



Commercial Airplanes

Quieter Airplanes and Flight Operations – A Boeing Perspective

Terry Christenson

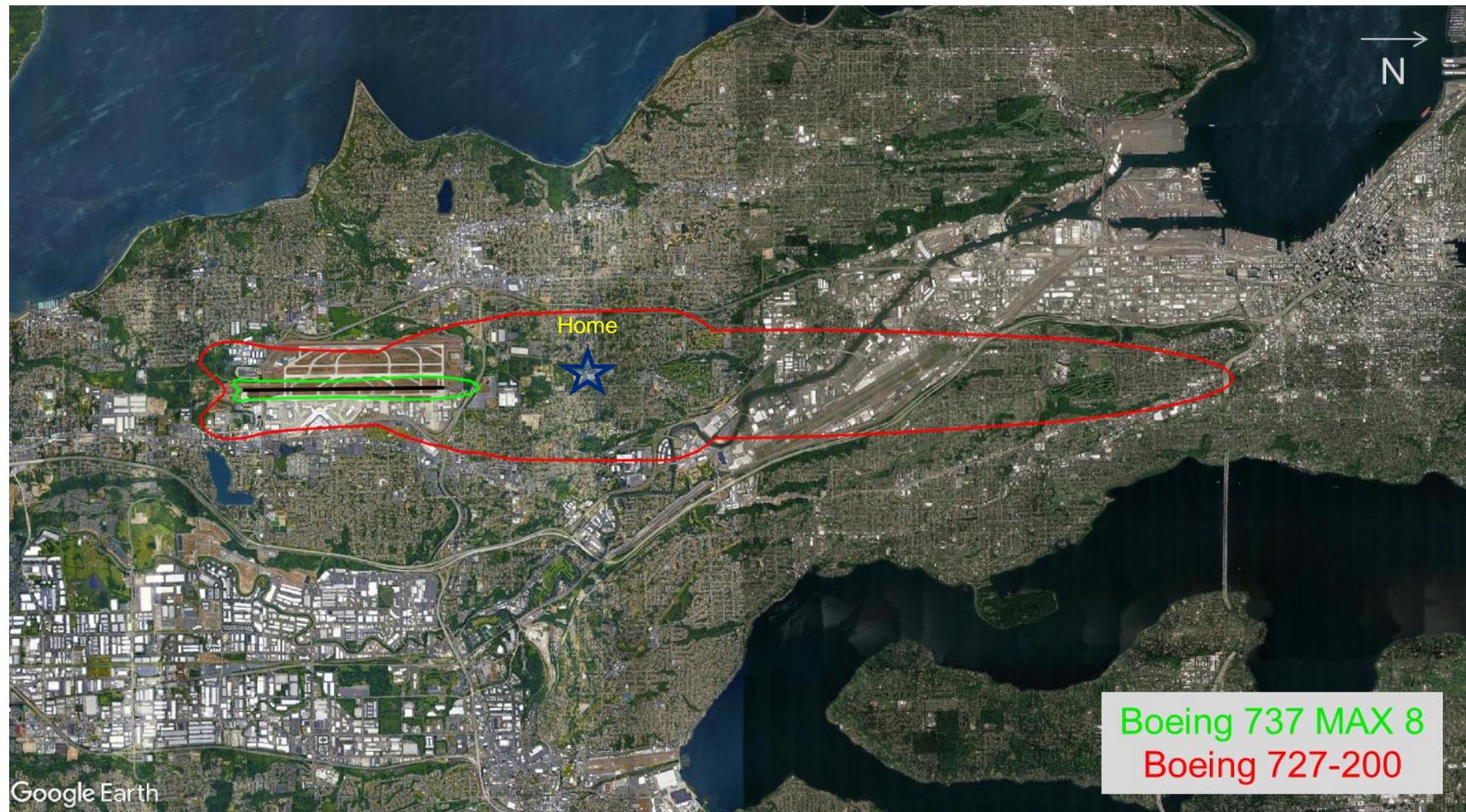
BCA Flight Sciences – Noise, Vibration & Emissions

Manager - PD Community Noise Engineering

March 4, 2019

Significant Reduction in Community Noise

Seattle-Tacoma International Airport – 85 dBA



Global Aviation Brings Together People, Countries and Cultures

38.2M annual global flights. Every day...

