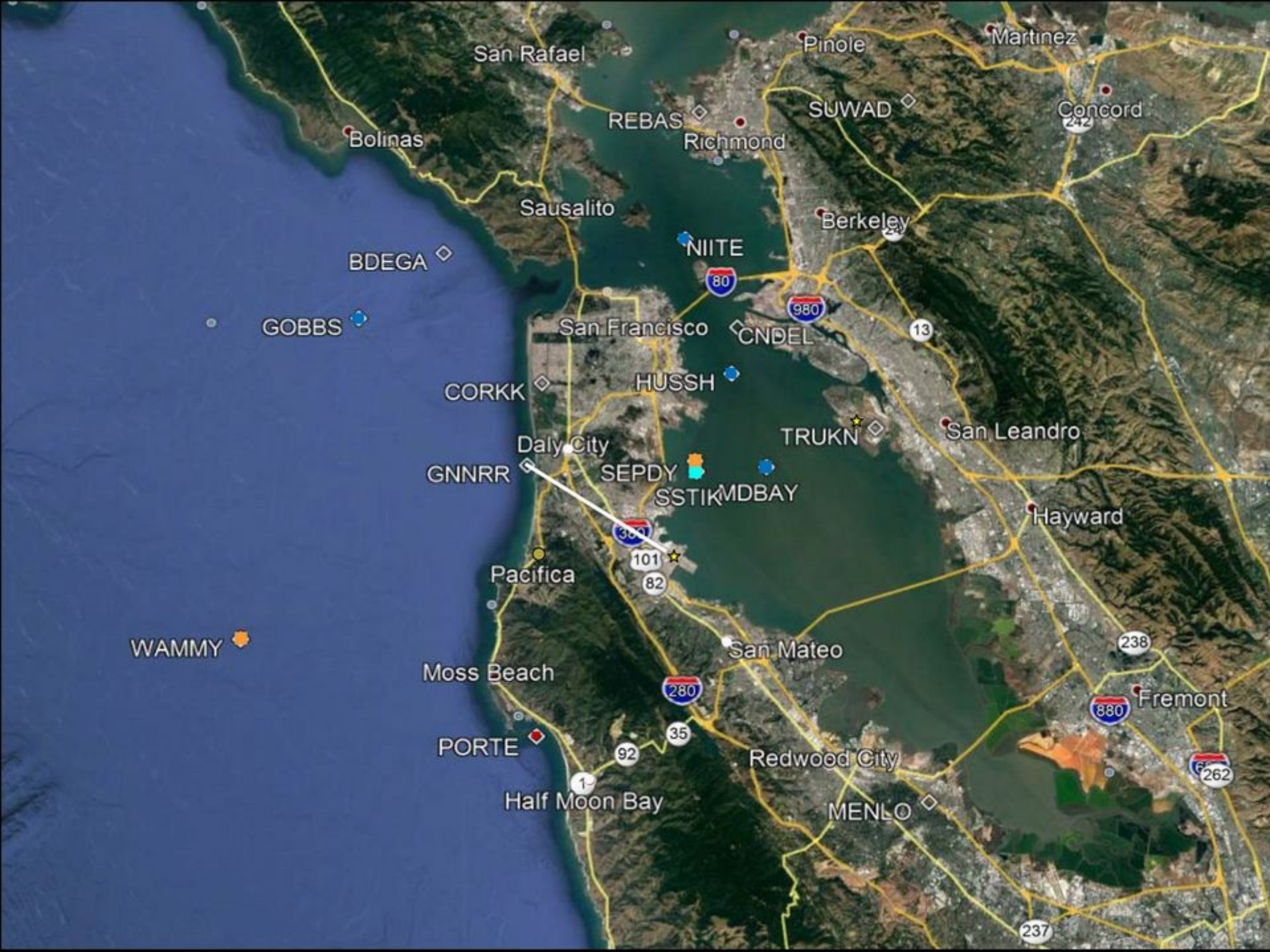
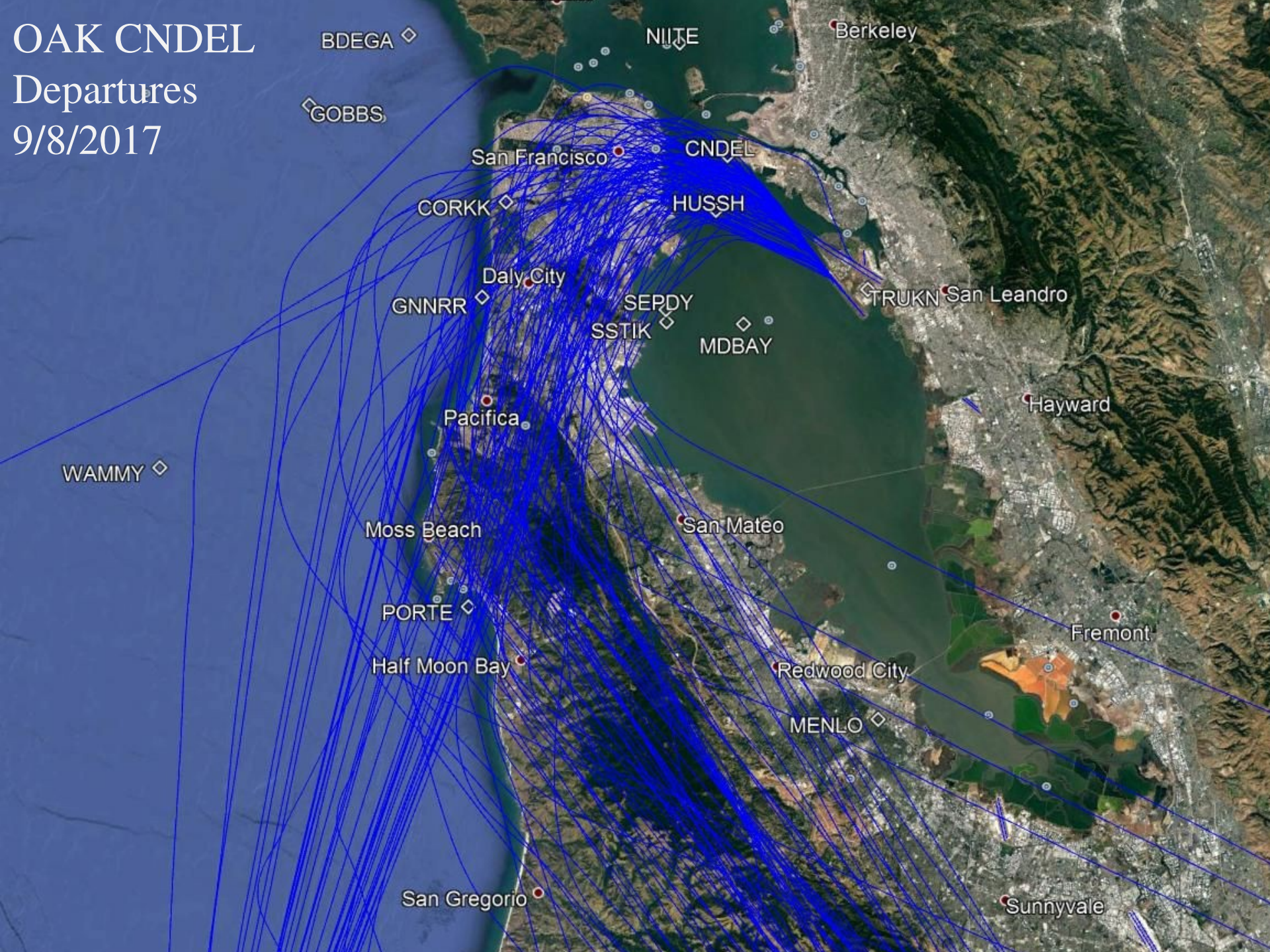
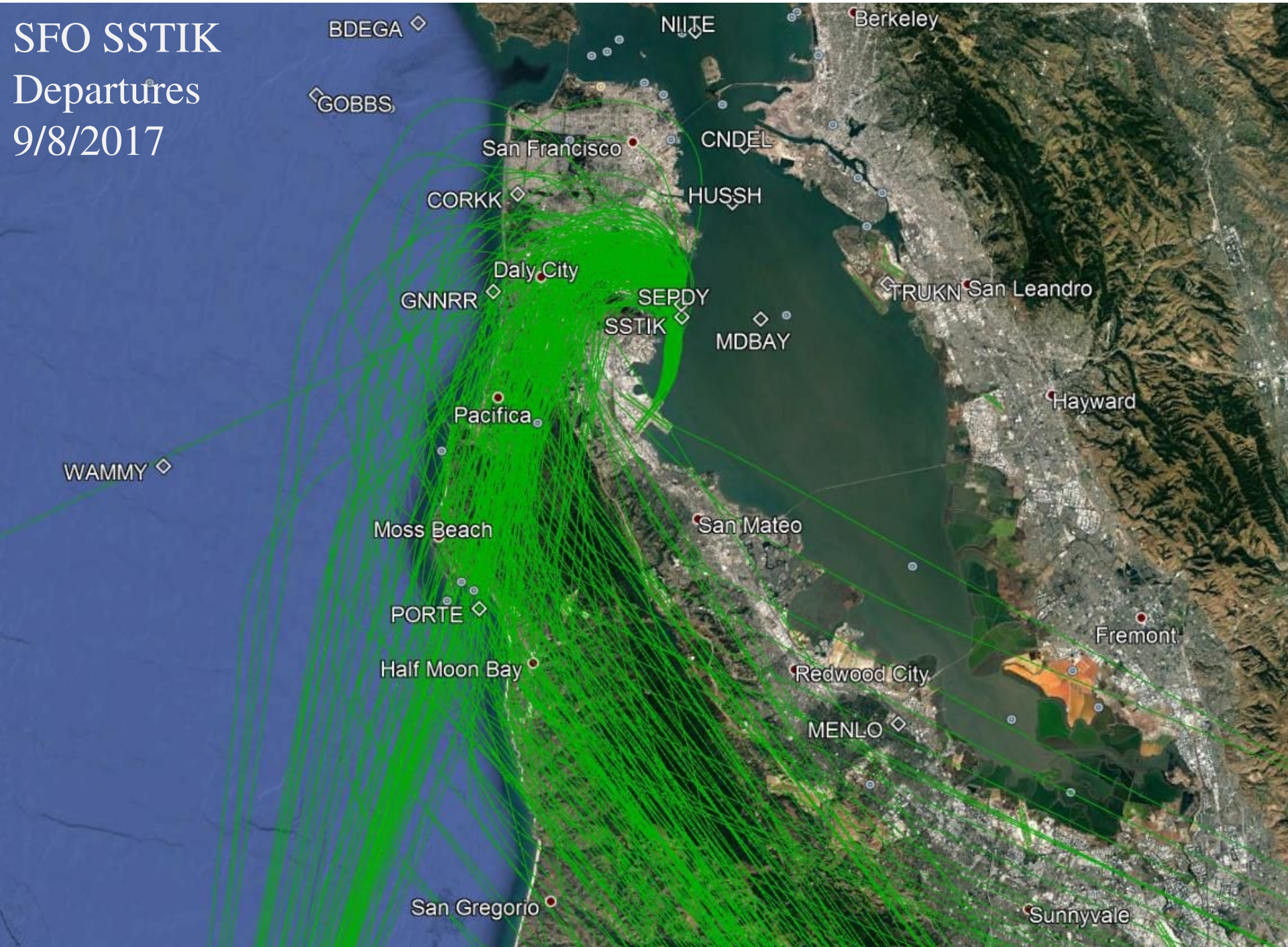
## SFO Community Roundtable

