DFW AAM Corridor Studies

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Presented to NCTCOG

Outline

Study 1:

- Motivation/objectives
- Design of corridors
- Example of analysis of Corridors
- Revised Corridors

Study 2:

- ATM Interoperability Simulation for UAM

Motivation/Objectives

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Previous Research

- Explored procedures for UAM operations accessing controlled airspace using current day helicopter routes and procedures
  - Letter of Agreement (LOA) reduces ATC communications by 20%
  - ATC workload creates limitations in scalability for UAM operations
  - Digital communications may change nature of workload but are not likely to reduce workload
- UTM inspiration
  - UTM airspace is below 400 ft AGL and does not require ATC services
  - Identify airspace in the National Airspace System that would require minimal or no ATC interaction for UAM operations

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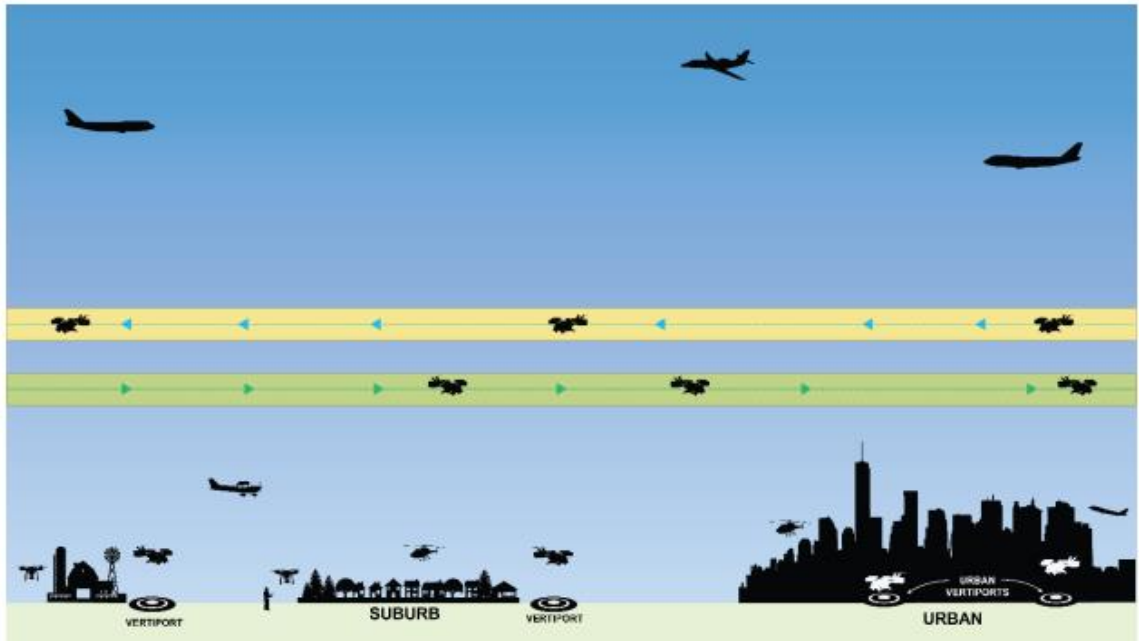
FAA Conops v2.0 on UAM Operations

- Air traffic management vision for initial UAM operations
- FAA-defined UAM corridors with specific performance requirements
- Vehicles planned for UAM likely to be electric vertical takeoff and landing (eVTOL)
- Aircraft operator connection to a “Provider of Services for UAM” (PSU)
- Separation within corridors assigned to pilots, operators, and PSUs - not ATC
- UAM operations will start with today’s rules and procedures and evolve to incorporate Cooperative Operating Practices (COPs)



Source: FAA UAM Conops v2.0

Objectives

- To design and analyze corridors in the Dallas area
  - Dallas Fort Worth (DFW)
  - Dallas Love field (DAL)
- Goals for the design of corridors
  - Does not require additional ATC infrastructure
  - Minimizes impact on ATC workload
  - Minimizes impacts to operations of traditional airspace users
  - Meets appropriate safety thresholds and requirements
  - Allows for scalability

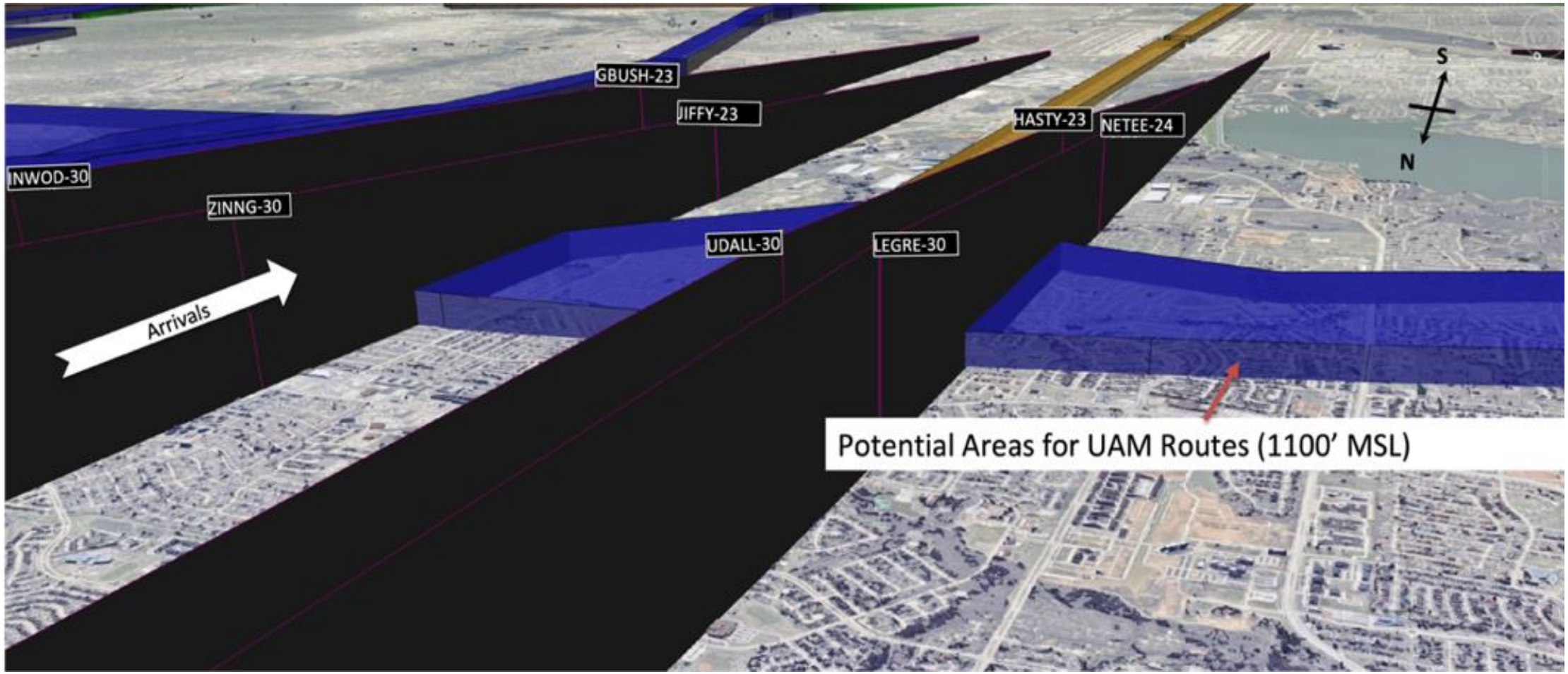
Design of Corridors

Assumptions

- DFW airspace is evaluated South Flow
- Visual Flight Rules under Visual Meteorological Conditions
- Pilot on board
- Vehicle is assumed to operate as a helicopter

Design of Corridors

Step 1: Use wake advisory criteria when one aircraft is behind another. ATC does NOT need to provide advisories if lateral separation is more than 2,500 ft OR vertical separation is more than 1,000 ft.
Step 2: Identify the airspace with the wake advisory criteria using published Instrument Approach Procedures (IAP)

