I ✈ OAK

## The Oakland Airport-Community Noise Management Forum

# Virtual Aircraft Noise 101 Workshop

Wednesday, May 31, 2023, 6:30 – 8:00 PM

PORT OF OAKLAND

# Topics

- OAK Noise History Timeline
- OAK Noise Abatement
- Aircraft Noise Regulations
- Aircraft Noise Terminology
- Aircraft Noise Sources & Propagation
- Measurements vs. Modeling

# OAK Noise Program History Timeline

## 1970

- Noise Abatement Task Force established
- Engine Run Up Policy established
- North Field Use Restrictions

## 1980

- North Field VFR departure
- South Field Cargo Procedures
- North Field Use Restrictions Update

## 1990

- Alameda, San Leandro, San Lorenzo noise monitoring terminals installed
- North Field Noise Abatement Runway Signs
- North Field Flight Research/Pattern Research Group
- Oakland Airport-Community Noise Management Forum

## 2000

- Alameda Sound Insulation Program
- North Field SALAD departure
- Ground Run-Up Enclosure – Hush House
- Runway 12 Quiet Departure
- Airport Noise Management website
- Additional remote noise monitor terminals installed

## 2010

- ANOMS
- The OAK Noise Office website updated
- Operations and Complaint Power bi Dashboards introduced

## 2020

- Viewpoint App
- The OAK Noise Office website refreshed
- EMU terminals and ANOMS upgrade

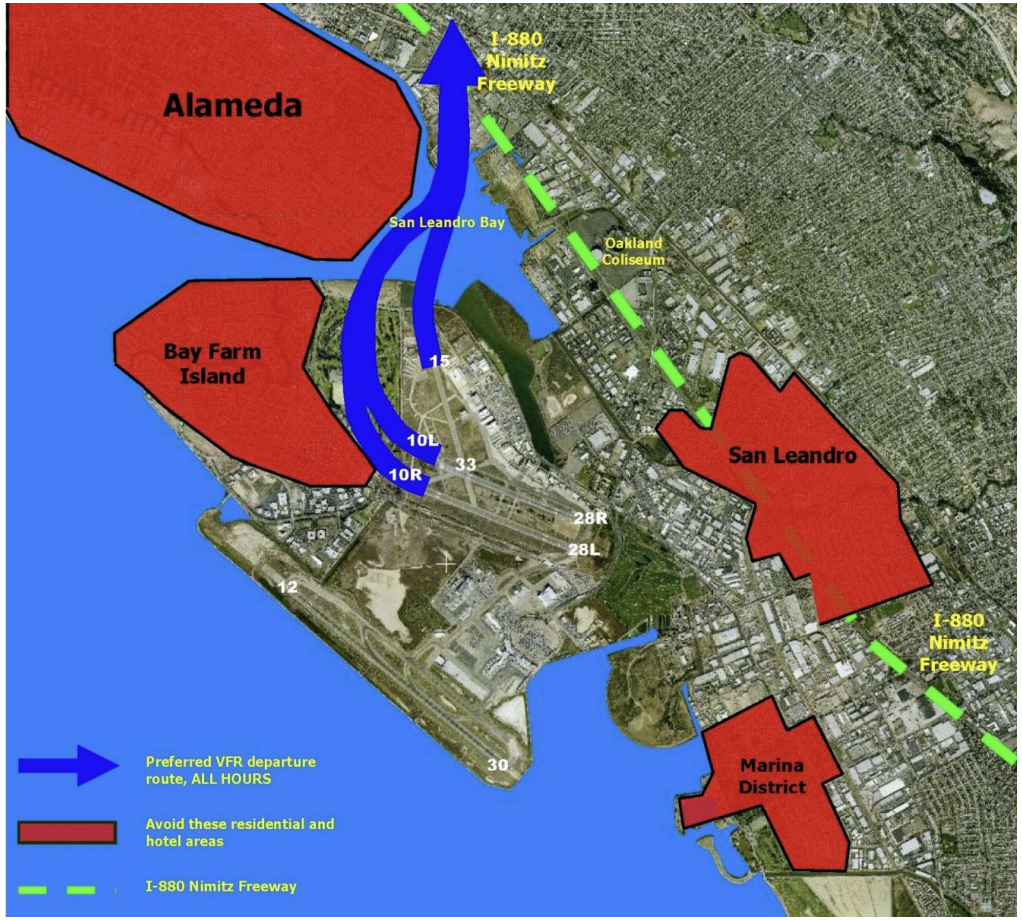
# OAK Noise Abatement Program

- Designed to minimize aircraft noise in the surrounding communities
- Developed through meetings with:
  - Local communities
  - FAA representative
  - Aircraft operators, e.g., airlines and pilots
- Pilot education is the cornerstone
- Monitoring system separates fact from fiction
- The Port operates the airport with the full integration of noise abatement

# OAK Flight Track/Noise Monitoring

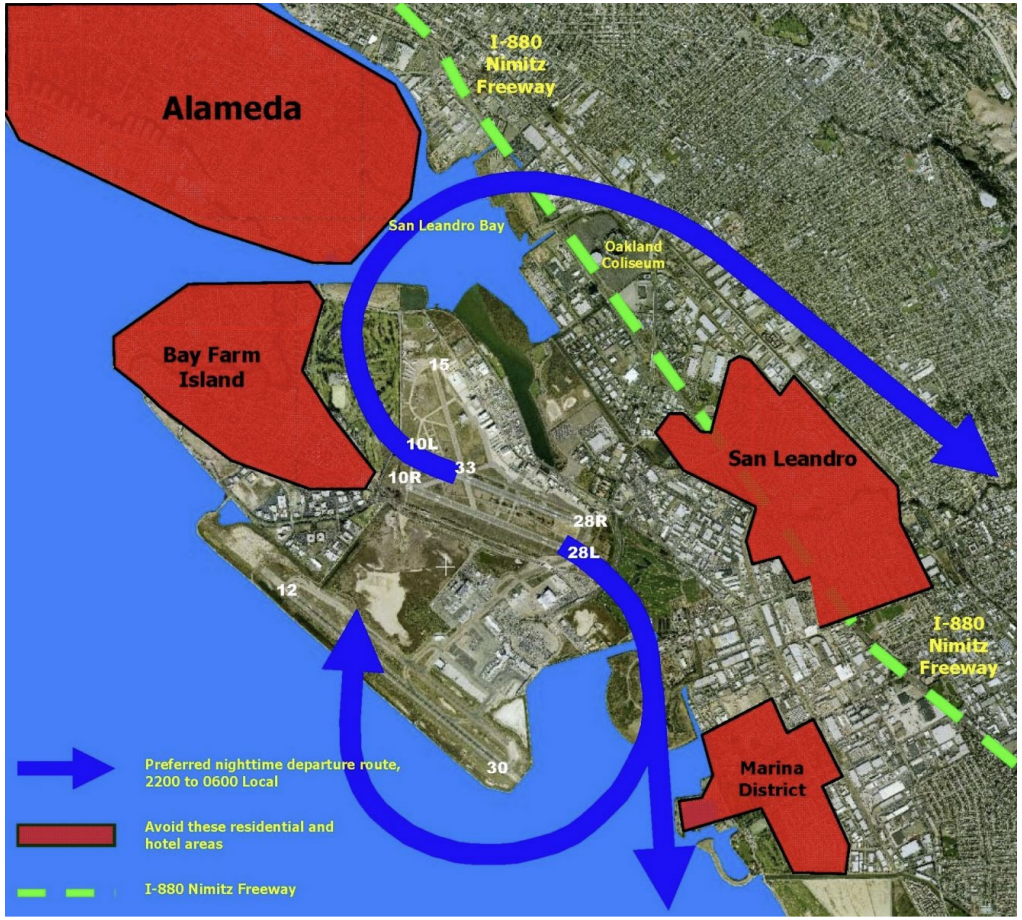
- The airport operates an Aircraft Noise and Operations Monitoring System (ANOMS) to monitor compliance with voluntary noise abatement procedures and to respond to community and stakeholder concerns or request for information
- The airport maintains 14 permanent noise monitors located throughout local communities and an additional one located within the airport Ground Runup Enclosure (GRE)

