Quarterly Noise Monitoring Report
July – September 2022

Metropolitan Oakland International Airport

HMMH Report No. 310930.000

November 2022

Prepared for:

Port of Oakland

Oakland, California

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Prepared for:

Port of Oakland, Oakland International Airport
1 Airport Drive, Box 45
Oakland, CA 94621

Prepared by:

Rhea Hanrahan
Doreen Stockdale
Vincent Ma

HMMH
300 South Harbor Boulevard, Suite 516
Anaheim, CA 92805
T 781.229.0707

Executive Summary

The California Airport Noise Regulation (California Code of Regulations, Title 21, Section 5025, County Report) requires the quarterly report include use of a standard information format provided by the California Department of Transportation "Department" (form DOA 617, dated 10/89). The information below fulfills this requirement.

CALIFORNIA FORM DOA 617

Summary of Statistical Information
For
California Department of Transportation
Oakland International Airport
Calendar Year 2022: Third Quarter 2022

1. Size of Noise Impact Area as defined in the Noise Standards (California Code of Regulations, Title 21, Chapter 2.5, Subchapter 6): 0 sq. miles
2. Estimated number of dwelling units included in the Noise Impact Area as defined by the Noise Standards: 0 dwelling units
3. Estimated number of people residing within the Noise Impact Area as defined by the Noise Standards: 0 people
4. Identification of aircraft type having highest takeoff noise level operating at this airport together with estimated number of operations by this aircraft type during the calendar quarter reporting period: Cessna Citation II; SEL: 97.9 dB; Estimated Operations: 6
5. Total number of aircraft operations during the calendar quarter: 44,058 aircraft operations
6. Number of Commercial operations during the calendar quarter (not mandatory): 30,206 Commercial Jet operations
7. Percentage of Air Carrier operations by aircraft certified under Federal Aviation Regulation (FAR) Part 36[1], Stage III (not mandatory): 100% of air carrier/air cargo operations Stage III or quieter
8. Estimated number of operations by General Aviation aircraft during the calendar quarter (not mandatory): 8,245 General Aviation aircraft operations estimated from FAA tower counts
9. Estimated number of operations by Military aircraft during the calendar quarter (not mandatory): 0 Military aircraft operations.

Per Title 21 requirements, the report must also include a map illustrating the location of the noise impact boundary, as validated by measurement, the location of the measurement points (Figure ES-1 satisfies this requirement) and the daily measured CNEL values at each of the noise monitoring sites (Tables ES-1 through ES-3 satisfy this requirement).

[1] This designation of the regulation (FAR Part 36) has been superseded by the current designation 14 CFR Part 36. The text of form DOA 617 is retained here.