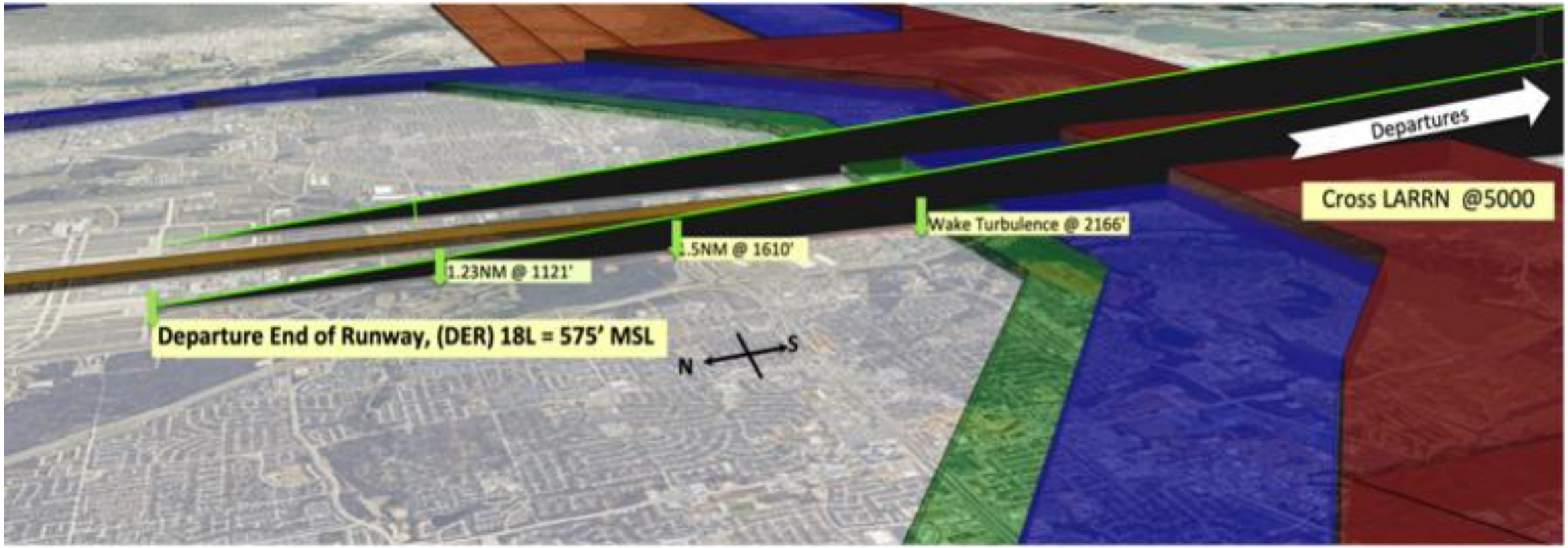


Instrument Approach Plate for South Arrivals into DFW

Design of Corridors

(Use of SID to define available altitudes for corridors)

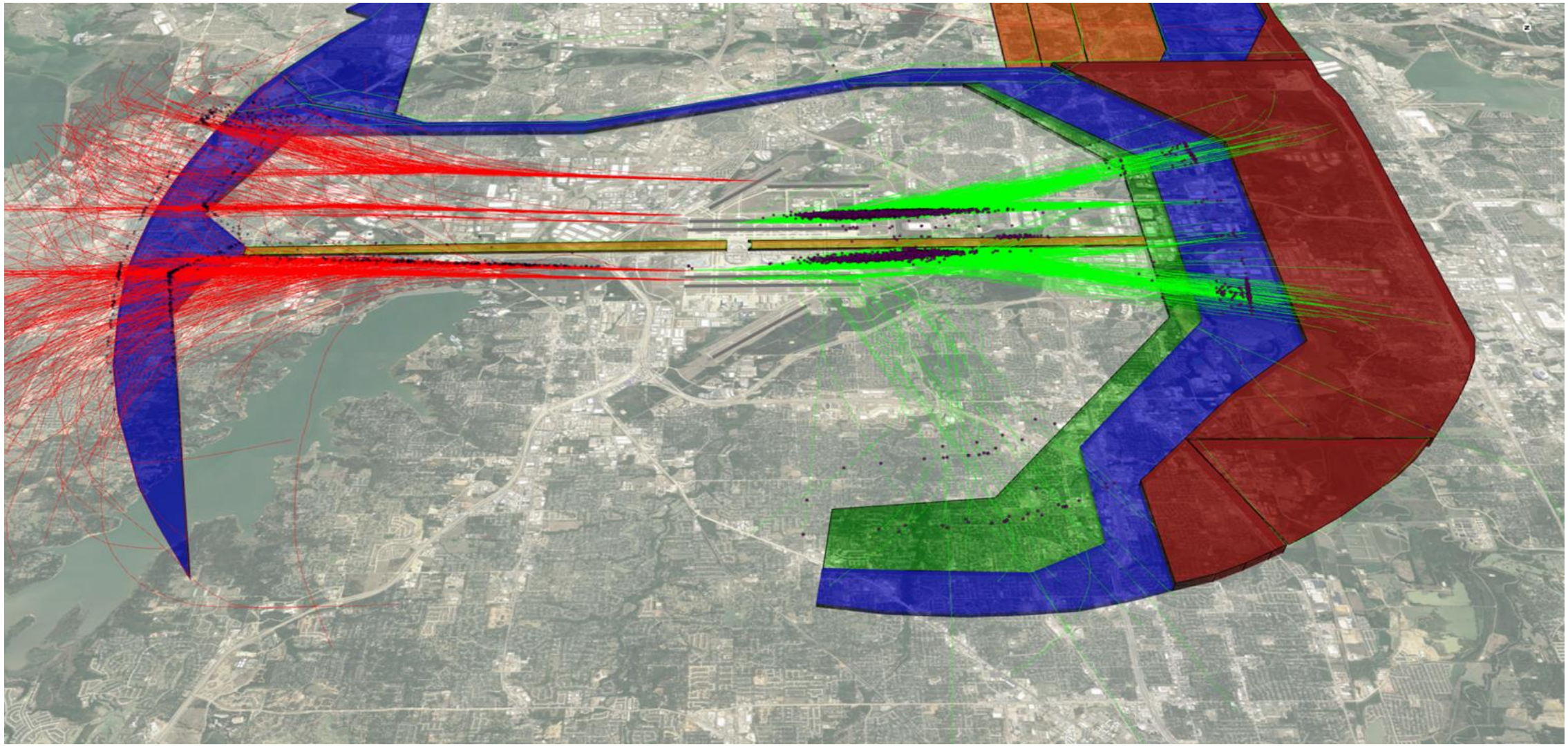
Step 3: Identify the airspace with the wake advisory criteria using published Standard Instrument Departures (SID).



Standard Instrument Departure for South Departure into DFW

Design of Corridors

Step 4: Historical track data was used to determine if the airspace identified for UAM is de-conflicted from legacy traffic using the wake advisory and Class Bravo separation criteria.



Arrivals and Departures for DFW in South Flow

Design of Corridors

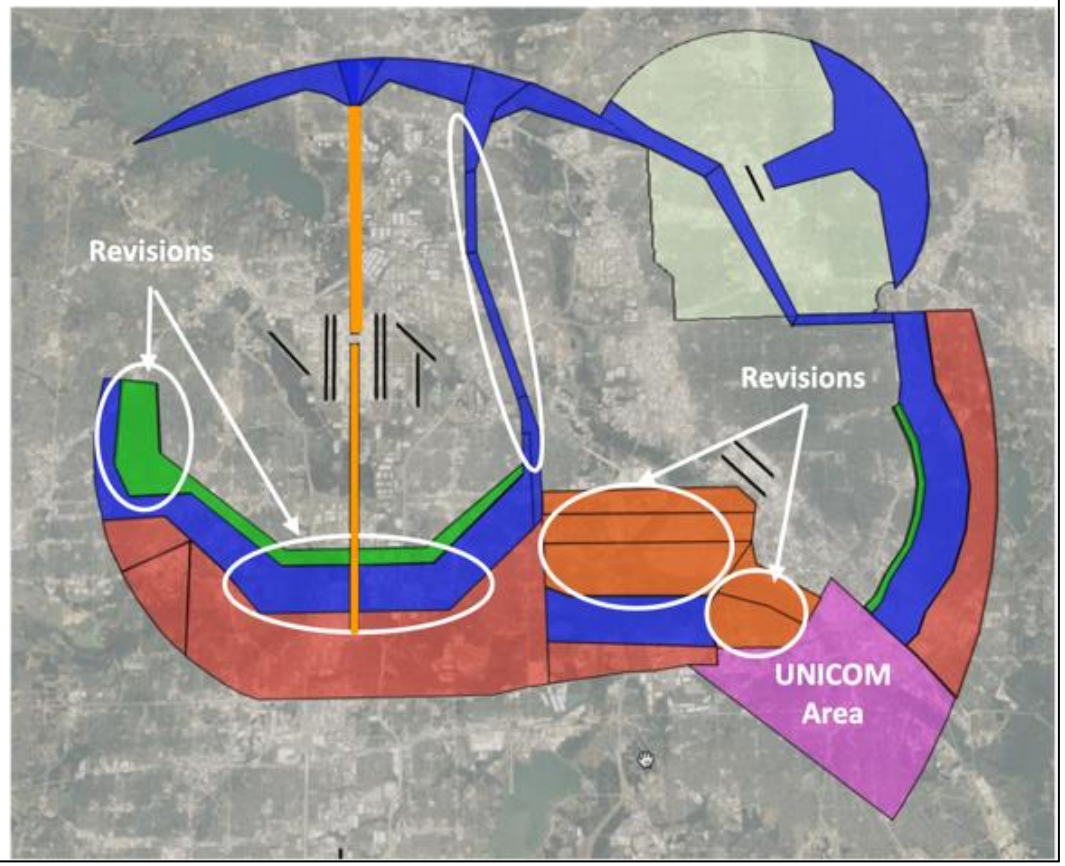
Altitudes (MSL)

- Orange 900’
- Green 1000’
- Blue 1100’
- Red 1600’
- Pink UNICOM Area 1500’

Step 5: Revise areas identified for UAM operations based on track data.