- 9.8 million passengers
- 104,000 flights

Supports 62.7M jobs globally

\$2.7T in global economic impact, 3.5% of global GDP

~ 41,000 new airplanes over next 20 years

- 71% of these will be single aisle aircraft



Sustainable Solutions

Collaboration Is Key

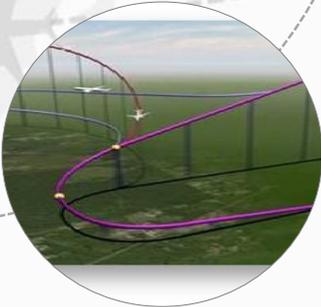


Airplanes

Airspace | ANSP's



**Airports |
Communities**



Regulators



Airlines | Pilots



Balanced Approach to Community Noise Reduction

Four concepts for a balanced approach

Source Noise Reduction



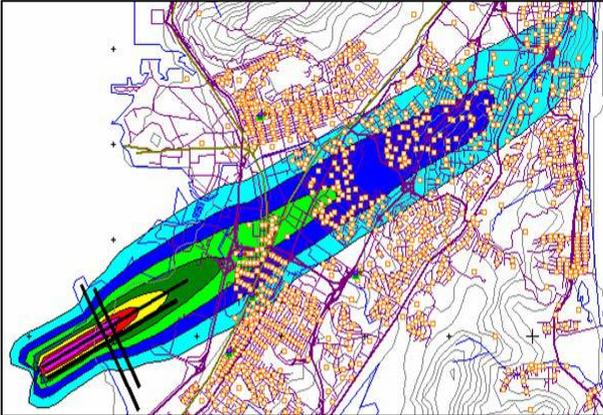
Low Noise – Operational Procedures



Operational Restrictions



Land Use Planning



Aircraft Noise Valuation

Source Noise Reduction

EPA DOT Fuel Economy and Environment Gasoline Vehicle

Fuel Economy
26 MPG combined city/hwy
 22 city 32 highway
 3.8 gallons per 100 miles

You save \$1,850 in fuel costs over 5 years compared to the average new vehicle.

Annual fuel cost \$2,150

Fuel Economy & Greenhouse Gas Rating (tailpipe only) 7
 Smog Rating (tailpipe only) 6

Actual results will vary for many reasons, including driving conditions and how you drive and maintain your vehicle. The average new vehicle gets 22 MPG and costs \$12,600 to fuel over 5 years. Cost estimates are based on 15,000 miles per year at \$3.70 per gallon. MPGe is miles per gasoline gallon equivalent. Vehicle emissions are a significant cause of climate change and smog.

fueleconomy.gov
 Calculate personalized estimates and compare vehicles

Smartphone QR Code

<https://www.fueleconomy.gov/feg/Find.do?action=bt1>

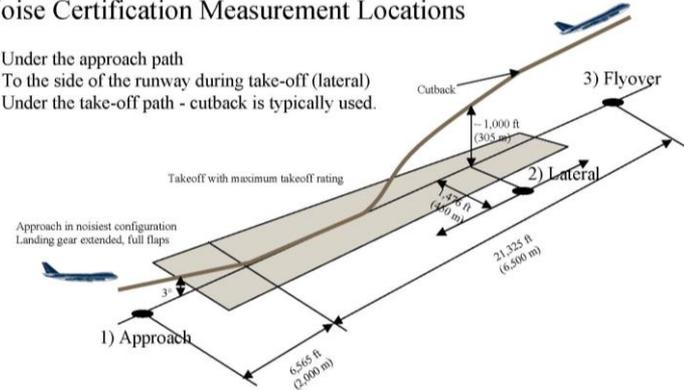
Certification Levels - EPNL

Airplane	737-800	737-8
Cumulative Margin	11.5	24.9

Change the Airplane's Design

Noise Certification Measurement Locations

- 1) Under the approach path
- 2) To the side of the runway during take-off (lateral)
- 3) Under the take-off path - cutback is typically used.

