Operational Aspects of Aircraft-Based On-Demand Mobility

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Aircraft-Based ODM

- **Intra-City, Aircraft-Based On-Demand Mobility (ODM)**
  - Multi-modal, point to point transit within a city
  - Enabled by advancements in electric aircraft and autonomy
  - Overcomes highway or transit infrastructure limitations and congestion
  - Expands the mobility reach of economic basins
  - Diversifies mobility options available to residents

- **Key Challenges Facing Intra-City ODM**
  1. Airspace Integration
  2. Air Traffic Interaction
  3. Ground Infrastructure Availability
  4. Noise Management
  5. Operations and Certification

Aircraft-Based ODM

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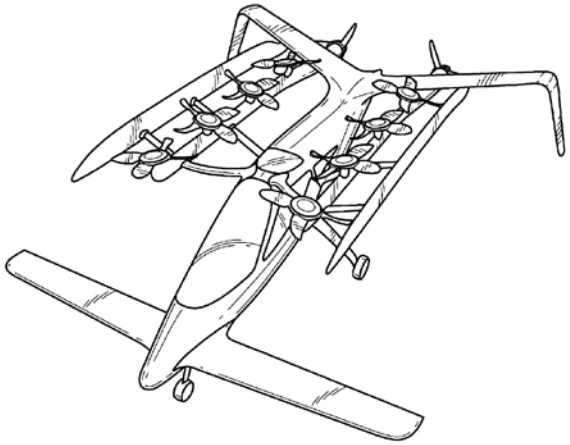

ZeeAero

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Are proposed CONOPS for On-Demand Mobility consistent with airspace integration, regulation, and operational constraints, both today and in the future?

MIT ODM CONOPS Study

- **MIT Study on ODM Airspace Operations and Integration**
  - Began collaboration in February, 2016
  - Goal is to determine the range of reasonable concept of operations (CONOPS) for intra-metropolitan air transportation
  - Consider airspace, regulatory and infrastructure constraints
  - Collect extensive stakeholder and subject matter expert input
  - Focus on Los Angeles county as preliminary case study

Phase 1: Short-Term Implementation

- Operation within existing airspace definitions, regulations and constraints
- Human piloted 1-2 PAX personal air vehicles and 2-4 passenger ODM vehicles

Phase 2: Longer-Term Architecting

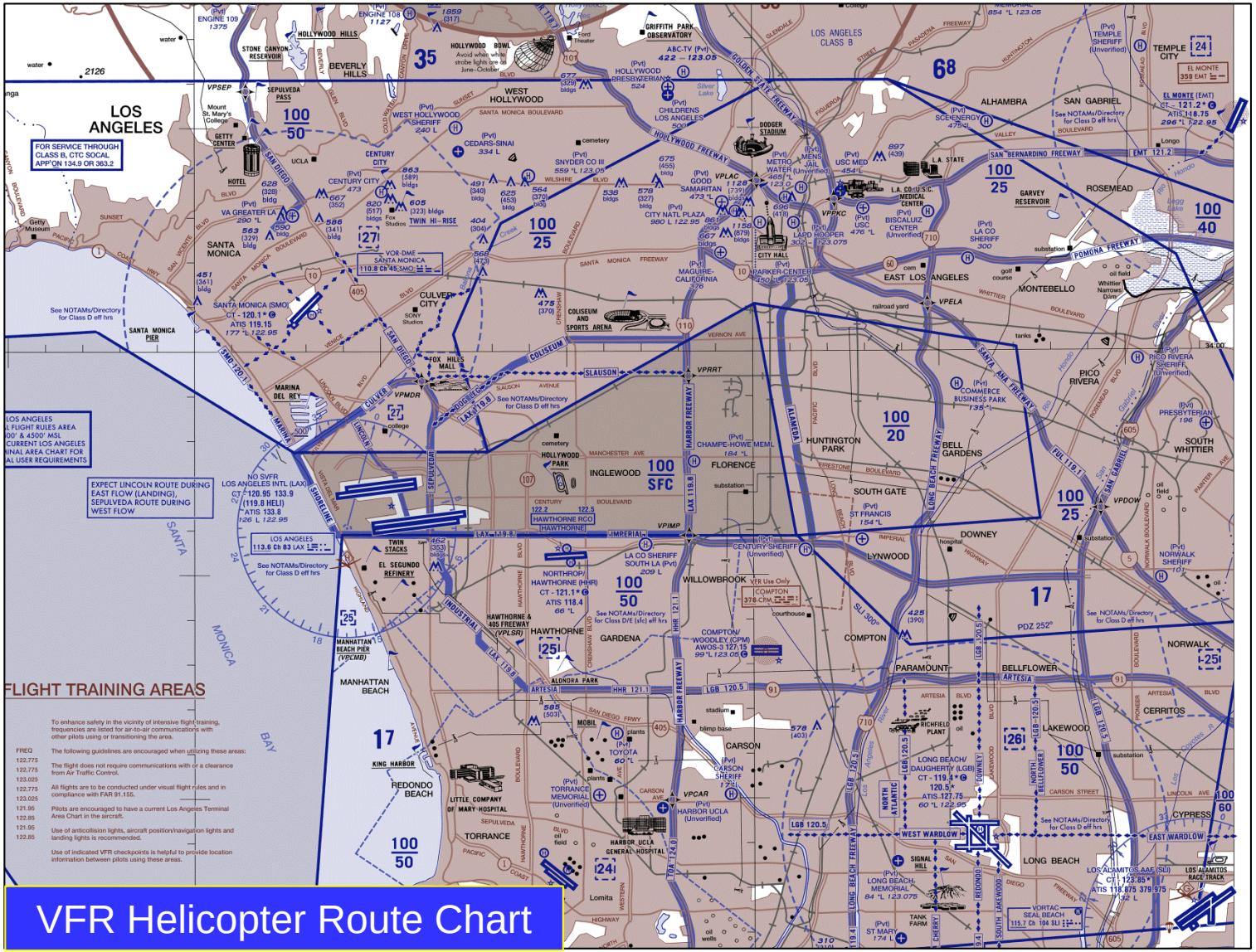
- Investigate airspace, regulation or constraint changes to enhance ODM operations
- Additionally consider package delivery UAS, automated manned vehicles and 4-9 passenger thin-haul aircraft

Preliminary LA Airspace Review

- **Characterize Existing LA Airspace**
  - Controlled airspace
  - VFR helicopter routes
  - Current air traffic density (fixed wing and rotorcraft) in potential ODM flight envelope
  - NOTAMs and Temporary Flight Restrictions (TFRs)
  - Minimum altitude and speed constraints

- **Influence of Airspace on ODM CONOPS**
  - Route planning
  - Aircraft equipage and pilot training
  - Vehicle flight envelope requirements

