# - 1 -

# SANTA BARBARA AIRPORT – AIRCRAFT NOISE ANALYSIS

## AIRCRAFT NOISE ANALYSIS

This appendix addresses aircraft noise exposure and describes the methodology used to analyze the aircraft noise environment, the metrics used to quantify aircraft noise exposure levels, and the resultant noise contours used to visually depict the noise levels extending from the Santa Barbara Airport (SBA or Airport).

The following subsections provide a generalized description of the existing noise exposure at SBA based on 2021 operational levels of activity. Projected noise levels for the 5-, 10-, and 20-year forecast (2028, 2031, and 2041) are based on the activity levels forecasted in the SBA Master Plan.

### Aircraft Noise

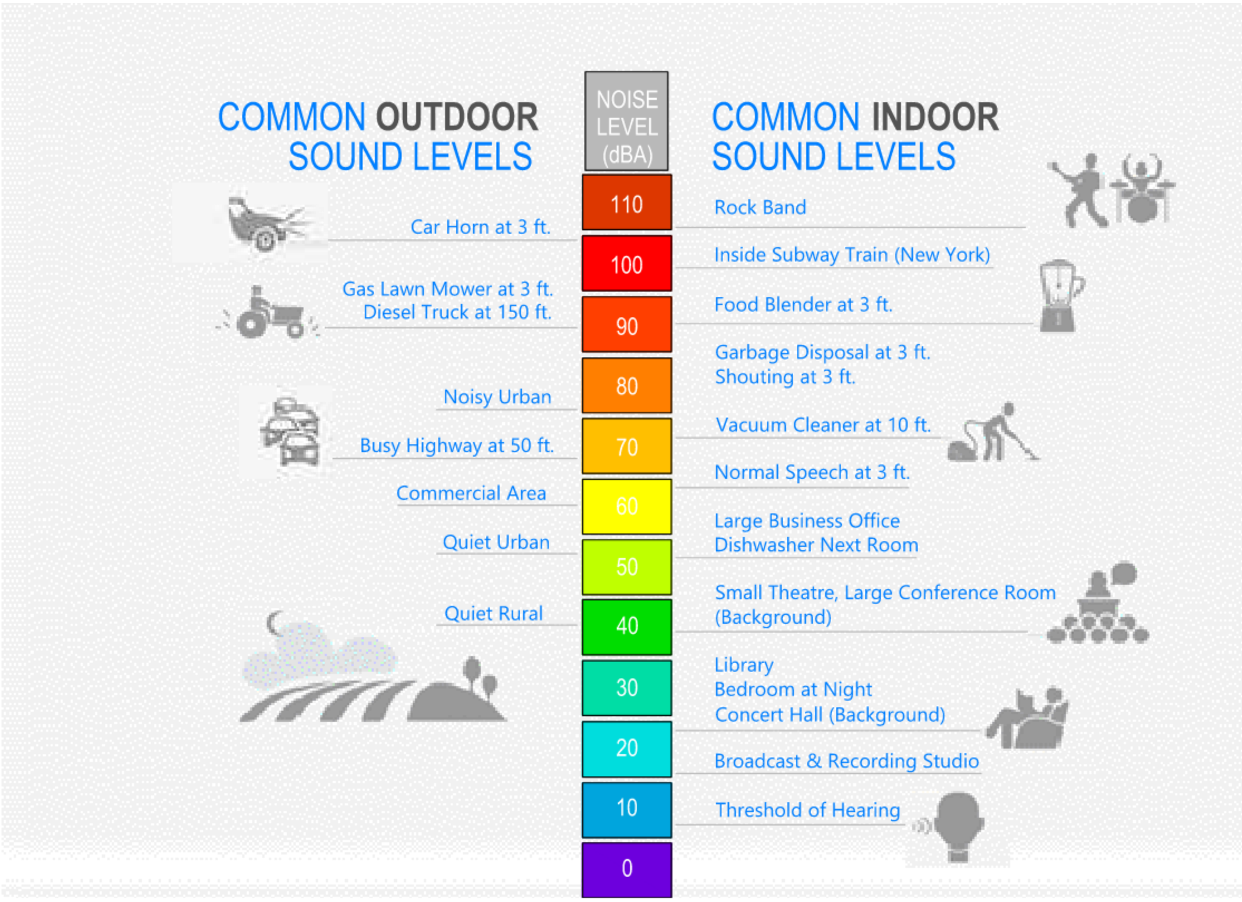
To understand airport noise and its effects on people, it is important to understand the characteristics of sound. Sound is a type of energy that travels in the form of a wave. Sound waves create minute pressure differences in the air that are recognized by the human ear or microphones. Sound waves can be measured using decibels (dB) to measure the amplitude or strength of the wave and Hertz (Hz) to measure the frequency or pitch of the wave.

