NASA Silicon Valley Urban VTOL Air-Taxi Study

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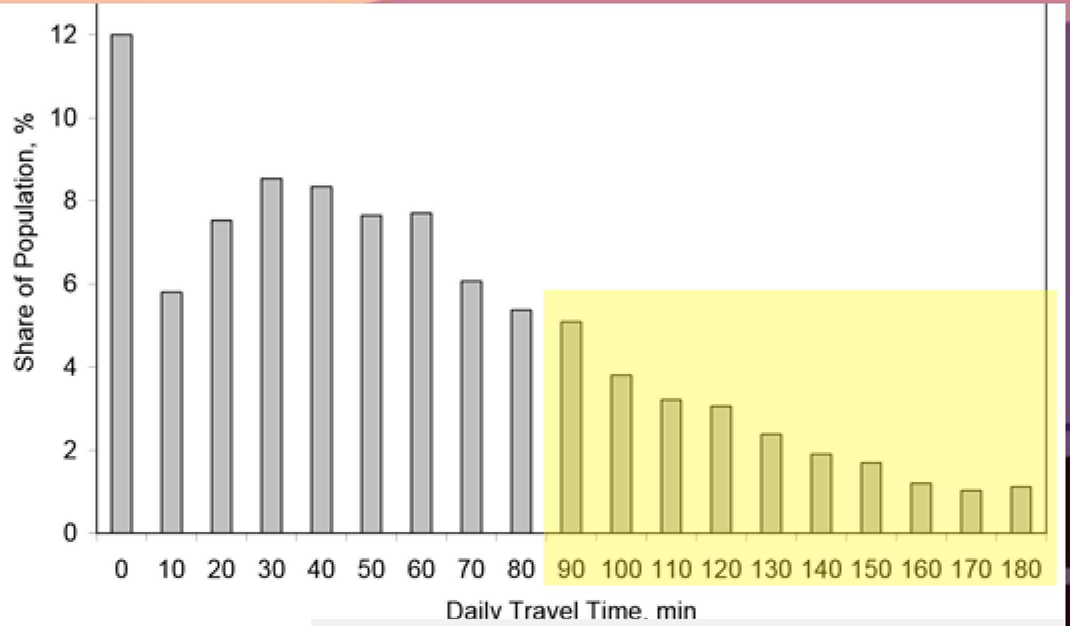
Metro Areas with Highest Mean Distance	Percent Mega Commutes
San Francisco-Oakland-Fremont, CA	2.06
San Jose-Sunnyvale-Santa Clara, CA	1.90
Salinas, CA	1.23
Gulfport-Biloxi, MS	0.94
Hinesville-Fort Stewart, GA	0.93
Lawton, OK	0.82
Fayetteville, NC	0.73
Brunswick, GA	0.64
Anchorage, AK	0.25
Honolulu, HI	

U.S. Census Mega Commuter Study

Top 3 Metro Areas

All in the Silicon Valley



Long-Term Trends in Global Passenger Mobility, Andreas Schaefer

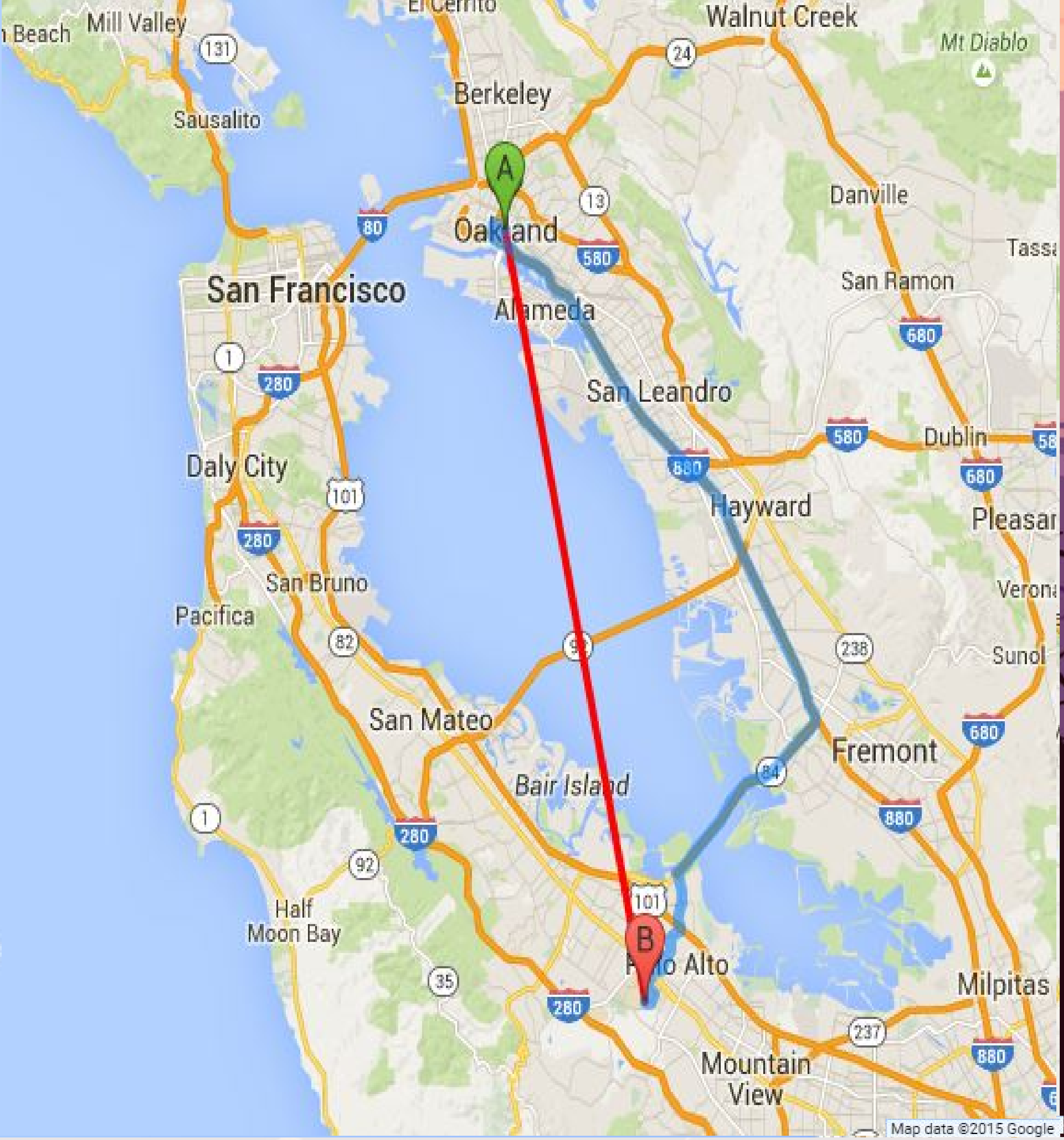
>25% have Daily Travel Times of >90 min.