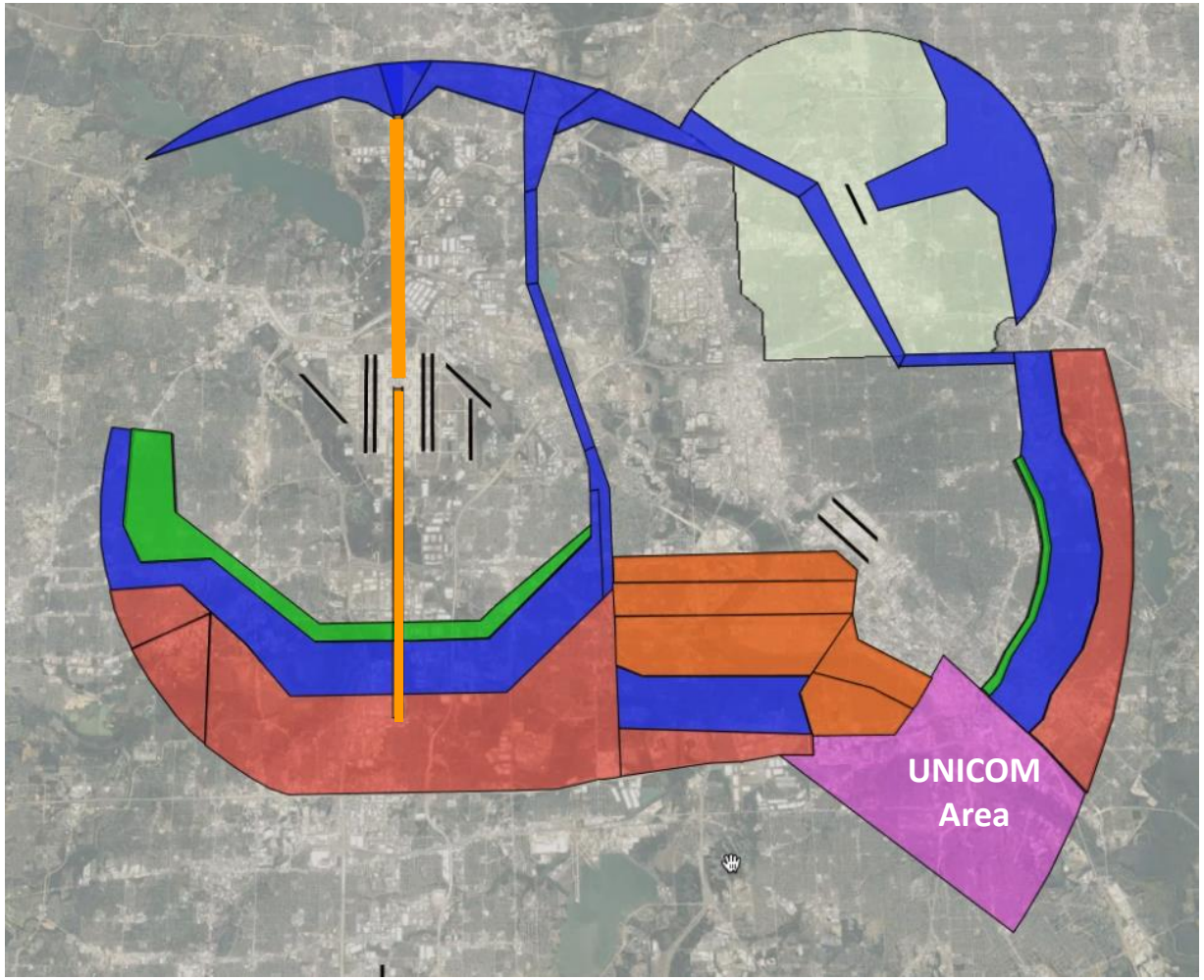
Identified airspace for UAM operations in Dallas area

Initial design using the SIDs as restrictions



Changes made to initial design based on historical track data to ensure that UAM routes were deconflicted from 99% of traditional traffic, and UNICOM added

Airspace identified for Corridors



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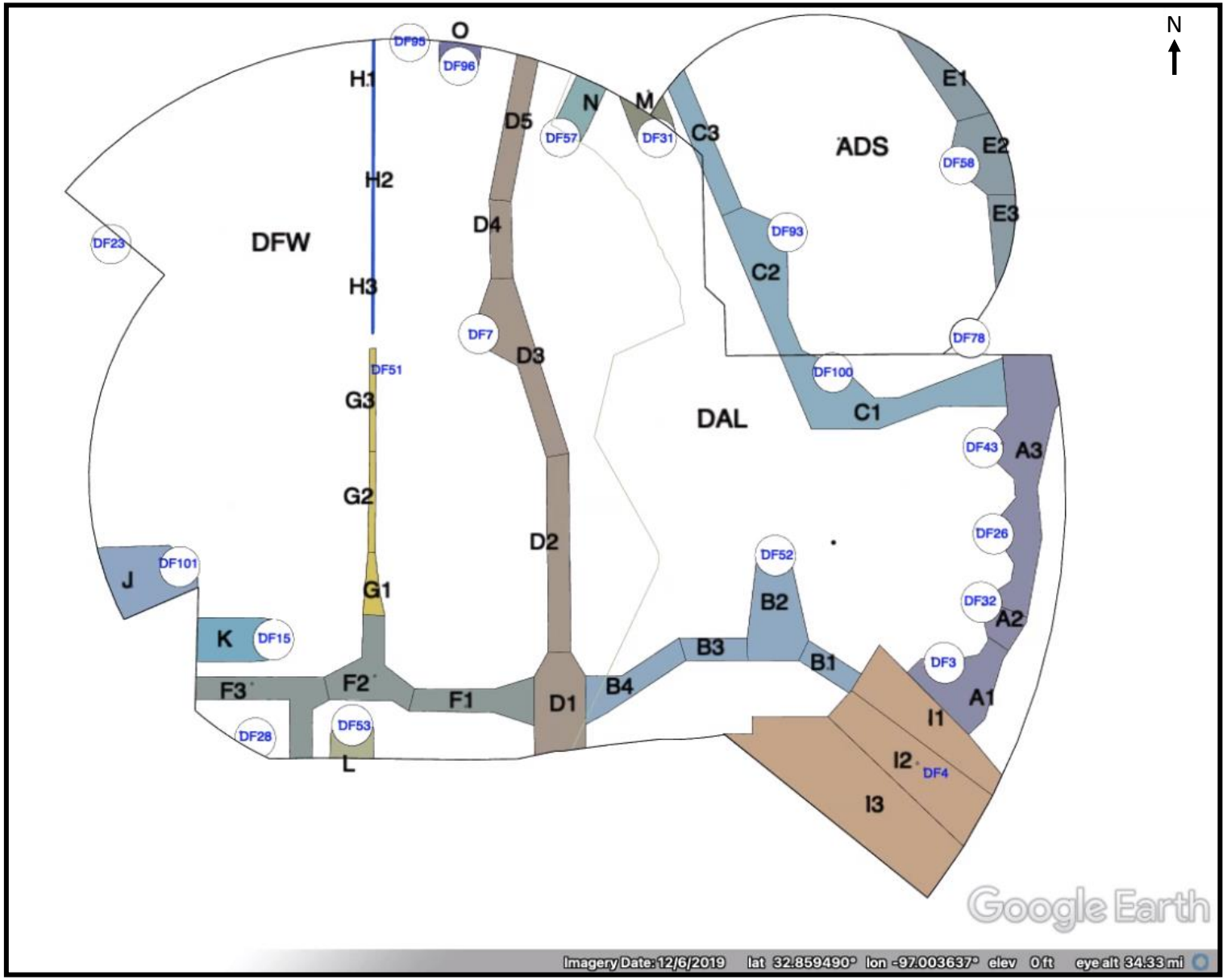
Example of Corridor Analysis