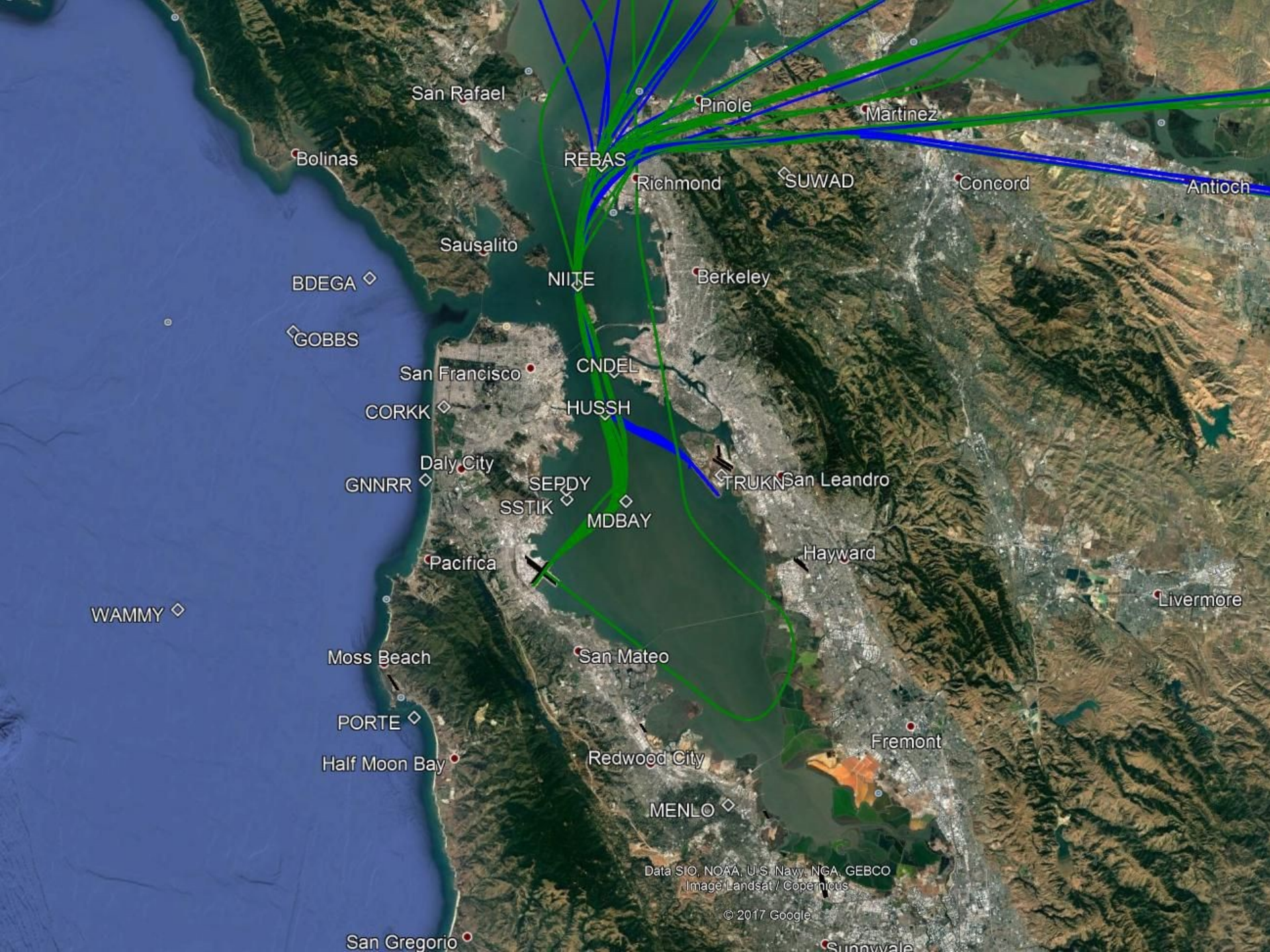
One of the oldest and most respected airport community forums, the Airport Community Roundtable has fostered a productive working relationship with surrounding communities. The Roundtable monitors a performance-based noise mitigation program implemented by airport staff, interprets community concerns and attempts to achieve noise mitigation through a cooperative sharing of authority among the aviation industry, the Federal Aviation Administration (FAA), SFO management and local government.


**County of San Mateo Board of Supervisors**
**Dave Pine**, Supervisor
**sforoundtable.org**


San Rafael
Pinole
Martinez
Bolinas
REBAS
Richmond
SUWAD
Concord
Sausalito
Berkeley
NIITE
BDEGA
GOBBS
San Francisco
CNDEL
CORKK
HUSSH
TRUKN
San Leandro
Daly City
GNNRR
SEPDY
SSTIK
MDBAY
Hayward
Pacifica
WAMMY
San Mateo
Moss Beach
Fremont
PORTE
Redwood City
Half Moon Bay
MENLO
80
980
13
242
280
880
92
35
101
82
238
262
237


OAK CNDEL
Departures
9/8/2017
BDEGA
NIITE
Berkeley
GOBBS
San Francisco
CNDEL
CORKK
HUSSH
Daly City
GNNRR
SEPDY
SSTIK
TRUKN
San Leandro
MDBAY
Hayward
Pacifica
WAMMY
Moss Beach
San Mateo
PORTE
Fremont
Half Moon Bay
Redwood City
MENLO
San Gregorio
Sunnyvale


SFO SSTIK
Departures
9/8/2017
BDEGA
NIITE
Berkeley
GOBBS
San Francisco
CNDEL
CORKK
HUSSH
Daly City
GNNRR
SEPDY
SSTIK
TRUKN
San Leandro
MDBAY
Hayward
Pacifica
WAMMY
Moss Beach
San Mateo
PORTE
Fremont
Half Moon Bay
Redwood City
MENLO
San Gregorio
Sunnyvale


San Rafael
Pinole
Martinez
Bolinas
REBAS
Richmond
SUWAD
Concord
Antioch
Sausalito
BDEGA
NIITE
Berkeley
GOBBS
San Francisco
CNDEL
CORKK
HUSSH
Daly City
GNNRR
SEPDY
TRUKN
San Leandro
SSTIK
MDBAY
Pacifica
Hayward
WAMMY
Livermore
Moss Beach
San Mateo
PORTE
Fremont
Half Moon Bay
Redwood City
MENLO
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
© 2017 Google
San Gregorio
Sunnyvale

SFO San Francisco International Airport

# SFO Aircraft Noise

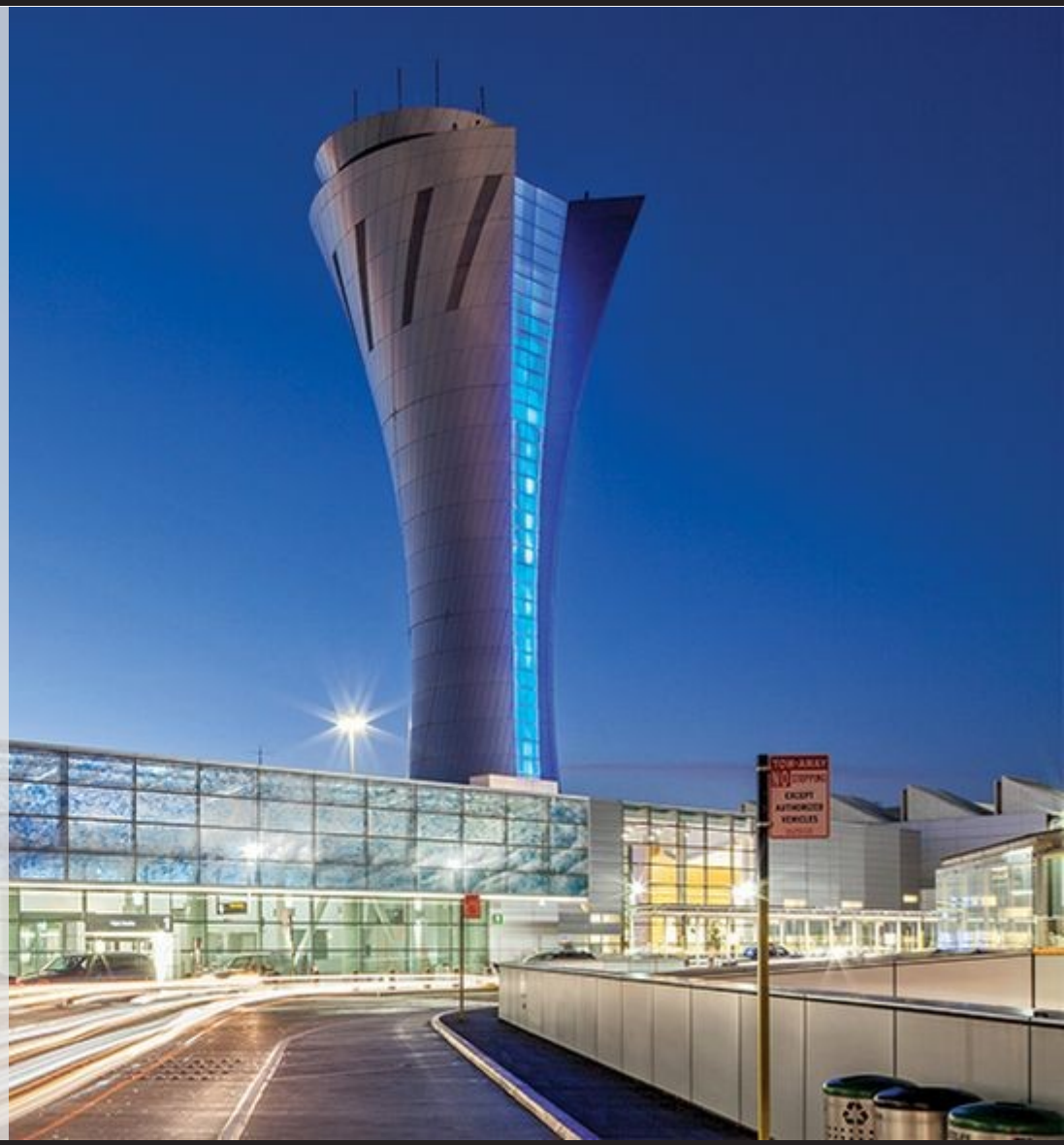
Aircraft Noise Abatement Office

Presented to the Mid Coast Community Council

September 13, 2017

# Table of Contents



SFO San Francisco International Airport


## Aircraft Noise Office Mission

We serve as a link between the public, airline operators, and federal agencies. Our goal is to provide clear and accessible information to our communities. We ensure that San Francisco International Airport meets or exceeds all Federal and State aircraft noise regulations and that flights operate as quietly as possible.