LA Basin Airspace Constraints



LA Basin Airspace Constraints

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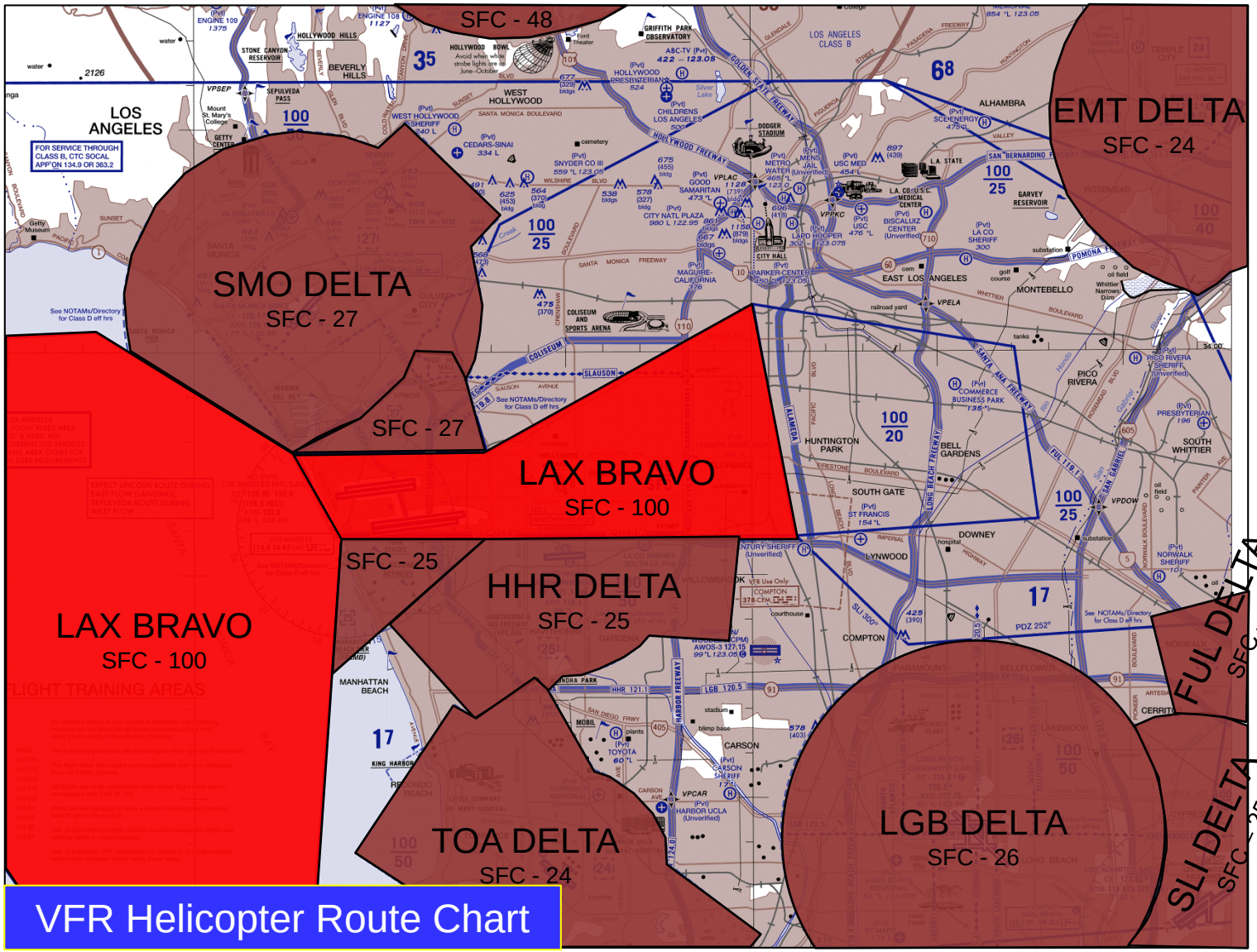

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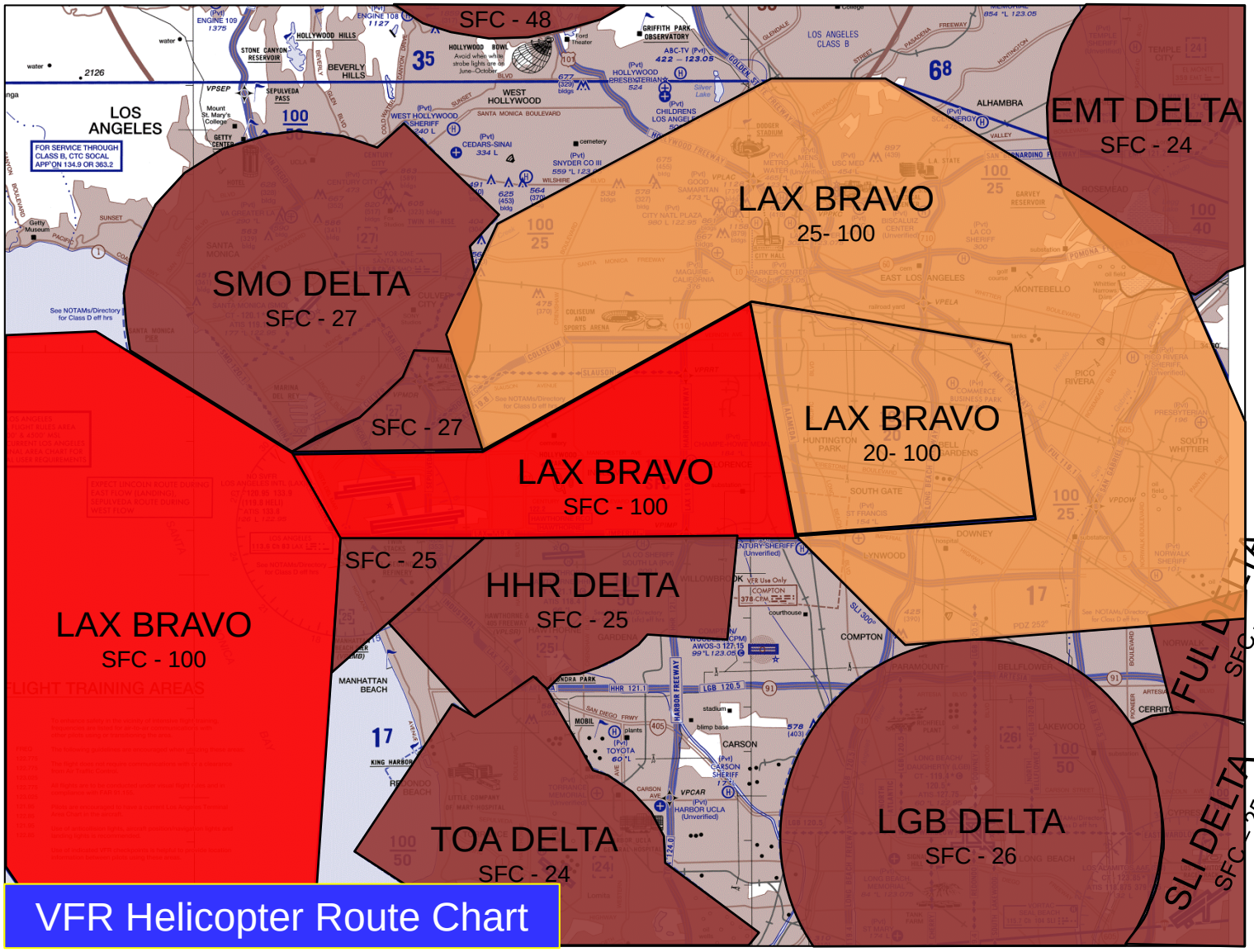