Corridors for Analysis

- 15 corridors with 36 segments
- Corridor
  - Width: 3000 ft
  - Floor and ceiling: 400 ft - 600 ft AGL
- Altitude of routes inside corridors: 500 AGL (1,100 MSL)
- 20 vertiports



Method

1. Historical Data

2018 track data from NASA's Sherlock Data Warehouse
SAMPLE SIZE: Total Days = 12

- Six days in summer (3 days in North Flow and 3 days in South flow)
- Six days in winter (3 days in North Flow and 3 days in South flow)

	Total Number of arrivals and departures			
Flow	**DFW**		**DAL**	
	Arrivals	*Departures*	*Arrivals*	*Departures*
North	5138	5109	1683	1577
South	5241	5142	1704	1627

2. Encounter Evaluation Criteria

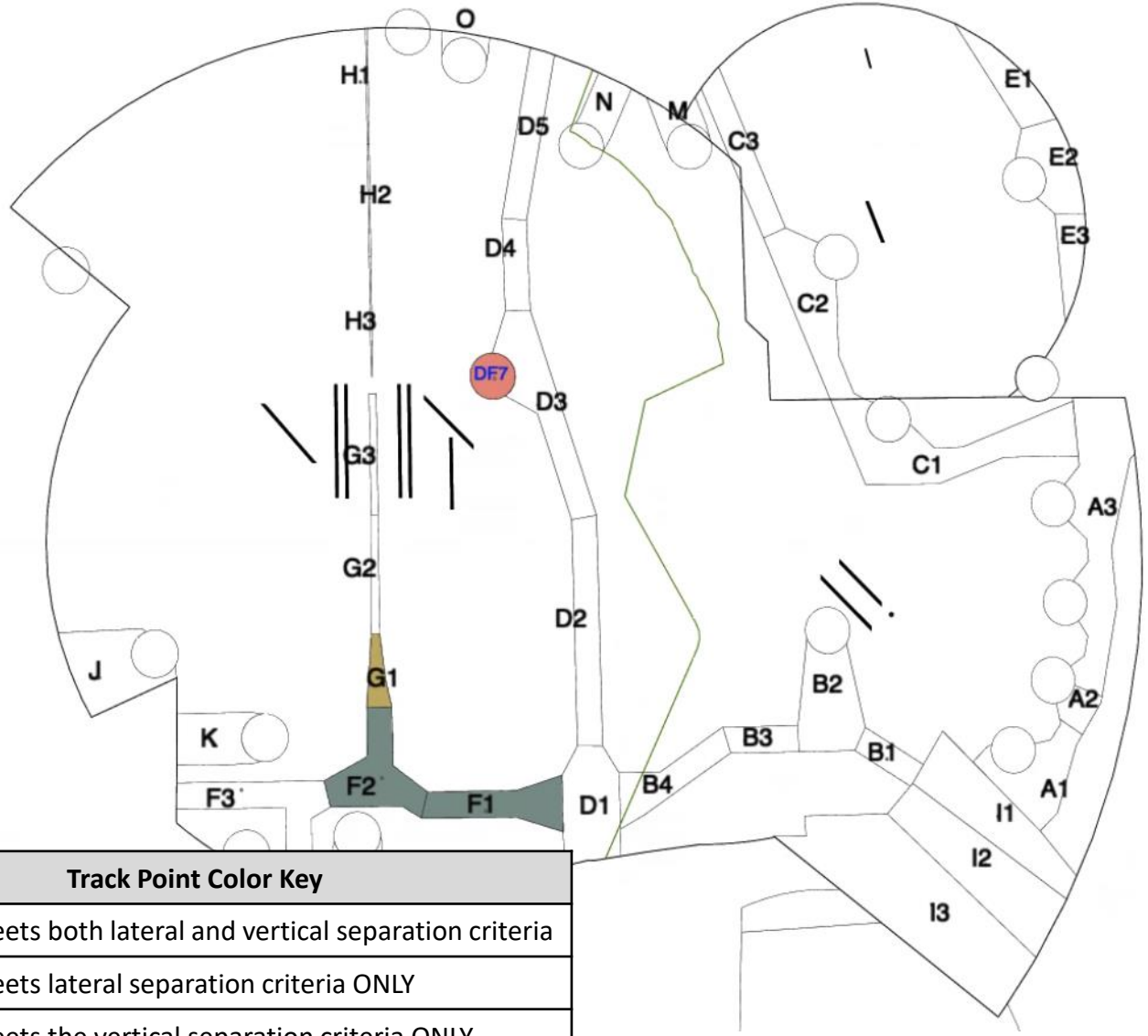
Wake Advisory	Lateral: <2,500 ft AND Vertical: <1,000 ft
Separation in Class B	Lateral: <1.5 miles AND Vertical: <500 ft

Encounters greater than 5% of the given criteria are presented

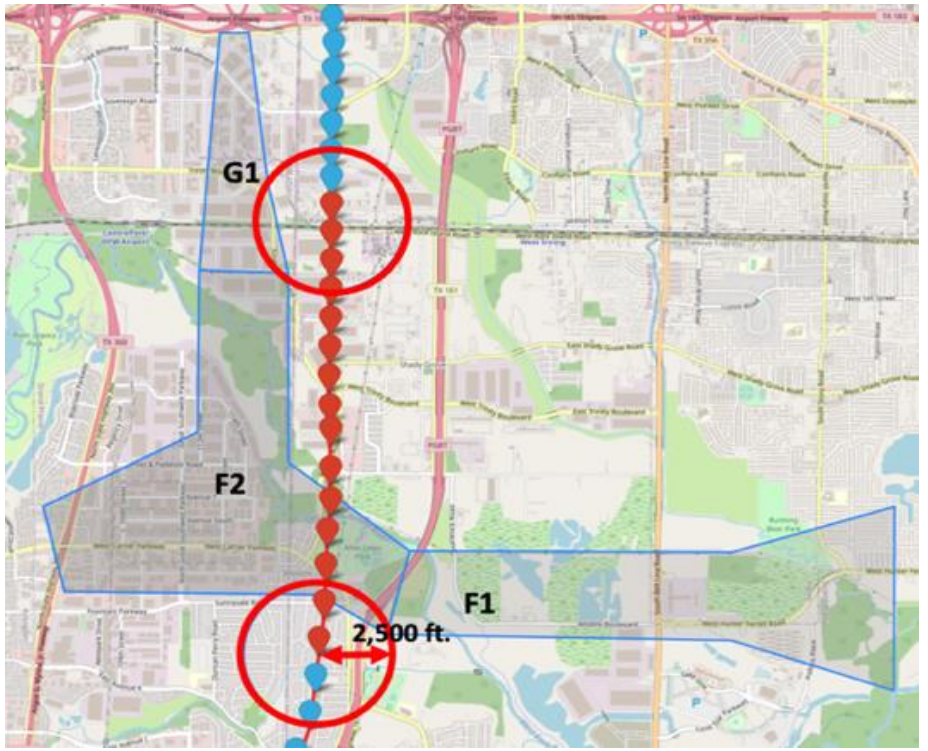
Example of Corridor Analysis

WAKE ADVISORY SEPARATION CRITERIA
Lateral: <2,500 ft AND vertical: <1,000 ft

DFW Encounters due to Wake Advisory Criteria



Track Point Color Key	
Green	Meets both lateral and vertical separation criteria
Blue	Meets lateral separation criteria ONLY
Orange	Meets the vertical separation criteria ONLY
Red	Fails both lateral and vertical separation criteria



Segment	Arrival/Departure	Percent
F1	North Arrivals	11%
F2	North Arrivals	25%
G1	North Arrivals	5%
Vertiport	**Arrival/Departure**	**Percent**
DF7	South Arrivals	25%