Although San Francisco International Airport economic footprint in the Bay Area is vast, we recognize responsibility as environmental stewards. SFO's mission "to provide exceptional airport in service to our communities" includes addressing aircraft noise impacts.

SFO San Francisco International Airport

## Historical Firsts

- ***Noise Compatibility Program Study.*** In 1983 SFO was the first airport in the country to prepare a Federal Aviation Regulation (FAR) Part 150 Noise Compatibility Study, allowing SFO to receive noise compatibility funding. This translated into the Residential Sound Insulation Program which reduced aircraft noise in more than 15,000 homes, 8 churches and 7 schools.

- ***Early phase out of noisier aircraft in the U.S.*** Prior to any federal regulations, SFO formed its own program to phase out older, noisier aircraft by the year 2000. Subsequently, the Federal Aviation Administration (FAA) adopted a similar nationwide policy to completely phase out older and louder airplanes, known as Stage 2 aircraft.

- ***First to track aircraft with an Aircraft Noise Management System.*** SFO installed its first noise monitoring system in 1975. Since that time the system has been regularly updated to incorporate the latest in technology.

## Accomplishments

- ***Nationally recognized collaborative community process.*** Since the late 1970s, SFO has been a participant and supporter of the Airport Community Roundtable, a public forum for aircraft noise reduction. The Roundtable develops an annual work plan to establish new noise abatement and mitigation programs and monitors existing ones. SFO also provides both financial and staff support to the Roundtable.

- ***Land use compatibility zoning.*** For over 30 years SFO has worked with surrounding communities to help preserve compatible land uses in areas under the flight paths. For example, SFO was successful in working with the local governmental agencies to keep the area along the shoreline north of the Airport an industrial zone.

- ***Community Noise Exposure Level.*** SFO has been very successful in reducing the size of the 65 dB CNEL noise impact boundary. In 1976, over 35,000 people lived within the 65 decibel CNEL contour. Today, through the Residential Sound Insulation Program, residential dwellings located inside high noise areas are now compatible with airport operations.

San Francisco International Airport

## SFO Aircraft Noise Management Structure

| | |
|---|---|
| Quieter Planes | Advocating for future quieter technology to ensure that residents share in the benefits. |
| Quieter Procedures | Developing noise mitigation procedures that benefit communities |
| Working with Communities | Open and transparent communication leading to a constructive dialog and good outcome.<br>Understand community concerns and provide accessible resources |
| Land-use Planning and Mitigation | Reducing environmental impact through compatible land use and planning through Residential Sound Insulation Program |
| Noise Program | Monitor existing flight operations and follow up with the airlines if there are deviations from the program, Fly Quiet Program. |

San Francisco International Airport

SFO Aircraft Noise Abatement Office

- Federal Agencies
- Community
- Airlines
- Elected officials
- Aviation industry

SFO Airport Community Roundtable Meeting

SFO COMMUNITY ROUNDTABLE

SAVE OUR SKIES Santa Cruz County

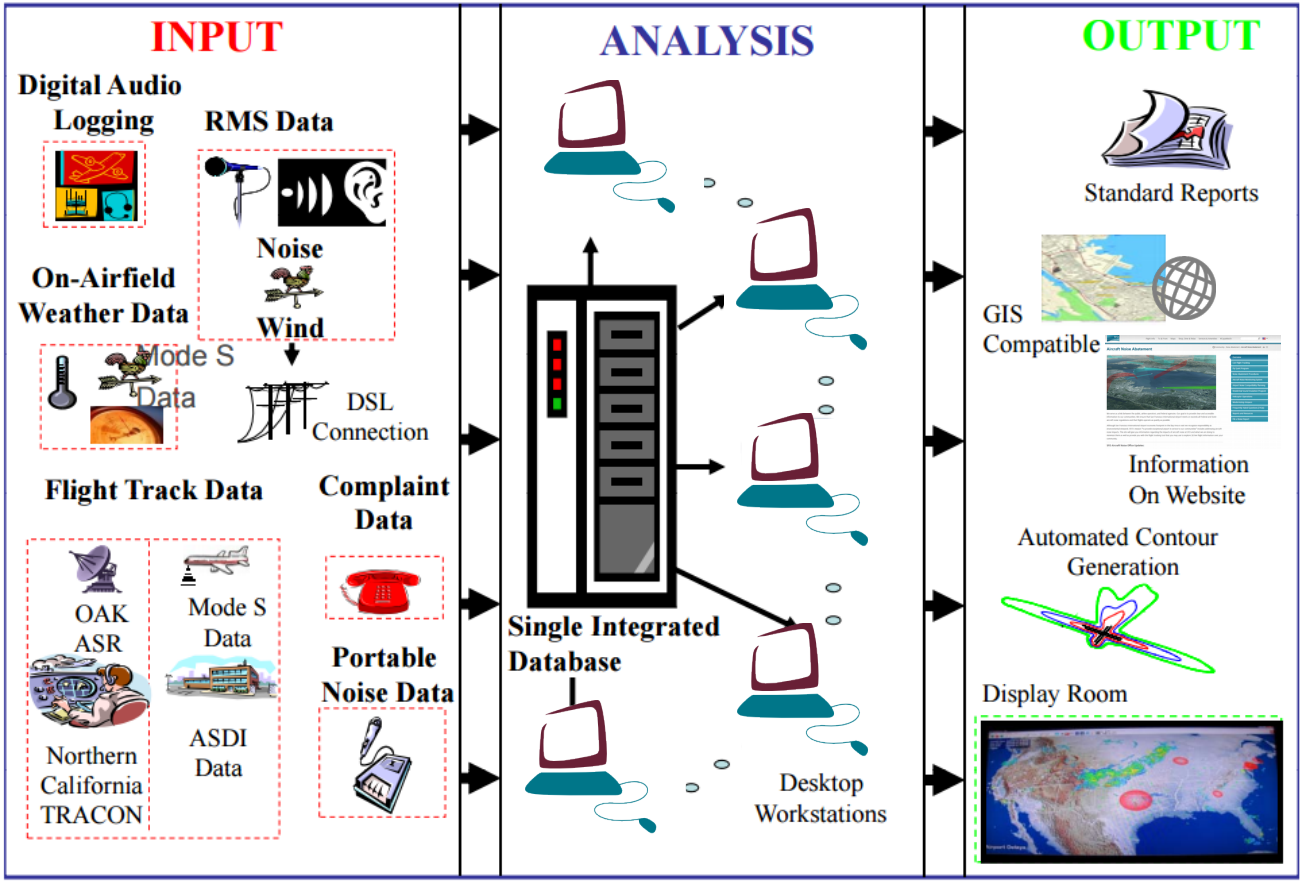
Sky Posse Palo Alto

SAVE OUR SKIES EASTBAY

S.C.R.E.A.A.M.