VFR Helicopter Route Chart

LA Basin Airspace Constraints

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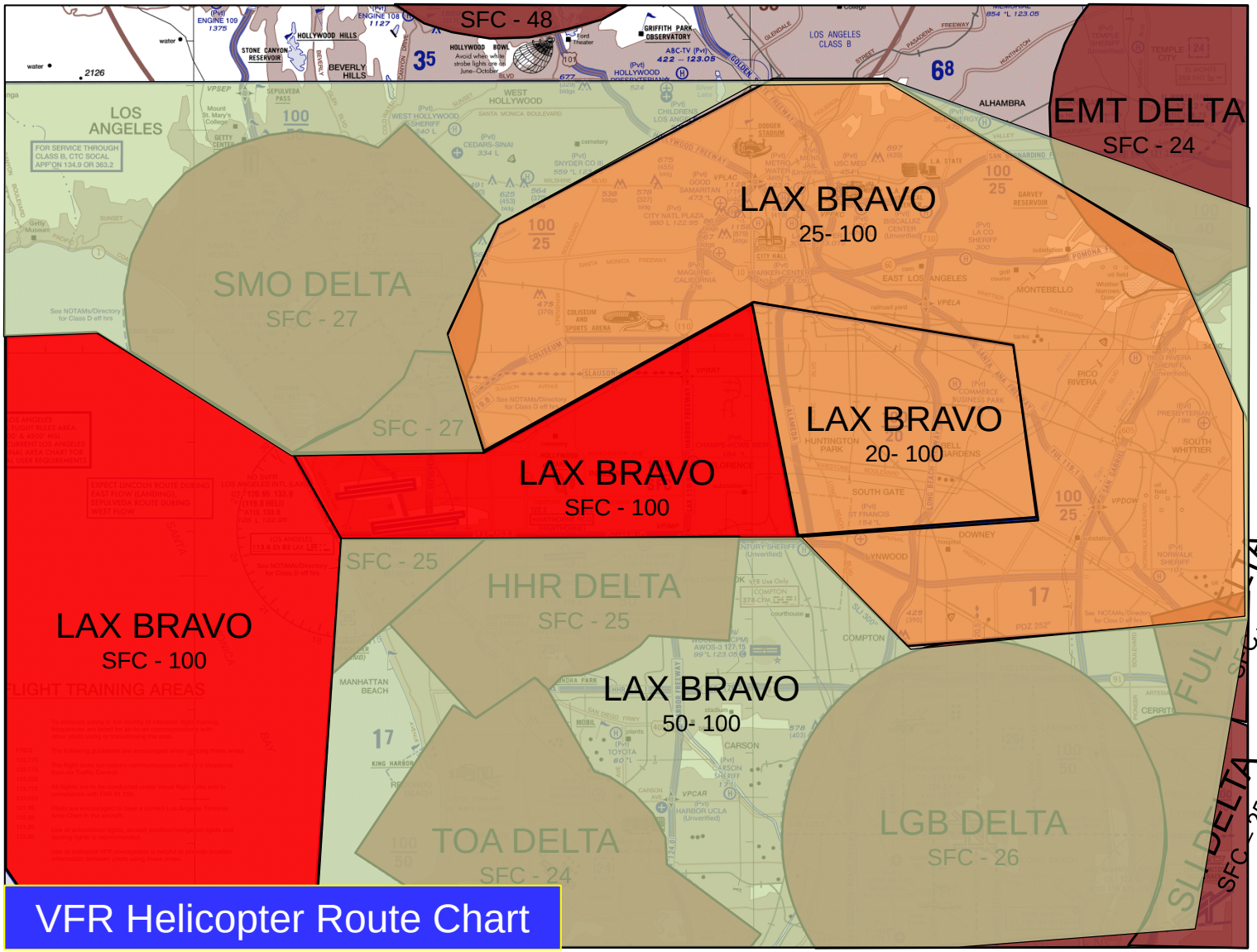
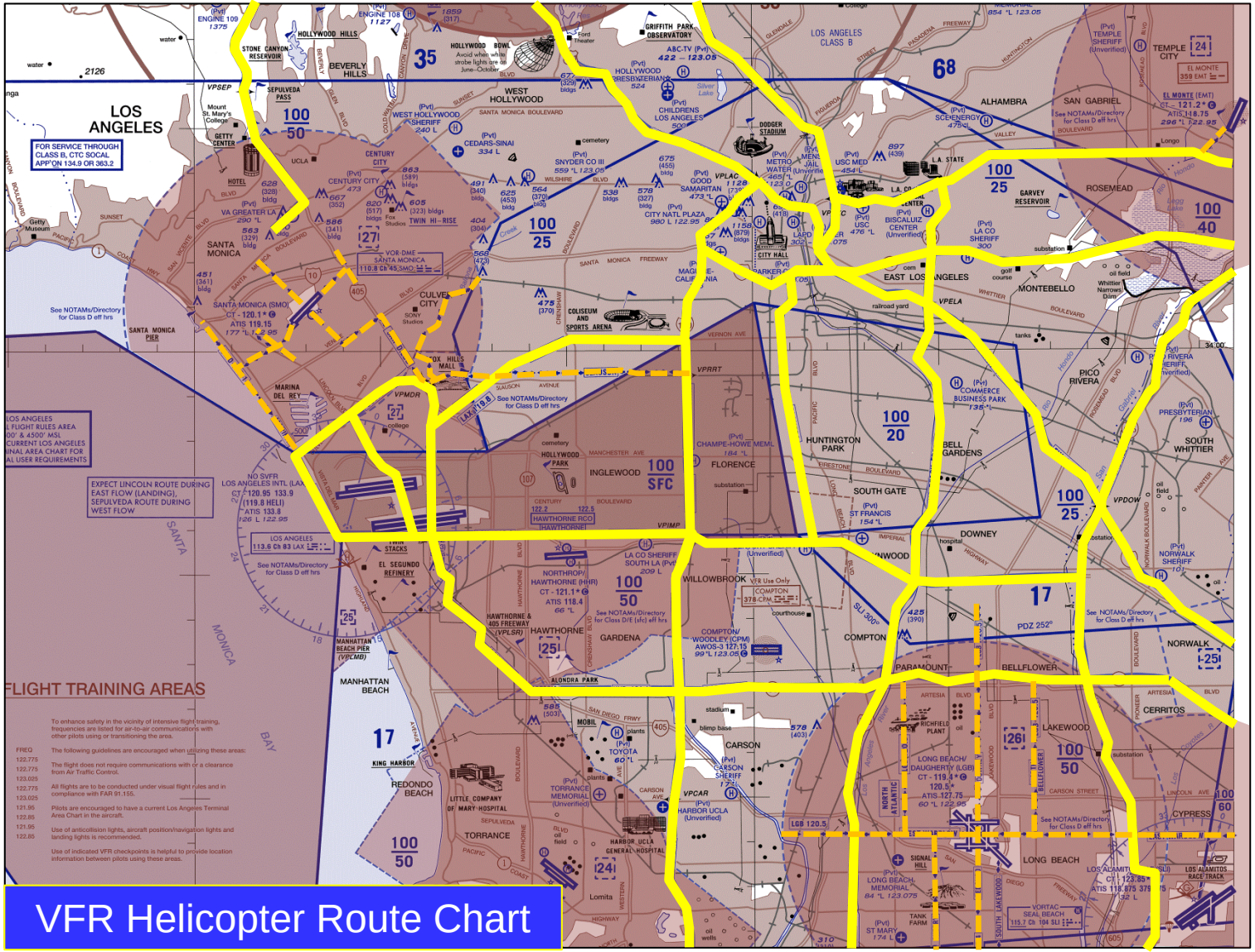


