Paine Field Master Plan 2040

Appendix E | Existing Noise Modeling Methodology & Results

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PREPARED FOR
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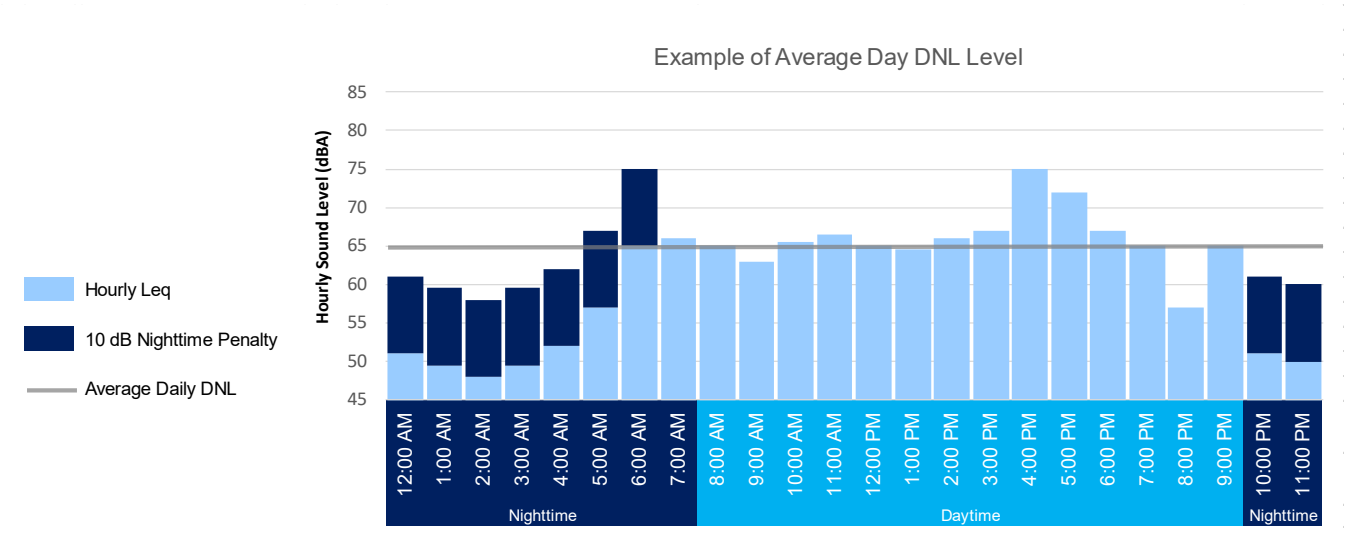
E.Existing Noise Modeling Methodology and Results Environmental Attachments

The following report describes the noise modeling methodology and assumptions for the Existing (2019) Noise Exposure Contours for the Paine Field Airport (PAE or Airport) Master Plan. After review and approval of this analysis by the County, additional noise exposure contours will be prepared for PAL 2 and PAL 3. The analysis of noise exposure for this Master Plan is being prepared using the Federal Aviation Administration (FAA) Aviation Environmental Design Tool (AEDT) Version 3d. Inputs to the AEDT include runway definition, number of aircraft operations during the time period evaluated, the types of aircraft flown, the time of day when they are flown, how frequently each runway is used for arriving and departing aircraft, the routes of flight used when arriving to and departing from the runways, and departure profiles. Data was developed to represent an existing (2019) average-annual day at PAE. Terrain data was obtained from the U.S. Geological Survey and uploaded into AEDT to processing and use in the noise exposure contour modeling. The AEDT calculates noise exposure in the vicinity of an airport and outputs contours of noise exposure using the Day/Night Average Sound Level (DNL) metric. The DNL is the A-weighted equivalent sound level for a 24-hour period with an additional 10 dB imposed on the equivalent sound levels for nighttime hours of 10:00 p.m. to 7:00 a.m.

The exhibit below provides an example of the application of the DNL nighttime penalty in the calculation of average day sound levels.

Exhibit 1 Example of Average Daily Noise Levels (DNL) With Nighttime Penalty



Source: Federal Aviation Administration, Fundamentals of Noise and Sound, Online at: https://www.faa.gov/regulations_policies/policy_guidance/noise/basics; Landrum & Brown, 2022.

E.1 Existing (2019) Noise Exposure Contour Input Data

E.1.1 Runway Definition

PAE has two parallel runways (16L/34R and 16R/34L) spaced approximately 3,400 feet apart. Runway 16R/34L is the longest runway on the airfield at 9,010 feet in length and is 150 feet wide. Runway 16L/34R is 3,004 feet long and 75 feet wide, and primarily used by general aviation propeller aircraft. The following provides the current runways and lengths at PAE:

Runway	Length (feet)
16R/34L	9,010
16L/34R	3,004

E.1.1 Number of Operations and Fleet Mix

The number of annual operations at PAE was based on data obtained from the Paine Field Master Plan Forecast, dated August 2021 (Master Plan Forecast). The base year for the forecast was 2019. This year was selected to show current conditions prior to the effects of the COVID-19 pandemic. The Master Plan Forecast included 137,995 total annual operations in 2019.,Tthere are 378.1 average-annual day operations.

Specific aircraft types and times of operation were developed from data located in the “Final Environmental Assessment for Amendment to the Operations Specifications for Air Carrier Operations and Amendment to Part 139 Airport Operating Certificate”, February 2019 (2019 EA), Official Airline Guide (OAG) data, and data from the Airport’s flight tracking system database. **Table 1** provides a summary of the average annual day operations by aircraft category and time of day that was used to model the Existing (2019) Noise Exposure Contour. **Table 2** shows the average daily number of arrivals and departures by time of day and individual aircraft type.

The time of day indicates operations that either occurred during the daytime (7:00 a.m. to 9:59 p.m.) or nighttime (10:00 p.m. to 6:59 a.m.) based on the definition used for the Day-Night Average Sound Level (DNL) noise metric. The DNL metric describes the total noise exposure during a 24-hour period. For this analysis, the DNL level is based on an average-annual day. In computing DNL, an extra weight of 10 decibels (dB) is assigned to any aircraft operations occurring during the nighttime the hours of 10:00 p.m. through 6:59 a.m. This is intended to account for the greater annoyance that nighttime noise is presumed to cause for most people. The majority of scheduled passenger operations (>90 percent) at PAE occur between 6:00 a.m. to 6:69 a.m. and 10:00 p.m. to 11:59 p.m.

Table 1 Summary of Average-Annual Day Operations – Existing (2019) Noise Exposure Contour

Aircraft Category	Arrivals		Departures		Touch & Go's		Total	Percent of Total
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime		
Widebody Jets	0.9	0.0	0.9	0.0	0.0	0.0	1.8	0.5%
Narrowbody Jets	19.8	5.6	23.2	2.2	0.0	0.0	50.9	13.5%
Regional Jets	7.7	0.5	7.5	0.6	0.0	0.0	16.3	4.3%
GA & Commuter Props	127.0	1.8	124.3	4.5	48.4	0.6	306.7	81.1%
Military Aircraft	1.2	0.0	1.2	0.0	0.0	0.0	2.3	0.6%
Helicopters	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.0%
Total	156.7	7.9	157.2	7.3	48.4	0.6	378.1	100.0%

Notes: Total may not equal sum total due to rounding.
Daytime = 7:00am – 9:59pm, Nighttime = 10:00pm – 6:59am.
Touch & Go operations include one landing and one takeoff; therefore, the number of touch & go operations in the noise model is one-half the number shown in the above table.

Sources: Paine Field Master Plan Forecast, August 2021 and Final Environmental Assessment for Amendment to the Operations Specifications for Air Carrier Operations and Amendment to Part 139 Airport Operating Certificate", February 2019; Official Airline Guide, PAE Flight Tracking Data, 2019-2021.

Table 2 Average-Annual Day Operations by Aircraft Type – Existing (2019) Noise Exposure Contour

Aircraft Type	Arrivals		Departures		Touch & Go's		Total
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime	
Widebody Jets							
Airbus A330-200 Series	0.01	0.00	0.01	0.00	0.00	0.00	0.03
Boeing 747-200 Series Freighter	0.02	0.00	0.02	0.00	0.00	0.00	0.04
Boeing 747-400 Series	0.26	0.00	0.26	0.00	0.00	0.00	0.53
Boeing 747-8F	0.05	0.00	0.05	0.00	0.00	0.00	0.09
Boeing 767-300 ER	0.10	0.00	0.09	0.00	0.00	0.00	0.19
Boeing 777-200 Series	0.03	0.00	0.03	0.00	0.00	0.00	0.06
Boeing 777-300 ER	0.15	0.00	0.15	0.00	0.00	0.00	0.31
Boeing 777-300 Series	0.06	0.00	0.06	0.00	0.00	0.00	0.12
Boeing 787-8 Dreamliner	0.21	0.00	0.18	0.03	0.00	0.00	0.43
Subtotal	0.89	0.00	0.86	0.03	0.00	0.00	1.79
Narrowbody Jets							
Airbus A319-100 Series	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Airbus A320-200 Series	0.01	0.00	0.01	0.00	0.00	0.00	0.03
Boeing 737-400 Series	0.02	0.00	0.02	0.00	0.00	0.00	0.04
Boeing 737-700 Series	0.65	0.55	1.07	0.13	0.00	0.00	2.40
Boeing 737-8	0.01	0.00	0.01	0.00	0.00	0.00	0.03
Boeing 737-800 with winglets	0.27	0.05	0.26	0.05	0.00	0.00	0.63
Embraer ERJ170-LR	18.51	4.31	20.83	1.99	0.00	0.00	45.64
Boeing 737-300 Series Freighter	0.01	0.00	0.01	0.00	0.00	0.00	0.02
Boeing 757-200 Series Freighter	0.36	0.68	1.03	0.01	0.00	0.00	2.08
Subtotal	19.84	5.59	23.25	2.19	0.00	0.00	50.87

Table 2 Average-Annual Day Operations by Aircraft Type – Existing (2019) Noise Exposure Contour, *(Continued)*

Aircraft Type	Arrivals		Departures		Touch and Go's		Total
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime	
Regional Jets							
1985 BUSINESS JET	0.19	0.03	0.22	0.00	0.00	0.00	0.44
Bombardier Challenger 600	0.51	0.04	0.55	0.00	0.00	0.00	1.09
Bombardier Challenger 601	0.49	0.04	0.52	0.00	0.00	0.00	1.04
Bombardier Global 5000	0.14	0.01	0.14	0.01	0.00	0.00	0.30
Bombardier Global Express	0.02	0.00	0.01	0.00	0.00	0.00	0.03
Bombardier Learjet 25	0.02	0.00	0.02	0.00	0.00	0.00	0.05
Bombardier Learjet 35	1.30	0.19	1.49	0.00	0.00	0.00	2.97
Cessna 500 Citation I	0.91	0.00	0.76	0.15	0.00	0.00	1.82
Cessna 525C CitationJet	0.08	0.00	0.08	0.00	0.00	0.00	0.16
Cessna 550 Citation II	0.47	0.03	0.23	0.28	0.00	0.00	1.01
Cessna 560 Citation Encore	0.04	0.00	0.04	0.00	0.00	0.00	0.10
Cessna 560 Citation Excel	0.38	0.01	0.33	0.06	0.00	0.00	0.79
Cessna 560 Citation Ultra	0.16	0.01	0.16	0.01	0.00	0.00	0.35
Cessna 650 Citation III	0.30	0.00	0.27	0.03	0.00	0.00	0.60
Cessna 680 Citation Sovereign	0.23	0.01	0.21	0.03	0.00	0.00	0.47
Cessna 750 Citation X	0.99	0.05	1.04	0.00	0.00	0.00	2.07
Cessna Citation 510	0.49	0.00	0.49	0.00	0.00	0.00	0.98
Dassault Falcon 20-F	0.01	0.00	0.01	0.00	0.00	0.00	0.02
Eclipse 500	0.10	0.01	0.11	0.00	0.00	0.00	0.22
Embraer ERJ145-XR	0.01	0.00	0.01	0.00	0.00	0.00	0.02
Gulfstream IV-SP	0.47	0.03	0.48	0.01	0.00	0.00	1.00
Gulfstream V-SP	0.16	0.01	0.16	0.00	0.00	0.00	0.33
Israel IAI-1125 Astra	0.13	0.00	0.13	0.00	0.00	0.00	0.27
Raytheon Beechjet 400	0.09	0.00	0.08	0.01	0.00	0.00	0.18
Subtotal	7.68	0.48	7.55	0.61	0.00	0.00	16.31

Table 2 Average-Annual Day Operations by Aircraft Type – Existing (2019) Noise Exposure Contour, *(Continued)*

