APPENDIX E -
AIRCRAFT NOISE ANALYSIS

SALEM-WILLAMETTE VALLEY AIRPORT

Aircraft Noise Analysis

This section 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 Salem-Willamette Valley Airport (SLE or Airport).

The following subsections provide a generalized description of the existing noise exposure at SLE based on the operational levels of activity in the base year of 2024 and the projected noise levels forecasted in 2042 (20-year forecast). The 2042 forecast contours are based on the activity levels contained in the FAA approved forecast (Chapter 3).

Aircraft Noise

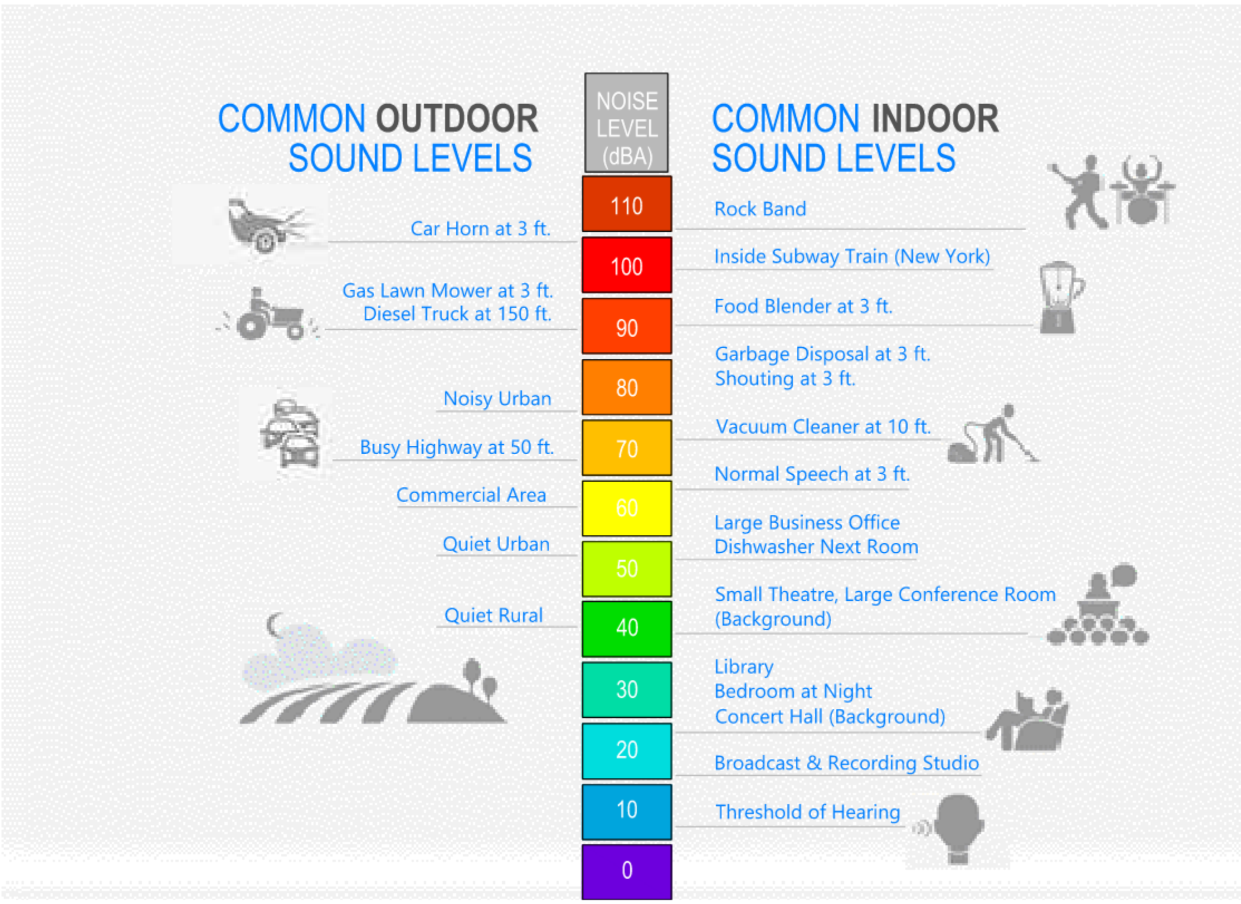
To understand airport noise and its effects on people, it is important to understand the characteristics of sound. Sound is a type of energy that travels in the form of a wave. Sound waves create minute pressure differences in the air that are recognized by the human ear or microphones. Sound waves can 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 often confuses people 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 10 dB 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**, 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: 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[1] for determining cumulative exposure of individuals to noise. The DNL