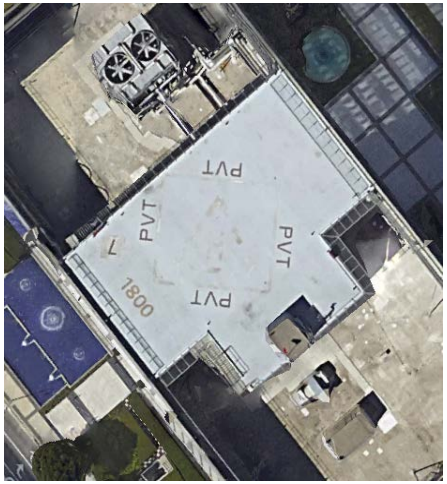
VFR Helicopter Route Chart

Current Helicopter Routes



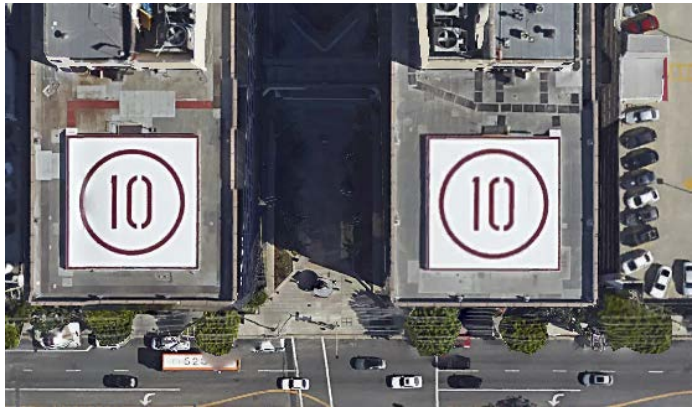
Existing LA Ground Infrastructure Constraints

- **Existing LA ODM Aircraft Ground Infrastructure**
  - 15 public use airports
  - 11 private use airports
  - 138 private use FAA registered heliports
  - A large number of Emergency Helicopter Landing Facilities (EHLF) on high-rise buildings



Century City

Los Angeles Times



Cedars Sinai (EHLF)

Existing LA Ground Infrastructure Constraints

- **Los Angeles Municipal Code 57.4705.4**
  - All buildings over 75 ft constructed since 1974 in LA County must have an Emergency Helicopter Landing Facility (EHLF) or heliport
  - Dimensions of pad must be at least 50 x 50 ft
  - EHLF facilities are not certified by the FAA for commercial use
  - LA Fire Policy 10 released buildings from this requirement beginning in 2014

- **California Public Utilities Code § 21662.5**
  - No helicopter may land or depart within 1,000ft of a public or private K-12 school unless the location is a permitted, permanent heliport

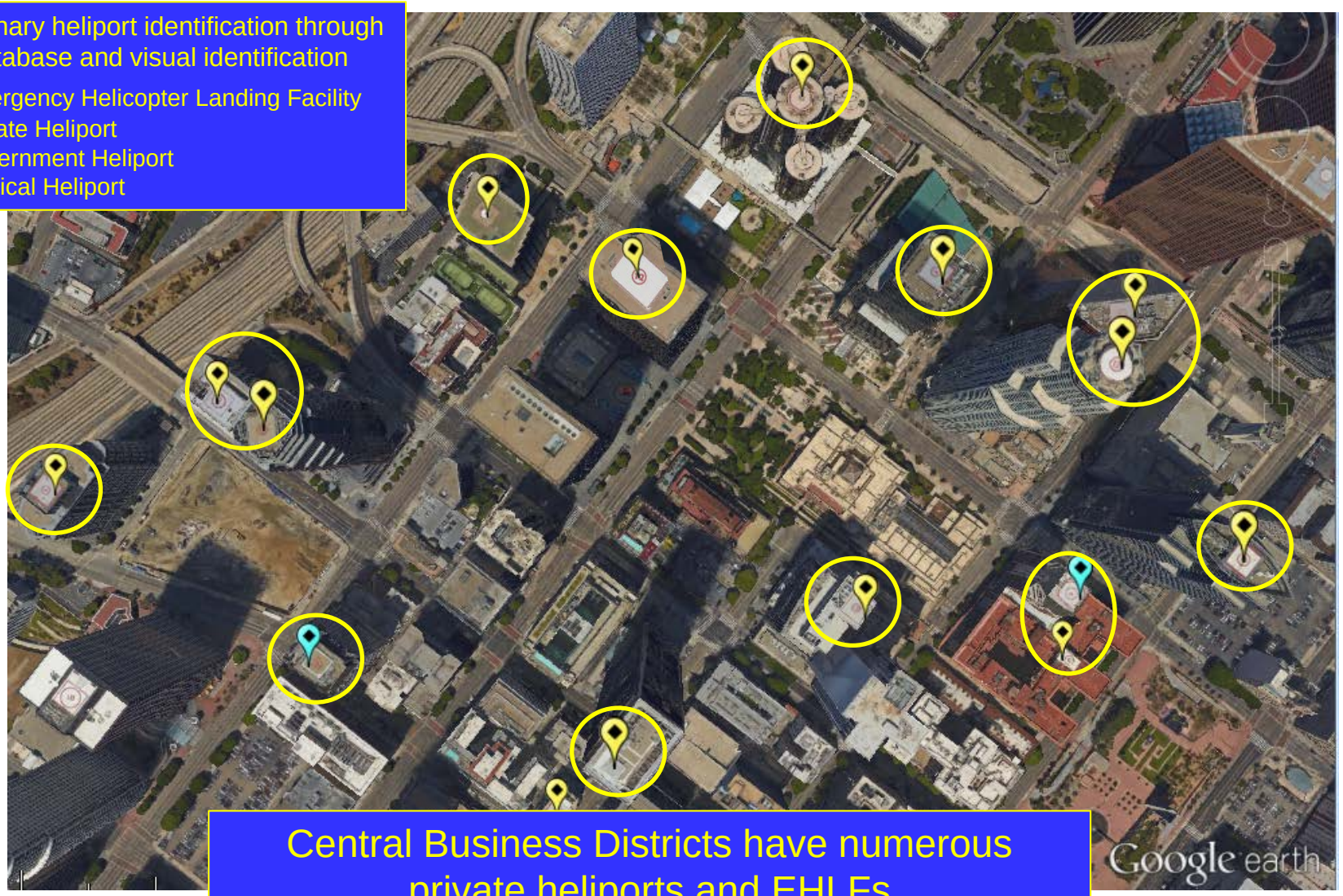
Existing LA Ground Infrastructure Constraints