# North Field Preferred VFR Departure Noise Abatement – Runway 28L/R & 33



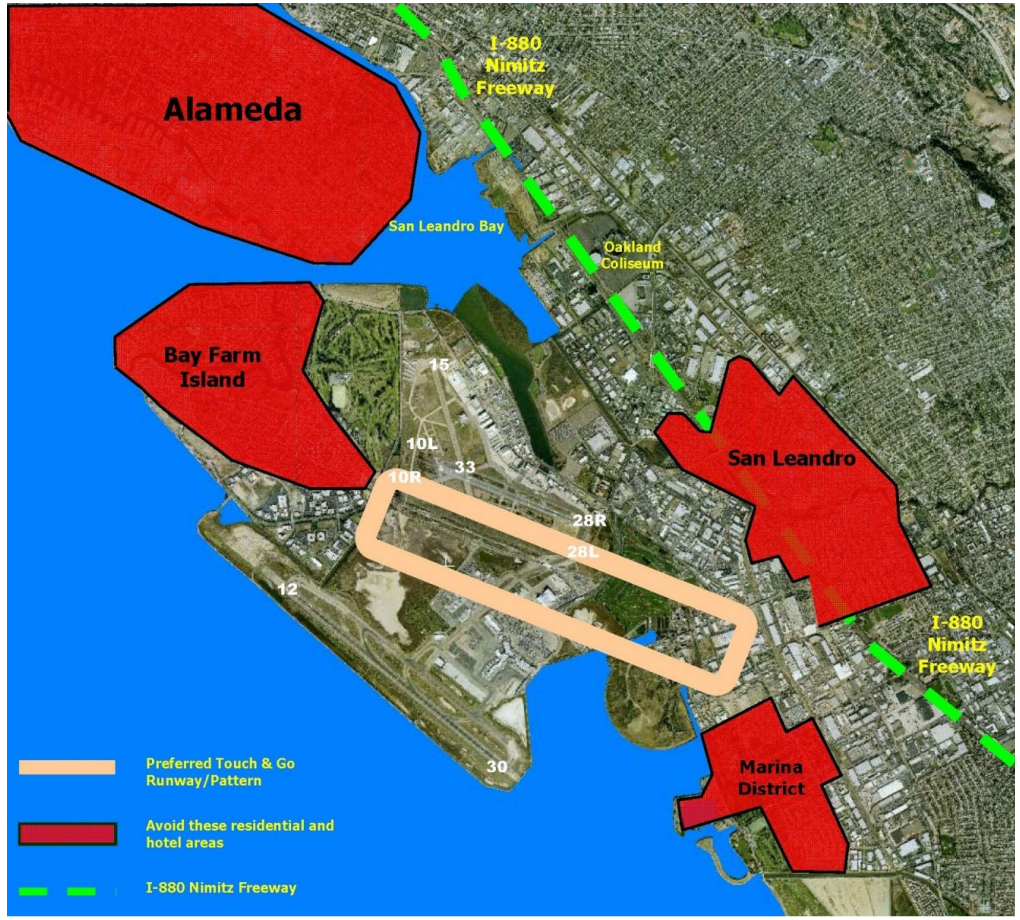

- Runway 28L/R
  - VFR departures should include a right crosswind or additional downwind segment avoiding Bay Farm Island and the main island of Alameda. (propeller/turboprop)
- Runway 33
  - Make right northerly turn over San Leandro Bay until reaching I-880
  - No straight-out or left crosswind/downwind departures

# North Field Night Departure Noise Abatement Runway 28L/R &10L/R




- Runway 10R
  - VFR and IFR departures use 180-degree departure heading for E/SE departures or for N/NE departures
  - No left turn departures
- Runway 28R
  - SALAD ONE departure (propeller/turboprop); do not use the OAK 313 or 310 heading departure
  - Right crosswind over San Leandro Bay until reaching I-880 (propeller/turboprop)
  - No straight-out departures

# North Field Touch & Go Noise Abatement Runway: RWY 10R/28L




- Standard traffic pattern altitude at approximately 600’ above ground level (AGL).

# Ground Run-Up Enclosure (GRE)

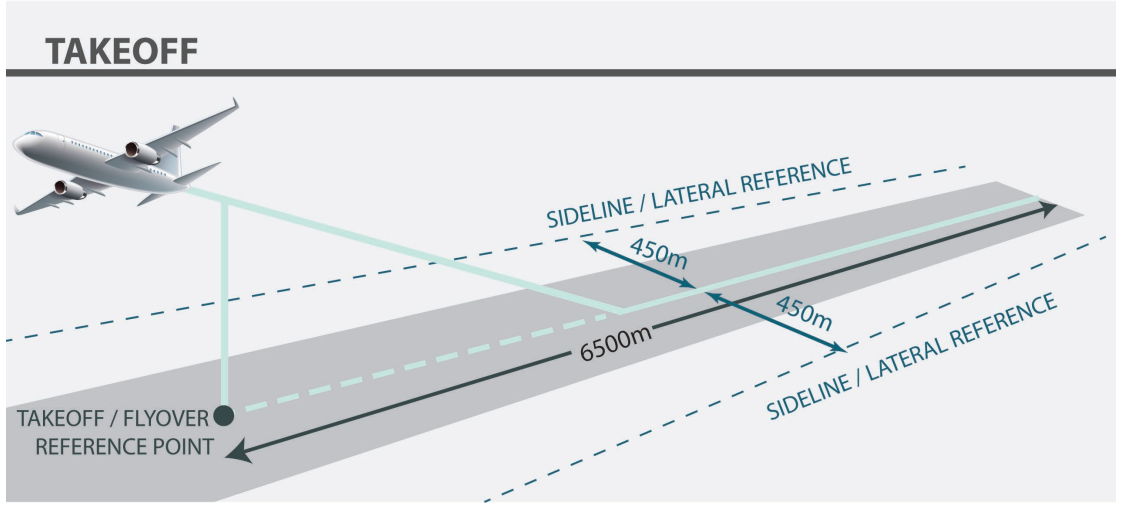
- Opened in 2002 – First in California
- Began operation July 2002. Three-sided structure in center of airfield 325-by-264 feet. Large enough for a Boeing 747
- Reduces noise from engine maintenance by 17 decibels
- Made of sloping zin-coated steel “noiseblotter” panels
- The enclosure allows for engine testing and maintenance which sometimes require full power.

