N
Measured CNEL:	**67.8**	**66.7**	**66.4**	59.6	58.9	59.9	56	**67.7**	43.9	56.4
Modeled CNEL:	**67.8**	**66.7**	**66.5**	59.6	59.0	60.0	56.0	**68.3**	45.6	55.3
Difference:	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.6	1.7	-1.1

Note: Noise monitors within the 65 CNEL are shown in **bold**. The 65 and 70 CNEL contours shall be validated by measurements made by noise monitors and be within a tolerance of plus or minus 1.5 dB CNEL.

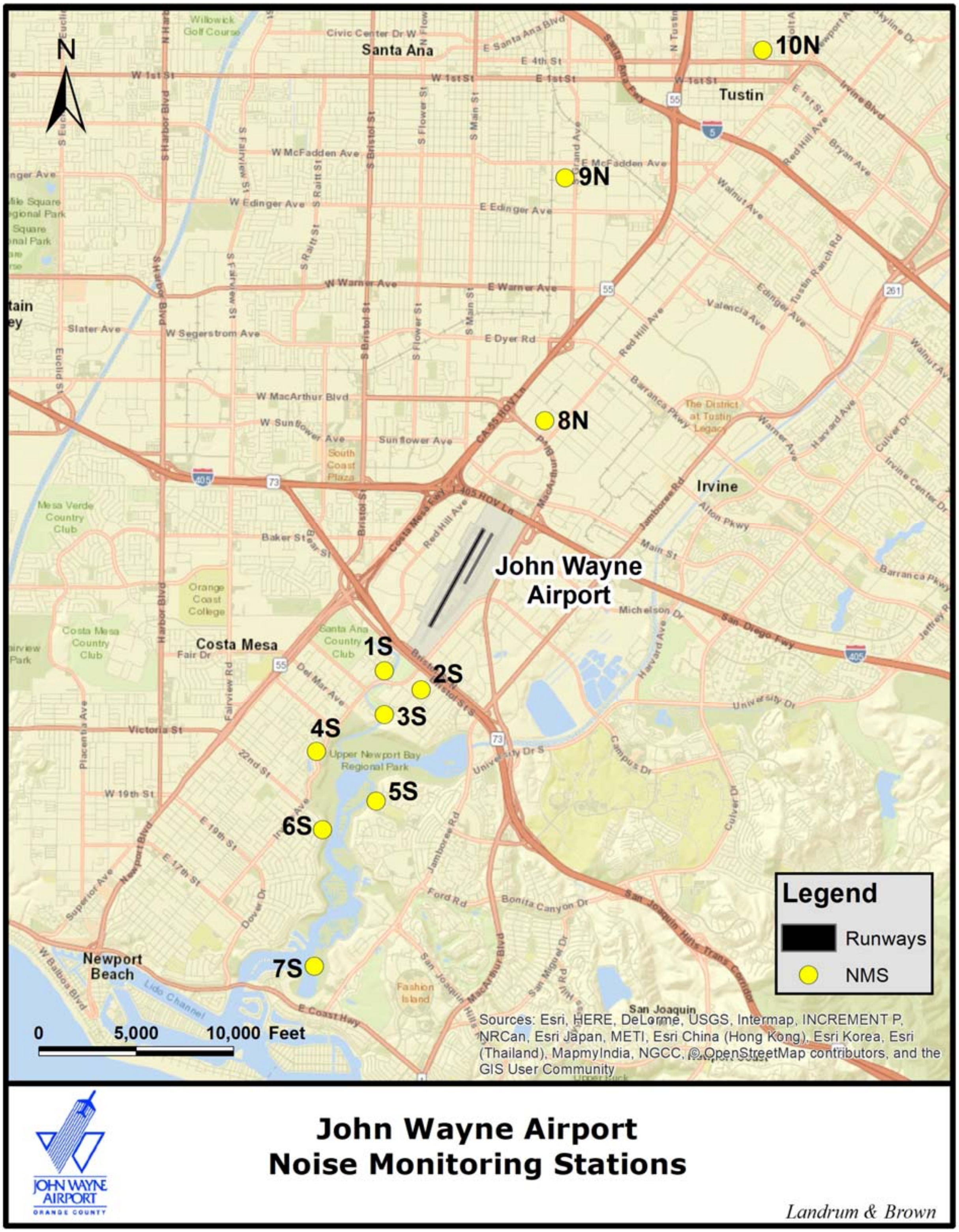
Source: John Wayne Airport Access/GANO Software System Database Data, January 2016-December 2016.

Figure 10 Existing Conditions (2016) CNEL Noise Contours



Source: John Wayne Airport Access/GANO Software System Database Data, January 2016-December 2016; Landrum & Brown, 2017.

Figure 11 Noise Monitoring Stations



Source: John Wayne Airport Access/GANO Software System Database Data; Landrum & Brown, 2017.

5.0 THRESHOLDS OF SIGNIFICANCE

5.1 INTRODUCTION

The significance of noise impacts are determined by the increase in noise due to the project or alternative over existing conditions, and the resulting noise level with the project or alternative. Areas with higher noise exposure levels are more sensitive to noise level increases; therefore, the allowable increase in noise is lower in these areas than in areas with lower noise exposures.

The County of Orange's aircraft noise increase significance thresholds, presented below in Section 5.2, are based on the land use compatibility standards described in the Orange County General Plan Noise Element, as augmented by the thresholds of significance used by the FAA on airport environmental analysis. The FAA significance thresholds are specified in Order 1050.1F, which was discussed previously in Section 2.5.1. It should be noted that the adjacent Cities of Costa Mesa, Irvine, and Tustin have also adopted the County of Orange's significance thresholds.

As discussed above in Section 2.6.2, the City of Newport Beach has established significance thresholds that are more stringent than the County/FAA significance thresholds. The significance of the noise impacts from the Project are assessed based on the County/FAA significance thresholds for purposes of a significance determination. The City of Newport Beach significance thresholds are provided for informational and disclosure purposes only. The City of Newport Beach's significance threshold are presented in Section 5.3.

The primary difference between the County of Orange and City of Newport Beach's significance thresholds is that the County's threshold requires at least a 1.5 dB increase in the CNEL noise level for a significant impact to occur. The City's threshold considers any sensitive use exposed to noise levels of 75 CNEL or greater to be significantly impacted. However, as discussed in Section 6.2.2 there are no sensitive uses in the City of Newport Beach exposed to noise levels greater than 75 CNEL. Below 75 CNEL, the significance threshold requires at least a 1 dB increase in CNEL levels for a significant impact to occur.

Traffic noise impact significance is determined using the same increase thresholds for aircraft presented below in Section 5.2 for the County of Orange and in Section 5.3 for the City of Newport Beach. Traffic noise impact significance thresholds are discussed in detail in Section 6.7.

5.2 COUNTY OF ORANGE AIRCRAFT NOISE LEVEL INCREASE SIGNIFICANCE THRESHOLD

Table 8 summarizes the County's aircraft noise level increase significance threshold. Sensitive receptors with noise exposures exceeding 65 CNEL with the project (or alternative under consideration) will be considered significantly impacted if the noise level with the project increases by 1.5 dB or more over the existing noise exposure. Sensitive receptors with noise exposures between 60 and 65 CNEL will be considered significantly impacted if the noise level with the project is 3.0 dB or more than the existing noise level. Sensitive receptors with noise exposures between 45 and 60 CNEL will be considered significantly impacted if the noise level with the project is 5.0 dB or more than the existing noise level. As mentioned in Section 5.1, the Cities of Costa Mesa, Irvine, and Tustin have adopted the County of Orange's significance thresholds.

Table 8 County CNEL Increase Significance Threshold

Noise Exposure With Project	CNEL Increase Over Existing Conditions
>65 CNEL	1.5 dB or greater
60-65 CNEL	3.0 dB or greater
45-60 CNEL	5.0 dB or greater

5.3 CITY OF NEWPORT BEACH AIRCRAFT NOISE LEVEL INCREASE SIGNIFICANCE THRESHOLD

As previously discussed, the City of Newport Beach has established significance thresholds that are more stringent than the County/FAA significance thresholds. These thresholds are presented in Table 9. The County of Orange is the lead agency for the CEQA approval, therefore; the noise analysis presented in the following sections will evaluate these City thresholds for information and disclosure purposes only.

Table 9 City of Newport Beach CNEL Increase Significance Threshold

Noise Exposure With Project	CNEL Increase Over Existing Conditions
55 CNEL	3 dB or greater
60 CNEL	2 dB or greater
65 CNEL	1 dB or greater
70 CNEL	1 dB or greater
>75 CNEL	Any increase is considered significant

5.4 TRAFFIC NOISE SIGNIFICANCE THRESHOLD

Traffic noise impacts from the project (or alternative under consideration) are assessed by comparing the existing traffic noise levels with noise levels that would occur with the implementation of the project without any other changes (i.e., existing plus project). Sensitive receptors projected to experience existing plus project traffic noise levels and increases over existing traffic noise levels greater than shown in Table 8 will be significantly impacted under the County of Orange significance thresholds. Sensitive receptors exposed to traffic noise level increases greater than shown in Table 9 will be impacted under the City of Newport Beach significance thresholds. The City of Newport Beach significance thresholds are shown for information and disclosure purposes only, as the County of Orange is the lead agency for the CEQA approval. The adjacent Cities of Costa Mesa, Irvine, and Tustin have adopted the County of Orange's significance thresholds.

Cumulative traffic noise impacts will be assessed by comparing the future with project (or alternative under consideration) traffic noise levels with the existing traffic noise levels. The same significance thresholds, as discussed in the previous paragraph, are used to determine if sensitive receptors are cumulatively significantly impacted by the project. If the project's contribution to the overall noise level increase is less than 1 dB (i.e. the minimum perceptible noise level difference) then it will not be considered cumulatively considerable. If the project's contribution to the cumulative increase is less than cumulatively considerable then the project will not result in a significant cumulative noise impact (see CEQA Guidelines Section 15064(h)).

6.0 PROPOSED PROJECT AND PROJECT ALTERNATIVE NOISE IMPACTS

This section analyzes noise impacts from the Proposed Project, Alternative 1, and the CEQA-mandated No Project Alternative. All three alternatives were evaluated for the Existing conditions plus the 2026 general aviation operating conditions as this is the horizon year for the GAIP. Please refer to the project description in Section 3.0 of the main EIR document for a full and complete description of the Proposed Project and Alternative 1.

Section 6.1 presents the assumptions used to model aircraft noise levels. Section 6.2 presents the results of the aircraft modeling at each of the Noise Monitoring Stations operated by the Airport. This information was used to determine the significance of the aircraft noise impacts associated with the project alternatives.

Section 6.3 presents the results of the aircraft noise modeling in graphical form. This section presents noise contours overlaid on aerial mapping. Section 6.4 discusses the land use impacts associated with the project alternatives. The contours are presented and compared along with the number of residences and persons within each contour. Further, the number of schools, places of worship, and hospitals within each contour are presented. Section 6.5 discusses the changes in single event aircraft noise levels associated with the project alternatives. Section 6.6 assesses the short-term noise impacts, i.e., construction noise, associated with the project. Section 6.7 examines potential noise impacts from increased traffic volumes and noise levels along roads in the vicinity of the airport. Section 7.0 discusses the Future (2026) project alternative scenarios. Section 8.0 discusses cumulative noise impacts.

6.1 JOHN WAYNE AIRPORT NOISE MODELING ASSUMPTIONS

The Proposed Project and each of the project alternatives have unique elements as discussed in Section 3.6 of the EIR. Key assumptions used to assess noise include number of operations, types of aircraft, flight tracks and operating procedures. Previously presented sections on Sound Rating Scales and Methodology explain the various metrics and related computer modeling. The computer model used for this analysis was the FAA AEDT version 2d, which was described earlier. The following sections summarize and explain the assumptions used in this analysis.

6.1.1 OPERATIONS, FLEET MIX, RUNWAY USE AND FLIGHT TRACKS

Aircraft operations by type of aircraft, time of day, stage length and runway were used to estimate noise levels. The following paragraphs describe the data used.

Time of Day of Operations

The day, evening, and night distribution for existing operations was presented in Table 6. It was assumed for this analysis, these percentages would not change for any alternative scenarios.

Operations Data Summaries

Table 10 summarizes the total yearly aircraft operations by aircraft type (fleet mix) for the Existing plus No Project, the Existing plus Proposed Project, and Existing plus Alternative 1 scenarios. The commercial operations remained the same as the Existing (2016) conditions for each scenario. The operations and fleet mix for the general aviation operations was developed based on the Orange County/John Wayne Airport (JWA) General Aviation Improvement Program (GAIP) Based Aircraft Parking—Capacity Analysis and General Aviation Constrained Forecasts, November 2017.

Runway Use and Flight Tracks

The flight tracks and runway use developed for the Existing condition (2016) case described in Section 4.1.3 were used for all alternative scenarios. Runway use at JWA is based on aircraft size with commercial aircraft and large jets using Runway 20R and smaller general aviation aircraft using Runway 20L. There is no reason to believe that this will change as it is primarily driven by the relative length of the two runways. Flight tracks into and out of JWA are well established, particularly with the Airport's noise abatement procedures.