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

is the annual, 24-hour average sound level, obtained from the accumulation of all noise events, with the addition of 10 decibels to weighted sound levels from 10:00 p.m. to 7:00 a.m. The 10 dB weighting of nighttime events accounts for the fact that noise events at night are more intrusive when ambient levels are lower, and people are trying to sleep. The 24-hour DNL 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 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.

Noise Modeling Methodology

Existing aircraft noise environments for SLE were determined through computer modeling using the Federal Aviation Administration (FAA) designated Aviation Environmental Design Tool (AEDT) version 3g. The following sub-sections explain the methodology and inputs used to generate the cumulative Day-Night Noise Level (DNL) contours.

Operational data used to generate the existing noise contours was derived from the FAA OPSNET and the FAA approved forecast (*Chapter 3*). Fleet mix data was derived from information provided by airport users and the FAA’s Traffic Flow Management System Counts (TFMSC) which provides data on traffic counts by airport, based on filed flight plans or flights detected by the National Airspace System (NAS). Operations per aircraft type was determined using information from the airport and TFMSC data.

Computer Modeling

Computer modeling generates maps or tabular data of an airport’s noise environment expressed in the applicable metric, such as DNL. 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 SLE 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 that can be tailored to the characteristics of specific individual airports.

FAA Order 1050.1F requires a noise analysis that includes noise exposure maps for projects at airports with 90,000 annual piston-powered aircraft operations or 700 annual jet-powered aircraft operations that involve runway relocation, runway strengthening, or a major runway expansion. The number of operations at SLE is currently approximately 26,000 annual piston-powered aircraft operations and over 6,500 jet-powered aircraft operations.

AEDT Version 3g, 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 SLE using the baseline (2024) and forecasted 2042 operations from the FAA approved forecast (*Chapter 3*). 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

Noise Model Inputs

Airport Activity Levels and Fleet Mix

The annual number of operations per aircraft is based on a combination of information from the airport and 2024 TFMSC data. The percentage of operations by aircraft engine type was provided by the airport and used to distribute the current and forecasted operations among the representative aircraft derived from the TFMSC records. The operations are then further broken down into daily operations per aircraft type per track. Runway and track utilization percentages were based on airport and FAA records. The operation counts in AEDT are divided by aircraft models that are shown in **Table 1.**

Table 1: Operations by Representative Aircraft

Aircraft	Operation Type	Engine	2024	2042
Itinerant Operations			**26,786**	**35,336**
B737 - Boeing 737-700	Air Carrier	Jet	481	2,633
B733 - Boeing 737-300	Air Carrier	Jet	4	20
B735 - Boeing 737-500	Air Carrier	Jet	9	51
CRJ2 - Bombardier CRJ-200	Air Taxi	Jet	8	14
BE99 - Beech Airliner 99	Air Taxi	Turbine	1,981	3,597
C208 - Cessna 208 Caravan	Air Taxi	Turbine	2,153	3,910
C550 - Cessna Citation II/Bravo	General Aviation	Jet	1,617	1,886
C525 - Cessna CitationJet/CJ1	General Aviation	Jet	1,194	1,392
C25C - Cessna Citation CJ4	General Aviation	Jet	1,073	1,251
C560 - Cessna Citation V/Ultra/Encore	General Aviation	Jet	786	917
FA7X - Dassault Falcon F7X	General Aviation	Jet	786	917
C56X - Cessna Excel/XLS	General Aviation	Jet	529	617
F2TH - Dassault Falcon 2000	General Aviation	Jet	514	599
C172 - Cessna Skyhawk 172/Cutlass	General Aviation	Piston	5,440	6,346
P28A - Piper Cherokee	General Aviation	Piston	997	1,163