Aircraft Type	Arrivals		Departures		Touch and Go's		Total
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime	
General Aviation & Commuter Propeller Aircraft							
Boeing DC-3	0.11	0.00	0.11	0.00	0.00	0.00	0.22
Bombardier de Havilland Dash 8 Q100	0.23	0.00	0.23	0.00	0.00	0.00	0.46
Bombardier de Havilland Dash 8 Q400	0.01	0.00	0.01	0.00	0.00	0.00	0.02
Cessna 172 Skyhawk	24.72	0.60	25.32	0.00	0.00	0.00	50.63
Cessna 182	3.89	0.03	3.77	0.15	0.00	0.00	7.84
Cessna 206	1.27	0.02	1.29	0.00	0.40	0.01	2.97
Cessna 208 Caravan	5.52	0.17	4.98	0.71	0.00	0.00	11.39
Cessna 441 Conquest II	2.62	0.00	2.56	0.06	2.00	0.03	7.27
Cirrus SR22	1.22	0.01	1.09	0.15	0.00	0.00	2.47
Embraer EMB120 Brasilia	0.01	0.00	0.01	0.00	0.00	0.00	0.03
Piper PA-28 Cherokee Series	64.71	0.49	62.30	2.90	34.47	0.45	165.31
Piper PA-30 Twin Comanche	1.42	0.00	1.42	0.00	0.00	0.00	2.85
Piper PA-42 Cheyenne Series	0.82	0.00	0.82	0.00	0.00	0.00	1.63
Raytheon Beech Baron 58	5.74	0.13	5.87	0.00	3.14	0.04	14.92
Raytheon Beech Bonanza 36	13.31	0.32	13.31	0.32	8.36	0.11	35.73
Raytheon Super King Air 300	1.42	0.04	1.24	0.23	0.00	0.00	2.93
Subtotal	127.01	1.82	124.32	4.51	48.36	0.64	306.66

Table 2 Average-Annual Day Operations by Aircraft Type – Existing (2019) Noise Exposure Contour, *(Continued)*

Aircraft Type	Arrivals		Departures		Touch and Go's		Total
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime	
Military Aircraft							
Beech Mentor (BE45)	0.04	0.00	0.04	0.00	0.00	0.00	0.08
Boeing 707-300 Series	0.04	0.00	0.04	0.00	0.00	0.00	0.08
Boeing DC-9-30 Series	0.79	0.00	0.79	0.00	0.00	0.00	1.57
Boeing F/A-18 Hornet	0.16	0.00	0.16	0.00	0.00	0.00	0.31
Lockheed P-3 Orion	0.13	0.00	0.13	0.00	0.00	0.00	0.25
Subtotal	1.15	0.00	1.15	0.00	0.00	0.00	2.31
Helicopters							
Agusta A-109	0.014	0.00	0.014	0.00	0.00	0.00	0.03
Bell 206B-3	0.014	0.00	0.014	0.00	0.00	0.00	0.03
Bell 407	0.014	0.00	0.014	0.00	0.00	0.00	0.03
Hughes 500D	0.014	0.00	0.014	0.00	0.00	0.00	0.03
Robinson R44 Raven	0.014	0.00	0.014	0.00	0.00	0.00	0.03
Subtotal	0.071	0.00	0.071	0.00	0.00	0.00	0.14
Total	156.7	7.9	157.2	7.3	48.4	0.6	378.1

Notes: Total may not equal sum total due to rounding.
Daytime = 7:00am – 9:59pm, Nighttime = 10:00pm – 6:59am.
Touch & Go operations include one landing and one takeoff; therefore, the number of touch & go operations in the noise model is one-half the number shown in the above table.

Sources: Paine Field Master Plan Forecast, August 2021 and Final Environmental Assessment for Amendment to the Operations Specifications for Air Carrier Operations and Amendment to Part 139 Airport Operating Certificate", February 2019; Official Airline Guide, PAE Flight Tracking Data, 2019-2021.

D.1.1 Runway End Utilization

The Airport operates in either north flow or south flow. In north flow, aircraft land and takeoff on Runways 34L and 34R. In south flow, aircraft land and takeoff on Runways 16L and 16R. Average-annual runway end utilization was obtained from the Airport's flight tracking systems database, which includes flight information including the type of aircraft, time of day, and runway end used for each flight operation. Average annual runway use was determined based on data from January 1, 2019 through December 31, 2021. Runway use percentages were summarized by aircraft category. **Table 3** provides a summary of the percentage of use by each aircraft category on each of the runways at PAE during the daytime (7:00 a.m. – 9:59 p.m.) and nighttime (10:00 p.m. – 6:59 a.m.) periods.

Table 3 Existing Runway End Utilization – Existing (2019) Noise Exposure Contour

Aircraft Category	Runway End				Total
	16L	34R	16R	34L	
Daytime Arrivals					
Widebody Jets	0.0%	0.0%	64.7%	35.3%	100.0%
Narrowbody Jets	0.0%	0.0%	65.7%	34.3%	100.0%
Regional Jets	0.0%	0.0%	60.0%	40.0%	100.0%
General Aviation Propeller Aircraft	14.8%	18.0%	32.7%	34.4%	100.0%
Military Aircraft	0.0%	0.0%	65.7%	34.3%	100.0%
Nighttime Arrivals					
Widebody Jets	0.0%	0.0%	82.4%	17.6%	100.0%
Narrowbody Jets	0.0%	0.0%	59.3%	40.7%	100.0%
Regional Jets	0.0%	0.0%	60.6%	39.4%	100.0%
General Aviation Propeller Aircraft	1.4%	2.5%	32.3%	63.9%	100.0%
Military Aircraft	0.0%	0.0%	0.0%	0.0%	0.0%
Daytime Departures					
Widebody Jets	0.0%	0.0%	64.6%	35.4%	100.0%
Narrowbody Jets	0.0%	0.0%	67.4%	32.6%	100.0%
Regional Jets	0.0%	0.0%	60.1%	39.9%	100.0%
General Aviation Propeller Aircraft	16.9%	18.7%	32.5%	32.0%	100.0%
Military Aircraft	0.0%	0.0%	67.4%	32.6%	100.0%
Nighttime Departures					
Widebody Jets	0.0%	0.0%	82.4%	17.6%	100.0%
Narrowbody Jets	0.0%	0.0%	59.3%	40.7%	100.0%
Regional Jets	0.0%	0.0%	60.6%	39.4%	100.0%
General Aviation Propeller Aircraft	1.3%	2.4%	35.1%	61.2%	100.0%
Military Aircraft	0.0%	0.0%	0.0%	0.0%	0.0%
Daytime Touch and Go's					
General Aviation Props	17.4%	19.3%	31.5%	31.8%	100%
Nighttime Touch and Go's					
General Aviation Props	1.5%	2.7%	29.7%	66.1%	1.5%

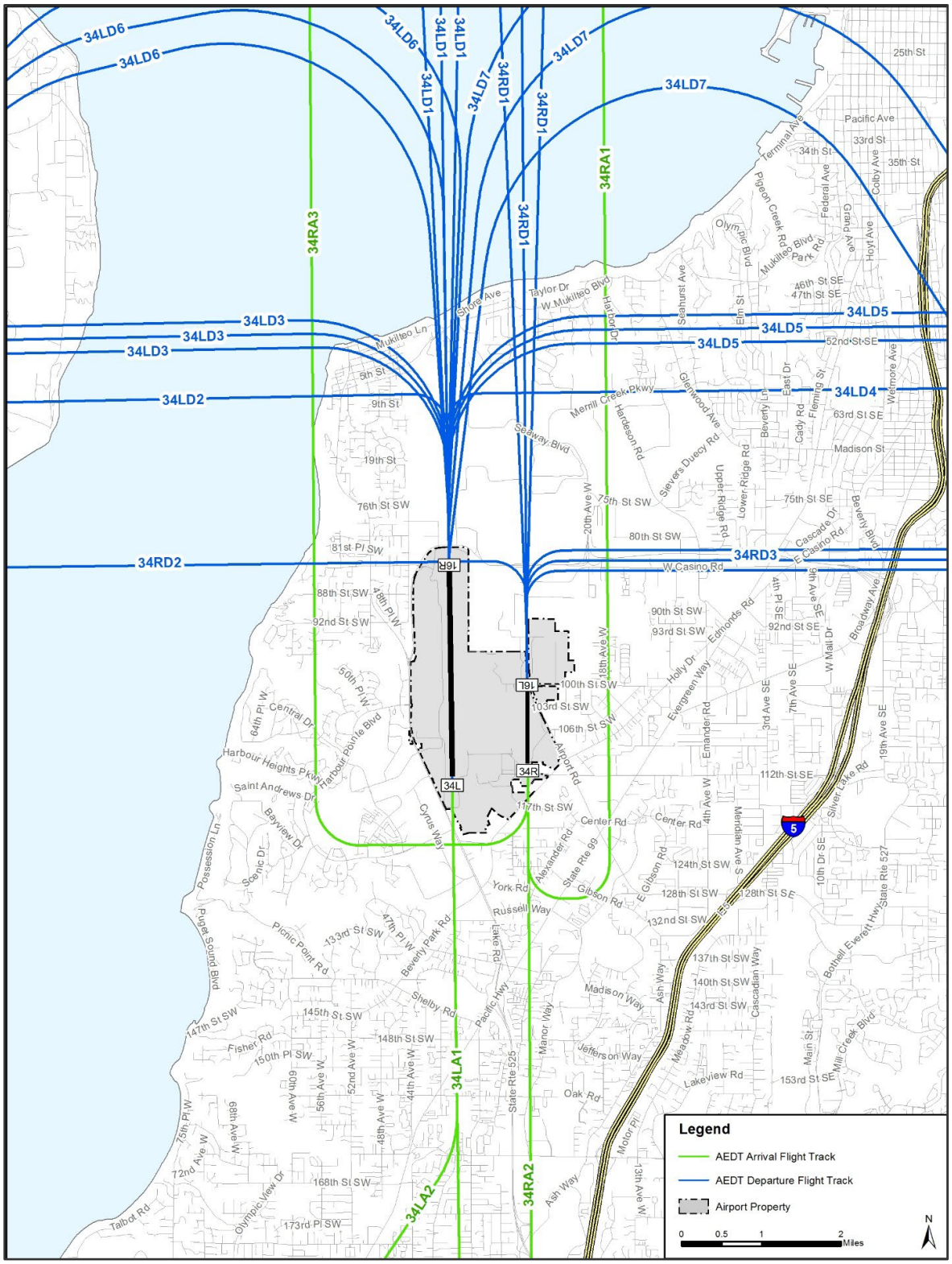
Notes: Daytime = 7:00 a.m. – 9:59 p.m., Nighttime = 10:00 p.m. – 6:59 a.m.
Total may not equal sum total due to rounding.
Source: PAE Flight Tracking Data, 2019-2021; Landrum & Brown analysis, 2022.

E.1.2 Flight Tracks

A flight track is the path over the ground as an aircraft flies to or from the Airport. For this Master Plan, the existing flight tracks were evaluated to ensure that the flight tracks used in the modeling of aircraft noise are representative of where aircraft are flying at PAE. Flight track locations and percent distribution for the Existing Noise Exposure Contour were primarily taken from the 2019 EA with adjustments made based on radar data from commercially available ADSB tracking sites to account for actual flight tracks used by scheduled commercial passenger and cargo aircraft.