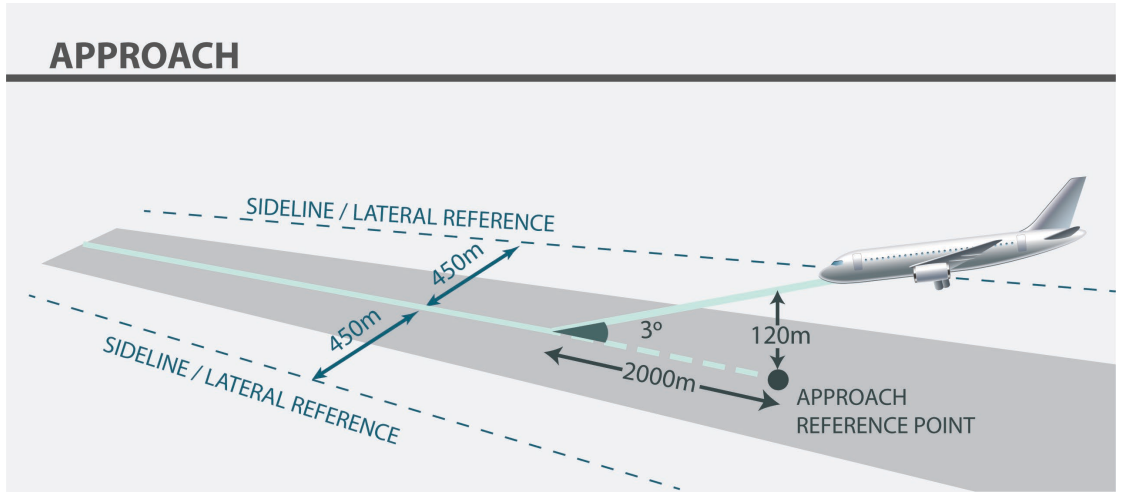
# Noise Regulation - Federal

| Statute | Aircraft Noise Related Purpose | Most Relevant FAA Regulation(s) |
|---|---|---|
| Aircraft Noise and Sonic Boom Act of 1968 | Authorizes FAA to prescribe standards for measurement of aircraft noise and establish regulations to abate noise | 14 CFR parts 36 and 91 |
| National Environmental Policy Act of 1969 (NEPA) | Directs all federal executive agencies to assess all environmental effects of proposed federal agency actions | FAA Orders 1050.1F, 5050.4B |
| The Noise Control Act of 1972 (Noise Act) | Amends 1968 act to add consideration of public health and welfare and to add EPA to the rulemaking process for aircraft noise and sonic boom standards | None directly; EPA responsibility |
| Aviation Safety and Noise Abatement Act of 1979 (ASNA) | Directs FAA to establish single system to measure noise and determine exposure of people to noise, and identify land uses normally compatible with various noise levels | 14 CFR part 150 |
| Airport and Airway Improvement Act of 1982 | Authorizes FAA funding for noise mitigation/compatibility planning and projects and establishes noise compatibility requirements for FAA-funded airport development | FAA Airport Improvement Program |
| Airport Noise and Capacity Act of 1990 (ANCA) | Mandates phase out of Stage 2 jet aircraft over 75,000 pounds, and established requirements regarding airport noise and access restrictions for Stage 2 and 3 aircraft | 14 CFR part 161 |
| Section 506 of the FAA Modernization and Reform Act of 2012 | Prohibition after 12/31/2015 of operation of civil subsonic jet airplanes with maximum weights of 75,000 pounds or less that do not meet stage 3 noise standards | 14 CFR part 91 |
| FAA Reauthorization, 2018 | Reauthorizes FAA through 2023 | None yet |

# Aircraft Noise Standards (14 CFR Part 36)

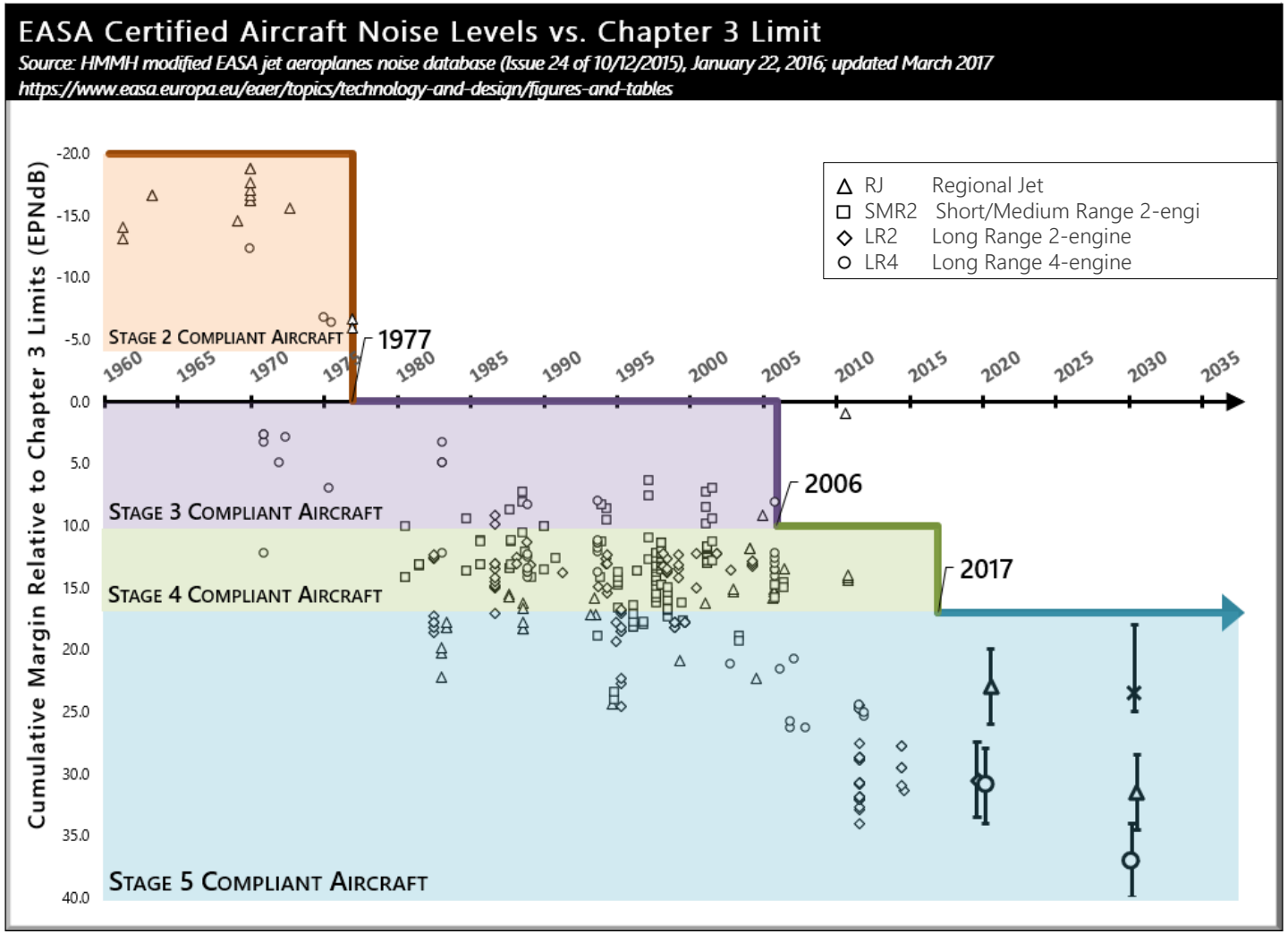
- Noise standards vary by design criteria and for most aircraft are in terms of “stages”
- Aircraft must meet Part 36 standards to obtain new or revised "type" or “airworthiness” certificates to operate in the U.S.
- The standards address noise limitations depending on aircraft type and weight
- Certification for most – *but not all* – aircraft is based on three measurements:
  Landing, Sideline, and Takeoff