Segments: F1, F2

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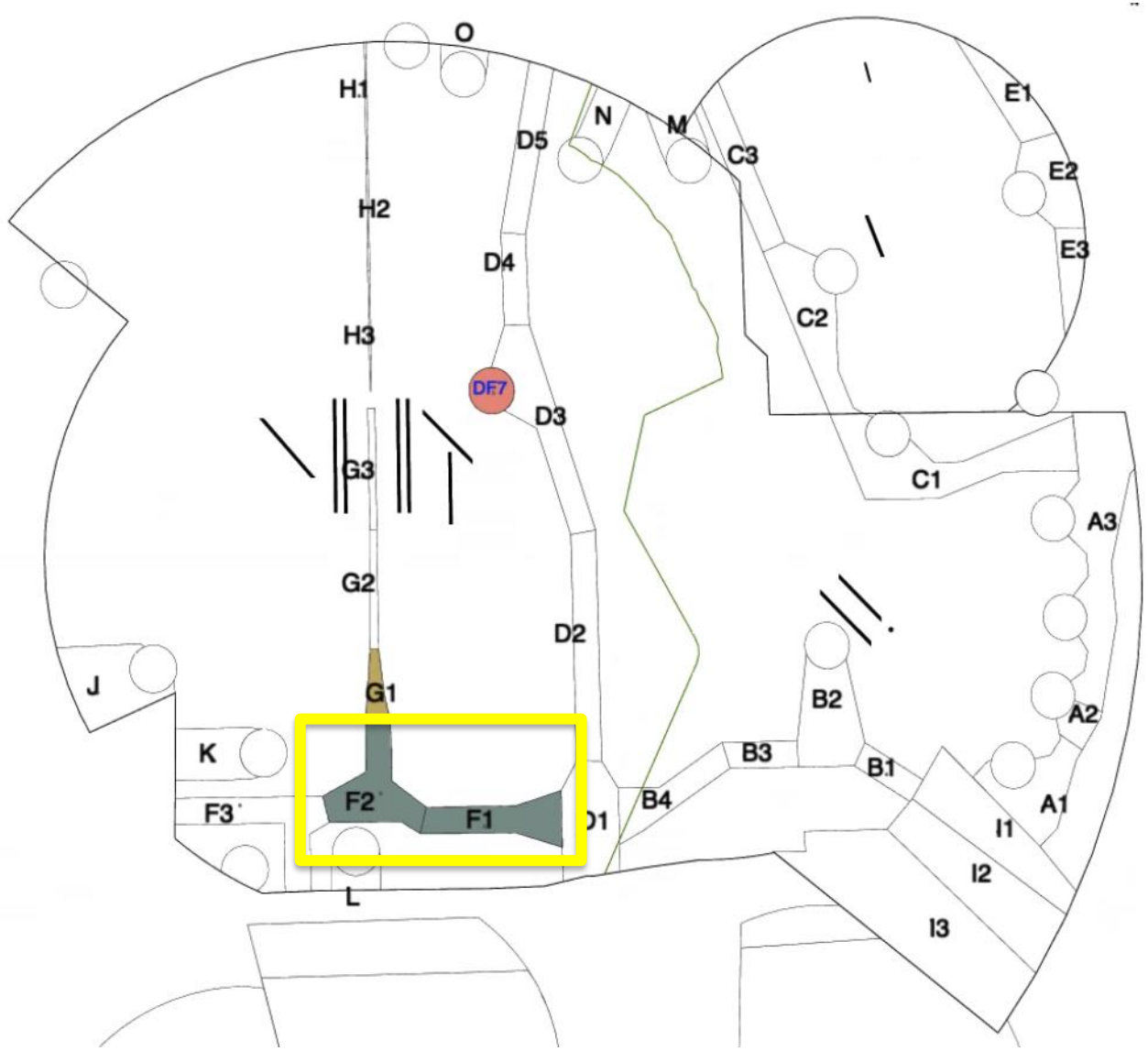

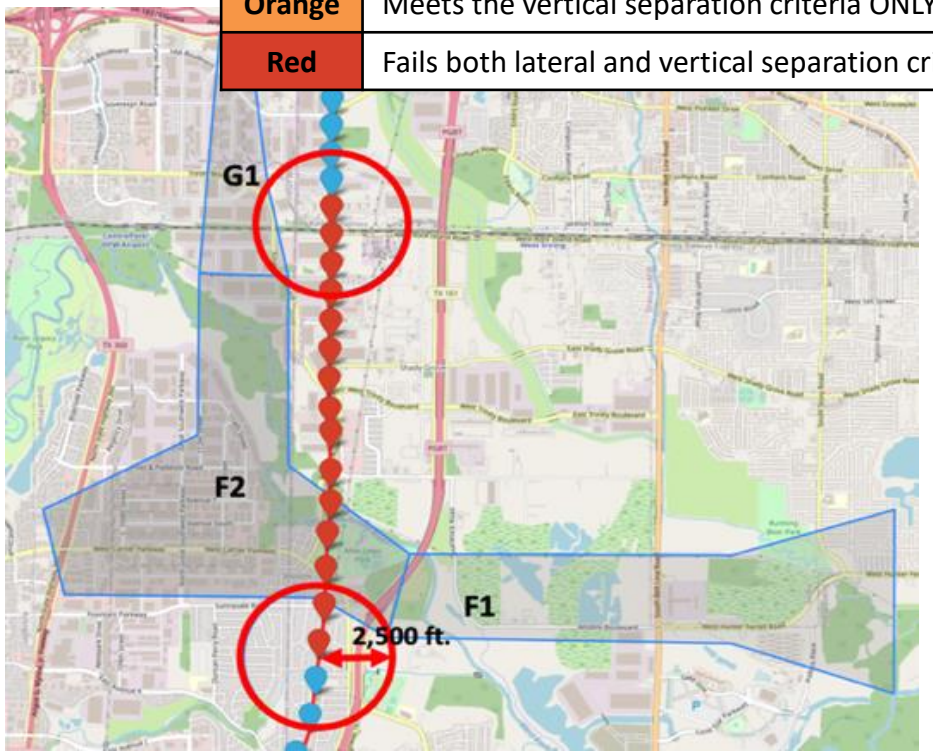

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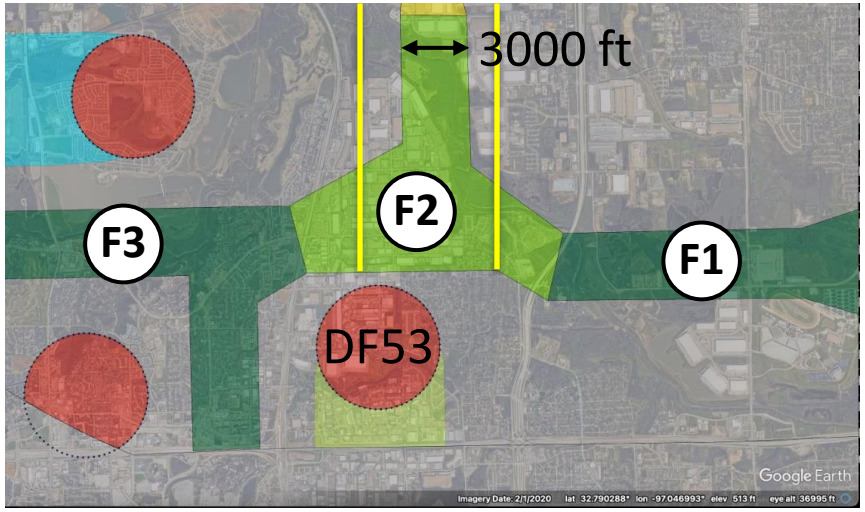
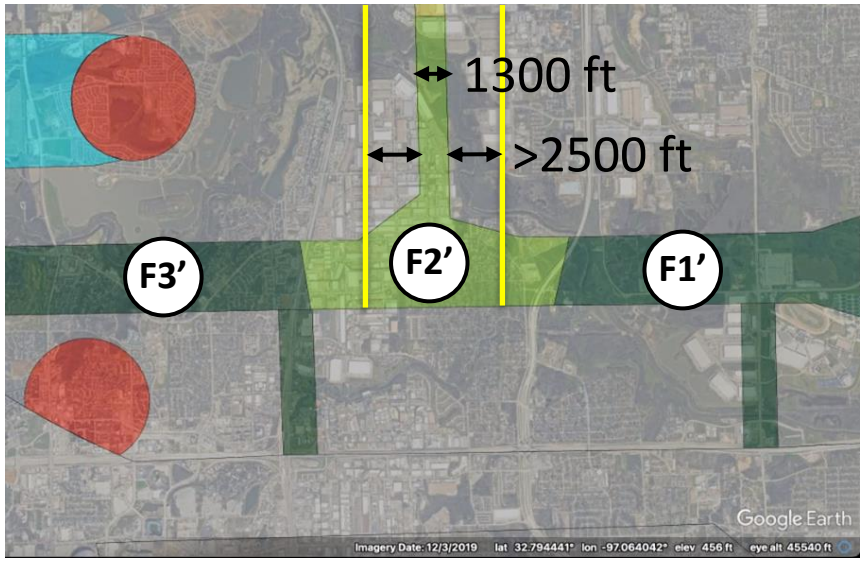
Segments: F1, F2