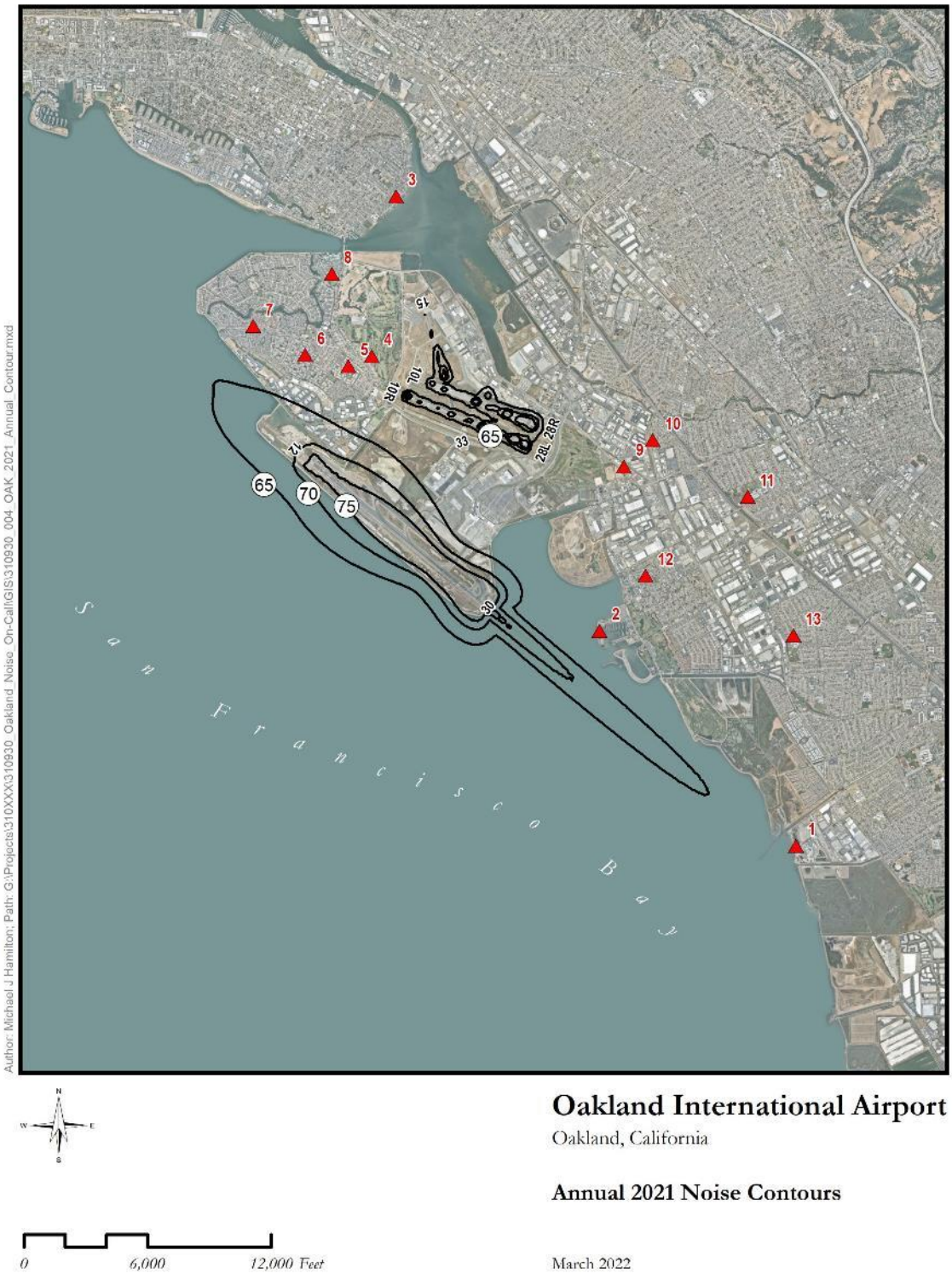

Figure ES-1. Noise Impact Boundary: 12-Month CNEL Contours for January 2021 – December 2021

Source: Port of Oakland ANOMS™ January 1, 2021 through December 31, 2021

Table ES-1. Measured Aircraft CNEL values, July 2022

Source: ANOMS™ July 1, 2022 through September 30, 2022

July	RMT Location Number													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	CNEL (dBA)													
1	62	57	42	54	58	59	59	49	59	48	53	45	46	39
2	60	53	40	52	57	59	59	41	57	47	51	43	40	30
3	59	53	44	52	56	58	59	47	56	48	51	46	39	N/A
4	60	53	44	54	57	58	58	43	58	47	61	68	50	54
5	61	54	43	53	56	59	60	47	56	49	48	46	41	38
6	63	56	43	53	59	61	62	46	55	48	47	59	45	42
7	64	55	49	58	61	61	61	47	58	48	50	46	40	41
8	63	56	51	54	59	61	61	49	57	49	48	49	33	40
9	61	53	44	52	56	58	58	47	57	46	51	46	N/A	37
10	58	60	44	55	57	58	58	48	58	48	51	43	41	N/A
11	57	53	45	60	63	62	60	55	59	49	53	45	38	31
12	63	56	48	56	58	60	60	50	59	48	51	46	36	31
13	62	55	43	55	60	61	61	49	56	46	50	57	39	39
14	62	56	49	55	59	61	61	49	57	46	56	50	39	37
15	63	58	46	53	58	59	60	48	57	47	50	59	37	39
16	60	52	40	53	56	57	57	48	56	42	46	42	N/A	38
17	60	57	40	56	58	59	59	49	58	47	50	42	36	N/A
18	63	55	42	56	59	59	59	47	60	48	52	56	38	N/A
19	63	57	51	58	59	60	60	56	59	48	50	51	30	36
20	63	56	40	55	59	59	60	49	59	52	51	47	34	33
21	62	55	46	57	59	60	60	51	56	46	48	47	34	48
22	64	57	45	55	58	60	60	49	58	50	50	47	38	41
23	60	54	43	53	58	59	59	48	56	44	48	45	N/A	38
24	60	54	42	51	57	58	59	49	57	45	50	42	N/A	32
25	62	56	42	61	63	61	60	54	58	48	51	49	43	53
26	64	56	46	54	59	60	60	46	57	47	48	52	32	36
27	63	56	47	55	59	60	60	46	58	47	49	60	N/A	39
28	63	56	45	54	60	61	59	46	58	48	50	49	N/A	39
29	62	55	44	55	58	N/A	60	51	58	47	50	43	36	46
30	61	53	41	52	58	N/A	59	45	56	46	48	50	31	41
31	60	58	43	51	56	N/A	58	49	58	49	50	43	N/A	32
Average	62	56	45	55	59	60	60	49	58	48	52	55	41	44
No. Day	31	31	31	31	31	28	31	31	31	31	31	31	24	27

Notes: Values reported are aircraft measured CNEL values at each monitor.
N/A represents an error or incomplete data.