- **While helipads are numerous in LA, their utilization for ODM operations faces numerous challenges**
  - Uneven distribution and the existence of unserved areas
  - No public heliport facilities
  - Certification and transition of emergency landing pads to usable commercial facilities
  - Airport facilities are limited and posses little ability to expand to accommodate high volume ODM operations
- **The development of new facilities or the use of alternative landing locations may be investigated**
  - Heliport design: AC 150/5390-2
  - Vertiport design: AC 150/5390-3 (cancelled 2010)

Existing LA Ground Infrastructure Constraints

Preliminary heliport identification through HAI database and visual identification

- Emergency Helicopter Landing Facility
- Private Heliport
- Government Heliport
- Medical Heliport



Central Business Districts have numerous private heliports and EHLFs

Existing LA Ground Infrastructure Constraints

Preliminary heliport identification through HAI database and visual identification

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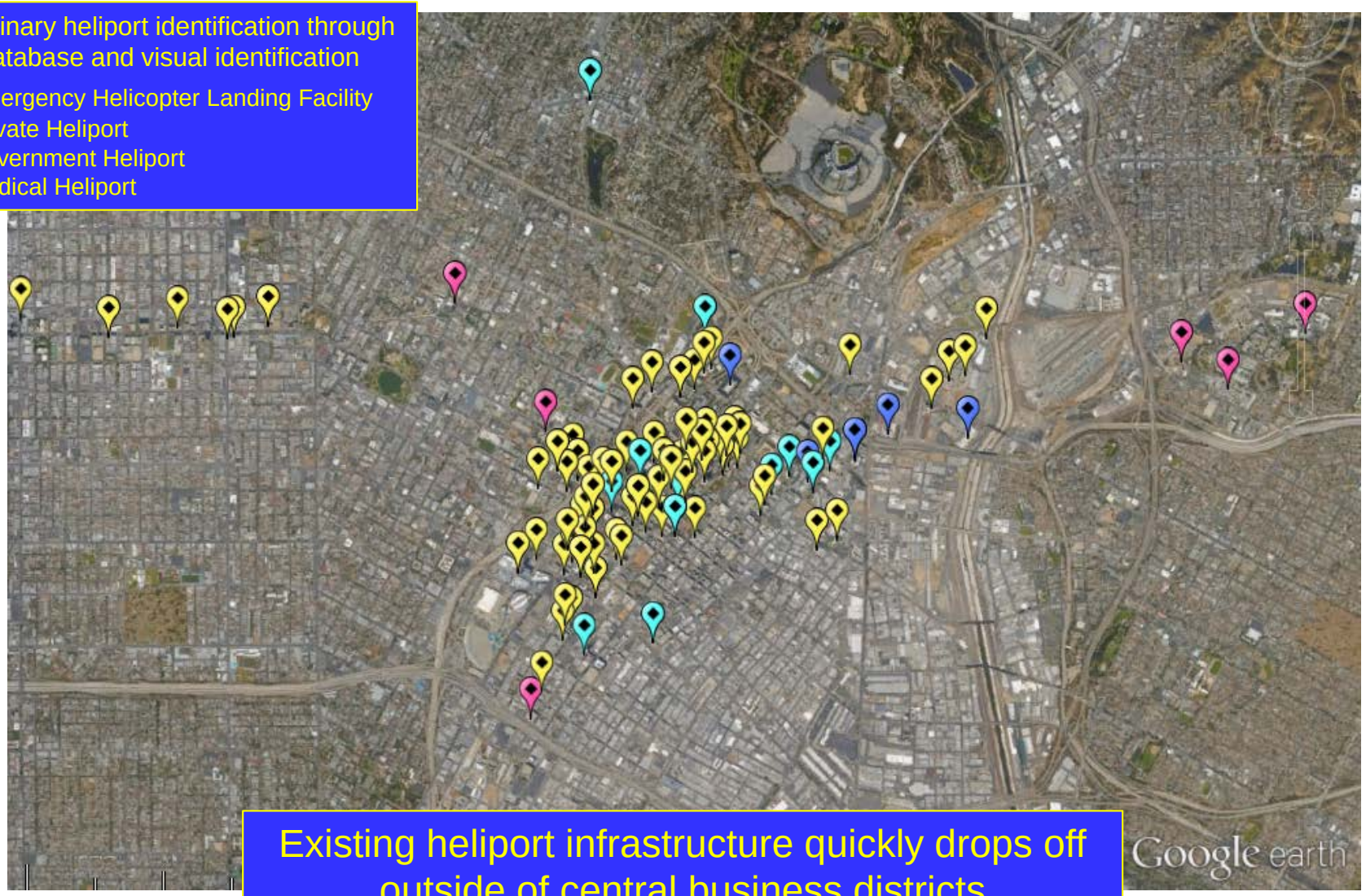
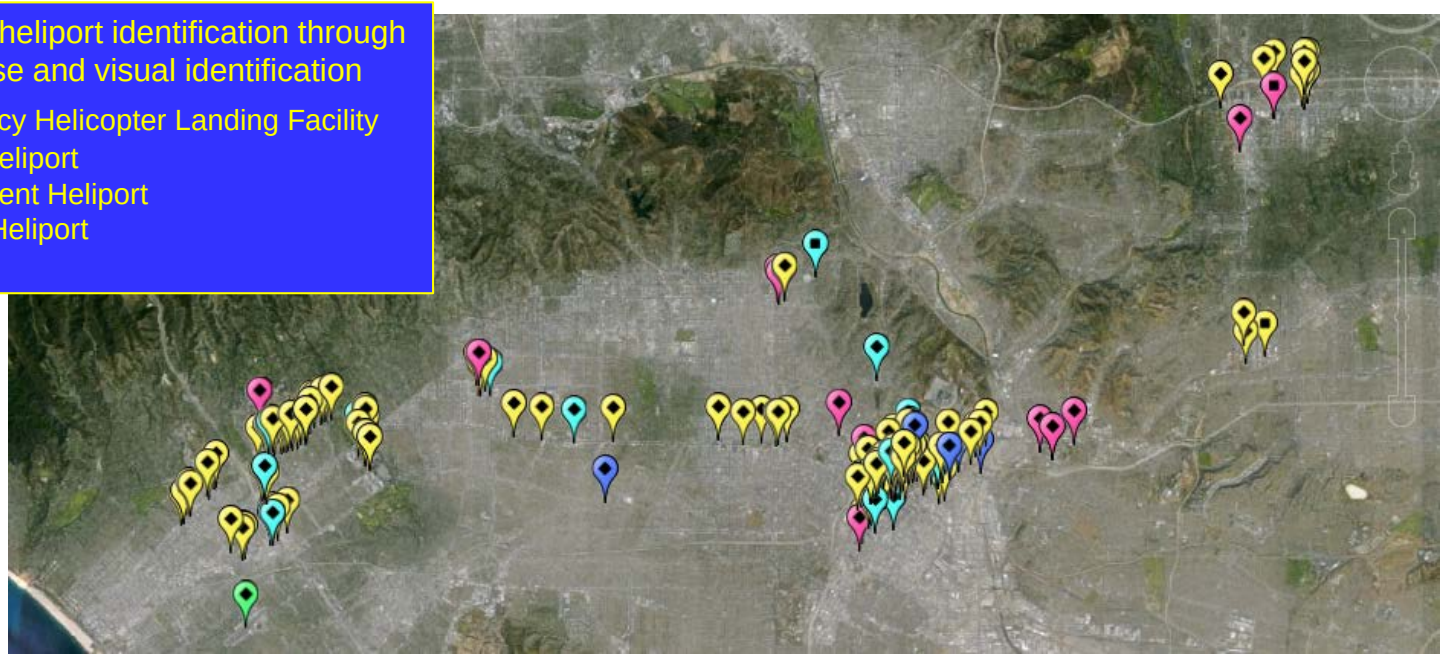