San Francisco International Airport

# SFO Aircraft Noise Management System



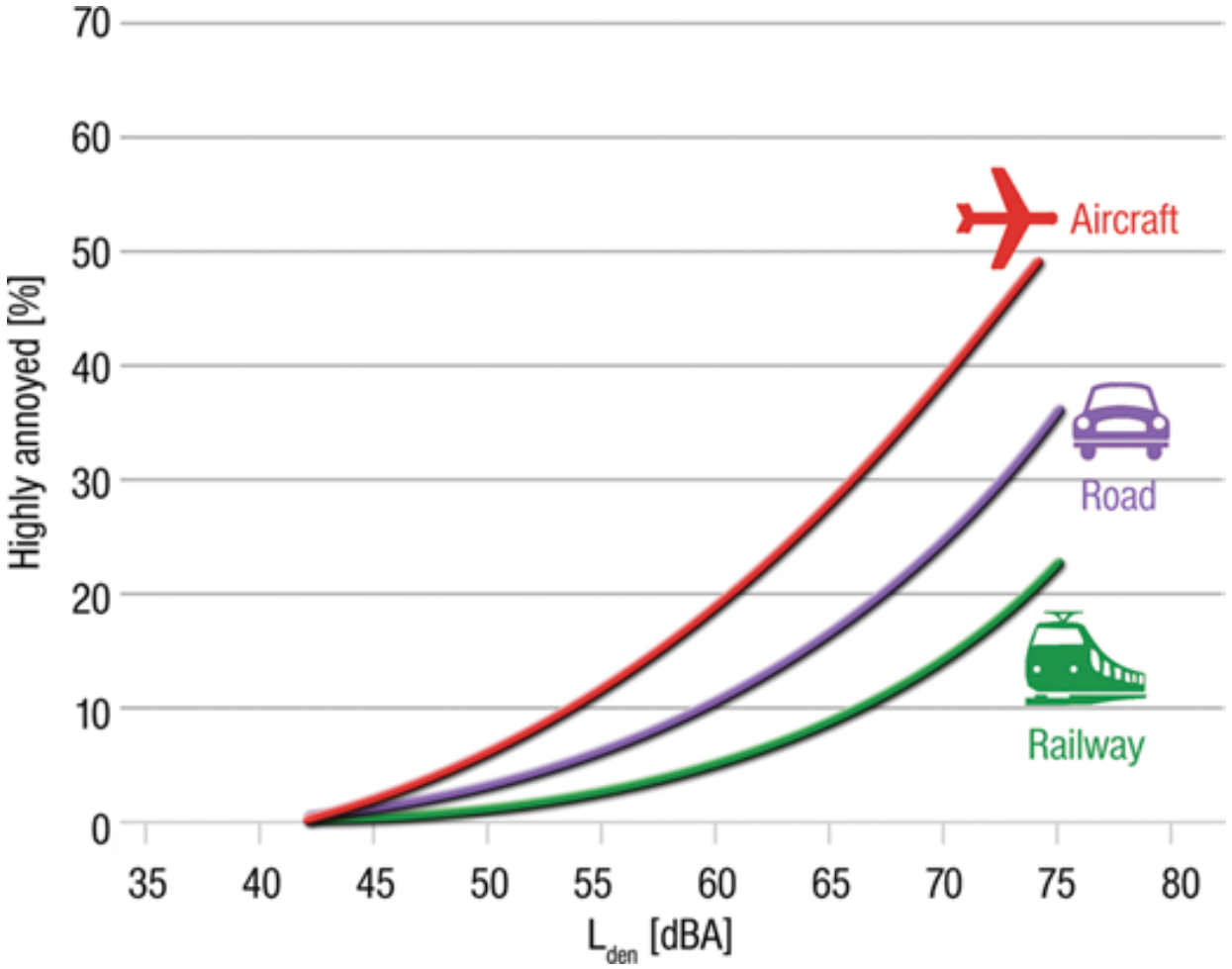

SFO San Francisco International Airport

# What is noise?

- Noise is unwanted sound
- Noise is subjective
- Relate sound levels to percent annoyed and activity interference

We can't measure perception of noise, we can only measure sound levels…

San Francisco International Airport

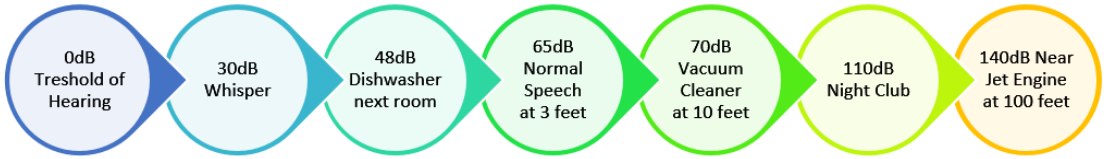



San Francisco International Airport

# How do we measure and model sound levels?

- **Sound Pressure** (any pressure variation that human ear can detect)

- **Decibel (dB)** is a ratio of measured sound pressure to a reference sound pressure.
  In sound, decibels measure a scale from the threshold of human hearing, 0 dB, upward towards the threshold of pain, about 120-140dB. Because decibels are such a small measure, they are computed logarithmically and cannot be added arithmetically. Outside of the laboratory a change of 3 dB is barely perceptible. An increase of ten dB is perceived by human ears as a doubling of noise.




- **A-Weighted Decibel (dBA)** adjust sound pressure weighting towards the frequency range of human hearing. The FAA and State of the California has adopted the A-weighted sound level for environmental analysis.

SFO San Francisco International Airport

# Example noise levels

Jet take-off
(25m distance)

Rock concert

Average street traffic

Conversation speech

Library

Bedroom


Construction site

Noisy workplace

Busy office

Martin Place lunch time

Living room

Rural location

San Francisco International Airport

# What affects our level of annoyance?

- Longer noise exposure = higher annoyance

Length, Frequency

Time of Day

- Higher annoyance at night (sleep)
- Background noise at night lower than during the day

Emotions

- Noise is unnecessary

Physical Environment

- Vegetation can alleviate noise by absorption or deflection of sound waves
- Summer months can expose you to more noise by having open windows

Control

Predictability

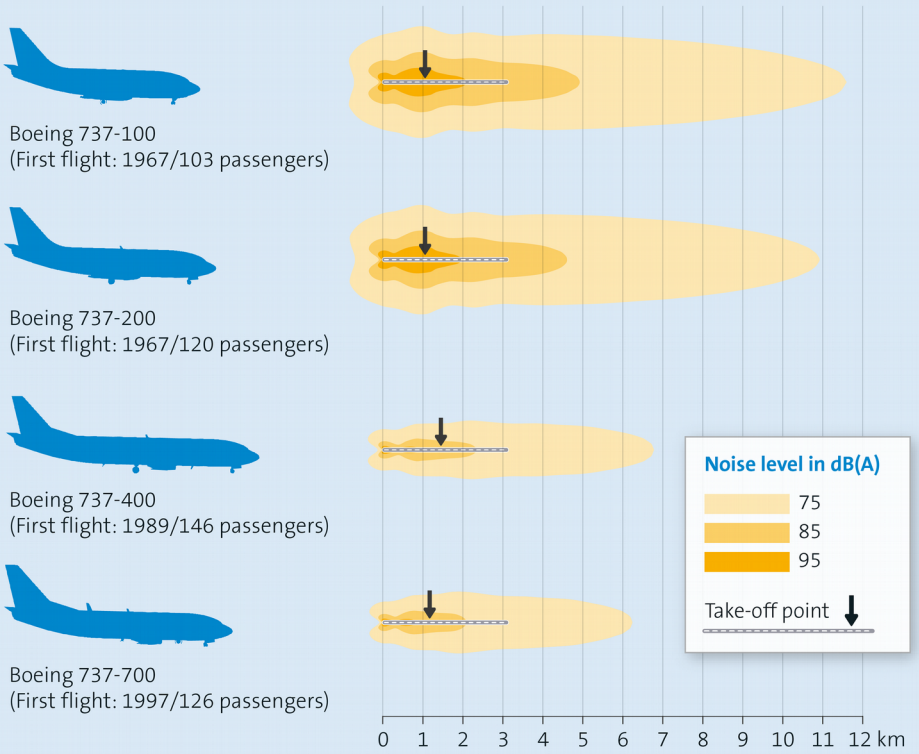
- Surprise effect

San Francisco International Airport

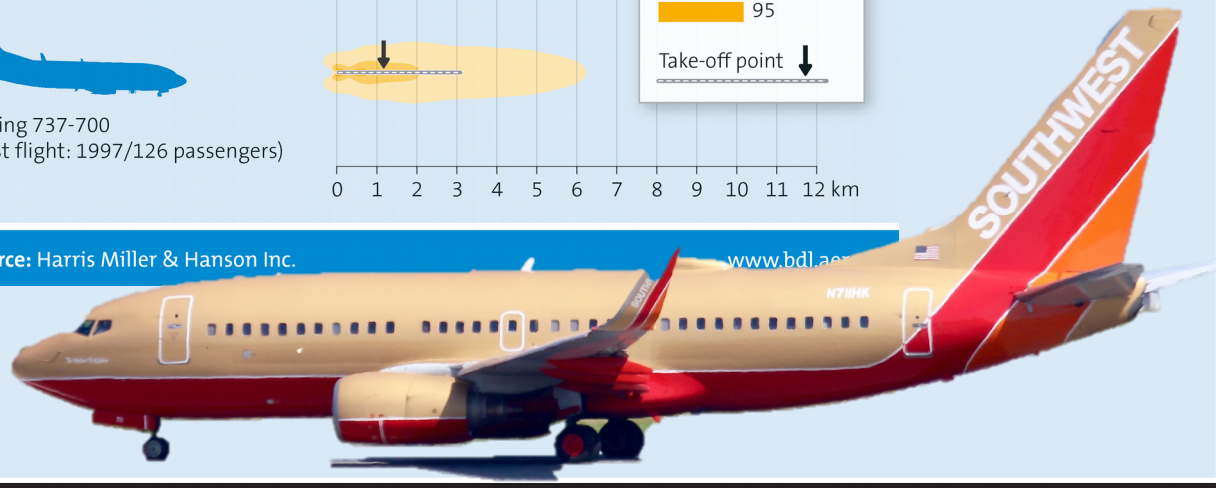
# Aircraft Noise Sources


SFO San Francisco International Airport

## Boeing 737 series: development of noise emissions

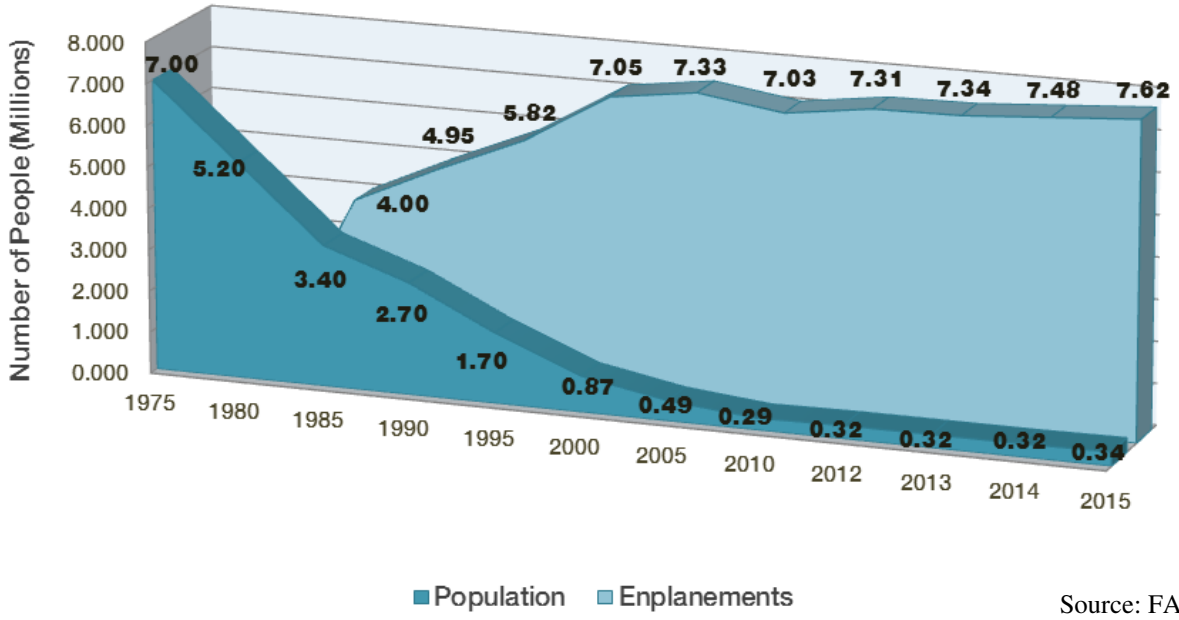



**Source:** Harris Miller & Hanson Inc.




San Francisco International Airport

# The Historical Record: Order of Magnitude Noise Exposure Reduction Despite Traffic Growth




Source: FAA

Since the late 1970s, the number of people exposed to significant aircraft noise has decreased by more than 95 percent while operations have more than doubled. Even with this decrease, community concern regarding aircraft noise is increasing.