Travel Statistics: Silicon Valley #1 commuter travel distance and time

Demographics: High income, high housing costs, high tech adoption rates

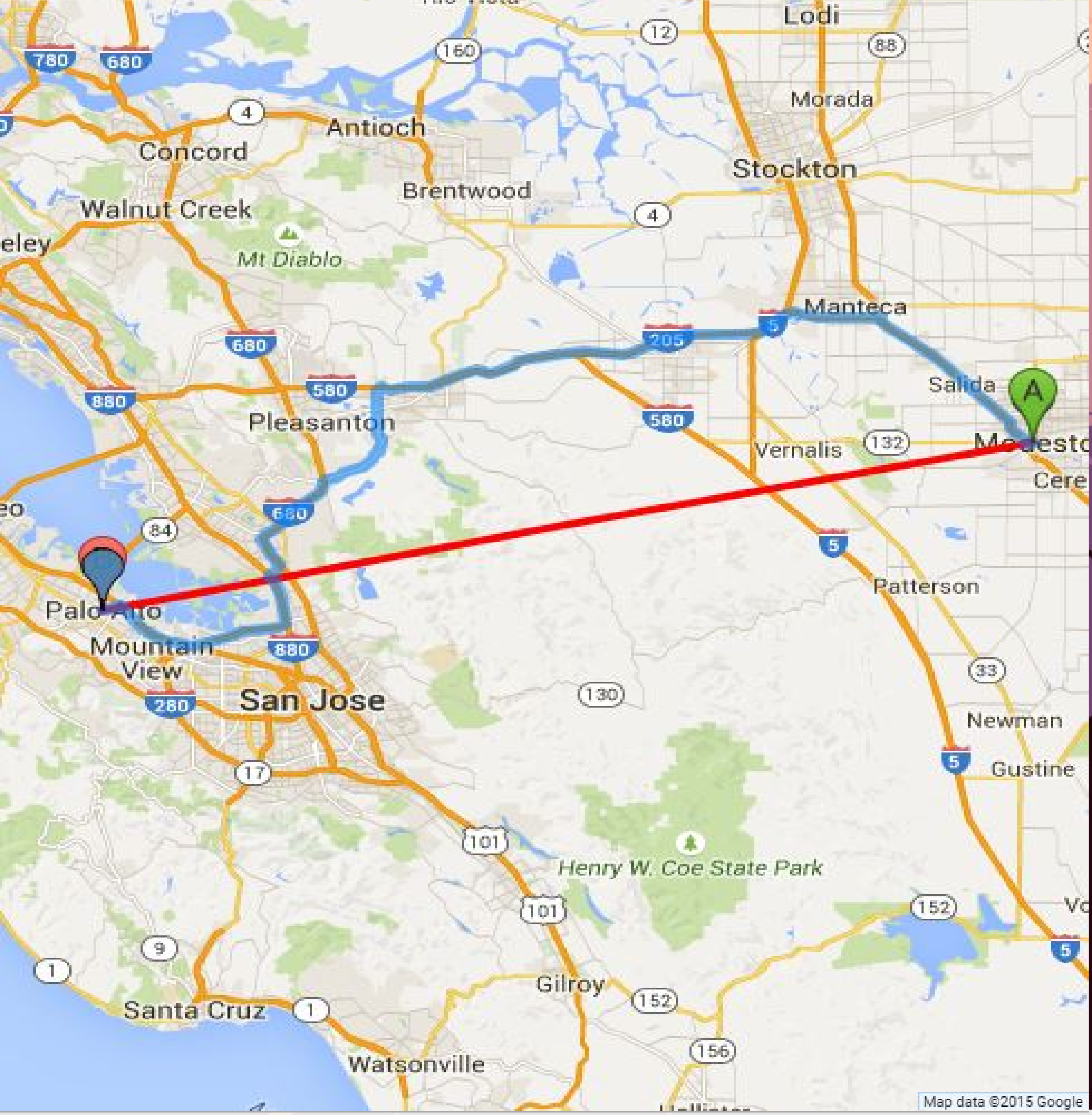
Capital Environment: Ability to attract capital for local/regional perceived needs