Existing heliport infrastructure quickly drops off outside of central business districts

Existing LA Ground Infrastructure Constraints

Preliminary heliport identification through HAI database and visual identification

- Emergency Helicopter Landing Facility
- Private Heliport
- Government Heliport
- Medical Heliport
- Airport

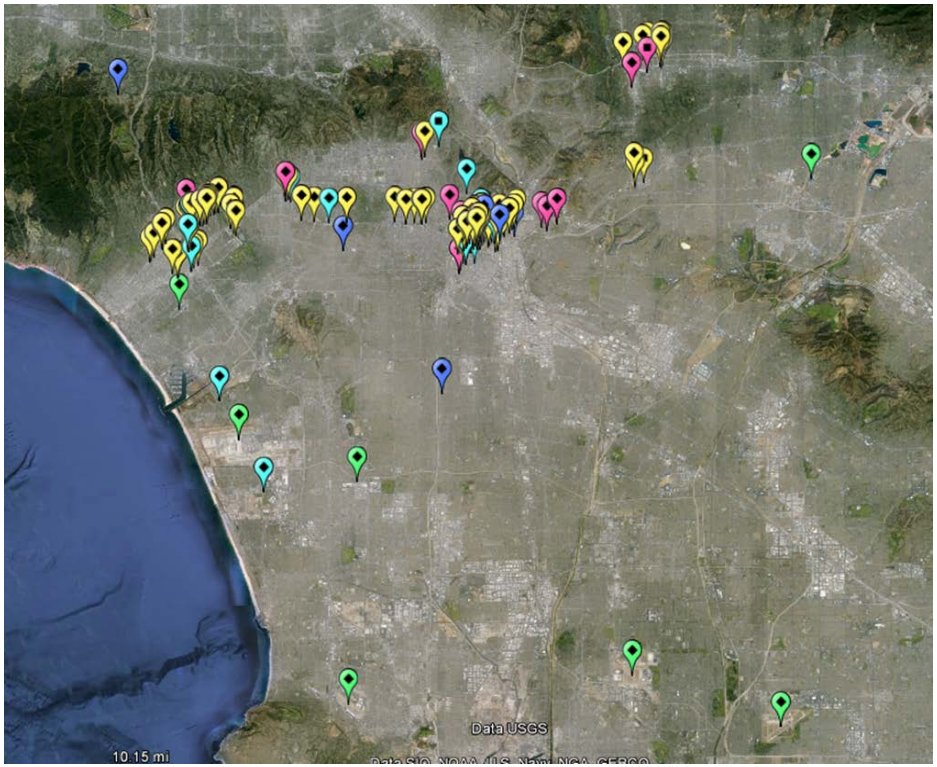


Google Earth

- **Polycentric nature of Los Angeles is apparent through clumping of existing heliport infrastructure**
- **EHLFs must be updated and certified by the FAA for use beyond emergency situations**
- **Additional ODM landing facilities may be necessary to support operations outside central business districts**