C182 - Cessna Skylane 182	General Aviation	Piston	997	1,163
M20P - Mooney M-20C Ranger	General Aviation	Piston	801	934
S22T - Cirrus SR-22 Turbo	General Aviation	Piston	756	881
AA5 - American AA-5 Traveler	General Aviation	Piston	378	441
BE58 - Beech 58	General Aviation	MEP	151	176
PC12 - Pilatus PC-12	General Aviation	Turbine	1,979	2,308
BE20 - Beech 200 Super King	General Aviation	Turbine	519	605
BE9L - Beech King Air 90	General Aviation	Turbine	398	464
TBM9 - Socata TBM	General Aviation	Turbine	374	436
B350 - Beech Super King Air 350	General Aviation	Turbine	338	394
R44 - Robinson R-44 Raven	General Aviation	Heli	256	298
EC35 - Eurocopter EC-135	General Aviation	Heli	70	81
EC45 - Eurocopter EC-145	General Aviation	Heli	23	27
H60 - Sikorsky SH-60 Seahawk	Military	Heli	956	795
EC35 - Eurocopter EC-135	Military	Heli	395	329
EC45 - Eurocopter EC-145	Military	Heli	211	176
H47 - Boeing CH-47 Chinook	Military	Heli	86	71
F15 - Boeing F-15 Eagle	Military	Jet	38	32
BE20 - Beech 200 Super King	Military	Turbine	490	408
Touch and Go Operations			**17,873**	**20,686**
C172 - Cessna Skyhawk 172/Cutlass	General Aviation	Piston	12,121	14,523
P28A - Piper Cherokee	General Aviation	Piston	2,222	2,663
C150 - Cessna 150	General Aviation	Piston	2,222	2,663
H60 - Sikorsky SH-60 Seahawk	Military	Heli	1,307	838
Total Operations			**44,659**	**56,022**

Sources: OPSNET, TFMSC, Mead & Hunt

Airport Utilization

Determining the frequency each runway end is used is important in generating accurate noise contours. **Table 2** shows the modeled runway end utilization at SLE. The utilization differs for jet aircraft which exclusively use Runway 13/31 while non-jet aircraft also utilize Runway 16/34.

Table 2: Runway Utilization

Runway End	Non-Jet		Jet	
	Departures	Arrivals	Departures	Arrivals
13	15.8%	10.6%	60.8%	27.7%
31	10.2%	27.6%	39.2%	72.3%
16	9.9%	15.9%	0%	0%
34	64.1%	45.9%	0%	0%

Sources: Airport and FAA records

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, the ATCT 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 mark-ups on aerial maps as well as written and verbal explanation. The percentage of tracks used per runway end is shown in **Table 3** with the track locations for the current Airport layout illustrated in **Figure 2**.