Location: Significant ground terrain obstructions, Near perfect weather



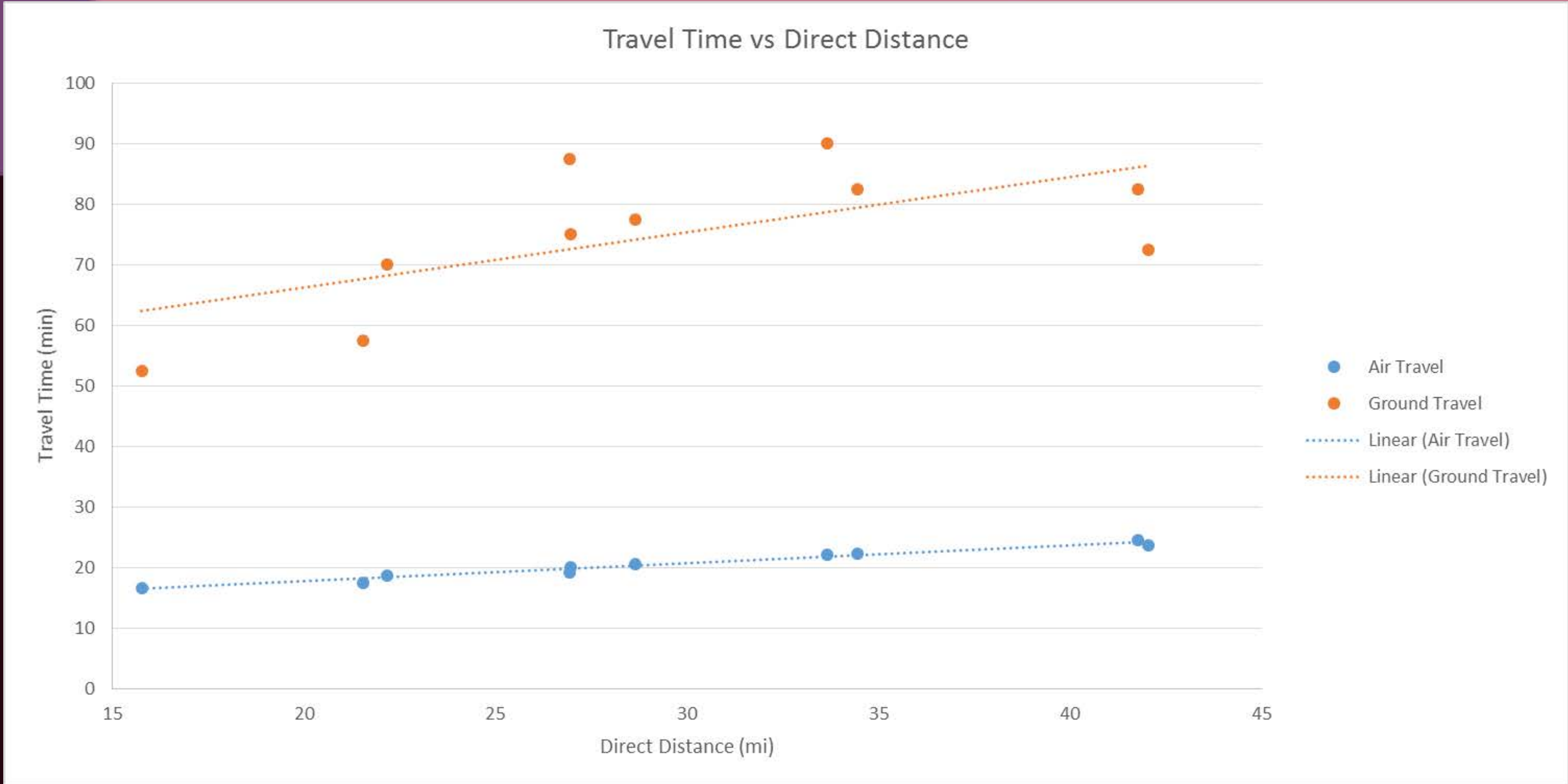
Average Speed: **47** (Non-Peak) | **21** (Peak) mph

Travel Times for Urban City-Pairs (with 1.2x longer road miles than air miles)



Average Speed: **60** (Non-Peak) | **34** (Peak) mph

Travel Times for Suburban City-Pairs (with 1.3x longer road miles than air miles)



- VTOL Air-Taxi cruise speed:

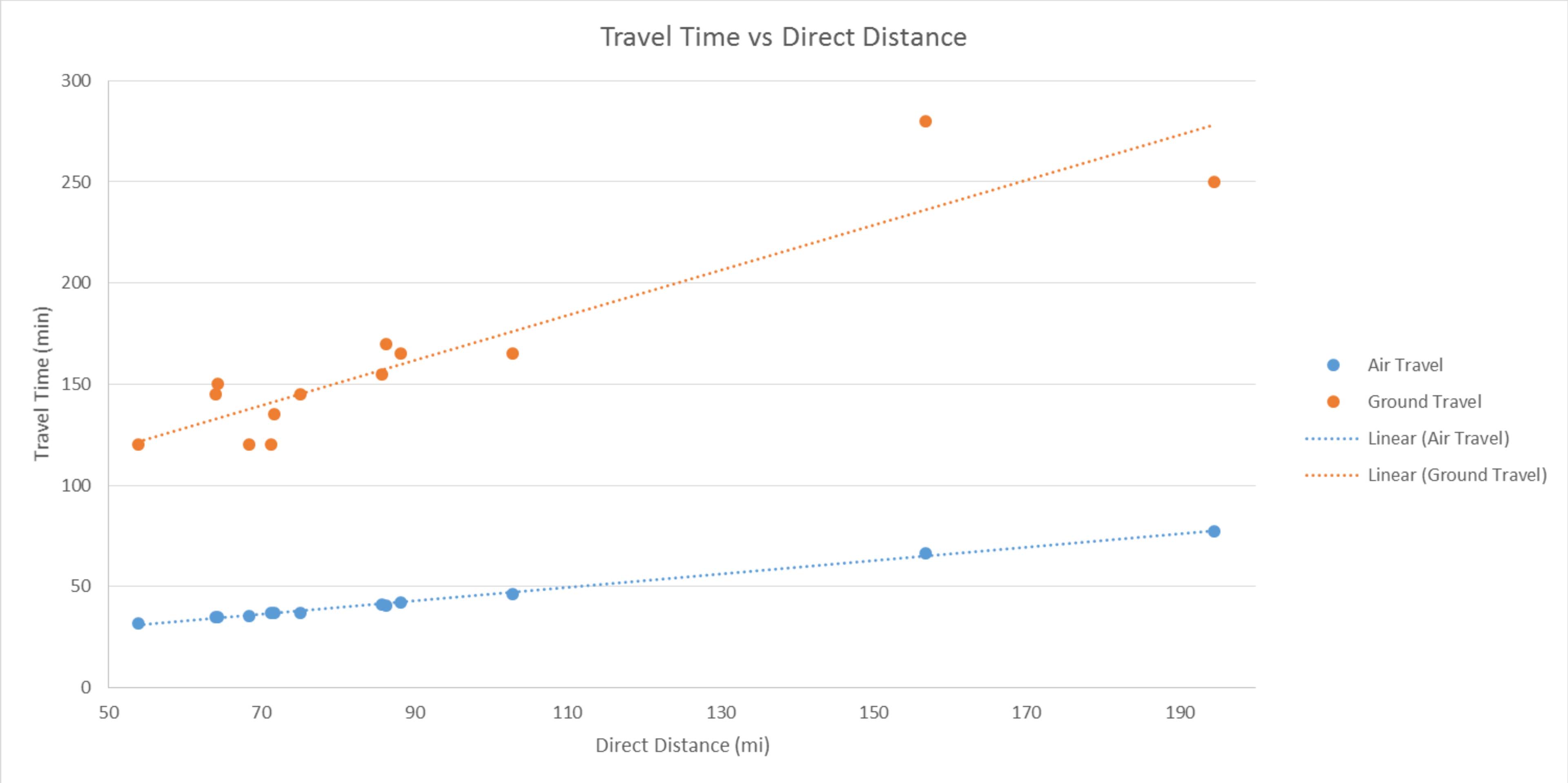
  200 mph

- Car average ground speed:

  34 mph

- Includes all block time penalties, assuming a ground trip of 1 mile on each end of the air-taxi trip.

