# *APPENDIX L.*
# *NOISE MODEL INPUTS*

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# TECHNICAL MEMORANDUM

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|---|---|
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| **From:** | Rhea Hanrahan, Principal Consultant<br>Scott McIntosh, Senior Technical Analyst<br>Timothy Middleton, C.M., Senior Consultant |
| **Date:** | November 30, 2021 |
| **Subject:** | Oakland International Airport Environmental Assessment and Environmental Impact Report<br>Existing Conditions Modeling Input Assumptions Memo |
| **Reference:** | HMMH Project Number 311530.000 |

## 1.0 Introduction

Harris Miller Miller & Hanson Inc. (HMMH) is assisting Reynolds, Smith, & Hills, Inc. (RS&H) in preparing an Environmental Assessment (EA) and Environmental Impact Report (EIR) for the Terminal Modernization and Development Project at Oakland International Airport (OAK), pursuant to the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA). The purpose of this technical memorandum is to present the noise and air quality modeling approach, input data, and assumptions, to establish concurrence prior to running the noise and air quality models to generate noise and air quality outputs for Existing Conditions (2019). Buildout and forecast years for the EA and EIR will be contained in a separate memorandum.

The subsequent sections address the noise and air quality modeling input data for the Federal Aviation Administration (FAA)'s Aviation Environmental Design Tool (AEDT). FAA guidance on use of the AEDT specifies using the most recent version of the model that is available at the time the project commences. In this case, it is AEDT Version 3d.[1] All AEDT modeling conducted for this study adheres to "*Guidance on Using the AEDT to Conduct Environmental modeling for FAA Actions Subject to NEPA*".[2]

## 2.0 Noise Analysis

The noise analysis for this EA will be conducted in accordance with federal requirements for Airport Noise Evaluations under NEPA. The noise analysis for this EIR will also be conducted in accordance with state of California requirements for airport noise evaluations under CEQA. For the EA,FAA Order 1050.1F and its associated Environmental Desk Reference, and FAA Order 5050.4B provide the required guidance. The latest update to CEQA guidelines became effective on December 28, 2018[3]. Noise analysis for projects under CEQA centers on whether the project or the proposed noise abatement would result in significant adverse environmental effects. California Airport Noise Regulations promulgated in accordance with the State Aeronautics Act and set forth in Section 5000 et seq. of the California Code of Regulations (Title 21, Division 2.5, Chapter 6) 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 within which there shall be no incompatible land uses. 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.

[1] Released March 29, 2021 https://aedt.faa.gov/3d_information.aspx
[2] Published September 12, 2016
[3] California Natural Resources Agency. CEQA: The California Environmental Quality Act. (2018) http://files.resources.ca.gov/ceqa/

The above documents and guidance specify several requirements for evaluating noise impacts, including:

- Acceptable noise models to be used and the circumstances under which their use is required.
- The metrics to be used for characterizing the noise environment and quantifying impacts; and
- Thresholds of significance for determining whether the effects of an action would constitute a significant impact under NEPA.

For an action occurring on, or in the vicinity of a single airport, the Environmental Desk Reference directs the use of the latest version of the AEDT for detailed noise modeling or another model, as approved by FAA. The model must be used to produce Day-Night Average Sound Level (DNL) contours of 65 dB, 70 dB, and 75 dB, and others as needed. FAA considers a DNL of 65 dB as the threshold below which all land uses are compatible.

FAA Orders 1050.1F and 5050.4B determine a significant noise impact to be a DNL increase of 1.5 dB or more at a noise-sensitive location with a DNL of 65 dB or higher. For example, an increase from 63.5 dB to 65.0 dB DNL within the same timeframe due to the Proposed Project would be considered a significant impact. If a noise increase is determined to be a significant impact to any of the surrounding noise sensitive properties, as defined in FAA Order 1050.1F, mitigation would be required.

Most aircraft noise studies focus on DNL, the metric adopted by FAA and Environmental Protection Agency (EPA) as the most appropriate long-term measure of airport noise exposure. DNL is determined by adding up the noise energy from all modeled aircraft activity at every individual point of a large array of grid points around an airport. In the DNL calculation, a 10-decibel weighting is applied to nighttime[4] operations. The State of California has adopted the Community Noise Equivalent Level (CNEL) in place of DNL, which adds a 3-decibel weighting to evening[5] operations. Appendix A provides an overview of basic airport noise terminology, including details of how CNEL is calculated.

Computer-generated estimates of CNEL are often depicted as noise contours reflecting lines of equal exposure around an airport (much as topographic maps indicate contours of equal elevation). The contours usually reflect long-term (annual average) operating conditions, accounting for the average flights per day, how often each runway is used throughout the year, and where over the surrounding communities the aircraft normally fly.

The State of California also requires that all municipal General Plans contain a Noise Element. 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.

The FAA requires that the following information must be disclosed for each modeled scenario that is analyzed:

- The number of residences or people exposed to CNEL between 65 dB and 70 dB, 70 dB and 75 dB and greater than or equal to 75 dB, and the net increase or decrease in the number of people or residences exposed to those levels of noise.
- The location and number of noise sensitive uses in addition to residences (e.g., schools, hospitals, parks, recreation areas) exposed to DNL 65 dB or greater.
- The identification of noise sensitive areas exposed to CNEL greater than or equal to 60 dB, and are projected to experience a CNEL increase of 3 dB or more, only when 1.5 dB DNL increases are predicted at noise sensitive areas with CNEL of at least 65 dB.
- Discussion of the noise impact on noise sensitive areas exposed to CNEL of at least 65 dB; and

[4] Nighttime is defined as 10 pm to 7 am
[5] Evening is defined as 7 pm to 10 pm

- Mapping providing land use data, noise contours, and flight tracks for each scenario.

## 3.0 Noise Modeling Methodology and Inputs

AEDT noise model inputs are developed under the following categories:

- Physical description of the airport layout
- Aircraft operations
- Aircraft noise and performance characteristics
- Runway utilization
- Flight track geometry and usage
- Meteorological conditions
- Terrain data

Section 3.1 through Section 3.7 address the noise model inputs for each of these categories.

### 3.1 Physical Description of the Airport Layout

OAK is located within Alameda County, approximately three nautical miles west of downtown San Leandro, CA. As shown in **Figure 1**, the airport includes three 150-foot wide runways (Runway 10L/28R, Runway 10R/28L, and Runway 12/30), and one 75-foot-wide runway (Runway 15/33). Runway 12/30 provides OAK with the greatest capacity to accommodate high numbers of aircraft operations and is the primary runway in use at the airport. Runways 10L/28R and 10R/28L are primarily used by air taxi/charter and general aviation aircraft. Runway 15/33 is the shortest and narrowest and is primarily used by small single-engine propeller aircraft.

The primary runway, Runway 12/30, has magnetic headings of 116.6° and 296.6° and is 10,520 feet long. Runway 10L/28R and Runway 10R/28L have magnetic headings of 98.8° and 278.8° and are 5,458 feet long and 6,213 feet long, respectively. Runway 15/33 has magnetic headings of 151.0° and 331.0° and is 3,376 feet long. [6] All helicopter operations are modeled as arriving and departing from a single helipad location south of the General Aviation area near the intersections of taxiways C, G, and H as shown on **Figure 1**.

Runway length, runway width, instrumentation, and declared distances do not directly affect noise calculations. However, these parameters may affect which aircraft might use a particular runway and under what conditions, and therefore how often a runway would be used relative to the other runways at the airport. **Table 1** provides the detailed parameters for each runway end.

[6] Each runway end is designated by a number that, with the addition of a trailing "0," reflects the magnetic heading of the runway to the nearest 10°, as seen by the pilot.

**Table 1. Runway Details**

Sources: FAA Form 5010, https://www.faa.gov/airports/airport_safety/airportdata_5010/, as of 7/13/2021

| Runway End | Latitude (dd-mm-ss) | Longitude (dd-mm-ss) | Latitude (decimal degrees) | Longitude (decimal degrees) | Elevation (feet, MSL) | Displaced Landing Threshold (feet) | Glide Slope (degrees) | Threshold Crossing (feet, AGL) | Magnetic Orientation (degrees) |
|---|---|---|---|---|---|---|---|---|---|
| 10L | 37-43-49.6865N | 122-13-19.8481W | 37.730468 | -122.222179 | 5.5 | 0 | 3.00 | 50 | 98.8 |
| 10R | 37-43-43.3450N | 122-13-33.2509W | 37.728706 | -122.225902 | 8.1 | 0 | 3.00 | 50 | 98.8 |
| 12 | 37-43-12.2256N | 122-14-31.6133W | 37.720062 | -122.242114 | 8.3 | 0 | 2.75 | 70 | 116.6 |
| 15 | 37-44-25.0497N | 122-13-22.1076W | 37.740291 | -122.222807 | 1.5 | 0 | N/A | N/A | 151.0 |
| 28R | 37-43-29.3247N | 122-12-16.9329W | 37.724812 | -122.204704 | 5.8 | 0 | 3.00 | 51 | 278.8 |
| 28L | 37-43-20.1780N | 122-12-21.6341W | 37.722271 | -122.206009 | 8.2 | 0 | 3.00 | 50 | 278.8 |
| 30 | 37-42-05.3735N | 122-12-51.3251W | 37.701493 | -122.214257 | 9.0 | 114 | 3.00 | 71 | 331.0 |
| 33 | 37-43-52.9005N | 122-13-10.8260W | 37.731361 | -122.219673 | 3.9 | 0 | N/A | N/A | 296.6 |
| H1 | 37-43-44.8062N | 122-12-45.6762W | 37.729113 | -122.212688 | 9.0 | N/A | | | |

*Note: H1 designates the location of the helipad*

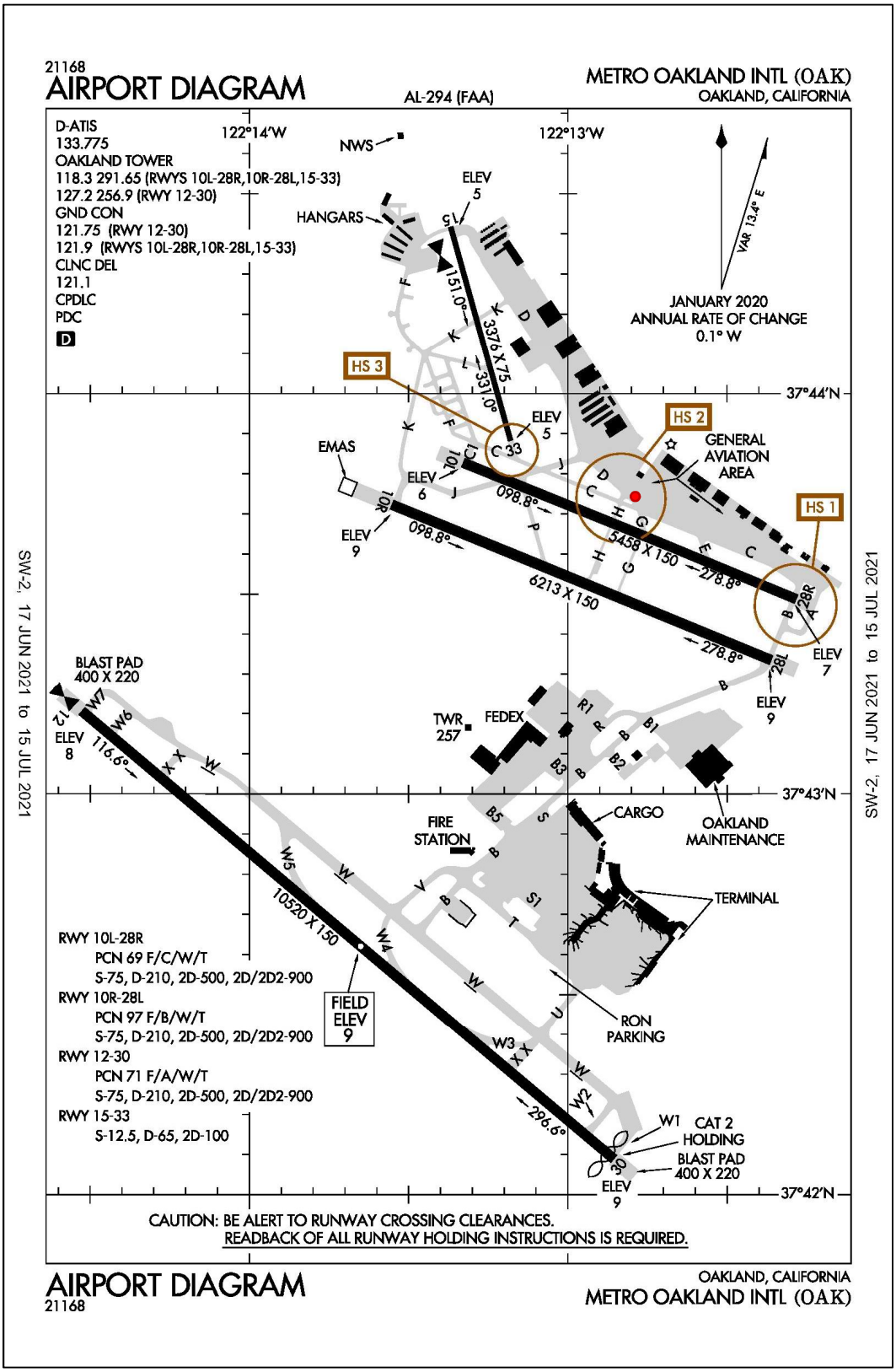



**Figure 1. Existing OAK Airport Layout**

Sources: FAA

*Note: Modeled Helipad location "H1" indicated by red dot*

## 3.2 Aircraft Operations

The Existing Conditions case for this study is representative of 2019 operation levels. **Table 2** presents the annual operations modeled for the existing condition. Aircraft operations for the Existing Condition was derived from the 2019-2038 Comprehensive Aviation Activity Forecast Report prepared by InterVISTAS Consulting, Inc. (InterVISTAS) and Landrum & Brown (L&B) dated July 28, 2020 and updated June 2021. The operational counts were broken out into four distinct categories: Commercial, Freighter, General Aviation and Military, and Fighter (to account for the activity of the US Navy's Blue Angels operating out of OAK).

**Table 2. Modeled Annual Aircraft Operations**

Sources: Oakland International Airport Comprehensive Airport Activity Forecast Report (2019-2038)

| Modeling Scenario | Commercial | Freighter | General Aviation and Military | Fighter | Total |
|---|---|---|---|---|---|
| 2019 Existing Conditions | 113,272 | 20,698 | 108,706 | 81 | 242,757 |
| *Note: Totals may not match exactly due to rounding* | | | | | |

The forecast prepared by InterVISTAS and L&B included specific fleet mix assumptions for all categories of aircraft operating at OAK. As the forecast does not separate operations by stage length or by the day, evening, and night time periods used in the calculation of CNEL (7:00 a.m. to 7:00 p.m. for daytime, 7:00 p.m. to 10:00 p.m. for evening, and 10:00 p.m. to 7:00 a.m. for night time, as discussed in Appendix A), the percentages of stage lengths and day, evening and night operations had to be derived from an analysis of the radar data obtained from the OAK Airport Noise and Operations Monitoring System (ANOMS).

**Table 3** presents the 2019 Existing Conditions case detailed forecast of average daily operations by aircraft type for arrivals and departures. The column labeled "Category" in **Table 3** indicates how the operations with similar runway requirements were combined, as discussed in section 3.5.

**Table 3. Modeled Average Daily Itinerant Aircraft Operations for 2019 Existing Conditions**

Sources: InterVISTAS, L&B, OAK ANOMS, HMMH

| Category | Engine Type | AEDT Aircraft Type | Arrivals | | | | Departures | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Day | Evening | Night | Total | Day | Evening | Night | Total | |
| Commercial | Jet | 717200 | 106 | 19 | 88 | 213 | 101 | 9 | 103 | 213 | 426 |
| | | 737700 | 20,544 | 5,652 | 4,281 | 30,478 | 20,622 | 5,384 | 4,472 | 30,478 | 60,956 |
| | | 737800 | 8,064 | 2,220 | 3,059 | 13,343 | 9,180 | 1,909 | 2,254 | 13,343 | 26,685 |
| | | 7378MAX | 165 | 59 | 37 | 262 | 173 | 45 | 45 | 262 | 524 |
| | | 7878R | 565 | 31 | 1 | 598 | 268 | 314 | 16 | 598 | 1,195 |
| | | A319-131 | 1,791 | 574 | 553 | 2,919 | 1,848 | 447 | 624 | 2,919 | 5,838 |
| | | A320-232 | 2,095 | 1,025 | 710 | 3,830 | 1,982 | 368 | 1,480 | 3,830 | 7,659 |
| | | A321-232 | 206 | 873 | 182 | 1,261 | 1,145 | 5 | 111 | 1,261 | 2,521 |
| | | A330-301 | 5 | 25 | 17 | 48 | 39 | 0 | 8 | 48 | 95 |
| | | CL600 | 44 | 6 | 3 | 53 | 47 | 3 | 3 | 53 | 107 |
| | | CL601 | 6 | 0 | 0 | 6 | 6 | 0 | 0 | 6 | 12 |
| | | CRJ9-ER | 207 | 17 | 38 | 262 | 170 | 47 | 45 | 262 | 523 |
| | | EMB145 | 695 | 129 | 19 | 843 | 719 | 101 | 23 | 843 | 1,685 |
| | | EMB14L | 5 | 1 | 0 | 6 | 5 | 0 | 0 | 6 | 12 |
| | | EMB175 | 1,651 | 216 | 5 | 1,872 | 1,431 | 427 | 14 | 1,872 | 3,743 |
| | Non-jet | CNA208 | 566 | 0 | 79 | 646 | 566 | 0 | 79 | 646 | 1,291 |
| | **Subtotal** | | **36,716** | **10,848** | **9,072** | **56,636** | **38,301** | **9,058** | **9,276** | **56,636** | **113,272** |
| Freighter | Jet | 727EM2 | 5 | 1 | 1 | 7 | 3 | 0 | 3 | 7 | 14 |
| | | 747400 | 5 | 1 | 5 | 10 | 3 | 2 | 5 | 10 | 20 |
| | | 757PW | 415 | 706 | 234 | 1,355 | 258 | 295 | 802 | 1,355 | 2,710 |
| | | 767300 | 796 | 235 | 1,149 | 2,180 | 565 | 475 | 1,140 | 2,180 | 4,360 |
| | | 777300 | 178 | 95 | 517 | 790 | 218 | 5 | 567 | 790 | 1,580 |
| | | A300-622R | 479 | 202 | 619 | 1,300 | 384 | 212 | 703 | 1,300 | 2,600 |
| | | A300B4-203 | 9 | 2 | 9 | 20 | 6 | 6 | 8 | 20 | 40 |
| | | DC1030 | 52 | 36 | 207 | 295 | 63 | 15 | 217 | 295 | 590 |
| | | DC93LW | 7 | 2 | 9 | 18 | 12 | 1 | 5 | 18 | 36 |
| | | MD11PW | 887 | 214 | 1,349 | 2,450 | 583 | 430 | 1,437 | 2,450 | 4,900 |
| | Non-jet | BEC58P | 2 | 7 | 27 | 37 | 32 | 0 | 4 | 37 | 74 |
| | | CNA206 | 1 | 0 | 9 | 10 | 10 | 0 | 0 | 10 | 19 |
| | | CNA208 | 1,833 | 22 | 23 | 1,878 | 1,336 | 4 | 538 | 1,878 | 3,755 |
| | **Subtotal** | | **4,669** | **1,523** | **4,157** | **10,349** | **3,475** | **1,446** | **5,429** | **10,349** | **20,698** |
| General Aviation and Military | Helicopter | B206L | 229 | 14 | 0 | 242 | 227 | 15 | 0 | 242 | 485 |
| | | B407 | 145 | 2 | 2 | 150 | 145 | 2 | 2 | 150 | 300 |
| | | EC130 | 281 | 86 | 180 | 547 | 307 | 113 | 127 | 547 | 1,094 |
| | Jet | BD-700-1A10 | 510 | 103 | 71 | 684 | 539 | 68 | 77 | 684 | 1,368 |
| | | CL600 | 911 | 67 | 36 | 1,013 | 908 | 57 | 49 | 1,013 | 2,027 |
| | | CL601 | 718 | 85 | 66 | 869 | 730 | 68 | 71 | 869 | 1,738 |
| | | CNA500 | 22 | 3 | 3 | 28 | 22 | 3 | 3 | 28 | 56 |
| | | CNA510 | 959 | 131 | 57 | 1,147 | 969 | 114 | 64 | 1,147 | 2,295 |
| | | CNA525C | 336 | 42 | 21 | 398 | 329 | 36 | 34 | 398 | 797 |
| | | CNA55B | 1,609 | 174 | 103 | 1,887 | 1,631 | 139 | 116 | 1,887 | 3,773 |
| | | CNA560U | 231 | 27 | 28 | 286 | 222 | 36 | 28 | 286 | 572 |
| | | CNA560XL | 815 | 108 | 60 | 984 | 876 | 59 | 49 | 984 | 1,967 |
| | | CNA680 | 603 | 68 | 27 | 697 | 607 | 46 | 44 | 697 | 1,394 |
| | | CNA750 | 638 | 74 | 32 | 744 | 659 | 37 | 47 | 744 | 1,488 |
| | | FAL900EX | 152 | 20 | 13 | 185 | 162 | 11 | 12 | 185 | 371 |

| Category | Engine Type | AEDT Aircraft Type | Arrivals | | | | Departures | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Day | Evening | Night | Total | Day | Evening | Night | Total | |
| | | GIIB | 23 | 3 | 1 | 27 | 21 | 2 | 4 | 27 | 54 |
| | | GIV | 1,188 | 183 | 110 | 1,482 | 1,165 | 166 | 151 | 1,482 | 2,963 |
| | | GV | 621 | 87 | 26 | 734 | 591 | 83 | 60 | 734 | 1,468 |
| | | LEAR25 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 3 |
| | | LEAR35 | 789 | 109 | 59 | 957 | 770 | 89 | 98 | 957 | 1,914 |
| | Non-jet | BEC58P | 5,231 | 473 | 240 | 5,944 | 5,332 | 433 | 179 | 5,944 | 11,889 |
| | | CNA172 | 9,458 | 1,569 | 267 | 11,294 | 10,527 | 626 | 140 | 11,294 | 22,588 |
| | | CNA182 | 3,164 | 441 | 79 | 3,685 | 3,351 | 247 | 88 | 3,685 | 7,370 |
| | | CNA206 | 1,039 | 60 | 45 | 1,144 | 978 | 129 | 37 | 1,144 | 2,288 |
| | | CNA208 | 3,491 | 220 | 182 | 3,893 | 3,538 | 186 | 168 | 3,893 | 7,786 |
| | | CNA441 | 973 | 81 | 41 | 1,094 | 945 | 112 | 37 | 1,094 | 2,188 |
| | | COMSEP | 1,607 | 203 | 104 | 1,913 | 1,613 | 270 | 30 | 1,913 | 3,827 |
| | | DHC6 | 712 | 107 | 104 | 923 | 667 | 114 | 142 | 923 | 1,847 |
| | | DHC8 | 270 | 0 | 0 | 270 | 270 | 0 | 0 | 270 | 541 |
| | | DHC830 | 129 | 154 | 0 | 283 | 116 | 129 | 39 | 283 | 566 |
| | | GASEPF | 3,220 | 546 | 36 | 3,802 | 3,584 | 150 | 68 | 3,802 | 7,603 |
| | | GASEPV | 849 | 92 | 19 | 960 | 864 | 63 | 33 | 960 | 1,920 |
| | | PA28 | 3,900 | 571 | 157 | 4,628 | 4,378 | 185 | 65 | 4,628 | 9,256 |
| | | PA30 | 1,165 | 229 | 56 | 1,449 | 1,182 | 150 | 117 | 1,449 | 2,898 |
| | | PA42 | 7 | 0 | 1 | 9 | 7 | 0 | 2 | 9 | 17 |
| | **Subtotal** | | **45,995** | **6,133** | **2,225** | **54,353** | **48,232** | **3,942** | **2,180** | **54,353** | **108,706** |
| **Fighter** | **Jet** | F-18 | 41 | 0 | 0 | 41 | 41 | 0 | 0 | 41 | 81 |
| | **Subtotal** | | **41** | **0** | **0** | **41** | **41** | **0** | **0** | **41** | **81** |
| **Grand Total** | | | **87,421** | **18,505** | **15,453** | **121,378** | **90,048** | **14,446** | **16,885** | **121,378** | **242,757** |
| *Note: Totals may not match exactly due to rounding* | | | | | | | | | | | |

## 3.3 Aircraft Noise and Performance Characteristics

AEDT requires the use of specific noise and performance data for each aircraft type operating at the airport. Noise data are specified in the form of Sound Exposure Level (SEL) at a range of distances (from 200 feet to 25,000 feet) from a receiver on the ground to a particular aircraft with engines operating at a range of thrust levels. Performance data include thrust, speed and altitude profiles for takeoff and landing operations. The AEDT automatically accesses the noise and performance data for takeoff and landing operations by those aircraft types.