Figure 2: SLE Traffic Patterns

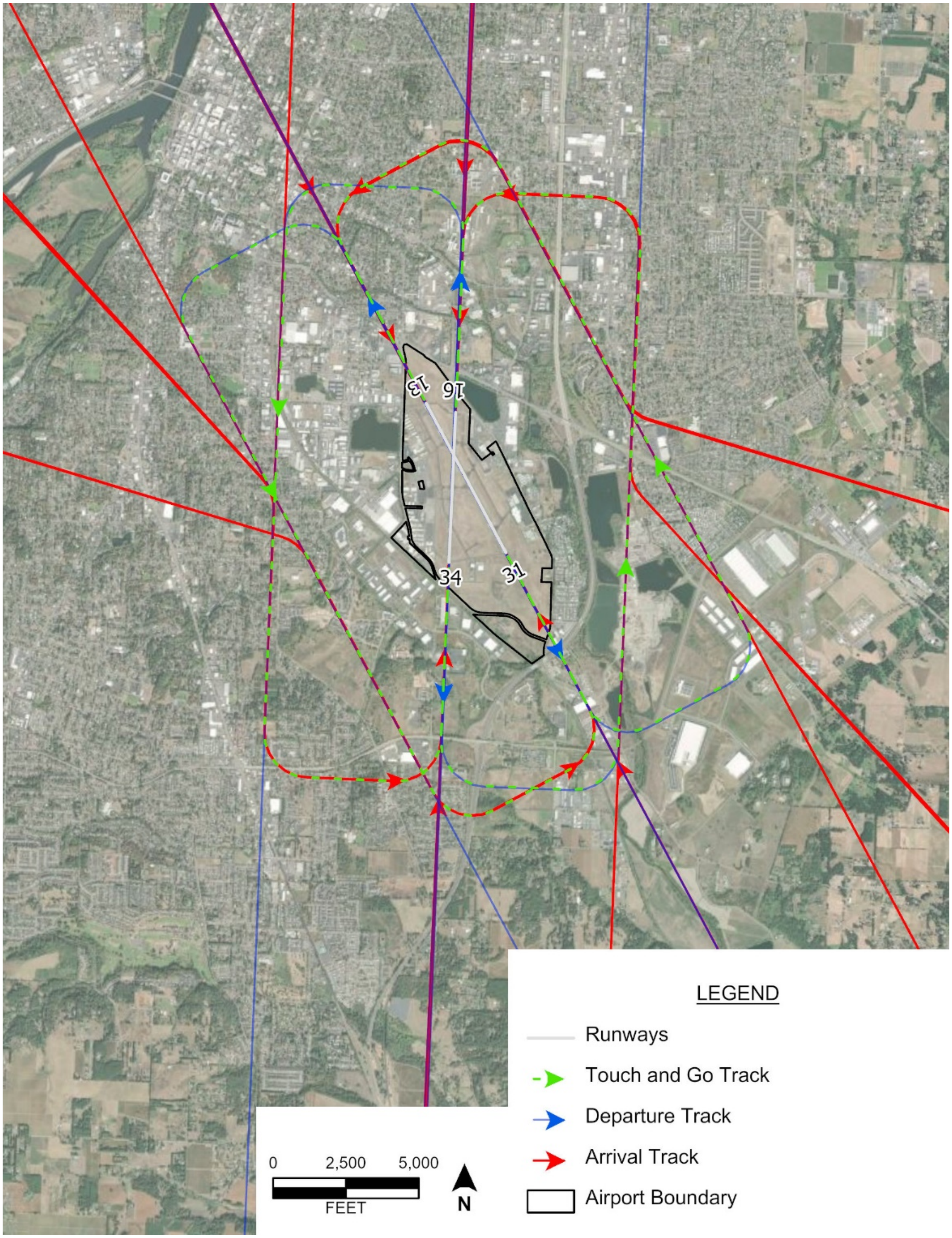


Table 3: SLE Track Utilization

Tracks	Track Utilization
Departures	**All Aircraft**
13 Straight Out	Based on runway utilization
31 Straight Out	Based on runway utilization
16 Straight Out	Based on runway utilization
34 Straight Out	Based on runway utilization
Arrivals	**All Aircraft**
13 Straight In	50%
31 Straight In	50%
16 Straight In	50%
34 Straight In	50%
13 Down Wind	50%
31 Down Wind	50%
16 Down Wind	50%
34 Down Wind	50%
Touch and Go	**Piston and Heli**
13 Touch and Go	Based on runway utilization
31 Touch and Go	Based on runway utilization
16 Touch and Go	Based on runway utilization
34 Touch and Go	Based on runway utilization

The track utilization percentages are multiplied by the runway utilization percentages to determine the number of operations taking place on each track. All departure tracks are modeled as straight out. Arrival tracks consisted of straight in tracks and downwind approach tracks. Arrival tracks for all runways were modeled to have even distribution between straight in operations and operations that used the downwind approach track.

Operations by Time of Day

The time of day or night that aircraft operate is an important component to the AEDT model. Every aircraft operation that occurs between 10 p.m. and 7 a.m. has 10 dB added to the aircraft noise level. This effectively doubles the noise level signifying that noise is more intrusive at night.