3.6X Improvement in Travel Time



- VTOL Air-Taxi cruise speed:

  200 mph
- Car average ground speed:

  47 mph
- Includes all block time penalties, assuming a ground trip of 5 miles on each end of the air-taxi trip.

3.7X Improvement in Travel Time

Travel Time | Suburban Trip with a 200 MPH Air-Taxi (fully burdened with other trip time penalties)

Ground

Pathway-based Transportation System

Pathway-dependence creates a high level of uncertainty

One accident disrupts the only pathway

Air

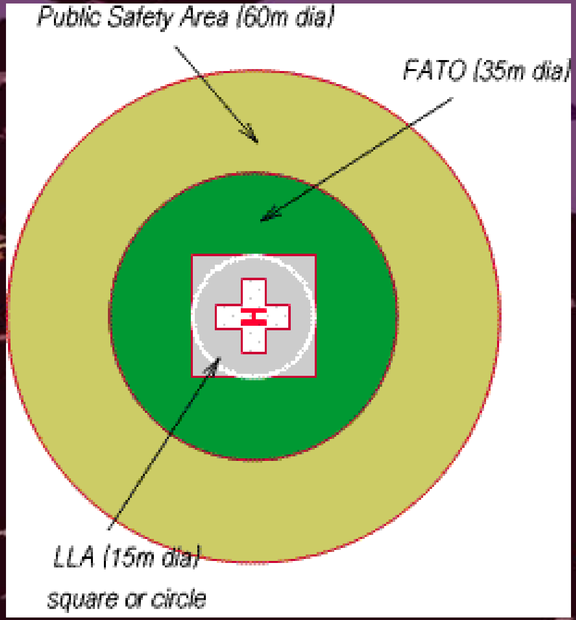
Nodal-based Transportation System

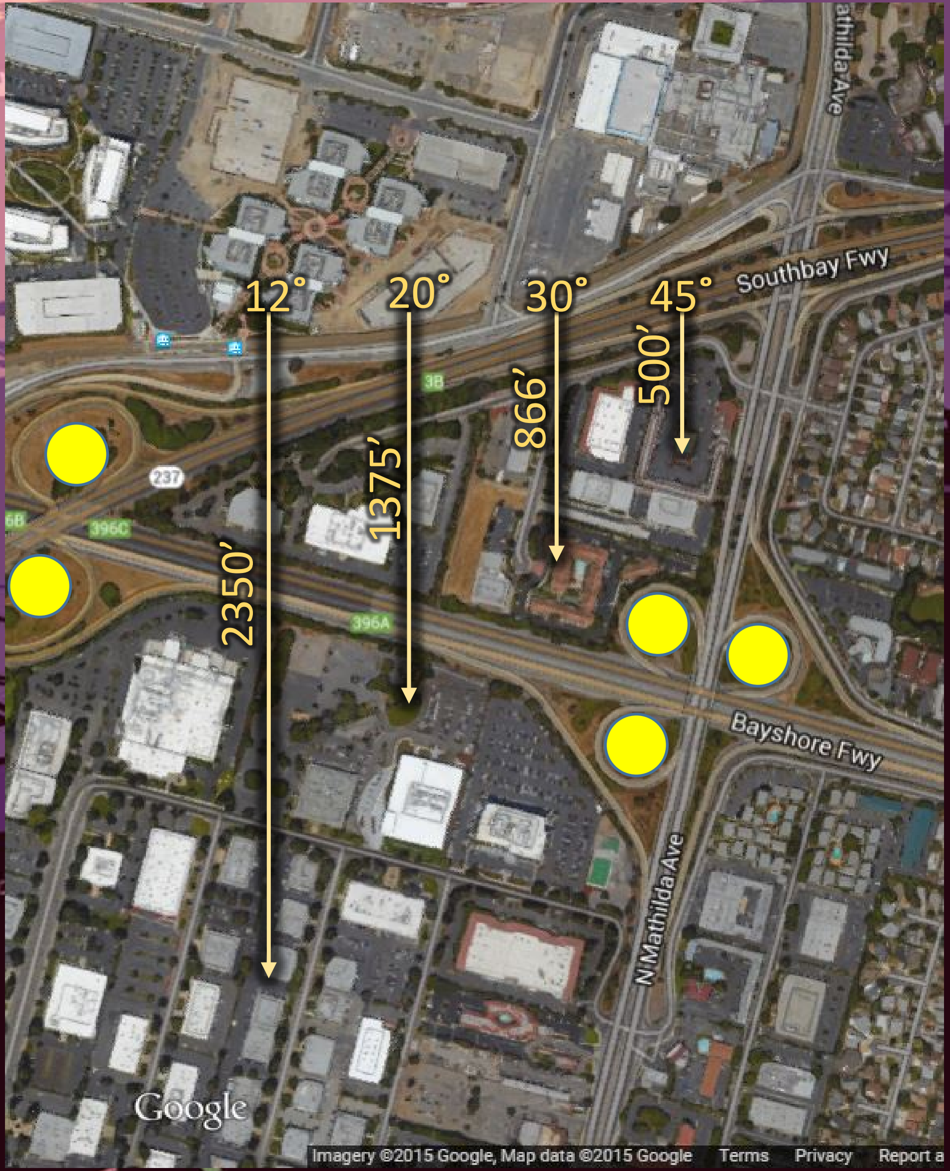
Path-independent

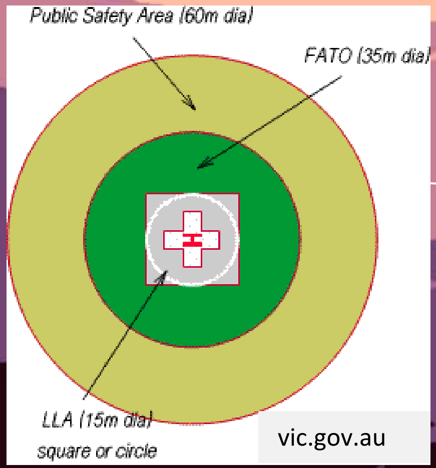
Multiple options to travel between nodes