The strength, or loudness, of a sound wave is measured using decibels on a logarithmic scale. The range of audibility of a human ear is 0 dB (threshold of hearing) to 120 dB (threshold of pain). The use of a logarithmic scale can be confusing because it does not directly correspond to the perception of relative loudness. A common misconception is that if two noise events occur at the same time, the result will be twice as loud. Realistically, the event doubles the sound energy, but only results in a 3 dB increase in magnitude. In person, a sound event needs to be 10dB higher to be observed as twice as loud as another.

Scientific studies have shown that people do not interpret sound the same way a microphone does. For example, humans are biased and sensitive to tones within a certain frequency range. The A-weighted decibel scale was developed to correlate sound tones with the sensitivity of the human ear. The A-weighted decibel (dBA) is a “frequency dependent” rating scale that emphasizes the sound components within the frequency range where most speech occurs. A comparative sound scale for the A-weighted decibel (dBA) is illustrated in Figure 1.0, which lists typical sound levels of common indoor and outdoor sound sources.

When sound becomes annoying to people, it is generally referred to as noise. A common definition of noise is any sound that is undesirable or interferes with people’s ability to hear other sounds. One person may find higher levels of noise bearable while others do not. Studies have also shown that a person will react differently to the same noise depending on that person’s activity at the time the noise is recognized, e.g., when that person is sleeping.

**Figure 1.0: Comparative Noise Levels (dBA)**




Source: FAA Fundamentals of Noise and Sound; https://www.faa.gov/regulations_policies/policy_guidance/noise/basics/#contours

## Noise Metrics

Noise metrics can be categorized as cumulative metrics and single event metrics. Cumulative noise metrics have been developed to assess community response to noise. They are useful because these scales attempt to include the loudness and duration of the noise, the total number of noise events, and the time of day these events occur into one rating scale. Day-night average sound level (DNL), expressed in decibels (dB), is the standard federal metric for determining cumulative exposure of individuals to noise.

California Airport Noise Standards require airports to use Community Noise Equivalent Level (CNEL) and is accepted by the Federal Aviation Administration (FAA). CNEL adds an additional 4.77-decibel penalty to evening (7:00 p.m. – 9:59 p.m.) operations and 10-decibel penalty to nighttime (10 p.m. – 6:59 a.m.) operations. The 24-hour CNEL is annualized to reflect noise generated by aircraft operations for an entire year and is identified by noise contours showing levels of aircraft noise.

Single event metrics (not included in this noise analysis) describe noise from individual events, such as an aircraft flyover. An example of this kind of metric is the maximum sound level (Lmax), which identifies the highest noise level reached during a particular noise "event" and ignores the duration of the event.

[1] In 1981, the FAA formally adopted the DNL as the primary measure for determining exposure of individuals to airport noise.

# NOISE MODELING METHODOLOGY

Existing and future aircraft noise environments for SBA were determined through computer modeling using the FAA's designated Aviation Environmental Design Tool (AEDT). The following sub-sections explain the methodology and inputs used to generate the cumulative CNEL contours.

Operational data used to generate the existing noise contours was derived from the Master Plan's Aviation Activity Forecast (approved by FAA on 6/1/2023), which provided the information on operations by aircraft category at SBA. Data for each aircraft type was then broken down by operation type, representative aircraft, runway utilization, and track utilization.

## Computer Modeling

Computer modeling generates maps or tabular data of an airport's noise environment expressed in the applicable metric, such as DNL or CNEL. Computer models are most useful in developing contours that depict areas of equal noise exposure, such as elevation contours on a topography map. Accurate noise contours are largely dependent on the use of reliable, validated, and updated noise models and collection of accurate aircraft operational data.

The AEDT software used to determine existing and future aircraft noise environments for SBA models civilian and military aviation operations and is required by FAA to be used for 14 CFR Part 150 Study aircraft noise analysis as well as NEPA noise analysis. The program includes standard aircraft noise and performance data for hundreds of aircraft types.

AEDT Version 3e, the most up-to-date version of the software at the time the noise analysis was conducted, was used to model the noise exposure contours at SBA using the existing (FAA FY2021) baseline operations. Results are indicated by a series of contour lines overlaid on a map of the airport and its environs.

## Noise Model Inputs

The AEDT model requires a variety of operational data to model the noise environment around an airport. These inputs include the following bulleted data categories that are presented and discussed in more detail within the following sections and tables.