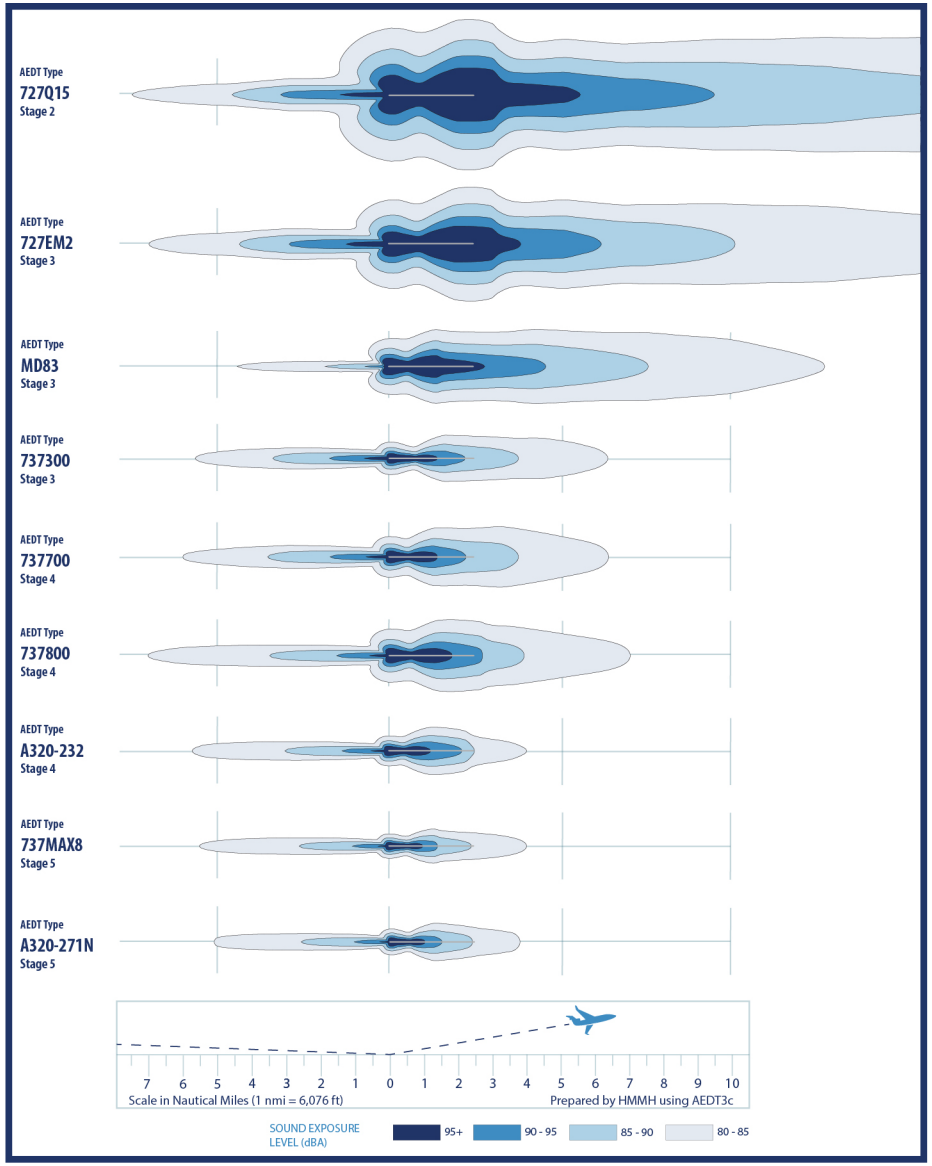



Measurement locations can vary with aircraft stage, number of engines, and lift mechanism. Some types are certificated based on level flyover.

# Evolution of Aircraft Noise Stages in U.S.



# Noise Thresholds for Aviation Environmental Analyses

- Significant Impact
  - 1.5 dB increase within 65 DNL
- Less than significant impact
  - 3 dB increase between 60 and 65 DNL
  - 5 dB increase between 45 and 60 DNL triggers additional analyses for air traffic actions

Table 5-5 – Color Coding Based on Change in DNL

| Baseline DNL | Change in Noise Level from Baseline to Alternative | |
|---|---|---|
| | Increase | Decrease |
| < 45 dB | No color | No color |
| 45-<50 dB | + 5 dB (yellow) | - 5 dB (purple) |
| 50-<55 dB | | |
| 55-<60 dB | | |
| 60-<65 dB | + 3 dB (orange) | - 3 dB (blue) |
| > 65 dB | + 1.5 dB (red) | - 1.5 dB (green) |

## Historical Background

Federal Interagency Committee on Noise ("FICON"), 1992

- 1.5 dB increase in DNL within 65 dB DNL
- 3 dB increase in DNL between 60 and 65 dB DNL

Expanded East Coast Plan ("EECP") EIS, 1992-3

FAA Order 7400.2M (Policies and Procedures for Air Traffic Environmental Actions)