San Francisco International Airport

# How does noise get into my home?


San Francisco International Airport

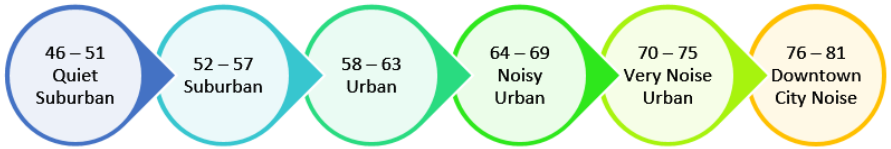
## Commonly Used Noise Metrics

IMPORTANT

- **Community Noise Equivalent Level (CNEL)**

used by the State of California to describe land use compatibility with respect to aircraft noise exposure. CNEL is defined in Title 21 of the California Code of Regulations, Airport Noise Standards. The acceptable level of aircraft noise for people living in the vicinity of an airport is 65 decibel A-Weighted (dBA) CNEL. It is a measurement of noise averaged over a 24-hour period. In addition, each aircraft noise event occurring between evening (7pm-10pm) has penalty of 4.77dBA, and night (10pm-7am) has a penalty of 10dBA. This penalty is to account for the higher sensitivity to noise in the night time and the expected nighttime decrease of background noise levels. The CNEL metric is unique to California in that it adds a penalty calculation for evening and night operations. Other states use the Day-Night Average Level (DNL).

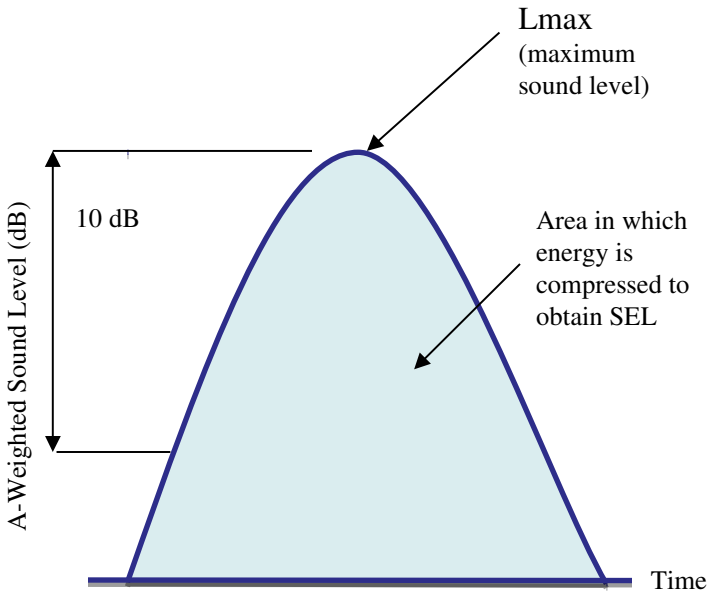
Average CNEL Levels in different communities.




- **SENEL – Single Event Noise Exposure Level**

The noise exposure level of a single aircraft event measured over the time between the initial and final points when the noise level exceeds a predetermined threshold. It is important to distinguish single event noise levels from cumulative noise levels such as CNEL. Single event noise level numbers are generally higher than CNEL numbers, because CNEL represents an average noise level over a period of time, usually a year.

- **LMax –** The peak noise level reached by a single aircraft event.

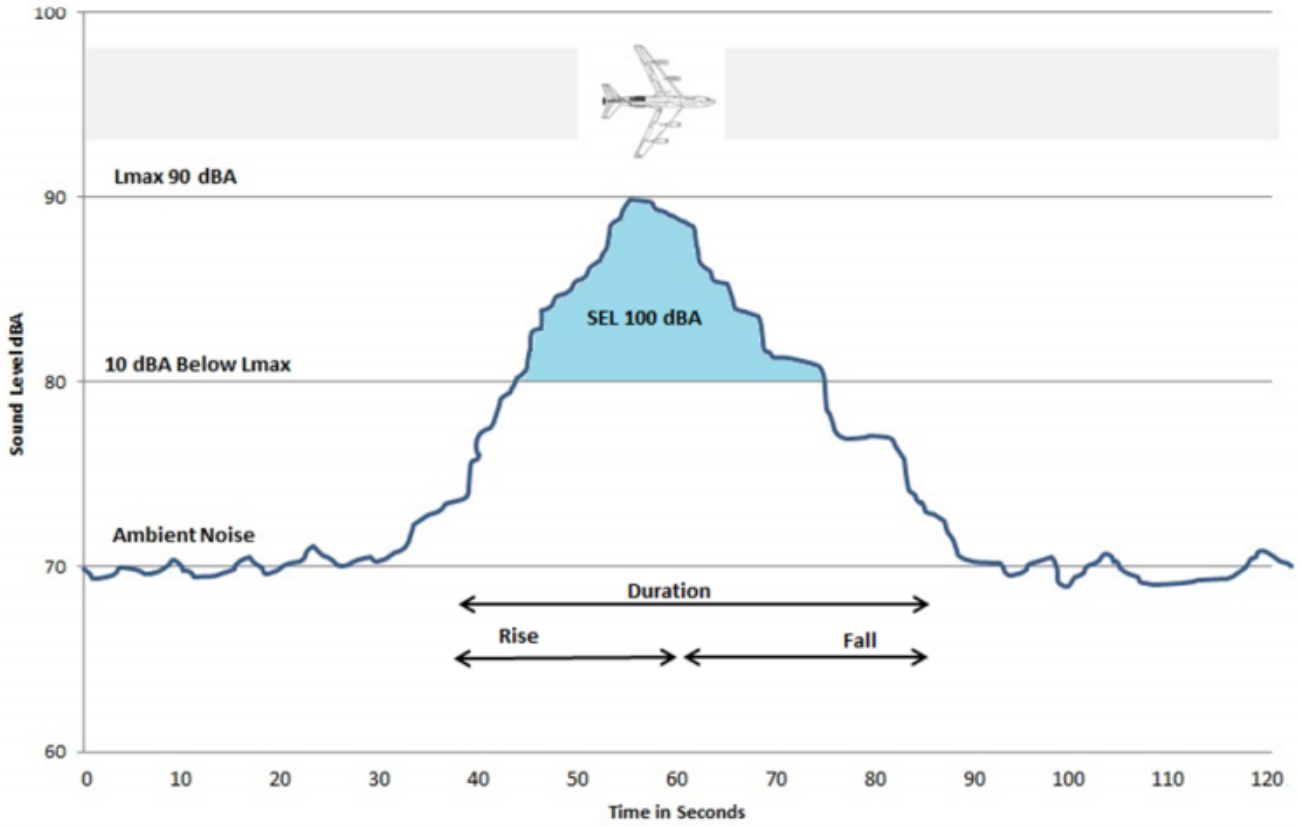



**Description of the Sound of a Single Event**

| Seconds | Sound Level | Energy |
|---|---|---|
| 1 | 60 dB | 1000000.0 |
| 2 | 63 dB | 1995262.3 |
| 3 | 65 dB (LMax) | 3162277.7 |
| 4 | 63 dB | 1995262.3 |
| 5 | 60 dB | 1000000.0 |
| | Total Energy | 9152802.3 |
| | **Aircraft Noise Event's SEL** | **69.6 dB** |

San Francisco International Airport

## Sound Exposure Level (SEL), Maximum Noise Level (Lmax) and Duration




San Francisco International Airport

## Measuring Sound Levels

- Measurements accurately tell us the sound levels at a specific site for a specific time period.
- Historical record and are not predictive, but can show historical trends.
- Useful in validating the output of a noise model.


Short-term, using portable monitoring equipment.

Long-term using permanent monitors.

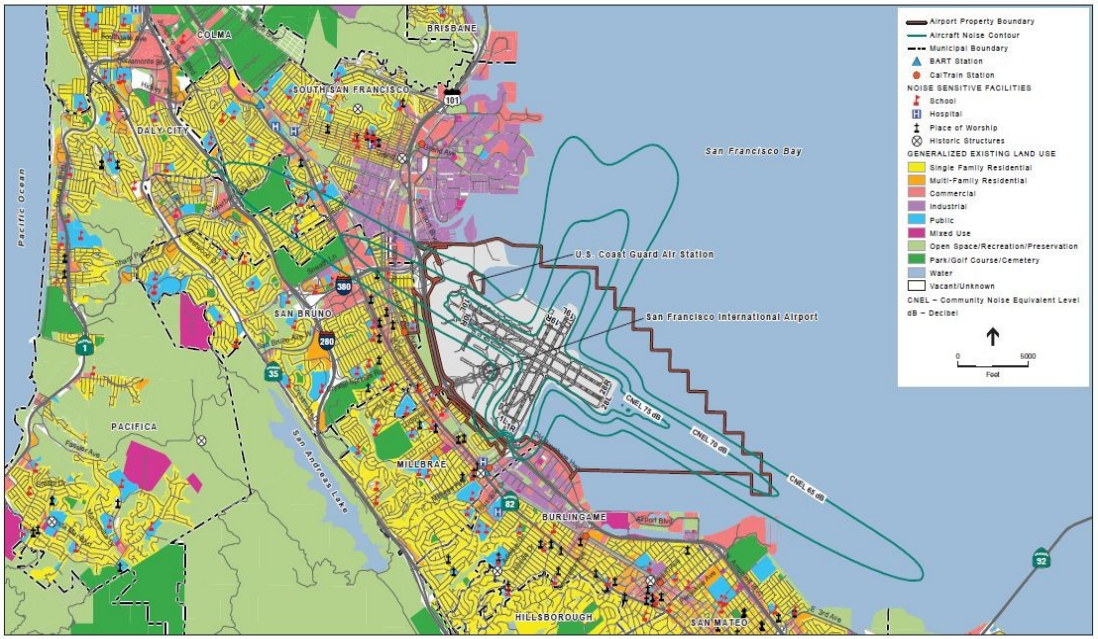
San Francisco International Airport

## Modeling Sound Levels

Modeling shows us sound levels over a broad geographic area as well as at specific location for a specific time period. Modeling can produce a historical record or it can be predictive by showing expected trends.