$$CNEL_{avg} = 10\log\left(\frac{1}{N}\sum 10^{CNEL_i/10}\right)$$

Table ES-2. Measured Aircraft CNEL values, August 2022

Source: ANOMS™ July 1, 2022 through September 30, 2022

August	RMT Location Number													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	CNEL (dBA)													
1	61	54	42	53	56	N/A	58	48	62	50	55	46	N/A	35
2	63	55	47	55	59	N/A	60	53	56	48	48	45	N/A	39
3	64	55	41	56	61	N/A	60	46	58	47	49	48	38	40
4	63	57	48	57	63	N/A	62	49	58	48	49	45	30	43
5	63	55	46	56	58	N/A	61	46	56	50	49	46	40	40
6	61	53	45	53	57	N/A	59	54	55	43	47	45	N/A	33
7	60	54	41	52	57	N/A	58	46	58	46	51	43	40	N/A
8	62	54	41	57	59	N/A	59	54	56	46	49	44	54	37
9	64	55	47	53	58	N/A	60	45	54	45	48	47	30	38
10	63	55	40	54	59	N/A	61	54	58	47	50	51	38	39
11	62	55	48	54	58	N/A	60	48	59	48	51	50	38	N/A
12	63	58	47	59	60	N/A	61	54	58	48	48	46	38	33
13	61	63	44	57	60	60	62	50	57	46	N/A	50	33	39
14	59	54	50	58	59	60	60	47	57	47	N/A	43	37	35
15	63	53	38	54	59	58	57	46	58	48	N/A	49	37	N/A
16	63	56	48	58	60	61	60	52	56	46	N/A	47	N/A	37
17	63	56	43	56	62	62	61	51	56	47	N/A	46	31	41
18	63	60	48	57	60	61	61	49	59	52	N/A	49	34	39
19	63	55	47	53	57	59	59	49	59	50	N/A	49	33	37
20	63	55	42	56	59	59	59	47	56	46	N/A	48	32	37
21	N/A	53	44	57	59	59	59	46	59	48	N/A	44	35	35
22	N/A	53	41	54	57	58	59	49	59	48	N/A	48	45	37
23	N/A	56	43	54	57	59	59	52	57	46	N/A	48	N/A	42
24	N/A	55	38	55	58	59	60	51	58	46	N/A	46	33	39
25	N/A	56	50	55	58	60	60	50	59	48	N/A	49	35	40
26	64	61	42	52	57	59	59	48	56	N/A	50	46	34	40
27	60	54	43	53	56	58	58	54	57	45	49	43	N/A	46
28	60	51	43	51	56	58	59	43	57	33	49	43	N/A	N/A
29	62	53	44	53	56	57	58	48	59	N/A	52	47	38	38
30	65	56	46	54	58	60	60	51	56	N/A	49	47	39	41
31	63	55	44	58	60	60	60	51	58	47	50	47	41	42
Average	63	56	45	55	59	60	60	50	58	47	50	47	42	40
No. Day	26	31	31	31	31	19	31	31	31	28	18	31	24	27

Notes: Values reported are aircraft measured CNEL values at each monitor.
N/A represents an error or incomplete data.

$$CNEL_{avg} = 10\log\left(\frac{1}{N}\sum 10^{CNEL_i/10}\right)$$

Table ES-3. Measured Aircraft CNEL values, September 2022

Source: ANOMS July 1, 2022 through September 30, 2022

September	RMT Location Number													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	CNEL (dBA)													
1	63	57	50	56	60	61	60	49	57	49	49	48	35	41
2	63	56	46	54	57	59	59	47	57	49	49	51	42	40
3	61	53	41	54	58	59	60	48	55	46	46	42	N/A	41
4	58	59	47	54	57	57	57	44	57	48	49	45	42	30
5	59	54	40	51	55	54	54	49	55	45	48	44	N/A	46
6	61	57	43	53	58	57	56	45	54	45	46	47	36	33
7	62	55	42	56	60	60	59	50	58	49	50	48	30	36
8	63	55	41	56	61	60	58	45	56	50	48	55	42	41
9	63	57	44	56	59	60	59	50	55	45	48	46	36	44
10	60	54	41	54	57	58	59	48	56	47	49	43	37	N/A
11	60	50	40	53	56	57	57	45	56	48	49	42	31	N/A
12	62	53	43	53	59	58	58	49	59	49	51	51	43	38
13	64	57	41	53	61	60	59	48	57	47	50	48	36	35
14	63	55	46	53	59	60	60	52	56	51	49	47	36	37
15	64	55	42	54	58	60	60	50	58	49	51	47	39	43
16	64	56	45	55	58	60	61	49	58	48	49	50	43	44
17	60	52	40	58	58	60	60	50	58	48	51	42	N/A	N/A
18	56	61	39	61	60	57	55	48	56	52	46	55	46	N/A
19	61	55	44	57	58	58	58	48	58	48	49	48	40	N/A
20	63	60	43	55	58	60	60	51	60	50	52	49	37	40
21	64	55	39	57	61	61	60	49	58	48	51	46	38	43
22	64	56	44	56	59	60	60	49	60	50	52	52	37	44
23	63	59	46	56	58	60	59	50	58	49	50	47	32	43
24	60	56	46	54	57	58	58	46	55	46	47	45	N/A	N/A
25	60	53	41	52	56	57	58	47	59	47	50	43	N/A	33
26	62	54	41	54	56	57	62	51	58	47	51	51	36	35
27	64	56	45	55	58	60	60	49	57	46	49	49	35	47
28	63	54	41	55	59	60	60	50	58	49	49	47	42	34
29	64	56	48	54	58	60	60	47	57	49	49	48	35	42
30	64	56	46	55	59	60	61	49	58	47	48	47	41	43
Average	62	56	44	55	58	59	59	49	57	48	49	49	40	42
No. Day	30	30	30	30	30	30	30	30	30	30	30	30	25	24