Original	Revised





Segment	Arrival/Departure	Percent
F1	North Arrivals	11%
F2	North Arrivals	25%
F3	North Arrivals	3%

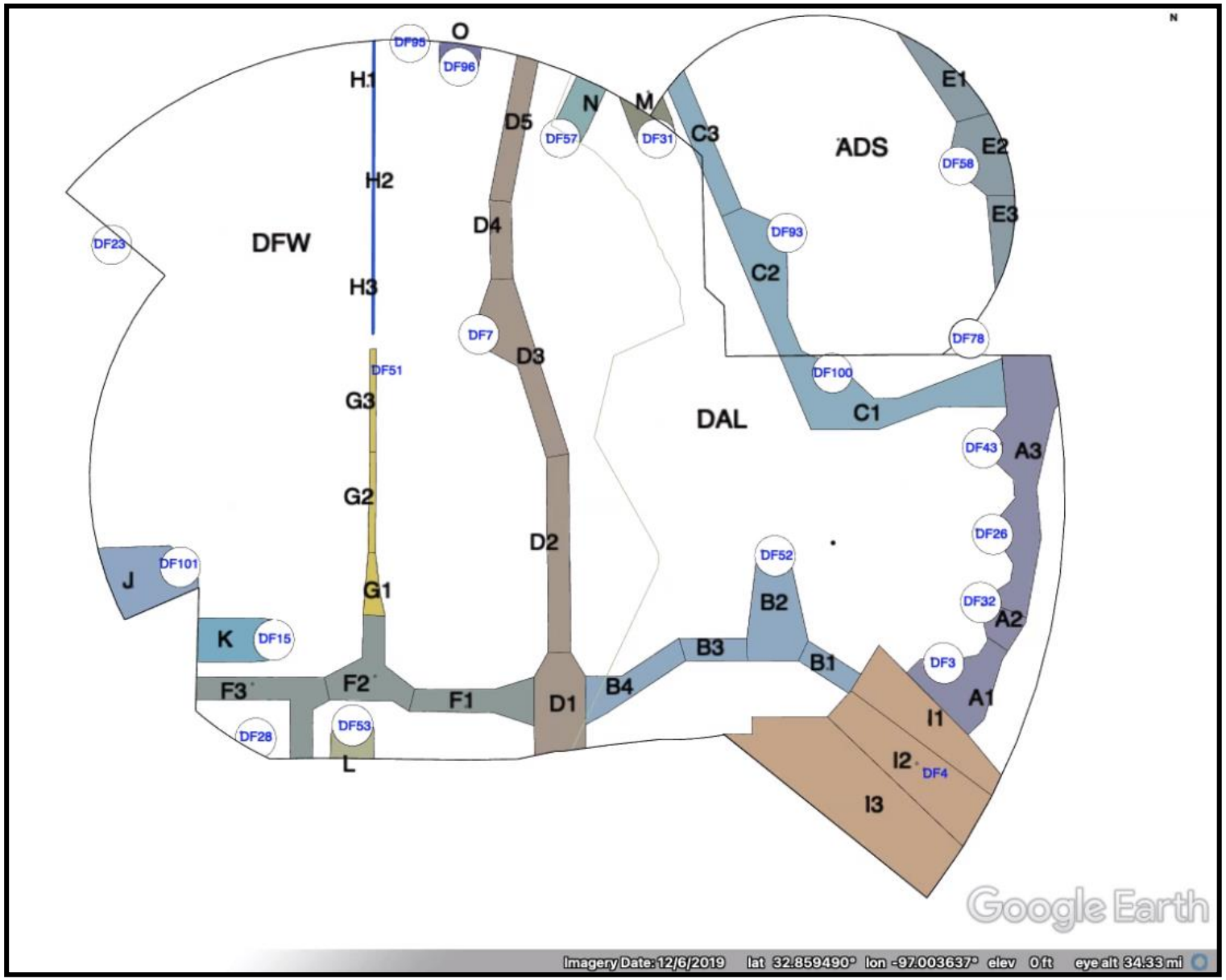
Segment	Arrival/Departure	Percent
F1'	North Arrivals	**11%***
F2'	North Arrivals	**5%**
F3'	North Arrivals	**<1%**

- F2 and F3 were moved south and vertiport DF53 was removed.
- The width of F2 was changed from 3,000 ft to be 1,300 ft to allow separation for instrument approaches to the inboard runways on each side
- F1 remained unchanged. Encounters could be mitigated through procedural changes- altitude restrictions for visual approaches