Order 1050.1F "Desk Reference" provides detailed guidance

# Airport Noise Compatibility Planning (14 CFR Part 150)

The Aviation Safety and Noise Abatement Act of 1979 ("ASNA") required FAA to:

- Establish a single, uniform, repeatable system for considering aviation noise around airport communities.
- Establish a single system for determining noise exposure from aircraft, which takes into account noise intensity, duration of exposure, frequency of operations, and time of occurrence.
- Identify land uses which are normally compatible with various exposures of individuals to noise

14 CFR Part 150 prescribes standards and systems for:

- measuring noise
- estimating cumulative noise exposure using computer modeling
- describing noise exposure
- coordinating with local land use agencies
- documenting the analytical process
- submitting the documentation to FAA
- FAA and public review processes
- FAA approval or disapproval process

# Airport Noise and Capacity Act of 1990, ANCA

| Act requirement | FAA Action |
| --- | --- |
| Required FAA to establish phase-out of Stage 2 aircraft over 75,000 pounds | FAA promulgated Part 91 amendment (1991) |
| Required FAA to establish regulations regarding analysis, notice, and approval of airport noise and access restrictions | FAA implemented through FAR Part 161 (1991) |
| Required FAA to develop “national aviation noise policy” by July 1, 1991 | FAA published draft “Aviation Noise Abatement Policy 2000” on July 14, 2000 to replace the 1976 Federal Noise Abatement Policy |

# Notice and Approval of Airport Noise and Access Restrictions 14 CFR Part 161

Establishes the federal program for reviewing noise and access restrictions on the use of Stage 2 and 3 aircraft (and perhaps beyond)

- Requires extensive benefit cost analyses
- Requires extensive notice process
- Requires different level of analysis for Stage 2 and 3
- Requires separate analysis of effects on aircraft less than 75,000 pounds
- Encourages voluntary agreements
- Measure of last resort for land use compatibility

# Title 21 Reporting Requirements

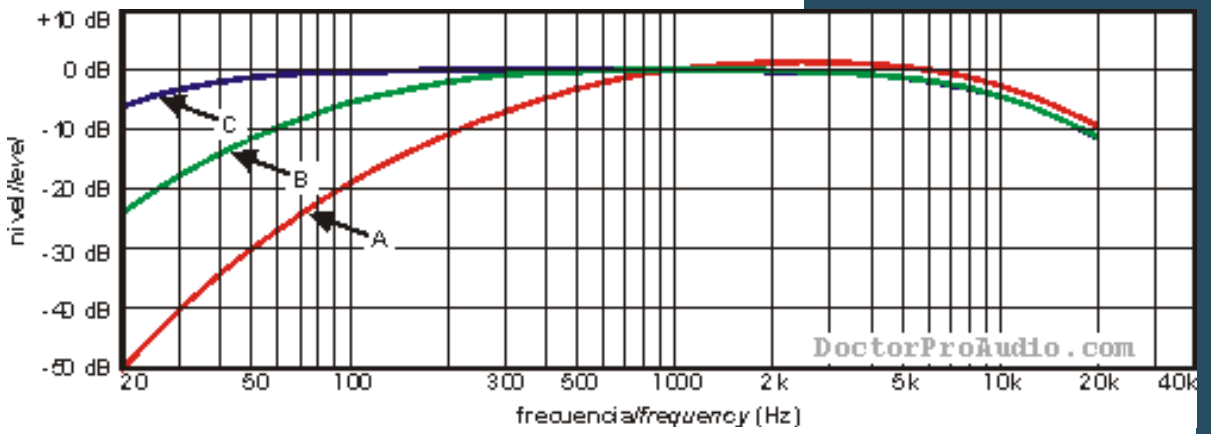
- County (not the airport proprietor) submits quarterly to Caltrans for each noise problem airport within 75 days of the end of each quarter
  - A map showing the noise impact boundary for the preceding “four calendar quarters” “as validated by measurement” and the location of the measurement locations
  - The annual noise impact area and number of dwelling units and people residing within
  - Daily CNEL measurement for the calendar quarter
  - Number of total aircraft operations for the calendar quarter
  - Number of aircraft operations for the highest noise level aircraft in the calendar quarter
  - Form DOA 671, dated 10/89

# Measurement of CNEL

- To calculate daily CNEL from measurement of aircraft operations, Title 21 requires:
  - Threshold noise level of 55 dB to capture single noise events
    - Waiver is required for Caltrans to allow the level greater than 55 dB
  - Single Event Noise Exposure Level (SENEL) be used as the total noise energy of aircraft operation as it is the noise exposure, in decibels, of a single event measured over the time interval the noise level exceeds a predetermined threshold noise level
  - Hourly Noise Levels (HNL) be calculated from noise events associated with aircraft operations, retained for at least three years and made available upon request

# Noise is Unwanted Sound

- Sound results from small and rapid changes in air pressure our ears detect
- We characterize and judge sounds by:
  - Magnitude (loudness) in decibels (dB)
  - Frequency (pitch) in hertz
- The EPA has adopted the A-weighted sound level for environmental analyses
  - All sound levels presented in aircraft noise studies are A-weighted unless otherwise specified

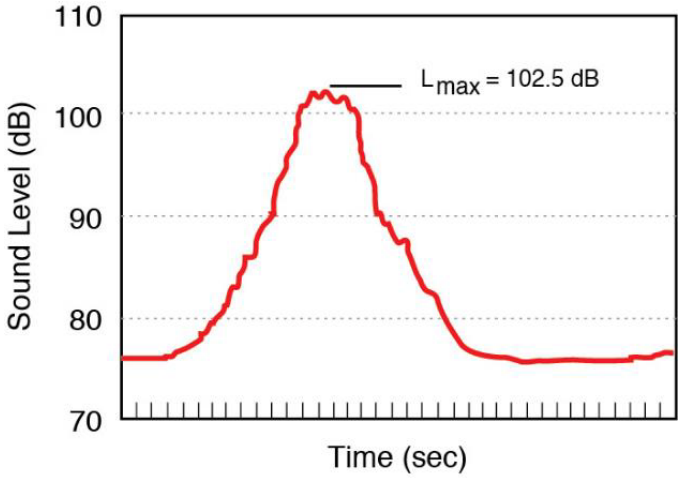


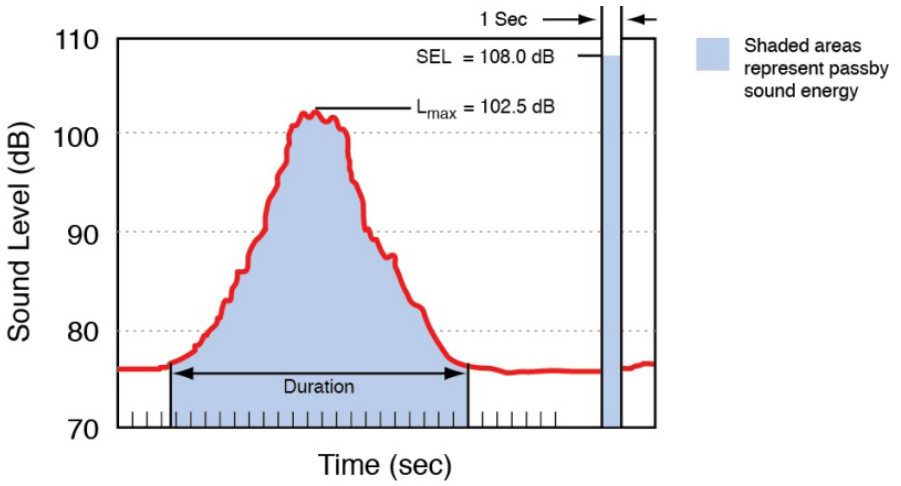

Studies have resulted in loudness curves:

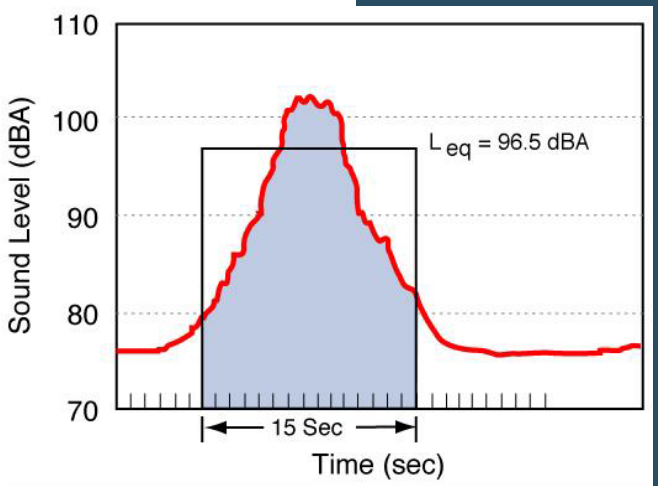
- A-weighted noise levels correlate to loudness of sounds in our everyday environment (relatively low energy)
- B-weighted noise levels correlate to medium energy sounds
- C-weighted noise levels correlate to high energy sounds

# Noise Terminology

- Maximum A-weighted Sound Level (Lmax)
- Sound Exposure Level (SEL)
- Equivalent Sound Level (Leq)

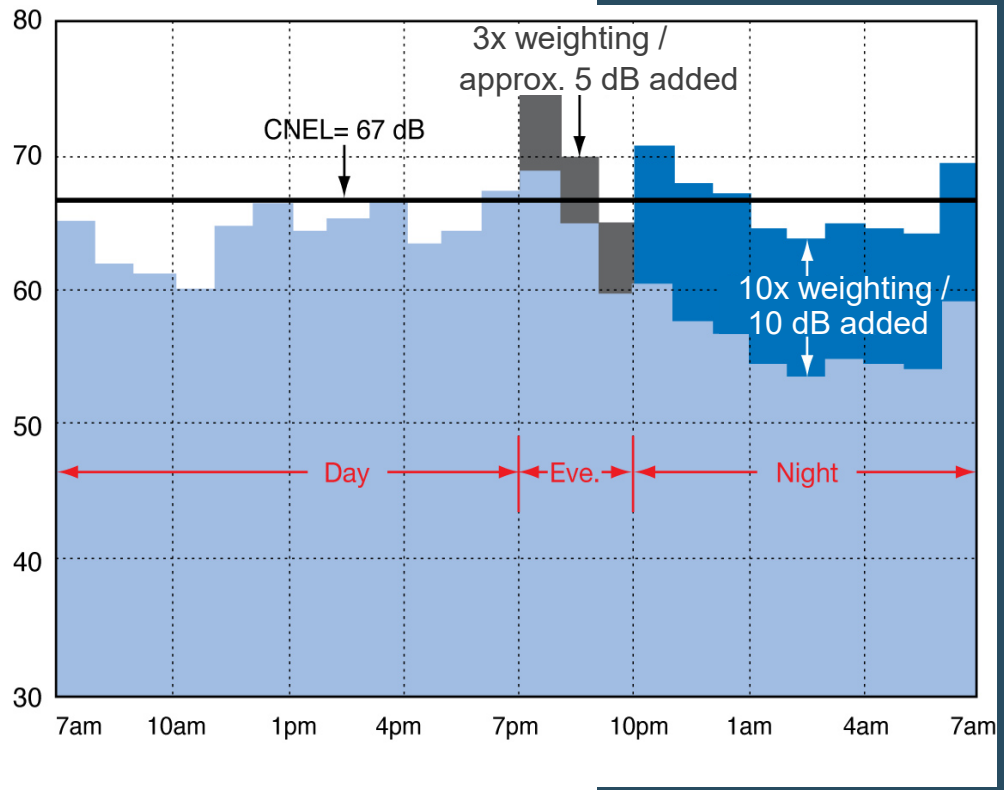


# Noise Terminology

- Community Noise Equivalent Level (CNEL)
  - Describes the noise dose for a 24-hour period
  - Accounts for event “noisiness” (SEL)
  - Accounts for number of noise events
  - Provides an additional weighting for evening and nighttime operations
    - Daytime is defined as 7:00 am to 7:00 pm
    - Evening is defined as 7:00 pm to 10:00pm
    - Nighttime is defined as 10:00pm to 7:00am