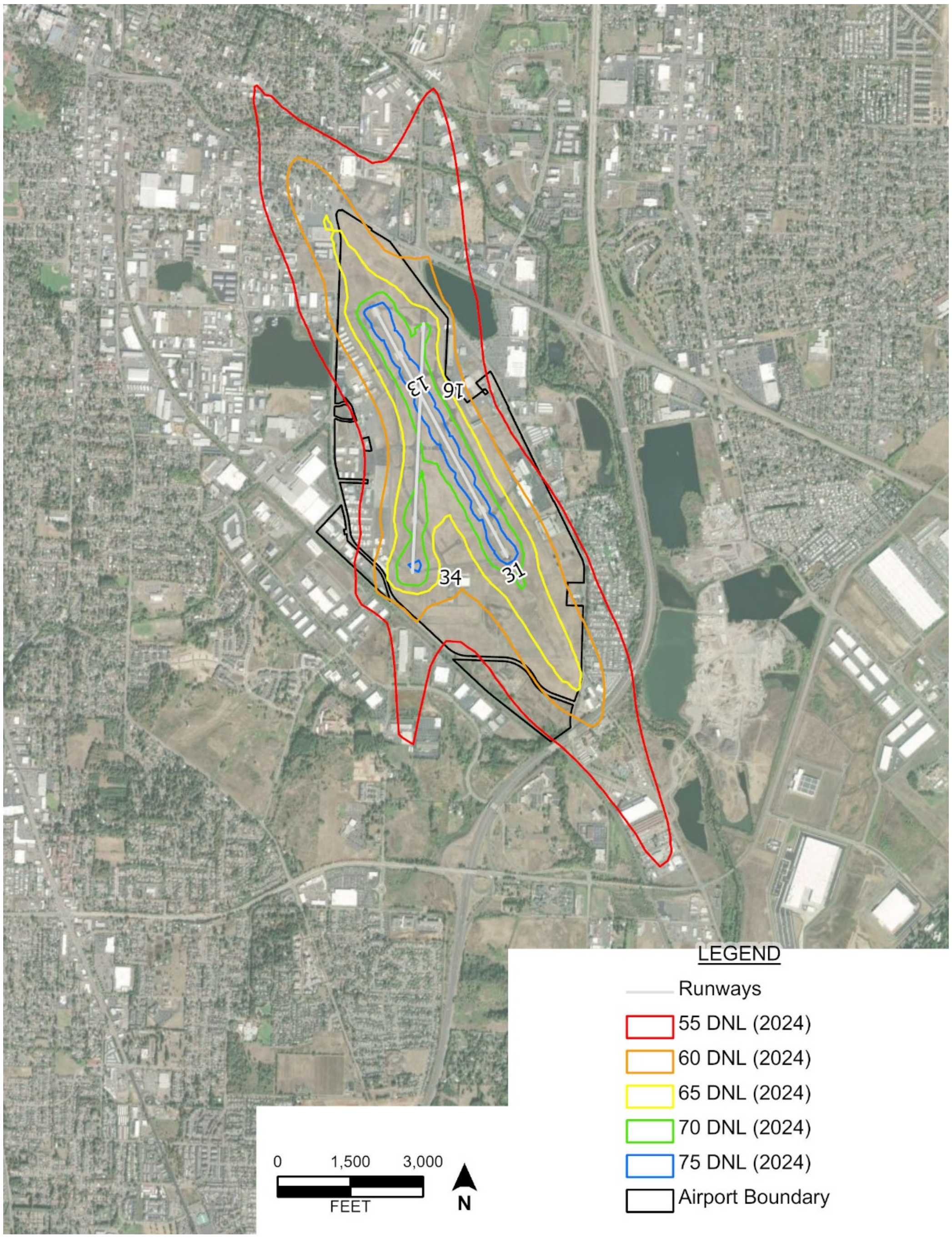
Conversations with Airport management and air traffic control personnel helped determine the ratio between daytime and nighttime activity. Commercial jet operations and touch and go operations were modeled to exclusively operate during the day while the rest of the operations were 95 percent during the day and 5 percent during the night.

Noise Contour Results

The weighted DNL metric is used to statistically predict the cumulative noise exposure levels in relationship to the land uses surrounding the Airport. A person does not “hear” a DNL due to the methodology of defining the DNL metric. The lower the contour dB, the quieter the represented noise level; the 60 DNL is quieter than the 65 DNL. As discussed in earlier sections, the 65 DNL contour is the federally defined threshold for land use compatibility.

Figure 3 shows the baseline (2024) noise contours at SLE. The 55 DNL, 60 DNL and most of 65 DNL contours are within the SLE property lines.