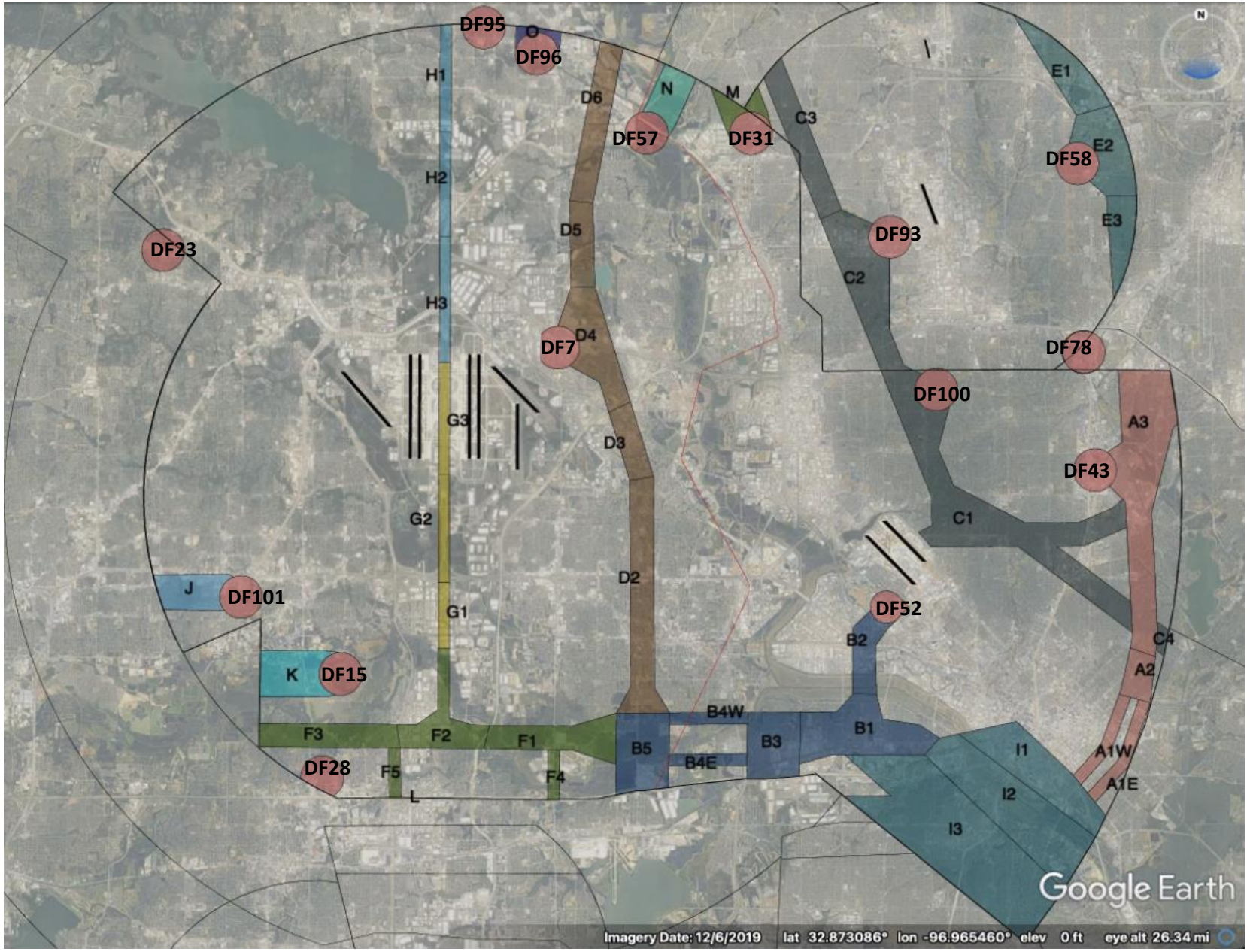
DFW

REVISED DESIGN OF CORRIDORS

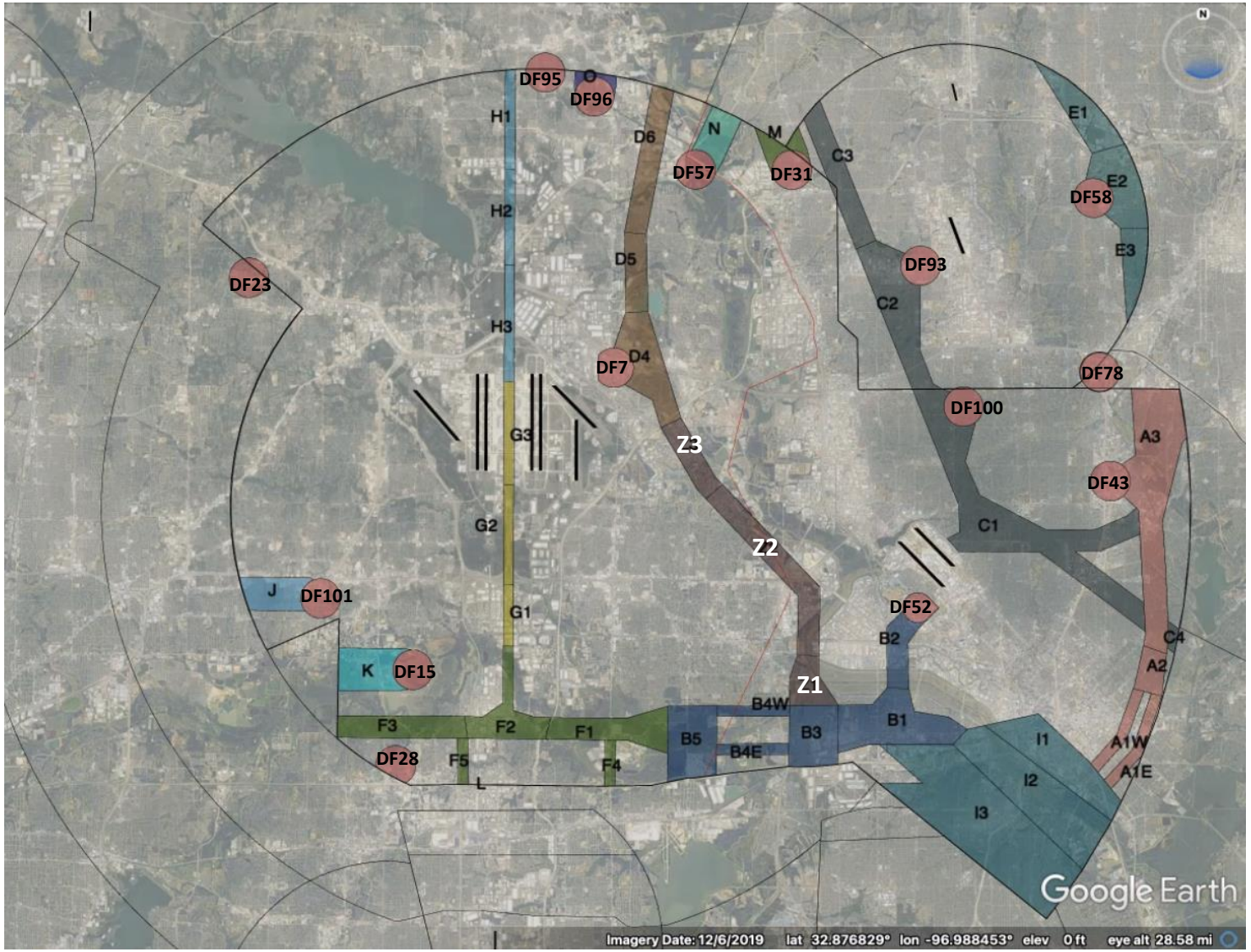
Original Corridors



Revised Corridors in South Traffic



Revised Corridors in North Traffic



Revised Corridor D for North Flow. Using Z corridor in North Flow.

Summary

- Corridors re-designed to meet the wake turbulence communication requirements in both South and North Flow
  - Spine road expanded to allow bi-directional traffic
  - Corridor D was redesigned for North flow
  - Corridors in the Dallas Downtown area- recommended to move out of Class B
- Corridors redesigned for ground obstructions
- Class Bravo separation criteria of 1.5 mi and 500 ft is not available in the DFW area.
  - Mitigation:
    - Visual separation delegated to pilots
    - Waiver from Class B separation criteria

NASA- Joby Collaboration

ATM INTEROPERABILITY SIMULATION

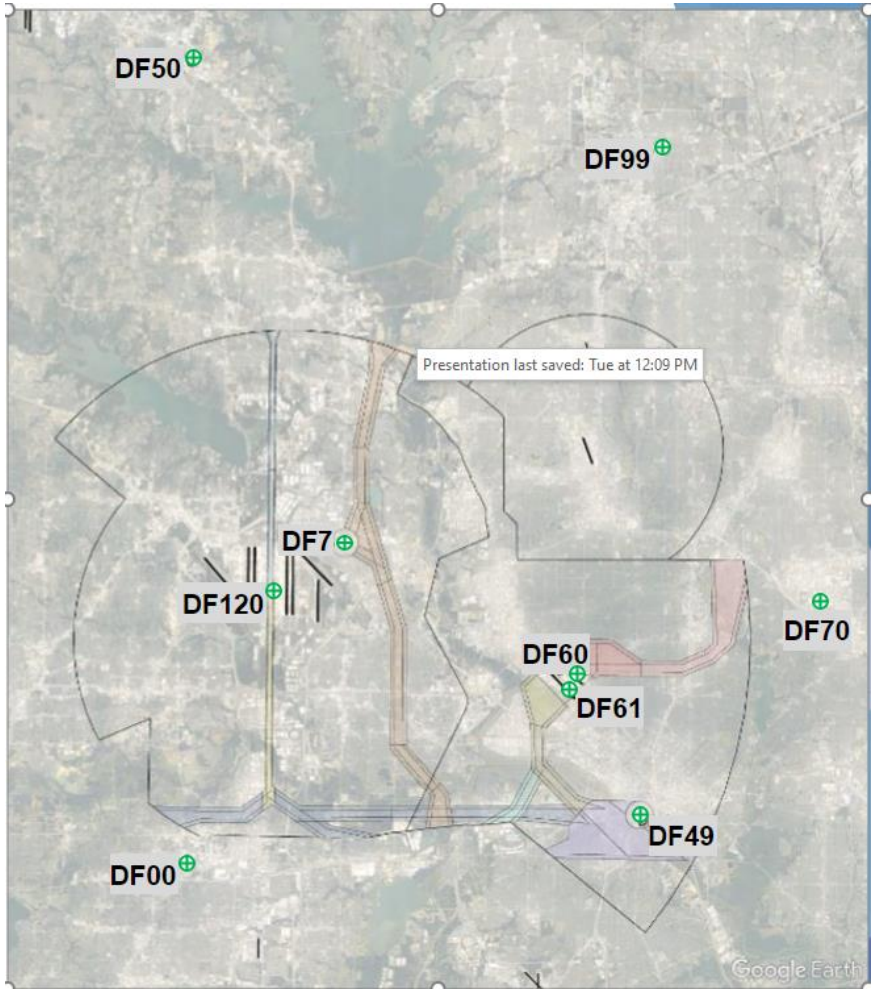
AIS Vertiports

Inside Class B

- **DF120**: DFW Terminal E Parking Garage
- **DF7**: Periphery of DFW
- **DF60**: Business Ramp at DAL (existing)
- **DF61**: DAL Terminal E Parking Garage
- **DF49**: Dallas Downtown T49 (existing)

Outside Class B

- **DF99**: Frisco Superdrome (existing)
- **DF50**: Denton (existing)
- **DF00**: AT&T Stadium (existing)
- **DF70**: Garland (existing)