Within the AEDT database, aircraft departure profiles are defined by a range of trip distances identified as "stage lengths." Higher stage lengths (longer trip distances) are associated with heavier aircraft due to the increase in fuel requirements for the flight. For example, a departure aircraft with a trip distance less than 500 Nautical Miles (nmi) would be assigned a stage length value of one, where a departure aircraft with a trip distance of 3,000 nmi would be assigned a stage length value of five. The noise calculations presented in this document used the standard AEDT departure profiles. **Table 4** provides the stage length classifications by their associated trip distances and **Table 5** presents the stage length utilization rates by AEDT aircraft type.

**Table 4. Stage Lengths by Trip Distance**

| Stage length | Trip Distance (nmi) |
|---|---|
| 1 | 0-500 |
| 2 | 501-1,000 |
| 3 | 1,001-1,500 |
| 4 | 1,501-2,500 |
| 5 | 2,501-3,500 |
| 6 | 3,501-4,500 |
| 7 | 4,501-5,500 |
| 8 | 5,501-6,500 |
| 9 | 6,501+ |

**Table 5. 2019 Existing Conditions Modeled Departure Stage Length Usage by Aircraft Type**

| AEDT Aircraft Type | Stage length | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
| 717200 | 0% | 97% | 0% | 3% | 0% | 0% | 0% | 0% | 0% | 100% |
| 737700 | 71% | 21% | 6% | 3% | 0% | 0% | 0% | 0% | 0% | 100% |
| 737800 | 27% | 27% | 11% | 35% | 0% | 0% | 0% | 0% | 0% | 100% |
| 747400 | 14% | 0% | 0% | 86% | 0% | 0% | 0% | 0% | 0% | 100% |
| 767300 | 23% | 3% | 8% | 66% | 0% | 0% | 0% | 0% | 0% | 100% |
| 777300 | 0% | 1% | 0% | 71% | 0% | 28% | <1% | 0% | 0% | 100% |
| 727EM2 | 17% | 17% | 50% | 17% | 0% | 0% | 0% | 0% | 0% | 100% |
| 7378MAX | 40% | 27% | 17% | 16% | 0% | 0% | 0% | 0% | 0% | 100% |
| 757PW | 58% | 10% | <1% | 31% | 0% | 0% | 0% | 0% | 0% | 100% |
| 7878R | 0% | 0% | 0% | 0% | 0% | 10% | 90% | 0% | 0% | 100% |
| A300-622R | 29% | 29% | 12% | 30% | 0% | 0% | 0% | 0% | 0% | 100% |
| A300B4-203 | 17% | 38% | 29% | 17% | 0% | 0% | 0% | 0% | 0% | 100% |
| A319-131 | 43% | 50% | 1% | 6% | 0% | 0% | 0% | 0% | 0% | 100% |
| A320-232 | 52% | 6% | 20% | 22% | 0% | 0% | 0% | 0% | 0% | 100% |
| A321-232 | <1% | 3% | 7% | 90% | 0% | 0% | 0% | 0% | 0% | 100% |
| A330-301 | 9% | 9% | 7% | 74% | 0% | 2% | 0% | 0% | 0% | 100% |
| B206L | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| B407 | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| BD-700-1A10 | 50% | 8% | 4% | 28% | 1% | 1% | 5% | <1% | 0% | 100% |
| BEC58P | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| CL600 | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| CL601 | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| CNA172 | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| CNA182 | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| CNA206 | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| CNA208 | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| CNA441 | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| CNA500 | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| CNA510 | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| CNA525C | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| CNA55B | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| CNA560U | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| CNA560XL | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| CNA680 | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| CNA750 | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| COMSEP | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| CRJ9-ER | 4% | 96% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| DC1030 | 53% | 8% | 1% | 38% | 0% | 0% | 0% | 0% | 0% | 100% |
| DC93LW | 6% | 19% | 75% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| DHC6 | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| DHC8 | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| DHC830 | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| EC130 | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| EMB145 | 88% | 12% | <1% | <1% | 0% | 0% | 0% | 0% | 0% | 100% |
| EMB14L | 60% | 40% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| EMB175 | 55% | 45% | <1% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| F-18 | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |

| AEDT Aircraft Type | Stage length | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
| **FAL900EX** | 49% | 11% | 12% | 23% | <1% | 4% | 0% | 0% | 0% | **100%** |
| **GASEPF** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **GASEPV** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **GIIB** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **GIV** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **GV** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **LEAR25** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **LEAR35** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **MD11PW** | 22% | 14% | 0% | 64% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **PA28** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **PA30** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **PA42** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| *Note: Totals may not match exactly due to rounding* | | | | | | | | | | |

## 3.4 Runway Utilization

Weather, particularly wind direction and wind speed, is the primary factor affecting runway use at airports. Additional factors that may affect runway use include the position of a facility (such as a passenger terminal) relative to the runways and temporary runway closures, generally for airfield maintenance and construction.

In the development of the updated OAK noise exposure maps, runway usage rates were calculated for four aircraft groups sharing common runway use characteristics, using actual operations data from the OAK ANOMS. All operation categories are subdivided based on aircraft powerplant type (i.e., jet, non-jet, and helicopter). **Table 6** provides the modeled runway use percentages for departures and arrivals for the day, evening and nighttime periods used in the calculation of CNEL for all fixed-wing aircraft categories. As all helicopters are modeled from a single helipad, its utilization rate is 100% for these operations.

**Table 6. Modeled Average Daily Runway Use**

Source: OAK ANOMS, HMMH

| Time of Day | Runway End | Commercial | | Freighter | | GA and Military | | Fighter |
|---|---|---|---|---|---|---|---|---|
| | | Jet | Non-jet | Jet | Non-jet | Jet | Non-jet | Jet |
| Day | 10L | <1% | <1% | 0% | 4% | <1% | 3% | 0% |
| | 10R | <1% | <1% | <1% | 4% | 6% | <1% | 0% |
| | 12 | 7% | 15% | 9% | <1% | 4% | <1% | 0% |
| | 15 | 0% | 0% | 0% | <1% | <1% | 3% | 0% |
| | 28L | <1% | 0% | <1% | 33% | 11% | 10% | 0% |
| | 28R | 4% | <1% | <1% | 54% | 35% | 64% | 0% |
| | 30 | 87% | 84% | 90% | 4% | 44% | <1% | 100% |
| | 33 | 0% | 0% | 0% | <1% | <1% | 19% | 0% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| Evening | 10L | 0% | 0% | 0% | 3% | <1% | 2% | 0% |
| | 10R | <1% | 0% | 0% | 41% | 4% | <1% | 0% |
| | 12 | 6% | 0% | 7% | 0% | 5% | <1% | 0% |
| | 15 | 0% | 0% | 0% | 0% | 0% | <1% | 0% |
| | 28L | <1% | 0% | 0% | 20% | 11% | 5% | 0% |
| | 28R | 4% | 0% | 0% | 32% | 40% | 78% | 0% |
| | 30 | 89% | 0% | 93% | 3% | 39% | 2% | 0% |
| | 33 | 0% | 0% | 0% | 0% | <1% | 11% | 0% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| Night | 10L | 0% | 0% | 0% | 3% | <1% | 6% | 0% |
| | 10R | <1% | 0% | 0% | 3% | 6% | 2% | 0% |
| | 12 | 6% | 6% | 7% | 0% | 4% | <1% | 0% |
| | 15 | 0% | 0% | 0% | <1% | 0% | <1% | 0% |
| | 28L | <1% | 38% | <1% | 77% | 9% | 3% | 0% |
| | 28R | <1% | 0% | <1% | 16% | 32% | 83% | 0% |
| | 30 | 92% | 56% | 93% | <1% | 49% | 3% | 0% |
| | 33 | 0% | 0% | 0% | <1% | <1% | 3% | 0% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |

*Note: Totals may not match exactly due to rounding*

## 3.5 Flight Track Geometry and Use

In addition to runway usage, radar data from the OAK ANOMS provided an ideal source of information for identifying where aircraft fly and how often they use different flight corridors in the vicinity of the airport. In the development of the OAK EA and EIR, sets of prototypical flight tracks were defined for noise modeling. Known as "backbones," these tracks follow the central tendency of more dispersed paths flown by aircraft along each major flight corridor. Additional model tracks were created to either side of the backbones to account for the dispersion within each corridor, and traffic is distributed normally[7] onto each track group to reflect the spreading of noise along the corridor.

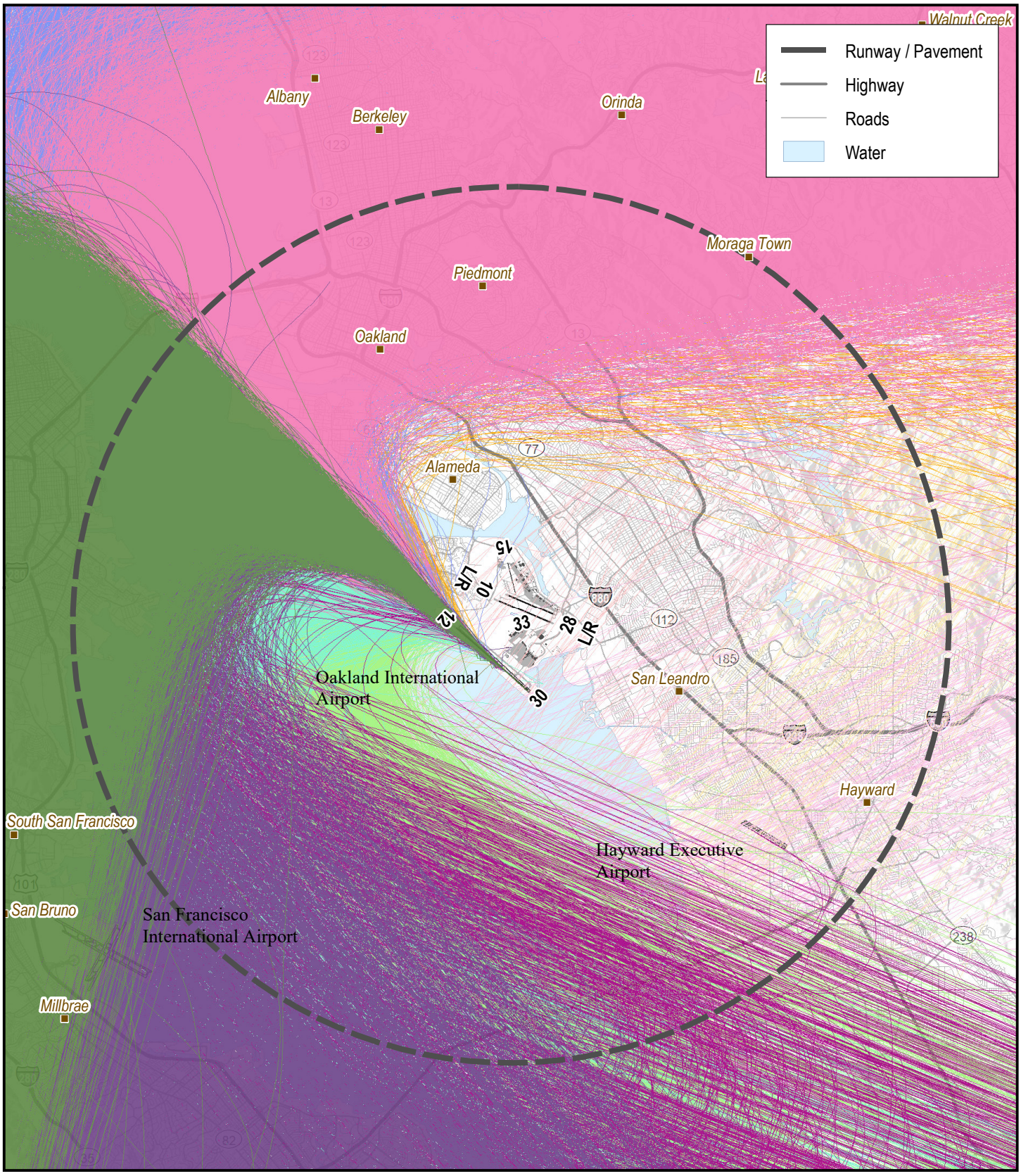
Aircraft are assigned to specific modeling tracks based on historical averages determined through analysis of the radar data. Knowledge of destinations for departures from the airport or points of origin for arrivals to the airport are also considered. The standard procedure for model track development entails separating tracks by operation type, (e.g., arrival or departure) and runway end. HMMH analyzed flight tracks with the same operation type and runway end for similar geometry and this resulted in the final flight track bundles used to create model tracks.

This process is illustrated in **Figure 2** and **Figure 3**. **Figure 2** displays departure radar tracks from Runway 30 in different colors and **Figure 3** displays a single set of Runway 30 departures with the AEDT model backbone and sub-tracks. Model flight tracks are labeled with a number following the designations distinguishing tracks that take different routes from the same runway end. For example, flight track D30010 identifies a departure flight track (**D**30010: D, as opposed to A if it were an arrival) from Runway 30 (D**30**010), and the first two digits identify the track group (0 D30**01**0). The number at the end of the track name differentiates it from others in its group. A zero indicates that the track is a backbone, while a one or two indicates that the track is a subtrack (D3001**0**).

All fixed-wing aircraft flight tracks start or end at runway ends. Helicopter tracks generally start and end at a defined helipad and thus are modeled as flights to and from the midfield area (the helipad "H1" identified in **Table 1** and marked on **Figure 1**).

**Figure 4** through **Figure 21** present the modeled flight track geometry, for arrival and departure operations by runway end. These tracks were developed using calendar year 2019 data from the OAK ANOMS. The set of flight tracks reflects existing operations following RNAV departures and some Required Navigational Performance (RNP) arrival procedures, which are a subset of the more advanced Performance Based Navigation (PBN) procedures that the FAA is in the process of implementing across the U.S. **Table 7** presents the modeled flight track usage rates by runway end and aircraft type category, for fixed-wing arrivals. **Table 8** and **Table 9** present the same information for fixed-wing departures and helicopters, respectively. The usage rates were developed using the same sample of radar data that formed the basis of the runway use and flight track geometry.

[7] According to a statistical normal (Gaussian) distribution




Radar Track (Various Colors)

Model Track Area Boundary

0 3 6 Nautical Miles

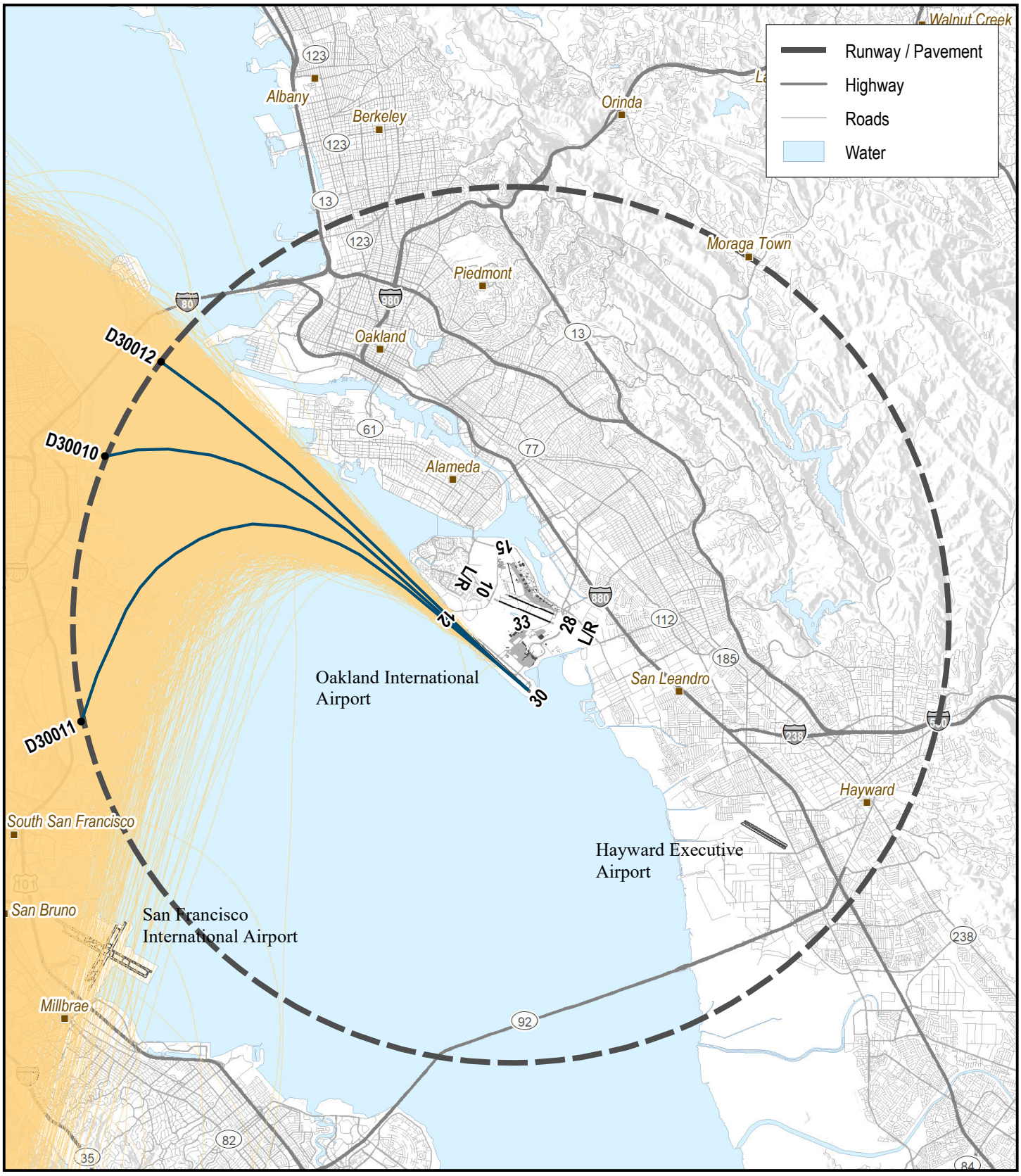
Source: HMMH, November 2021

# Oakland International Airport

Oakland, California

Figure 2

**Departure Radar Tracks from Runway 30**




Source: HMMH, November 2021

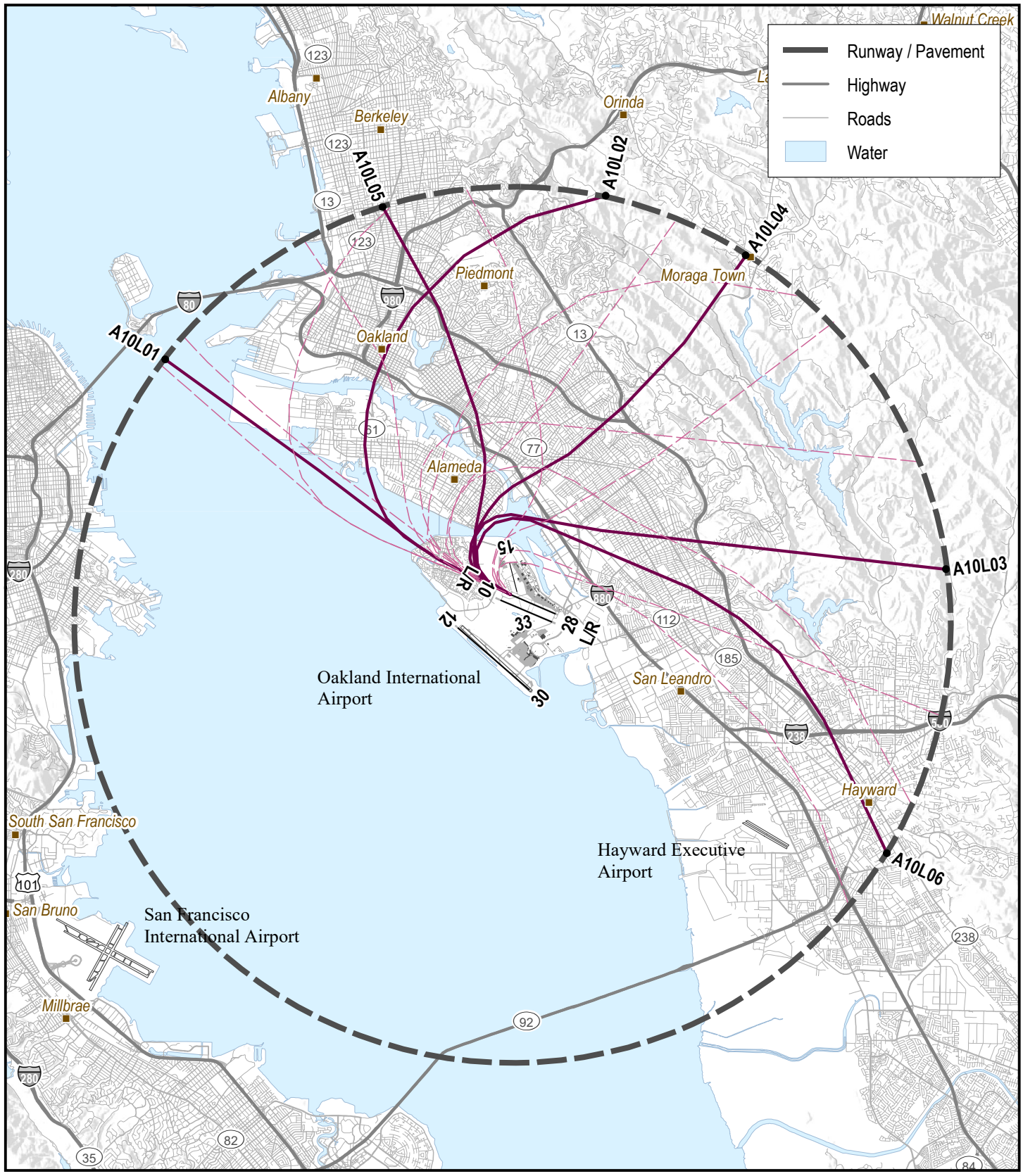
Document Path: G:\Projects\311XXX\311530_OAK_NEPA_2020\GIS\311530_OAK_Figure3_RWY30_Dep_Model_Tracks.mxd