Noise Exposure Map (NEM)

is a map of the airport and vicinity that shows areas of average noise exposure over a period of one year. CNEL metric is used in creating noise exposure contours.




SOURCE: ESRI, 2014; San Mateo County Planning and Building Department, 2014; ESA Airports, 2014

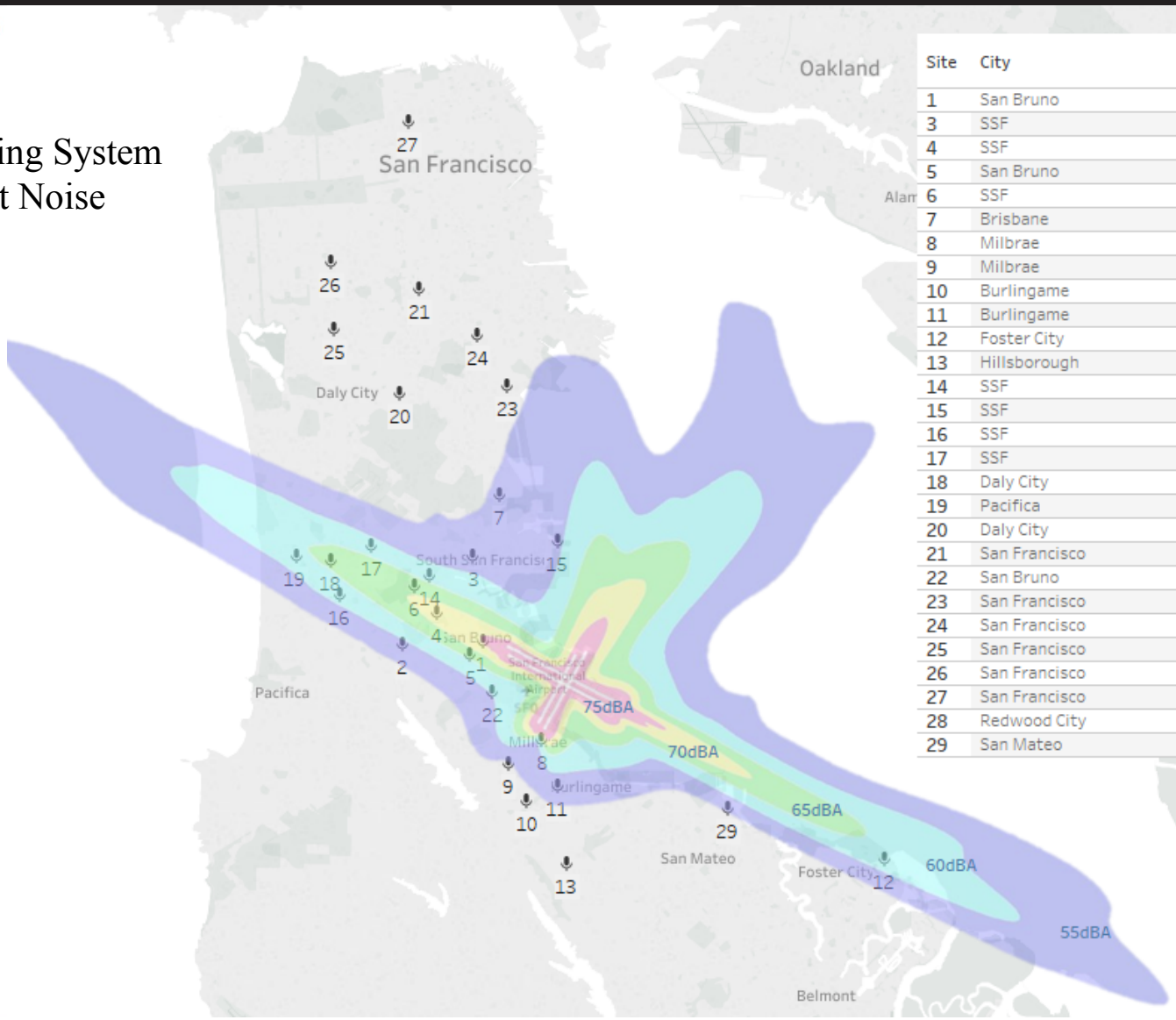
SFO FAR Part 150 Noise Exposure Map Report . 120832

**Exhibit 5-1**

2014 Noise Exposure Map – San Francisco International Airport

San Francisco International Airport

Aircraft Noise Monitoring System consist of **29** Permanent Noise Monitors.

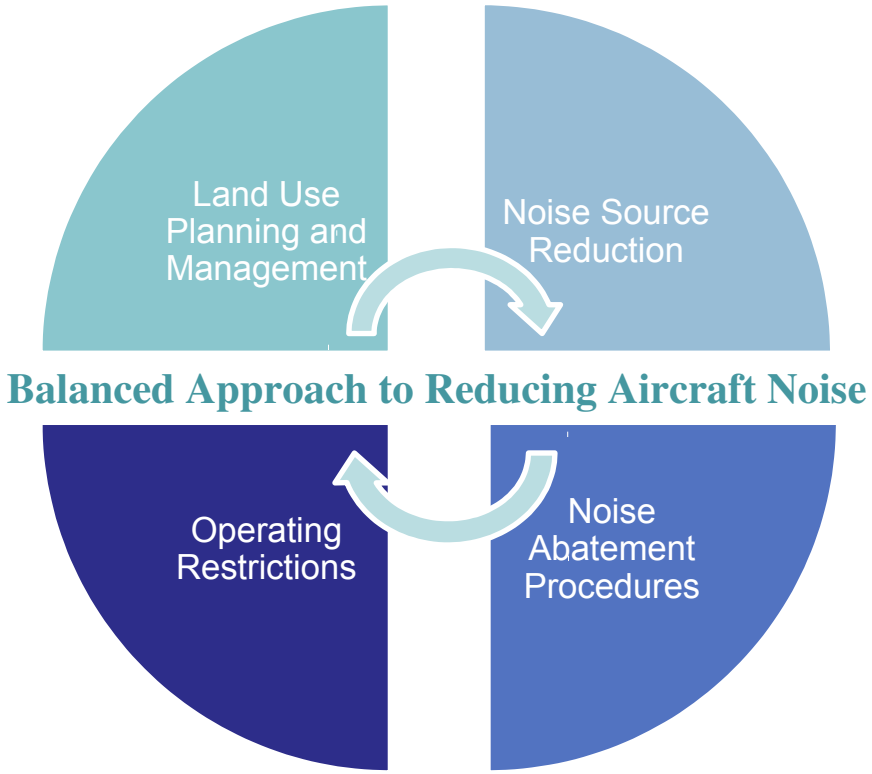



| Site | City |
|---|---|
| 1 | San Bruno |
| 3 | SSF |
| 4 | SSF |
| 5 | San Bruno |
| 6 | SSF |
| 7 | Brisbane |
| 8 | Milbrae |
| 9 | Milbrae |
| 10 | Burlingame |
| 11 | Burlingame |
| 12 | Foster City |
| 13 | Hillsborough |
| 14 | SSF |
| 15 | SSF |
| 16 | SSF |
| 17 | SSF |
| 18 | Daly City |
| 19 | Pacifica |
| 20 | Daly City |
| 21 | San Francisco |
| 22 | San Bruno |
| 23 | San Francisco |
| 24 | San Francisco |
| 25 | San Francisco |
| 26 | San Francisco |
| 27 | San Francisco |
| 28 | Redwood City |
| 29 | San Mateo |

SFO San Francisco International Airport

## Where to now that we have zero impact?

Although SFO is now quieter than it's been anytime since 1970s, and we have complied with all regulations, we can do more. Our social responsibility is to continue working with all stakeholders to reduce the aircraft noise impacts in the communities surrounding the airport.




San Francisco International Airport

## Aviation Noise Law

### Airport Noise and Capacity Act of 1990 (ANCA)

- Stage 2 Aircraft Phase-Out by 2000
- Part 161- Airports to seek public and FAA comment before implementing restrictions

The restrictions cannot be discriminatory, unreasonable, nor unduly burdensome to interstate commerce, nor can they impede the FAA's execution of the national Stage 3 transition.

- Part 150 Funding through Airport Improvement Plan and passenger facility charges
- ANCA does not affect any airport noise or access restrictions in effect before November 5, 1990
- Noise Compatibility Program

San Francisco International Airport

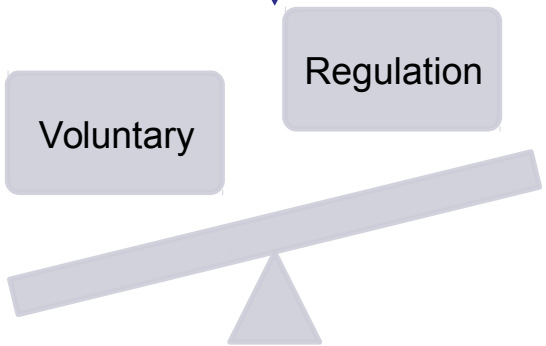

SFO San Francisco International Airport

## SFO Noise Abatement Procedures combine elements of:

- Part 150 Noise Compatibility Plan
- City and County of San Francisco Noise Resolutions
- Airport Community Roundtable
- FAA Air Traffic Control

Runway Use and Departure/Arrival Procedures

Safety ALWAYS takes precedence over noise abatement procedures if such procedures are inconsistent with it.