Existing LA Ground Infrastructure Constraints

Existing Helicopter Infrastructure



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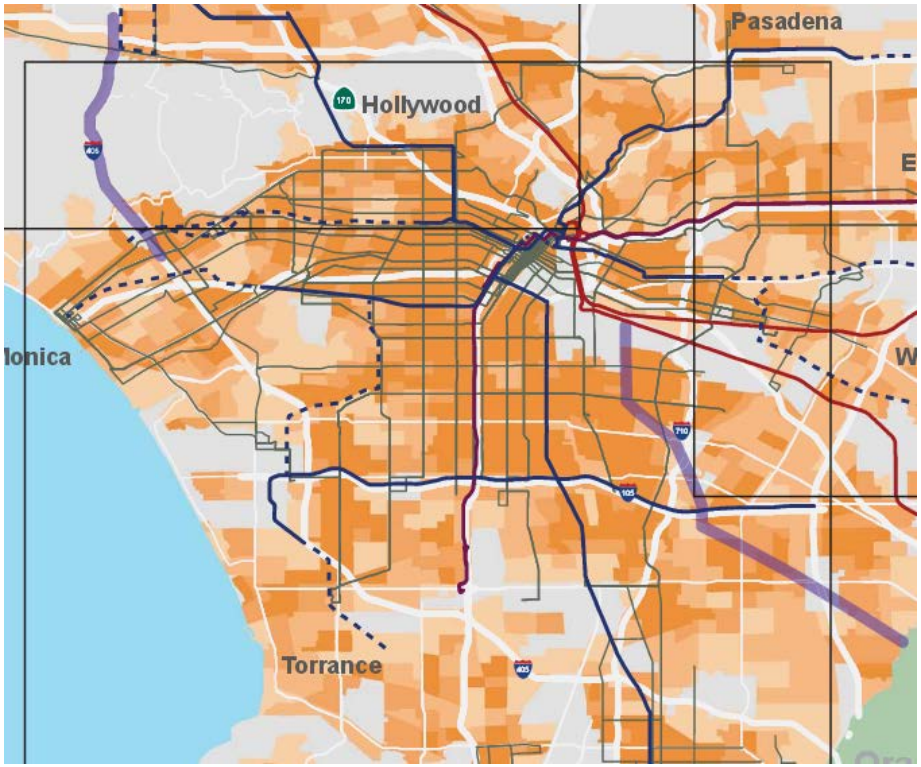
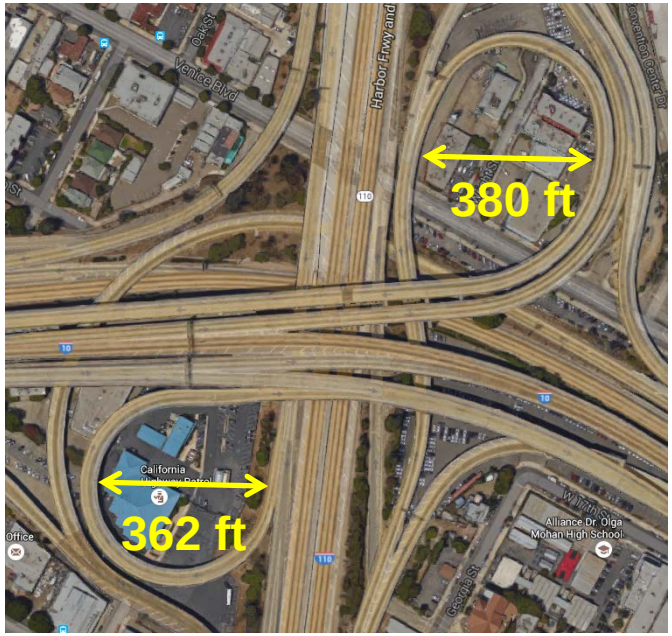
Population Density

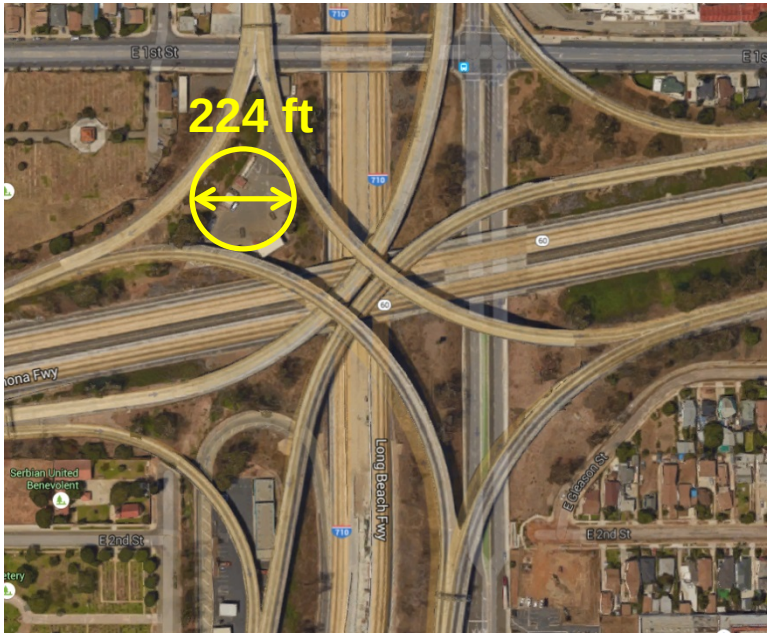


reconnectingamerica.org

Existing LA Ground Infrastructure Constraints

- **Developing vertiports in traffic interchange "clover leafs" has been proposed, as well as over interstates**
  - Land is generally already utilized in LA county if space is sufficient
  - Approach and departure path clearances and ground vehicle access requires further exploration