# Oakland International Airport

Oakland, California

Figure 3

**Departure Radar Tracks from Runway 30 with Model Tracks for Track Group D3001**

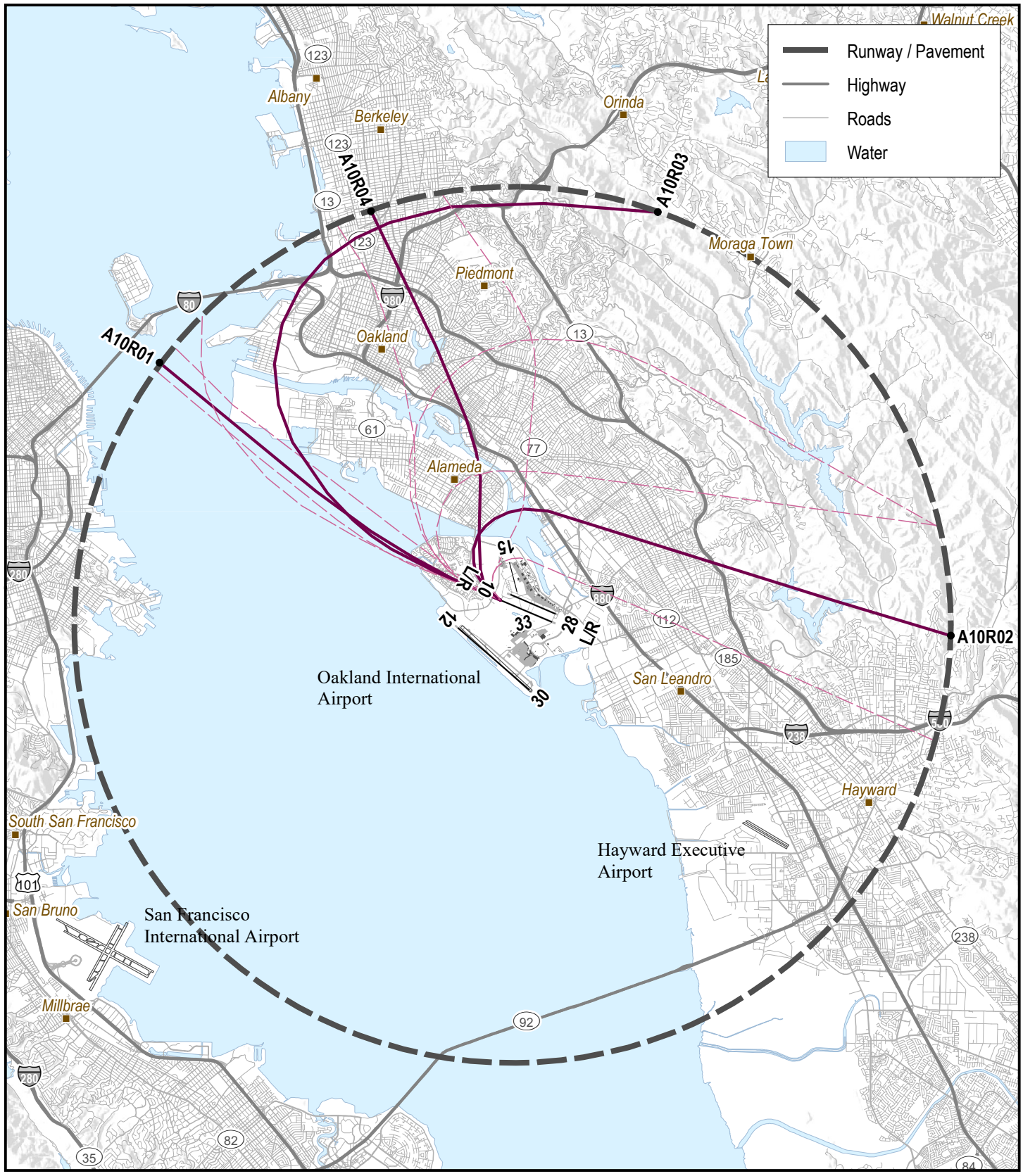



# Oakland International Airport

Oakland, California

Figure 4

**Arrival Model Tracks to Runway 10L**




Modeled Backbone Arrival Track

Modeled Dispersed Arrival Track

Model Track Area Boundary

0 3 6 Nautical Miles

Source: HMMH, November 2021

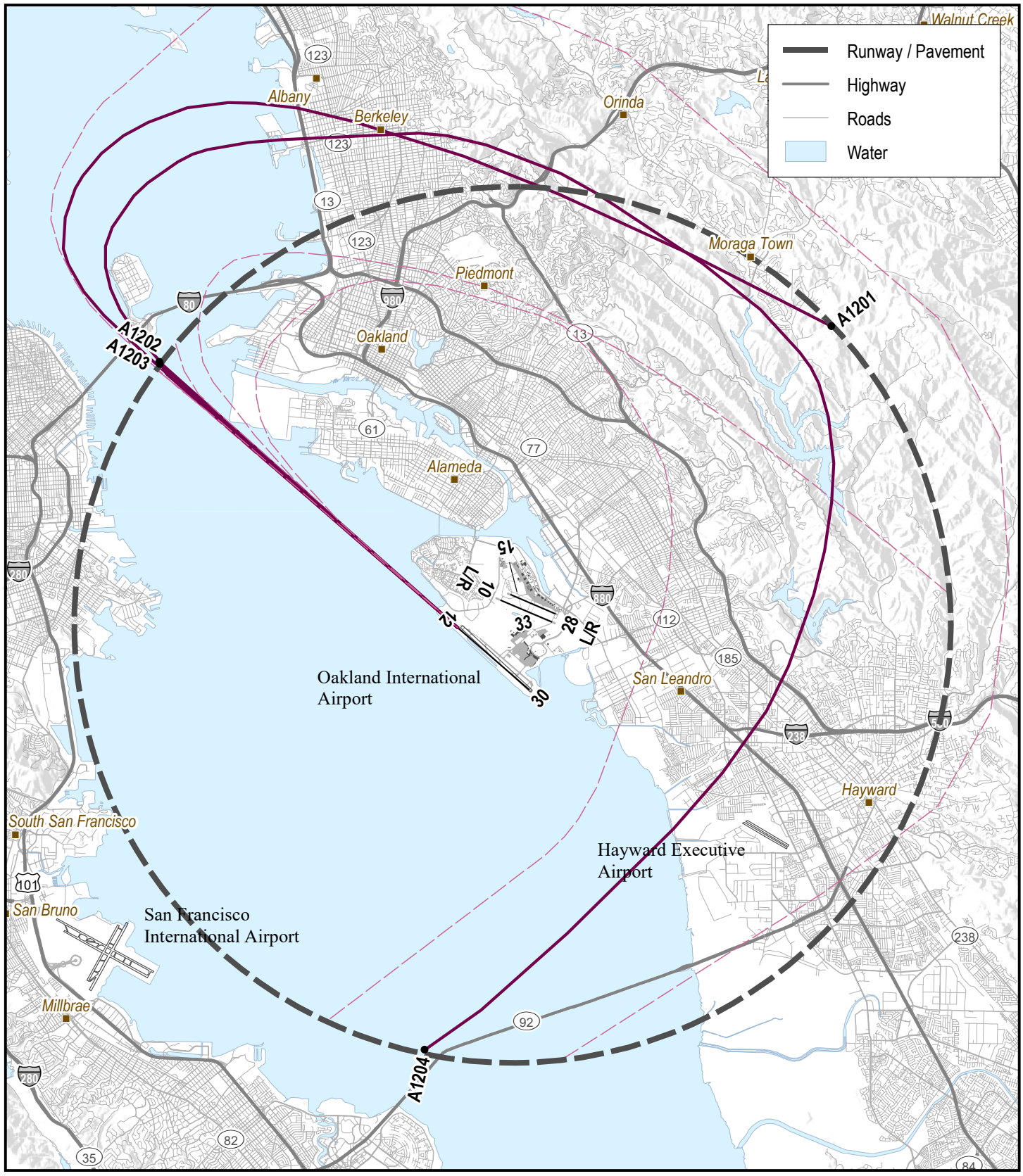
# Oakland International Airport

Oakland, California

Figure 5

**Arrival Model Tracks to Runway 10R**

Document Path: G:\Projects\311XXX\311530_OAK_NEPA_2020\GIS\311530_OAK_Figure5_RWY10R_Arr_Model_Tracks.mxd




Source: HMMH, November 2021

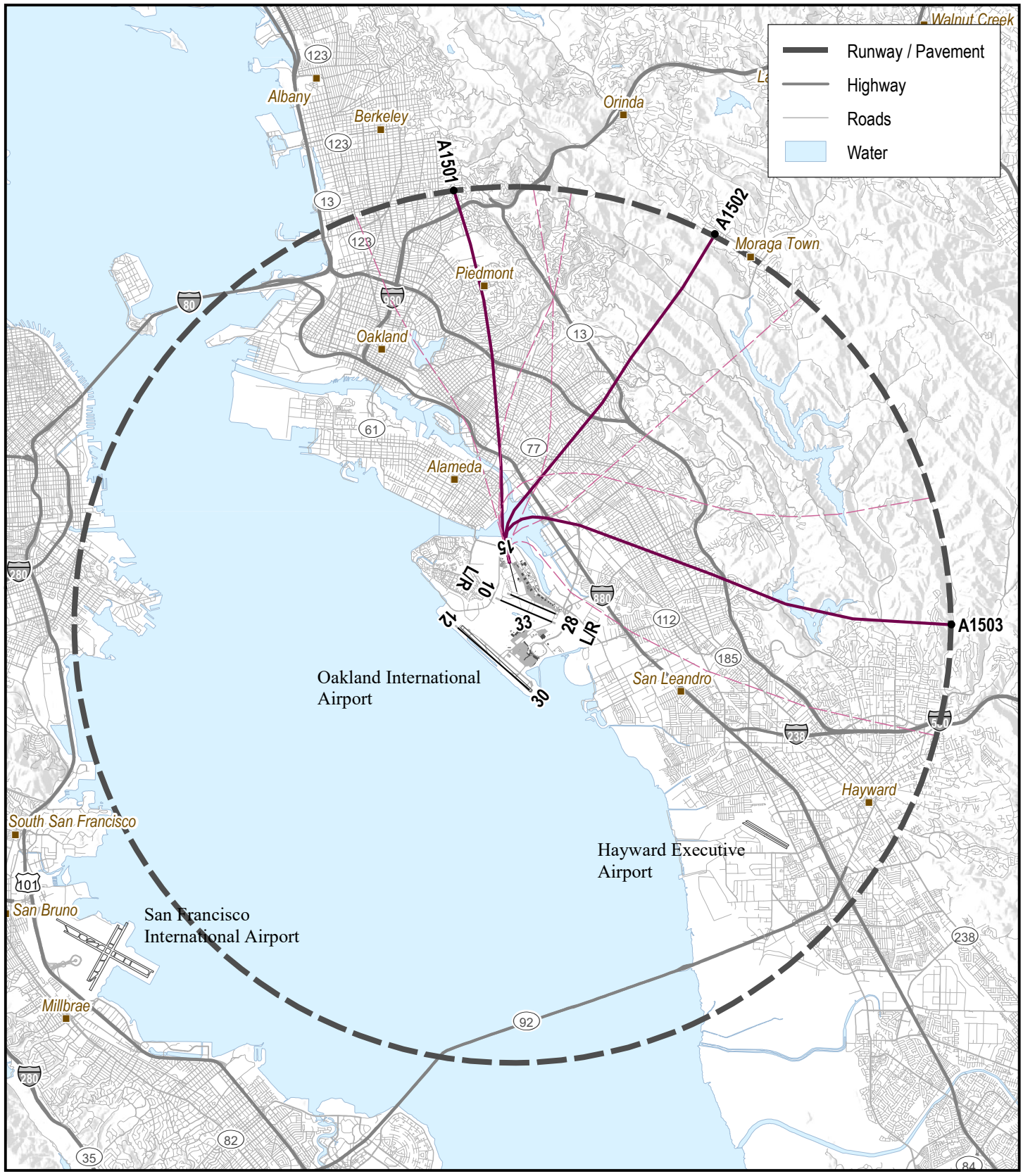
Document Path: G:\Projects\311XXX\311530_OAK_NEPA_2020\GIS\311530_OAK_Figure6_RWY12_Arr_Model_Tracks.mxd

# Oakland International Airport

Oakland, California

Figure 6

**Arrival Model Tracks to Runway 12**




Document Path: G:\Projects\311XXX\311530_OAK_NEPA_2020\GIS\311530_OAK_Figure7_RWY15_Arr_Model_Tracks.mxd

Modeled Backbone Arrival Track

Modeled Dispersed Arrival Track

Model Track Area Boundary

0 3 6 Nautical Miles

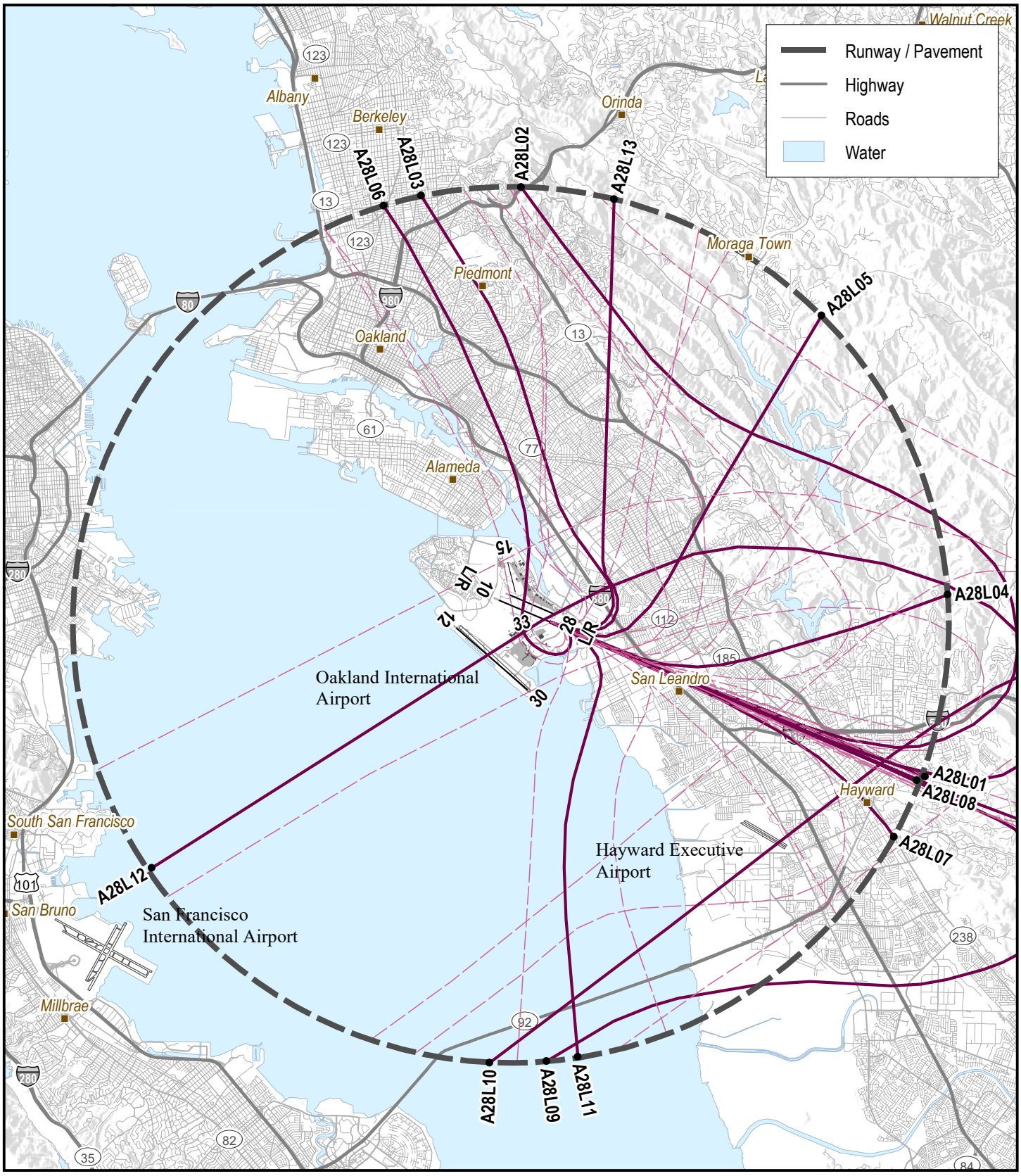
Source: HMMH, November 2021

# Oakland International Airport

Oakland, California

Figure 7

**Arrival Model Tracks to Runway 15**




Document Path: G:\Projects\311XXX\311530_OAK_NEPA_2020\GIS\311530_OAK_Figure8_RWY28L_Arr_Model_Tracks.mxd

Modeled Backbone Arrival Track

Modeled Dispersed Arrival Track

Model Track Area Boundary

0 3 6 Nautical Miles

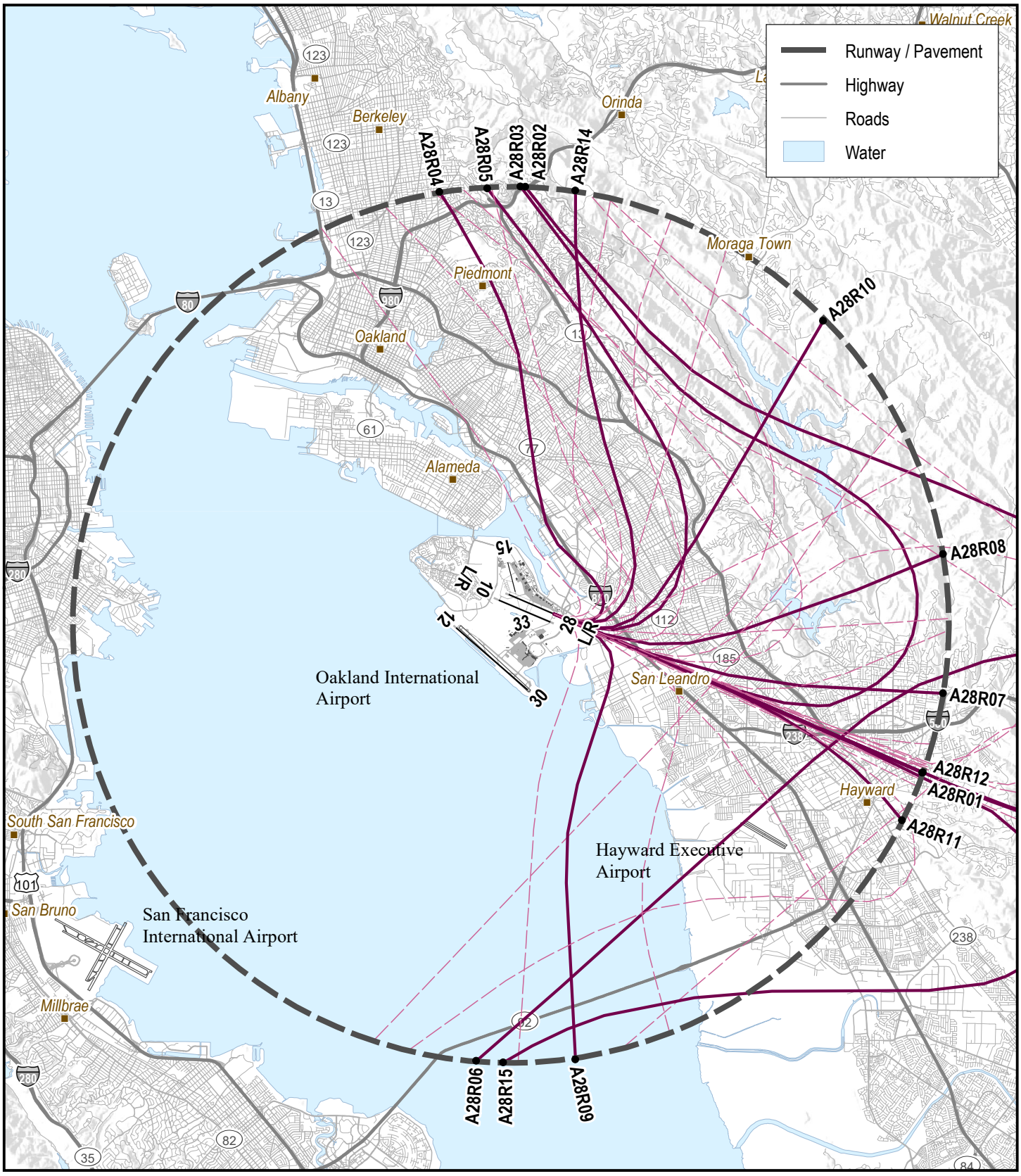
Source: HMMH, November 2021

# Oakland International Airport

Oakland, California

Figure 8

**Arrival Model Tracks to Runway 28L**




Modeled Backbone Arrival Track

Modeled Dispersed Arrival Track

Model Track Area Boundary

0 3 6 Nautical Miles

Source: HMMH, November 2021

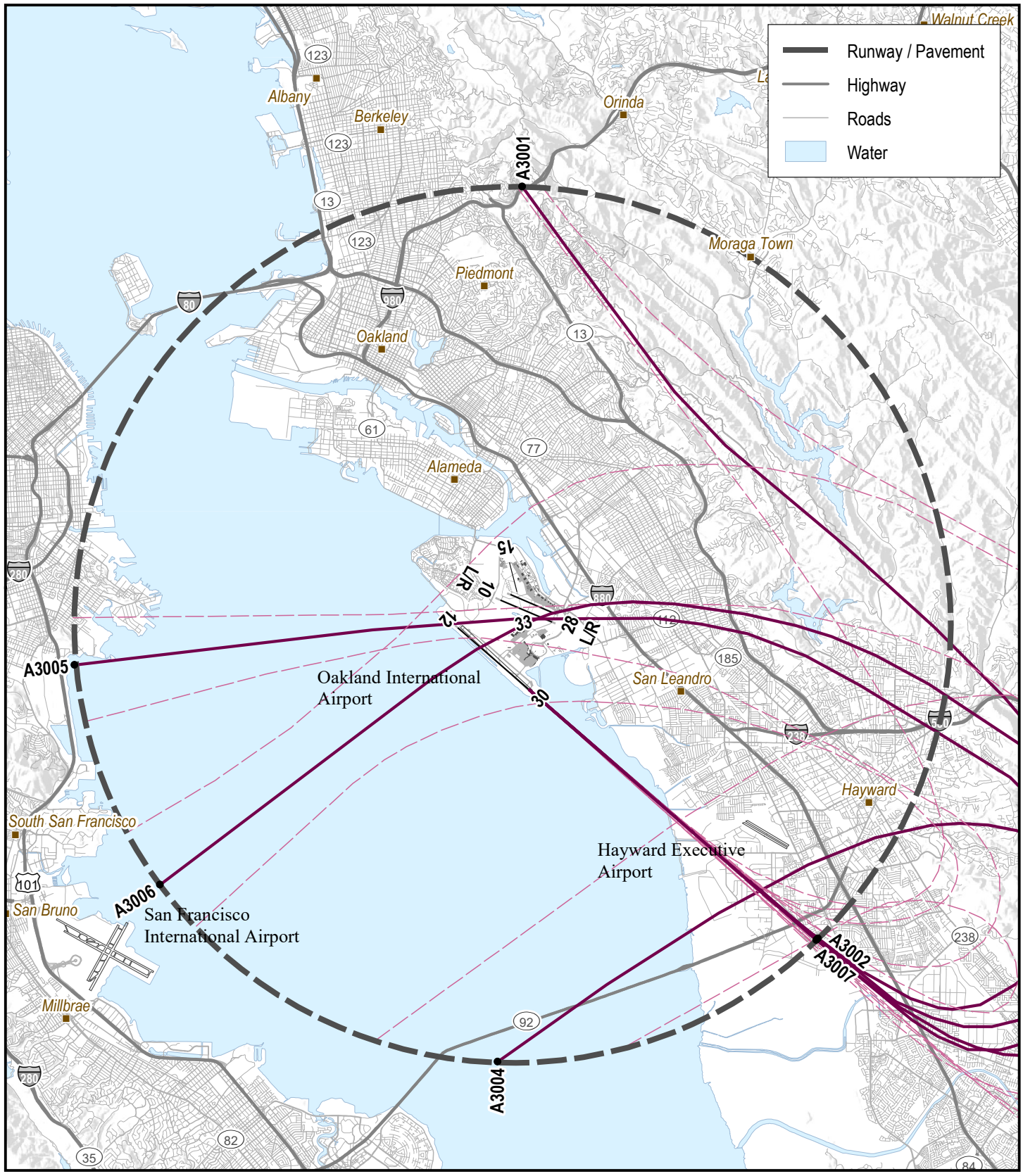
# Oakland International Airport

Oakland, California

Figure 9

**Arrival Model Tracks to Runway 28R**

Document Path: G:\Projects\311XXX\311530_OAK_NEPA_2020\GIS\311530_OAK_Figure9_RWY28R_Arr_Model_Tracks.mxd