N/A represents an error or incomplete data.

$$CNEL_{avg} = 10\log\left(\frac{1}{N}\sum 10^{CNEL_i/10}\right)$$

Contents

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Tables

1 Introduction

This Quarterly Noise Monitoring report for the Third Quarter of 2022 (3Q2022) was prepared for the Port of Oakland by HMMH. This report provides the aircraft noise levels and airport operations at Metropolitan Oakland International Airport (OAK) for the three-month period from July 1, 2022 to September 30, 2022 and satisfies the California Division of Aeronautics Noise Standards[2], Section 5025 requirements.

According to the California Noise Standards, hereinafter referred to as "Title 21", a county may declare an airport within its boundaries to have a noise problem and shall enforce Title 21 requirements. Alameda County has declared OAK a "noise problem" airport. As such, the County must provide quarterly reports to the California Department of Transportation containing at least the following information:

- A map illustrating the noise impact boundary; Title 21, Section 5012, Airport Noise Standard, indicates that the "noise impact area" is based on the standard of 65 dB Community Noise Equivalent Level (CNEL); see Figure ES-1 in the Executive Summary
- The annual noise impact area and the estimated number of dwelling units and people residing with the noise impact area; see Form DOA 617 in the Executive Summary
- Daily CNEL measurements, number of aircraft operations, and estimated number of operations of the highest noise level aircraft type during the calendar quarter; see Tables ES-1 through ES-3 and Form DOA 617 in the Executive Summary
- Form DOA 617; see the Executive Summary

This report meets and exceeds Title 21's reporting requirements for 3Q2022. The following sections provide the methodology used to obtain the information reported and further details about the aircraft operations and noise exposure from those operations in the OAK environs. This report is organized as follows:

Section 2: Aircraft Noise and Operations Measurements

Section 3: Airport Operations

Section 4: Preparation of Annual CNEL Contours

Section 5: Validation of Noise Impact Area Map

[2] State of California Department of Transportation Division of Aeronautics, Title 21, Subchapter 6, Noise Standards, Register 90, No. 10—3-10-90.

2 Aircraft Noise and Operations Measurements

On September 14, 1990, the Port of Oakland (Port), as the airport proprietor, installed a state-of-the-art noise and operations monitoring system (NOMS)[3], which automatically collects flight track and aircraft identification data for a majority of all operations at the airport and measures and reports noise levels at specific locations. In 2006 and 2011, the Port upgraded their NOMS with ANOMS8 software and Envirosuite, formerly EMS Brüel & Kjaer (B&K) 3639-E noise monitors, respectively. To maintain the most up-to-date technology, the Port upgraded to ANOMS9 software in 2016. In December 2021, the Port upgraded the EMS Brüel & Kjaer (B&K) 3639-E noise monitors to Envirosuite 3680 Environmental Monitoring Units (EMUs).

As shown in Figure ES-1, OAK's NOMS is currently configured with fourteen (14) Remote Monitoring Terminals (RMTs) dispersed in the communities surrounding OAK to assist in evaluating compliance with OAK's established flight pattern and aircraft noise abatement procedures, and to assess the noise impact in residential areas from OAK aircraft operations. ANOMS™ correlates recorded noise events at each RMT with aircraft flight track records obtained from the Federal Aviation Administration's (FAA) System Wide Information Management (SWIM) advanced technology program.

The SWIM data is used to separate aircraft and non-aircraft noise events recorded at the RMTs. ANOMS™ also excludes noise events due to aircraft overflights from other airports (such as San Francisco International) using the aircraft identification information included in the data.