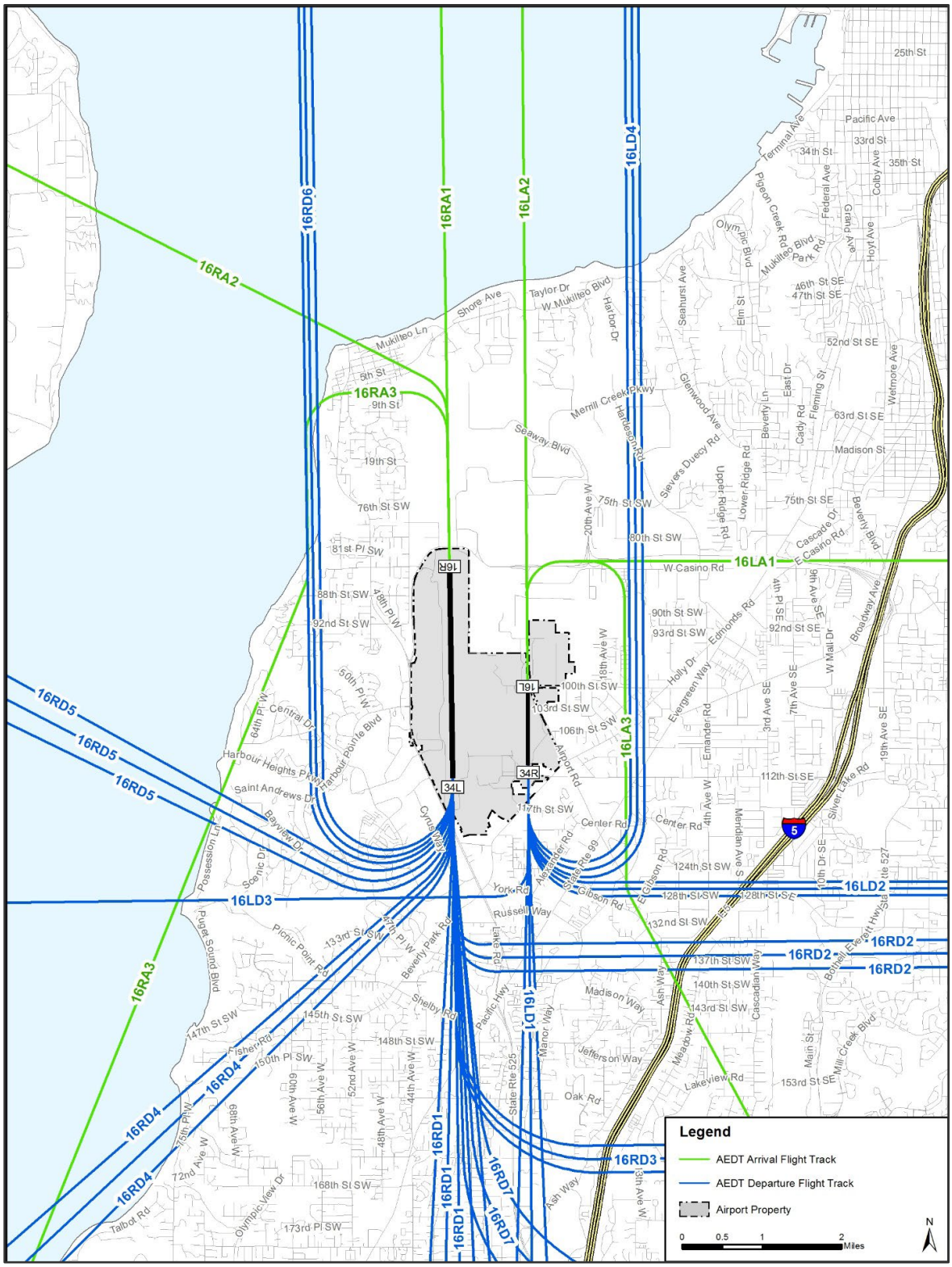
In order to model the flight corridors in AEDT, consolidated flight tracks were developed. The following exhibits show the AEDT consolidated flight tracks used for the Existing Noise Exposure Contour. Each flight track is given a unique flight track ID that is used in the noise model. **Exhibit 2** shows north flow arrival and departure tracks. **Exhibit 3** shows south flow arrival and departure tracks. **Exhibit 4** shows touch-and-go flight tracks typically conducted by small fixed-wing aircraft for training purposes and helicopter flight tracks. Each of these exhibits show the flight tracks represented by two-dimensional lines leading to or from the runway or helicopter landing area at PAE. Each track is labeled with the unique flight track ID. Several flight tracks include a “backbone” track and subtrack to represent flight corridors. **Table 4** and **Table 5** present the percentage of flight track use by each aircraft category and total of all flights (Grand Total) for each of the runways at PAE for arrivals and departures respectively. **Table 6** includes the percentage of flight track use by touch-and-go operations conducted by general aviation propeller aircraft. The tables include the flight track ID and the percent time each flight track is used by each aircraft type in the noise model.

Exhibit 2 North Flow Aircraft Flight Tracks



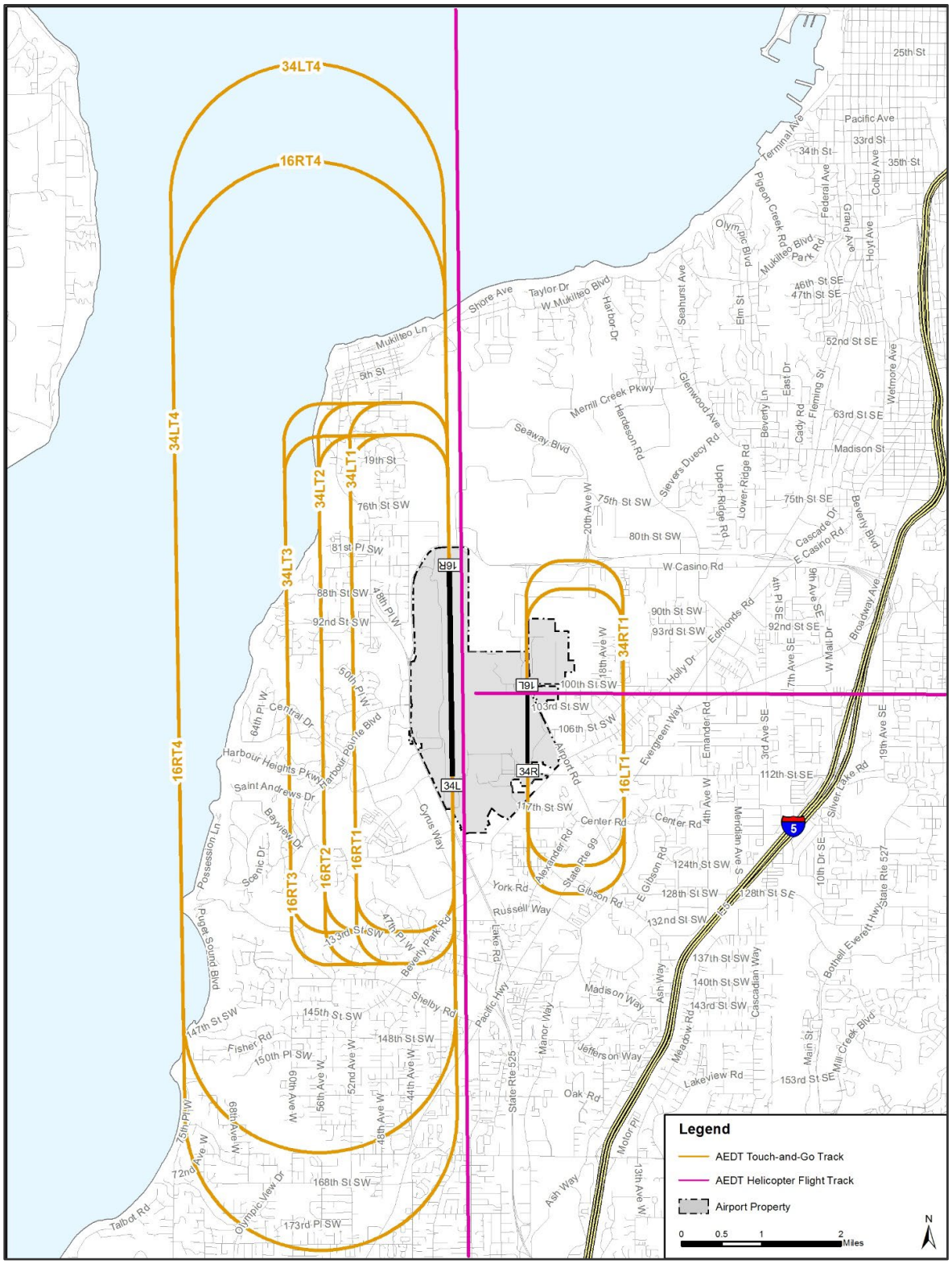
Source: Final Environmental Assessment for Amendment to the Operations Specifications for Air Carrier Operations and Amendment to Part 139 Airport Operating Certificate", February 2019; flightradar24.com, Landrum & Brown analysis, 2022.

Exhibit 3 South Flow Aircraft Flight Tracks



Source: Final Environmental Assessment for Amendment to the Operations Specifications for Air Carrier Operations and Amendment to Part 139 Airport Operating Certificate", February 2019; flightradar24.com, Landrum & Brown analysis, 2022.

Exhibit 4 Touch and Go Flight Tracks and Helicopter Flight Tracks



Source: Final Environmental Assessment for Amendment to the Operations Specifications for Air Carrier Operations and Amendment to Part 139 Airport Operating Certificate", February 2019; flightradar24.com, Landrum & Brown analysis, 2022.

Table 4 Arrival Flight Track Utilization – Existing (2019) Noise Exposure Contour

Arrival Runway End or Helipad	Track ID	Widebody Jets	Narrowbody Jets	Regional Jets	General Aviation Propeller Aircraft	Military Aircraft	Helicopters
16L	16LA1	0.0%	0.0%	0.0%	2.2%	0.0%	0.0%
16L	16LA2	0.0%	0.0%	0.0%	11.0%	0.0%	0.0%
16L	16LA3	0.0%	0.0%	0.0%	1.5%	0.0%	0.0%
16R	16RA1	64.7%	63.0%	58.8%	23.4%	64.4%	0.0%
16R	16RA2	0.0%	0.6%	0.6%	5.7%	0.7%	0.0%
16R	16RA3	0.0%	0.6%	0.6%	3.7%	0.7%	0.0%
34L	34LA1	26.5%	26.8%	30.0%	26.3%	25.7%	0.0%
34L	34LA2	8.8%	8.9%	10.0%	8.5%	8.6%	0.0%
34R	34RA1	0.0%	0.0%	0.0%	2.7%	0.0%	0.0%
34R	34RA2	0.0%	0.0%	0.0%	12.5%	0.0%	0.0%
34R	34RA3	0.0%	0.0%	0.0%	2.7%	0.0%	0.0%
HP-E	HPEA1	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%
HP-W	HPWA1	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%
Total		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Final Environmental Assessment for Amendment to the Operations Specifications for Air Carrier Operations and Amendment to Part 139 Airport Operating Certificate", February 2019; Landrum & Brown, 2022.

Table 5 Departure Flight Track Utilization – Existing (2019) Noise Exposure Contour

Arrival Runway End or Helipad	Track ID	Widebody Jets	Narrowbody Jets	Regional Jets	General Aviation Propeller Aircraft	Military Aircraft	Military Aircraft
16L	16LD1	0.0%	0.0%	0.0%	8.1%	0.0%	0.0%
16L	16LD2	0.0%	0.0%	0.0%	3.2%	0.0%	0.0%
16L	16LD3	0.0%	0.0%	0.0%	1.4%	0.0%	0.0%
16L	16LD4	0.0%	0.0%	0.0%	3.7%	0.0%	0.0%
16R	16RD1	40.5%	39.9%	33.0%	18.4%	60.6%	0.0%
16R	16RD2	0.0%	0.0%	11.0%	5.7%	0.0%	0.0%
16R	16RD3	0.0%	0.0%	2.6%	1.4%	0.0%	0.0%
16R	16RD4	0.0%	0.0%	4.5%	2.3%	0.0%	0.0%
16R	16RD5	0.0%	0.0%	2.3%	1.2%	0.0%	0.0%
16R	16RD6	0.0%	0.0%	6.9%	3.6%	0.0%	0.0%
16R	16RD7	24.8%	26.8%	0.0%	0.0%	6.7%	0.0%
34L	34LD1	2.1%	2.0%	2.4%	18.0%	32.0%	0.0%
34L	34LD2	0.0%	0.0%	0.0%	4.9%	0.0%	0.0%
34L	34LD3	0.0%	0.0%	0.0%	1.2%	0.0%	0.0%
34L	34LD4	0.0%	0.0%	0.0%	4.9%	0.0%	0.0%
34L	34LD5	0.0%	0.0%	0.0%	1.2%	0.0%	0.0%
34L	34LD6	16.3%	15.7%	18.7%	1.3%	0.3%	0.0%
34L	34LD7	16.3%	15.7%	18.7%	1.3%	0.3%	0.0%
34R	34RD1	0.0%	0.0%	0.0%	3.8%	0.0%	0.0%
34R	34RD2	0.0%	0.0%	0.0%	2.0%	0.0%	0.0%
34R	34RD3	0.0%	0.0%	0.0%	12.2%	0.0%	0.0%
HP-E	HPED1	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%
HP-W	HPWD1	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%
Total		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Final Environmental Assessment for Amendment to the Operations Specifications for Air Carrier Operations and Amendment to Part 139 Airport Operating Certificate", February 2019; Landrum & Brown, 2022.

Table 6 Touch-and-Go Flight Track Utilization – Existing (2019) Noise Exposure Contour

Runway	Track ID	General Aviation Propeller Aircraft
16L	16LT1	17.3%
16R	16RT1	10.5%
16R	16RT2	12.6%
16R	16RT3	8.2%
16R	16RT4	0.0%
34L	34LT1	10.7%
34L	34LT2	12.9%
34L	34LT3	8.7%
34L	34LT4	0.0%
34R	34RT1	19.1%
Grand Total	0.0%	100.0%

E.1.2 Aircraft Weight and Departure Stage Length

Aircraft weight upon departure is a factor in the propagation of noise because it impacts the rate at which an aircraft is able to climb. Generally, heavier aircraft apply more thrust and have a slower rate of climb and a wider propagation of noise along the flight route. Where specific aircraft weights are unknown, the AEDT uses the distance flown to the first stop as a surrogate for the weight, by assuming that the weight has a direct relationship with the fuel load necessary to reach the first destination. The AEDT groups trip lengths into nine stage categories and assigns standard aircraft weights to each stage category. These categories are:

Stage Category	Stage Length
1	0-500 nautical miles
2	501-1000 nautical miles
3	1001-1500 nautical miles
4	1501-2500 nautical miles
5	2501-3500 nautical miles
6	3501-4500 nautical miles
7	4501-5500 nautical miles
8	5501-6500 nautical miles
9	6500+ nautical miles

The stage lengths modeled for the Existing (2021) Noise Exposure Contour are based upon a review of radar data providing aircraft destinations for scheduled departures at PAE. **Table 7** indicates the proportion of the operations that were modeled within each of the nine stage length categories for Existing (2019) Noise Exposure Contour.