Table 10 Existing (2016) + Future (2026) GAIP Alternative Scenario Yearly Aircraft Operations by Aircraft Type

Aircraft type	AEDT Type	Existing + No Project	Existing + Proposed Project	Existing + Alternative 1
LARGE AIRCRAFT				
Airbus 319-131	A319-131191_A	6,260	6,260	6,260
Airbus 320-232	A320-232202_A	2,662	2,662	2,662
Airbus 320-211	A320-211201_A	1,786	1,786	1,786
Airbus 321-232	A321-232212_A	582	582	582
Airbus 300-662R	A300-622RF46_A	560	560	560
Boeing 737-700	737700377_E	26,828	26,828	26,828
Boeing 737-700	737700377_A	24,208	24,208	24,208
Boeing 737-800	737800378_A	17,392	17,392	17,392
Boeing 756-PW	757PW572_A	2,576	2,576	2,576
Large Aircraft Subtotal		***82,854***	***82,854***	***82,854***
REGIONAL JETS				
Bombardier CRJ900	CRJ9-ER9ER_E	3,298	3,298	3,298
Embraer 170	EMB170	5,370	5,370	5,370
Regional Jets Subtotal		***8,668***	***8,668***	***8,668***
BUSINESS JETS				
Twin Engine Regional Jet	CNA55B	5,249	5,537	5,674
Twin Engine Regional Jet	CL600	4,027	4,247	4,353
Twin Engine Regional Jet	CNA525C	3,836	4,046	4,146
Twin Engine Regional Jet	LEAR35	3,623	3,822	3,916
Twin Engine Regional Jet	GIV	3,454	3,644	3,734
Twin Engine Regional Jet	CNA560XL	2,797	2,951	3,024
Twin Engine Regional Jet	CL601	2,345	2,474	2,535
Twin Engine Regional Jet	GV	2,261	2,385	2,444
Twin Engine Regional Jet	CNA750	1,836	1,936	1,984
Twin Engine Regional Jet	CNA560U	1,754	1,850	1,896
Twin Engine Regional Jet	MU3001	1,749	1,845	1,890
Twin Engine Regional Jet	CNA680	1,372	1,447	1,483
Twin Engine Regional Jet	F10062	1,157	1,220	1,251
Twin Engine Regional Jet	CNA510	1,012	1,068	1,094
Twin Engine Regional Jet	CIT3	952	1,004	1,029
Twin Engine Regional Jet	IA1125	592	624	640
Twin Engine Regional Jet	ECLIPSE500	285	301	308
Business Jets Subtotal		***38,300***	***40,400***	***41,400***
TURBO PROPS				
Commuter Prop	DHC6	3,215	3,451	3,186
Commuter Prop	CNA441	3,213	3,449	3,183
Commuter Prop	DO228	400	430	397
Commuter Prop	CNA208	2,786	2,990	2,760
Commuter Prop	DHC830	1,286	1,380	1,274
Turbo Props Subtotal		***10,900***	***11,700***	***10,800***
GENERAL AVIATION PROPS				
GA Prop	GASEPF	30,980	23,393	23,519
GA Prop	CNA172	9,890	7,468	7,509
GA Prop	GASEPV	6,895	5,207	5,235
GA Prop	BEC58P	3,053	2,305	2,318
GA Prop	CNA182	2,281	1,722	1,731
GA Prop	CNA206	1,496	1,130	1,136
GA Prop	PA28	964	728	732
GA Prop	PA31	301	227	229
Touch and Go	GASEPF	91,140	68,820	69,192
General Aviation Props Subtotal		***147,000***	***111,000***	***111,600***
HELICOPTER				
Helicopter	R44	3,719	3,719	3,719
Helicopter	SA350D	1,081	1,081	1,081
Helicopter Subtotal		***4,800***	***4,800***	***4,800***
Commercial Operations Subtotal		**91,522**	**91,522**	**91,522**
General Aviation Operations Subtotal		**201,000**	**167,900**	**168,600**
TOTAL		**292,522**	**259,422**	**260,122**

Note: Commercial Operations remain constant in each scenario. Commercial operations include the Large and Regional Jet categories.

Source: Orange County/John Wayne Airport (JWA) General Aviation Improvement Program (GAIP) Based Aircraft Parking—Capacity Analysis and General Aviation Constrained Forecasts November 2017; Landrum & Brown, 2018.

6.2 CNEL AT NOISE MONITORING STATIONS

In addition to the CNEL contours, specific CNEL values are calculated for each Noise Monitoring Station (NMS) shown on Figure 11. Table 11 presents CNEL values at each NMS for Existing (2016) conditions, and all of the alternative scenarios. NMS with noise levels equal to or above 65 CNEL are shown in bold type. Only the close-in NMS 1S, 2S, 3S located in the Santa Ana Heights community in the City of Newport Beach and NMS 8N located in the City of Irvine show noise levels above 65 CNEL for any case. Note that NMS 8N is located in a commercial area with no nearby residences.

Table 12 presents the change in noise level in terms of CNEL relative to existing year 2016 conditions. NMSs that are located in areas with noise levels above 65 CNEL are bolded. Note that the AEDT computes the noise level to hundredths of a decibel, but that the overall absolute accuracy of the model is more in the range of plus or minus 1.5 to 2 dB.

6.2.1 COUNTY OF ORANGE SIGNIFICANCE THRESHOLDS

Table 12 shows that the Existing plus No Project, Existing plus Proposed Project and Existing plus Alternative 1 will not result in a significant noise impact at any NMS using the County of Orange's significance thresholds. These same thresholds apply for the Cities of Costa Mesa, Irvine, and Tustin as they have adopted the same significance thresholds as the County of Orange.

6.2.2 CITY OF NEWPORT BEACH SIGNIFICANCE THRESHOLDS

As discussed in Section 2.6.2, the City of Newport Beach has adopted significance thresholds for noise impacts in its Noise Element. Under the City's thresholds, any increase in any area exposed to noise levels in excess of 75 CNEL is significant independent of the increase. However, there are no noise sensitive uses in the City exposed to this level of noise.

When the resulting noise level is between 65 and 75 CNEL, a 1 dB increase results in a significant impact. Tables 11 and 12 show that this threshold will not be exceeded.

When the resulting noise level is between 60 and 65 CNEL, a 2 dB increase results in a significant impact. Tables 11 and 12 show that this threshold will not be exceeded.

When the resulting noise level is between 55 and 60 CNEL, a 3 dB increase results in a significant impact. There were no NMS exposed to noise levels between 55 and 60 CNEL that are projected to experience a 3 dB or greater increase.

Table 11 Existing (2016) + Future (2026) GAIP Alternative Scenario Modeled CNEL Levels at NMS

NMS[1]	EXISTING (2016)	EXISTING + NO PROJECT	EXISTING + PROPOSED PROJECT	EXISTING + ALTERNATIVE 1
1S	**67.77**	**67.85**	**67.86**	**67.87**
2S	**66.66**	**66.74**	**66.73**	**66.74**
3S	**66.46**	**66.60**	**66.61**	**66.63**
4S	59.62	59.72	59.73	59.74
5S	58.95	59.05	59.06	59.07
6S	59.95	60.10	60.11	60.13
7S	56.00	56.04	56.04	56.04
8N	**68.31**	**68.36**	**68.37**	**68.37**
9N	45.59	45.65	45.64	45.63
10N	55.27	55.32	55.32	55.31

1. NMS 1S, 2S, and 3S are located in the Santa Ana Heights Community of the City of Newport Beach; NMS 4S, 5S, 6S and 7S are located in the City of Newport Beach, NMS 8N is located in the City of Irvine, NMS 9N is located in the City of Santa Ana; and NMS 10N is located in the City of Tustin.

Table 12 Change in Noise Level Over Existing Conditions

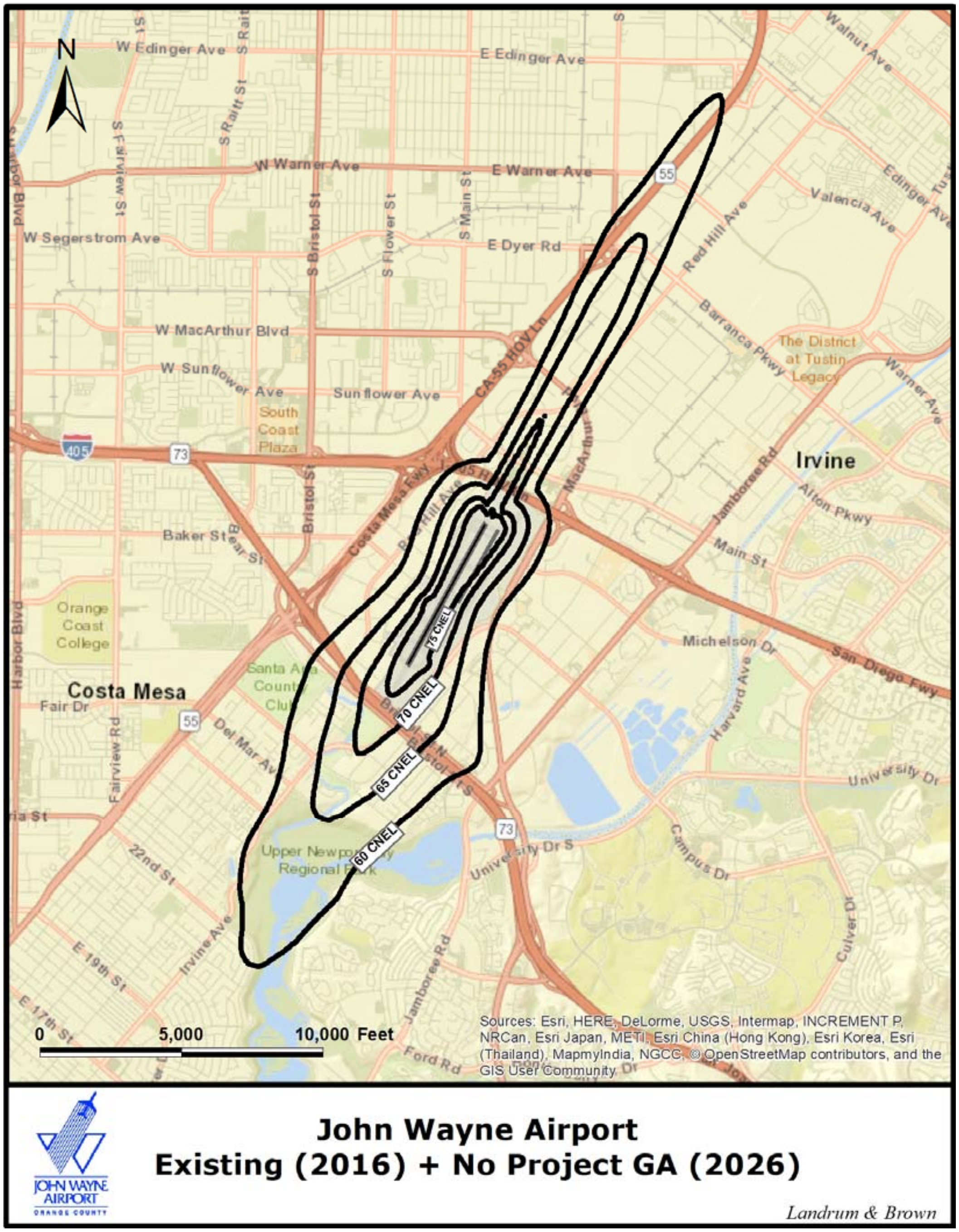
NMS[1]	EXISTING (2016)	EXISTING + NO PROJECT	EXISTING + PROPOSED PROJECT	EXISTING + ALTERNATIVE 1
1S	**-**	**0.08**	**0.09**	**0.10**
2S	**-**	**0.08**	**0.07**	**0.08**
3S	**-**	**0.14**	**0.15**	**0.17**
4S	-	0.10	0.11	0.12
5S	-	0.10	0.11	0.12
6S	-	0.15	0.16	0.18
7S	-	0.04	0.04	0.04
8N	**-**	**0.05**	**0.06**	**0.06**
9N	-	0.06	0.05	0.04
10N	-	0.05	0.05	0.04

Note: Noise monitors within the 65 CNEL are shown in **bold**. The change in noise level does not increase at a level greater than the significance threshold at any NMS.

6.3 ALTERNATIVE SCENARIO CNEL CONTOURS

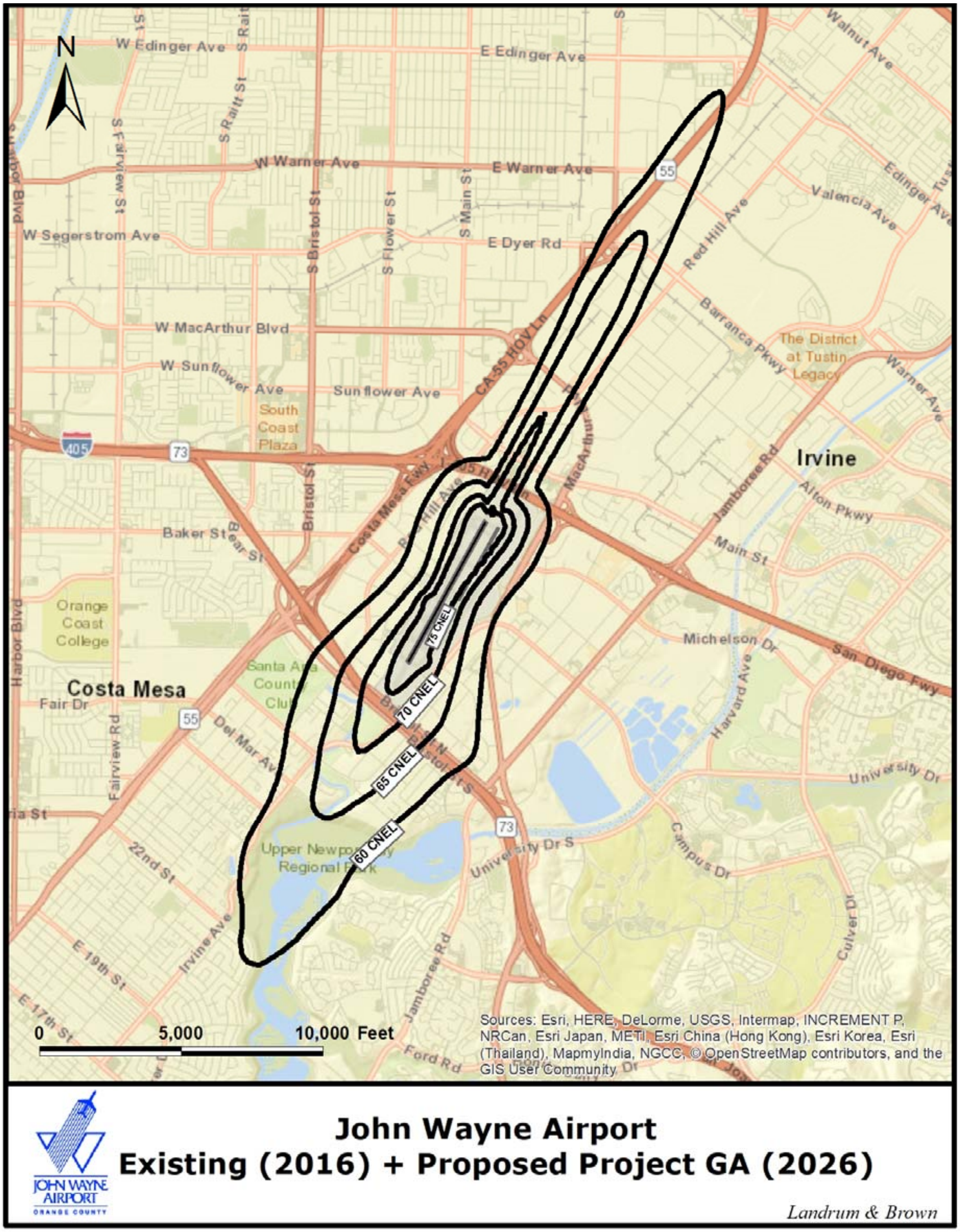
Figures 12, 13 and 14 show the CNEL contours for JWA for the Existing plus No Project, Existing plus Proposed Project, and Existing plus Alternative 1 scenarios, respectively. None of the contours exceed the County of Orange or City of Newport Beach significance thresholds.