- Aircraft Activity Levels
- Aircraft Fleet Mix
- Runway Utilization
- Time of Day
- Surrounding Terrain
- Flight Tracks

## Airport Activity Levels and Fleet Mix

The operation counts entered into AEDT are divided by aircraft models. The operation numbers for the base year and forecasted years are derived from the Master Plan forecast chapter and the fleet mix was provided by SBA. Representative aircraft selected for use in the AEDT model were chosen by operation count and similarity with other aircraft operating at SBA. The aircraft and operations used for AEDT input are shown in **Table 1.0.**

**Table 1.0: Operations by Representative Aircraft**

| Operations by Type | 2021 | 2026 | 2031 | 2041 |
|---|---|---|---|---|
| **Itinerant Air Carrier** | **10,328** | **14,000** | **16,680** | **19,173** |
| B737-700 | 4,094 | 5,405 | 5,751 | 5,179 |
| B737-800 | 1,000 | 1,500 | 2,190 | 3,650 |
| A319 | 4,344 | 5,889 | 6,772 | 7,529 |
| CRJ7 | 890 | 1,206 | 1,967 | 2,815 |
| **Itinerant Air Taxi** | **12,311** | **14,252** | **13,520** | **12,427** |
| CRJ2 | 1,144 | 827 | 730 | 0 |
| C680 | 3,036 | 3,650 | 1,739 | 845 |
| C550/C650 | | | 869 | 1,267 |
| BD-700 | | | 869 | 1,267 |
| CL30 | 1,684 | 2,025 | 1,929 | 1,874 |
| PC12 | 4,305 | 5,175 | 4,930 | 4,790 |
| AT43 | 915 | 1,100 | 1,048 | 1,018 |
| B350 | 769 | 925 | 881 | 856 |
| TBM7 | 458 | 550 | 524 | 509 |
| **Itinerant General Aviation** | **42,258** | **43,900** | **44,260** | **48,725** |
| C680 | 2,243 | 2,330 | 1,174 | 597 |
| C550/C650 | | | 587 | 896 |
| BD700 | | | 587 | 896 |
| CL30 | 1,244 | 1,293 | 1,303 | 1,326 |
| PC12 | 3,180 | 3,303 | 3,330 | 3,388 |
| AT43 | 676 | 702 | 708 | 720 |
| B350 | 568 | 590 | 595 | 606 |
| TBM7 | 338 | 351 | 354 | 360 |
| C172 | 28,556 | 29,666 | 29,909 | 30,422 |
| SR22 | 2,627 | 2,729 | 3,733 | 3,797 |
| BE36 or A36 | 937 | 973 | 0 | 0 |
| C206 | 461 | 479 | 483 | 491 |
| BE58 | 568 | 590 | 595 | 606 |
| C310 | 215 | 223 | 113 | 115 |
| C421 | 154 | 160 | 80 | 82 |
| DA42 | 108 | 112 | 306 | 311 |
| AS50 | 138 | 144 | 145 | 147 |
| B06 | 92 | 96 | 97 | 98 |
| R44 | 92 | 96 | 97 | 98 |
| eVTOL aircraft (R44 in AEDT)* | | | | 3,705 |
| EC35 | 61 | 64 | 64 | 65 |

| | | | | |
|---|---|---|---|---|
| **Itinerant Military** | **1,229** | **1,083** | **1,083** | **1,083** |
| C-130 | 269 | 175 | 175 | 175 |
| E-2 | 367 | 323 | 323 | 323 |
| F-18 | 73 | 65 | 65 | 65 |
| Apache | 173 | 173 | 173 | 173 |
| UH-60 | 173 | 173 | 173 | 173 |
| Osprey | 173 | 173 | 173 | 173 |
| **Total Itinerant Operations** | **66,126** | **73,235** | **75,543** | **81,408** |
| **Local Civil (T&G)** | **36,695** | **37,320** | **37,680** | **38,440** |
| C172 | 33,604 | 34,176 | 34,506 | 35,202 |
| SR22 | 3,091 | 3,144 | 3,174 | 3,238 |
| **Local Military (T&G)** | **598** | **512** | **512** | **512** |
| Osprey | 598 | 512 | 512 | 512 |
| **Total Local Operations** | **37,293** | **37,832** | **38,192** | **38,952** |
| **Total Operations** | **103,419** | **111,067** | **113,735** | **120,360** |

Sources: Santa Barbara Airport, Mead & Hunt.

*eVTOL aircraft are not present in the version of AEDT used for this noise analysis so the Robinson R44 was used as a placeholder for noise modeling purposes.