Table 7 Stage Length Distribution – Existing (2019) Noise Exposure Contour

Aircraft Type	Departure Stage Length									Total
	1	2	3	4	5	6	7	8	9	
Widebody Jets	52.8%	1.5%	10.0%	13.0%	1.3%	14.6%	2.2%	3.5%	1.0%	100.0%
Narrowbody Jets	59.7%	24.8%	13.5%	2.1%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Regional Jets	97.9%	1.1%	0.4%	0.5%	0.0%	0.1%	0.0%	0.0%	0.0%	100.0%
GA Propeller Aircraft	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Military Aircraft	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Helicopters	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Total	**93.4%**	**3.9%**	**2.2%**	**0.4%**	**0.0%**	**0.1%**	**0.0%**	**0.0%**	**0.0%**	**100.0%**

Source: Final Environmental Assessment for Amendment to the Operations Specifications for Air Carrier Operations and Amendment to Part 139 Airport Operating Certificate", February 2019.

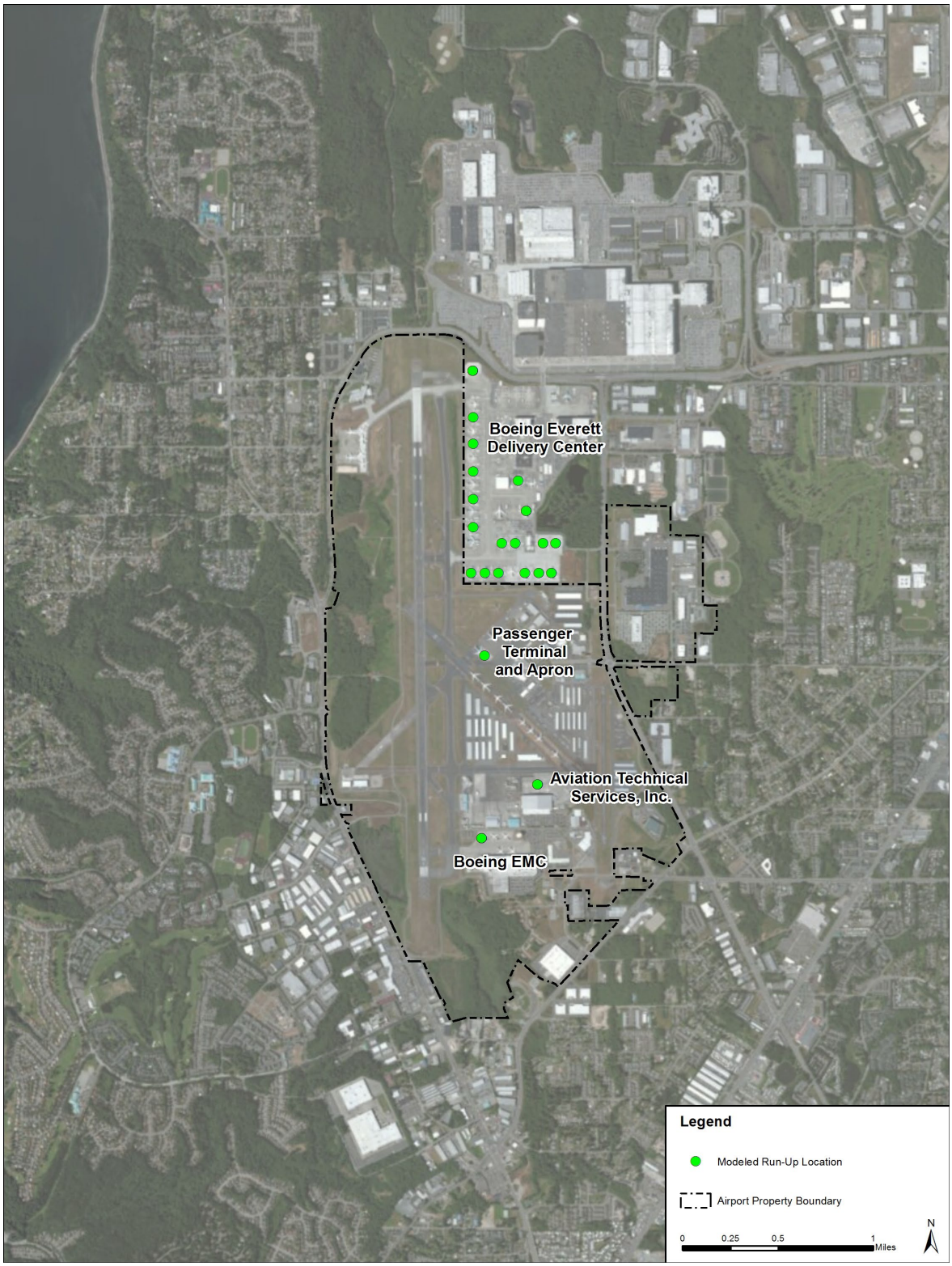
E.1.2 Ground Run-Up Activity

Ground run-up activity was modeled in AEDT to account for engine run-ups that were conducted for maintenance purposes at PAE. Run-up activity was based on run-up logs provided by Boeing and ATS for aircraft maintenance and testing for calendar year 2019. Additional run-ups were assumed to occur on an as-needed basis for scheduled passenger aircraft. Run-up log data was averaged to reflect average-annual day conditions. Note that general aviation run-up activity was not included because it is intermittent and has a negligible effect on the size and shape of the noise exposure contours. Run-up activity was modeled for the following commercial aircraft types:

- Boeing 747-400 Series
- Boeing 767-300 ER
- Boeing 777-300 ER
- Boeing 787-8 Dreamliner
- Boeing 737-700 Series
- Boeing 737-800 with winglets
- Embraer ERJ170-LR

Run-ups were modeled at various locations (stalls) at the Boeing Delivery Center Facility, the Boeing EMC ramp, ATS Maintenance apron, and the passenger terminal apron. Approximately 1.20 average daily run-ups (8.3 per week) were included in the noise modeling. Average run-up duration was approximately 43 minutes. Approximately half of the run-ups were modeled as nighttime operations which included the nighttime “penalty” in the DNL calculation.

Exhibit 5 Modeled Run-Up Locations



Source: Landrum & Brown, 2022.

E.1.2 Existing (2019) Noise Exposure Contour Modeling Results

The Existing (2019) Noise Exposure Contour is presented on **Exhibit 6**. The area within each five-decibel noise exposure contour interval is shown in **Table 8**. The noise exposure contour reflects the average-annual day runway use patterns at PAE. The noise exposure contour extends outward from the parallel runway ends. The noise exposure contour extends further out from Runway 16R/34L due to the greater usage of this runway compared to Runway 16L/34R. The 65 DNL noise exposure contour is visible surrounding various areas on the east side of the airport due to the run-ups that are performed on the ramp areas east of Runway 16R/34. The 65+ DNL of the Existing (2019) Noise Exposure Contour encompasses approximately 1.35 square miles. The 65 DNL of the Existing (2019) Noise Exposure Contour is located over Airport property, highway right-of-way, commercial property, or vacant land. No residential or other noise-sensitive land uses are located within the 65 DNL of the Existing (2019) Noise Exposure Contour.

Table 8 Existing (2019) Noise Exposure Contour Area

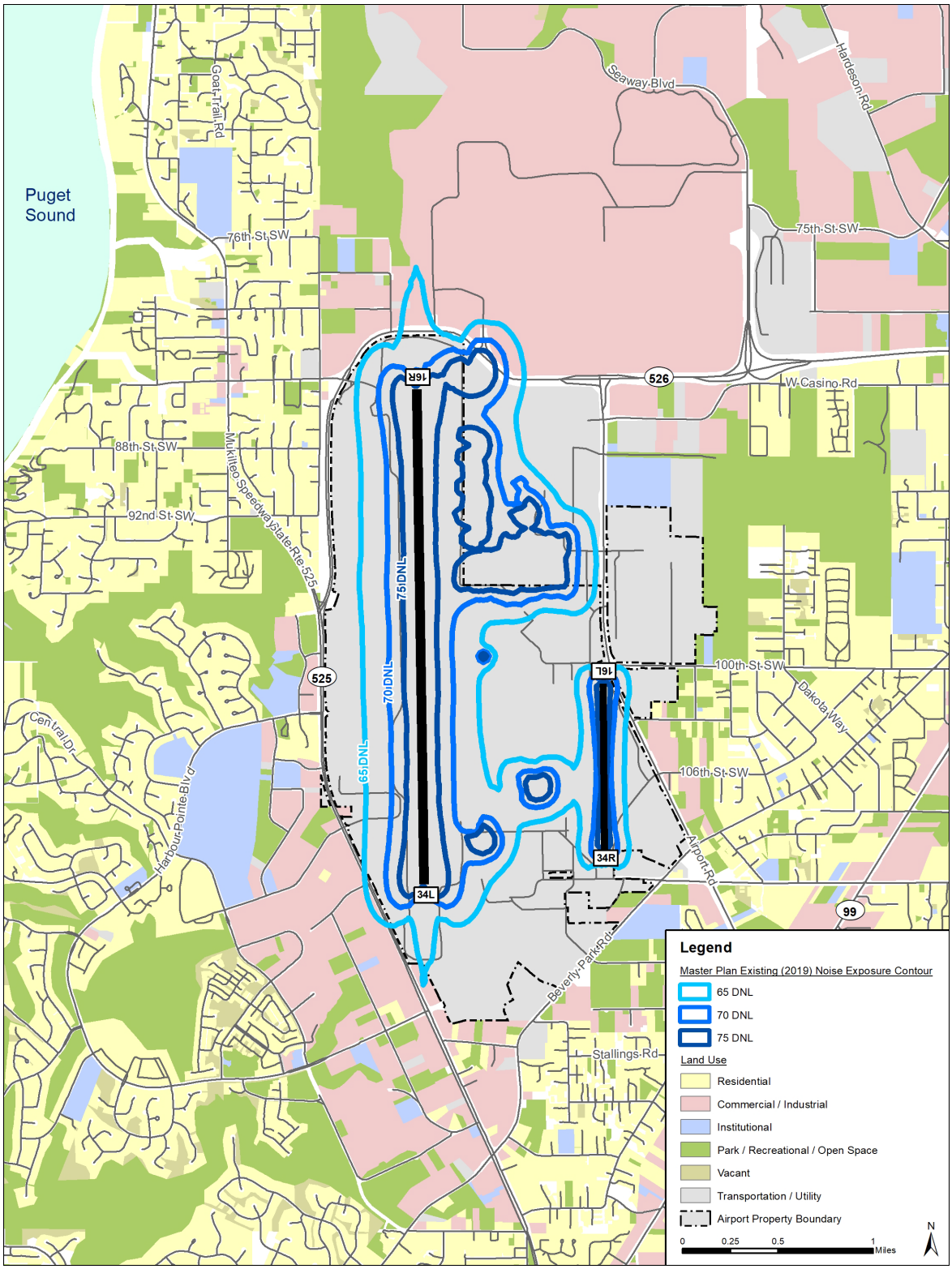
Contour Range	Existing (2019) Noise Exposure Contour Area (Square Miles)
65-70 DNL	0.58
70-75 DNL	0.36
75 + DNL	0.41
65 + DNL	1.35

Source: AEDT Version 3d, Landrum & Brown, 2022

Exhibit 7 shows a comparison of the Existing (2019) Noise Exposure Contour to a digital recreation of the 2008 NEM Noise Exposure Contour from the 2003 Noise Exposure Map (NEM) Update at PAE.[1] The Existing (2019) Noise Exposure Contour is larger than the 2008 NEM Noise Exposure Contour due to a variety of factors. One factor is the change in noise modeling software. According to the NEM documentation, the 2008 NEM Noise Exposure Contour was modeled using the Integrated Noise Model (INM), Version 6.0c, which was the FAA's currently approved noise modeling software at the time the NEM Update was prepared. Additionally, changes to the aircraft fleet mix, run up locations, flight profiles and terrain data also contributed to differences in the noise exposure contour results.