SFO San Francisco International Airport

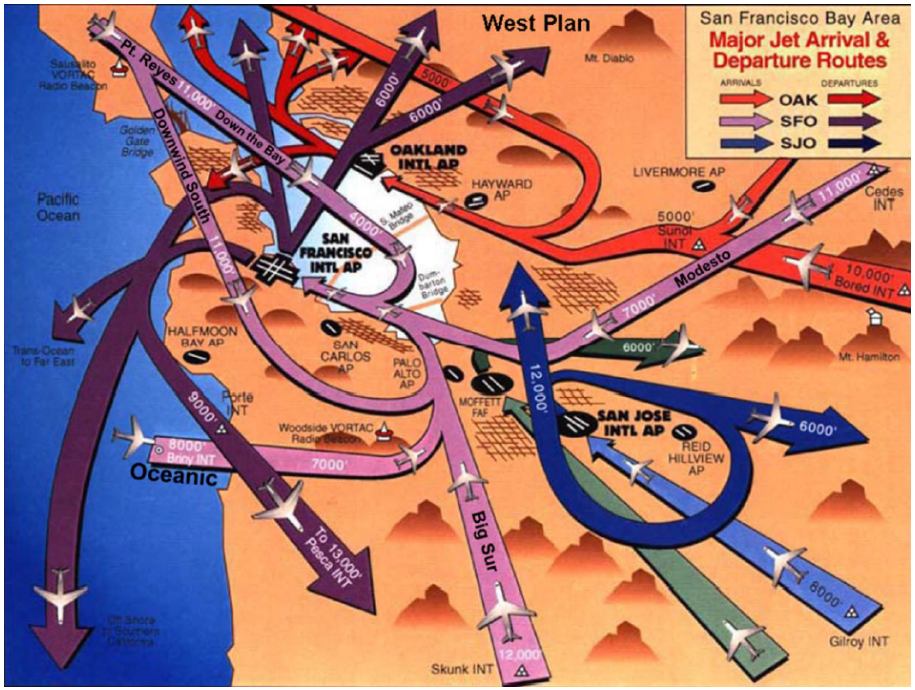
Key Component: Use of water facing runways whenever wind and weather conditions allow.

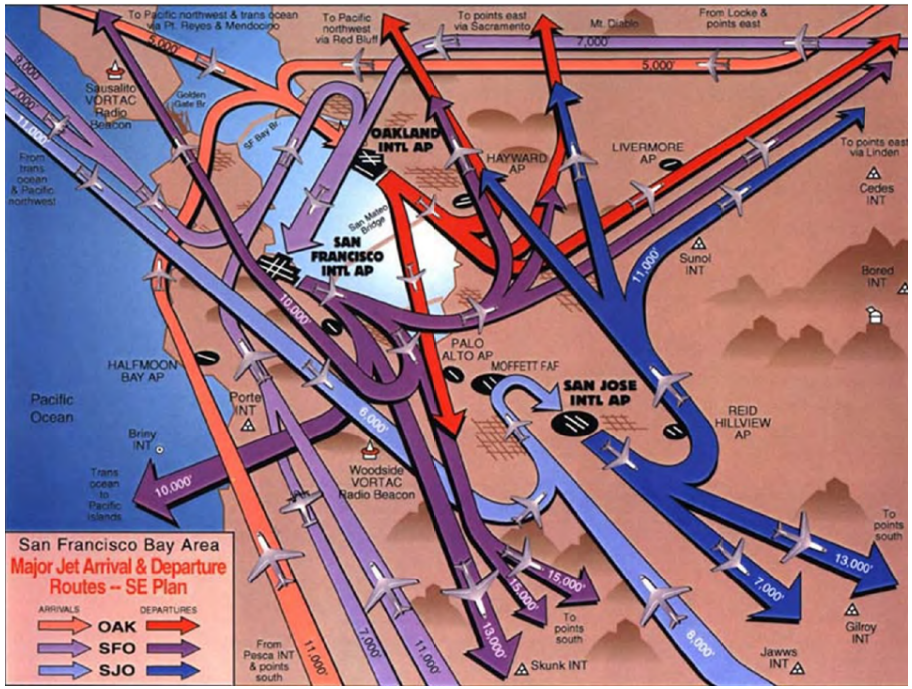

Over the Bay Flights

80% Departures

99% Arrivals

*San Francisco International Airport*
*Airfield layout*




West Plan 95%

Southeast Plan 5%

*Wind direction* and *speed* have a direct impact on the direction of arrivals and departures. For safety reasons aircraft need to land and take-off into the wind.

**Fly Quiet Program** = Airport Community Roundtable initiative implemented by the Aircraft Noise Abatement Office.

- Its purpose is to encourage individual airlines to operate as quietly as possible at SFO.
- The program promotes a participatory approach in complying with noise abatement procedures and objectives by grading an airline's performance and by making the scores available to the public via newsletters, publications, and public meetings.

SFO San Francisco International Airport

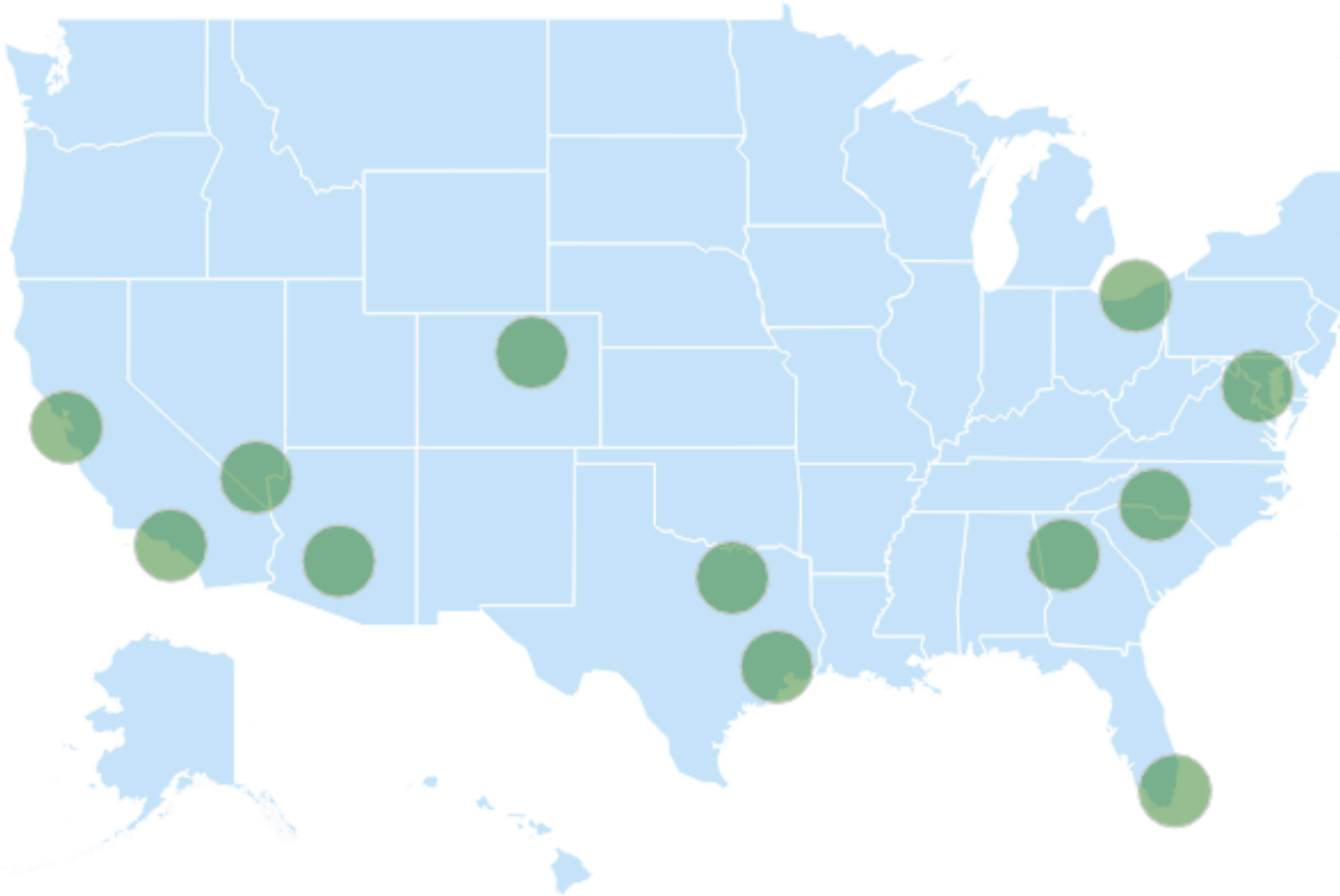
# Airspace Modernization

NextGen is a congressionally mandated initiative to modernize the U.S. Air Transportation System between 2012 and 2025. NextGen is transformation of air traffic control from a radar-based system to a satellite-based system. The goals of the project are to improve safety, increase system efficiency and capacity and reduce delays.

- Collaborative Air Traffic Management
- Improved Approaches and Low-Visibility Operations
- Improved Multiple Runway Operations
- Improved Surface Operations
- On-Demand NAS Information
- Performance Based Navigation
- Separation Management
- Time Based Flow Management

SFO San Francisco International Airport

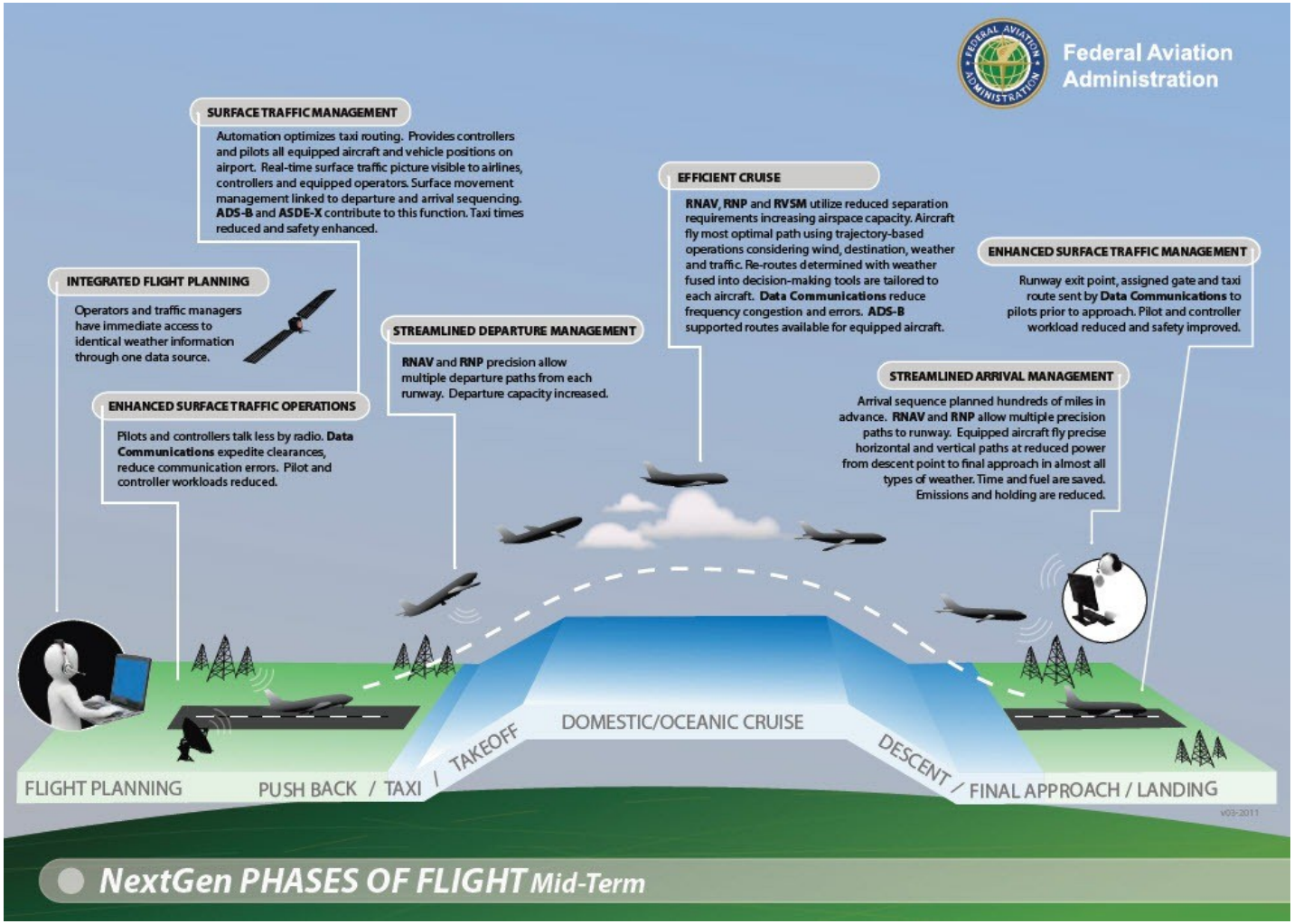
## What is Metroplex?