The 14 RMTs located in the community are Envirosuite 3680 Environmental Monitoring Units (EMUs) fitted HBK Type 4952 outdoor microphone assemblies. The RMTs are housed in weatherproof cabinets, and the microphones are placed on booms at least 20 feet above the ground surface or at least 10 feet above neighboring rooftops, whichever is higher, and has a clear line of sight to the path of aircraft in flight. The RMTs report the maximum A-weighted sound level (Lmax), the duration of a noise event at a pre-programmed threshold sound level, and the (A-weighted) Single Event Noise Exposure Level (SENEL) for single noise events. The RMT's pre-programmed parameters were determined from previous field observations of aircraft and background noise levels at each measurement site. ANOMS™ also reports the Hourly Noise Level (HNL) and CNEL based on both overall noise levels and individual noise events exceeding the selected measurement threshold levels.

The RMT's internal calibration system performs daily checks using an acoustic actuator. The RMTs are externally calibrated periodically, per manufacturer's recommendations, using an acoustical calibrator certified to be consistent with National Institute of Standards and Technology (NIST) reference levels. The measurement systems meet all pertinent specifications of the American National Standards Institute (ANSI) and the International Electrotechnical Commission (IEC) for Type 1 Precision sound level meters and microphones and comply with all applicable requirements of Title 21.

[3] The OAK system utilizes ANOMS™, which is a product of Envirosuite.

3 Airport Operations

Title 21 requires the reporting of the total number of airport operations during the calendar quarter. Table 1 provides a summary of the monthly activity for July through September 2022 as captured in ANOMS™, along with the previous quarter totals. The table presents aircraft operations at OAK in the following eight categories: commercial jets, regional jets, corporate jets, turbo-propeller (turboprops), propeller, helicopters, military, and unknown. Commercial jets are primarily large jets consisting of both passenger carriers and freight operators as defined in FAA Order 7210.3. Regional jets are primarily small commercial jets while corporate jets have fewer seats and are typically flown as charter operations. The military category contains propeller, rotorcraft, and jet aircraft.

Table 1 indicates an increase in commercial jets by 9.5% in the third quarter 2022. Regional and corporate jet activity decreased by 3.8% and 4.2% respectively, while turboprop activity increased by 12.4%. Propeller activity decreased by 1.5%. Helicopters operations increased by 12.0%. Military aircraft captured by ANOMS™ remained the same at zero operations in the third quarter 2022[4] compared to the second quarter 2022. Unknown aircraft activity remained the same at zero operations in the third quarter 2022 compared to the second quarter 2022. Overall, OAK total aircraft operations, as captured in ANOMS™, increased by 5.9% during the third quarter of 2022 compared to the second quarter of 2022.

Table 1. Monthly Aircraft Operational Activity – Third Quarter 2022

Aircraft Category	Monthly Arrivals and Departures					Percent Change
	Jul	Aug	Sep	Total	2Q2022	
Commercial Jets	10,261	10,366	9,579	30,206	27,593	9.5%
Regional Jets	1,381	1,326	1,201	3,908	4,061	-3.8%
Corporate Jets	1,548	1,697	1,704	4,949	5,166	-4.2%
Turboprops	579	705	716	2,000	1,780	12.4%
Propeller	803	972	773	2,548	2,588	-1.5%
Helicopters	140	149	158	447	399	12.0%
Military	0	0	0	0	0	0.0%
Unknown	0	0	0	0	0	0.0%
Total	14,712	15,215	14,131	44,058	41,587	5.9%

Aircraft operations from OAK determine CNEL in the OAK environs, which by definition is a daily noise exposure. To determine the average daily noise exposure from OAK operations, additional information is required for determining aircraft fleet mix, runway use, and time of day of the operations, since CNEL weights evening (7pm to 10pm) and night (10pm to 7am) noise levels by adding approximately 5 dB and 10 dB respectively to noise levels during evening and night periods.

[4] Majority of ANOMS military operations unavailable due to security reasons. FAA Air Traffic Activity System (ATADS) reported 108 itinerant and 28 local military operations during 3Q2022.

4 Preparation of Annual CNEL Contours

CNEL can be calculated or estimated through modeling. OAK measures CNEL at each of the aforementioned RMTs, but determination of CNEL contours requires the use of a noise model such as the FAA Aviation Environmental Design Tool (AEDT). Title 21, Section 5012, Airport Noise Standard, indicates that the "noise impact area" is based on the standard of 65 dB CNEL. AEDT incorporates a comprehensive set of computer routines for calculating airport noise exposure contours. HMMH used the most current release of AEDT, namely Version 3d, to prepare the annual contours for the 12 months ending with the fourth quarter 2021.

HMMH used the Port of Oakland's flight track files and noise level measurement data collected by ANOMS™ as the basis for predicting and validating aircraft noise at OAK using AEDT. Data for aircraft activity, aircraft fleet mix including helicopters, and airport configuration used in the noise modeling process were obtained from ANOMS™ for the time period of January 1, 2021 through December 31, 2021. The following sections provide a summary of the data, methods and assumptions used to prepare the Annual CNEL contours.

4.1 AEDT Required Data

AEDT requires data in three principal categories: (1) aircraft noise and performance data, (2) airport layout, and (3) aircraft operational data.