Figure 12 CNEL Contours - Existing (2016) + No Project GA (2026)



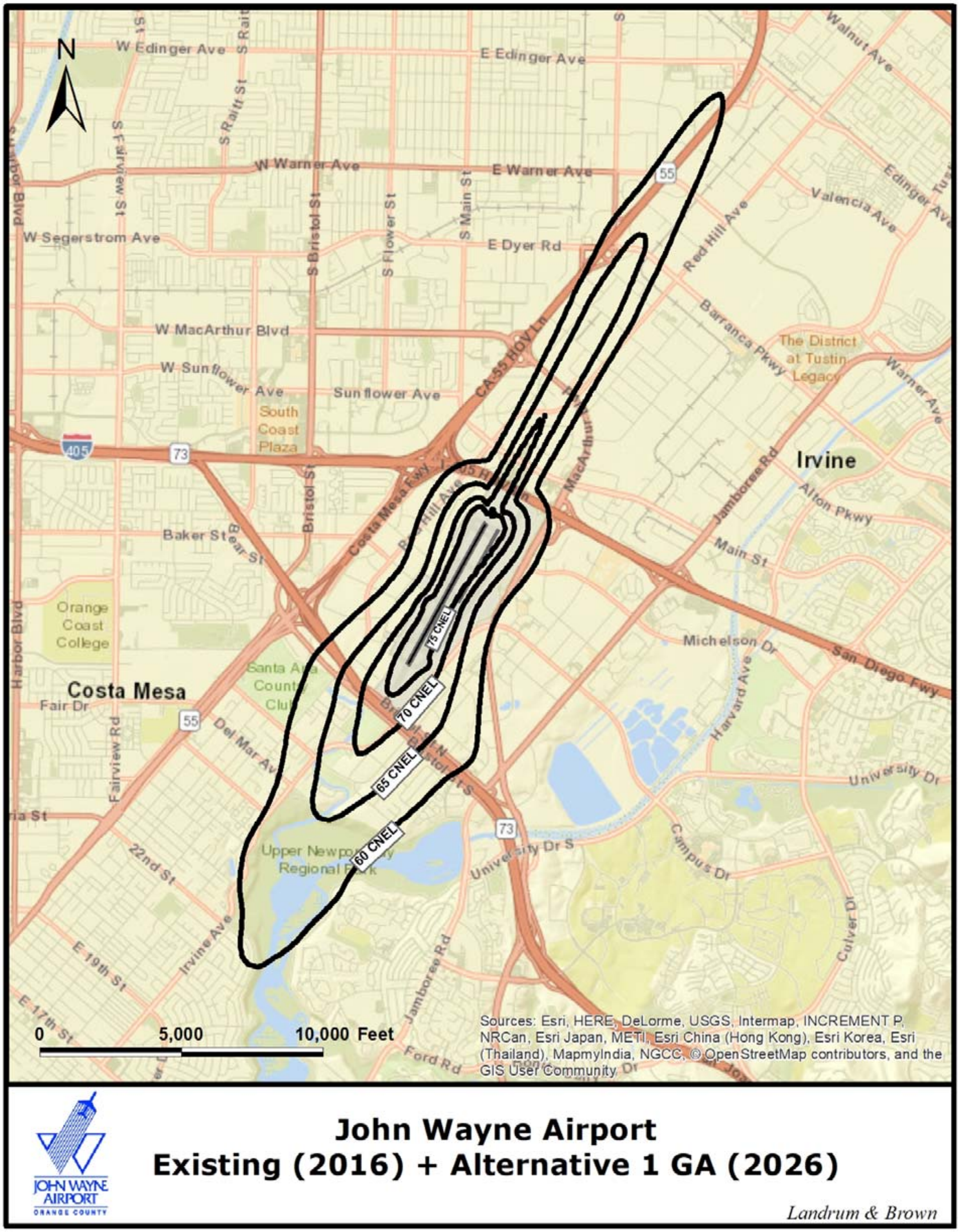
Source: Orange County/John Wayne Airport (JWA) General Aviation Improvement Program (GAIP) Based Aircraft Parking—Capacity Analysis and General Aviation Constrained Forecasts November 2017; Landrum & Brown, 2018.

Figure 13 CNEL Contours – Existing (2016) + Proposed Project GA (2026)



Source: Orange County/John Wayne Airport (JWA) General Aviation Improvement Program (GAIP) Based Aircraft Parking—Capacity Analysis and General Aviation Constrained Forecasts November 2017; Landrum & Brown, 2018.

Figure 14 CNEL Contours – Existing (2016) + Alternative 1 GA (2026)



Source: Orange County/John Wayne Airport (JWA) General Aviation Improvement Program (GAIP) Based Aircraft Parking—Capacity Analysis and General Aviation Constrained Forecasts November 2017; Landrum & Brown, 2018.

6.4 CNEL LAND USE IMPACTS

Table 13 provides a comparison of the land uses located within the CNEL contours for the existing year 2016 conditions, Existing plus No Project, Existing plus Proposed Project, and Existing plus Alternative 1. Table 13 shows that the contour bands between 60 and 65 CNEL, 65 and 70 CNEL, and greater than 70 CNEL. For each contour band, the area in square miles are shown as well as the number of schools, hospitals, places of worship, dwellings, and population. The total number of dwelling units within each contour band is shown along with the number of dwelling units located in and outside of the Santa Ana Heights Acoustical Insulation Program (AIP) boundary implemented as mitigation for the 1985 Master Plan EIR.

Table 13 Land Uses Within CNEL Contours

CNEL	Existing	Existing + No Project	Existing + Proposed Project	Existing + Alternative 1
Total Contour Area (sq. mi.)				
60-65	3.36	3.41	3.39	3.39
65-70	1.49	1.51	1.50	1.50
>70	0.91	0.93	0.92	0.92
Number of Schools				
60-65	6	6	6	6
65-70	0	0	0	0
>70	0	0	0	0
Number of Hospitals				
60-65	0	0	0	0
65-70	0	0	0	0
>70	0	0	0	0
Number of Places of Worship				
60-65	5	5	5	5
65-70	3	3	3	3
>70	1	1	1	1
Total Population				
60-65	2,772	2,852	2,847	2,846
65-70	401	504	504	507
>70	0	0	0	0
Total Number of Dwelling Units				
60-65	1,365	1,392	1,389	1,388
65-70	247	257	257	259
>70	0	0	0	0
Total Number of Dwelling Units In the Santa Ana Heights Acoustical Insulation Program (AIP) Boundary				
60-65	425	408	408	407
65-70	247	257	257	259
>70	0	0	0	0
Total Number of Dwelling Units Outside of the Santa Ana Heights Acoustical Insulation Program (AIP) Boundary				
60-65	940	983	981	981
65-70	0	0	0	0
>70	0	0	0	0

Source: US Census population data, 2016; John Wayne Airport AIP; Landrum & Brown, 2018.

6.4.1 CHANGE OVER EXISTING CONDITIONS

Existing plus No Project

The CNEL noise contours in the Existing plus No Project remain approximately the same size and shape as the Existing noise contours. The change in general aviation operations from the GAIP has a negligible impact on the CNEL noise contours in the Existing plus No Project alternative. In this scenario, as shown in Table 14, the total contour areas between 60 and 65 CNEL will increase by 0.05 square miles (1.5 percent) and the area between 65 and 70 CNEL will increase by 0.02 square miles (0.7 percent) when compared to the Existing noise contours. The area exceeding 70

CNEL will increase by 0.02 square miles (0.7 percent) over Existing conditions. The total number of residences exposed to noise levels between 60 and 65 CNEL will increase by 27 dwelling units (2.0 percent) and the number of dwelling units exposed to noise levels between 65 and 70 CNEL will increase by ten (4.0 percent), and no additional dwelling units will be exposed to 70+ CNEL. Under the Existing plus No Project scenario, no additional schools will be exposed to a noise level between 60 and 65 CNEL.

Existing plus Proposed Project

The CNEL noise contours in the Existing plus Proposed Project remain approximately the same size and shape as the Existing noise contours. The change in general aviation operations from the GAIP has a negligible impact on the CNEL noise contours in the Existing plus Proposed Project scenario. In this scenario, the total contour areas between 60 and 65 CNEL will increase by 0.03 square miles (0.9 percent) and the area between 65 and 70 CNEL will increase by 0.01 square miles (0.6 percent) when compared to the Existing noise contours. The area exceeding 70 CNEL will increase by 0.01 square miles (0.7 percent) over Existing conditions. The total number of residences exposed to noise levels between 60 and 65 CNEL will increase by 24 dwelling units (1.8 percent); the number of residences exposed to noise levels between 65 and 70 CNEL will increase by ten (4.0 percent); and no additional dwelling units will be exposed to 70+ CNEL. Under the Existing plus Proposed Project scenario, no additional schools will be exposed to a noise level between 60 and 65 CNEL.

Existing plus Alternative 1

The CNEL noise contours in the Existing plus Alternative 1 remain approximately the same size and shape as the Existing noise contours. The change in general aviation operations from the GAIP has a negligible impact on the CNEL noise contours in the Existing plus Alternative 1 scenario. In this scenario, the total contour areas between 60 and 65 CNEL will increase by 0.03 square miles (0.9 percent) and the area between 65 and 70 CNEL will increase by 0.01 square miles (0.6 percent) when compared to the Existing noise contours. The area exceeding 70 CNEL will increase by 0.01 square miles (0.7 percent) over Existing conditions. The total number of residences exposed to noise levels between 60 and 65 CNEL will increase by 23 dwelling units (1.7 percent); the number of dwelling units exposed to noise levels between 65 and 70 CNEL will increase by 12 (4.9 percent); and no additional dwelling units will be exposed to 70+ CNEL. Under the Existing plus Alternative 1 scenario, no additional schools will be exposed to a noise level between 60 and 65 CNEL.

Table 14 Change Over Existing Conditions

CNEL	Existing	Existing + No Project	Existing + Proposed Project	Existing + Alternative 1
Total Contour Area (sq. mi.)				
60-65	-	0.05	0.03	0.03
65-70	-	0.02	0.01	0.01
>70	-	0.02	0.01	0.01
Number of Schools				
60-65	-	0	0	0
65-70	-	0	0	0
>70	-	0	0	0
Number of Hospitals				
60-65	-	0	0	0
65-70	-	0	0	0
>70	-	0	0	0
Number of Places of Worship				
60-65	-	0	0	0
65-70	-	0	0	0
>70	-	0	0	0
Total Population				
60-65	-	80	75	74
65-70	-	103	103	106
>70	-	0	0	0
Total Number of Dwelling Units				
60-65	-	27	24	23
65-70	-	10	10	12
>70	-	0	0	0
Total Number of Dwelling Units In the Santa Ana Heights Acoustical Insulation Program (AIP) Boundary				
60-65	-	(17)	(17)	(18)
65-70	-	10	10	12
>70	-	0	0	0
Total Number of Dwelling Units Outside the Santa Ana Heights Acoustical Insulation Program (AIP) Boundary				
60-65	-	43	41	41
65-70	-	0	0	0
>70	-	0	0	0

Source: US Census population data, 2016; John Wayne Airport AIP; Landrum & Brown, 2018.

6.4.2 ALTERNATIVE COMPARISON

The differences in land use impacts between the Existing, Existing plus No Project, Existing plus Proposed Project, and Existing plus Alternative 1 scenarios are negligible. Under all alternatives the area exposed between 65 and 70 CNEL would increase approximately by less than one percent, the population with the 65 and 70 CNEL would increase approximately 4 to 5 percent, and zero schools would be within the 65 and 70 CNEL. As previously stated, the change in general aviation operations from the GAIP has a negligible impact on the CNEL noise contours in any of the Alternative scenarios.

6.5 CHANGE IN SINGLE EVENT NOISE LEVELS

Single event noise levels represent the noise generated by a single aircraft overflight. Specifically, it is a measure of the total noise energy from an overflight at a specific location. For aircraft noise, SENEL levels are typically about 10 dB higher than the maximum (Lmax) noise levels. The Lmax represents the maximum instantaneous noise energy at a specific location.

Single event noise levels can be used for specific estimates of potential speech interference or sleep disturbance. Speech interference is one of the primary complaints from residents in the most impacted area, Santa Ana Heights. Further, speech interference is the primary cause of noise impacts to schools as aircraft flights can interrupt teacher-student communication and disrupt the learning environment. This is discussed further at the end of Section 2.4.3 under the heading School Room Effects.

It should be noted that CNEL levels are dependent on the single event noise levels and the number of operations during the daytime, evening, and nighttime periods. Further, the CNEL noise level criterion, 65 CNEL outdoors and 45 CNEL indoors for most noise sensitive uses, was selected based on speech interference. The 10 dB nighttime noise penalty, used by the CNEL metric, accounts for sleep disturbance as well.

The aircraft expected to use JWA in the future are the same that currently use the Airport. The only exception will be the addition of the Boeing 737-MAX and Airbus A320-NEO in the future. The SENEL contours of the aircraft in the existing and future fleet are shown in Attachment 1. As shown, the Boeing 737-MAX and Airbus A320-NEO SENEL contours are smaller (quieter) on departures and similar on arrival when compared the Boeing 737-700 and the Airbus A320, respectively.

6.6 SHORT TERM CONSTRUCTION NOISE IMPACTS

The nearest sensitive land use to the project construction is a new multi-story residential building on the south corner of Baker Street and the 55 Freeway. These residences are located about 1,760 feet from the nearest section of the construction zone. There are existing commercial buildings located between the Airport and the residential buildings which provide mitigation to the construction noise. Based on this distance and the height of the intervening buildings, the worst-case mitigated peak (Lmax) construction noise levels would be in the 44 to 59 dBA range at those residences on the east side of the 55 Freeway for very short periods. The average noise levels are typically 5 to 15 dB lower than the peak noise levels. Average noise levels (Leq) at the nearby residences could be in the range of 34 to 49 dBA. These noise levels are below the nighttime noise ordinance level (50 dBA) for the City of Costa Mesa, and the resultant noise levels are lower than existing ambient conditions in this area, which are about 65 dB CNEL. Therefore, noise from construction activities at the project site for the Proposed Project and any of the Alternative scenarios will not impact the noise sensitive land uses nearest to the project site.

6.7 TRAFFIC NOISE IMPACTS

Changes in traffic patterns caused by the Proposed Project and its alternatives will result in a slight increase in traffic noise levels along the roadways on the west side of the project site, and a slight decrease in traffic noise levels on the east side of the project site. Changes in CNEL traffic noise levels along roadways in the vicinity of JWA were calculated using the methodology described in Section 3.20 and traffic volumes provided by the traffic engineer for the Project, Austin Transportation Consulting. Two tables showing the results of these calculations are presented in Attachment 2. The first table shows the traffic noise level increases in dB CNEL on each of the roadway segments affected by the project for the Proposed Project scenario, and the second table shows the traffic noise level increases for the Alternative 1 scenario. In each table, the first column lists the roadway and segment analyzed. The second column of the table lists the Existing average daily traffic (ADT) volume for the roadway segment. The third column lists the ADT due to either the Proposed Project scenario or the Alternative 1 scenario. The fourth column lists either the Existing plus Proposed Project ADT volume or the Existing plus Alternative 1 ADT. The fifth column lists the increase in noise level due to the Proposed Project or due to Alternative 1. The values listed in this column are due to the difference between the Existing traffic volumes and either the Existing plus Proposed Project traffic volumes or Existing plus Alternative 1. The noise increase is due solely to the project and represents the greatest increase that can be attributable to the project scenario. Although the traffic increase will occur over time, the courts have determined that examination of the Existing plus Proposed Project scenario or Existing plus Alternative 1 scenario represents the worst-case impact generated solely by the project.