Figure 3: Base Year 2024 Noise Contours (75 DNL to 55 DNL)

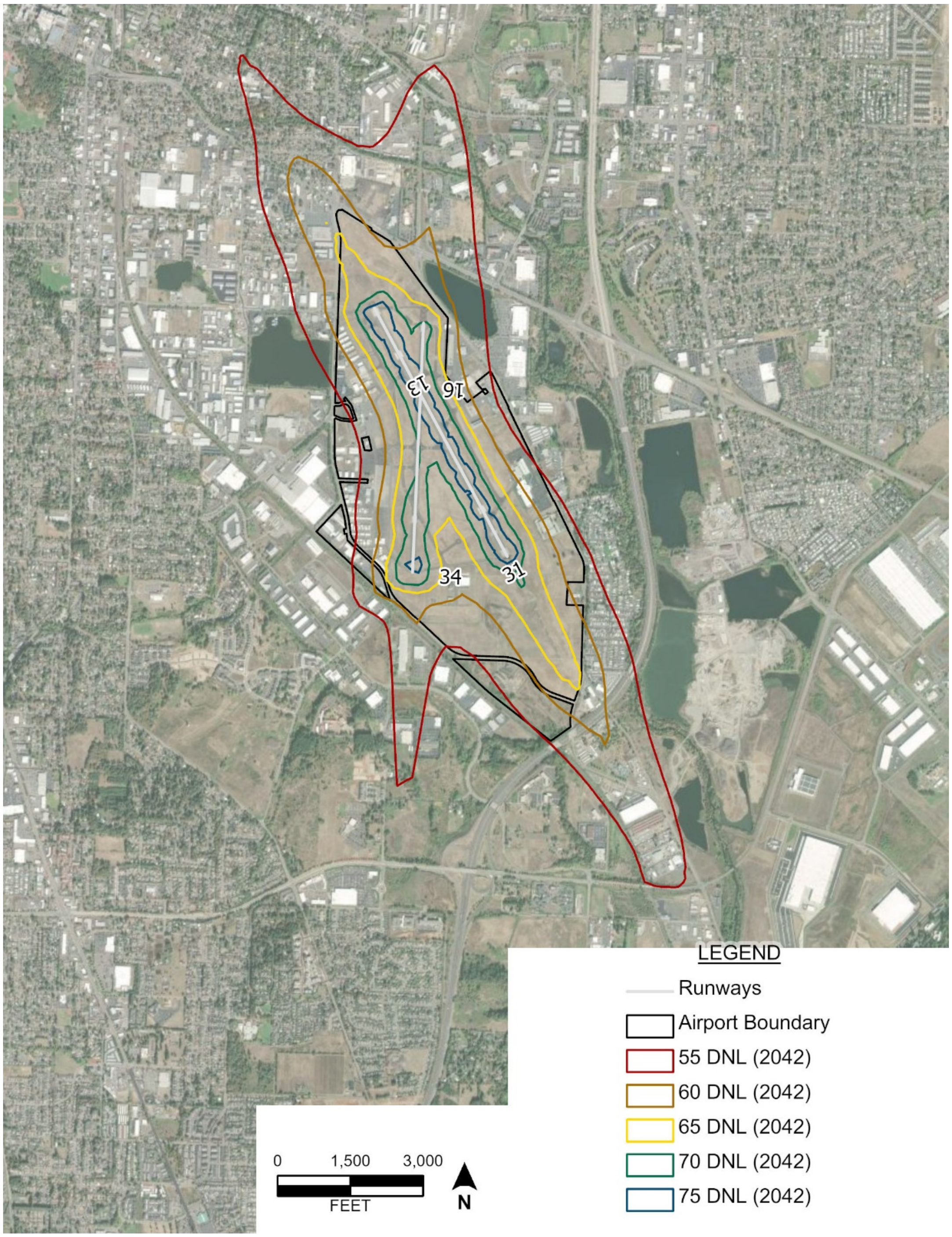


Source: Mead & Hunt

Forecasted Noise Contours

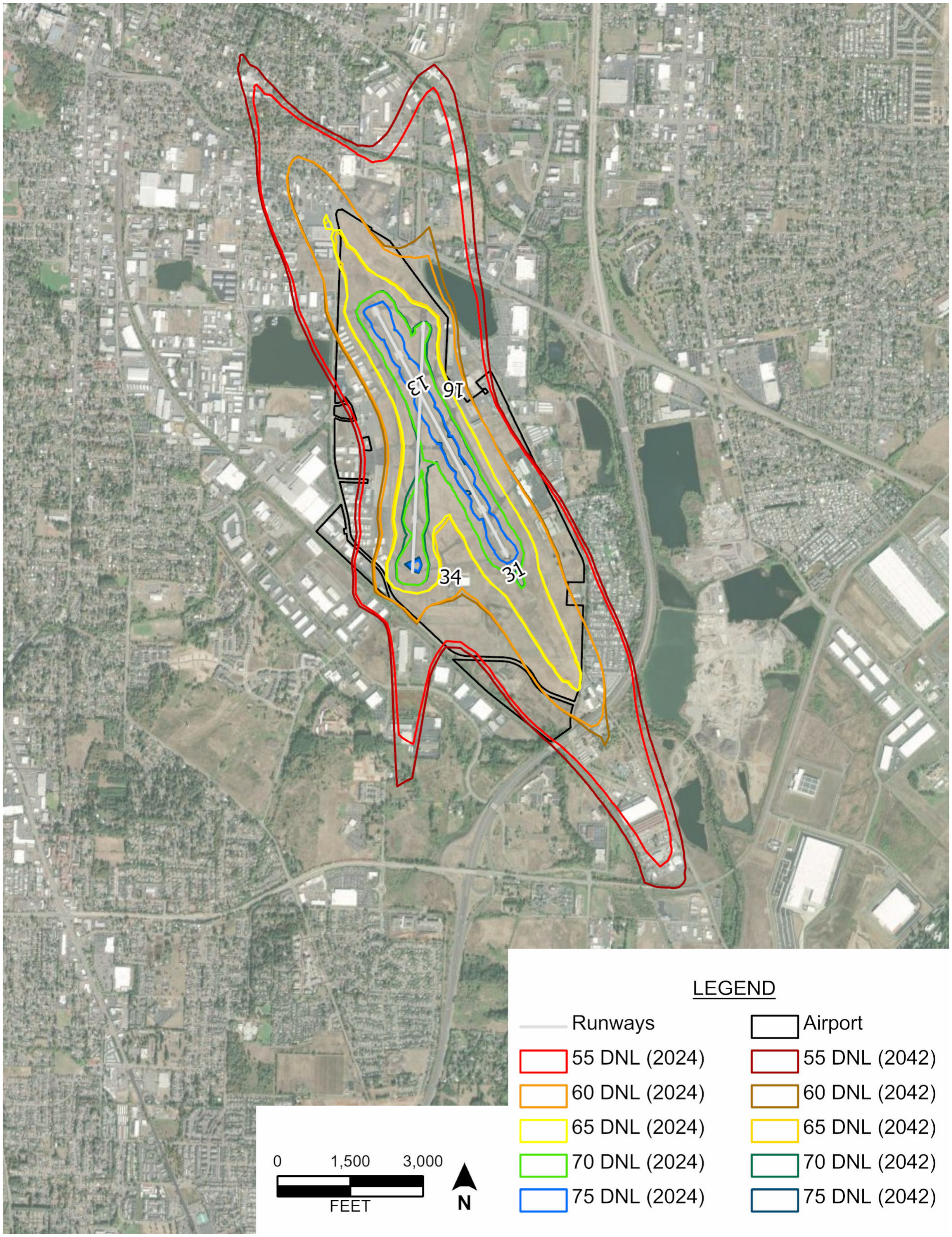
Figure 4 shows the projected noise contours for operation levels forecasted for 2042. **Figure 5** compares the contours in 2024 to those in 2042. Even with an increase in operation counts, the noise impact is not expected to change significantly with the 55 DNL, 60 DNL and most of 65 DNL contours remaining within airport property lines.

Figure 4: Base Year 2042 Noise Contours (75 DNL to 55 DNL)



Source: Mead & Hunt

Figure 5: 2024 and 2042 Noise Contour Comparison (75 DNL to 55 DNL)



Source: Mead & Hunt