# Aircraft Noise Sources

## Departure Noise

## Arrival Noise

## Ground Noise

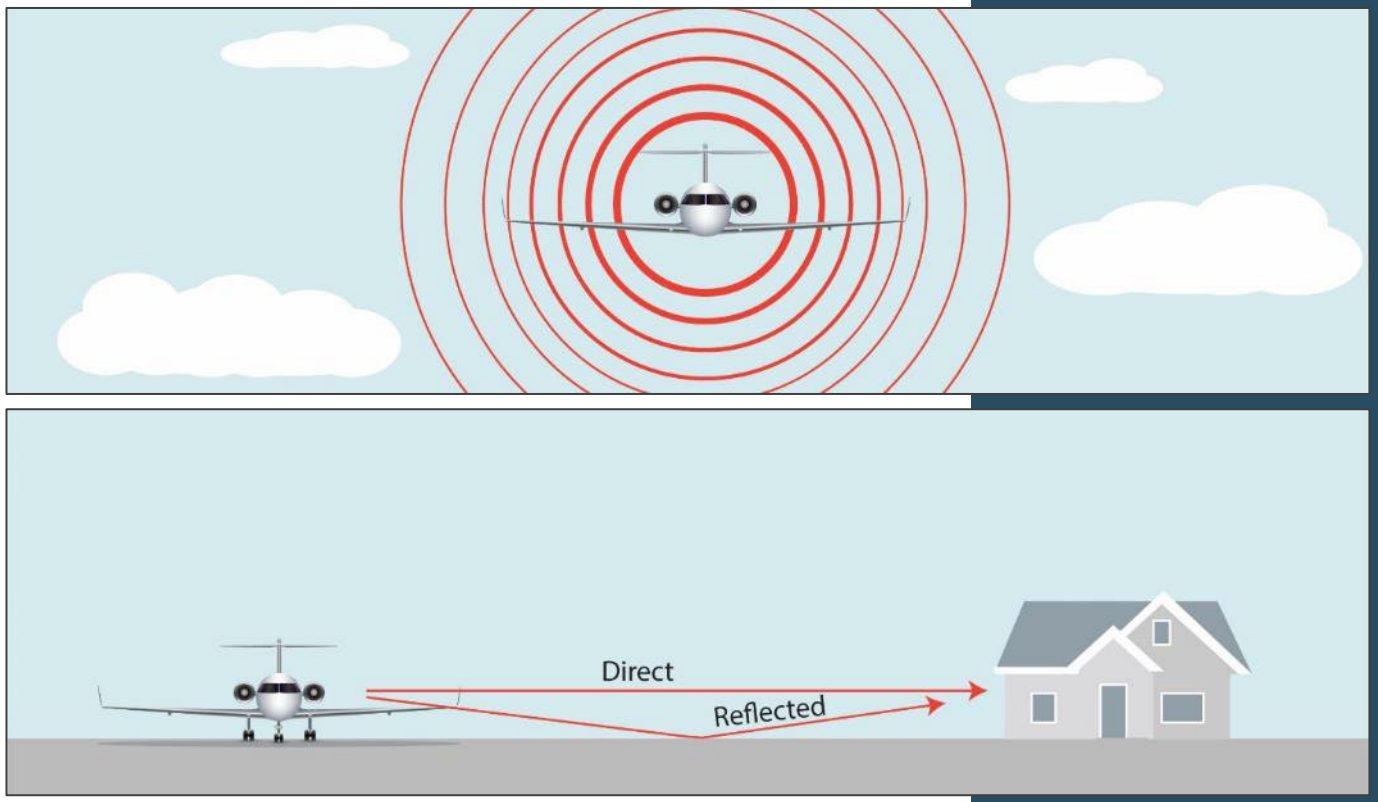
# Sound Propagation

## Spherical Spreading:

- Sound level decreases by 6 dB per doubling of distance
- Additional losses due to atmospheric absorption

## Ground Effect:

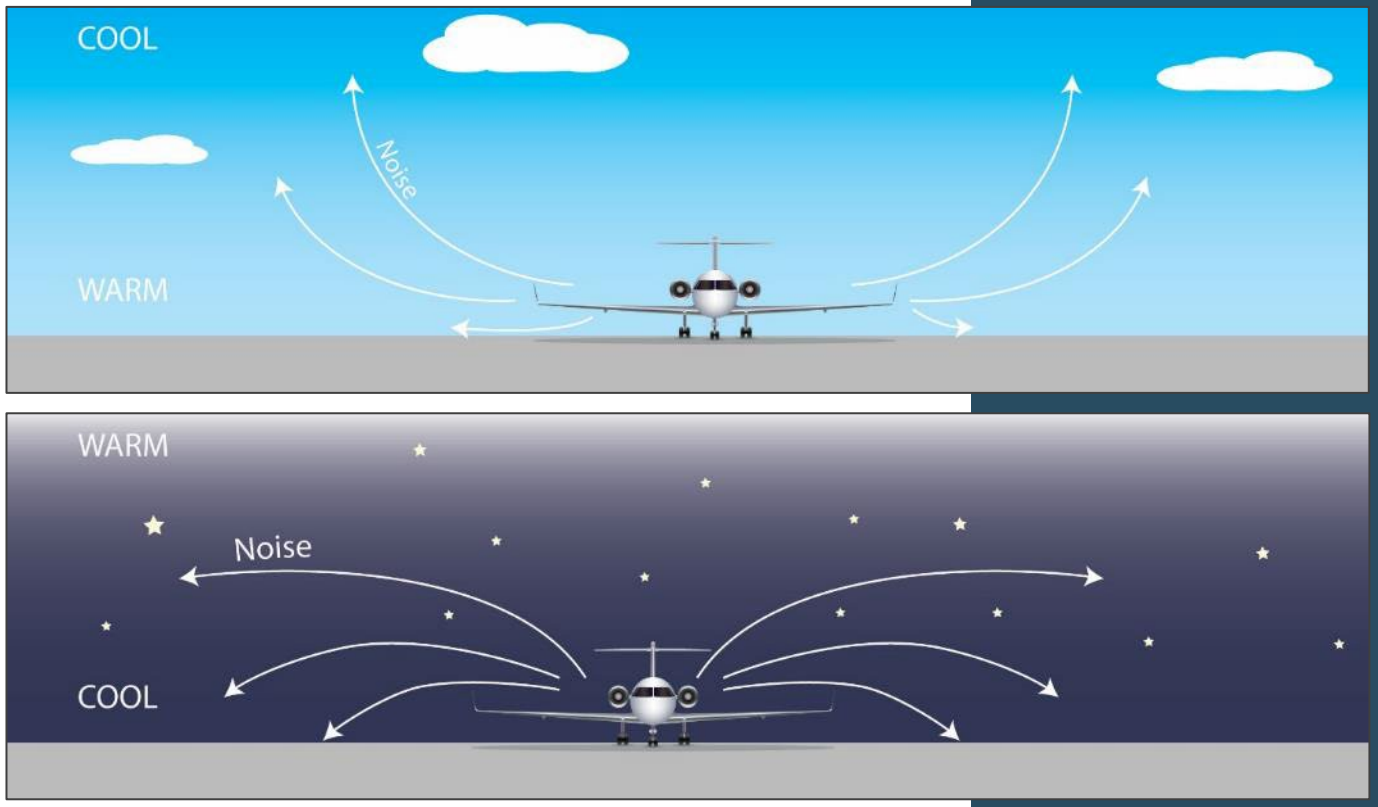
- Sound levels are lower when reflected off soft ground vs. hard ground