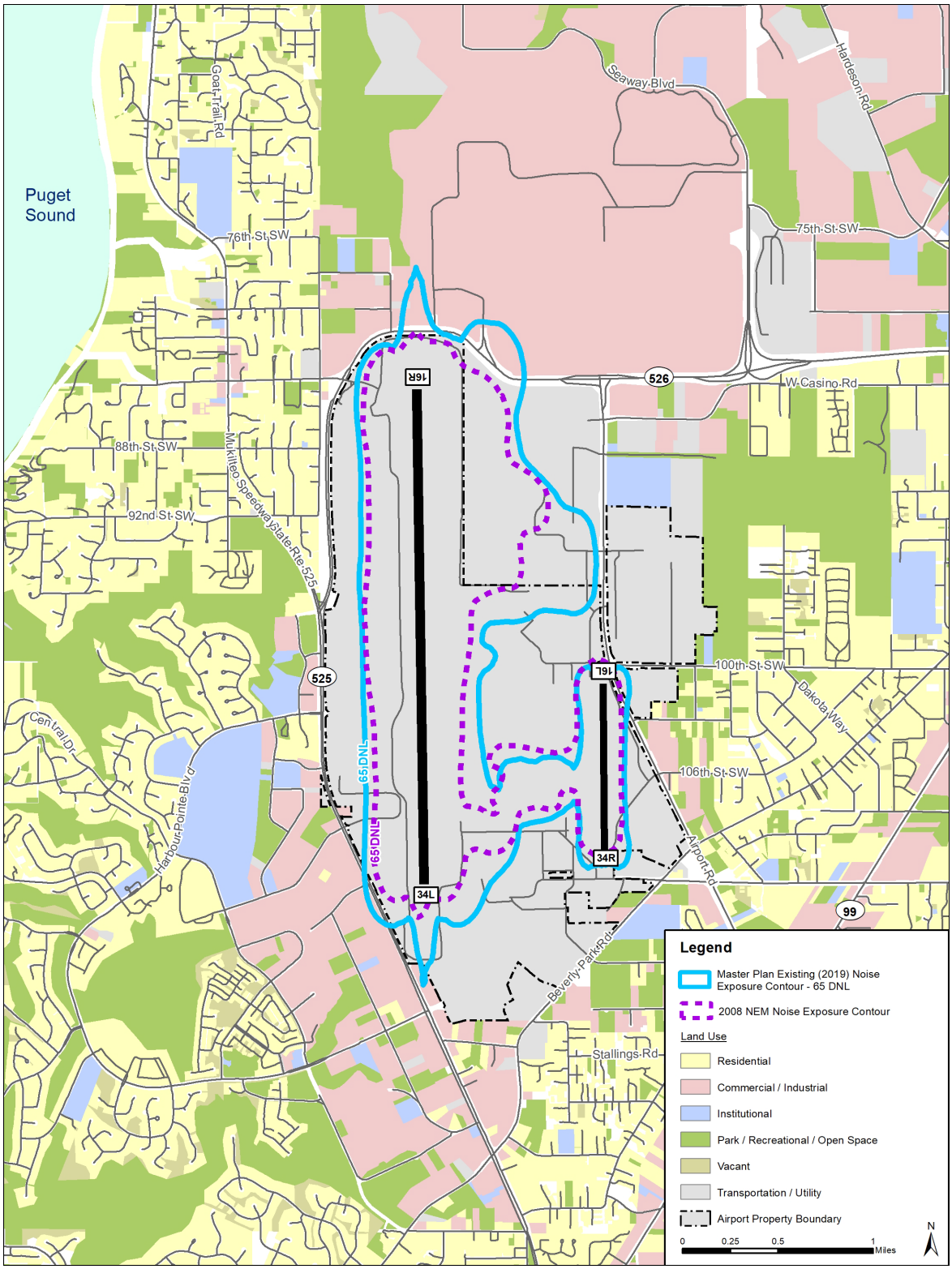
[1] Snohomish County Airport / Paine Field, FAR Part 150 Noise Exposure Map Update, September 2003.

Exhibit 6 Existing (2019) Noise Exposure Contour



Source: Land use data from Snohomish County Assessor, February 2022; Master Plan Existing (2019) Noise Exposure Contour from FAA Aviation Environmental Design Tool (AEDT) Version 3d, Landrum & Brown analysis, 2022.

Exhibit 7 Existing (2019) Noise Exposure Contour Compared to 2008 NEM Noise Exposure Contour



Source: Land use data from Snohomish County Assessor, February 2022; 2008 NEM Contour recreated from FAR Part 150 Noise Exposure Map Update, September 2003, Master Plan Existing (2019) Noise Exposure Contour from FAA Aviation Environmental Design Tool (AEDT) Version 3d, Landrum & Brown analysis, 2022.

E.2 Future (2030) Noise Exposure Contour Input Data

E.1.2.Runway Definition

No change in runway layout is expected at PAE by 2030. Therefore, the same runway configuration used to model the Existing (2019) Noise Exposure Contour was used for the Future (2030) Noise Exposure Contour modeling.

E.1.2 Number of Operations and Fleet Mix

The number of annual operations at PAE was based on data obtained from the Paine Field Master Plan Forecast, dated August 2021 (Master Plan Forecast). Total annual operations forecast for 2030 is 155,028, which equals 424.74 average-annual day operations.

Specific aircraft types and times of operation were developed from data located in the "Final Environmental Assessment for Amendment to the Operations Specifications for Air Carrier Operations and Amendment to Part 139 Airport Operating Certificate", February 2019 (2019 EA), Official Airline Guide (OAG) data, and data from the Airport's flight tracking system database. Adjustments were made to account for changes in Boeing operating levels based on changes to manufacturing lines including the reduction in Boeing 747-8F and Boeing 787-8 production. **Table 9** provides a summary of the average annual day operations by aircraft category and time of day that was used to model the Future (2030) Noise Exposure Contour. **Table 10** shows the average daily number of arrivals and departures by time of day and individual aircraft type.

Table 9 Summary of Average-Annual Day Operations – Future (2030) Noise Exposure Contour

Aircraft Category	Arrivals		Departures		Touch & Go's		Total	Percent of Total
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime		
Widebody Jets	0.9	0.0	0.9	0.0	0.0	0.0	1.9	0.4%
Narrowbody Jets	27.8	3.3	30.6	0.5	0.0	0.0	62.1	14.6%
Regional Jets	8.4	0.6	8.3	0.7	0.0	0.0	18.1	4.3%
GA & Commuter Props	140.6	2.0	137.7	5.0	52.3	2.0	339.6	79.9%
Military Aircraft	1.5	0.0	1.5	0.0	0.0	0.0	3.0	0.7%
Helicopters	0.1	0.0	0.1	0.0	0.0	0.0	0.2	0.0%
Total	179.3	5.9	179.1	6.2	52.3	2.0	424.7	100.0%

Notes: Total may not equal sum total due to rounding.
Daytime = 7:00am – 9:59pm, Nighttime = 10:00pm – 6:59am.
Touch & Go operations include one landing and one takeoff; therefore, the number of touch & go operations in the noise model is one-half the number shown in the above table.

Sources: Paine Field Master Plan Forecast, August 2021 and Final Environmental Assessment for Amendment to the Operations Specifications for Air Carrier Operations and Amendment to Part 139 Airport Operating Certificate", February 2019; Official Airline Guide, PAE Flight Tracking Data, 2019-2021.

Table 10 Average-Annual Day Operations by Aircraft Type – Future (2030) Noise Exposure Contour

Aircraft Type	Arrivals		Departures		Touch & Go's		Total
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime	
Widebody Jets							
Airbus A330-200 Series	0.03	0.00	0.03	0.00	0.00	0.00	0.06
Boeing 747-200 Series Freighter	0.04	0.00	0.04	0.00	0.00	0.00	0.08
Boeing 747-400 Series	0.04	0.00	0.04	0.00	0.00	0.00	0.08
Boeing 747-8F	0.02	0.00	0.02	0.00	0.00	0.00	0.04
Boeing 767-300 ER	0.22	0.00	0.22	0.00	0.00	0.00	0.44
Boeing 777-200 Series	0.07	0.00	0.07	0.00	0.00	0.00	0.14
Boeing 777-300 ER	0.14	0.00	0.14	0.00	0.00	0.00	0.28
Boeing 777-300 Series	0.36	0.00	0.35	0.01	0.00	0.00	0.72
Boeing 787-8 Dreamliner	0.02	0.00	0.02	0.00	0.00	0.00	0.04
Subtotal	0.94	0.00	0.93	0.01	0.00	0.00	1.88
Narrowbody Jets							
Airbus A319-100 Series	0.01	0.00	0.01	0.00	0.00	0.00	0.02
Airbus A320-200 Series	0.03	0.00	0.03	0.00	0.00	0.00	0.06
Boeing 737-400 Series	0.04	0.00	0.04	0.00	0.00	0.00	0.08
Boeing 737-700 Series	1.52	1.27	2.48	0.31	0.00	0.00	5.58
Boeing 737-8	0.03	0.00	0.03	0.00	0.00	0.00	0.06
Boeing 737-800 with winglets	0.62	0.11	0.60	0.13	0.00	0.00	1.46
Boeing 737-900 Series	5.65	0.77	6.42	0.00	0.00	0.00	12.84
Embraer ERJ170-LR	19.25	0.00	19.25	0.00	0.00	0.00	38.50
Boeing 737-300 Series Freighter	0.01	0.01	0.02	0.00	0.00	0.00	0.04
Boeing 757-200 Series Freighter	0.60	1.11	1.70	0.01	0.00	0.00	3.42
Subtotal	27.76	3.27	30.58	0.45	0.00	0.00	62.06

Table 10 Average-Annual Day Operations by Aircraft Type – Future (2030) Noise Exposure Contour, *(Continued)*

Aircraft Type	Arrivals		Departures		Touch and Go's		Total
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime	
Regional Jets							
1985 BUSINESS JET	0.21	0.03	0.25	0.00	0.00	0.00	0.49
Bombardier Challenger 600	0.56	0.04	0.60	0.00	0.00	0.00	1.20
Bombardier Challenger 601	0.54	0.04	0.58	0.00	0.00	0.00	1.16
Bombardier Global 5000	0.15	0.01	0.15	0.02	0.00	0.00	0.33
Bombardier Global Express	0.02	0.00	0.02	0.00	0.00	0.00	0.04
Bombardier Learjet 25	0.03	0.00	0.03	0.00	0.00	0.00	0.06
Bombardier Learjet 35	1.44	0.21	1.65	0.00	0.00	0.00	3.30
Cessna 500 Citation I	1.01	0.00	0.84	0.17	0.00	0.00	2.02
Cessna 525C CitationJet	0.09	0.00	0.09	0.00	0.00	0.00	0.18
Cessna 550 Citation II	0.53	0.03	0.25	0.31	0.00	0.00	1.12
Cessna 560 Citation Encore	0.05	0.00	0.05	0.00	0.00	0.00	0.10
Cessna 560 Citation Excel	0.43	0.01	0.37	0.07	0.00	0.00	0.88
Cessna 560 Citation Ultra	0.18	0.01	0.18	0.01	0.00	0.00	0.38
Cessna 650 Citation III	0.33	0.00	0.30	0.03	0.00	0.00	0.66
Cessna 680 Citation Sovereign	0.26	0.01	0.23	0.03	0.00	0.00	0.53
Cessna 750 Citation X	1.09	0.05	1.15	0.00	0.00	0.00	2.29
Cessna Citation 510	0.54	0.00	0.54	0.00	0.00	0.00	1.08
Dassault Falcon 20-F	0.01	0.00	0.01	0.00	0.00	0.00	0.02
Eclipse 500	0.11	0.02	0.12	0.00	0.00	0.00	0.25
Embraer ERJ145-XR	0.01	0.00	0.01	0.00	0.00	0.00	0.02
Gulfstream IV-SP	0.45	0.10	0.50	0.05	0.00	0.00	1.10
Gulfstream V-SP	0.17	0.01	0.18	0.01	0.00	0.00	0.37
Israel IAI-1125 Astra	0.15	0.00	0.15	0.00	0.00	0.00	0.30
Raytheon Beechjet 400	0.09	0.00	0.09	0.01	0.00	0.00	0.19
Subtotal	8.45	0.57	8.34	0.71	0.00	0.00	18.07

Table 10 Average-Annual Day Operations by Aircraft Type – Future (2030) Noise Exposure Contour, *(Continued)*

Aircraft Type	Arrivals		Departures		Touch and Go's		Total
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime	
General Aviation & Commuter Propeller Aircraft							
Boeing DC-3	0.12	0.00	0.12	0.00	0.00	0.00	0.24
Bombardier de Havilland Dash 8 Q100	0.25	0.00	0.25	0.00	0.00	0.00	0.50
Bombardier de Havilland Dash 8 Q400	0.01	0.00	0.01	0.00	0.00	0.00	0.02
Cessna 172 Skyhawk	27.37	0.66	28.03	0.00	0.00	0.00	56.06
Cessna 182	4.31	0.03	4.18	0.17	0.00	0.00	8.69
Cessna 206	1.40	0.02	1.42	0.00	0.45	0.00	3.29
Cessna 208 Caravan	6.11	0.19	5.52	0.79	0.00	0.00	12.61
Cessna 441 Conquest II	2.90	0.00	2.84	0.06	2.20	0.05	8.05
Cirrus SR22	1.35	0.01	1.20	0.16	0.00	0.00	2.72
Embraer EMB120 Brasilia	0.02	0.00	0.02	0.00	0.00	0.00	0.04
Piper PA-28 Cherokee Series	71.65	0.54	68.98	3.21	36.95	1.72	183.05
Piper PA-30 Twin Comanche	1.58	0.00	1.58	0.00	0.00	0.00	3.16
Piper PA-42 Cheyenne Series	0.90	0.00	0.90	0.00	0.00	0.00	1.80
Raytheon Beech Baron 58	6.35	0.14	6.50	0.00	3.52	0.00	16.51
Raytheon Beech Bonanza 36	14.73	0.36	14.73	0.36	9.15	0.22	39.55
Raytheon Super King Air 300	1.57	0.05	1.37	0.25	0.00	0.00	3.24
Subtotal	140.62	2.00	137.65	5.00	52.27	1.99	339.53