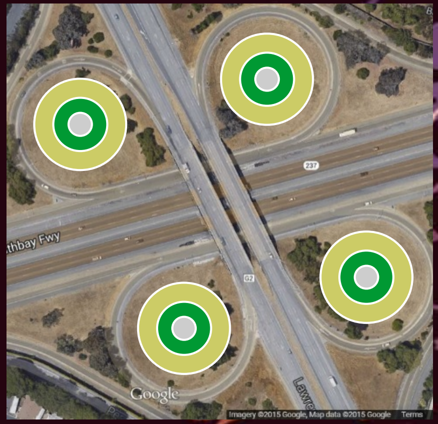
CTOL, STOL, ESTOL, and VTOL infrastructure was investigated, with a requirement to clear 500 ft above surrounding private property.

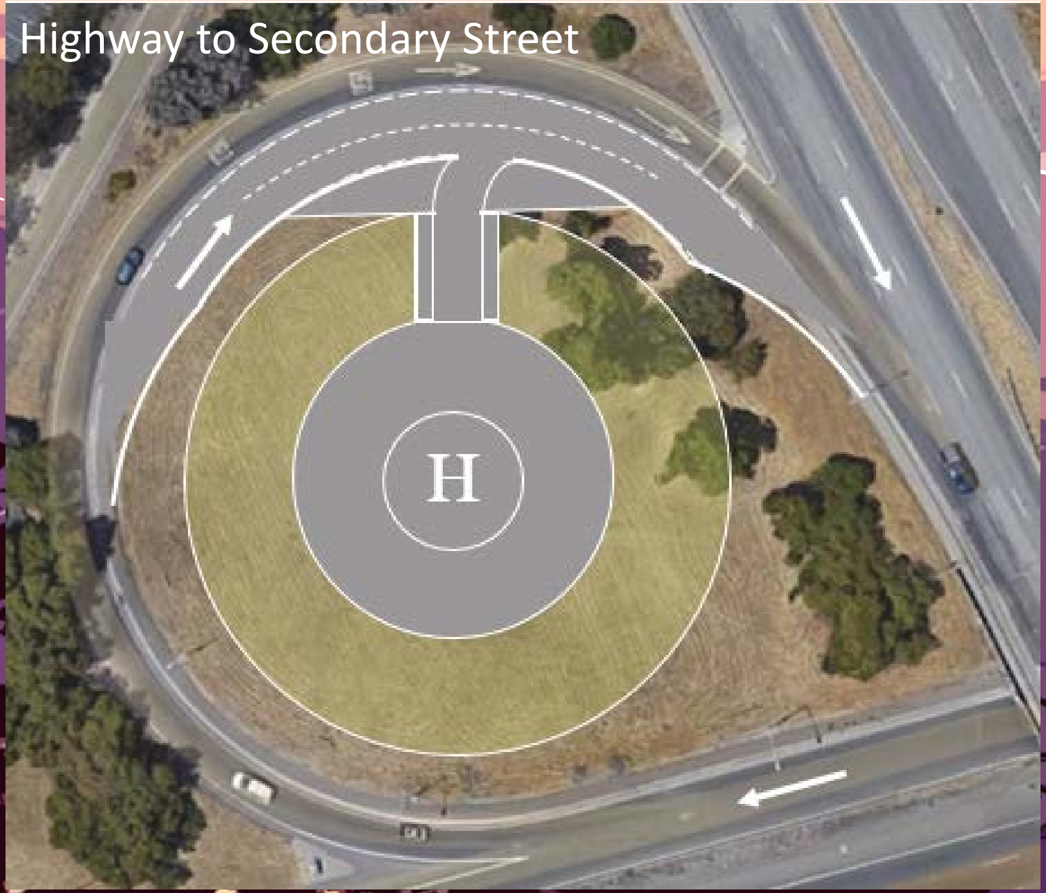
- CTOL with 3˚ glideslope requires 9550’ (not shown)
- STOL with 12˚ glideslope requires 2350’ field length
- ESTOL with 20˚ glideslope requires 1375’ field length
- ESTOL with 30˚ glideslope requires 866’ field length
- ESTOL with 45˚ glideslope requires 500’ field length
- VTOL with 90˚ glideslope requires 0’ field length, but FAA guidelines for setbacks require a 200’ circle.