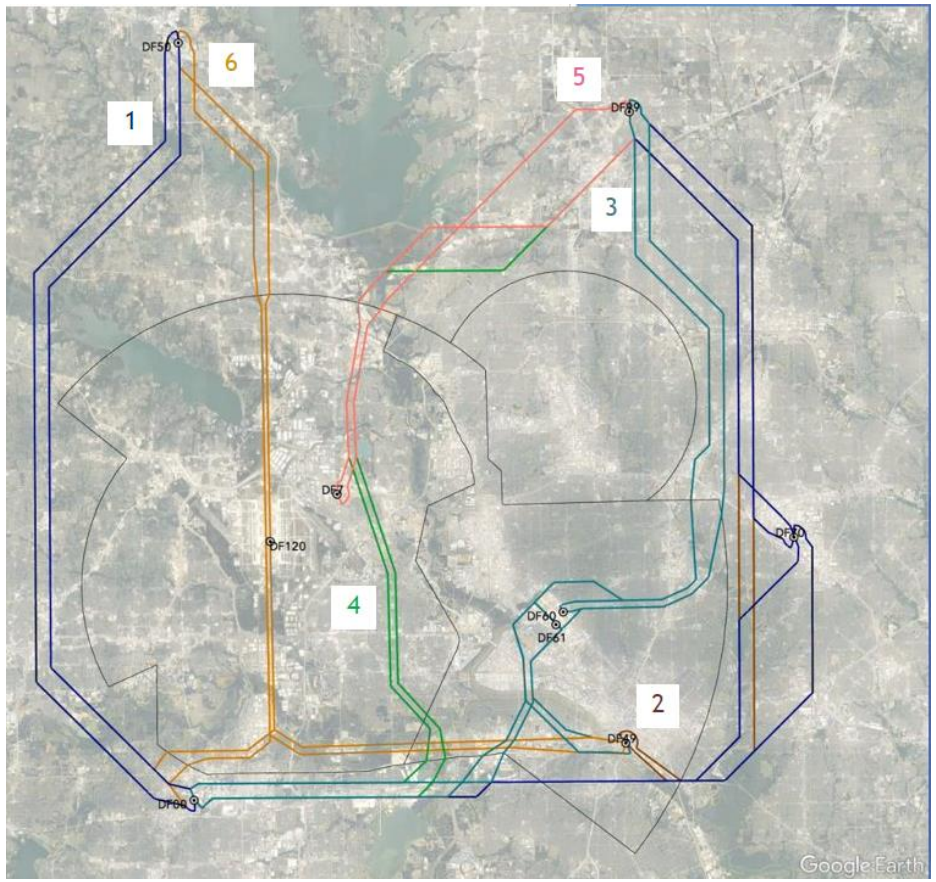


Selected based on business use cases while keeping airspace factors in mind

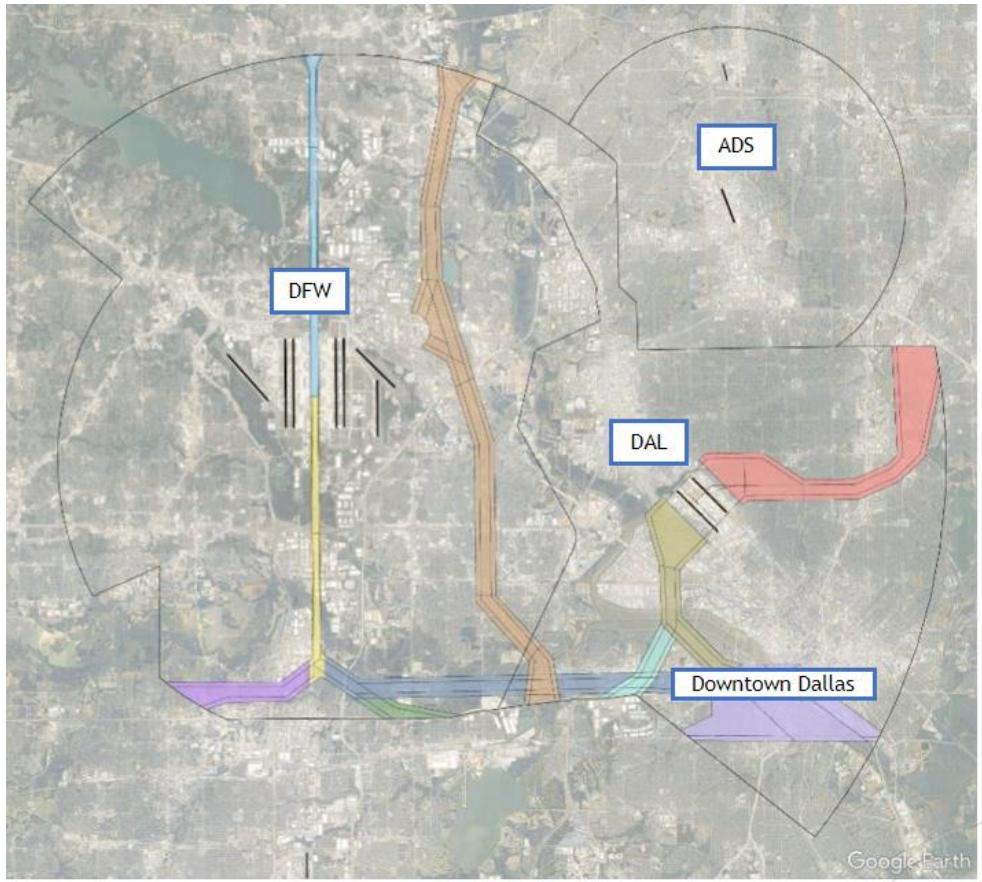
Use cases for AIS

1. UAM Flights primarily in Class G/E
2. UAM Flying in Class Bravo (entry and exit)
3. Airport Transfers
4. Inside Class B
5. Airport Periphery
6. UAM Parallel to Arrival/Departures

AIS Airspace

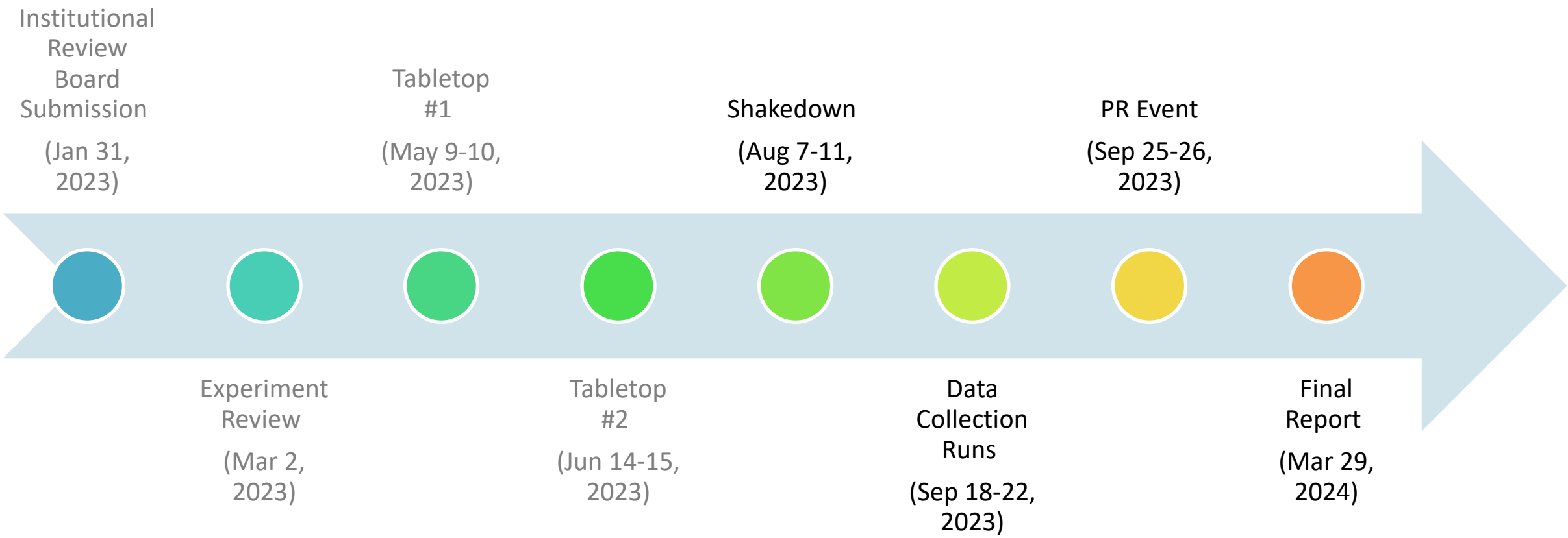


Routes: current-day condition



Corridors: mid-term condition

AIS Schedule



QUESTIONS/COMMENTS?

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