Modeled Backbone Arrival Track

Modeled Dispersed Arrival Track

Model Track Area Boundary

0 3 6 Nautical Miles

Source: HMMH, November 2021

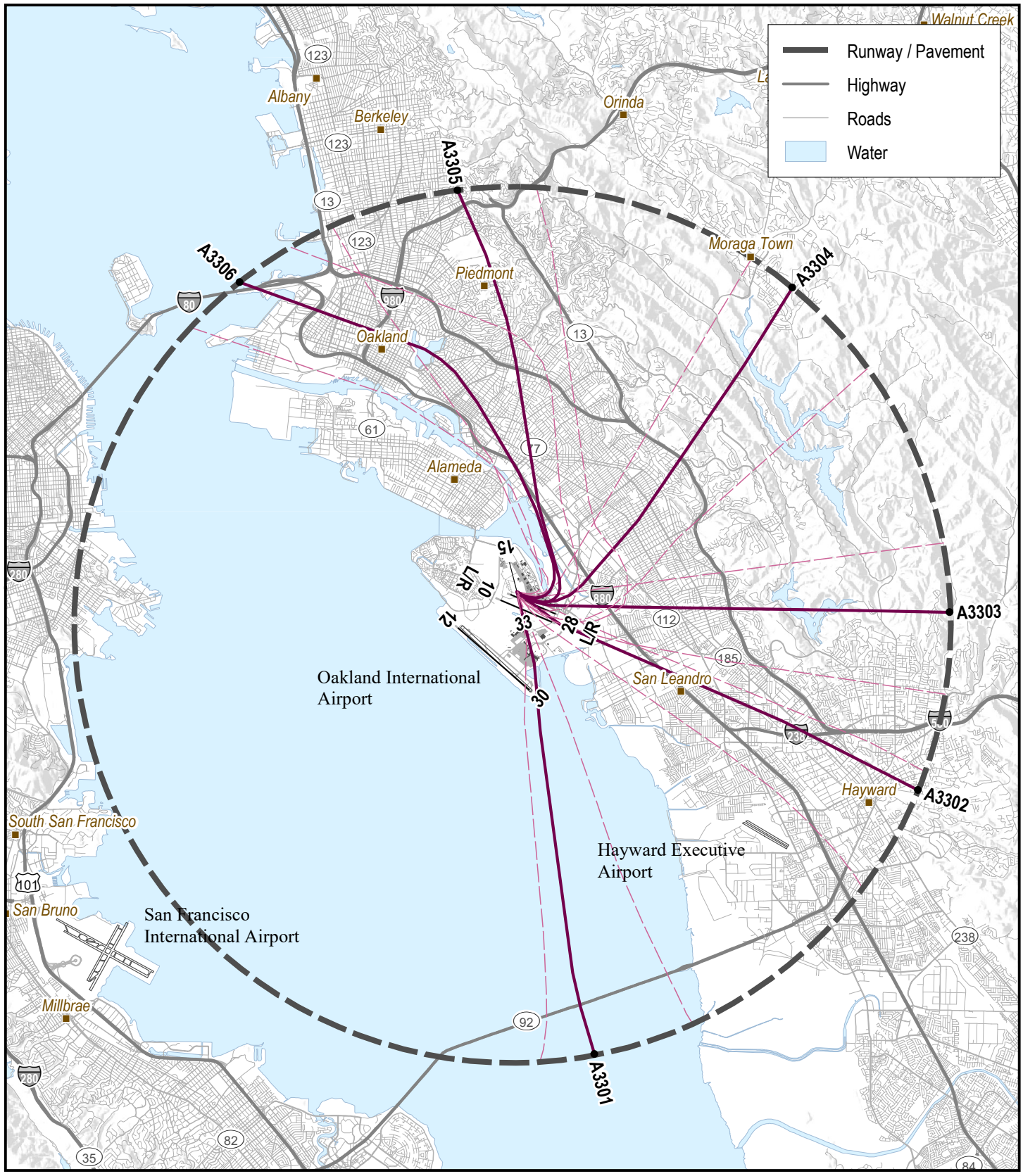
# Oakland International Airport

Oakland, California

Figure 10

**Arrival Model Tracks to Runway 30**

Document Path: G:\Projects\311XXX\311530_OAK_NEPA_2020\GIS\311530_OAK_Figure10_RWY30_Arr_Model_Tracks.mxd




Document Path: G:\Projects\311XXX\311530_OAK_NEPA_2020\GIS\311530_OAK_Figure11_RWY33_Arr_Model_Tracks.mxd

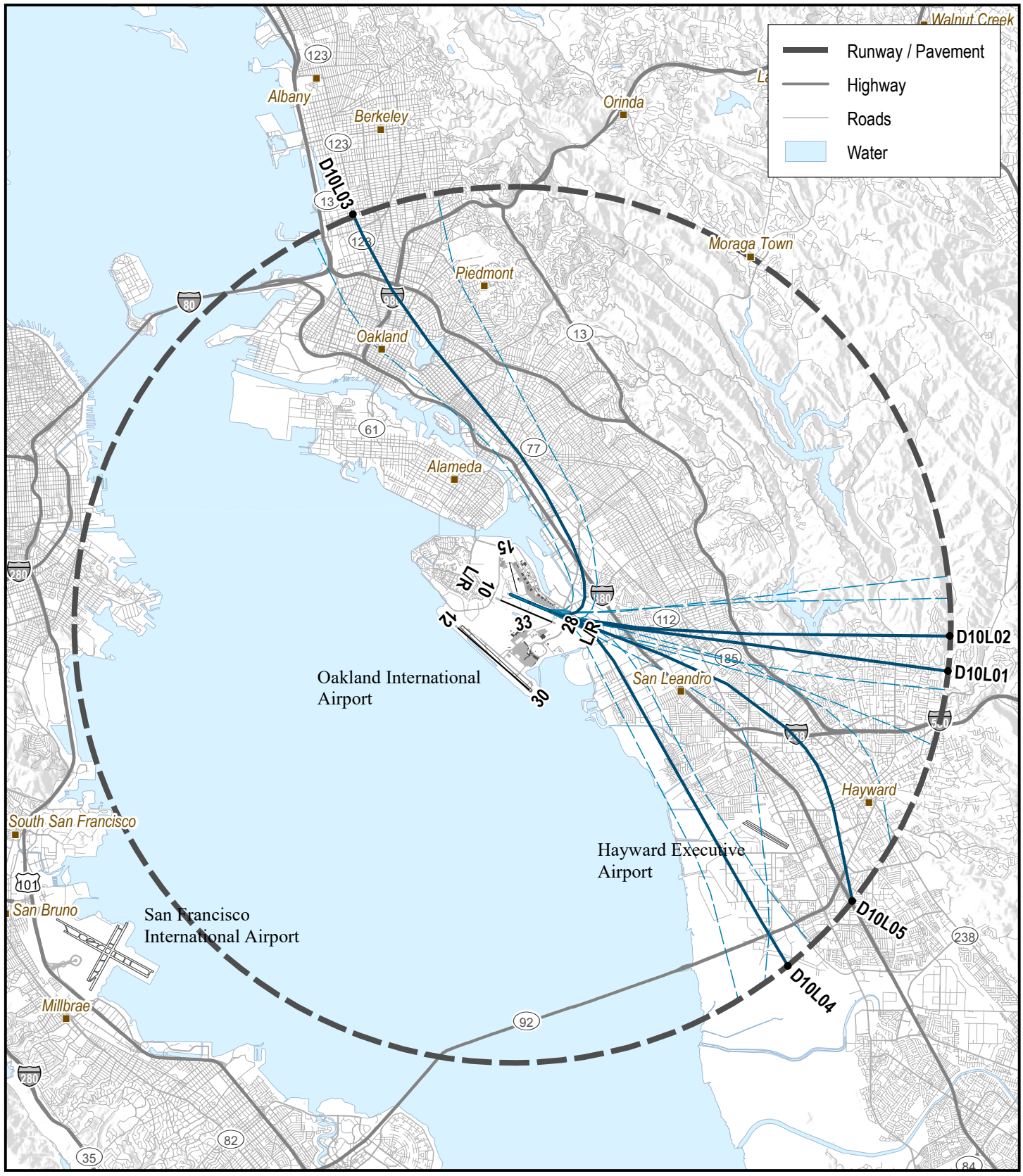
Source: HMMH, November 2021

# Oakland International Airport

Oakland, California

Figure 11

**Arrival Model Tracks to Runway 33**




Document Path: G:\Projects\311XXX\311530_OAK_NEPA_2020\GIS\311530_OAK_Figure12_RWY10L_Dep_Model_Tracks.mxd

Source: HMMH, November 2021

# Oakland International Airport

Oakland, California

Figure 12

**Departure Model Tracks from Runway 10L**




Modeled Backbone Departure Track

Modeled Dispersed Departure Track

Model Track Area Boundary

0 3 6 Nautical Miles

Source: HMMH, November 2021

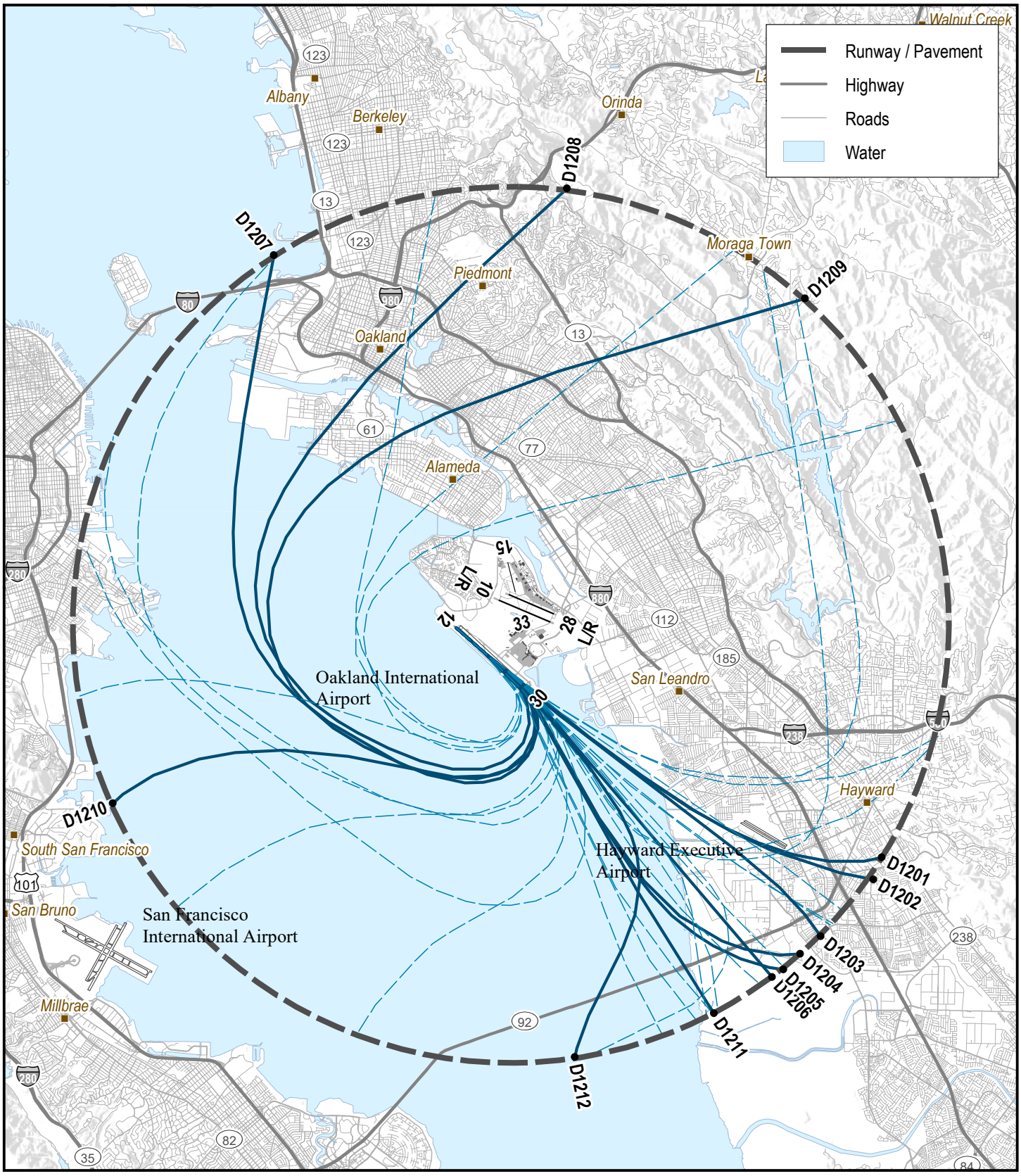
# Oakland International Airport

Oakland, California

Figure 13

**Departure Model Tracks from Runway 10R**

Document Path: G:\Projects\311XXX\311530_OAK_NEPA_2020\GIS\311530_OAK_Figure13_RWY10R_Dep_Model_Tracks.mxd