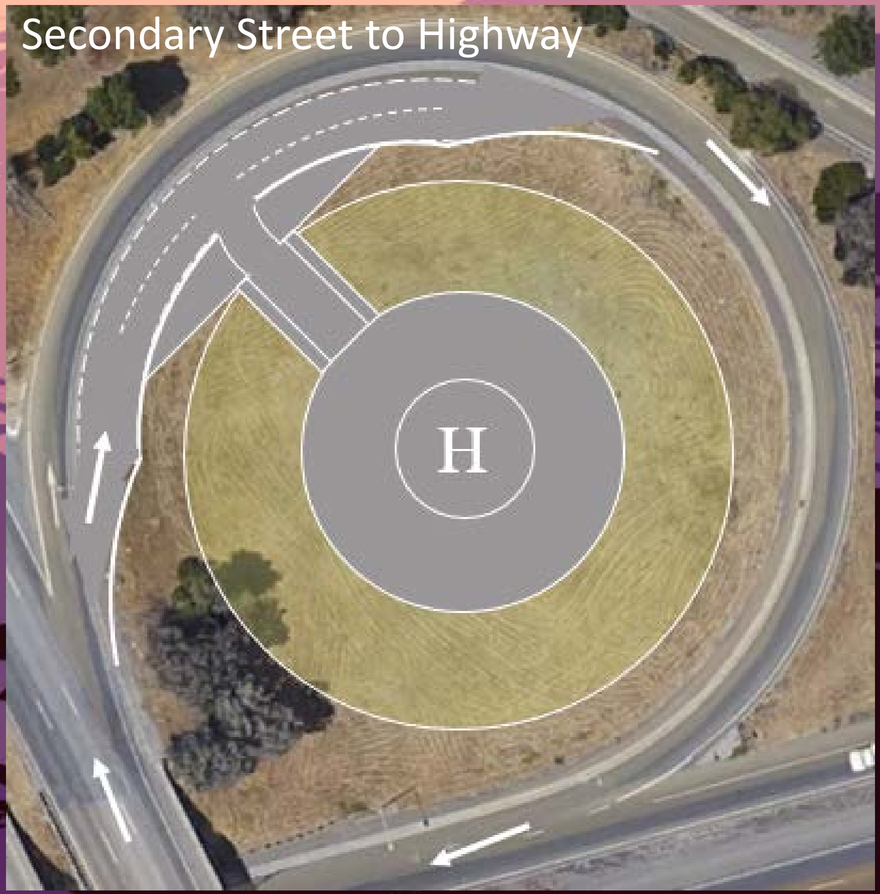






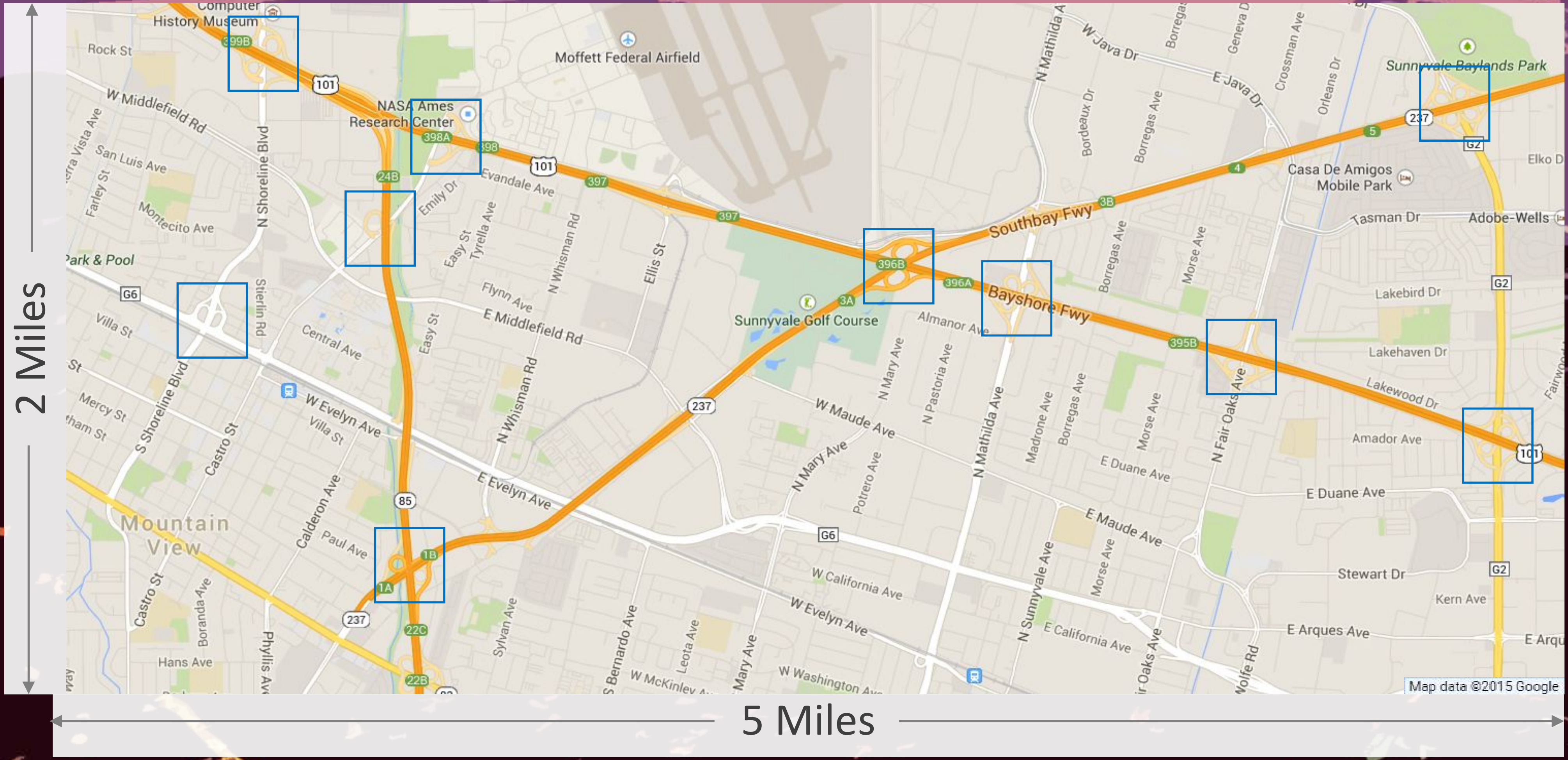






- Available DOT land resource provides approach/departure paths without overflight of private property at <500 ft.
- Existing high noise area that the community accepts with established setbacks
- Distribution that couples to existing ground roads for minimum travel time