## Runway Utilization

Determining the frequency that each runway is used is an important step in generating accurate noise contours. Table 2.0 shows the runway use percentage by operation type. These grouping categories were developed to determine the percentages for runway utilization, time of day for operations, and track utilization. The runway utilization data was provided by the Airport's Noise and Operations Monitoring System (ANOMS).

**Table 2.0: Runway Utilization by Operation Type**

| Runway | 15L | 15R | 25 | 33L | 33R | 07 |
|---|---|---|---|---|---|---|
| **Arrival** | | | | | | |
| General Aviation | 19% | 0% | 54% | 0% | 4% | 22% |
| Other | 1% | 0% | 65% | 0% | 1% | 34% |
| Scheduled Passenger | 0% | 0% | 60% | 0% | 0% | 40% |
| **Departure** | | | | | | |
| General Aviation | 41% | 1% | 44% | 0% | 3% | 10% |
| Other | 5% | 0% | 69% | 0% | 0% | 26% |
| Scheduled Passenger | 0% | 0% | 67% | 0% | 0% | 33% |
| **Touch and Go** | | | | | | |
| General Aviation | 85% | 5% | 0% | 5% | 5% | 0% |

Source: Santa Barbara Airport

Based on data obtained from the airport, scheduled passenger operations, performed by large passenger jets, are limited to Runway 07-25, the longest and widest runway at the airport. Other operations include business jets or chartered operations which also operate mainly on 07-25 with smaller jets and turboprop aircraft. General aviation operations mainly operate on Runway 15L-33R and 15R-33L. The noise analysis for the 20-year forecasted condition was modeled with the expected closure of Runway 15L-33R, with operations on that runway being shifted onto Runway 15R-33L.

## Operations by Time of Day

The time of day, evening or night that aircraft operate is an important component to the AEDT model. CNEL adds an additional 4.77-decibel penalty to evening operations and 10-decibel penalty to nighttime operations.

The ANOMS also tracks operation time which provided the ratio of day, evening, and nighttime operations. **Table 3.0** shows the time-of-day information provided by the airport. The percentages are based on the same classification as runway utilization.

**Table 3.0: Operations by Type of Day**

| Time of Day[1] | Day | Evening | Night |
|---|---|---|---|
| **Arrival** | | | |
| General Aviation | 89% | 7% | 5% |
| Other | 87% | 7% | 6% |
| Scheduled Passenger | 85% | 10% | 5% |
| **Departure** | | | |
| General Aviation | 87% | 8% | 6% |
| Other | 84% | 10% | 5% |
| Scheduled Passenger | 86% | 9% | 6% |
| **Touch and Go** | | | |
| General Aviation | 93% | 7% | 0% |

Source: Santa Barbara Airport

## Flight Tracks

Flight paths represent where aircraft fly in relation to the ground. Aircraft do not fly exact or precise "tracks" associated with general aviation airports, but rather a wider "path" that represents some dispersion due to several factors, including weather (temperature, wind, barometric pressure), pilot proficiency, aircraft performance, other air traffic, and separation requirements.

In order to determine a representation of aircraft flight paths, Airport operations staff was asked to provide input on the location and usage of tracks. The tracks used for the noise analysis not only include straight in, straight out, and touch and go tracks but also accounts for the various turns aircraft are likely to take when departing and arriving. Input was received in the form of aircraft operation heatmaps generated from

[1] Day is defined as 7:00 a.m. – 6:59 p.m., evening is 7:00 p.m. – 9:59 p.m. and nighttime 10 p.m. – 6:59 a.m.