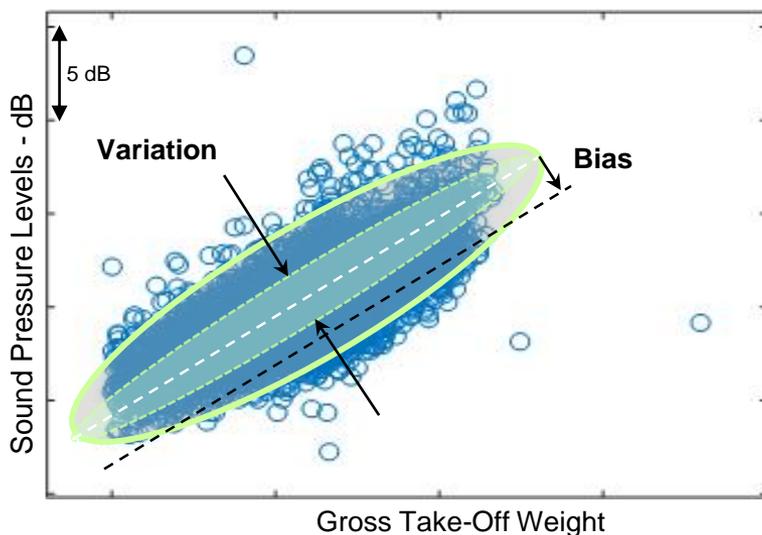


Aircraft Noise Valuation

Low - Noise Operational Procedures

Actual results will vary for many reasons, including driving conditions and how you drive and maintain your vehicle.

Aircraft Take Off Airport Monitor Levels



Change how the airplane is flown

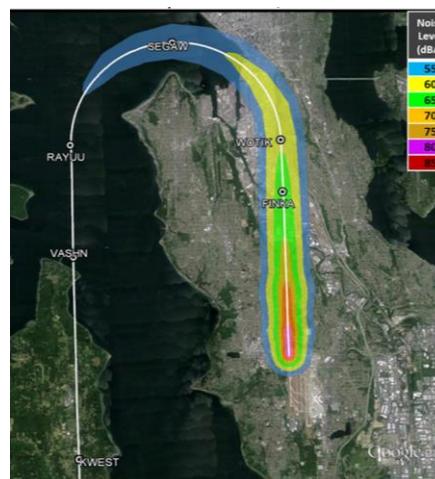
- Identify/implement low noise procedures
- Enable airplane to be flown to:
 - ➔ limit variation – NextGen, Automation
 - ➔ bias procedures toward lower noise levels – employ data analytics to identify opportunities