6.7.1 COUNTY OF ORANGE SIGNIFICANCE THRESHOLDS

The tables in Attachment 2 show that there are no roadways with existing adjacent noise sensitive uses that are projected to experience a traffic noise level increase greater than 0.5 dB. Therefore, neither the Proposed Project scenario nor the Alternative 1 scenario would result in a significant direct or cumulative traffic noise impact.

6.7.2 CITY OF COSTA MESA SIGNIFICANCE THRESHOLDS

The City of Costa Mesa has not established a specific traffic noise level increase significance threshold. A review of recent environmental documents from the City's website showed that an increase of 3 dB or greater is typically applied to determine the significance of traffic noise increases. The increase is less than the City of Costa Mesa's 3 dB threshold as well as the County's more stringent 1.5 dB threshold.

In the case of noise exposure greater than 75 dBA CNEL, the impact is considered significant if there is any increase in noise level (i.e., 0.1 dB or greater). However, there are no roadways in the project area that are adjacent to noise sensitive uses with traffic volumes that could generate a noise level approaching 75 dBA in a private yard area where the noise standards are applicable. Therefore, traffic noise levels will not exceed 75 CNEL at any sensitive uses and there are no significant impacts based on this criterion.

In summary, there are no road segments located within the City of Costa Mesa that are projected to experience increases in traffic noise levels greater than 0.5 dB or noise levels greater than 75 dBA CNEL in a private yard area. Therefore, neither the Proposed Project nor Alternative 1 would result in a significant direct or cumulative traffic noise impact based on the City of Costa Mesa's thresholds.

6.7.3 CITY OF NEWPORT BEACH SIGNIFICANCE THRESHOLDS

There are no road segments located within the City of Newport Beach that are projected to experience an increase in traffic noise level due either to the Proposed Project or to Alternative 1. Therefore, neither the Proposed Project nor Alternative 1 would result in a significant direct or cumulative traffic noise impact based on the City of Newport Beach thresholds.

7.0 FUTURE (2026) PROJECT ALTERNATIVE SCENARIOS

The year 2026 is the expected year of full build out for the GAIP. Section 6.0 analyzed the impacts of the GAIP program compared to the existing conditions. The only change in the Future (2026) project alternative scenarios from the scenarios presented in Section 6.0 is the increase in the commercial operations.

7.1 MODELING ASSUMPTIONS

Key assumptions used to assess noise include number of operations, types of aircraft, flight tracks and operating procedures. Previously presented sections on Sound Rating Scales and Methodology explain the various metrics and related computer modeling. The computer model used for this analysis was the FAA AEDT version 2d, which was described earlier. The following sections summarize and explain the assumptions used in this analysis.

7.1.1 OPERATIONS, FLEET MIX, RUNWAY USE AND FLIGHT TRACKS

Aircraft operations by type of aircraft, time of day, stage length and runway were used to estimate noise levels. The following paragraphs describe the operations data used.

Time of Day of Operations

The day, evening, and night distribution for existing operations was presented in Table 6. It was assumed for this analysis that these percentages would not change for any future scenarios. This is consistent with noise modeling assumptions used in the modeling for the 2014 Settlement Agreement Amendment, EIR No. 617 Proposed Project Phase 3.

Operations Data Summaries

Table 15 summarizes the total yearly aircraft operations by aircraft type (fleet mix) for the No Project, the Proposed Project, and Alternative 1 scenarios. The annual number of commercial operations from the 2014 Settlement Agreement Amendment, EIR No. 617 Proposed Project Phase 3 alternative scenario was used to calculate the number of commercial operations for the year 2026. Note that this noise analysis does take into account the Boeing 737-MAX and Airbus A320-NEO families increasing in operation at JWA. The forecasted increase at JWA is based on the current aircraft orders reported by Boeing[1] and Airbus[2] in the U.S. These aircraft families include substantial noise reduction features and are beginning to operate at JWA now. The AEDT version 2d includes the Boeing 737-MAX aircraft in the model however, the A320-NEO is not currently included in the model. Therefore, measured data at the NMS for the NEO was used to create a new aircraft type in the AEDT that reflects the

[1] http://www.boeing.com/commercial/#/orders-deliveries, Accessed April 27, 2018
[2] http://www.airbus.com/aircraft/market/orders-deliveries.html, Accessed April 27, 2018

operating characteristics of the NEO. The operations and fleet mix for the general aviation operations was developed based on the *Orange County/John Wayne Airport (JWA) General Aviation Improvement Program (GAIP) Based Aircraft Parking—Capacity Analysis and General Aviation Constrained Forecasts.*

Runway Use and Flight Tracks

The flight tracks and runway use developed for the Existing condition (2016) case described in Section 4.1.3 were used for all future scenarios. Runway use at JWA is based on aircraft size with commercial aircraft and large jets using Runway 20R and smaller general aviation aircraft using Runway 20L. There is no reason to believe that this will change as it is primarily driven by the relative length of the two runways. Existing flight tracks were assumed to remain the same for the Future (2026) noise modeling as any changes that could be made in the future would be speculative.

Table 15 Future (2026) Yearly Aircraft Operations by Aircraft Type

Aircraft type	AEDT Type	No Project	Proposed Project	Alternative 1
LARGE AIRCRAFT				
Airbus 319-131	A319-131191_A	12,833	12,833	12,833
Airbus 320-232	A320-232202_A	2,869	2,869	2,869
Airbus 320-211	A320-211201_A	4,303	4,303	4,303
Airbus 320-211	A320-232NEO_A	5,194	5,194	5,194
Airbus 321-232	A321-232212_A	1,022	1,022	1,022
Airbus 300-662R	A300-622RF46_A	1,621	1,621	1,621
Boeing 737-700	737700377_E	26,849	26,849	26,849
Boeing 737-700	7377MAX_E	17,900	17,900	17,900
Boeing 737-700	737700377_A	12,947	12,947	12,947
Boeing 737-700	737700MAX_A	8,632	8,632	8,632
Boeing 737-800	737800378_A	8,896	8,896	8,896
Boeing 737-800	737800MAX_A	5,931	5,931	5,931
Boeing 756-PW	757PW572_A	5,103	5,103	5,103
Large Aircraft Subtotal		***114,100***	***114,100***	***114,100***
REGIONAL JETS				
Bombardier CRJ900	CRJ9-ER9ER_E	8,394	8,394	8,394
Regional Jets Subtotal		***8,394***	***8,394***	***8,394***
BUSINESS JETS				
Twin Engine Regional Jet	CNA55B	5,249	5,537	5,674
Twin Engine Regional Jet	CL600	4,027	4,247	4,353
Twin Engine Regional Jet	CNA525C	3,836	4,046	4,146
Twin Engine Regional Jet	LEAR35	3,623	3,822	3,916
Twin Engine Regional Jet	GIV	3,454	3,644	3,734
Twin Engine Regional Jet	CNA560XL	2,797	2,951	3,024
Twin Engine Regional Jet	CL601	2,345	2,474	2,535
Twin Engine Regional Jet	GV	2,261	2,385	2,444
Twin Engine Regional Jet	CNA750	1,836	1,936	1,984
Twin Engine Regional Jet	CNA560U	1,754	1,850	1,896
Twin Engine Regional Jet	MU3001	1,749	1,845	1,890
Twin Engine Regional Jet	CNA680	1,372	1,447	1,483
Twin Engine Regional Jet	F10062	1,157	1,220	1,251
Twin Engine Regional Jet	CNA510	1,012	1,068	1,094
Twin Engine Regional Jet	CIT3	952	1,004	1,029
Twin Engine Regional Jet	IA1125	592	624	640
Twin Engine Regional Jet	ECLIPSE500	285	301	308
Business Jets Subtotal		***38,300***	***40,400***	***41,400***
TURBO PROPS				
Commuter Prop	DHC6	3,215	3,451	3,186
Commuter Prop	CNA441	3,213	3,449	3,183
Commuter Prop	DO228	400	430	397
Commuter Prop	CNA208	2,786	2,990	2,760
Commuter Prop	DHC830	1,286	1,380	1,274
Turbo Props Subtotal		***10,900***	***11,700***	***10,800***
GENERAL AVIATION PROPS				
GA Prop	GASEPF	30,980	23,393	23,519
GA Prop	CNA172	9,890	7,468	7,509
GA Prop	GASEPV	6,895	5,207	5,235
GA Prop	BEC58P	3,053	2,305	2,318
GA Prop	CNA182	2,281	1,722	1,731
GA Prop	CNA206	1,496	1,130	1,136
GA Prop	PA28	964	728	732
GA Prop	PA31	301	227	229
Touch and Go	GASEPF	91,140	68,820	69,192
General Aviation Props Subtotal		***147,000***	***111,000***	***111,600***
HELICOPTER				
Helicopter	R44	3,719	3,719	3,719
Helicopter	SA350D	1,081	1,081	1,081
Helicopter Subtotal		***4,800***	***4,800***	***4,800***
Commercial Operations Subtotal		**122,494**	**122,494**	**122,494**
General Aviation Operations Subtotal		**201,000**	**167,900**	**168,600**
TOTAL		**323,494**	**290,394**	**291,094**

Note: Commercial Operations remain constant in each scenario as dictated by the 2014 JWA Settlement Agreement Amendment, EIR No.617. Commercial operations include the Large and Regional Jet categories.

Source: 2013 John Wayne Airport Settlement Agreement Amendment No. EIR 617; Orange County/John Wayne Airport (JWA) General Aviation Improvement Program (GAIP) Based Aircraft Parking—Capacity Analysis and General Aviation Constrained Forecasts November 2017 Landrum & Brown, 2018.

7.2 CNEL AT NOISE MONITORING STATIONS

In addition to the CNEL contours, specific CNEL values are calculated for each Noise Monitoring Station (NMS) shown on Figure 11. Table 16 presents CNEL values at each of the NMS for Existing (2016) conditions, and all of the future (2026) scenarios. NMS with noise levels equal to or above 65 CNEL are shown in bold type. Only the close-in NMS 1S, 2S, 3S located in the Santa Ana Heights community in the City of Newport Beach and NMS 8N located in the City of Irvine show noise levels above 65 CNEL for any case. Note that NMS 8N is located in a commercial area with no nearby residences. Tables 16 and 17 present the change in noise level in terms of CNEL relative to existing year 2016 conditions. NMSs that are located in areas with noise levels above 65 CNEL are bolded.

Table 16 Modeled CNEL Levels at NMS For Future (2026) Alternatives

NMS[1]	EXISTING (2016)	FUTURE (2026) NO PROJECT	FUTURE (2026) PROPOSED PROJECT	FUTURE (2026) ALTERNATIVE 1
1S	**67.77**	**67.60**	**67.61**	**67.63**
2S	**66.66**	**66.72**	**66.73**	**66.75**
3S	**66.46**	**66.90**	**66.95**	**66.98**
4S	59.62	59.68	59.70	59.72
5S	58.95	59.56	59.59	59.61
6S	59.95	60.81	60.86	60.88
7S	56.00	57.06	57.10	57.12
8N	**68.31**	**69.18**	**69.20**	**69.20**
9N	45.59	48.08	48.08	48.07
10N	55.27	57.54	57.54	57.53

1. NMS 1S, 2S, and 3S are located in the Santa Ana Heights Community of the City of Newport Beach; NMS 4S, 5S, 6S and 7S are located in the City of Newport Beach, NMS 8N is located in the City of Irvine, NMS 9N is located in the City of Santa Ana; and NMS 10N is located in the City of Tustin.

Table 17 Change in Noise Level Over Existing Conditions

NMS[1]	EXISTING (2016)	FUTURE (2026) NO PROJECT	FUTURE (2026) PROPOSED PROJECT	FUTURE (2026) ALTERNATIVE 1
1S	**-**	**-0.17**	**-0.16**	**-0.14**
2S	**-**	**0.06**	**0.07**	**0.09**
3S	**-**	**0.44**	**0.49**	**0.52**
4S	-	0.06	0.08	0.10
5S	-	0.61	0.64	0.66
6S	-	0.86	0.91	0.93
7S	-	1.06	1.10	1.12
8N	**-**	**0.87**	**0.89**	**0.89**
9N	-	2.49	2.49	2.48
10N	-	2.27	2.27	2.26

Note: Noise monitors within the 65 CNEL are shown in **bold**. The change in noise level does not increase at a level greater than the significance threshold at any NMS.

7.2.1 COUNTY OF ORANGE SIGNIFICANCE THRESHOLDS

Table 16 shows that the Future (2026) No Project alternative, Future (2026) Proposed Project and Future (2026) Alternative 1 are not projected to result in a significant noise impact at any NMS. The noise contours are dominated by the commercial aircraft. The increase in size of the noise contours from 2016 to 2026 is mainly due to the increase in commercial aircraft.

7.2.2 CITY OF NEWPORT BEACH SIGNIFICANCE THRESHOLDS

As discussed in Section 5.3, the County of Orange is the lead agency for the CEQA approval therefore; the noise analysis presents the Newport Beach thresholds for disclosure and information purposes only.

Under the City's thresholds, any increase in any area exposed to noise levels in excess of 75 CNEL is significant independent of the increase. However, there are no noise sensitive uses in the City exposed to this level of noise.

When the resulting noise level is between 65 and 75 CNEL, a 1 dB increase results in a significant impact. Tables 16 and 17 show this threshold will not be exceeded.