4.1.1 Aircraft noise and performance data

AEDT includes a database of noise and performance data for a broad range of representative aircraft types. Noise data cover a range of distances (from 200 feet to 25,000 feet) for specific thrust levels. Performance data include thrust, speed, and altitude profiles for takeoff and landing operations. The AEDT database contains standard noise and performance data for more than 250 different aircraft types. The program automatically accesses the applicable noise and performance data for departure and approach operations by those aircraft. For aircraft not included in the database, the FAA maintains a list of acceptable "substitutes".

Airfield elevation and average temperature have an effect on aircraft performance; these are accounted for in AEDT. For example, aircraft departing from a high-altitude airport and/or at high temperatures must use more thrust than at lower elevations and temperatures. The performance data used by AEDT define the length of the takeoff roll (based on aircraft takeoff weight), the climb rate, and speeds for each flight segment.

4.1.2 Airport layout

AEDT requires the following airfield layout related inputs:

- Runway orientations
- Runway lengths
- Runway end elevations
- Start-of-takeoff-roll points on each runway
- Landing touchdown points on each runway
- Runway threshold crossing heights
- Runway approach slopes
- Annual average temperature, pressure, relative humidity, and runway-specific headwinds

4.1.3 Aircraft operational data

AEDT requires the following aircraft operational inputs:

- Number of aircraft operations
- Aircraft fleet mix
- Day-evening-night split of operations
- Runway utilization
- Flight track geometry and utilization

For accurate determination of daily noise exposure using actual aircraft operations for modeling purposes, the ANOMS™ database provided complete and accurate information for approximately 152,528 operations on 365 days[5].

4.2 Preparation of AEDT-input Files

As directed by the Port, HMMH prepared the AEDT input files through the use of our proprietary preprocessor which takes maximum advantage of both AEDT's capabilities and the investment that the Port has made in operations monitoring with ANOMS™. Our preprocessor automates the process of preparing the AEDT inputs directly from the flight operations monitoring results, to permit airports to model the full diversity of activity as precisely as possible. Rather than modeling a single annual-average day, this allows the determination of noise exposure from actual OAK flight operations for a total of 365 days. It should be noted that AEDT is used for all noise calculations. The preprocessor provides an organizational structure to model individual flight tracks in AEDT. It does not modify AEDT standard noise, performance, or aircraft substitution data, but rather selects the best standard data or FAA approved non-standard data available to AEDT for each individual flight track. The following subsections summarize the noise modeling inputs for January 1, 2021 through December 31, 2021 operations at OAK.

[5] The AEDT preprocessor, successfully processed 365 days of complete and accurate flight track data to determine the average daily noise exposure. Traditional modeling techniques determine daily noise exposure from a single day of "annual-average" activity.

4.2.1 Annual-average airport operations, aircraft fleet mix and period of day

AEDT aircraft types were assigned based on the FAA aircraft code associated with each flight, supplemented by FAA registration data. For commercial operations, selection of the specific AEDT aircraft type was accomplished by using the fleet mix of each airline. This information permits a rational and representative selection of AEDT aircraft types. In cases where multiple AEDT types are available for a single FAA code, the preprocessor chooses the AEDT type using a random process, with weightings corresponding to the number of each aircraft type operated by that particular airline.

To account for the noise level adjustments applied to evening and nighttime operations, all AEDT input must be coded as to whether it occurs in the day, evening or at night. Our preprocessor uses the time recorded in the operations data to assign each operation to the appropriate time of day based on the actual arrival or departure time at OAK. Operations between 7 a.m. and 7 p.m. are unweighted. When the time of the operation is between 7 p.m. and 10 p.m., the operation is considered to occur during the evening, and a weighting factor of 3 times the noise energy (approximately 4.7 dB) is added in the computation of CNEL by AEDT. When the time of the operation is between 10 p.m. and 7 a.m., the operation is considered to occur during the night and a weighting factor of 10 times (10 dB) is added in the computation of CNEL by AEDT.

4.2.2 Annual runway utilization

Runway use was determined from the actual flight track data acquired in ANOMS™. Table 2 summarizes the observed runway utilization rates during January 1, 2021 through December 31, 2021, collapsed into the following major aircraft type categories: (1) commercial jet, (2) regional jet, (3) corporate jet, (4) turbo-propeller (turboprops), (5) piston propeller aircraft (propeller), (6) military (7) helicopters and (8) other. AEDT modeled each aircraft operation on the individual runway and flight track found in the ANOMS™ sample, thus each aircraft type has unique runway utilization.

Table 2 summarizes the annual arrival and departure activity.