San Francisco Trial



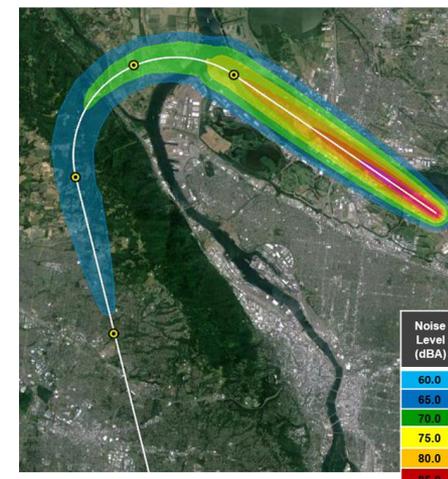
Greener Skies over Seattle

RNAV (RNP) Z RWY 16R



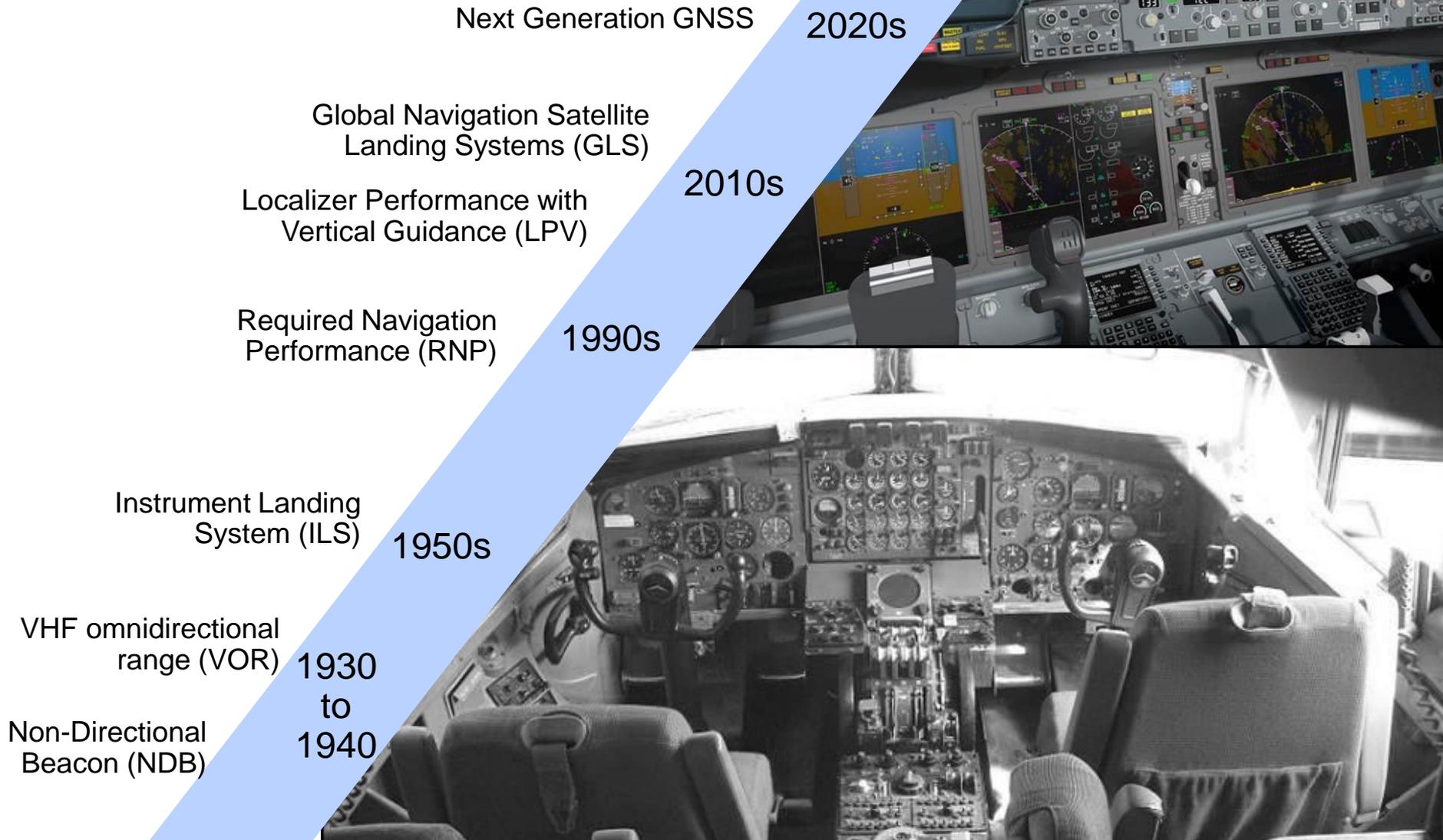
Portland, Oregon

RNAV (RNP) Z RWY 10R



Low Noise Operations Opportunity

Evolution of ATM Advances



Sustainable Solutions

Collaboration Is Key



Boeing will continue to seek opportunities and collaborations to:

- ➔ pursue additional source noise reduction.
- ➔ Identify ways for airplanes to be flown quieter

Creating a Better Future Together

Thank You!