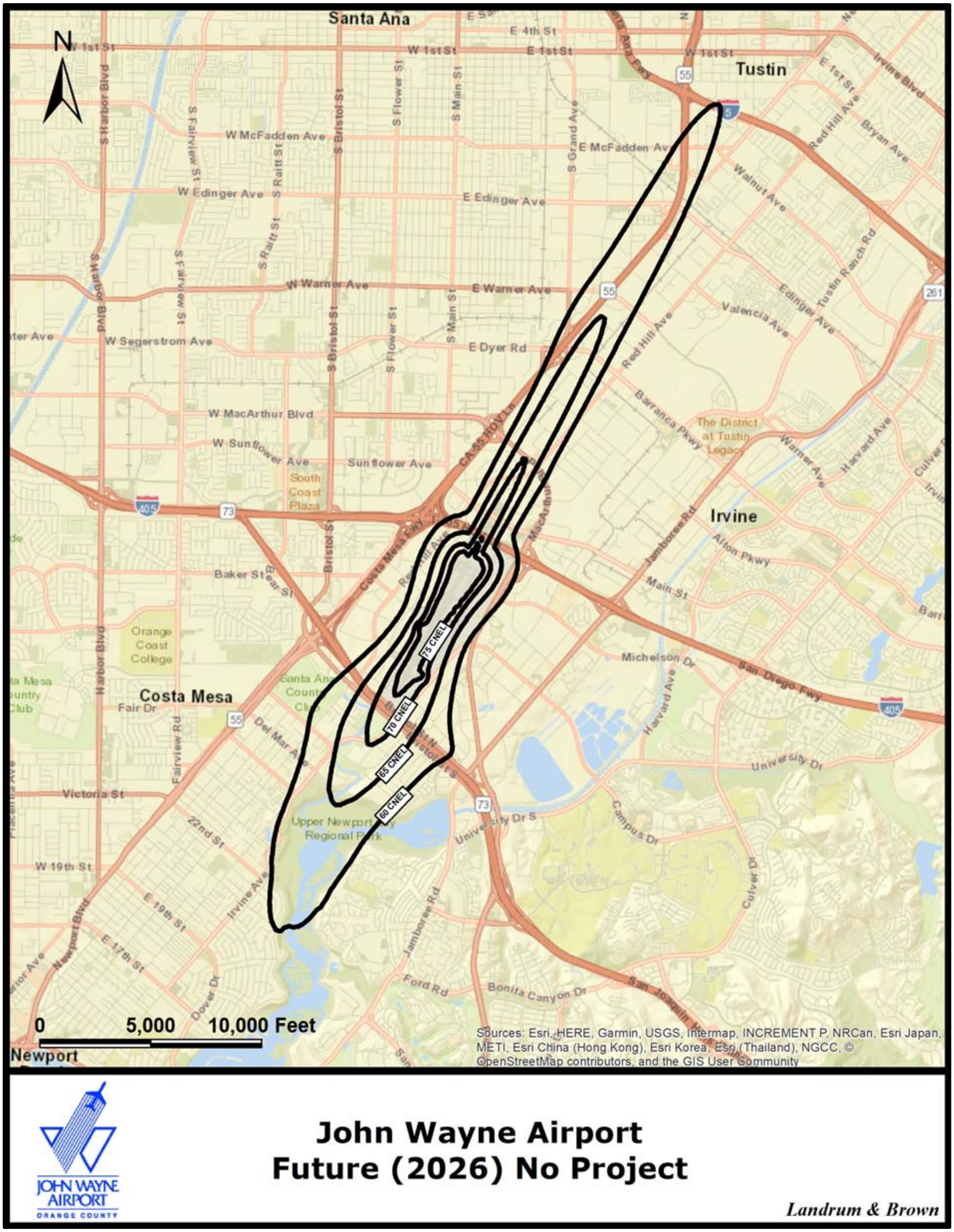
When the resulting noise level is between 60 and 65 CNEL, a 2 dB increase results in a significant impact. Tables 16 and 17 show this threshold will not be exceeded.

When the resulting noise level is between 55 and 60 CNEL, a 3 dB increase results in a significant impact. There were no NMS exposed to noise levels between 55 and 60 CNEL that are projected to experience a 3 dB or greater increase.

7.2.3 FUTURE (2026) CNEL CONTOURS

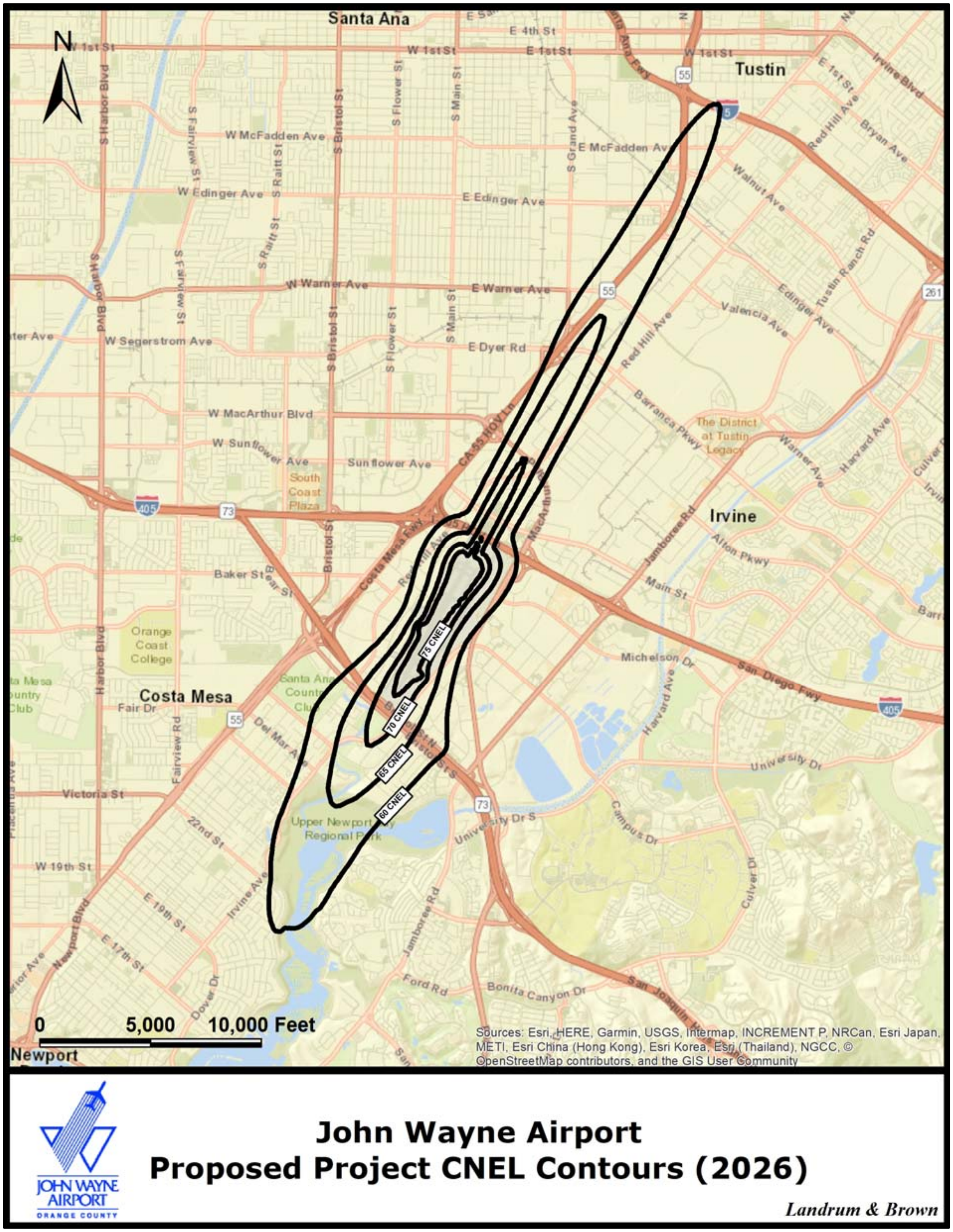
Figures 15, 16 and 17 show the Future (2026) CNEL contours for JWA for the No Project, Proposed Project, and Alternative 1 scenarios, respectively.

Figure 15 CNEL Contours – Future (2026) No Project



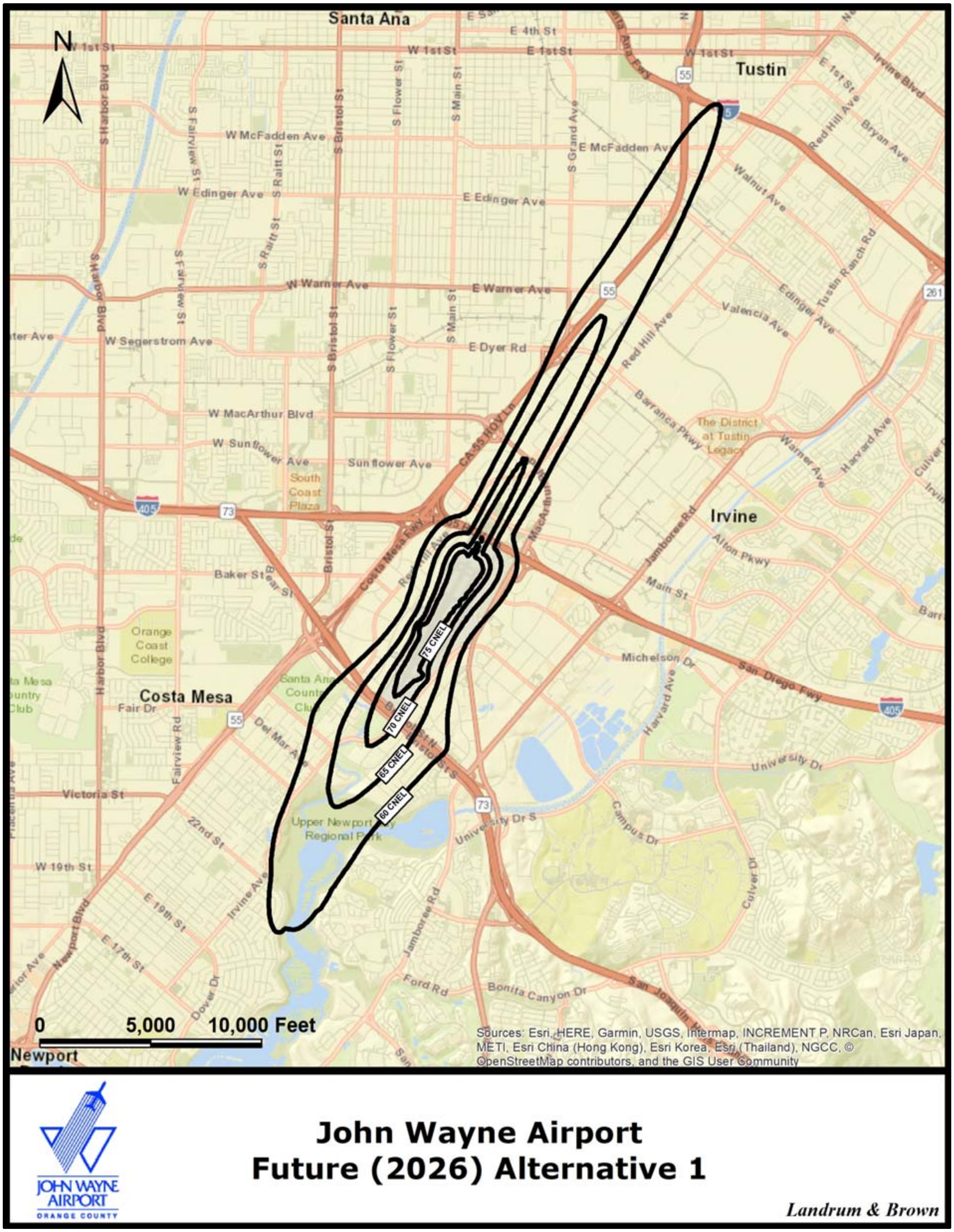
Source: Environmental Impact Report No. 617, John Wayne Airport Settlement Agreement Amendment; Orange County/John Wayne Airport (JWA) General Aviation Improvement Program (GAIP) Based Aircraft Parking—Capacity Analysis and General Aviation Constrained Forecasts November 2017; Landrum & Brown, 2018.

Figure 16 CNEL Contours – Future (2026) Proposed Project



Source: Environmental Impact Report No. 617, John Wayne Airport Settlement Agreement Amendment; Orange County/John Wayne Airport (JWA) General Aviation Improvement Program (GAIP) Based Aircraft Parking—Capacity Analysis and General Aviation Constrained Forecasts November 2017; Landrum & Brown, 2018.

Figure 17 CNEL Contours – Future (2026) Alternative 1



Source: Environmental Impact Report No. 617, John Wayne Airport Settlement Agreement Amendment; Orange County/John Wayne Airport (JWA) General Aviation Improvement Program (GAIP) Based Aircraft Parking—Capacity Analysis and General Aviation Constrained Forecasts November 2017; Landrum & Brown, 2018.

7.3 CNEL LAND USE IMPACTS

Table 18 provides a comparison of the land uses located within the CNEL contours for the existing year 2016 conditions, Future (2026) No Project, Future (2026) Proposed Project, and Future (2026) Alternative 1 scenarios. Table 18 shows land use information for the contour bands between 60 and 65 CNEL, 65 and 70 CNEL, and greater than 70 CNEL. For each contour band, the area in square miles is shown as well as the number of schools, hospitals, places of worship, dwellings, and population. The total number of dwelling units within each contour band is shown along with the number of dwelling units located in and outside of the Santa Ana Heights AIP boundary implemented as mitigation for the 1985 Master Plan EIR.

Table 18 Land Uses Within CNEL Contours

CNEL	Existing	Future (2026) No Project	Future (2026) Proposed Project	Future (2026) Alternative 1
Total Contour Area (sq. mi.)				
60-65	3.36	4.27	4.24	4.24
65-70	1.49	1.56	1.55	1.55
>70	0.91	0.86	0.86	0.86
Number of Schools				
60-65	6	7	7	7
65-70	0	0	0	0
>70	0	0	0	0
Number of Hospitals				
60-65	0	0	0	0
65-70	0	0	0	0
>70	0	0	0	0
Number of Places of Worship				
60-65	5	7	7	7
65-70	3	2	2	2
>70	1	1	1	1
Total Population				
60-65	2,772	7,064	7,036	8,328
65-70	401	536	538	542
>70	0	0	0	0
Total Number of Dwelling Units				
60-65	1,365	2,744	2,734	3,189
65-70	247	273	274	276
>70	0	0	0	0
Total Number of Dwelling Units In the Santa Ana Heights Acoustical Insulation Program (AIP) Boundary				
60-65	425	271	270	268
65-70	247	271	272	274
>70	0	0	0	0
Total Number of Dwelling Units Outside the Santa Ana Heights Acoustical Insulation Program (AIP) Boundary				
60-65	940	2473	2,464	2,921
65-70	0	2	2	2
>70	0	0	0	0

Source: US Census population data, 2016; John Wayne Airport AIP; Landrum & Brown, 2018.

Table 19 Change Over Existing Conditions

CNEL	Existing	Future (2026) No Project	Future (2026) Proposed Project	Future (2026) Alternative 1
Total Contour Area (sq. mi.)				
60-65	-	0.91	0.88	0.88
65-70	-	0.07	0.06	0.06
>70	-	-0.05	-0.05	-0.05
Number of Schools				
60-65	-	1	1	1
65-70	-	0	0	0
>70	-	0	0	0
Number of Hospitals				
60-65	-	0	0	0
65-70	-	0	0	0
>70	-	0	0	0
Number of Places of Worship				
60-65	-	2	2	2
65-70	-	(1)	(1)	(1)
>70	-	0	0	0
Total Population				
60-65	-	4,292	4,264	5,556
65-70	-	135	137	141
>70	-	0	0	0
Total Number of Dwelling Units				
60-65	-	1,379	1,369	1,824
65-70	-	26	27	29
>70	-	0	0	0
Total Number of Dwelling Units In the Santa Ana Heights Acoustical Insulation Program (AIP) Boundary				
60-65	-	(154)	(155)	(157)
65-70	-	24	25	27
>70	-	0	0	0
Total Number of Dwelling Units Outside the Santa Ana Heights Acoustical Insulation Program (AIP) Boundary				
60-65	-	1,533	1,524	1,981
65-70	-	2	2	2
>70	-	0	0	0

Source: US Census population data, 2016; John Wayne Airport AIP; Landrum & Brown, 2018.

7.4 COMPARISON TO THE 2014 SETTLEMENT AGREEMENT AMENDMENT, EIR NO.617

The GAIP would make no changes to the approved 2014 Settlement Agreement Amendment. However, since the preparation of the 2014 JWA Settlement Agreement Amendment EIR No. 617, two conditions have changed at JWA that affect the measured noise levels at each NMS and the modeling of noise contours.