Table 10 Average-Annual Day Operations by Aircraft Type – Future (2030) Noise Exposure Contour, *(Continued)*

Aircraft Type	Arrivals		Departures		Touch and Go's		Total
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime	
Military Aircraft							
Beech Mentor (BE45)	0.06	0.00	0.06	0.00	0.00	0.00	0.12
Boeing 707-300 Series	0.06	0.00	0.06	0.00	0.00	0.00	0.12
Boeing DC-9-30 Series	1.02	0.00	1.02	0.00	0.00	0.00	2.04
Boeing F/A-18 Hornet	0.20	0.00	0.20	0.00	0.00	0.00	0.40
Lockheed P-3 Orion	0.16	0.00	0.16	0.00	0.00	0.00	0.32
Subtotal	1.50	0.00	1.50	0.00	0.00	0.00	3.00
Helicopters							
Agusta A-109	0.02	0.00	0.02	0.00	0.00	0.00	0.04
Bell 206B-3	0.02	0.00	0.02	0.00	0.00	0.00	0.04
Bell 407	0.02	0.00	0.02	0.00	0.00	0.00	0.04
Hughes 500D	0.02	0.00	0.02	0.00	0.00	0.00	0.04
Robinson R44 Raven	0.02	0.00	0.02	0.00	0.00	0.00	0.04
Subtotal	0.10	0.00	0.10	0.00	0.00	0.00	0.20
Total	179.37	5.84	179.10	6.17	52.27	1.99	424.74

Notes: Total may not equal sum total due to rounding.
Daytime = 7:00am – 9:59pm, Nighttime = 10:00pm – 6:59am.
Touch & Go operations include one landing and one takeoff; therefore, the number of touch & go operations in the noise model is one-half the number shown in the above table.

Sources: Paine Field Master Plan Forecast, August 2021 and Final Environmental Assessment for Amendment to the Operations Specifications for Air Carrier Operations and Amendment to Part 139 Airport Operating Certificate", February 2019; Official Airline Guide, PAE Flight Tracking Data, 2019-2021.

D.1.2 Runway End Utilization

Runway use patterns are not expected to change considerably by 2030. Therefore, the same runway use percentages modeled for the Existing (2019) Noise Exposure Contour shown in **Table 3** were used to model the Future (2030) Noise Exposure Contour.

E.1.2 Flight Tracks

Flight track patterns are not expected to change considerably by 2030. Therefore, the same flight track locations shown on Exhibits 2, 3, and 4; and flight track percentages shown in Tables 4, 5, and 6 were used to model the Future (2030) Noise Exposure Contour.

E.1.3 Aircraft Weight and Departure Stage Length

The stage lengths modeled for the Future (2030) Noise Exposure Contour are based upon a review of radar data providing aircraft destinations for scheduled departures at PAE. No major changes to departure stage length distribution are expected to occur by 2030. **Table 11** indicates the proportion of the operations that were modeled within each of the nine stage length categories for Future (2030) Noise Exposure Contour.

Table 11 Stage Length Distribution – Future (2030) Noise Exposure Contour

Aircraft Type	Departure Stage Length									Total
	1	2	3	4	5	6	7	8	9	
Widebody Jets	8.6%	4.1%	11.1%	23.0%	6.2%	12.3%	17.3%	9.9%	7.4%	100.0%
Narrowbody Jets	20.3%	18.2%	14.7%	22.4%	3.5%	4.2%	4.9%	5.6%	6.3%	100.0%
Regional Jets	55.0%	9.6%	8.6%	15.3%	0.0%	11.5%	0.0%	0.0%	0.0%	100.0%
GA Propeller Aircraft	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Military Aircraft	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Helicopters	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Total	41.3%	7.5%	9.0%	16.3%	2.8%	8.0%	6.8%	4.5%	3.8%	**100.0%**

Source: Final Environmental Assessment for Amendment to the Operations Specifications for Air Carrier Operations and Amendment to Part 139 Airport Operating Certificate", February 2019.

D.1.3 Ground Run-Up Activity

Run-ups were modeled at various locations (stalls) at the Boeing Delivery Center Facility, the Boeing EMC ramp, ATS Maintenance apron, and the passenger terminal apron. Aircraft types for which run-ups were modeled remained similar to those modeled for the Existing (2019) Noise Exposure Contour, with some adjustments made to account for changes in Boeing operating levels based on changes to manufacturing lines including the reduction in Boeing 747-8F and Boeing 787-8 production. Approximately 1.21 average daily run-ups (8.5 per week) were included in the noise modeling. Average run-up duration was approximately 43 minutes. Approximately half of the run-ups were modeled as nighttime operations which included the nighttime "penalty" in the DNL calculation.

E.1.4 Future (2030) Noise Exposure Contour Modeling Results

The Future (2030) Noise Exposure Contour is presented on **Exhibit 8**. The area within each five-decibel noise exposure contour interval is shown in **Table 12**. The noise exposure contour reflects the average-annual day runway use patterns at PAE. The noise exposure contour extends outward from the parallel runway ends. The noise exposure contour extends further out from Runway 16R/34L due to the greater usage of this runway compared to Runway 16L/34R. The 65 DNL noise exposure contour is visible surrounding various areas on the east side of the airport due to the run-ups that are performed on the ramp areas east of Runway 16R/34. The 65+ DNL of the Future (2030) Noise Exposure Contour encompasses approximately 1.38 square miles. The 65 DNL of the Future (2030) Noise Exposure Contour is located over Airport property, highway right-of-way, commercial property, or vacant land. No residential or other noise-sensitive land uses are located within the 65 DNL of the Future (2030) Noise Exposure Contour.

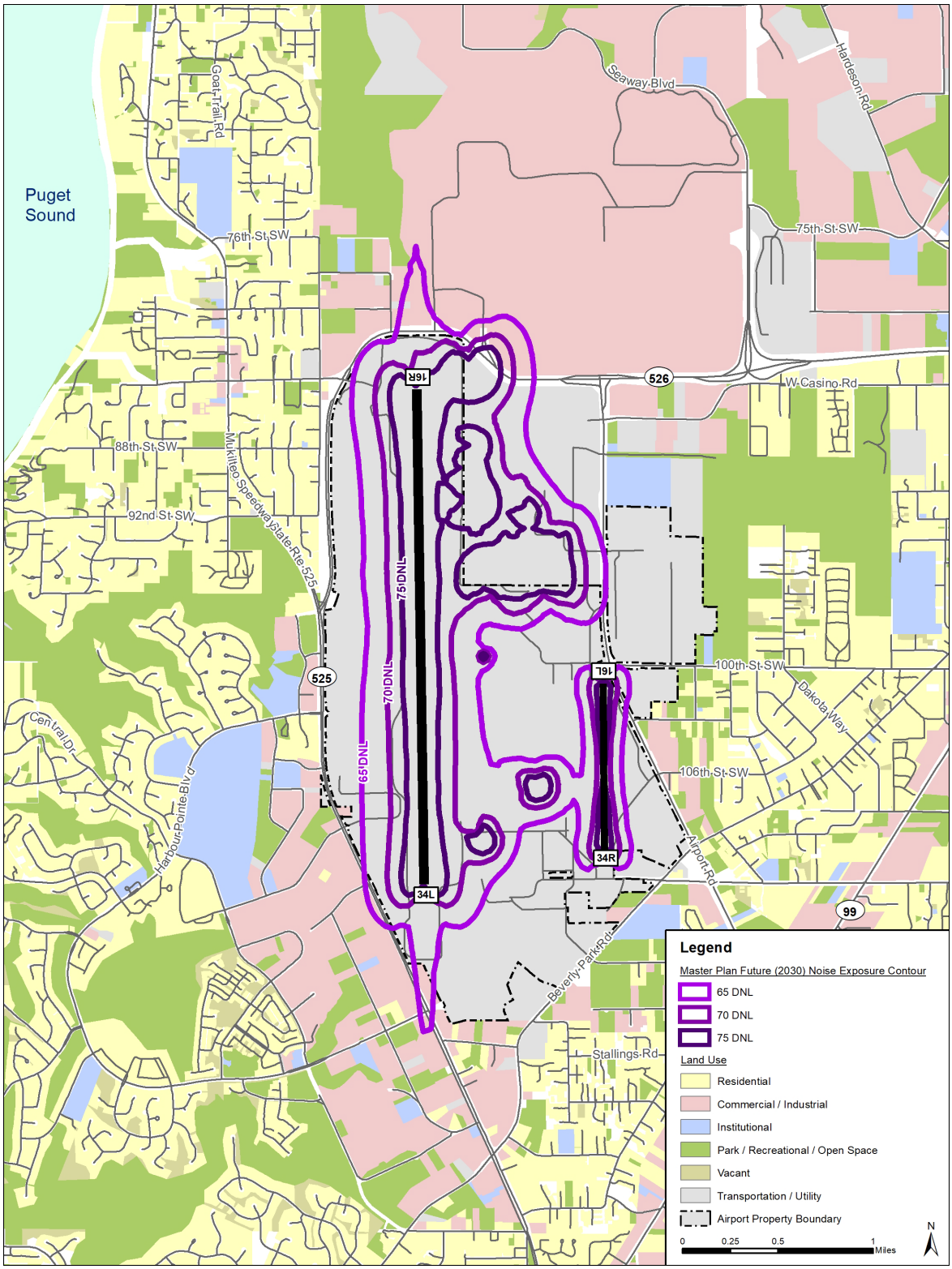
Table 12 Future (2030) Noise Exposure Contour Area

Contour Range	Future (2030) Noise Exposure Contour Area (Square Miles)
65-70 DNL	0.61
70-75 DNL	0.37
75 + DNL	0.45
65 + DNL	1.43

Source: AEDT Version 3d, Landrum & Brown, 2022

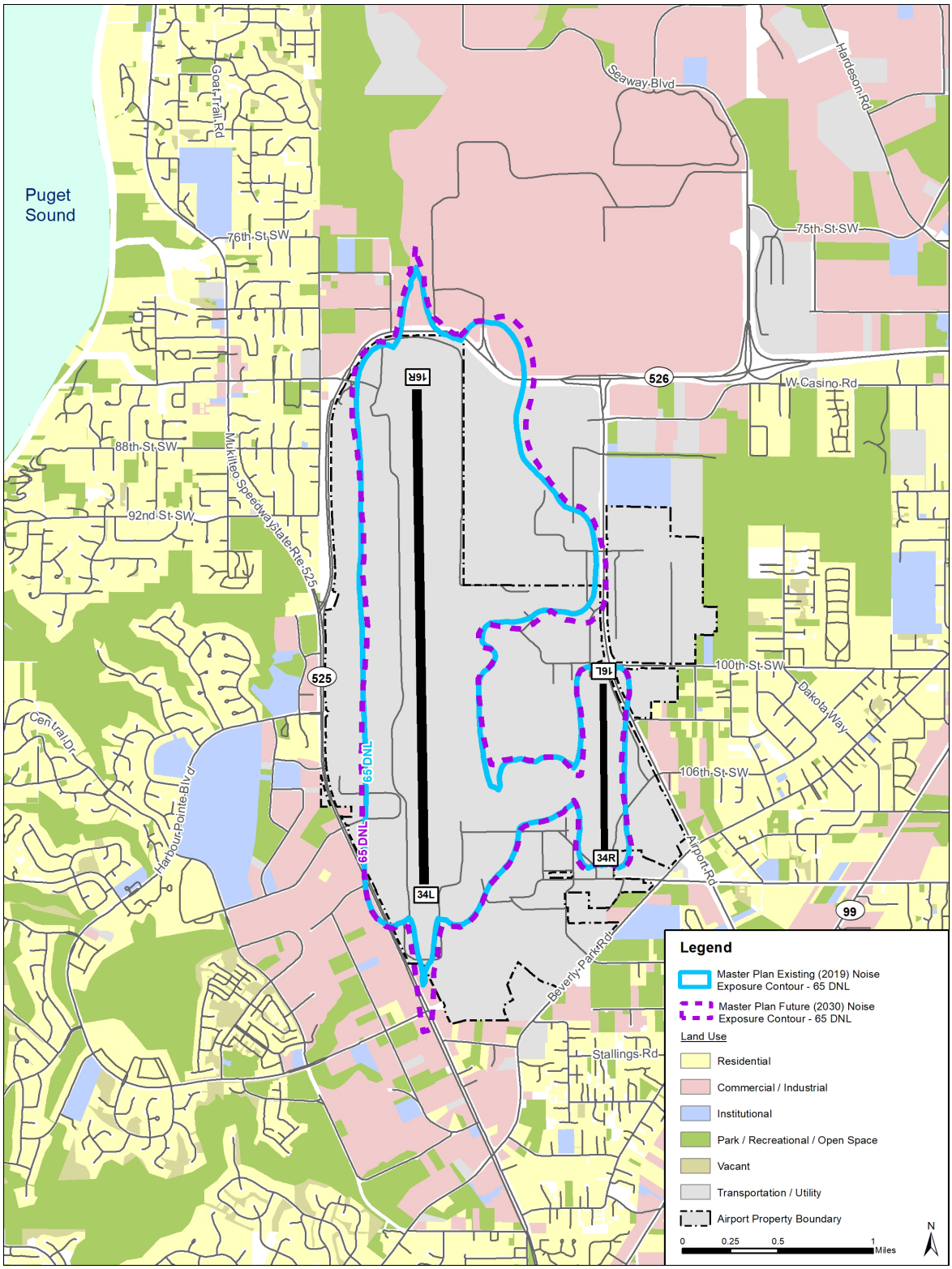
Exhibit 9 shows a comparison of the Future (2030) Noise Exposure Contour to the Existing (2019) Noise Exposure Contour.