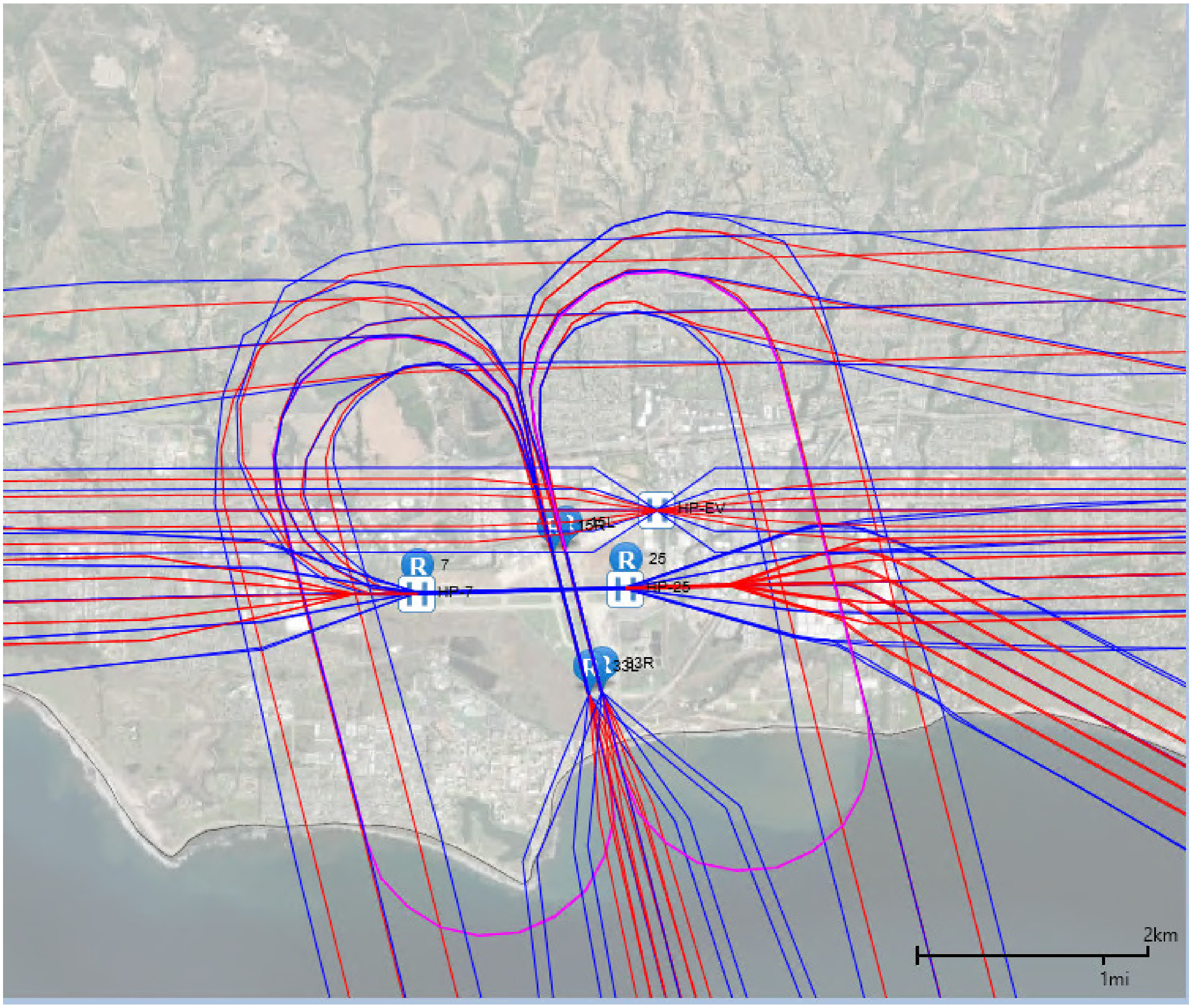
the ANOMS and Vector Airport Systems data which indicated where the operations around the airport concentrated. The percentage of tracks used per runway end is shown in **Table 4.0** with the track routes are illustrated on **Figure 2.0.**

**Table 4.0: SBA Track Utilization**

| Runway | Track | Air carrier | Fixed Wing | Helicopter |
|---|---|---|---|---|
| **Arrival** | | | | |
| 7 | Straight In | 100% | 50% | 100% |
| | Left Turn In | 0% | 50% | 0% |
| 25 | Straight In | 25% | 50% | 100% |
| | Coastal Approach | 38% | 25% | 0% |
| | Offshore Approach | 38% | 25% | 0% |
| 15L | Coastal Approach | 0% | 25% | 0% |
| | Inland Approach | 0% | 75% | 0% |
| 15L | Coastal Approach | 0% | 25% | 0% |
| | Inland Approach | 0% | 75% | 0% |
| 33L | Straight In | 0% | 100% | 0% |
| 33R | Straight In | 0% | 100% | 0% |
| **Departure** | | | | |
| 7 | Straight Out | 25% | 50% | 100% |
| | Coastal Departure | 38% | 25% | 0% |
| | Offshore Departure | 38% | 25% | 0% |
| 25 | Straight Out | 100% | 50% | 100% |
| | Right Turn Out | 0% | 50% | 0% |
| 15L | Straight Out | 0% | 100% | 0% |
| 15R | Straight Out | 0% | 100% | 0% |
| 33L | Inland Departure | 0% | 50% | 0% |
| | Coastal Departure | 0% | 50% | 0% |
| 33R | Inland Departure | 0% | 50% | 0% |
| | Coastal Departure | 0% | 50% | 0% |
| **Touch & Go** | | | | |
| 15L | Touch & Go | 0% | 100% | 0% |
| 15R | Touch & Go | 0% | 100% | 0% |
| 33L | Touch & Go | 0% | 100% | 0% |
| 33R | Touch & Go | 0% | 100% | 0% |

Source: Santa Barbara Airport and Mead & Hunt. The percentages are per runway end for each operation type.