# Oakland International Airport

Oakland, California

Figure 14

**Departure Model Tracks from Runway 12**




Modeled Backbone Departure Track

Modeled Dispersed Departure Track

Model Track Area Boundary

0 3 6 Nautical Miles

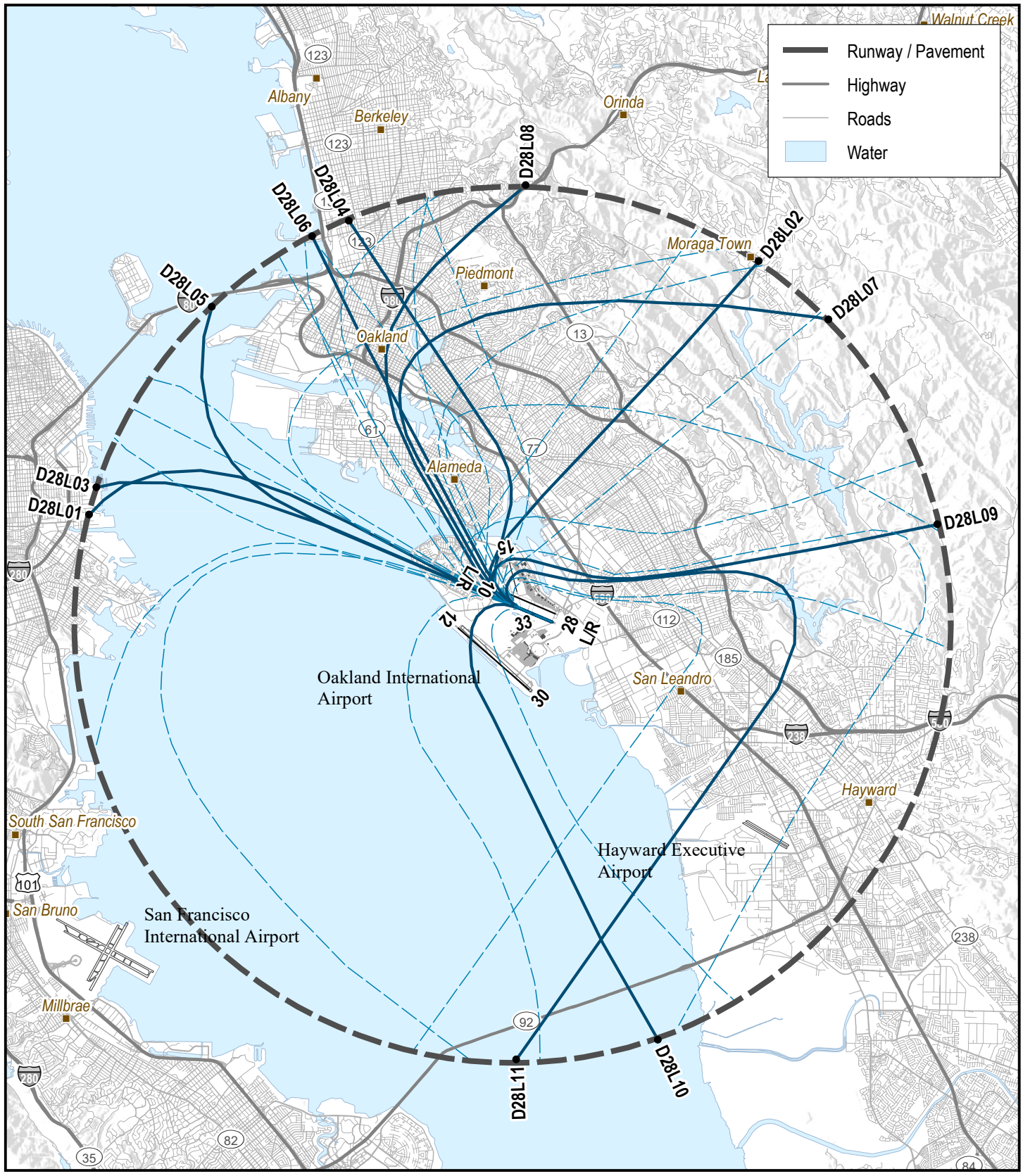
Source: HMMH, November 2021

# Oakland International Airport

Oakland, California

Figure 15

**Departure Model Tracks from Runway 15**




Modeled Backbone Departure Track

Modeled Dispersed Departure Track

Model Track Area Boundary

0 3 6 Nautical Miles

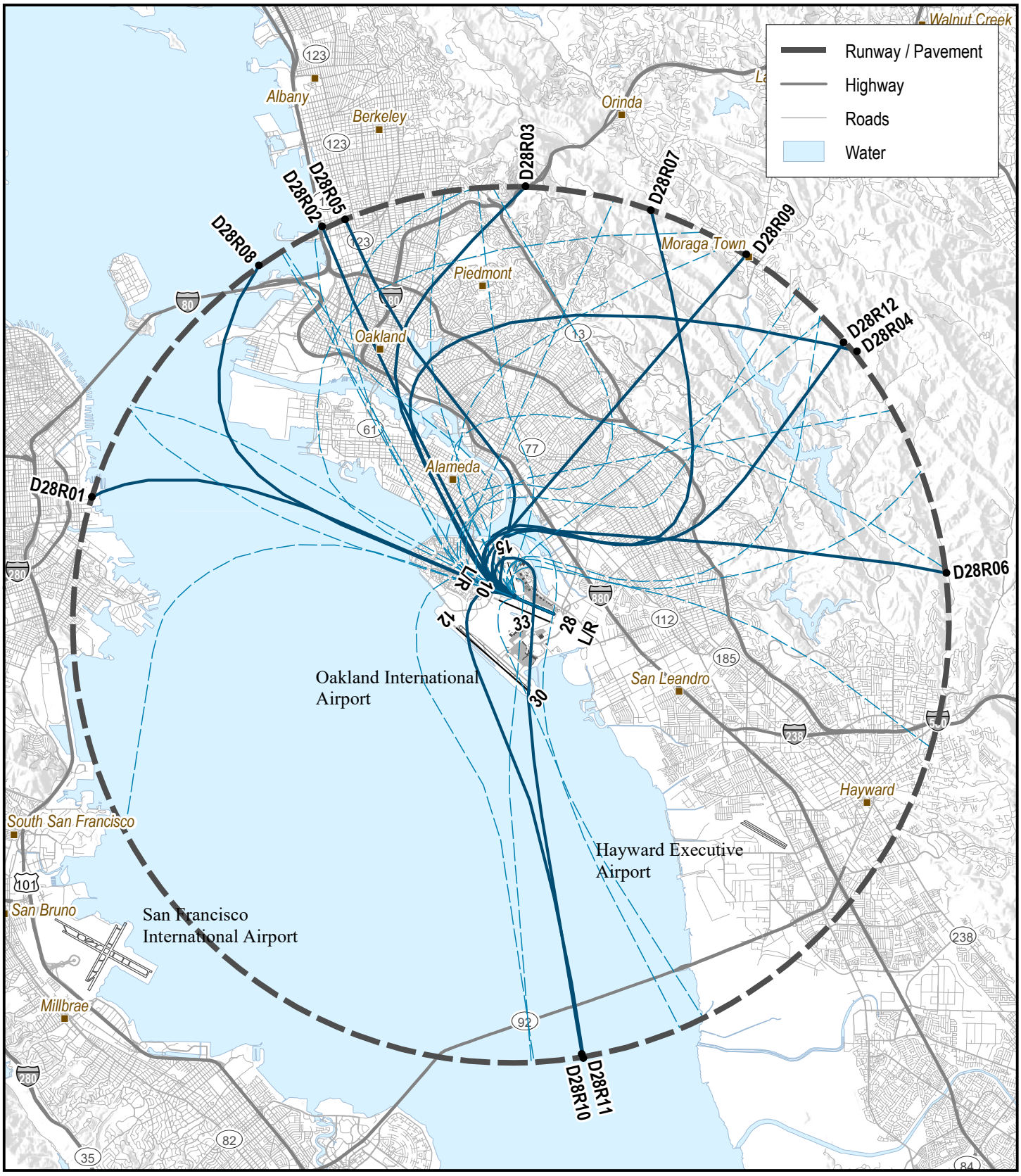
Source: HMMH, November 2021

# Oakland International Airport

Oakland, California

Figure 16

**Departure Model Tracks from Runway 28L**




Modeled Backbone Departure Track

Modeled Dispersed Departure Track

Model Track Area Boundary

0 3 6 Nautical Miles

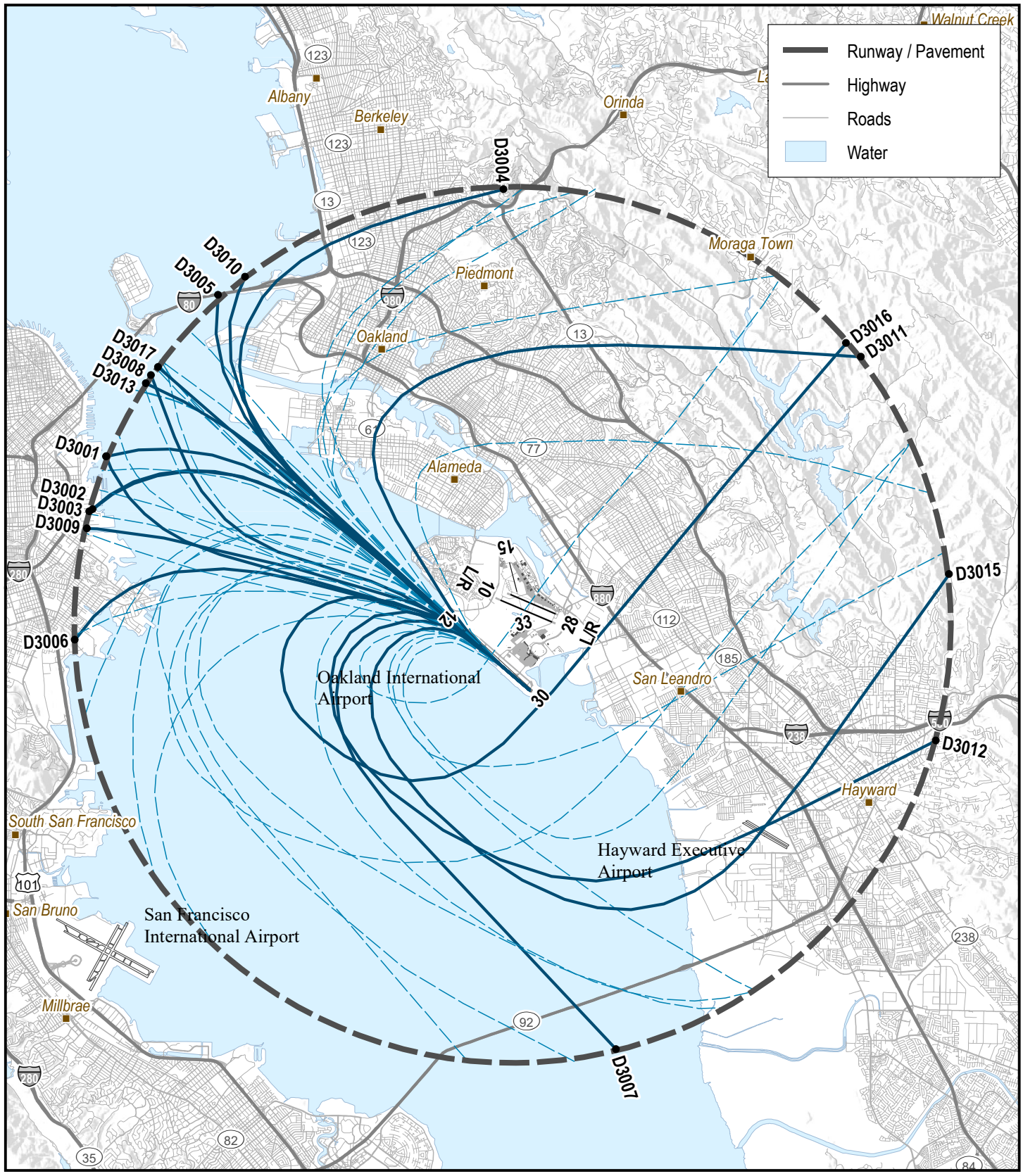
Source: HMMH, November 2021

# Oakland International Airport

Oakland, California

Figure 17

**Departure Model Tracks from Runway 28R**




Modeled Backbone Departure Track

Modeled Dispersed Departure Track

Model Track Area Boundary

0 3 6 Nautical Miles

Source: HMMH, November 2021

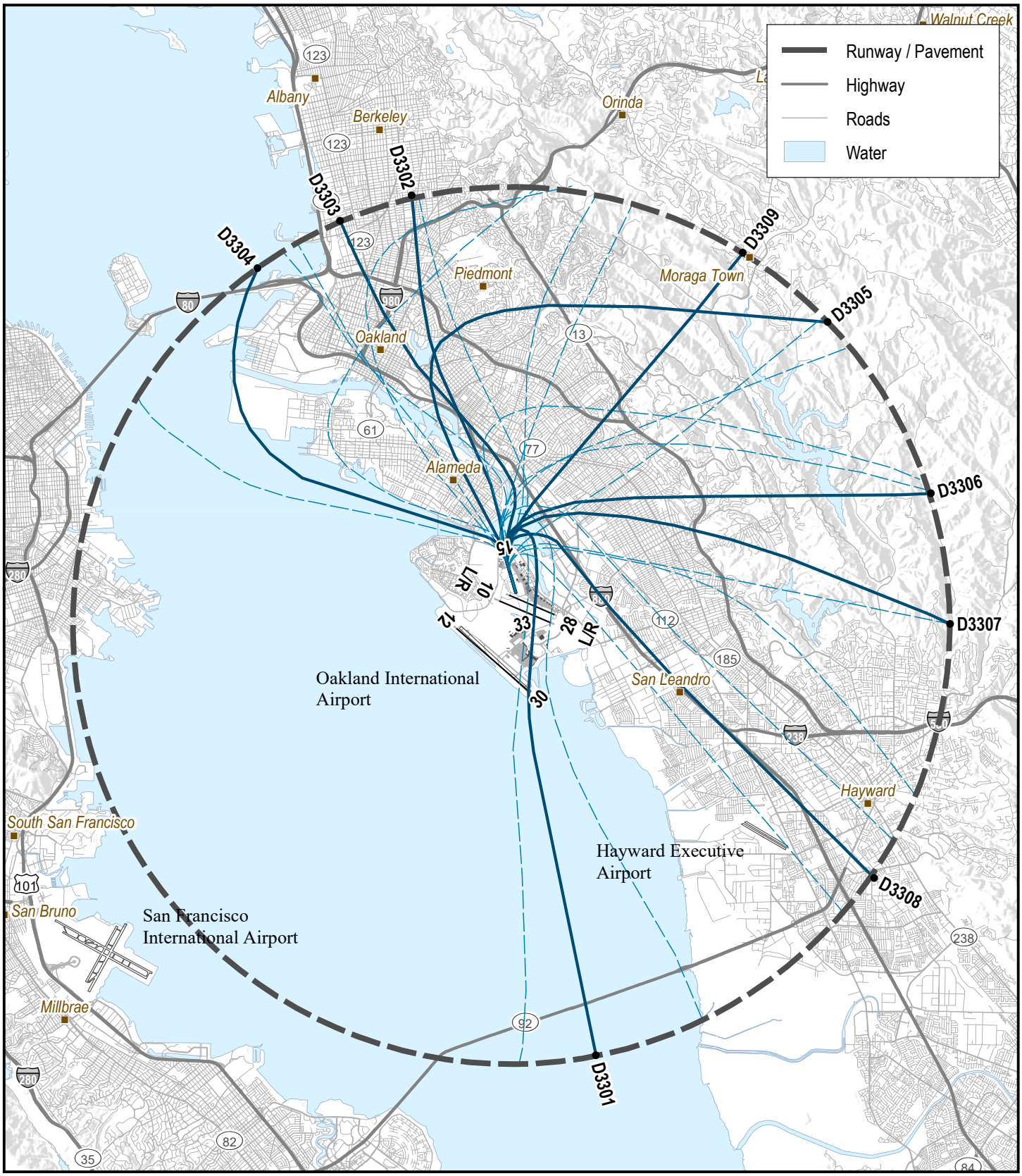
# Oakland International Airport

Oakland, California

Figure 18

**Departure Model Tracks from Runway 30**

Document Path: G:\Projects\311XXX\311530_OAK_NEPA_2020\GIS\311530_OAK_Figure18_RWY30_Dep_Model_Tracks.mxd




Document Path: G:\Projects\311XXX\311530_OAK_NEPA_2020\GIS\311530_OAK_Figure19_RWY33_Dep_Model_Tracks.mxd

Modeled Backbone Departure Track

Modeled Dispersed Departure Track

Model Track Area Boundary

0 3 6 Nautical Miles

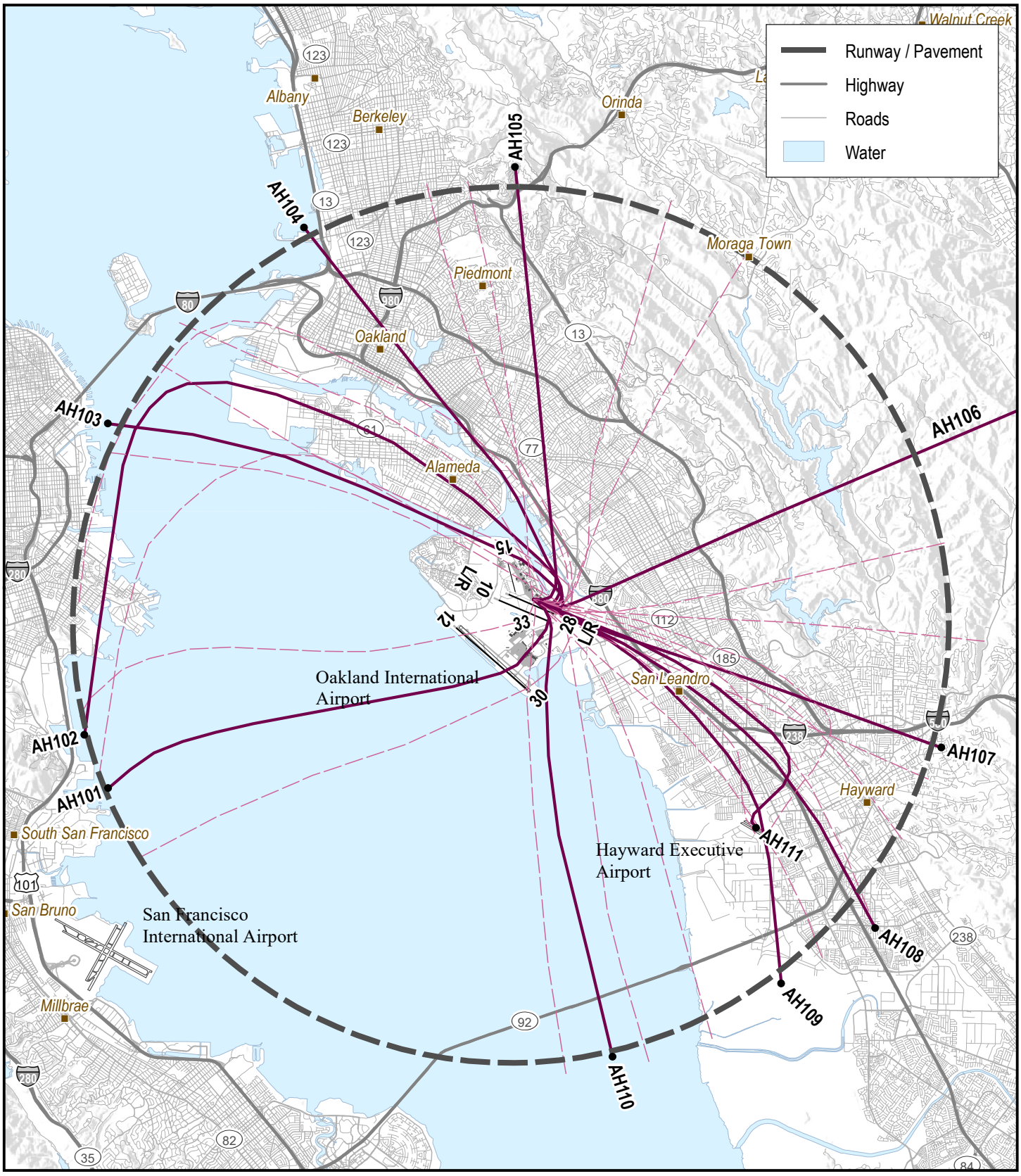
Source: HMMH, November 2021

# Oakland International Airport

Oakland, California

Figure 19

**Departure Model Tracks from Runway 33**




Source: HMMH, November 2021

Document Path: G:\Projects\311XXX\311530_OAK_NEPA_2020\GIS\311530_OAK_Figure20_Helo_Arr_Model_Tracks.mxd

# Oakland International Airport

Oakland, California

Figure 20

**Arrival Helicopter Model Tracks**




Modeled Backbone Departure Track

Modeled Dispersed Departure Track

Model Track Area Boundary

0 3 6 Nautical Miles

Source: HMMH, November 2021

# Oakland International Airport

Oakland, California

Figure 21

**Departure Helicopter Model Tracks**

**Table 7. Modeled Fixed-wing Arrival Flight Track Utilization**

Source: OAK ANOMS, HMMH

| Runway End | Track Group | Commercial | | Freighter | | GA and Military | |
|---|---|---|---|---|---|---|---|
| | | Jet | Non-jet | Jet | Non-jet | Jet | Non-jet |
| 10L | A10L01 | 86% | 0% | 0% | 22% | 89% | 63% |
| | A10L02 | 0% | 0% | 0% | 0% | 5% | 2% |
| | A10L03 | 14% | 0% | 0% | 41% | 0% | 20% |
| | A10L04 | 0% | 0% | 0% | 0% | 0% | 5% |
| | A10L05 | 0% | 0% | 0% | 34% | 2% | 6% |
| | A10L06 | 0% | 0% | 0% | 4% | 4% | 4% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| 10R | A10R01 | 93% | 0% | 0% | 64% | 95% | 87% |
| | A10R02 | 0% | 0% | 0% | 16% | <1% | 8% |
| | A10R03 | 7% | 0% | 0% | 5% | 5% | 2% |
| | A10R04 | 0% | 0% | 0% | 15% | 0% | 3% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| 12 | A1201 | 11% | 74% | 8% | 0% | 7% | 27% |
| | A1202 | 85% | 26% | 88% | 0% | 87% | 67% |
| | A1203 | 5% | 0% | 4% | 0% | 6% | 5% |
| | A1204 | <1% | 0% | <1% | 0% | <1% | 0% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| 15 | A1501 | 0% | 0% | 0% | 83% | 0% | 42% |
| | A1502 | 0% | 0% | 0% | 0% | 0% | 27% |
| | A1503 | 0% | 0% | 0% | 17% | 0% | 30% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| 28L | A28L01 | 75% | 0% | 80% | 49% | 72% | 38% |
| | A28L02 | 13% | 0% | 20% | 2% | 20% | 4% |
| | A28L03 | 0% | 0% | 0% | 18% | <1% | 9% |
| | A28L04 | 0% | 0% | 0% | <1% | <1% | 7% |
| | A28L05 | 0% | 0% | 0% | <1% | <1% | 8% |
| | A28L06 | 0% | 0% | 0% | 16% | 0% | 1% |
| | A28L07 | 2% | 0% | 0% | 12% | 2% | 14% |
| | A28L08 | 3% | 0% | 0% | <1% | 2% | 3% |
| | A28L09 | 4% | 0% | 0% | 0% | <1% | <1% |
| | A28L10 | 4% | 0% | 0% | 0% | <1% | 0% |
| | A28L11 | 0% | 0% | 0% | <1% | 0% | 10% |
| | A28L12 | <1% | 0% | 0% | 0% | <1% | 0% |
| | A28L13 | 0% | 0% | 0% | <1% | 0% | 5% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| 28R | A28R01 | 85% | 0% | 100% | 60% | 72% | 34% |
| | A28R02 | 5% | 0% | 0% | 2% | 8% | 5% |
| | A28R03 | 7% | 0% | 0% | 1% | 11% | 2% |
| | A28R04 | <1% | 0% | 0% | 28% | <1% | 17% |
| | A28R05 | <1% | 0% | 0% | 1% | 2% | 3% |
| | A28R06 | <1% | 0% | 0% | 0% | <1% | <1% |
| | A28R07 | 2% | 0% | 0% | 1% | 2% | 10% |
| | A28R08 | 0% | 0% | 0% | <1% | <1% | 7% |
| | A28R09 | 0% | 0% | 0% | 0% | <1% | 3% |
| | A28R10 | 0% | 0% | 0% | <1% | <1% | 10% |

| Runway End | Track Group | Commercial | | Freighter | | GA and Military | |
|---|---|---|---|---|---|---|---|
| | | Jet | Non-jet | Jet | Non-jet | Jet | Non-jet |
| | A28R11 | <1% | 0% | 0% | 4% | 2% | 6% |
| | A28R12 | <1% | 0% | 0% | <1% | 2% | <1% |
| | A28R14 | 0% | 0% | 0% | <1% | <1% | 2% |
| | A28R15 | <1% | 0% | 0% | 0% | <1% | <1% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| **30** | A3001 | 18% | 0% | 20% | 5% | 15% | 54% |
| | A3002 | 77% | 100% | 77% | 95% | 82% | 43% |
| | A3004 | 5% | 0% | 2% | 0% | 3% | 3% |
| | A3005 | <1% | 0% | <1% | 0% | 0% | 0% |
| | A3006 | <1% | 0% | <1% | 0% | <1% | 0% |
| | A3007 | 0% | 0% | 0% | 0% | 0% | 0% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| **33** | A3301 | 0% | 0% | 0% | 0% | 0% | 39% |
| | A3302 | 0% | 0% | 0% | 40% | 89% | 6% |
| | A3303 | 0% | 0% | 0% | 0% | 0% | 21% |
| | A3304 | 0% | 0% | 0% | 0% | 0% | 14% |
| | A3305 | 0% | 0% | 0% | 60% | 11% | 17% |
| | A3306 | 0% | 0% | 0% | 0% | 0% | 4% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |

**Table 8. Modeled Fixed-wing Departure Flight Track Utilization**
Source: OAK ANOMS, HMMH

| Runway End | Track Group | Commercial | | Freighter | | GA and Military | |
|---|---|---|---|---|---|---|---|
| | | Jet | Non-jet | Jet | Non-jet | Jet | Non-jet |
| 10L | D10L01 | 0% | 100% | 0% | 68% | 34% | 72% |
| | D10L02 | 0% | 0% | 0% | 26% | 17% | 20% |
| | D10L03 | 0% | 0% | 0% | 6% | 0% | 6% |
| | D10L04 | 0% | 0% | 0% | 0% | 43% | <1% |
| | D10L05 | 0% | 0% | 0% | 0% | 7% | 2% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| 10R | D10R01 | 15% | 100% | 100% | 100% | 39% | 75% |
| | D10R02 | 72% | 0% | 0% | 0% | 43% | 18% |
| | D10R03 | 11% | 0% | 0% | 0% | 7% | 5% |
| | D10R04 | 2% | 0% | 0% | 0% | 10% | 2% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| 12 | D1201 | 12% | 0% | 3% | 0% | 4% | 76% |
| | D1202 | 19% | 100% | 37% | 0% | 35% | 0% |
| | D1203 | 6% | 0% | 4% | 0% | 6% | 0% |
| | D1204 | <1% | 0% | 6% | 0% | 0% | 0% |
| | D1205 | 1% | 0% | 12% | 0% | 1% | 12% |
| | D1206 | 42% | 0% | 13% | 0% | 21% | 0% |
| | D1207 | 2% | 0% | 4% | 0% | 3% | 0% |
| | D1208 | 1% | 0% | 1% | 0% | 3% | 0% |
| | D1209 | 2% | 0% | 4% | 0% | 9% | 0% |
| | D1210 | 9% | 0% | 2% | 0% | 15% | 0% |
| | D1211 | 3% | 0% | 14% | 0% | 3% | 0% |
| | D1212 | 2% | 0% | <1% | 100% | 0% | 12% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| 15 | D1501 | 0% | 0% | 0% | 0% | 0% | 14% |
| | D1502 | 0% | 0% | 0% | 0% | 0% | 10% |
| | D1503 | 0% | 0% | 0% | 0% | 0% | 8% |
| | D1504 | 0% | 0% | 0% | 0% | 0% | 16% |
| | D1505 | 0% | 0% | 0% | 100% | 100% | 10% |
| | D1506 | 0% | 0% | 0% | 0% | 0% | 43% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |

| Runway End | Track Group | Commercial | | Freighter | | GA and Military | |
|---|---|---|---|---|---|---|---|
| | | Jet | Non-jet | Jet | Non-jet | Jet | Non-jet |
| 28L | D28L01 | 47% | 0% | 0% | <1% | 37% | <1% |
| | D28L02 | 0% | 0% | 0% | <1% | <1% | 9% |
| | D28L03 | 17% | 0% | 0% | 23% | 15% | 4% |
| | D28L04 | 0% | 0% | 0% | 13% | 0% | 7% |
| | D28L05 | 36% | 0% | 100% | 0% | 43% | <1% |
| | D28L06 | 0% | 0% | 0% | 10% | <1% | 15% |
| | D28L07 | 0% | 0% | 0% | 18% | <1% | 30% |
| | D28L08 | 0% | 0% | 0% | <1% | 1% | 22% |
| | D28L09 | 0% | 100% | 0% | 29% | <1% | 6% |
| | D28L10 | 0% | 0% | 0% | 2% | 2% | 6% |
| | D28L11 | 0% | 0% | 0% | 6% | 0% | 0% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| 28R | D28R01 | 62% | 0% | 0% | 18% | 49% | 3% |
| | D28R02 | 0% | 0% | 0% | 57% | 0% | 11% |
| | D28R03 | 0% | 0% | 0% | 0% | 1% | 13% |
| | D28R04 | 0% | 100% | 0% | 5% | 2% | 23% |
| | D28R05 | 6% | 0% | 0% | 9% | 1% | 9% |
| | D28R06 | 0% | 0% | 0% | 10% | 6% | 22% |
| | D28R07 | 0% | 0% | 0% | 0% | 0% | 1% |
| | D28R08 | 31% | 0% | 100% | 0% | 37% | <1% |
| | D28R09 | 0% | 0% | 0% | <1% | 3% | 12% |
| | D28R10 | 0% | 0% | 0% | 0% | 0% | 3% |
| | D28R11 | 0% | 0% | 0% | <1% | <1% | 2% |
| | D28R12 | 0% | 0% | 0% | <1% | 0% | <1% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| 30 | D3001 | 21% | 0% | 4% | 34% | 13% | 12% |
| | D3002 | 25% | 0% | 7% | 26% | 28% | 34% |
| | D3003 | 8% | 0% | <1% | 0% | 8% | 5% |
| | D3004 | 11% | 3% | 24% | 0% | 18% | 16% |
| | D3005 | 19% | 0% | 6% | 13% | 26% | 23% |
| | D3006 | 8% | 0% | 4% | 18% | 4% | 3% |
| | D3007 | <1% | 0% | 14% | 4% | <1% | 1% |
| | D3008 | 7% | 0% | 36% | 0% | 3% | 3% |
| | D3009 | <1% | 0% | <1% | 0% | <1% | 0% |
| | D3010 | <1% | 0% | <1% | 0% | <1% | 0% |
| | D3011 | 0% | 97% | 0% | 4% | <1% | <1% |
| | D3012 | <1% | 0% | 2% | 0% | <1% | 0% |
| | D3013 | <1% | 0% | <1% | 0% | <1% | 0% |
| | D3014 | <1% | 0% | <1% | 0% | <1% | 0% |
| | D3015 | <1% | 0% | 1% | 0% | <1% | 0% |
| | D3016 | <1% | 0% | <1% | 0% | <1% | <1% |
| | D3017 | 0% | 0% | 0% | 0% | 0% | 0% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |

| Runway End | Track Group | Commercial | | Freighter | | GA and Military | |
|---|---|---|---|---|---|---|---|
| | | Jet | Non-jet | Jet | Non-jet | Jet | Non-jet |
| 33 | **D3301** | **0%** | **0%** | **0%** | **5%** | **0%** | **5%** |
| | D3302 | 0% | 0% | 0% | 68% | 2% | 13% |
| | D3303 | 0% | 0% | 0% | 5% | 0% | 25% |
| | D3304 | 0% | 0% | 0% | 0% | 64% | <1% |
| | D3305 | 0% | 0% | 0% | 5% | 4% | 3% |
| | D3306 | 0% | 0% | 0% | 0% | 2% | 25% |
| | D3307 | 0% | 0% | 0% | 11% | 5% | 8% |
| | D3308 | 0% | 0% | 0% | 5% | 5% | 4% |
| | D3309 | 0% | 0% | 0% | 0% | 18% | 16% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |

**Table 9. Modeled Helicopter Flight Track Utilization**

Source: OAK ANOMS, HMMH

| Arrivals | | Departures | |
|---|---|---|---|
| Track Group | Percent Use | Track Group | Percent Use |
| AH101 | 8% | DH101 | 9% |
| AH102 | 3% | DH102 | 5% |
| AH103 | 36% | DH103 | 19% |
| AH104 | 13% | DH104 | 18% |
| AH105 | 4% | DH105 | 8% |
| AH106 | 7% | DH106 | 15% |
| AH107 | 4% | DH107 | 12% |
| AH108 | 6% | DH108 | 5% |
| AH109 | 9% | DH109 | 8% |
| AH110 | 4% | | |
| AH111 | 6% | | |
| **Total** | **100%** | **Total** | **100%** |
| *Note: Totals may not match exactly due to rounding* | | | |

## 3.6 Meteorological Data

Meteorological settings within the AEDT affect its calculation of aircraft performance profiles and sound propagation. These settings include average annual temperature, barometric pressure, relative humidity, and average headwind speed. The AEDT contains standard reference climatological data for airports throughout the US.

The noise modeling utilized the following average data for OAK from the AEDT database:

- Temperature: 58.18 F
- Station Pressure: 1013.51 mbar
- Sea Level Pressure: 1016.79 mbar
- Dew point: 49.46° F
- Relative humidity: 72.78%

The headwind speed was set to the AEDT default of 7.13 knots.

### 3.7 Terrain

Terrain data describes the elevation of the ground surrounding the airport, and on airport property. The AEDT uses terrain data to adjust the ground level under the flight paths. The terrain data does not affect the aircraft's performance or noise levels but does affect the vertical distance between the aircraft and a "receiver" on the ground. This in turn affects assumptions about how noise propagates over ground. The National Elevation Dataset (NED) 1/3 arc second terrain data were obtained from the United States Geological Survey (USGS).[8] The NED data set has a resolution of 10 meters or 33 feet.

## 4.0 Air Quality Modeling Methodology and Inputs

The sources assessed in this emission inventory will include aircraft engines and auxiliary power units (APU), ground support equipment (GSE), and on-airport stationary sources where applicable.[9] HMMH will conduct the analysis following FAA's *Aviation Emissions and Air Quality Handbook, Version 3 Update 1*[10] *and* AEDT. AEDT is the FAA-required computer model for assessing air emissions associated with airports. The fleet mix, LTO and touch and go operations will be consistent with the noise analysis.

The U.S. Environmental Protection Agency (EPA) enforces the Clean Air Act (CAA), established in 1970 and last amended in 1990, which requires the review of seven criteria pollutants in analysis of air quality according to the National Ambient Air Quality Standards (NAAQS). Prior to the CAA, in 1959, the California State Department of Public Health received direction from their state legislature to develop California Ambient Air Quality Standards (CAAQS), established in 1962. In 1967, the legislature created the Air Resources Board (ARB). In 1969, the CAAQS became under the jurisdiction of the ARB, prior to any federal law on air quality.[11] CAAQS criteria pollutants include all seven NAAQS criteria pollutants, plus an additional four, two of which are covered under particulate matter, one odor-based, and the final a historical CAAQS, in place should sources of it arise again. The seven overlapping criteria air pollutants analyzed for the purposes of the OAK EA/EIR plan include:[12]

1. Carbon monoxide (CO)
2. Nitrogen dioxide ($NO_2$); calculated and expressed as $NO_x$
3. Particulate matter (PM10)
4. Particulate matter (PM2.5)
5. Sulfur dioxide ($SO_2$)
6. Lead (Pb)
7. Ozone ($O_3$)

Regarding the seventh pollutant, ozone is an indirect or secondary pollutant that occurs due to chemical reactions primarily between $NO_x$ and volatile organic compounds (VOCs). As a result, volatile organic compounds (VOCs) and NOx, the primary precursors to ozone formation, provide surrogate information for assessing ozone levels. In addition, HMMH will estimate carbon dioxide ($CO_2$) emissions as a greenhouse gas, though this estimation does not account for the varying greenhouse gases and their associated emissions factors in comparison to $CO_2$.
AEDT requires additional input data for air quality analysis including aircraft type operating at the airport. Engine type, taxi times, ground support equipment (GSE), on-airport stationary sources (such as boilers, heaters, etc.) and auxiliary power unit (APU)usage is needed to determine air quality pollutant emissions; including greenhouse gas emissions and fuel burn. The analysis of aircraft taxi activity to and from the ramps will include both aircraft types selected from the 2019 baseline fleet mix at OAK and default taxi times from the AEDT as inputs. Similarly, HMMH will assume default AEDT APU times for each aircraft type. Annual aircraft emissions are a function of the number of aircraft operations expressed as landing and takeoff (LTO) cycles, the aircraft fleet mix (types of aircraft used),

[8] Data downloaded from https://viewer.nationalmap.gov/basic/?howTo=true on 06/10/2019 in 1/3 Arc second GeoTIFF format.
[9] APU analysis is to be done by a separate sub-consultant, so emissions data for APUs are not included in this document
[10] FAA. *Aviation Emissions and Air Quality Handbook.* https://www.faa.gov/regulations_policies/policy_guidance/envir_policy/airquality_handbook/media/Air_Quality_Handbook_Appendices.pdf
[11] ARB. 2017. *CAAQS.* https://www.arb.ca.gov/research/aaqs/caaqs/caaqs.htm. Accessed September 20, 2017.
[12] EPA. 2017. *NAAQS Table.* https://www.epa.gov/criteria-air-pollutants/naaqs-table. Accessed September 20, 2017.

and the length of time aircraft spend in each of the modes of operation defined in AEDT. For this analysis, estimates for emissions will come from the following aircraft modes[13]:

- Startup
- Taxiing
- Takeoff ground roll
- Climb to mixing height and Descend from mixing height and
- Landing ground roll

Pollutant emissions for aircraft operations using the above assumptions will be estimated using AEDT for the LTO modes and touch and go (e.g. circuit model) operations below the mixing height including idle, taxing, climb, and descent. Per standard, HMMH assumed a default mixing height of 3,000 feet above ground level. Lead emissions are associated with leaded aviation fuel used in GA piston engine aircraft. AEDT does not estimate lead emissions directly. Therefore, HMMH will calculate these emissions based on fuel consumption and lead fuel content consistent with FAA/EPA methodology described in the Handbook.[14]

[13] In the AEDT output, these modes are all represented in the "ClimbBelowMixingHeight" and "DescendBelowMixingHeight" source grouping.

[14] FAA. Equation A1-3 (Lead Emission Calculation) found on page 4 of Appendix A, page 119 of the full document. *Aviation Emissions and Air Quality Handbook.* https://www.faa.gov/regulations_policies/policy_guidance/envir_policy/airquality_handbook/media/Air_Quality_Handbook_Appendices.pdf

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# TECHNICAL MEMORANDUM

| | |
|---|---|
| **To:** | Dave Full, RS&H<br>369 Pine St, Suite 610<br>San Francisco, CA 94104 |
| **From:** | Rhea Hanrahan, Principal Consultant<br>Scott McIntosh, Senior Technical Analyst<br>Vincent Ma, Staff Consultant |
| **Date:** | April 21, 2022 |
| **Subject:** | Oakland International Airport Environmental Assessment/Environmental Impact Statement and Environmental Impact Report Forecast Conditions Noise Modeling Input Assumptions Memo |
| **Reference:** | HMMH Project Number 311530.000 |

## 1.0 Introduction

Harris Miller Miller & Hanson Inc. (HMMH) is assisting Reynolds, Smith, & Hills, Inc. (RS&H) in preparing an Environmental Assessment/Environmental Impact Statement (EA/EIS)[1] and Environmental Impact Report (EIR) for the Terminal Modernization and Development Project at Oakland International Airport (OAK), pursuant to the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA). The purpose of this technical memorandum is to present the noise modeling approach, input data, and assumptions, to establish concurrence prior to running the noise model to generate noise outputs for Buildout and Forecast years, 2028 and 2038.

The subsequent sections address the noise modeling input data for the Federal Aviation Administration (FAA)'s Aviation Environmental Design Tool (AEDT). FAA guidance on use of the AEDT specifies using the most recent version of the model that is available at the time the project commences. In this case, it is AEDT Version 3d.[2] All AEDT modeling conducted for this study adheres to "*Guidance on Using the AEDT to Conduct Environmental modeling for FAA Actions Subject to NEPA*".[3]

## 2.0 Noise Analysis

The noise analysis for this EA/EIS will be conducted in accordance with federal requirements for Airport Noise Evaluations under NEPA. The noise analysis for this EIR will also be conducted in accordance with state of California requirements for airport noise evaluations under CEQA. For the EA/EIS, FAA Order 1050.1F and its associated Environmental Desk Reference, and FAA Order 5050.4B provide the required guidance. The latest update to CEQA guidelines became effective on December 28, 2018[4]. Noise analysis for projects under CEQA centers on whether the project or the proposed noise abatement would result in significant adverse environmental effects. California Airport Noise Regulations promulgated in accordance with the State Aeronautics Act and set forth in Section 5000 et seq. of the California Code of Regulations (Title 21, Division 2.5, Chapter 6) 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 within which there shall be no incompatible land uses. 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

[1] FAA is still determining the level of NEPA documentation
[2] Released March 29, 2021 https://aedt.faa.gov/3d_information.aspx
[3] Published September 12, 2016
[4] California Natural Resources Agency. CEQA: The California Environmental Quality Act. (2018) http://files.resources.ca.gov/ceqa/

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.

The above documents and guidance specify several requirements for evaluating noise impacts, including:

- Acceptable noise models to be used and the circumstances under which their use is required.
- The metrics to be used for characterizing the noise environment and quantifying impacts; and
- Thresholds of significance for determining whether the effects of an action would constitute a significant impact under NEPA.

For an action occurring on, or in the vicinity of a single airport, the Environmental Desk Reference directs the use of the latest version of the AEDT for detailed noise modeling or another model, as approved by FAA. The model must be used to produce Day-Night Average Sound Level (DNL) contours of 65 dB, 70 dB, and 75 dB, and others as needed. FAA considers a DNL of 65 dB as the threshold below which all land uses are compatible.

FAA Orders 1050.1F and 5050.4B determine a significant noise impact to be a DNL increase of 1.5 dB or more at a noise-sensitive location with a DNL of 65 dB or higher. For example, an increase from 63.5 dB to 65.0 dB DNL within the same timeframe due to the Proposed Project would be considered a significant impact. If a noise increase is determined to be a significant impact to any of the surrounding noise sensitive properties, as defined in FAA Order 1050.1F, mitigation would be required.

Most aircraft noise studies focus on DNL, the metric adopted by FAA and Environmental Protection Agency (EPA) as the most appropriate long-term measure of airport noise exposure. DNL is determined by adding up the noise energy from all modeled aircraft activity at every individual point of a large array of grid points around an airport. In the DNL calculation, a 10-decibel weighting is applied to nighttime[5] operations. The State of California has adopted the Community Noise Equivalent Level (CNEL) in place of DNL, which adds a 3-decibel weighting to evening[6] operations. Appendix A provides an overview of basic airport noise terminology, including details of how CNEL is calculated.

Computer-generated estimates of CNEL are often depicted as noise contours reflecting lines of equal exposure around an airport (much as topographic maps indicate contours of equal elevation). The contours usually reflect long-term (annual average) operating conditions, accounting for the average flights per day, how often each runway is used throughout the year, and where over the surrounding communities the aircraft normally fly.

The State of California also requires that all municipal General Plans contain a Noise Element. 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.

The FAA requires that the following information must be disclosed for each modeled scenario that is analyzed:

- The number of residences or people exposed to CNEL between 65 dB and 70 dB, 70 dB and 75 dB and greater than or equal to 75 dB, and the net increase or decrease in the number of people or residences exposed to those levels of noise.
- The location and number of noise sensitive uses in addition to residences (e.g., schools, hospitals, parks, recreation areas) exposed to DNL 65 dB or greater.

[5] Nighttime is defined as 10 pm to 7 am

[6] Evening is defined as 7 pm to 10 pm

- The identification of noise sensitive areas exposed to CNEL greater than or equal to 60 dB, and are projected to experience a CNEL increase of 3 dB or more, only when 1.5 dB DNL increases are predicted at noise sensitive areas with CNEL of at least 65 dB.
- Discussion of the noise impact on noise sensitive areas exposed to CNEL of at least 65 dB; and
- Mapping providing land use data, noise contours, and flight tracks for each scenario.

## 3.0 Noise Modeling Methodology and Inputs

AEDT noise model inputs are developed under the following categories:

- Physical description of the airport layout
- Aircraft operations
- Aircraft noise and performance characteristics
- Runway utilization
- Flight track geometry and usage
- Meteorological conditions
- Terrain data

Section 3.1 through Section 3.7 address the noise model inputs for each of these categories.

### 3.1 Physical Description of the Airport Layout

OAK is located within Alameda County, approximately three nautical miles west of downtown San Leandro, CA. As shown in **Figure 1**, the airport includes three 150-foot wide runways (Runway 10L/28R, Runway 10R/28L, and Runway 12/30), and one 75-foot-wide runway (Runway 15/33). Runway 12/30 provides OAK with the greatest capacity to accommodate high numbers of aircraft operations and is the primary runway in use at the airport. Runways 10L/28R and 10R/28L are primarily used by air taxi/charter and general aviation aircraft. Runway 15/33 is the shortest and narrowest and is primarily used by small single-engine propeller aircraft.

The primary runway, Runway 12/30, has magnetic headings of 116.6° and 296.6° and is 10,520 feet long. Runway 10L/28R and Runway 10R/28L have magnetic headings of 98.8° and 278.8° and are 5,458 feet long and 6,213 feet long, respectively. Runway 15/33 has magnetic headings of 151.0° and 331.0° and is 3,376 feet long. [7] All helicopter operations are modeled as arriving and departing from a single helipad location south of the General Aviation area near the intersections of taxiways C, G, and H as shown on **Figure 1**.

Runway length, runway width, instrumentation, and declared distances do not directly affect noise calculations. However, these parameters may affect which aircraft might use a particular runway and under what conditions, and therefore how often a runway would be used relative to the other runways at the airport. **Table 1** provides the detailed parameters for each runway end.

[7] Each runway end is designated by a number that, with the addition of a trailing "0," reflects the magnetic heading of the runway to the nearest 10°, as seen by the pilot.

**Table 1. Runway Details**

Sources: FAA Form 5010, https://www.faa.gov/airports/airport_safety/airportdata_5010/, as of 7/13/2021

| Runway End | Latitude (dd-mm-ss) | Longitude (dd-mm-ss) | Latitude (decimal degrees) | Longitude (decimal degrees) | Elevation (feet, MSL) | Displaced Landing Threshold (feet) | Glide Slope (degrees) | Threshold Crossing (feet, AGL) | Magnetic Orientation (degrees) |
|---|---|---|---|---|---|---|---|---|---|
| 10L | 37-43-49.6865N | 122-13-19.8481W | 37.730468 | -122.222179 | 5.5 | 0 | 3.00 | 50 | 98.8 |
| 10R | 37-43-43.3450N | 122-13-33.2509W | 37.728706 | -122.225902 | 8.1 | 0 | 3.00 | 50 | 98.8 |
| 12 | 37-43-12.2256N | 122-14-31.6133W | 37.720062 | -122.242114 | 8.3 | 0 | 2.75 | 70 | 116.6 |
| 15 | 37-44-25.0497N | 122-13-22.1076W | 37.740291 | -122.222807 | 1.5 | 0 | N/A | N/A | 151.0 |
| 28R | 37-43-29.3247N | 122-12-16.9329W | 37.724812 | -122.204704 | 5.8 | 0 | 3.00 | 51 | 278.8 |
| 28L | 37-43-20.1780N | 122-12-21.6341W | 37.722271 | -122.206009 | 8.2 | 0 | 3.00 | 50 | 278.8 |
| 30 | 37-42-05.3735N | 122-12-51.3251W | 37.701493 | -122.214257 | 9.0 | 114 | 3.00 | 71 | 296.6 |
| 33 | 37-43-52.9005N | 122-13-10.8260W | 37.731361 | -122.219673 | 3.9 | 0 | N/A | N/A | 331.0 |
| H1 | 37-43-44.8062N | 122-12-45.6762W | 37.729113 | -122.212688 | 9.0 | N/A | | | |

*Note: H1 designates the location of the helipad*

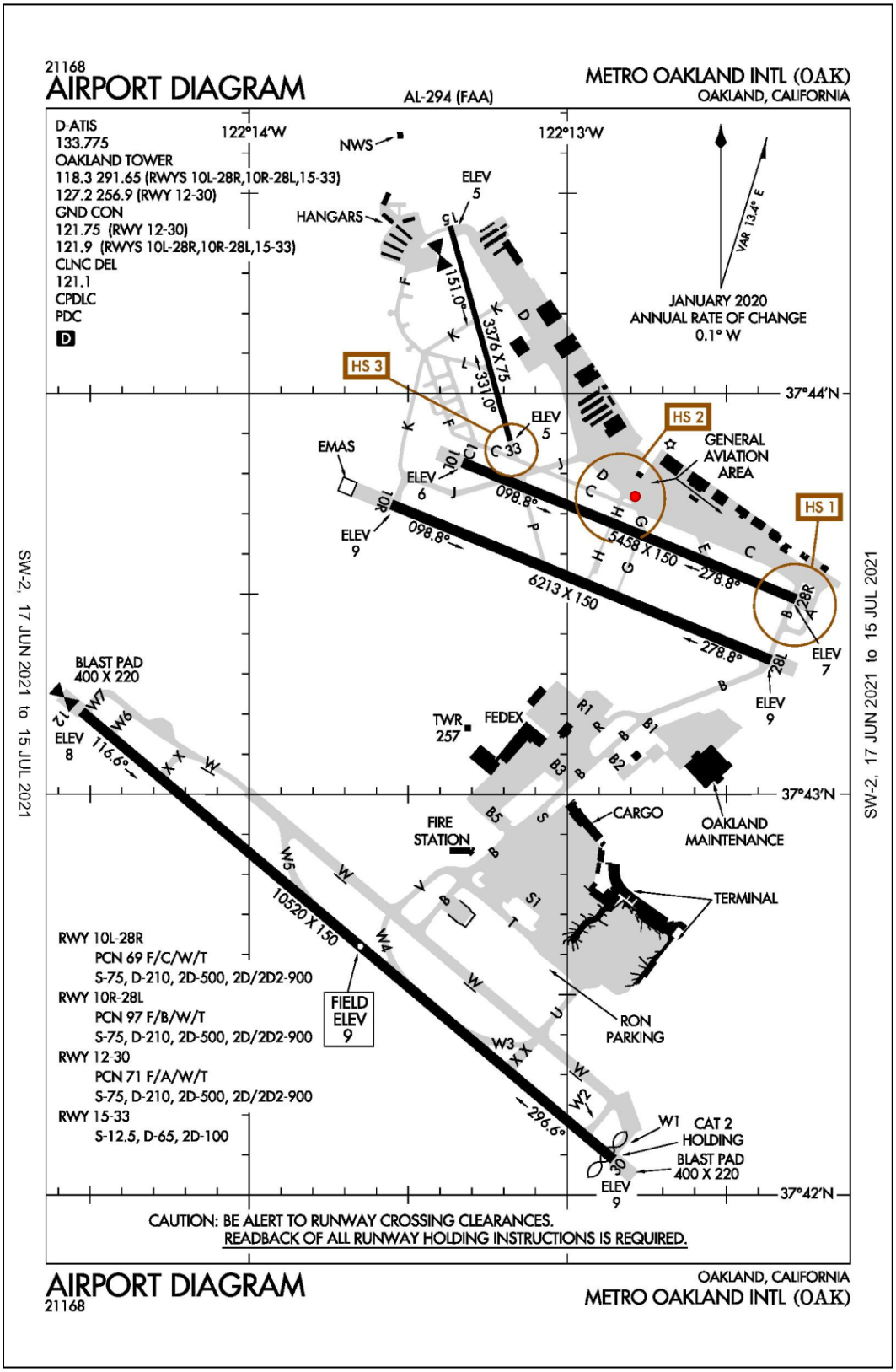



**Figure 1. Existing OAK Airport Layout**

Sources: FAA

*Note: Modeled Helipad location "H1" indicated by red dot*

## 3.2 Aircraft Operations

The Forecast Conditions cases for this study is representative of the forecasted operation levels for 2028 and 2038. **Table 2** presents the annual operations modeled for the forecast years conditions. Aircraft operations for the forecast years conditions were derived from the 2019-2038 Comprehensive Aviation Activity Forecast Report prepared by InterVISTAS Consulting, Inc. (InterVISTAS) and Landrum & Brown (L&B) dated July 28, 2020 and updated June 2021. The operational counts were broken out into four distinct categories: Commercial, Freighter, General Aviation and Military, and Fighter (to account for the activity of the US Navy's Blue Angels operating out of OAK).