Exhibit 8 Future (2030) Noise Exposure Contour



Source: Land use data from Snohomish County Assessor, February 2022; Master Plan Future (2030) Noise Exposure Contour from FAA Aviation Environmental Design Tool (AEDT) Version 3d, Landrum & Brown analysis, 2022.

Exhibit 9 Future (2030) Noise Exposure Contour Compared to Existing (2019) Noise Exposure Contour



Source: Land use data from Snohomish County Assessor, February 2022 Land use data from Snohomish County Assessor, February 2022; Master Plan Existing (2019) and Future (2030) Noise Exposure Contours from FAA Aviation Environmental Design Tool (AEDT) Version 3d, Landrum & Brown analysis, 2022.

E.2 Future (2040) Noise Exposure Contour Input Data

E.1.4 Runway Definition

No change in runway layout is expected at PAE by 2040. Therefore, the same runway configuration used to model the Existing (2019) Noise Exposure Contour and Future (2030) Noise Exposure Contour was used for the Future (2040) Noise Exposure Contour modeling.

E.1.5 Number of Operations and Fleet Mix

The number of annual operations at PAE was based on data obtained from the Paine Field Master Plan Forecast, dated August 2021 (Master Plan Forecast). Total annual operations forecast for 2040 is 187,303, which equals 513.16 average-annual day operations.

Specific aircraft types and times of operation were developed from data located in the "Final Environmental Assessment for Amendment to the Operations Specifications for Air Carrier Operations and Amendment to Part 139 Airport Operating Certificate", February 2019 (2019 EA), Official Airline Guide (OAG) data, and data from the Airport's flight tracking system database. Adjustments were made to account for changes in Boeing operating levels based on changes to manufacturing lines. **Table 13** provides a summary of the average annual day operations by aircraft category and time of day that was used to model the Future (2040) Noise Exposure Contour. **Table 14** shows the average daily number of arrivals and departures by time of day and individual aircraft type.

Table 13 Summary of Average-Annual Day Operations – Future (2040) Noise Exposure Contour

Aircraft Category	Arrivals		Departures		Touch & Go's		Total	Percent of Total
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime		
Widebody Jets	1.95	0.01	1.88	0.07	0.00	0.00	3.91	0.76%
Narrowbody Jets	56.16	5.84	61.57	0.43	0.00	0.00	123.99	24.16%
Regional Jets	9.00	0.64	8.89	0.76	0.00	0.00	19.30	3.76%
GA & Commuter Props	150.26	2.15	147.07	5.34	55.84	2.13	333.81	65.05%
Military Aircraft	1.50	0.00	1.50	0.00	0.00	0.00	3.00	0.59%
Helicopters	0.08	0.00	0.08	0.00	0.00	0.00	0.17	0.03%
Total	218.96	8.64	221.00	6.60	55.84	2.13	513.16	100.00%

Notes: Total may not equal sum total due to rounding.
Daytime = 7:00am – 9:59pm, Nighttime = 10:00pm – 6:59am.
Touch & Go operations include one landing and one takeoff; therefore, the number of touch & go operations in the noise model is one-half the number shown in the above table.

Sources: Paine Field Master Plan Forecast, August 2021 and Final Environmental Assessment for Amendment to the Operations Specifications for Air Carrier Operations and Amendment to Part 139 Airport Operating Certificate", February 2019; Official Airline Guide, PAE Flight Tracking Data, 2019-2021.

Table 14 Average-Annual Day Operations by Aircraft Type – Future (2040) Noise Exposure Contour

Aircraft Type	Arrivals		Departures		Touch & Go's		Total
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime	
Widebody Jets							
Airbus A330-200 Series	0.03	0.00	0.03	0.00	0.00	0.00	0.06
Boeing 747-200 Series Freighter	0.04	0.00	0.04	0.00	0.00	0.00	0.08
Boeing 747-400 Series	0.57	0.00	0.57	0.00	0.00	0.00	1.15
Boeing 747-8F	0.10	0.00	0.10	0.00	0.00	0.00	0.20
Boeing 767-300 ER	0.21	0.00	0.20	0.00	0.00	0.00	0.42
Boeing 777-200 Series	0.07	0.00	0.07	0.00	0.00	0.00	0.13
Boeing 777-300 ER	0.34	0.00	0.34	0.00	0.00	0.00	0.68
Boeing 777-300 Series	0.13	0.00	0.13	0.00	0.00	0.00	0.27
Boeing 787-8 Dreamliner	0.46	0.01	0.40	0.07	0.00	0.00	0.93
Subtotal	1.95	0.01	1.88	0.07	0.00	0.00	3.91
Narrowbody Jets							
Airbus A319-100 Series	0.01	0.00	0.01	0.00	0.00	0.00	0.01
Airbus A320-200 Series	0.03	0.00	0.03	0.00	0.00	0.00	0.06
Boeing 737-400 Series	0.04	0.00	0.04	0.00	0.00	0.00	0.08
Boeing 737-700 Series	1.42	1.19	2.33	0.29	0.00	0.00	5.23
Boeing 737-8	0.03	0.00	0.03	0.00	0.00	0.00	0.06
Boeing 737-800 with winglets	0.58	0.10	0.57	0.12	0.00	0.00	1.37
Boeing 737-900 Series	25.02	3.41	28.43	0.00	0.00	0.00	56.86
Embraer ERJ170-LR	28.43	0.00	28.43	0.00	0.00	0.00	56.86
Boeing 737-300 Series Freighter	0.01	0.01	0.02	0.00	0.00	0.00	0.05
Boeing 757-200 Series Freighter	0.60	1.11	1.70	0.01	0.00	0.00	3.42
Subtotal	56.16	5.84	61.57	0.43	0.00	0.00	123.99

Table 14 Average-Annual Day Operations by Aircraft Type – Future (2040) Noise Exposure Contour, *(Continued)*

Aircraft Type	Arrivals		Departures		Touch & Go's		Total
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime	
Regional Jets							
1985 BUSINESS JET	0.23	0.03	0.26	0.00	0.00	0.00	0.53
Bombardier Challenger 600	0.60	0.05	0.65	0.00	0.00	0.00	1.29
Bombardier Challenger 601	0.57	0.04	0.62	0.00	0.00	0.00	1.23
Bombardier Global 5000	0.16	0.02	0.16	0.02	0.00	0.00	0.36
Bombardier Global Express	0.02	0.00	0.02	0.00	0.00	0.00	0.04
Bombardier Learjet 25	0.03		0.03	0.00	0.00	0.00	0.06
Bombardier Learjet 35	1.53	0.22	1.76	0.00	0.00	0.00	3.52
Cessna 500 Citation I	1.08		0.90	0.18	0.00	0.00	2.15
Cessna 525C CitationJet	0.09	0.00	0.09	0.00	0.00	0.00	0.19
Cessna 550 Citation II	0.56	0.04	0.27	0.33	0.00	0.00	1.20
Cessna 560 Citation Encore	0.05	0.00	0.05	0.00	0.00	0.00	0.11
Cessna 560 Citation Excel	0.45	0.01	0.40	0.07	0.00	0.00	0.94
Cessna 560 Citation Ultra	0.19	0.02	0.19	0.02	0.00	0.00	0.41
Cessna 650 Citation III	0.35		0.32	0.04	0.00	0.00	0.71
Cessna 680 Citation Sovereign	0.27	0.01	0.25	0.04	0.00	0.00	0.56
Cessna 750 Citation X	1.17	0.06	1.23	0.00	0.00	0.00	2.45
Cessna Citation 510	0.58	0.00	0.58	0.00	0.00	0.00	1.16
Dassault Falcon 20-F	0.01		0.01	0.00	0.00	0.00	0.02
Eclipse 500	0.11	0.02	0.13	0.00	0.00	0.00	0.26
Embraer ERJ145-XR	0.01		0.01	0.00	0.00	0.00	0.02
Gulfstream IV-SP	0.48	0.11	0.54	0.05	0.00	0.00	1.18
Gulfstream V-SP	0.19	0.01	0.19	0.01	0.00	0.00	0.39
Israel IAI-1125 Astra	0.16		0.16	0.00	0.00	0.00	0.32
Raytheon Beechjet 400	0.10	0.00	0.10	0.01	0.00	0.00	0.21
Subtotal	9.00	0.64	8.89	0.76	0.00	0.00	19.30

Table 14 Average-Annual Day Operations by Aircraft Type – Future (2040) Noise Exposure Contour, *(Continued)*

Aircraft Type	Arrivals		Departures		Touch and Go's		Total
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime	
General Aviation & Commuter Propeller Aircraft							
Boeing DC-3	0.13	0.00	0.13	0.00	0.00	0.00	0.26
Bombardier de Havilland Dash 8 Q100	0.27	0.00	0.27	0.00	0.00	0.00	0.54
Bombardier de Havilland Dash 8 Q400	0.01	0.00	0.01	0.00	0.00	0.00	0.02
Cessna 172 Skyhawk	29.24	0.71	29.95	0.00	0.00	0.00	59.90
Cessna 182	4.60	0.04	4.46	0.18	0.00	0.00	9.28
Cessna 206	1.50	0.02	1.52	0.00	0.48	0.00	3.52
Cessna 208 Caravan	6.53	0.20	5.89	0.84	0.00	0.00	13.47
Cessna 441 Conquest II	3.10	0.00	3.03	0.07	2.35	0.05	8.60
Cirrus SR22	1.44	0.02	1.29	0.17	0.00	0.00	2.92
Embraer EMB120 Brasilia	0.02	0.00	0.02	0.00	0.00	0.00	0.04
Piper PA-28 Cherokee Series	76.55	0.58	73.70	3.43	39.48	1.84	195.57
Piper PA-30 Twin Comanche	1.68	0.00	1.68	0.00	0.00	0.00	3.37
Piper PA-42 Cheyenne Series	0.96	0.00	0.96	0.00	0.00	0.00	1.93
Raytheon Beech Baron 58	6.79	0.15	6.94	0.00	3.76	0.00	17.65
Raytheon Beech Bonanza 36	15.74	0.38	15.74	0.38	9.78	0.24	42.27
Raytheon Super King Air 300	1.68	0.05	1.46	0.27	0.00	0.00	3.46
Subtotal	150.26	2.15	147.07	5.34	55.84	2.13	362.79

Table 14 Average-Annual Day Operations by Aircraft Type – Future (2040) Noise Exposure Contour, *(Continued)*

Aircraft Type	Arrivals		Departures		Touch and Go's		Total
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime	
Military Aircraft							
Beech Mentor (BE45)	0.06	0.00	0.06	0.00	0.00	0.00	0.11
Boeing 707-300 Series	0.06	0.00	0.06	0.00	0.00	0.00	0.11
Boeing DC-9-30 Series	1.02	0.00	1.02	0.00	0.00	0.00	2.05
Boeing F/A-18 Hornet	0.20	0.00	0.20	0.00	0.00	0.00	0.41
Lockheed P-3 Orion	0.16	0.00	0.16	0.00	0.00	0.00	0.33
Subtotal	1.50	0.00	1.50	0.00	0.00	0.00	3.00
Helicopters							
Agusta A-109	0.02	0.00	0.02	0.00	0.00	0.00	0.03
Bell 206B-3	0.02	0.00	0.02	0.00	0.00	0.00	0.03
Bell 407	0.02	0.00	0.02	0.00	0.00	0.00	0.03
Hughes 500D	0.02	0.00	0.02	0.00	0.00	0.00	0.03
Robinson R44 Raven	0.02	0.00	0.02	0.00	0.00	0.00	0.03
Subtotal	0.08	0.00	0.08	0.00	0.00	0.00	0.17
Total	218.96	8.64	221.00	6.60	55.84	2.13	513.16

Notes: Total may not equal sum total due to rounding.
Daytime = 7:00am – 9:59pm, Nighttime = 10:00pm – 6:59am.
Touch & Go operations include one landing and one takeoff; therefore, the number of touch & go operations in the noise model is one-half the number shown in the above table.