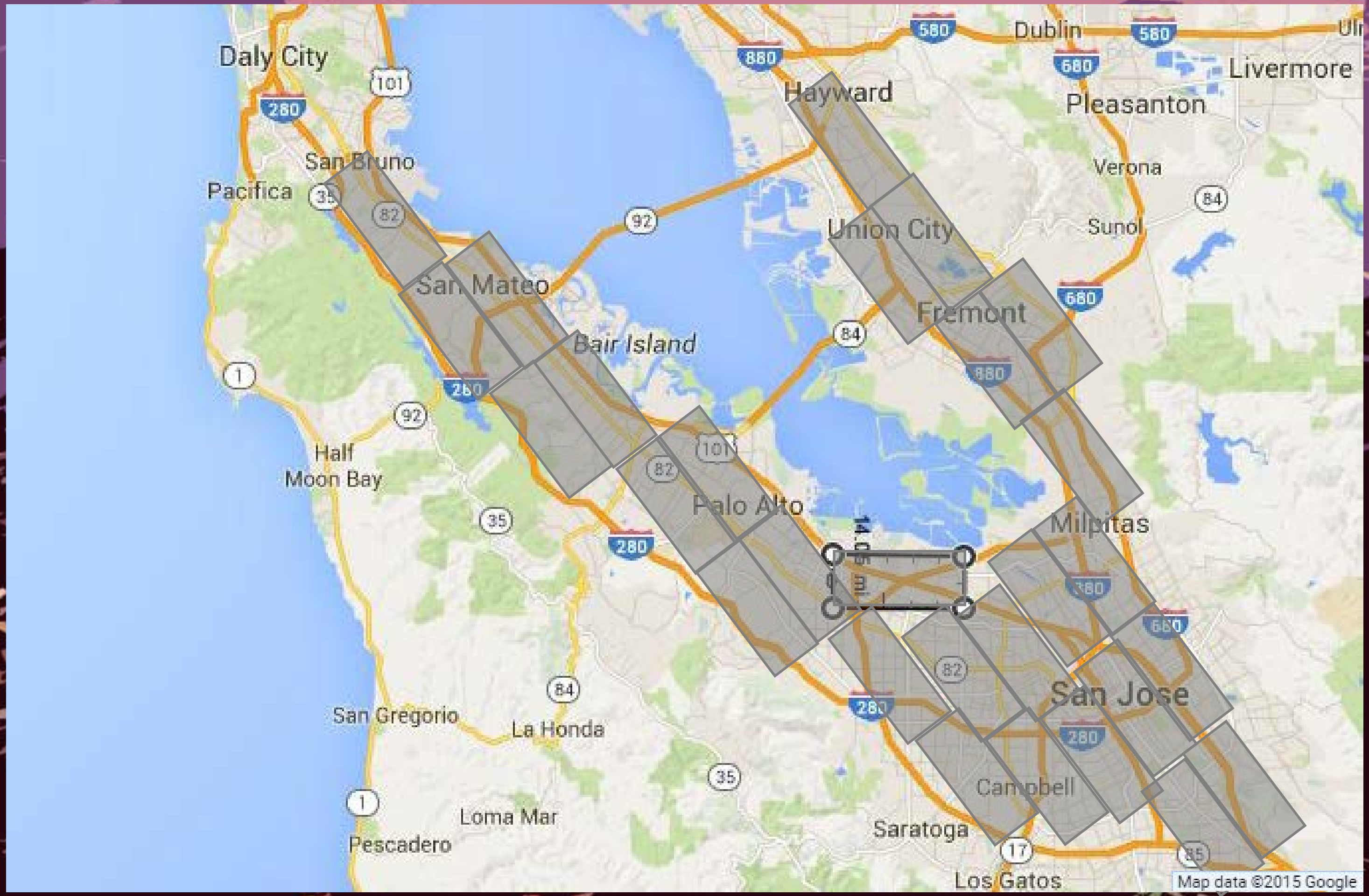
10 Sq. Miles | 10 Intersections | 19 Potential Helipads



Selection Criteria:

- > 200 ft. diameter cloverleaf
- No obstructions

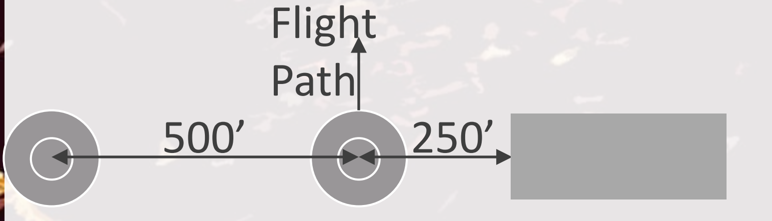
280 Sq. Miles | 105 Intersections | 200 Potential Helipads