Table 2. Annual Aircraft Operational Activity – January 1, 2021 through December 31, 2021

Source: Port of Oakland ANOMS™ January 1, 2021 through December 31, 2021

Aircraft Category	South Field			North Field						Grand Total
	RWY 30	RWY 12	South Field Total	RWY 28R/L	RWY 33	RWY 10R/L	RWY 15	PAD 1	North Field Total	
Aircraft Landings										
Commercial Jets	41,167	2,035	**43,202**	283	0	10	0	0	**293**	**43,495**
Regional Jets	3,294	242	**3,536**	3,044	0	20	0	0	**3,064**	**6,600**
Corporate Jets	406	335	**741**	9,975	2	172	0	0	**10,149**	**10,890**
Turboprops	242	21	**263**	3,458	2	150	6	0	**3,616**	**3,879**
Propeller	13	1	**14**	5,268	166	76	94	0	**5,604**	**5,618**
Military	0	0	**0**	4	0	0	0	0	**4**	**4**
Helicopters	0	0	**0**	8	0	0	0	677	**685**	**685**
Other	(114)	(4)	**(118)**	(177)	(34)	(9)	(8)	(44)	**(272)**	**(390)**
Total	**45,008**	**2,630**	**47,638**	**21,863**	**136**	**419**	**92**	**633**	**23,143**	**70,781**
Aircraft Departures										
Commercial Jets	41,152	2,097	**43,249**	120	0	8	0	0	**128**	**43,377**
Regional Jets	5,926	150	**6,076**	407	0	121	0	0	**528**	**6,604**
Corporate Jets	8,099	38	**8,137**	2,100	30	512	0	0	**2,642**	**10,779**
Turboprops	188	9	**197**	2,801	36	164	5	0	**3,006**	**3,203**
Propeller	130	5	**135**	2,165	2,466	89	172	0	**4,892**	**5,027**
Military	1	0	**1**	0	0	0	0	0	**0**	**1**
Helicopters	1	0	**1**	5	0	0	0	424	**429**	**430**
Other	(43)	(7)	**(50)**	(153)	(116)	(7)	(4)	109	**(171)**	**(221)**
Total	**55,454**	**2,292**	**57,746**	**7,445**	**2,416**	**887**	**173**	**533**	**11,454**	**69,200**
Touch & Go / Circuit Operations										
Total	100	16	**204**	9,725	2224	363	99	20	**10,659**	**12,547**
Total Operations	**100,562**	**4,938**	**105,588**	**39,033**	**4,776**	**1,669**	**364**	**1,186**	**45,256**	**152,528**

Note: "Other" aircraft category implies operations with known aircraft types, but no category associations.
"(#)" denotes runways with operations that were incorrectly assigned and adjusted prior to modeling.

4.2.3 Flight track geometry and utilization

The preprocessor uses every available flight track in the radar sample as an input to the Aviation Environmental Design Tool (AEDT). As discussed in Section 4.1.3, the OAK ANOMS database includes flight tracks with associated flight identification data for 152,528[6] operations from a total of 365 days modeled. The preprocessor converts each available flight track into AEDT noise model inputs. AEDT is then invoked to model these operations and generate an annual CNEL contour.

4.2.4 Annual-average weather conditions

AEDT has several settings that affect aircraft performance profiles and sound propagation based on meteorological data at the airport. Meteorological settings include average temperature, sea level pressure, standard pressure, relative humidity, dew point, and headwind speed. Weather data were obtained from the National Oceanic and Atmospheric Administration's National Climatic Data Center averaged over a 1-year period for OAK, and these values were used in AEDT for computing the annual noise exposure map.

- Temperature: 60.6 °F
- Sea Level Pressure: 1017.2 millibars
- Standard Pressure: 1016.9 millibars
- Relative humidity: 67.6%
- Dew Point: 48.8°F
- Headwind speed: 1.7 knots

4.3 Annual Noise Impact Area Map

AEDT was used to prepare the OAK 12-month CNEL noise impact area map shown in Figure ES-1 based on the aircraft noise levels and airport operational factors described in the previous sections. Our preprocessor developed AEDT inputs for each available flight track in the radar data spanning 365 total days. These inputs were imported into and run through AEDT to produce the CNEL contour results.

AEDT predicted slightly higher CNEL than measured during the same period to the south of Runway 12/30 centerline. In compliance with the California Airport Noise Regulation, the AEDT modeled contour was adjusted to the 2021 annual-average measured results. Title 21 specifies that the measured results come from monitors near the closure point of the 65 dB CNEL contour, thus for OAK, the measured results from RMT1 were used. The measured and modeled CNEL at RMT1 was 61 dB and 63 dB, respectively. Thus, by applying a -1 dB correction to the contour, the modeled results match the measured data. This 1-dB adjustment was applied equally to the AEDT produced contours. The AEDT-produced 66 dB CNEL contour was used to represent the 65 dB CNEL contour shown in Figure ES-1, the AEDT-produced 71 dB CNEL contour represents the 70 dB CNEL contour shown in Figure ES-1 and the AEDT-produced 76 dB CNEL contour represents the 75 dB CNEL contour shown in Figure ES-1.