**Figure 2.0: SBA Flight Tracks for Noise Modeling**



# RESULTING NOISE CONTOURS

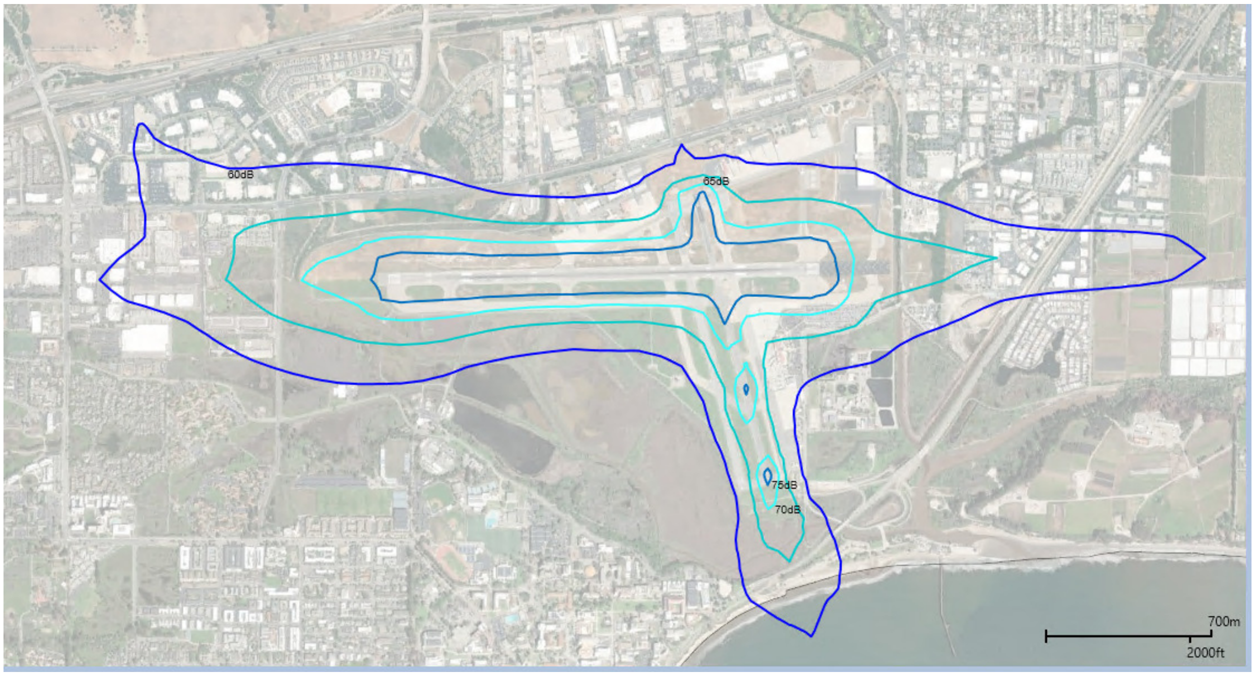
### i. Baseline (2021) Cumulative Noise Contours

The weighted CNEL metric is used to statistically predict the cumulative noise exposure levels in relationship to the land uses surrounding the Airport. However, a person does not “hear” a CNEL due to the methodology of defining the CNEL metric.

The lower the contour dB, the quieter the represented noise level; the 60dB is quieter than the 65dB. As discussed in earlier sections, the 65dB contour is the federally defined threshold for land use compatibility.

**Figure 3.0** shows the baseline (2021) noise contours at SBA. The contours shown on the figure represent the 60dB, 65dB, 70dB and 75dB contours.

**Figure 3.0: 2021 SBA Noise Contours (60dB to 70dB)**




### ii. Forecast Noise Contours

The forecasted contours are based on the aviation activity forecast from the SBA Master Plan. To summarize the three forecasted contours are:

- 2026 operations and fleet mix with the current runway layout.
- 2031 operations and fleet mix with the current runway layout.
- 2041 operations and fleet mix with Runway 15L-33R removed.

In general, the contours for the forecasted operations on the current runway layout is similar to the 2021 noise contours while growing for each modeled year. Comparing the 2021 and 2041 contours shows no more than 1000 feet of differences for the 60dB contour at the runway ends. **Figures 4.0 to 6.0** show the 2026, 2031, and 2041 noise contours.