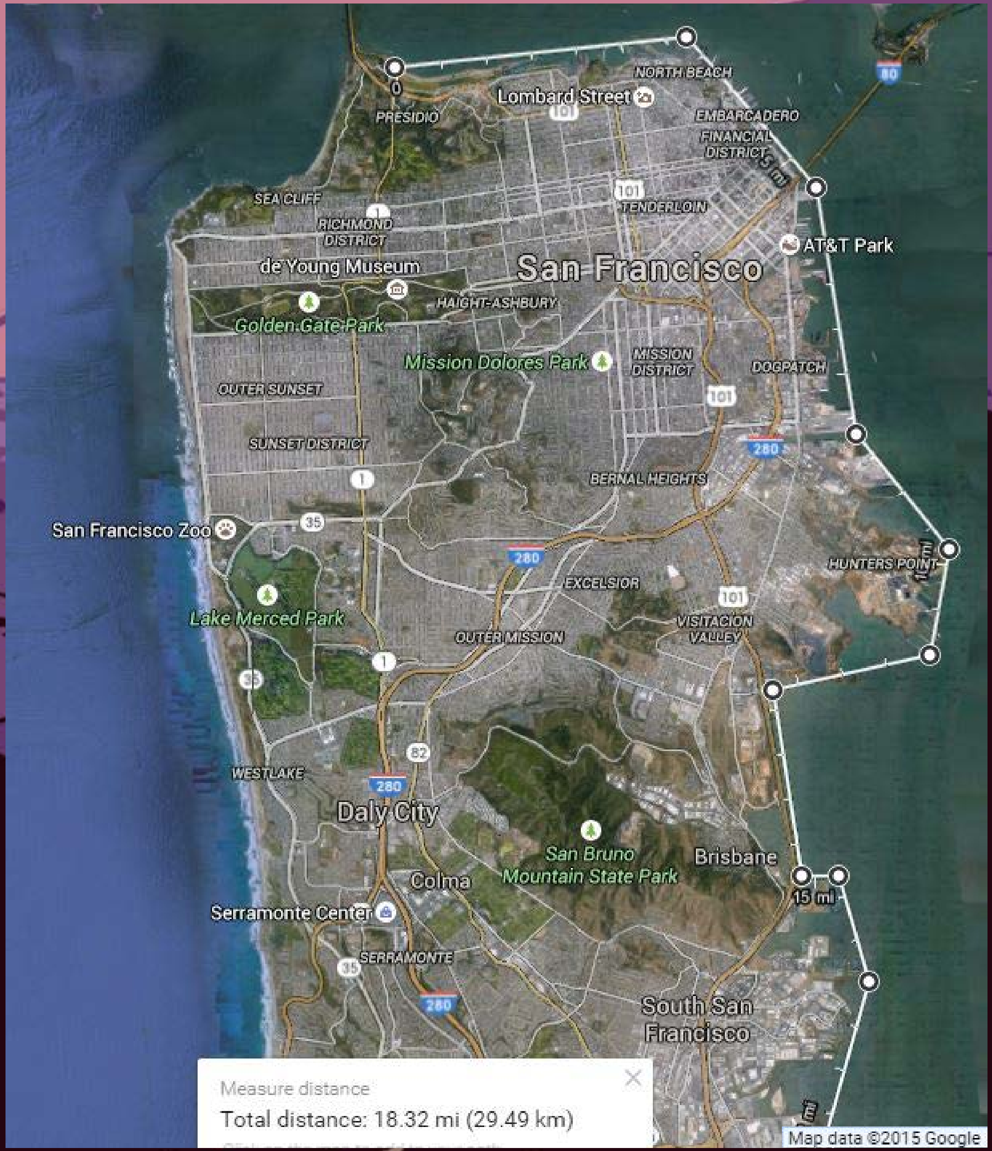


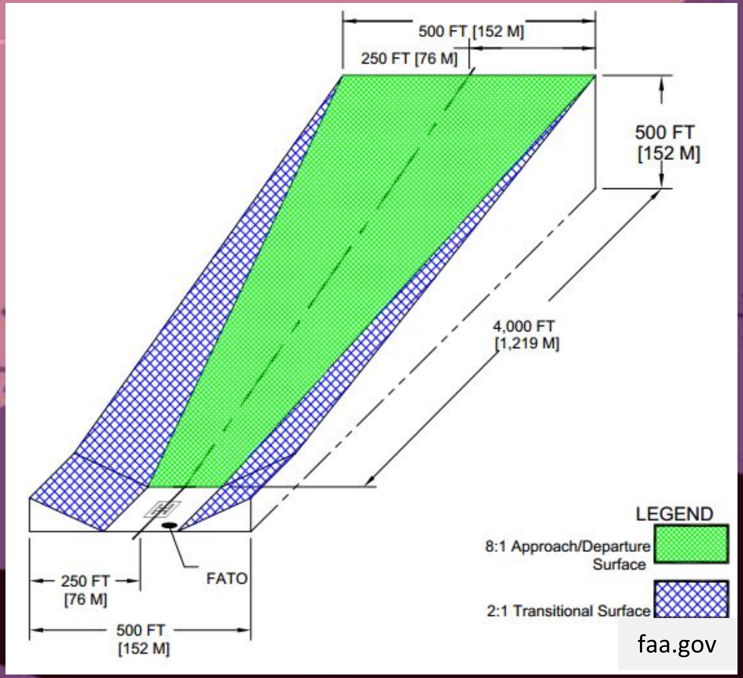
18 Coastal Miles | 50 Potential Helipads

Selection Criteria:

- Direct Roadway Access
- 500’ distance between two helipads perpendicular to flight path
- 250’ distance from center of helipad to other obstruction perpendicular to flight path







Additional Requirements:

- Min: 45 deg. crosswind
- 500 ft. private ground clearance

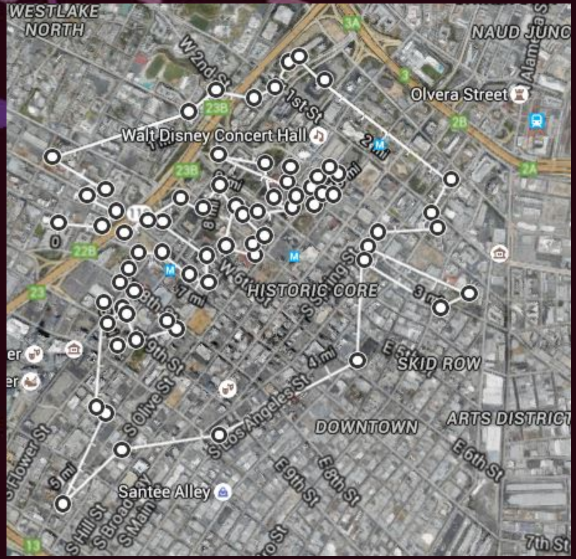
Los Angeles no longer requires helipads on buildings, allowing for bolder skyscraper designs

All buildings required helipads with heights >75' built between 1974 - 2014

Table 3: Mean Travel Time and Mean Distance for the Most Frequent Mega Commuter Flows

Top 10 Mega County Commuter Flows by Frequency

State	County	POW State	POW County	Mean Travel Time	Mean Distance
California	San Bernardino County	California	Los Angeles County	104.2	68.0
California	Riverside County	California	Los Angeles County	109.3	77.4
New York	Suffolk County	New York	New York County	114.2	64.5
Connecticut	Fairfield County	New York	New York County	104.2	60.4
New York	Orange County	New York	New York County	110.7	62.3
New Jersey	Mercer County	New York	New York County	104.6	59.3
California	Riverside County	California	San Diego County	102.3	75.5
New York	Dutchess County	New York	New York County	116.8	76.3
California	San Joaquin County	California	Alameda County	104.1	61.5
Pennsylvania	Monroe County	New York	New York County	120.5	91.1



- A follow-on study has been funded in FY16, to include the following additional modeling and analysis…
- Demand modeling using the Transportation Systems Analysis Model (TSAM), with validation from aggregate cell phone location data.
- Assess the effects of the flown trajectories on existing air traffic using airspace simulation to determine airspace capacity limits for the region.
- Implement specific concept approaches designed to meet detailed CONOPs requirements.
- Analyze the effects across mobility metrics of door to door trip speed, emissions, energy cost, and percentage of trips captured; across several specific markets.
- Partnering with MIT to investigate Los Angeles as another specific early adopter market location.