# Sound Propagation

**Refraction due to Temperature:**

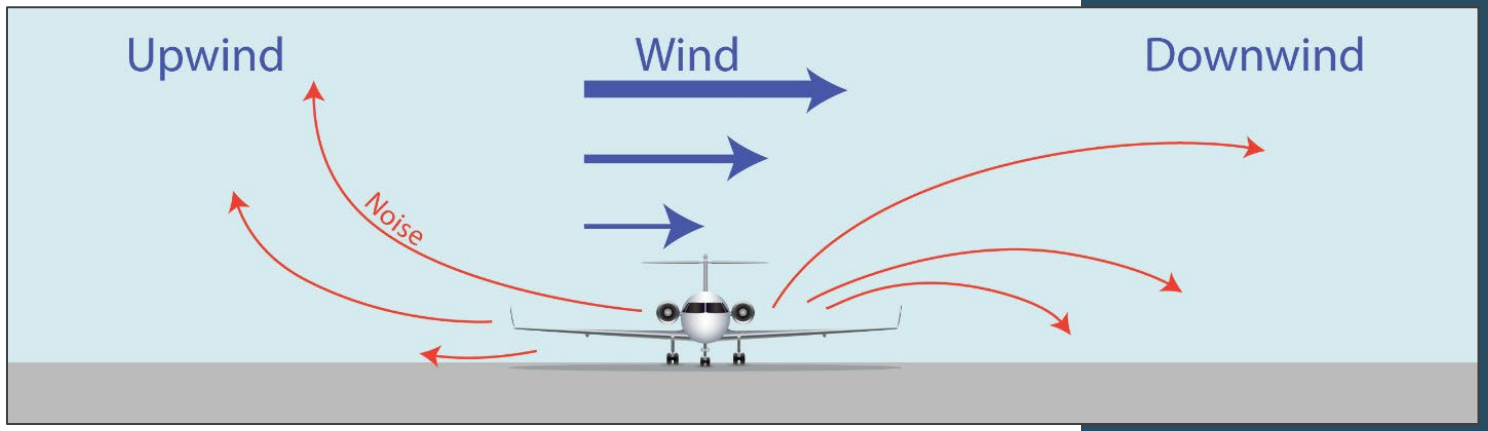
- Gradients in temperature cause the bending of sound paths
- Sound bends upward during a temperature lapse (cool air over warm)
- Sound bends downward during a temperature inversion (warm air over cool)



# Sound Propagation

**Refraction due to Wind:**

- Gradients in wind speed cause the bending of sound paths
- Sound bends upward causing sound shadows in the upwind direction
- Sound bends downward increasing sound levels in the downwind direction
- Differences between upwind and downwind directions can be 20 dB

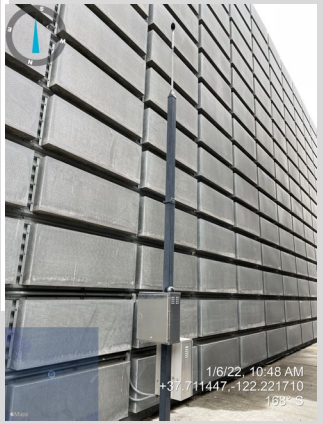


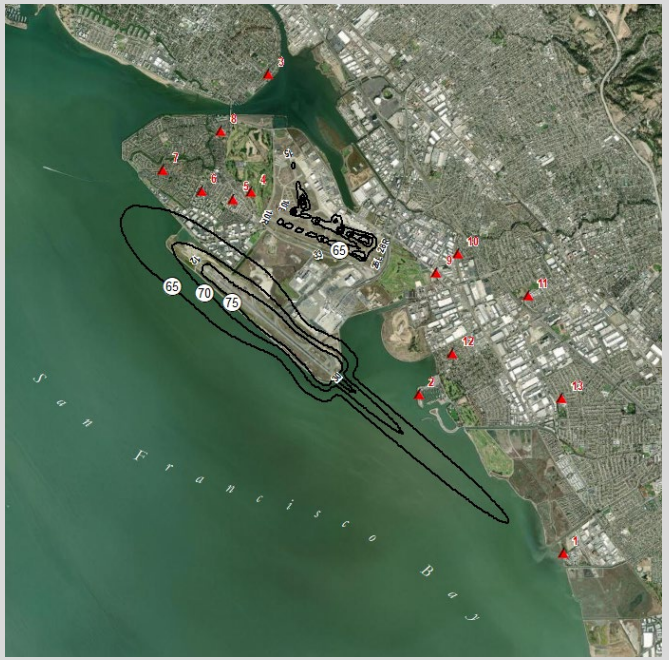
# Measure vs. Model

## Measurements

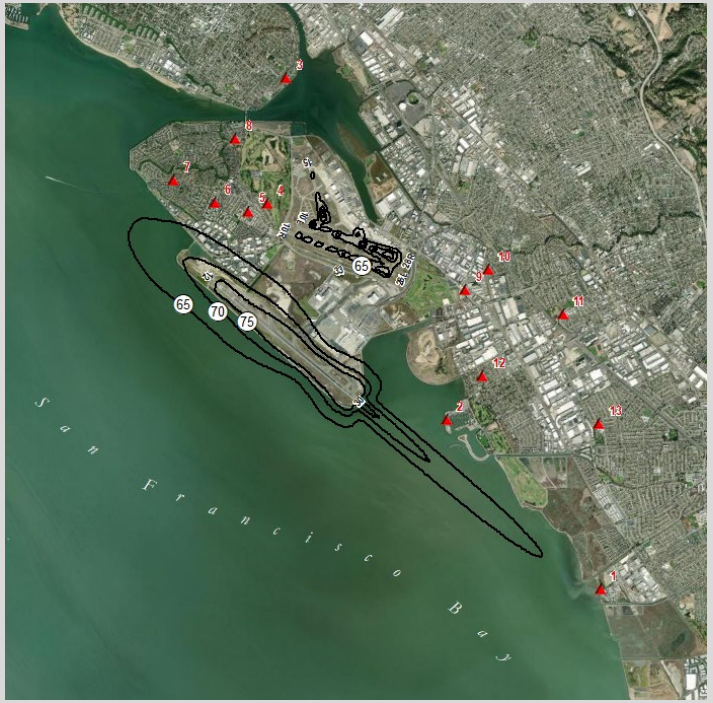
- Provide historical noise levels at discrete points
- Difficult to attribute noise entirely to aircraft operations
- Reports noise levels from individual aircraft operations





# Measure vs. Model




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| + 59.8 | + 60.6 | + 58.9 | + 56.7 | + 55.2 | + 54.1 | + 52.9 | + 51.8 |
| + 61.4 | + 62.4 | + 61.5 | + 59.4 | + 57.6 | + 56.1 | + 54.3 | + 52.6 |
| + 63.4 | + 64.2 | + 64.5 | + 63.1 | + 61.5 | + 59.8 | + 57.3 | + 54.7 |
| + 61.9 | + 64.2 | + 66.7 | + 67.5 | + 66.9 | + 65.9 | + 62.6 | + 59 |
| + 58.6 | + 60.7 | + 63.1 | + 65.8 | + 68.9 | + 92.3 | + 72.9 | + 67.3 |
| + 55.4 | + 57.1 | + 58.9 | + 61 | + 63.4 | + 66 | + 69 | + 74.6 |

*Modeling*

- *Provides past or future noise levels throughout the study area*
- *Produces results from only aircraft operations*
- *Generates noise levels from average daily aircraft operations*
- *Calculates consistent, comparable outputs (if consistent inputs)*

I ✈ OAK

# Questions?

PORT OF OAKLAND