Sources: Paine Field Master Plan Forecast, August 2021 and Final Environmental Assessment for Amendment to the Operations Specifications for Air Carrier Operations and Amendment to Part 139 Airport Operating Certificate", February 2019; Official Airline Guide, PAE Flight Tracking Data, 2019-2021.

E.1.4 Runway End Utilization

Runway use patterns are not expected to change considerably by 2040. Therefore, the same runway use percentages modeled for the Existing (2019) Noise Exposure Contour shown in **Table 3** were used to model the Future (2040) Noise Exposure Contour.

E.1.5 Flight Tracks

Flight track patterns are not expected to change considerably by 2040. Therefore, the same flight track locations shown in Exhibits 2, 3, and 4 were used to model the Future (2040) Noise Exposure Contour. The percentages modeled for the Existing (2019) Noise Exposure Contour shown in Tables 4, 5, and 6 were used to model the Future (2040) Noise Exposure Contour.

E.1.6 Aircraft Weight and Departure Stage Length

The stage lengths modeled for the Future (2040) Noise Exposure Contour are based upon a review of radar data providing aircraft destinations for scheduled departures at PAE. No major changes to departure stage length distribution are expected to occur by 2040. **Table 15** indicates the proportion of the operations that were modeled within each of the nine stage length categories for Future (2040) Noise Exposure Contour.

Table 15 Stage Length Distribution – Future (2040) Noise Exposure Contour

Aircraft Type	Departure Stage Length									Total
	1	2	3	4	5	6	7	8	9	
Widebody Jets	8.6%	4.1%	11.1%	23.0%	6.2%	12.3%	17.3%	9.9%	7.4%	100.0%
Narrowbody Jets	20.3%	18.2%	14.7%	22.4%	3.5%	4.2%	4.9%	5.6%	6.3%	100.0%
Regional Jets	55.0%	9.6%	8.6%	15.3%	0.0%	11.5%	0.0%	0.0%	0.0%	100.0%
GA Propeller Aircraft	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Military Aircraft	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Helicopters	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Total	41.3%	7.5%	9.0%	16.3%	2.8%	8.0%	6.8%	4.5%	3.8%	**100.0%**

Source: Final Environmental Assessment for Amendment to the Operations Specifications for Air Carrier Operations and Amendment to Part 139 Airport Operating Certificate", February 2019.

E.1.4 Ground Run-Up Activity

Run-ups were modeled at various locations (stalls) at the Boeing Delivery Center Facility, the Boeing EMC ramp, ATS Maintenance apron, and the passenger terminal apron. Aircraft types for which run-ups were modeled remained similar to those modeled for the Future (2030) Noise Exposure Contour Approximately 1.24 average daily run-ups (8.7 per week) were included in the noise modeling. Average run-up duration was approximately 43 minutes. Approximately half of the run-ups were modeled as nighttime operations which included the nighttime "penalty" in the DNL calculation.

E.1.4 Future (2040) Noise Exposure Contour Modeling Results

The Future (2040) Noise Exposure Contour is presented on **Exhibit 10**. The area within each five-decibel noise exposure contour interval is shown in **Table 16**. The noise exposure contour reflects the average-annual day runway use patterns at PAE. The noise exposure contour extends outward from the parallel runway ends. The noise exposure contour extends further out from Runway 16R/34L due to the greater usage of this runway compared to Runway 16L/34R. The 65 DNL noise exposure contour is visible surrounding various areas on the east side of the airport due to the run-ups that are performed on the ramp areas east of Runway 16R/34. The 65+ DNL of the Future (2040) Noise Exposure Contour encompasses approximately 1.66 square miles. The 65 DNL of the Future (2040) Noise Exposure Contour is located over Airport property, highway right-of-way, commercial property, or vacant land. No residential or other noise-sensitive land uses are located within the 65 DNL of the Future (2040) Noise Exposure Contour.

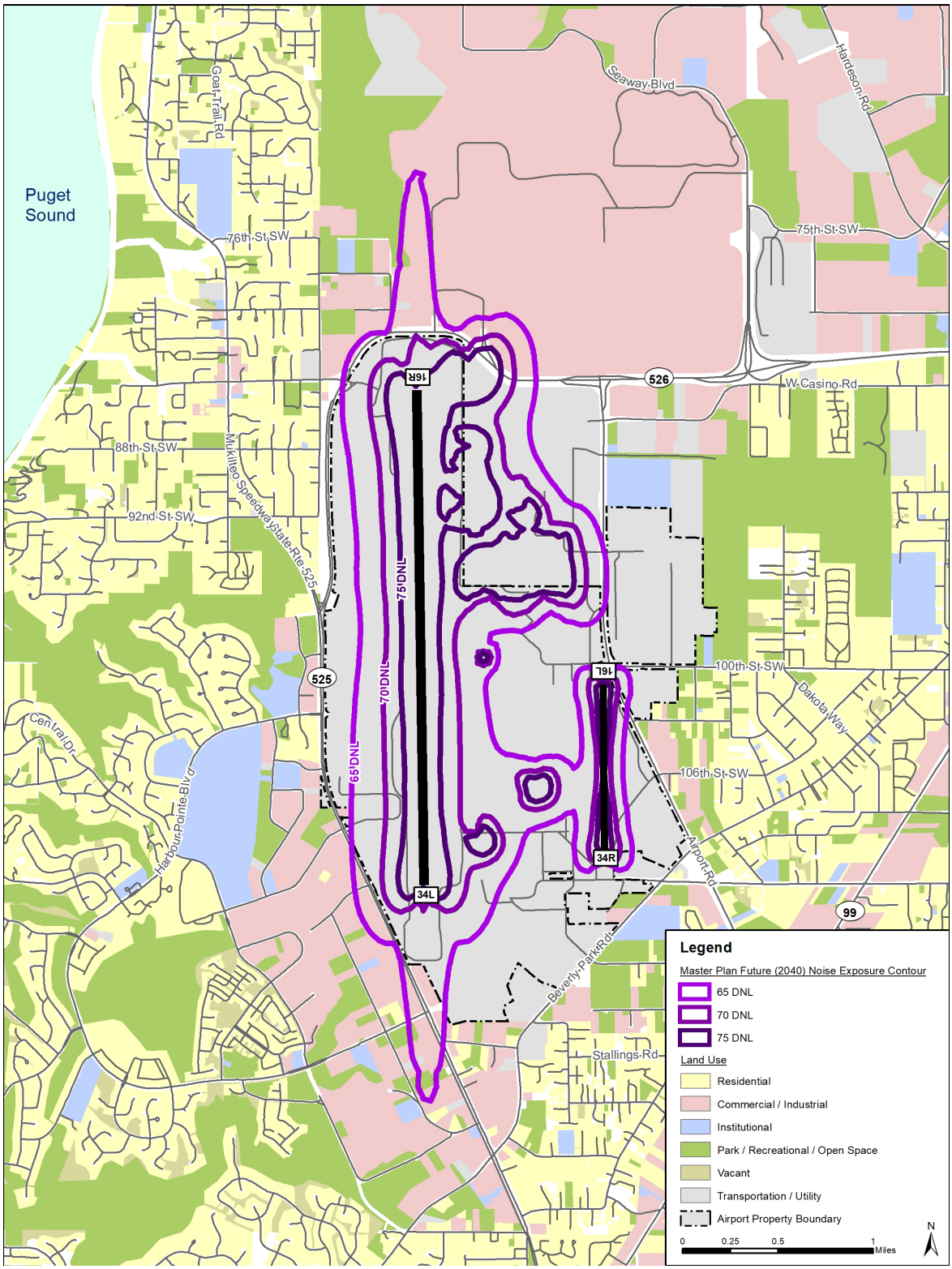
Table 16 Future (2040) Noise Exposure Contour Area

Contour Range	Future (2040) Noise Exposure Contour Area (Square Miles)
65-70 DNL	0.78
70-75 DNL	0.39
75 + DNL	0.49
65 + DNL	1.66

Source: AEDT Version 3d, Landrum & Brown, 2022

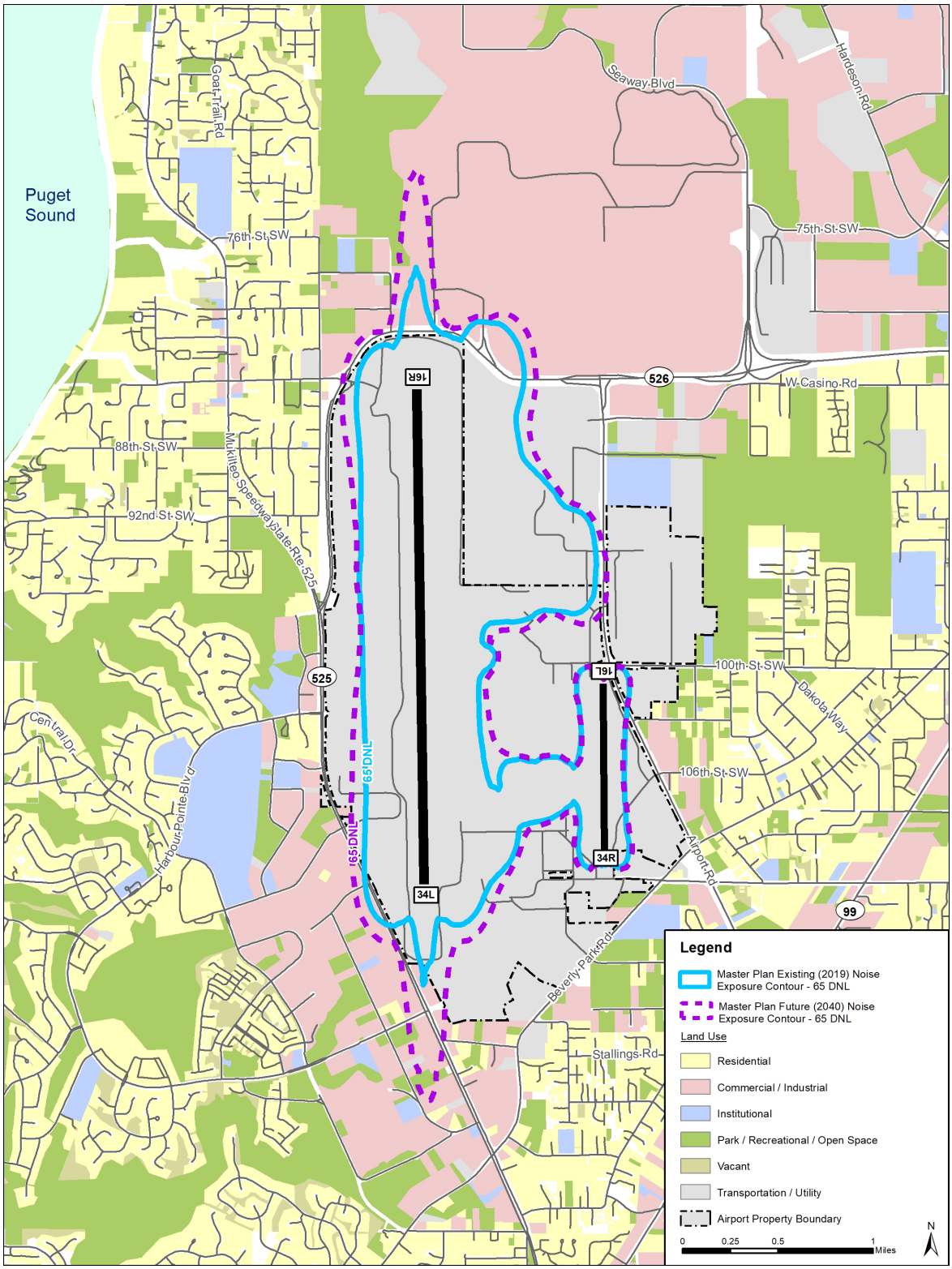
Exhibit 11 shows a comparison of the Future (2040) Noise Exposure Contour to the Existing (2019) Noise Exposure Contour.

Exhibit 10 Future (2040) Noise Exposure Contour



Source: Land use data from Snohomish County Assessor, February 2022; Master Plan Future (2040) Noise Exposure Contour from FAA Aviation Environmental Design Tool (AEDT) Version 3d, Landrum & Brown analysis, 2022.

Exhibit 11 Future (2040) Noise Exposure Contour Compared to Existing (2019) Noise Exposure Contour



Source: Land use data from Snohomish County Assessor, February 2022 Land use data from Snohomish County Assessor, February 2022; Master Plan Existing (2019) and Future (2040) Noise Exposure Contours from FAA Aviation Environmental Design Tool (AEDT) Version 3d, Landrum & Brown analysis, 2022.