**Table 2. Modeled Annual Aircraft Operations**

Sources: Oakland International Airport Comprehensive Airport Activity Forecast Report (2019-2038)

| Modeling Scenario | Commercial | Freighter | General Aviation and Military | Fighter | Total |
|---|---|---|---|---|---|
| 2028 Forecast | 132,830 | 23,200 | 111,677 | 81 | 267,788 |
| 2038 Forecast | 181,270 | 24,800 | 117,350 | 81 | 323,501 |
| *Note: Totals may not match exactly due to rounding* | | | | | |

The forecast prepared by InterVISTAS and L&B included specific fleet mix assumptions for all categories of aircraft operating at OAK. As the forecast does not separate operations by stage length or by the day, evening, and night time periods used in the calculation of CNEL (7:00 a.m. to 7:00 p.m. for daytime, 7:00 p.m. to 10:00 p.m. for evening, and 10:00 p.m. to 7:00 a.m. for night time, as discussed in Appendix A), the percentages of stage lengths and day, evening and night operations had to be derived from an analysis of the radar data obtained from the OAK Airport Noise and Operations Monitoring System (ANOMS).

**Table 3** presents the 2028 Forecast Conditions case detailed forecast of average daily operations by aircraft type for arrivals and departures. The column labeled "Category" in **Table 3** indicates how the operations with similar runway requirements were combined, as discussed in section 3.5. **Table 4** presents the 2038 Forecast Conditions case detailed forecast of average daily operations by aircraft type for arrivals and departures. The column labeled "Category" in **Table 4** indicates how the operations with similar runway requirements were combined, as discussed in section 3.5.

**Table 3. Modeled Average Daily Itinerant Aircraft Operations for 2028 Forecast Conditions**

Sources: InterVISTAS, L&B, OAK ANOMS, HMMH

| Category | Engine Type | AEDT Aircraft Type | Arrivals | | | | Departures | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Day | Evening | Night | Total | Day | Evening | Night | Total | |
| Commercial | Jet | 717200 | 159 | 29 | 132 | 321 | 152 | 14 | 155 | 321 | 641 |
| | | 737700 | 4,755 | 1,308 | 991 | 7,055 | 4,773 | 1,246 | 1,035 | 7,055 | 14,109 |
| | | 737800 | 10,466 | 2,881 | 3,970 | 17,316 | 11,914 | 2,478 | 2,925 | 17,316 | 34,632 |
| | | 7378MAX | 16,181 | 5,821 | 3,651 | 25,653 | 16,937 | 4,358 | 4,358 | 25,653 | 51,306 |
| | | 7878R | 1,820 | 101 | 3 | 1,924 | 862 | 1,010 | 52 | 1,924 | 3,848 |
| | | A319-131 | 1,574 | 505 | 486 | 2,566 | 1,624 | 393 | 549 | 2,566 | 5,131 |
| | | A320-232 | 2,982 | 1,460 | 1,010 | 5,452 | 2,821 | 524 | 2,107 | 5,452 | 10,903 |
| | | A321-232 | 210 | 888 | 185 | 1,283 | 1,165 | 5 | 113 | 1,283 | 2,565 |
| | | A330-301 | 34 | 170 | 116 | 321 | 266 | 0 | 55 | 321 | 641 |
| | | CRJ9-ER | 253 | 21 | 47 | 321 | 208 | 58 | 55 | 321 | 641 |
| | | EMB145 | 532 | 99 | 14 | 645 | 550 | 77 | 18 | 645 | 1,291 |
| | | EMB14L | 17 | 4 | 0 | 21 | 19 | 2 | 1 | 21 | 42 |
| | | EMB175 | 2,828 | 370 | 9 | 3,207 | 2,451 | 731 | 24 | 3,207 | 6,413 |
| | Non-jet | CNA208 | 293 | 0 | 41 | 334 | 293 | 0 | 41 | 334 | 667 |
| | **Subtotal** | | **42,104** | **13,657** | **10,655** | **66,419** | **44,035** | **10,896** | **11,488** | **66,419** | **132,830** |
| Freighter | Jet | 727EM2 | 218 | 55 | 55 | 327 | 164 | - | 164 | 327 | 654 |
| | | 747400 | 218 | 55 | 218 | 491 | 164 | 109 | 218 | 491 | 981 |
| | | 757PW | 466 | 792 | 263 | 1,520 | 289 | 331 | 900 | 1,520 | 3,040 |
| | | 767300 | 922 | 272 | 1,331 | 2,525 | 655 | 550 | 1,320 | 2,525 | 5,050 |
| | | 777300 | 272 | 146 | 792 | 1,210 | 334 | 8 | 868 | 1,210 | 2,420 |
| | | A300-622R | 349 | 147 | 450 | 945 | 279 | 154 | 512 | 945 | 1,891 |
| | | A300B4-203 | 6 | 2 | 6 | 15 | 4 | 4 | 6 | 15 | 29 |
| | | DC1030 | 37 | 25 | 148 | 210 | 45 | 11 | 154 | 210 | 420 |
| | | DC93LW | 327 | 109 | 436 | 872 | 600 | 55 | 218 | 872 | 1,745 |
| | | MD11PW | 482 | 116 | 732 | 1,330 | 317 | 233 | 780 | 1,330 | 2,660 |
| | Non-jet | BEC58P | 3 | 10 | 36 | 49 | 43 | 0 | 6 | 49 | 98 |
| | | CNA206 | 1 | 0 | 12 | 13 | 13 | 0 | 0 | 13 | 26 |
| | | CNA208 | 2,043 | 24 | 25 | 2,093 | 1,489 | 4 | 599 | 2,093 | 4,186 |
| | **Subtotal** | | **5,344** | **1,753** | **4,504** | **11,600** | **4,396** | **1,459** | **5,745** | **11,600** | **23,200** |
| General Aviation and Military | Helicopter | B206L | 202 | 12 | 0 | 213 | 200 | 13 | 0 | 213 | 427 |
| | | B407 | 128 | 2 | 2 | 132 | 128 | 2 | 2 | 132 | 264 |
| | | EC130 | 248 | 76 | 158 | 482 | 270 | 100 | 112 | 482 | 963 |
| | Jet | BD-700-1A10 | 646 | 131 | 90 | 867 | 683 | 86 | 98 | 867 | 1,733 |
| | | CL600 | 1,137 | 83 | 45 | 1,266 | 1,133 | 71 | 61 | 1,266 | 2,531 |
| | | CL601 | 897 | 106 | 82 | 1,085 | 912 | 85 | 88 | 1,085 | 2,170 |
| | | CNA500 | 27 | 4 | 4 | 35 | 27 | 4 | 4 | 35 | 69 |
| | | CNA510 | 1,258 | 171 | 75 | 1,504 | 1,271 | 150 | 84 | 1,504 | 3,009 |
| | | CNA525C | 416 | 52 | 25 | 494 | 407 | 44 | 42 | 494 | 987 |
| | | CNA55B | 2,082 | 226 | 133 | 2,440 | 2,110 | 180 | 151 | 2,440 | 4,880 |
| | | CNA560U | 288 | 33 | 35 | 357 | 277 | 45 | 35 | 357 | 714 |
| | | CNA560XL | 1,017 | 135 | 75 | 1,227 | 1,092 | 74 | 61 | 1,227 | 2,454 |
| | | CNA680 | 748 | 84 | 33 | 865 | 753 | 57 | 55 | 865 | 1,731 |
| | | CNA750 | 795 | 92 | 40 | 926 | 821 | 46 | 59 | 926 | 1,853 |

| Category | Engine Type | AEDT Aircraft Type | Arrivals | | | | Departures | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Day | Evening | Night | Total | Day | Evening | Night | Total | |
| | | FAL900EX | 190 | 26 | 16 | 231 | 202 | 14 | 15 | 231 | 463 |
| | | GIIB | 29 | 3 | 2 | 34 | 26 | 3 | 4 | 34 | 67 |
| | | GIV | 1,484 | 229 | 137 | 1,850 | 1,455 | 207 | 188 | 1,850 | 3,700 |
| | | GV | 775 | 109 | 33 | 916 | 738 | 104 | 75 | 916 | 1,833 |
| | | LEAR25 | 2 | 0 | 0 | 2 | 2 | 0 | 0 | 2 | 4 |
| | | LEAR35 | 982 | 136 | 73 | 1,191 | 958 | 111 | 122 | 1,191 | 2,383 |
| | Non-jet | BEC58P | 4,597 | 415 | 211 | 5,223 | 4,685 | 380 | 158 | 5,223 | 10,446 |
| | | CNA172 | 8,310 | 1,379 | 235 | 9,923 | 9,250 | 550 | 123 | 9,923 | 19,846 |
| | | CNA182 | 2,781 | 388 | 70 | 3,239 | 2,945 | 217 | 77 | 3,239 | 6,477 |
| | | CNA206 | 913 | 53 | 40 | 1,005 | 859 | 114 | 32 | 1,005 | 2,011 |
| | | CNA208 | 4,927 | 311 | 257 | 5,495 | 4,994 | 263 | 238 | 5,495 | 10,989 |
| | | CNA441 | 1,372 | 114 | 57 | 1,543 | 1,332 | 158 | 53 | 1,543 | 3,085 |
| | | COMSEP | 1,413 | 179 | 91 | 1,683 | 1,419 | 238 | 26 | 1,683 | 3,366 |
| | | DHC6 | 995 | 150 | 146 | 1,291 | 932 | 160 | 199 | 1,291 | 2,582 |
| | | DHC8 | 381 | 0 | 0 | 381 | 381 | 0 | 0 | 381 | 762 |
| | | DHC830 | 181 | 218 | 0 | 399 | 163 | 181 | 54 | 399 | 799 |
| | | GASEPF | 2,831 | 480 | 32 | 3,342 | 3,151 | 132 | 60 | 3,342 | 6,685 |
| | | GASEPV | 748 | 81 | 16 | 845 | 761 | 55 | 29 | 845 | 1,690 |
| | | PA28 | 3,428 | 502 | 138 | 4,067 | 3,847 | 163 | 57 | 4,067 | 8,134 |
| | | PA30 | 1,023 | 201 | 49 | 1,273 | 1,039 | 132 | 102 | 1,273 | 2,546 |
| | | PA42 | 10 | 0 | 2 | 12 | 10 | 0 | 2 | 12 | 24 |
| | **Subtotal** | | **47,261** | **6,181** | **2,402** | **55,838** | **49,233** | **4,139** | **2,466** | **55,838** | **111,677** |
| **Fighter** | **Jet** | F-18 | 41 | 0 | 0 | 41 | 41 | 0 | 0 | 41 | 81 |
| | **Subtotal** | | **41** | **0** | **0** | **41** | **41** | **0** | **0** | **41** | **81** |
| **Grand Total** | | | **94,750** | **21,591** | **17,561** | **133,898** | **97,705** | **16,494** | **19,699** | **133,898** | **267,788** |
| *Note: Totals may not match exactly due to rounding* | | | | | | | | | | | |

**Table 4. Modeled Average Daily Itinerant Aircraft Operations for 2038 Forecast Conditions**

Sources: InterVISTAS, L&B, OAK ANOMS, HMMH

| Category | Engine Type | AEDT Aircraft Type | Arrivals | | | | Departures | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Day | Evening | Night | Total | Day | Evening | Night | Total | |
| Commercial | Jet | 717200 | 160 | 29 | 133 | 323 | 153 | 14 | 156 | 323 | 645 |
| | | 737700 | 3,912 | 1,076 | 815 | 5,804 | 3,927 | 1,025 | 852 | 5,804 | 11,607 |
| | | 737800 | 4,677 | 1,287 | 1,774 | 7,738 | 5,324 | 1,107 | 1,307 | 7,738 | 15,476 |
| | | 7378MAX | 34,574 | 12,438 | 7,800 | 54,813 | 36,189 | 9,312 | 9,312 | 54,813 | 109,626 |
| | | 7878R | 2,440 | 136 | 4 | 2,580 | 1,156 | 1,355 | 69 | 2,580 | 5,159 |
| | | A319-131 | 2,176 | 698 | 672 | 3,547 | 2,245 | 543 | 758 | 3,547 | 7,093 |
| | | A320-232 | 3,880 | 1,899 | 1,315 | 7,094 | 3,671 | 681 | 2,741 | 7,094 | 14,187 |
| | | A321-232 | 264 | 1,116 | 232 | 1,612 | 1,464 | 6 | 142 | 1,612 | 3,224 |
| | | A330-301 | 103 | 515 | 350 | 968 | 803 | 0 | 165 | 968 | 1,935 |
| | | EMB145 | 532 | 99 | 14 | 645 | 550 | 77 | 18 | 645 | 1,291 |
| | | EMB14L | 17 | 4 | 0 | 21 | 19 | 2 | 1 | 21 | 42 |
| | | EMB175 | 4,551 | 595 | 14 | 5,159 | 3,944 | 1,177 | 38 | 5,159 | 10,318 |
| | Non-jet | CNA208 | 293 | 0 | 41 | 334 | 293 | 0 | 41 | 334 | 667 |
| | **Subtotal** | | **57,579** | **19,892** | **13,164** | **90,638** | **59,738** | **15,299** | **15,600** | **90,638** | **181,270** |
| Freighter | Jet | 727EM2 | 329 | 82 | 82 | 494 | 247 | 0 | 247 | 494 | 987 |
| | | 747400 | 329 | 82 | 329 | 740 | 247 | 165 | 329 | 740 | 1,481 |
| | | 757PW | 498 | 846 | 281 | 1,625 | 309 | 354 | 962 | 1,625 | 3,250 |
| | | 767300 | 1,035 | 306 | 1,494 | 2,835 | 735 | 617 | 1,482 | 2,835 | 5,670 |
| | | 777300 | 381 | 204 | 1,109 | 1,695 | 468 | 12 | 1,216 | 1,695 | 3,390 |
| | | A300-622R | 223 | 94 | 288 | 606 | 179 | 99 | 328 | 606 | 1,211 |
| | | A300B4-203 | 4 | 1 | 4 | 9 | 3 | 3 | 4 | 9 | 19 |
| | | DC1030 | 25 | 17 | 98 | 140 | 30 | 7 | 103 | 140 | 280 |
| | | DC93LW | 494 | 165 | 658 | 1,316 | 905 | 82 | 329 | 1,316 | 2,632 |
| | | MD11PW | 230 | 55 | 350 | 635 | 151 | 111 | 372 | 635 | 1,270 |
| | Non-jet | BEC58P | 4 | 13 | 49 | 66 | 58 | 0 | 8 | 66 | 132 |
| | | CNA206 | 2 | 0 | 16 | 17 | 17 | 0 | 0 | 17 | 35 |
| | | CNA208 | 2,169 | 26 | 27 | 2,222 | 1,581 | 4 | 636 | 2,222 | 4,443 |
| | **Subtotal** | | **5,723** | **1,891** | **4,785** | **12,400** | **4,930** | **1,454** | **6,016** | **12,400** | **24,800** |
| General Aviation and Military | Helicopter | B206L | 192 | 11 | 0 | 203 | 190 | 13 | 0 | 203 | 406 |
| | | B407 | 122 | 2 | 2 | 126 | 122 | 2 | 2 | 126 | 251 |
| | | EC130 | 236 | 72 | 151 | 458 | 257 | 95 | 106 | 458 | 917 |
| | Jet | BD-700-1A10 | 780 | 158 | 108 | 1,046 | 824 | 104 | 118 | 1,046 | 2,092 |
| | | CL600 | 1,372 | 101 | 55 | 1,527 | 1,367 | 86 | 73 | 1,527 | 3,054 |
| | | CL601 | 1,082 | 128 | 99 | 1,309 | 1,100 | 103 | 106 | 1,309 | 2,618 |
| | | CNA500 | 32 | 4 | 5 | 42 | 33 | 4 | 4 | 42 | 83 |
| | | CNA510 | 1,487 | 203 | 89 | 1,779 | 1,503 | 177 | 99 | 1,779 | 3,558 |
| | | CNA525C | 500 | 63 | 31 | 593 | 490 | 53 | 51 | 593 | 1,186 |
| | | CNA55B | 2,482 | 269 | 158 | 2,909 | 2,515 | 214 | 179 | 2,909 | 5,818 |
| | | CNA560U | 348 | 40 | 42 | 430 | 334 | 54 | 42 | 430 | 861 |
| | | CNA560XL | 1,226 | 163 | 90 | 1,480 | 1,317 | 89 | 73 | 1,480 | 2,960 |
| | | CNA680 | 900 | 101 | 40 | 1,040 | 905 | 69 | 66 | 1,040 | 2,081 |
| | | CNA750 | 957 | 110 | 48 | 1,115 | 988 | 56 | 71 | 1,115 | 2,231 |
| | | FAL900EX | 229 | 31 | 19 | 279 | 243 | 17 | 18 | 279 | 558 |

| Category | Engine Type | AEDT Aircraft Type | Arrivals | | | | Departures | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Day | Evening | Night | Total | Day | Evening | Night | Total | |
| | | GIIB | 35 | 4 | 2 | 41 | 32 | 4 | 5 | 41 | 81 |
| | | GIV | 1,790 | 276 | 166 | 2,232 | 1,755 | 250 | 227 | 2,232 | 4,464 |
| | | GV | 935 | 131 | 39 | 1,106 | 890 | 125 | 91 | 1,106 | 2,212 |
| | | LEAR25 | 2 | 0 | 0 | 2 | 2 | 0 | 0 | 2 | 4 |
| | | LEAR35 | 1,183 | 164 | 89 | 1,435 | 1,154 | 134 | 147 | 1,435 | 2,870 |
| | Non-jet | BEC58P | 4,370 | 395 | 201 | 4,966 | 4,454 | 362 | 150 | 4,966 | 9,931 |
| | | CNA172 | 7,899 | 1,311 | 223 | 9,433 | 8,793 | 523 | 117 | 9,433 | 18,866 |
| | | CNA182 | 2,645 | 369 | 66 | 3,080 | 2,800 | 206 | 73 | 3,080 | 6,159 |
| | | CNA206 | 868 | 50 | 38 | 956 | 817 | 108 | 31 | 956 | 1,912 |
| | | CNA208 | 5,636 | 356 | 294 | 6,286 | 5,713 | 301 | 272 | 6,286 | 12,571 |
| | | CNA441 | 1,569 | 130 | 66 | 1,765 | 1,524 | 180 | 60 | 1,765 | 3,529 |
| | | COMSEP | 1,344 | 170 | 87 | 1,601 | 1,349 | 226 | 25 | 1,601 | 3,201 |
| | | DHC6 | 1,136 | 171 | 166 | 1,473 | 1,064 | 183 | 227 | 1,473 | 2,946 |
| | | DHC8 | 436 | 0 | 0 | 436 | 436 | 0 | 0 | 436 | 872 |
| | | DHC830 | 208 | 249 | 0 | 457 | 187 | 208 | 62 | 457 | 913 |
| | | GASEPF | 2,692 | 457 | 30 | 3,178 | 2,996 | 125 | 57 | 3,178 | 6,356 |
| | | GASEPV | 711 | 77 | 16 | 804 | 724 | 53 | 28 | 804 | 1,608 |
| | | PA28 | 3,258 | 477 | 131 | 3,866 | 3,657 | 155 | 54 | 3,866 | 7,732 |
| | | PA30 | 973 | 191 | 46 | 1,210 | 988 | 125 | 97 | 1,210 | 2,421 |
| | | PA42 | 11 | 0 | 2 | 14 | 11 | 0 | 3 | 14 | 28 |
| | **Subtotal** | | **49,646** | **6,434** | **2,599** | **58,677** | **51,534** | **4,404** | **2,734** | **58,677** | **117,350** |
| **Fighter** | **Jet** | F-18 | 41 | 0 | 0 | 41 | 41 | 0 | 0 | 41 | 81 |
| | **Subtotal** | | **41** | **0** | **0** | **41** | **41** | **0** | **0** | **41** | **81** |
| **Grand Total** | | | **112,989** | **28,217** | **20,548** | **161,756** | **116,243** | **21,157** | **24,350** | **161,756** | **323,501** |
| *Note: Totals may not match exactly due to rounding* | | | | | | | | | | | |

## 3.3 Aircraft Noise and Performance Characteristics

AEDT requires the use of specific noise and performance data for each aircraft type operating at the airport. Noise data are specified in the form of Sound Exposure Level (SEL) at a range of distances (from 200 feet to 25,000 feet) from a receiver on the ground to a particular aircraft with engines operating at a range of thrust levels. Performance data include thrust, speed and altitude profiles for takeoff and landing operations. The AEDT automatically accesses the noise and performance data for takeoff and landing operations by those aircraft types.

Within the AEDT database, aircraft departure profiles are defined by a range of trip distances identified as "stage lengths." Higher stage lengths (longer trip distances) are associated with heavier aircraft due to the increase in fuel requirements for the flight. For example, a departure aircraft with a trip distance less than 500 Nautical Miles (nmi) would be assigned a stage length value of one, where a departure aircraft with a trip distance of 3,000 nmi would be assigned a stage length value of five. The noise calculations presented in this document used the standard AEDT departure profiles. **Table 5** provides the stage length classifications by their associated trip distances and **Table 6** presents the stage length utilization rates by AEDT aircraft type for Forecast Year 2028. **Table 7** presents the stage length utilization rates by AEDT aircraft type for Forecast Year 2038.