First, a new noise monitoring system was installed in 2015 replacing the system that was in place during the preparation of the 2014 Settlement Agreement Amendment.

In early 2015, JWA began installing a new noise monitoring system. A side-by-side comparison of noise levels as recorded by the new system and the old system was conducted from March 1 through May 31, 2015. Based upon the results of the comparison, and recommendations from the County's noise consultant, the Board of Supervisors approved technical adjustments to the permitted noise levels at JWA in order to maintain parity with the existing noise levels at JWA and to maintain the grandfathered status of the County's noise and access restrictions under the Airport Noise and Capacity Act of 1990 (ANCA). (The Board approved similar parity adjustments for the same reasons in 1999 when the prior noise monitoring equipment was installed.)

Based upon an analysis of the side-by-side noise data, the Board approved noise level adjustments for Class A and Class E commercial aircraft operations at JWA noise monitoring stations (NMS) 1S, 2S, 3S, 4S, 5S, 6S, and 7S. Specifically, Class A and Class E aircraft noise levels of the Phase 2 Access Plan, which regulate noise levels for scheduled commercial operations, were revised. Additionally, the Board approved adjustments to permitted noise levels for general aviation aircraft operations at NMS 1S, 2S, 3S (daytime and curfew hours), and NMS 4S, 5S, 6S, 7S, 8N, 9N, and 10N (curfew hours) by revising applicable sections of the GANO, which regulates noise levels for general aviation aircraft.

In the context of these approved adjustments, it is important to note, although ideally the new noise monitoring system would measure the exact same level for each noise event as the previous system, this type of accuracy is not technologically feasible because the new equipment is more advanced and more sensitive than the previous equipment. The approved adjustments were required solely to reflect the technical capabilities of the new equipment in comparison to the previous equipment. The comparative values for each NMS are presented after this paragraph. For example, the parity study identified a noise level at NMS 5S of 94.6 dB for a Class A flight with the previous noise monitoring system and a noise level of 95.3 dB with the new noise monitoring system when monitoring the same noise level. The 0.7 dB increase is not a change in the amount of noise actually generated, rather an adjustment to ensure that the change in noise monitoring technology and equipment neither increased nor decreased the noise levels permitted in the County's access and noise regulations.

The approved adjustments in the permitted noise levels were as follows:

Class A Aircraft

Site	Prior SENEL	Adjusted SENEL	Change
NMS 1S	101.8 dB	102.5 dB	0.7 dB
NMS 2S	101.1 dB	101.8 dB	0.7 dB
NMS 3S	100.7 dB	101.1 dB	0.4 dB
NMS 4S	94.1 dB	94.8 dB	0.7 dB
NMS 5S	94.6 dB	95.3 dB	0.7 dB
NMS 6S	96.1 dB	96.8 dB	0.7 dB
NMS 7S	93.0 dB	93.7 dB	0.7 dB

Class E Aircraft

Site	Prior SENEL	Adjusted SENEL	Change
NMS 1S	93.5 dB	94.1 dB	0.6 dB
NMS 2S	93.0 dB	93.5 dB	0.5 dB
NMS 3S	89.7 dB	90.3 dB	0.6 dB
NMS 4S	86.0 dB	86.6 dB	0.6 dB
NMS 5S	86.6 dB	87.2 dB	0.6 dB
NMS 6S	86.6 dB	87.2 dB	0.6 dB
NMS 7S	86.0 dB	86.6 dB	0.6 dB

General Aviation Noise Ordinance

Daytime

Site	Prior SENEL	Adjusted SENEL	Change
NMS 1S	101.8 dB	102.5 dB	0.7 dB
NMS 2S	101.1 dB	101.8 dB	0.7 dB
NMS 3S	100.7 dB	101.1 dB	0.4 dB

Curfew

Site	Prior SENEL	Adjusted SENEL	Change
NMS 1S	86.8 dB	87.5 dB	0.7 dB
NMS 2S	86.9 dB	87.6 dB	0.7 dB
NMS 3S	86.0 dB	86.7 dB	0.7 dB
NMS 4S	86.0 dB	86.7 dB	0.7 dB
NMS 5S	86.0 dB	86.7 dB	0.7 dB
NMS 6S	86.0 dB	86.7 dB	0.7 dB
NMS 7S	86.0 dB	86.7 dB	0.7 dB
NMS 8N	86.0 dB	86.9 dB	0.9 dB
NMS 9N	86.0 dB	86.9 dB	0.9 dB
NMS 10N	86.0 dB	86.9 dB	0.9 dB

Second, the FAA has implemented flight track changes around the Airport's airspace since 2016. These changes concentrate aircraft flight paths, specifically departures to the southwest, on a more narrowly defined flight corridor when compared with a more dispersed flight corridor prior to 2016.

As a result, the measured NMS noise levels for the Existing (2016) conditions are not directly comparable to the 2013 measured NMS noise levels shown in the 2014 Settlement Agreement Amendment EIR No. 617. Additionally, since the Existing (2016) and Future (2026) noise contours in this report are based on the 2016 measured NMS noise levels, these contours are also not directly comparable those in the EIR No. 617 report.

7.5 GAIP NOISE EXPOSURE CONTOURS

The GAIP only changes the general aviation operations and fleet mix at JWA. The Proposed Project and alternatives do not affect the number of commercial operations, fleet mix, runway use or flight tracks. The commercial operations at JWA are the greatest influence on the size and shape of the noise contours while the general aviation traffic contributes only a small amount to the size and shape. The following noise exposure contours present this in a graphical form in Figures 18, 19, 20, and 21. These are shown for informational purposes only.

In addition to the CNEL contours, specific CNEL values are calculated for each NMS shown on Figure 11. Table 20 presents CNEL values at each of the NMS for Existing (2016) conditions, and all of the individual future (2026) scenarios for the commercial and the general aviation scenarios.

Table 21 presents the change in noise level in terms of CNEL relative to existing year 2016 conditions. As shown, the GAIP-only contours produce less noise than the Existing (2016) or Future 2026 commercial only noise levels.

Table 20 Modeled CNEL Levels at NMS For All Individual Future (2026) Alternatives

NMS[1]	EXISTING (2016)	AIR CARRIER ONLY (2026)	NO PROJECT GAIP ONLY (2026)	PROPOSED PROJECT GAIP ONLY (2026)	ALTERNATIVE 1 GAIP ONLY (2026)
1S	**67.77**	**66.78**	**60.18**	**60.21**	**60.3**
2S	**66.66**	**65.99**	**59.01**	**58.97**	**59.05**
3S	**66.46**	**65.74**	**61.24**	**61.3**	**61.38**
4S	59.62	58.74	52.83	52.89	52.97
5S	58.95	58.78	52.58	52.64	52.71
6S	59.95	59.71	55.18	55.23	55.31
7S	56.00	56.2	46.43	46.39	46.43
8N	**68.31**	**68.66**	**59.76**	**59.89**	**59.89**
9N	45.59	47.45	39.41	39.38	39.27
10N	55.27	57.10	47.34	47.34	47.28

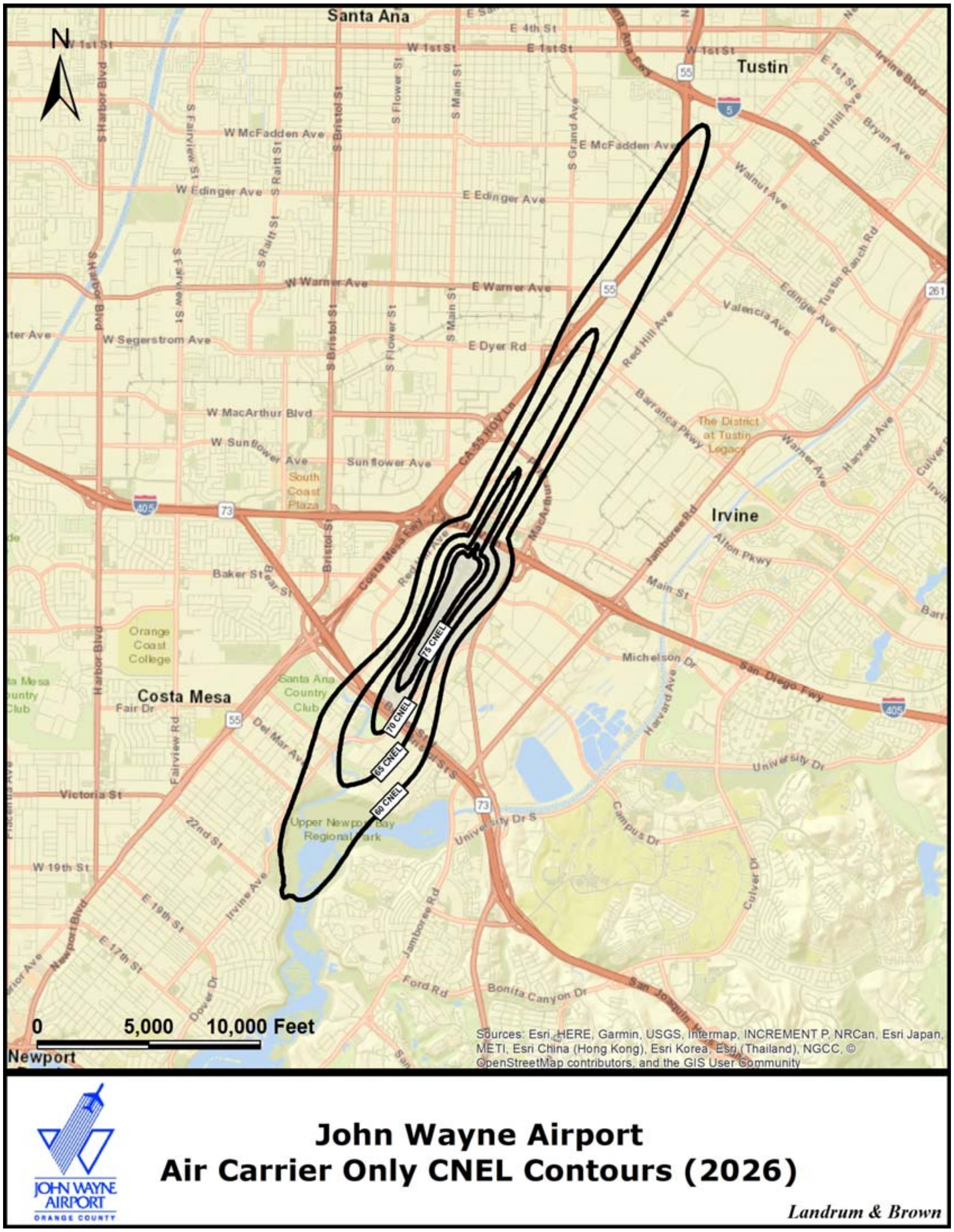
1 NMS 1S, 2S, and 3S are located in the Santa Ana Heights Community of the City of Newport Beach; NMS 4S, 5S, 6S and 7S are located in the City of Newport Beach, NMS 8N is located in the City of Irvine, NMS 9N is located in the City of Santa Ana; and NMS 10N is located in the City of Tustin.

Table 21 Change in Noise Level Over Existing Conditions

NMS[1]	EXISTING (2016)	AIR CARRIER ONLY (2026)	NO PROJECT GAIP ONLY (2026)	PROPOSED PROJECT GAIP ONLY (2026)	ALTERNATIVE 1 GAIP ONLY (2026)
1S	**-**	**-0.99**	**-7.59**	**-7.56**	**-7.47**
2S	**-**	**-0.67**	**-7.65**	**-7.69**	**-7.61**
3S	**-**	**-0.72**	**-5.22**	**-5.16**	**-5.08**
4S	-	-0.88	-6.79	-6.73	-6.65
5S	-	-0.17	-6.37	-6.31	-6.24
6S	-	-0.24	-4.77	-4.72	-4.64
7S	-	0.20	-9.57	-9.61	-9.57
8N	**-**	**0.35**	**-8.55**	**-8.42**	**-8.42**
9N	-	1.86	-6.18	-6.21	-6.32
10N	-	1.83	-7.93	-7.93	-7.99

Note: Noise monitors within the 65 CNEL are shown in **bold**. The change in noise level does not increase at a level greater than the significance threshold at any NMS.

Figure 18 CNEL Contours – Air Carrier Only (2026)



Source: Environmental Impact Report No. 617, John Wayne Airport Settlement Agreement Amendment; Landrum & Brown, 2018.

Figure 19 CNEL Contours –No Project GAIP Only (2026)

Source: Orange County/John Wayne Airport (JWA) General Aviation Improvement Program (GAIP) Based Aircraft Parking—Capacity Analysis and General Aviation Constrained Forecasts November 2017; Landrum & Brown, 2018.

Figure 20 CNEL Contours – Proposed Project GAIP Only (2026)

Source: Orange County/John Wayne Airport (JWA) General Aviation Improvement Program (GAIP) Based Aircraft Parking—Capacity Analysis and General Aviation Constrained Forecasts November 2017; Landrum & Brown, 2018.

Figure 21 CNEL Contours – Alternative 1 GAIP Only (2026)

Source: Orange County/John Wayne Airport (JWA) General Aviation Improvement Program (GAIP) Based Aircraft Parking—Capacity Analysis and General Aviation Constrained Forecasts November 2017; Landrum & Brown, 2018.

8.0 CUMULATIVE NOISE IMPACTS

For purposes of CEQA, “cumulative impacts” refer to individual effects which, when considered together, are considerable, or which compound or increase other environmental impacts. Because of the way noise levels are combined, in order for two noise sources to result in a cumulative impact, the noise levels generated by the sources need to generate similar noise levels that are just below or exceeding an applicable noise standard, 65 CNEL for residences. Two noise sources generating equal noise levels will result in a cumulative noise level 3 dB greater than the level from only one of the sources. Therefore, the noise levels from two individual sources would need to be within 3 dB of the standard for a cumulative impact to be possible. If the noise levels from two sources differ by 10 dB or more, the cumulative noise level is the same as the loudest noise sources. The noise levels must be within 4 dB of each other for the cumulative noise level to be 1.5 dB greater than the loudest noise level. These facts considerably limit the situations where cumulative noise impacts could occur.

Here, the two primary environmental noise sources are aircraft, from both JWA as well as other air traffic passing over the area, and roadway traffic. State and Federal Laws prohibit local municipalities from directly controlling these noise sources. The only practical ways for local municipalities to control noise from these sources is through planning; separating noise sensitive uses from major roadways and airports, and through noise standards for new developments located near these noise sources.

Local municipalities can regulate noise sources on private property, such as generators, HVAC units, or other noise generating equipment. The County of Orange and all of the cities within the project area have adopted Noise Ordinances that provide noise limits that cannot be exceeded at neighboring properties. These standards limit noise levels on an hourly or shorter basis (Newport Beach’s standards are based on 15 minute Leq noise levels). Further, allowable noise levels in residential areas during the nighttime are reduced by 10 dB. Facilities operating in compliance with these standards would need to generate the maximum allowable noise levels for 24 hours a day at an adjacent residential area to generate a noise level approaching the 65 CNEL residential noise standard. In general, the types of facilities that could cause such impacts are located in industrial areas, away from residential areas, and we are not aware of any existing or proposed facilities located near residential areas that operate under such conditions. Therefore, there is no indication that aircraft and stationary noise sources would result in a significant cumulative impact.