**Figure 4.0: 2026 SBA Noise Contours – Existing Runway Layout**

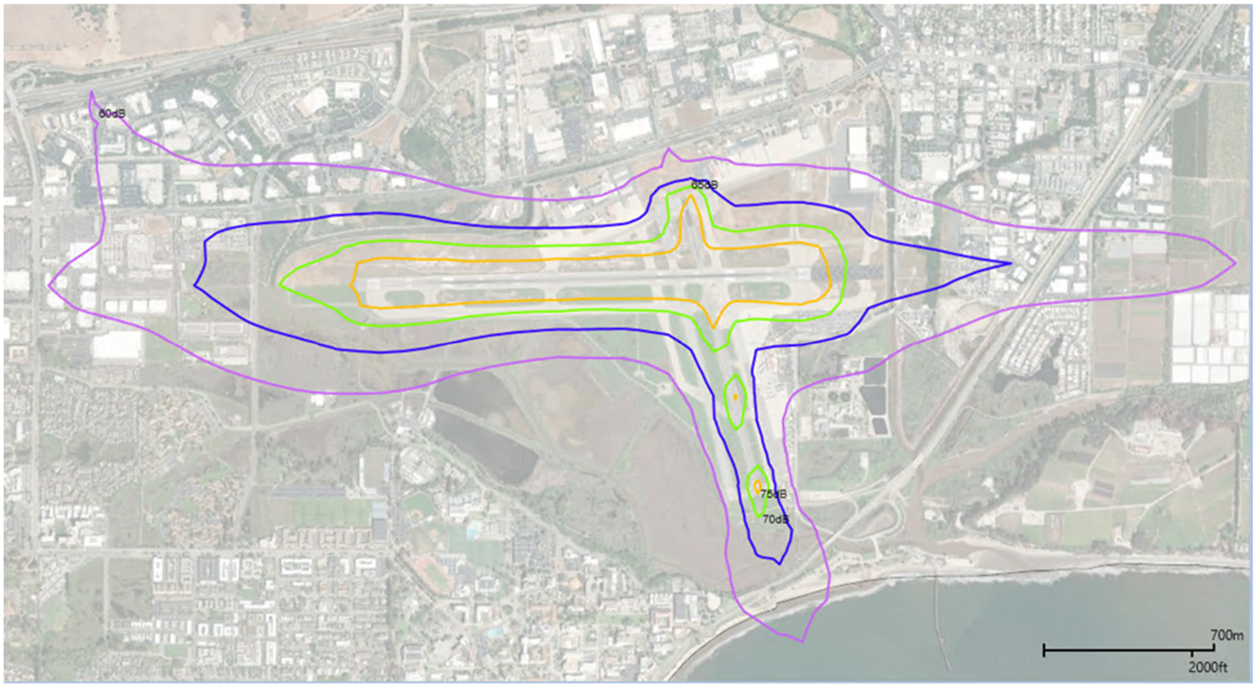



**Figure 5.0: 2031 SBA Noise Contours – Existing Runway Layout**

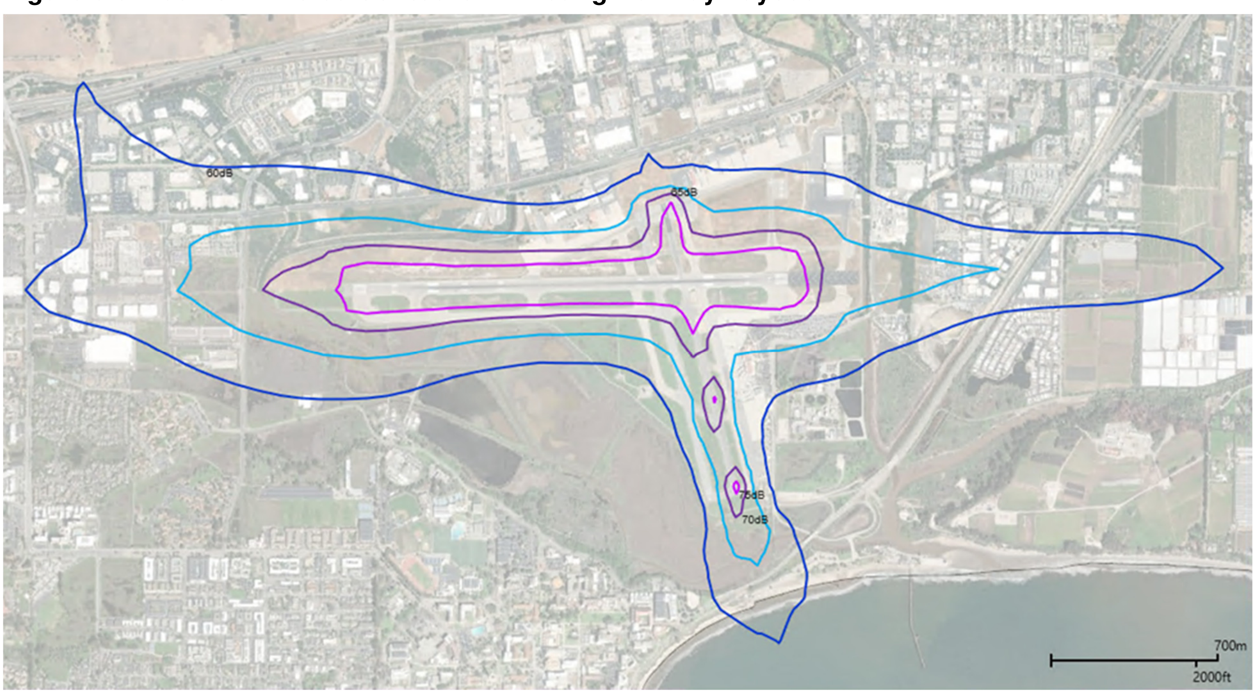
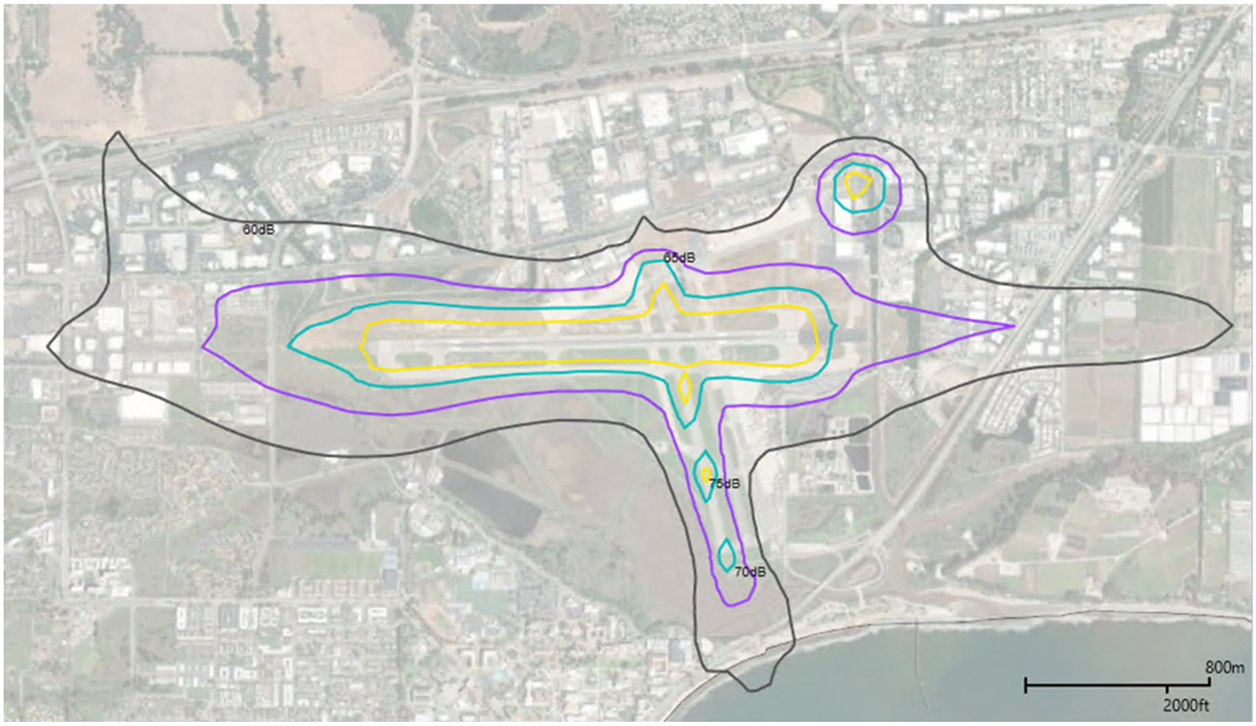


**Figure 6.0: 2041 SBA Noise Contours – Existing Runway Layout**




The main change in the 20-year forecast period is the addition of the eVTOL site north of the Runway 25 end. This site would be served by rotorcraft similar to helicopters which would create a new concentration of noise. The eVTOL aircraft are expected to operate with departures and arrival tracks parallel to straight in and out tracks for Runway 7/25.