[6] There are 611 operations from ANOMs that could not be modeled due to irregular track geometry.

The resulting 65, 70 and 75 dB CNEL contours were plotted on an ArcView map of the area surrounding the airport, as shown by Figure ES-1. The CNEL contours prepared for current annual average daily operations at OAK describe the airport noise environment within the requirements of the California Airport Noise Regulations.

The contour map was used to determine the number of dwelling units included within the Noise Impact Boundary defined by the California Airport Noise Regulations. For this analysis, it was assumed that a parcel was affected if it included an incompatible land use, and if any portion of the parcel was included in the 65 dB CNEL contour. Land use was determined from the AutoCAD parcel map prepared by the Port of Oakland, which was imported into ArcView. Based upon these data and in congruence with the previous reports, no incompatible residences exist within the current Noise Impact Boundary.

5 Validation of Noise Impact Area Map

AEDT modeled the 2021 CNEL values at each of the current noise monitoring sites as described in the section above. Table 3 compares the measured CNEL values for the 12 months ending September 30, 2022 to the modeled CNEL values at each RMT location for calendar year 2021.

RMT 1 is the monitoring terminal nearest to the 65 CNEL contour. The third quarter 2022, 12 month rolling-average CNEL at RMT 1 was equal to the modeled CNEL. The results at RMT 4, 5, 6, 7, and 9 were reviewed to assist with the 60 CNEL contour assessment of the noise impact boundary as modeled using AEDT. As discussed in Section 4.3, the AEDT-modeled CNEL values were adjusted to the 2021 annual-average RMT results.

Table 3. Measured and Predicted Aircraft Annual CNEL Values

Source: Port of Oakland ANOMS™ October 1, 2021 through September 30, 2022

RMT No.	RMT Name	Measured[1] CNEL (column A)	Modeled[2] CNEL (column B)	Difference (dB) (column B minus column A)
1	Oro Loma San. Dist.	62	62	0.0
2	San Leandro Marina	58	54	-4.5
3	Fernside	46	47	1.4
4	Godfrey Park	56	59	2.7
5	Garden Isle	60	60	-0.5
6	Wake Lane	60	59	-0.2
7	Fire Station	59	59	-0.2
8	Earhart School	51	52	1.0
9	Doolittle Drive	58	59	1.2
10	Tudor Court	50	49	-0.4
11	John Muir School	51	51	0.0
12	Garfield School	49	49	-0.4
13	SLUSD Admin Office	39	43	3.9
14[3]	Washington School	40	39	-1.6

Notes: [1] Average, October 2021 – September 2022
[2] Modeled using AEDT 3d for 4Q2021 Model.
[3] Average, January 2022 – September 2022 (RMT 14 returned online after multi-year outage)

5.1 South Field Contour Validation

RMT 1 measured an annual CNEL equal to the modeled CNEL, after adjustment applied, at that location. Therefore, the lobe extending to the east southeast (predominant south runway arrival lobe) is accurate compared to the measured value.

Since no RMTs exist within the 65 dB CNEL contour on the opposite side of the airport (the predominant departure end of the south runway), the 60 dB contour was used to compare to measured levels at RMT 5, 6 and 7 to validate the shape and size of the predominant departure lobe. As shown in Table 3, the measured noise levels were all within 1 dB of the modeled values. Therefore, the size and shape of the 65 dB CNEL is validated for South Field.

5.2 North Field Contour Validation

Due to the relatively small noise impact boundary associated with North Field operations, RMT locations 4 and 9 were used to validate the 65 dB contour for North Field. RMT 4 is to the west of North Field and had a measured annual noise level of 56 dB, 2.7 dB less than modeled. RMT 9 is to the east of North Field and had measured annual noise level of 58 dB, 1.2 dB less than the modeled levels. OAK elects to adopt the contour as presented despite the larger values to the North Field since the results produce zero persons within the contour. Therefore, the size and shape of the 65 dB CNEL is acceptable to report for North Field.

5.3 Single-Event Aircraft Noise Levels

ANOMS™ enables the airport to monitor the highest measured single-event noise levels for aircraft operations at all permanent noise monitors. As shown in Table 4, the highest measured A-weighted single-event aircraft noise level, i.e., SEL, during the calendar quarter from July 1, 2022 through September 30, 2022 from OAK was 97.9 dB SEL produced by a Cessna Citation II at RMT number 5.

Table 4. Highest Takeoff Noise Levels by Aircraft Type

Source: Port of Oakland ANOMS™ July 1, 2022 through September 30, 2022

Aircraft Type	Total Operations[1]	Highest Measured SEL (dB)	Correlated RMT No.
C650	6	97.9	5
GLF4	187	96.6	5
LJ35	64	96.5	5
Note: [1]Information is based on Third Quarter 2022 ANOMS data.			