The cumulative projects that would contribute to a change in the noise environment at Airport are the FAA’s SoCal Metroplex project and the 2014 John Wayne Airport Settlement Agreement Amendment Project that was analyzed in EIR No. 617. The final procedures in the Metroplex were fully implemented in April 2017; however, the departure patterns were modified three times in 2017, with the latest modifications occurring in December 2017. The FAA is reviewing the possible implementation of the City of Newport Beach-requested procedure that would utilize satellite guidance to more accurately direct aircraft along the middle of the Upper Newport Bay. Due to the uncertainty of the final departure pattern, the cumulative noise analysis does not assume different flight paths than what are currently being used because it would be speculative.

As noted in Section 4.0 of the main EIR document, the Settlement Agreement Amendment provided for the modification to the terms of an agreement between the Orange County Board of Supervisors, City of Newport Beach, and two community groups pertaining to the commercial carrier operations at JWA. The amendment, which was approved in 2014, extends the term of the agreement through 2030 and allows an incremental increase in the number of regulated flights and passengers at the Airport. The amendment allows an increase from 10.8 million annual passengers (MAP) up to 12.5 MAP in 2026.[3] This amendment did not propose any physical improvements at the Airport. The 2014 Final EIR No. 617, prepared for the Settlement Agreement Amendment, identified significant unavoidable impacts for noise. The noise impact and the associated land use impact, is because there will be an increase in the number of noise-sensitive uses exposed to noise levels in excess of the 65 A-weighted decibel ("dBA") Community Noise Equivalent Level ("CNEL") contour for JWA exterior noise standard compared to the EIR 617 existing conditions (2013) baseline. There are no feasible mitigation measures for exterior noise level; however, mitigation was proposed that would potentially reduce impacts associated with excess interior noise levels to less than significant levels.

The GAIP cumulative analysis assumes the Phase 3 (2026 to 2030) operation of the commercial carriers consistent with the 2014 JWA Settlement Agreement Amendment. The assumptions on the total yearly aircraft operations by aircraft type (fleet mix) for the No Project, the Proposed Project, and Alternative 1 scenarios are provided in Section 6.1 of this Report. As discussed in Section 6.1, this noise analysis does take into account the Boeing 737-MAX and Airbus A320-NEO families increasing in operation at JWA. The forecasted increase at JWA is based on the current aircraft orders reported by Boeing[4] and Airbus[5] in the U.S. These aircraft families include substantial noise reduction features and are beginning to operate at JWA now. The GAIP Proposed Project and Alternative 1 do not change the number of air carrier operations, runway use, or flight tracks. The air carrier operations at JWA are the greatest influence on the size and shape of the noise contours, while the general aviation traffic contributes only a small amount to the size and shape. The assumptions for commercial operations are consistent for each of the scenarios evaluated.

3 The Settlement Agreement at the time amendment was being processed allowed up to 85 Class A Average Daily Departures ("ADD") and 10.8 Million Annual Passengers ("MAP"). The 2014 amendment requires the flight and passenger levels allowed under the Settlement Agreement to remain unchanged until January 1, 2021, at which point they would be allowed to increase to 95 Class A ADDs and 11.8 MAP. On January 1, 2026, the number of passengers would again be able to increase, to up to 12.5 MAP, depending upon the actual service levels in the preceding five years.

4 http://www.boeing.com/commercial/#/orders-deliveries, Accessed April 27, 2018

5 http://www.airbus.com/aircraft/market/orders-deliveries.html, Accessed April 27, 2018

9.0 NOISE MITIGATION MEASURES

RR NOI-1 identifies that the Orange County Municipal Code Article 3 Section 2-1-30, General Aviation Noise Ordinance, would apply to general aviation activities and would serve to avoid potential noise impacts from nighttime operations.

SC NOI-1 would serve to ensure interior noise standards specified in the Noise Element and Land Use/Noise Compatibility Manual are achieved for noise-sensitive uses at the Airport, such as office space.

No significant noise impacts were identified; therefore, no additional noise mitigation measures are required.

10.0 REFERENCES

[1] U.S. EPA. (1974). *Information on Levels on Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Martin of Saf*ety (EPA 550/9-74-004). Office of Noise Abatement and Control. Washington DC: U.S. Environmental Protection Agency.

[2] Harris, C. M. (1979). *Handbook of Noise Control*. McGraw-Hill Book Co.

[3] Fields, J. M. (1992). *Effect of Personal and Situational Variables on Noise Annoyance: with Special Reference to Implications for En Route Noise*. Federal Avaition Administration and NASA Langly Research Center.

[4] State of California. (1970). *California Airport Noise Regulations.* Sacramento: State of California.

[5] Fidell, S., & Teffeteller, S. (1978). *The Relationship Between Annoyance and Detectibility of Low Level Sounds*. Report 3699. Bolt, Beranek and Newman, Boston.

[6] Green, D. M., & Swets, J. A. (1966). *Signal Detection Theory and Psychophysics*. New York: John Wiley and Sons.

[7] Fidell, S., Pearsons, K. S., & Bennett, R. L. (1974). *Predicting Aural Detectability of Aircraft in Noise Backgrounds*. Report 2202. Boston: Bolt, Beranek and Newman.

[8] Fidell, S., & Bishop, D. E. (1972). *Prediction of Acoustic Detecability*. Technical Report 11949. Boston: Bolt Beranek and Newman.

[9] Fidell, S., & Teffeteller, S. R. (1981). *Scaling the Annoyance of Intrusive Sounds*. Journal of Sound and Vibration , 78, 291-298.

[10] Dunholter, P. H., & Harrison, R. T. (1988). *Military Aircraft Overflight and Wilderness Perceptions*. Acoustical Society of America Conference. Acoustical Society of America.

[11] National Association of Noise Control Officials. (1981). *Noise Effects Handbook.* New York.

[12] Department of Transport. (1992). *Report of a Field Study of Aircraft Noise and Sleep Disturbance.* Department of Safety, Environment and Engineering CIvil Aviation Authority.

[13] Horn, J. A., Pankhurst, F. L., Reyner, L. A., Hume, K., & Diamond, I. D. (1994). *A field Study of Sleep DisturbanceL: Effects of Noise and Other Factors on 5,742 Nights of Actimetrically Monitored Sleep in a Large Subject Sample*. Sleep *, 17* (2), 146-59.

[14] FICON. (1992). *Federal Agency Review Of Selected Airport Noise Analysis Issues .* Federal Interagency Committe on Noise (FICON). Available at www.fican.org.

[15] FICAN. (1997) *Effects of Aviation Noise on Awakenings from Sleep*. Federal Interagency Committe on Aircraft Noise (FICAN) Available at www.fican.org.

[16] ANSI. (2008). *Quantities and Procedures for Description and Measurmeent of Environmental Sound - Part 6 Methods for Estimateion of Awakenings Associated with Outdoor Noise Events Heard in Homes (ANSI S12.9-2000/Part 6).* American National Standards Institute.

[17] Lercher P, Stansfield S. A., Thompson S.J., *Non Auditory Health Effects of Noise; Review of the 1993-1998 Period*, Noise Effects-98 conference Proceedings, p. 213. 1998.

[18] ACRP. (2008). *Synthesis 9: Effects of Aircraft Noise: Research Update on Selected Topics.* Transportation Research Board of the National Academies.

[19] Hansell, A. L., Blangiardo, M., Fortunato, L., Floud, S., de Hoogh, K., Fecht, D., et al. (2013). Aircraft Noise and Cardiovascular Diseas Nar Heathrow Airport in London: Small Area Study. *British Medical Journal , BMJ2013* (347), f5432.

[20] Correia, A. W., Peters, J., Levy, J., Melly, S., & Dominici, F. (2013). *Residential Exposure to Aircraft Noise and Hospital Admissions for Cardiovascular Diseases: Multi-Airport Retrospective Study*. British Medical Journal , BMJ2013 (347), f5561.

[21] Miedema, H., & Vos, H. (1998). *Exposure Repsoonse Relationships for Transporation Noise.* Journal of the Acoustical Society of America (104), 3432-3445.

[22] Fidell, S., Mestre, V., Schomer, P., Berry, B., Giestland, T., Vallet, M., et al. (2011). *A First Principals Model for Estimating the Prevelance of Annoyance with Aircraft Noise Exposure*. Journal of the Acoustical Society of America (130 (2)), 791-806.

[23] (2012). *Roll of a Community Tolerance Value in Predicitons of the Prevalence of Annoyance due to Road and Rail Noise*. Journal of the Acoustical Society of America (131 (4)), 2772-2786.

[24] State of California. (1974). *California Code of Regulations, Part 2, Title 24.* State of California.

[25] State of California. *Section 21675 of the Public Utilities Code.* Sacramento: State of California.

[26] State of California. *State Government Code Section 65302(f) and Section 4605.1 of the Health and Safety Code.* Sacramento: State of California.

[27] County of Orange. (1990 as ammended through 2011). *Phase 2 Commercial Airline Access Plan and Regulation (October 1, 1990 - December 31, 2015)*.

[28] County of Orange. (1985, July 1). Municipal Code Article 3 Section 2-1-30, General Aviation Noise Ordinance.

[29] U.S. Department of Transportation, Federal Aviation Administration. (2015). *Aviation Environmental Design Tool (AEDT) version 2d User Guide.*

[30] Federal Aviation Administration NextGen Advisory Committee. (2013) *CatEx2: Recommendation for Implementing the Categorical Exclusion in Section 213(c)(2) of the FAA Modernization and Reform Act of 2012.*

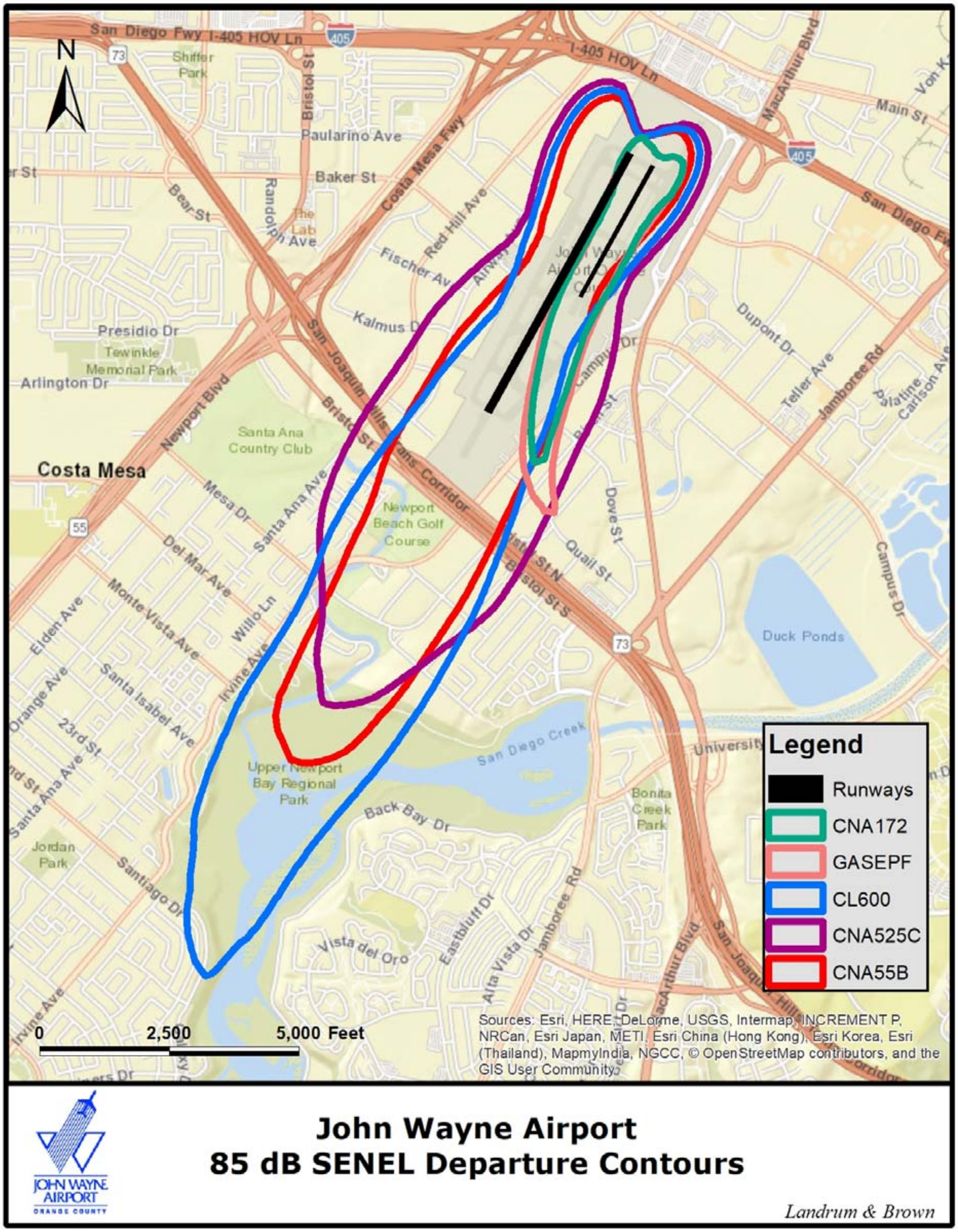
[31] U.S. Department of Transportation, Federal Aviation Administration Memorandum, August 17, 2012 (rev. November 7, 2012), Subject: Action: Program Guidance Letter 12-09 Eligibility and Justification Requirements for Noise Insulation Projects.