**Table 5. Stage Lengths by Trip Distance**

| Stage length | Trip Distance (nmi) |
|---|---|
| 1 | 0-500 |
| 2 | 501-1,000 |
| 3 | 1,001-1,500 |
| 4 | 1,501-2,500 |
| 5 | 2,501-3,500 |
| 6 | 3,501-4,500 |
| 7 | 4,501-5,500 |
| 8 | 5,501-6,500 |
| 9 | 6,501+ |

**Table 6. 2028 Forecast Conditions Modeled Departure Stage Length Usage by Aircraft Type**

| AEDT Aircraft Type | Stage length | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
| **717200** | 0% | 97% | 0% | 3% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **737700** | 71% | 21% | 6% | 3% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **737800** | 27% | 27% | 11% | 35% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **747400** | 14% | 0% | 0% | 86% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **767300** | 23% | 3% | 8% | 66% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **777300** | 0% | 1% | 0% | 71% | 0% | 28% | <1% | 0% | 0% | **100%** |
| **727EM2** | 17% | 17% | 50% | 17% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **7378MAX** | 40% | 27% | 17% | 16% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **757PW** | 58% | 10% | <1% | 31% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **7878R** | 0% | 0% | 0% | 0% | 0% | 10% | 90% | 0% | 0% | **100%** |
| **A300-622R** | 29% | 29% | 12% | 30% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **A300B4-203** | 17% | 38% | 29% | 17% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **A319-131** | 43% | 50% | 1% | 6% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **A320-232** | 52% | 6% | 20% | 22% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **A321-232** | <1% | 3% | 7% | 90% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **A330-301** | 9% | 9% | 7% | 74% | 0% | 2% | 0% | 0% | 0% | **100%** |
| **B206L** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **B407** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **BD-700-1A10** | 50% | 8% | 4% | 28% | 1% | 1% | 5% | <1% | 0% | **100%** |
| **BEC58P** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA172** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA182** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA206** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA208** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA441** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA500** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA510** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA525C** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA55B** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA560U** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA560XL** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA680** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA750** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **COMSEP** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CRJ9-ER** | 4% | 96% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **DC1030** | 53% | 8% | 1% | 38% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **DC93LW** | 6% | 19% | 75% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **DHC6** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **DHC8** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **DHC830** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **EC130** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **EMB145** | 88% | 12% | <1% | <1% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **EMB14L** | 60% | 40% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **EMB175** | 55% | 45% | <1% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **F-18** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **FAL900EX** | 49% | 11% | 12% | 23% | <1% | 4% | 0% | 0% | 0% | **100%** |
| **GASEPF** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |

| AEDT Aircraft Type | Stage length | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
| **GASEPV** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **GIIB** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **GIV** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **GV** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **LEAR25** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **LEAR35** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **MD11PW** | 22% | 14% | 0% | 64% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **PA28** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **PA30** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **PA42** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| *Note: Totals may not match exactly due to rounding* | | | | | | | | | | |

**Table 7. 2038 Forecast Conditions Modeled Departure Stage Length Usage by Aircraft Type**

| AEDT Aircraft Type | Stage length | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
| **717200** | 0% | 97% | 0% | 3% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **737700** | 71% | 21% | 6% | 3% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **737800** | 27% | 27% | 11% | 35% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **747400** | 14% | 0% | 0% | 86% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **767300** | 23% | 3% | 8% | 66% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **777300** | 0% | 1% | 0% | 71% | 0% | 28% | <1% | 0% | 0% | **100%** |
| **727EM2** | 17% | 17% | 50% | 17% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **7378MAX** | 40% | 27% | 17% | 16% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **757PW** | 58% | 10% | <1% | 31% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **7878R** | 0% | 0% | 0% | 0% | 0% | 10% | 90% | 0% | 0% | **100%** |
| **A300-622R** | 29% | 29% | 12% | 30% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **A300B4-203** | 17% | 38% | 29% | 17% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **A319-131** | 43% | 50% | 1% | 6% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **A320-232** | 52% | 6% | 20% | 22% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **A321-232** | <1% | 3% | 7% | 90% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **A330-301** | 9% | 9% | 7% | 74% | 0% | 2% | 0% | 0% | 0% | **100%** |
| **B206L** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **B407** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **BD-700-1A10** | 50% | 8% | 4% | 28% | 1% | 1% | 5% | <1% | 0% | **100%** |
| **BEC58P** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA172** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA182** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA206** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA208** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA441** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA500** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA510** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA525C** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA55B** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA560U** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA560XL** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA680** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **CNA750** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **COMSEP** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **DC1030** | 53% | 8% | 1% | 38% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **DC93LW** | 6% | 19% | 75% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **DHC6** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **DHC8** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **DHC830** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **EC130** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **EMB145** | 88% | 12% | <1% | <1% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **EMB14L** | 60% | 40% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **EMB175** | 55% | 45% | <1% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **F-18** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **FAL900EX** | 49% | 11% | 12% | 23% | <1% | 4% | 0% | 0% | 0% | **100%** |
| **GASEPF** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **GASEPV** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |

| AEDT Aircraft Type | Stage length | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
| **GIIB** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **GIV** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **GV** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **LEAR25** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **LEAR35** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **MD11PW** | 22% | 14% | 0% | 64% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **PA28** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **PA30** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| **PA42** | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | **100%** |
| *Note: Totals may not match exactly due to rounding* | | | | | | | | | | |

## 3.4 Runway Utilization

Weather, particularly wind direction and wind speed, is the primary factor affecting runway use at airports. Additional factors that may affect runway use include the position of a facility (such as a passenger terminal) relative to the runways and temporary runway closures, generally for airfield maintenance and construction.

In the development of the updated OAK noise exposure maps, runway usage rates were calculated for four aircraft groups sharing common runway use characteristics, using actual operations data from the OAK ANOMS. All operation categories are subdivided based on aircraft powerplant type (i.e., jet, non-jet, and helicopter). **Table 8** provides the modeled runway use percentages for departures and arrivals for the day, evening and nighttime periods used in the calculation of CNEL for all fixed-wing aircraft categories. As all helicopters are modeled from a single helipad, its utilization rate is 100% for these operations.

**Table 8. Modeled Average Daily Runway Use**

Source: OAK ANOMS, HMMH

| Time of Day | Runway End | Commercial | | Freighter | | GA and Military | | Fighter |
|---|---|---|---|---|---|---|---|---|
| | | Jet | Non-jet | Jet | Non-jet | Jet | Non-jet | Jet |
| Day | 10L | <1% | <1% | 0% | 4% | <1% | 3% | 0% |
| | 10R | <1% | <1% | <1% | 4% | 6% | <1% | 0% |
| | 12 | 7% | 15% | 9% | <1% | 4% | <1% | 0% |
| | 15 | 0% | 0% | 0% | <1% | <1% | 3% | 0% |
| | 28L | <1% | 0% | <1% | 33% | 11% | 10% | 0% |
| | 28R | 4% | <1% | <1% | 54% | 35% | 64% | 0% |
| | 30 | 87% | 84% | 90% | 4% | 44% | <1% | 100% |
| | 33 | 0% | 0% | 0% | <1% | <1% | 19% | 0% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| Evening | 10L | 0% | 0% | 0% | 3% | <1% | 2% | 0% |
| | 10R | <1% | 0% | 0% | 41% | 4% | <1% | 0% |
| | 12 | 6% | 0% | 7% | 0% | 5% | <1% | 0% |
| | 15 | 0% | 0% | 0% | 0% | 0% | <1% | 0% |
| | 28L | <1% | 0% | 0% | 20% | 11% | 5% | 0% |
| | 28R | 4% | 0% | 0% | 32% | 40% | 78% | 0% |
| | 30 | 89% | 0% | 93% | 3% | 39% | 2% | 0% |
| | 33 | 0% | 0% | 0% | 0% | <1% | 11% | 0% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| Night | 10L | 0% | 0% | 0% | 3% | <1% | 6% | 0% |
| | 10R | <1% | 0% | 0% | 3% | 6% | 2% | 0% |
| | 12 | 6% | 6% | 7% | 0% | 4% | <1% | 0% |
| | 15 | 0% | 0% | 0% | <1% | 0% | <1% | 0% |
| | 28L | <1% | 38% | <1% | 77% | 9% | 3% | 0% |
| | 28R | <1% | 0% | <1% | 16% | 32% | 83% | 0% |
| | 30 | 92% | 56% | 93% | <1% | 49% | 3% | 0% |
| | 33 | 0% | 0% | 0% | <1% | <1% | 3% | 0% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |

*Note: Totals may not match exactly due to rounding*

## 3.5 Flight Track Geometry and Use

In addition to runway usage, radar data from the OAK ANOMS provided an ideal source of information for identifying where aircraft fly and how often they use different flight corridors in the vicinity of the airport. In the development of the OAK EA/EIS and EIR, sets of prototypical flight tracks were defined for noise modeling. Known as "backbones," these tracks follow the central tendency of more dispersed paths flown by aircraft along each major flight corridor. Additional model tracks were created to either side of the backbones to account for the dispersion within each corridor, and traffic is distributed normally[8] onto each track group to reflect the spreading of noise along the corridor.

Aircraft are assigned to specific modeling tracks based on historical averages determined through analysis of the radar data. Knowledge of destinations for departures from the airport or points of origin for arrivals to the airport are also considered. The standard procedure for model track development entails separating tracks by operation type, (e.g., arrival or departure) and runway end. HMMH analyzed flight tracks with the same operation type and runway end for similar geometry and this resulted in the final flight track bundles used to create model tracks.

All fixed-wing aircraft flight tracks start or end at runway ends. Helicopter tracks generally start and end at a defined helipad and thus are modeled as flights to and from the midfield area (the helipad "H1" identified in **Table 1** and marked on **Figure 1**).

Airspace changes and new flight procedures are not anticipated to occur during the duration of this study. Future condition cases with and without project will be modeled utilizing the same model flight tracks developed for the baseline conditions case. **Figure 4** through **Figure 21** in the *'Oakland International Airport Environmental Assessment and Environmental Impact Report Existing Conditions Modeling Input Assumptions Memo'* dated November 30, 2021, present the modeled flight track geometry, for arrival and departure operations by runway end. These tracks were developed using calendar year 2019 data from the OAK ANOMS. The set of flight tracks reflects existing operations following RNAV departures and some Required Navigational Performance (RNP) arrival procedures, which are a subset of the more advanced Performance Based Navigation (PBN) procedures that the FAA is in the process of implementing across the U.S. **Table 9** presents the modeled flight track usage rates by runway end and aircraft type category, for fixed-wing arrivals. **Table 10** and **Table 11** present the same information for fixed-wing departures and helicopters, respectively. The usage rates were developed using the same sample of radar data that formed the basis of the runway use and flight track geometry.

[8] According to a statistical normal (Gaussian) distribution

**Table 9. Modeled Fixed-wing Arrival Flight Track Utilization**

Source: OAK ANOMS, HMMH

| Runway End | Track Group | Commercial | | Freighter | | GA and Military | |
|---|---|---|---|---|---|---|---|
| | | Jet | Non-jet | Jet | Non-jet | Jet | Non-jet |
| 10L | A10L01 | 86% | 0% | 0% | 22% | 89% | 63% |
| | A10L02 | 0% | 0% | 0% | 0% | 5% | 2% |
| | A10L03 | 14% | 0% | 0% | 41% | 0% | 20% |
| | A10L04 | 0% | 0% | 0% | 0% | 0% | 5% |
| | A10L05 | 0% | 0% | 0% | 34% | 2% | 6% |
| | A10L06 | 0% | 0% | 0% | 4% | 4% | 4% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| 10R | A10R01 | 93% | 0% | 0% | 64% | 95% | 87% |
| | A10R02 | 0% | 0% | 0% | 16% | <1% | 8% |
| | A10R03 | 7% | 0% | 0% | 5% | 5% | 2% |
| | A10R04 | 0% | 0% | 0% | 15% | 0% | 3% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| 12 | A1201 | 11% | 74% | 8% | 0% | 7% | 27% |
| | A1202 | 85% | 26% | 88% | 0% | 87% | 67% |
| | A1203 | 5% | 0% | 4% | 0% | 6% | 5% |
| | A1204 | <1% | 0% | <1% | 0% | <1% | 0% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| 15 | A1501 | 0% | 0% | 0% | 83% | 0% | 42% |
| | A1502 | 0% | 0% | 0% | 0% | 0% | 27% |
| | A1503 | 0% | 0% | 0% | 17% | 0% | 30% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| 28L | A28L01 | 75% | 0% | 80% | 49% | 72% | 38% |
| | A28L02 | 13% | 0% | 20% | 2% | 20% | 4% |
| | A28L03 | 0% | 0% | 0% | 18% | <1% | 9% |
| | A28L04 | 0% | 0% | 0% | <1% | <1% | 7% |
| | A28L05 | 0% | 0% | 0% | <1% | <1% | 8% |
| | A28L06 | 0% | 0% | 0% | 16% | 0% | 1% |
| | A28L07 | 2% | 0% | 0% | 12% | 2% | 14% |
| | A28L08 | 3% | 0% | 0% | <1% | 2% | 3% |
| | A28L09 | 4% | 0% | 0% | 0% | <1% | <1% |
| | A28L10 | 4% | 0% | 0% | 0% | <1% | 0% |
| | A28L11 | 0% | 0% | 0% | <1% | 0% | 10% |
| | A28L12 | <1% | 0% | 0% | 0% | <1% | 0% |
| | A28L13 | 0% | 0% | 0% | <1% | 0% | 5% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| 28R | A28R01 | 85% | 0% | 100% | 60% | 72% | 34% |
| | A28R02 | 5% | 0% | 0% | 2% | 8% | 5% |
| | A28R03 | 7% | 0% | 0% | 1% | 11% | 2% |
| | A28R04 | <1% | 0% | 0% | 28% | <1% | 17% |
| | A28R05 | <1% | 0% | 0% | 1% | 2% | 3% |
| | A28R06 | <1% | 0% | 0% | 0% | <1% | <1% |
| | A28R07 | 2% | 0% | 0% | 1% | 2% | 10% |
| | A28R08 | 0% | 0% | 0% | <1% | <1% | 7% |
| | A28R09 | 0% | 0% | 0% | 0% | <1% | 3% |
| | A28R10 | 0% | 0% | 0% | <1% | <1% | 10% |

| Runway End | Track Group | Commercial | | Freighter | | GA and Military | |
|---|---|---|---|---|---|---|---|
| | | Jet | Non-jet | Jet | Non-jet | Jet | Non-jet |
| | A28R11 | <1% | 0% | 0% | 4% | 2% | 6% |
| | A28R12 | <1% | 0% | 0% | <1% | 2% | <1% |
| | A28R14 | 0% | 0% | 0% | <1% | <1% | 2% |
| | A28R15 | <1% | 0% | 0% | 0% | <1% | <1% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| **30** | A3001 | 18% | 0% | 20% | 5% | 15% | 54% |
| | A3002 | 77% | 100% | 77% | 95% | 82% | 43% |
| | A3004 | 5% | 0% | 2% | 0% | 3% | 3% |
| | A3005 | <1% | 0% | <1% | 0% | 0% | 0% |
| | A3006 | <1% | 0% | <1% | 0% | <1% | 0% |
| | A3007 | 0% | 0% | 0% | 0% | 0% | 0% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| **33** | A3301 | 0% | 0% | 0% | 0% | 0% | 39% |
| | A3302 | 0% | 0% | 0% | 40% | 89% | 6% |
| | A3303 | 0% | 0% | 0% | 0% | 0% | 21% |
| | A3304 | 0% | 0% | 0% | 0% | 0% | 14% |
| | A3305 | 0% | 0% | 0% | 60% | 11% | 17% |
| | A3306 | 0% | 0% | 0% | 0% | 0% | 4% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |

**Table 10. Modeled Fixed-wing Departure Flight Track Utilization**
Source: OAK ANOMS, HMMH

| Runway End | Track Group | Commercial | | Freighter | | GA and Military | |
|---|---|---|---|---|---|---|---|
| | | Jet | Non-jet | Jet | Non-jet | Jet | Non-jet |
| **10L** | D10L01 | 0% | 100% | 0% | 68% | 34% | 72% |
| | D10L02 | 0% | 0% | 0% | 26% | 17% | 20% |
| | D10L03 | 0% | 0% | 0% | 6% | 0% | 6% |
| | D10L04 | 0% | 0% | 0% | 0% | 43% | <1% |
| | D10L05 | 0% | 0% | 0% | 0% | 7% | 2% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| **10R** | D10R01 | 15% | 100% | 100% | 100% | 39% | 75% |
| | D10R02 | 72% | 0% | 0% | 0% | 43% | 18% |
| | D10R03 | 11% | 0% | 0% | 0% | 7% | 5% |
| | D10R04 | 2% | 0% | 0% | 0% | 10% | 2% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| **12** | D1201 | 12% | 0% | 3% | 0% | 4% | 76% |
| | D1202 | 19% | 100% | 37% | 0% | 35% | 0% |
| | D1203 | 6% | 0% | 4% | 0% | 6% | 0% |
| | D1204 | <1% | 0% | 6% | 0% | 0% | 0% |
| | D1205 | 1% | 0% | 12% | 0% | 1% | 12% |
| | D1206 | 42% | 0% | 13% | 0% | 21% | 0% |
| | D1207 | 2% | 0% | 4% | 0% | 3% | 0% |
| | D1208 | 1% | 0% | 1% | 0% | 3% | 0% |
| | D1209 | 2% | 0% | 4% | 0% | 9% | 0% |
| | D1210 | 9% | 0% | 2% | 0% | 15% | 0% |
| | D1211 | 3% | 0% | 14% | 0% | 3% | 0% |
| | D1212 | 2% | 0% | <1% | 100% | 0% | 12% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| **15** | D1501 | 0% | 0% | 0% | 0% | 0% | 14% |
| | D1502 | 0% | 0% | 0% | 0% | 0% | 10% |
| | D1503 | 0% | 0% | 0% | 0% | 0% | 8% |
| | D1504 | 0% | 0% | 0% | 0% | 0% | 16% |
| | D1505 | 0% | 0% | 0% | 100% | 100% | 10% |
| | D1506 | 0% | 0% | 0% | 0% | 0% | 43% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |

| Runway End | Track Group | Commercial | | Freighter | | GA and Military | |
|---|---|---|---|---|---|---|---|
| | | Jet | Non-jet | Jet | Non-jet | Jet | Non-jet |
| 28L | D28L01 | 47% | 0% | 0% | <1% | 37% | <1% |
| | D28L02 | 0% | 0% | 0% | <1% | <1% | 9% |
| | D28L03 | 17% | 0% | 0% | 23% | 15% | 4% |
| | D28L04 | 0% | 0% | 0% | 13% | 0% | 7% |
| | D28L05 | 36% | 0% | 100% | 0% | 43% | <1% |
| | D28L06 | 0% | 0% | 0% | 10% | <1% | 15% |
| | D28L07 | 0% | 0% | 0% | 18% | <1% | 30% |
| | D28L08 | 0% | 0% | 0% | <1% | 1% | 22% |
| | D28L09 | 0% | 100% | 0% | 29% | <1% | 6% |
| | D28L10 | 0% | 0% | 0% | 2% | 2% | 6% |
| | D28L11 | 0% | 0% | 0% | 6% | 0% | 0% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| 28R | D28R01 | 62% | 0% | 0% | 18% | 49% | 3% |
| | D28R02 | 0% | 0% | 0% | 57% | 0% | 11% |
| | D28R03 | 0% | 0% | 0% | 0% | 1% | 13% |
| | D28R04 | 0% | 100% | 0% | 5% | 2% | 23% |
| | D28R05 | 6% | 0% | 0% | 9% | 1% | 9% |
| | D28R06 | 0% | 0% | 0% | 10% | 6% | 22% |
| | D28R07 | 0% | 0% | 0% | 0% | 0% | 1% |
| | D28R08 | 31% | 0% | 100% | 0% | 37% | <1% |
| | D28R09 | 0% | 0% | 0% | <1% | 3% | 12% |
| | D28R10 | 0% | 0% | 0% | 0% | 0% | 3% |
| | D28R11 | 0% | 0% | 0% | <1% | <1% | 2% |
| | D28R12 | 0% | 0% | 0% | <1% | 0% | <1% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |
| 30 | D3001 | 21% | 0% | 4% | 34% | 13% | 12% |
| | D3002 | 25% | 0% | 7% | 26% | 28% | 34% |
| | D3003 | 8% | 0% | <1% | 0% | 8% | 5% |
| | D3004 | 11% | 3% | 24% | 0% | 18% | 16% |
| | D3005 | 19% | 0% | 6% | 13% | 26% | 23% |
| | D3006 | 8% | 0% | 4% | 18% | 4% | 3% |
| | D3007 | <1% | 0% | 14% | 4% | <1% | 1% |
| | D3008 | 7% | 0% | 36% | 0% | 3% | 3% |
| | D3009 | <1% | 0% | <1% | 0% | <1% | 0% |
| | D3010 | <1% | 0% | <1% | 0% | <1% | 0% |
| | D3011 | 0% | 97% | 0% | 4% | <1% | <1% |
| | D3012 | <1% | 0% | 2% | 0% | <1% | 0% |
| | D3013 | <1% | 0% | <1% | 0% | <1% | 0% |
| | D3014 | <1% | 0% | <1% | 0% | <1% | 0% |
| | D3015 | <1% | 0% | 1% | 0% | <1% | 0% |
| | D3016 | <1% | 0% | <1% | 0% | <1% | <1% |
| | D3017 | 0% | 0% | 0% | 0% | 0% | 0% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |

| Runway End | Track Group | Commercial | | Freighter | | GA and Military | |
|---|---|---|---|---|---|---|---|
| | | Jet | Non-jet | Jet | Non-jet | Jet | Non-jet |
| 33 | **D3301** | **0%** | **0%** | **0%** | **5%** | **0%** | **5%** |
| | D3302 | 0% | 0% | 0% | 68% | 2% | 13% |
| | D3303 | 0% | 0% | 0% | 5% | 0% | 25% |
| | D3304 | 0% | 0% | 0% | 0% | 64% | <1% |
| | D3305 | 0% | 0% | 0% | 5% | 4% | 3% |
| | D3306 | 0% | 0% | 0% | 0% | 2% | 25% |
| | D3307 | 0% | 0% | 0% | 11% | 5% | 8% |
| | D3308 | 0% | 0% | 0% | 5% | 5% | 4% |
| | D3309 | 0% | 0% | 0% | 0% | 18% | 16% |
| | **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |

**Table 11. Modeled Helicopter Flight Track Utilization**

Source: OAK ANOMS, HMMH

| Arrivals | | Departures | |
|---|---|---|---|
| Track Group | Percent Use | Track Group | Percent Use |
| AH101 | 8% | DH101 | 9% |
| AH102 | 3% | DH102 | 5% |
| AH103 | 36% | DH103 | 19% |
| AH104 | 13% | DH104 | 18% |
| AH105 | 4% | DH105 | 8% |
| AH106 | 7% | DH106 | 15% |
| AH107 | 4% | DH107 | 12% |
| AH108 | 6% | DH108 | 5% |
| AH109 | 9% | DH109 | 8% |
| AH110 | 4% | | |
| AH111 | 6% | | |
| **Total** | **100%** | **Total** | **100%** |
| *Note: Totals may not match exactly due to rounding* | | | |

## 3.6 Meteorological Data

Meteorological settings within the AEDT affect its calculation of aircraft performance profiles and sound propagation. These settings include average annual temperature, barometric pressure, relative humidity, and average headwind speed. The AEDT contains standard reference climatological data for airports throughout the US.

The noise modeling utilized the following average data for OAK from the AEDT database:

- Temperature: 58.18 F
- Station Pressure: 1013.51 mbar
- Sea Level Pressure: 1016.79 mbar
- Dew point: 49.46° F
- Relative humidity: 72.78%

The headwind speed was set to the AEDT default of 7.13 knots.

## 3.7 Terrain

Terrain data describes the elevation of the ground surrounding the airport, and on airport property. The AEDT uses terrain data to adjust the ground level under the flight paths. The terrain data does not affect the aircraft's performance or noise levels but does affect the vertical distance between the aircraft and a "receiver" on the ground. This in turn affects assumptions about how noise propagates over ground. The National Elevation Dataset (NED) 1/3 arc second terrain data were obtained from the United States Geological Survey (USGS).[9] The NED data set has a resolution of 10 meters or 33 feet.

[9] Data downloaded from https://viewer.nationalmap.gov/basic/?howTo=true on 06/10/2019 in 1/3 Arc second GeoTIFF format.

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