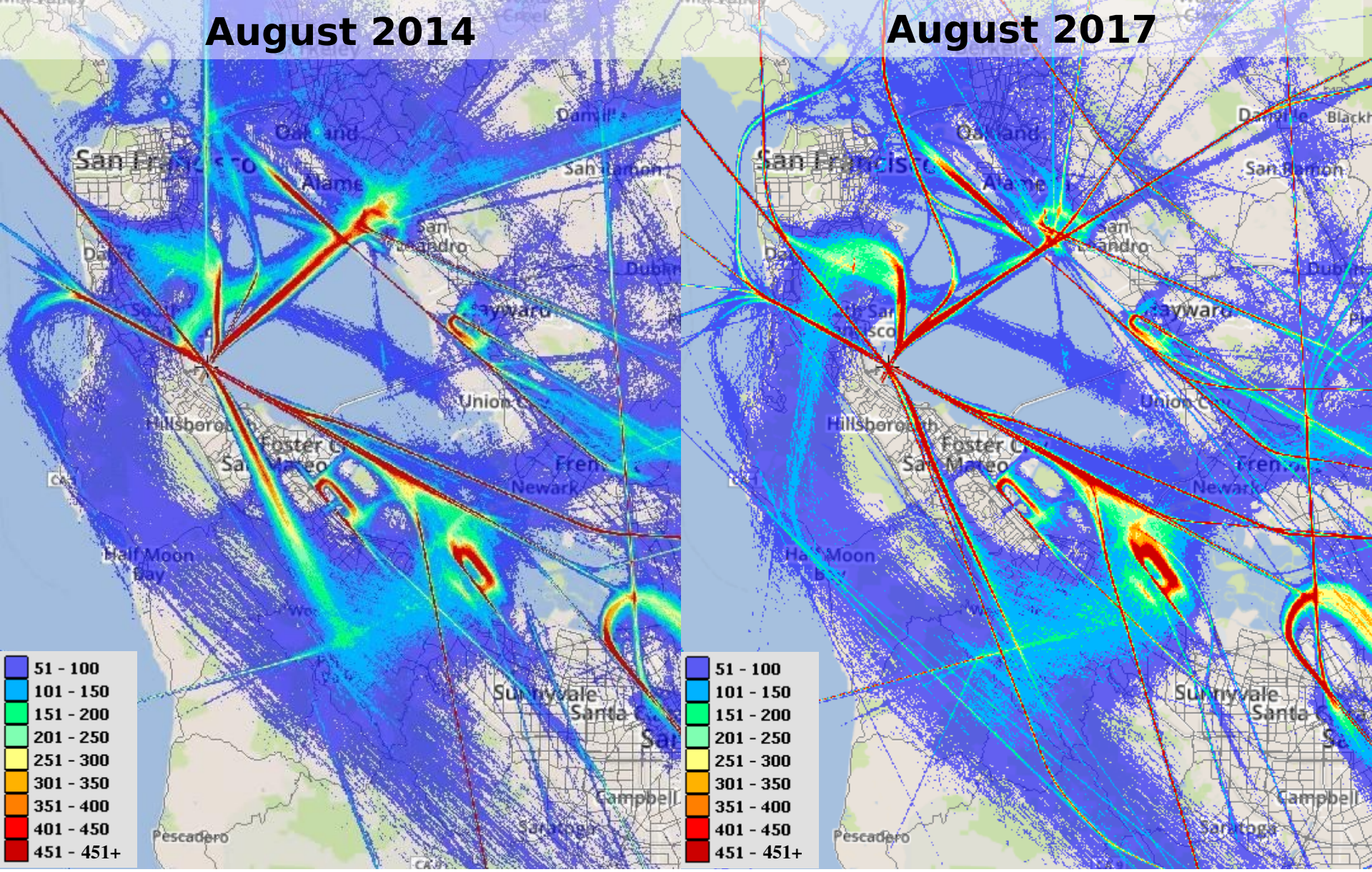


Metroplex is a metropolitan area with several major airports and complex airspace. The FAA has identified a total of 21 metroplex areas where congestion and other limiting factors create a deficiencies across the entire national airspace system.

San Francisco International Airport

# NextGen Phases of Flight



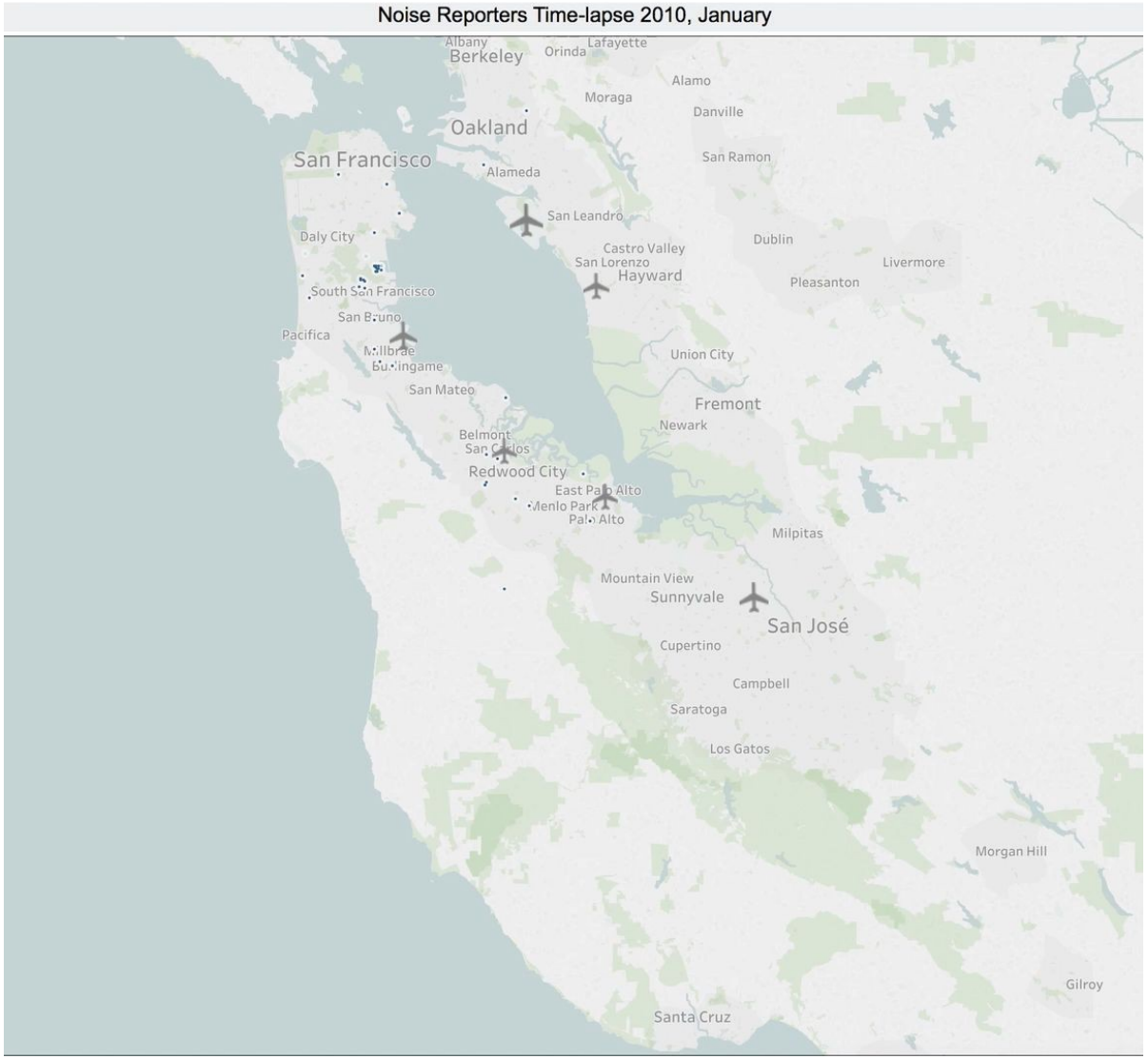

**Comparison of all Bay Area flight tracks in August of 2014 and August 2017 using grid density**.

**Legend:**

The track densities are created on a 70 meter grid. The cooler colors represent fewer

San Francisco International Airport

Noise Reporters Time-lapse 2010, January




SFO San Francisco International Airport


## References, Links and Credits

SFO Noise Abatement Office Webpage
www.flyquietsfo.com

Filing Noise Reports or Concerns

Online form:
http://www.flysfo.com/community/noise-abatement/file-a-complaint

Email:
sfo.noise@flysfo.com

Telephone hotline:
(650) 821-4736

SFO Aircraft Photography Anthony Carpeneti