[32] U.S. Department of Transportation, Federal Aviation Administration Order 5100.38C Airport Improvement Program Handbook, June 28, 2005. (With Replacement Paragraph 812 included in [31])

ATTACHMENT 1

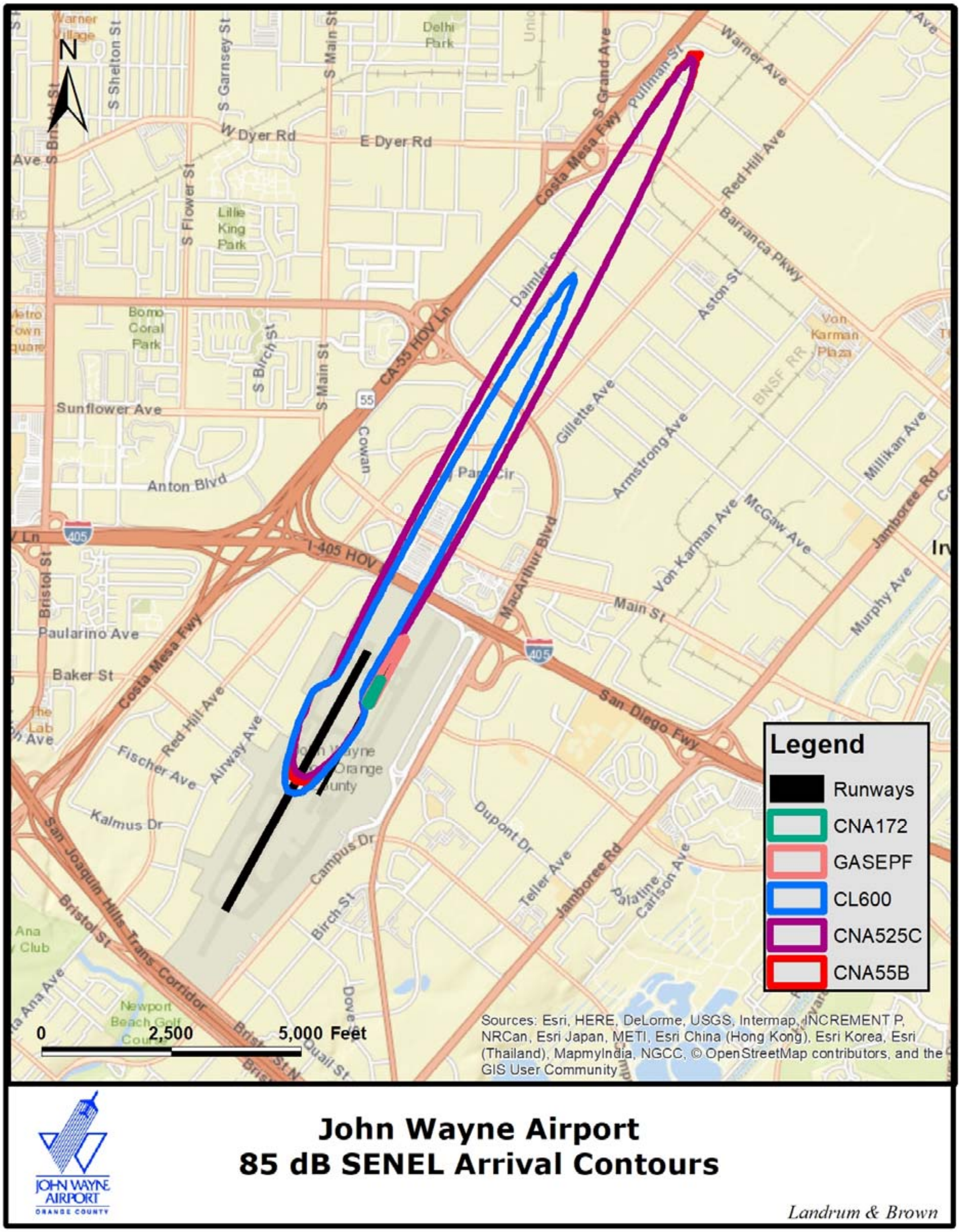
SENEL NOISE CONTOURS

Figure 22 Departure SENEL Contour – General Aviation



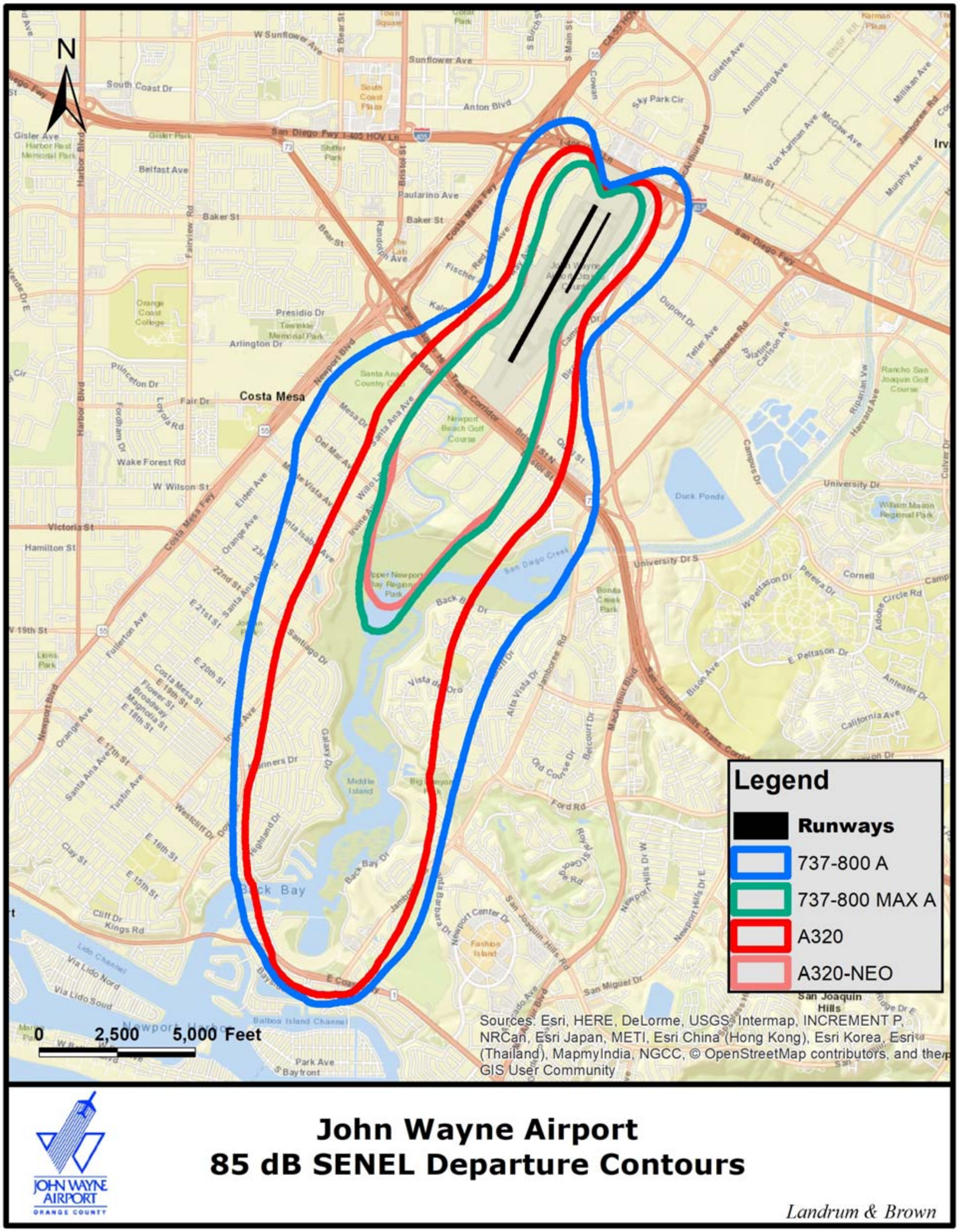
Source: Environmental Impact Report No. 617, John Wayne Airport Settlement Agreement Amendment; Orange County/John Wayne Airport (JWA) General Aviation Improvement Program (GAIP) Based Aircraft Parking—Capacity Analysis and General Aviation Constrained Forecasts November 2017; Landrum & Brown, 2018.

Figure 23 Arrival SENEL Contour – General Aviation



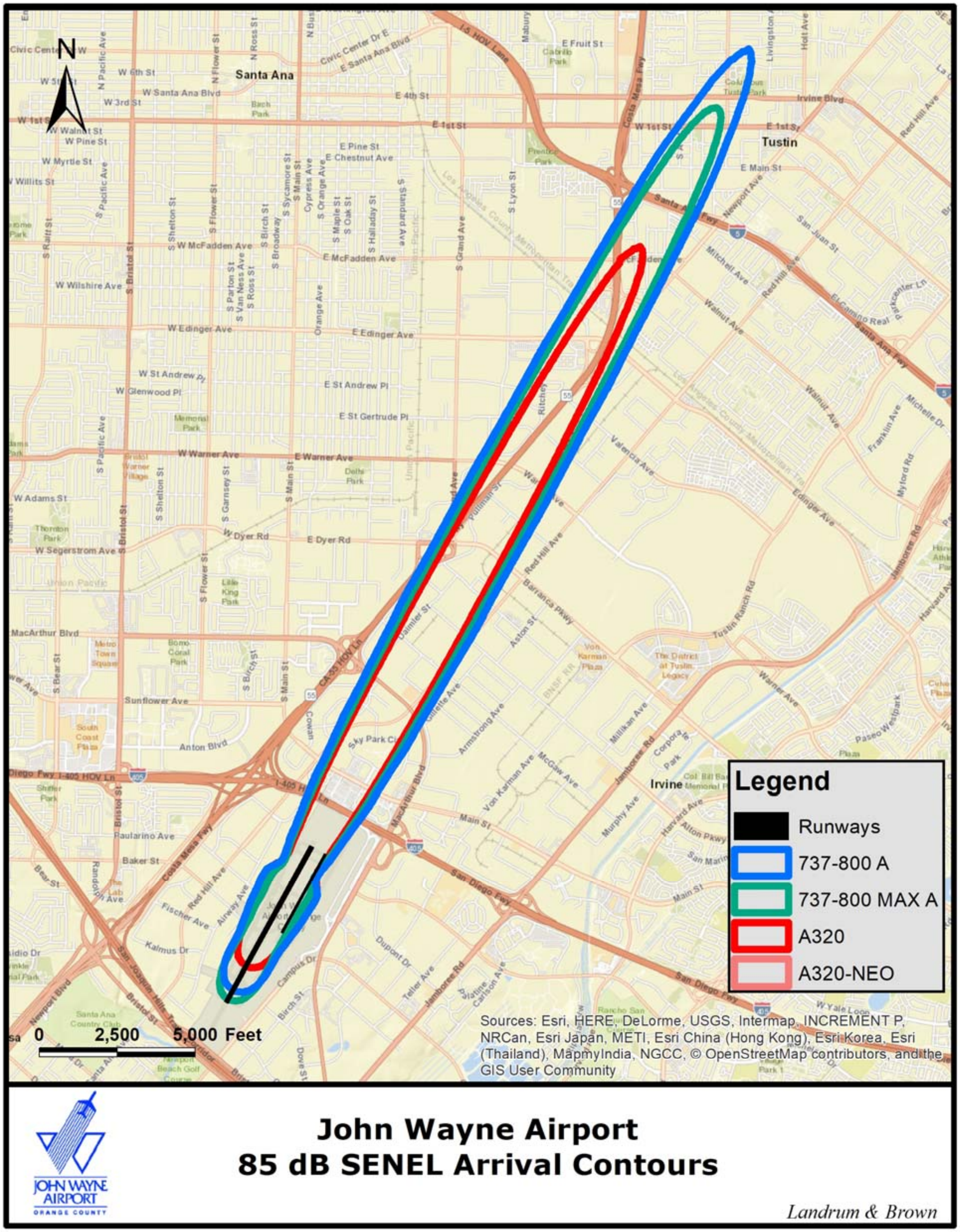
Source: Environmental Impact Report No. 617, John Wayne Airport Settlement Agreement Amendment; Orange County/John Wayne Airport (JWA) General Aviation Improvement Program (GAIP) Based Aircraft Parking—Capacity Analysis and General Aviation Constrained Forecasts November 2017; Landrum & Brown, 2018.

Figure 24 Departure SENEL Contour – 737-800's and A320's



Source: Environmental Impact Report No. 617, John Wayne Airport Settlement Agreement Amendment; Orange County/John Wayne Airport (JWA) General Aviation Improvement Program (GAIP) Based Aircraft Parking—Capacity Analysis and General Aviation Constrained Forecasts November 2017; Landrum & Brown, 2018.

Figure 25 Arrival SENEL Contour – 737-800's and A320's



Source: Environmental Impact Report No. 617, John Wayne Airport Settlement Agreement Amendment; Orange County/John Wayne Airport (JWA) General Aviation Improvement Program (GAIP) Based Aircraft Parking—Capacity Analysis and General Aviation Constrained Forecasts November 2017; Landrum & Brown, 2018.

ATTACHMENT 2

TRAFFIC NOISE LEVEL INCREASES OVER EXISTING CONDITIONS

Table 22 Traffic Noise Level Increases – Existing plus Project (CNEL)

Roadway & Segment	Existing (2016) ADT	Project ADT	Existing + Project ADT	Increase in Noise Level (dB)
Paularino Ave.				
w/o 55 Freeway	16,000	80	16,080	0.0
55 Freeway to Red Hill Ave.	12,000	480	12,480	0.2
Red Hill Ave. to Airway Ave.	4,000	520	4,520	0.5
Baker St.				
w/o 55 Freeway	27,000	40	27,040	0.0
55 Freeway to Red Hill Ave.	20,000	140	20,140	0.0
Red Hill Ave. to Airway Ave.	6,000	220	6,220	0.2
Bristol St.				
Paularino Ave. to I-405	36,000	80	36,080	0.0
Red Hill Ave.				
n/o SR-73	19,000	80	19,080	0.0
s/o Baker St.	15,000	80	15,080	0.0
Baker Ave. to Paularino Ave.	18,000	60	18,060	0.0
Paularino Ave. to Airport Loop Dr.	19,000	40	19,040	0.0
Airport Loop Dr. to Main St.	20,000	40	20,040	0.0
Campus Dr.				
SR-73 to Quail St.	34,000	-440	33,560	-0.1
n/o Dove St.	32,000	-450	31,550	-0.1
s/o MacArthur Blvd.	32,000	-300	31,700	0.0
MacArthur Blvd. to Von Karman Ave.	13,000	-40	12,960	0.0
MacArthur Blvd.				
Campus Dr. to Michelson Dr.	35,000	-260	34,740	0.0
Michelson Dr. to I-405	53,000	-250	52,750	0.0

Table 23 Traffic Noise Level Increases – Existing plus Alternative 1 (CNEL)

Roadway & Segment	Existing (2016) ADT	Project Alt-1 ADT	Existing + Project Alt-1 ADT	Increase in Noise Level (dB)
Paularino Ave.				
w/o 55 Freeway	16,000	60	16,060	0.0
55 Freeway to Red Hill Ave.	12,000	380	12,380	0.1
Red Hill Ave. to Airway Ave.	4,000	410	4,410	0.4
Baker St.				
w/o 55 Freeway	27,000	30	27,030	0.0
55 Freeway to Red Hill Ave.	20,000	110	20,110	0.0
Red Hill Ave. to Airway Ave.	6,000	170	6,170	0.1
Bristol St.				
Paularino Ave. to I-405	36,000	60	36,060	0.0
Red Hill Ave.				
n/o SR-73	19,000	60	19,060	0.0
s/o Baker St.	15,000	60	15,060	0.0
Baker Ave. to Paularino Ave.	18,000	45	18,045	0.0
Paularino Ave. to Airport Loop Dr.	19,000	30	19,030	0.0
Airport Loop Dr. to Main St.	20,000	30	20,030	0.0
Campus Dr.				
SR-73 to Quail St.	34,000	-340	33,660	0.0
n/o Dove St.	32,000	-350	31,650	0.0
s/o MacArthur Blvd.	32,000	-230	31,770	0.0
MacArthur Blvd. to Von Karman Ave.	13,000	-30	12,970	0.0
MacArthur Blvd.				
Campus Dr. to Michelson Dr.	35,000	-200	34,800	0.0
Michelson Dr. to I-405	53,000	-190	52,810	0.0