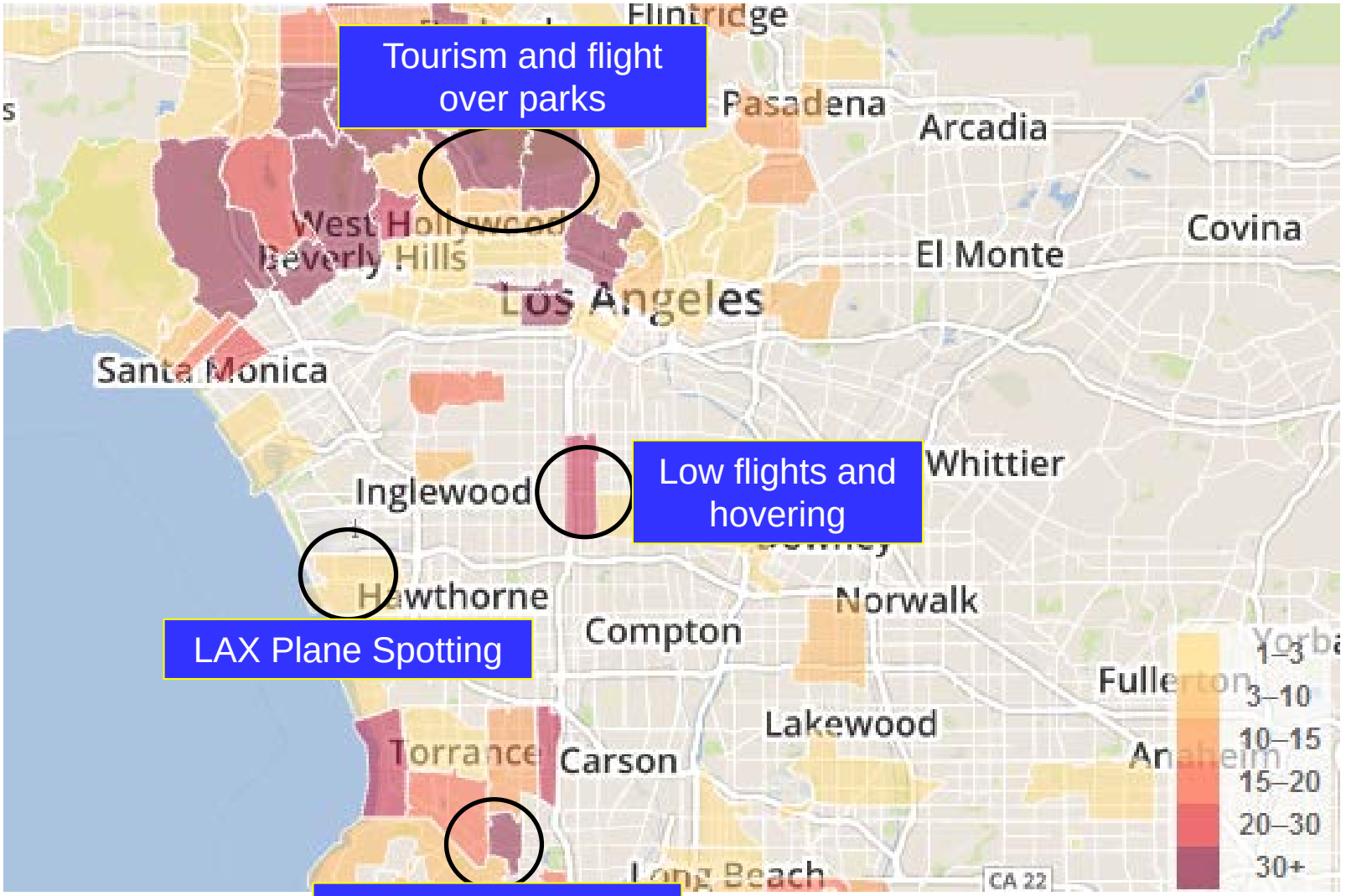


Google Earth

Noise Constraints

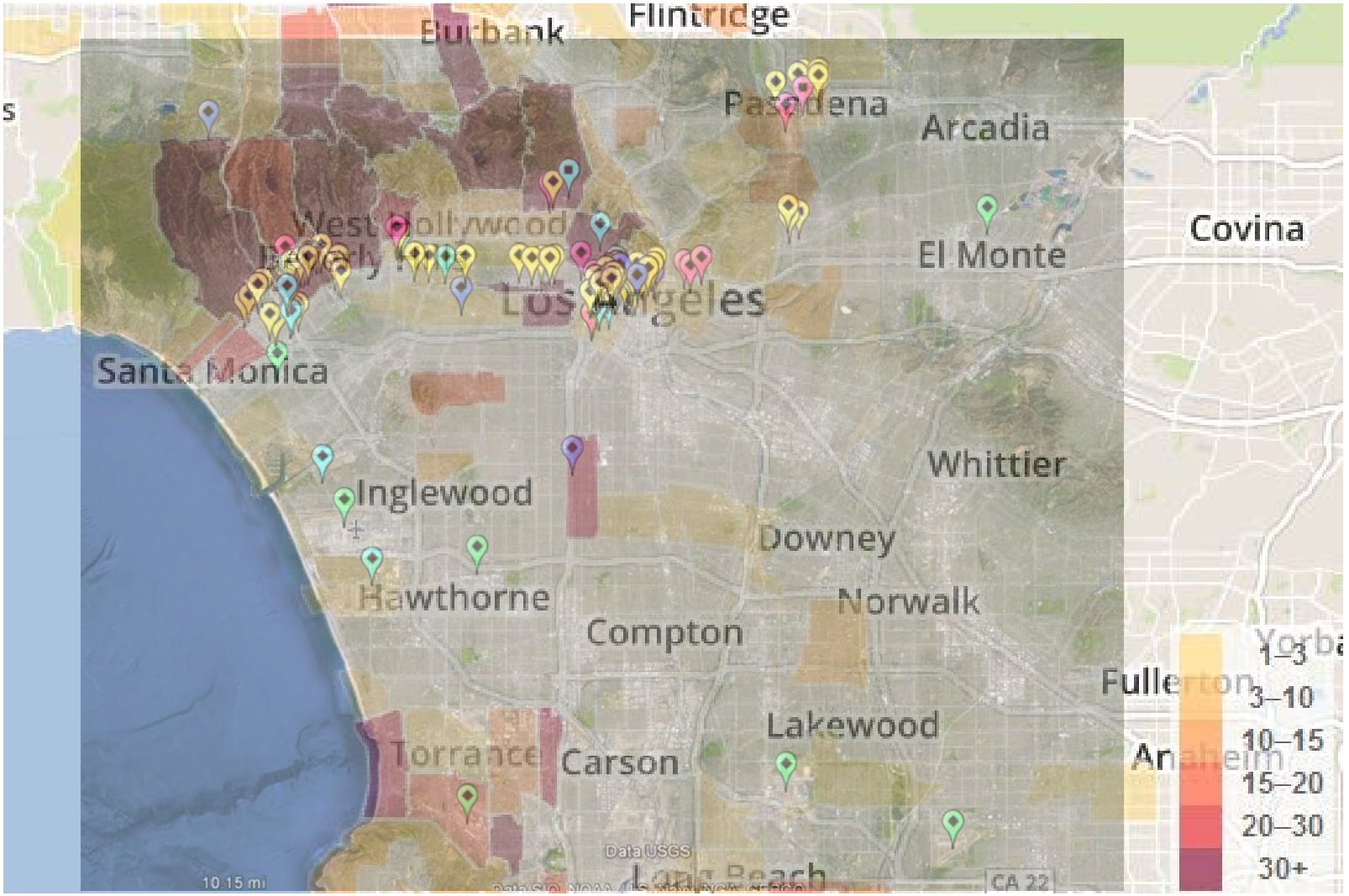
- **One of the most significant constraints for intra-city ODM operations will be noise**
- **The FAA has released multiple studies on the subject, including the 2013 *Los Angeles Helicopter Noise Initiative***
  - Identified noise “hot spots” in LA
  - Led to the development of three new helicopter routes
  - Created the LA Automated Complaint System (ACS) for noise
- **A majority of complaints originate from:**
  - Low altitude flights over neighborhoods
  - Extended hovering over tourist sites or news events
  - Flights over recreation areas and large, public events
  - The high concentration of flights near airports
  - Training and test flights near Robinson Helicopters

Noise Constraints



ACS: heli-noise-la.com

Noise Constraints



ACS: heli-noise-la.com Google Earth Overlay

ODM Operations and Certification

- **Numerous operations and certification questions create significant uncertainty in the design of CONOPS for ODM vehicles**
  - Certification as helicopters or fixed wing vehicles?
  - 0, 1, 2 pilots?
  - What are the significant demand patterns?
    - Flight to or from residential areas
    - Flight to or from airports
    - Flight to or from central business districts

ODM Operations and Certification

- **A preliminary review of the Federal Aviation Regulations provides initial insights into potential ODM operation constraints**
  - § 91.117: Aircraft speed limitations
  - § 91.119: Minimum safe altitudes
    - Helicopters exempt if causing no hazard
  - § 91.151: Reserve fuel requirements for VFR conditions
  - § 93.95: Special air traffic rules for flight in vicinity of LAX
    - Basic VFR weather minimums in effect
    - Class B equipage required
    - Airspeed shall not exceed 140 knots
  - § 135.4: Pilot requirements for eligible on-demand operations
    - Must have a two-pilot crew
    - Pilots must have instrument ratings
  - § 135.203: VFR Minimum Altitudes

Summary

- ODM aircraft intra-city operations present fundamentally new opportunities and challenges
- Our approach is to identify constraints, review the existing FARs, and develop CONOPS for near short and long-term operations

We welcome feedback from this group about our approach and their ideas for ODM CONOPS development

Thank You

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